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Valuing wildfire risk mitigation in Kyle Canyon, Nevada

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VALUING WILDFIRE RISK MITIGATION
IN KYLE CANYON, NEVADA

by

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1973

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of the requirements for the

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ABSTRACT

Valuing Wildfire Risk Mitigation in Kyle Canyon, Nevada

by

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The federal government lists Kyle Canyon, Nevada, as an at-risk wildland-urban interface community. Stakeholders' attitudes and preferences about wildfires and mitigation options were assessed through a survey. 541 surveys were sent and 107 returned. More than a majority of stakeholders report the chances of wildfire occurrence as very likely. Stakeholders demonstrate consensus in reporting high concern about wildfire potential for Kyle Canyon, Nevada. Fire fighters assign the greatest responsibility for mitigating wildfire risks to Clark County, Nevada, and the federal government, while resident property owners do not assign responsibility consistently to any particular group. Trimming is the most favored mitigation method, and most stakeholders report an aversion to prescribed burning. The amounts of money that people are willing to pay monthly or annually for mitigation methods are variable and not significant for property owners, yet significant negatively for fire fighters with respect to the annual payment. Within the framework of the risk, communication and economics disciplines, this study offers strong evidence that resident and non-resident property
owners and firefighters should be directly involved in making decisions regarding wildfire risk in Kyle Canyon, Nevada.
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DEDICATION

This work is dedicated to my granddaughters, Caley and Kylie, hoping that they might find the educational role model in their grandfather that I found in mine.
CHAPTER ONE

INTRODUCTION

Secretary of the Interior, Bruce Babbitt, during a press conference following the disastrous Cerro Grande fire in Los Alamos, New Mexico, responded to a question about the fire’s cause: “I would liken it to what happens on a mountainside when a rock is dislodged, starts rolling down a hill and pretty soon there are more rocks clattering down the hillside, and then pretty soon there's a whole rain of rocks and pretty soon there's a landslide by the time it gets to the bottom. And sometimes a rock is dislodged and nothing happens, but other times a rock is dislodged and it starts a cascading series of events which might have been slowed or stopped by different kinds of--of decisions [italics added] but which in the end when you have the landslide at the bottom, in this case a disaster that overwhelmed Los Alamos, there will be a complex chain of causation” (Babbitt, 2000).

Karter (1992) asserts that the largest amount of wildfire destruction usually occurs when wildfires ignite homes that are intermixed with forest vegetation. Pyne (1997, 1996) and others define this hazard area as the wildland-urban interface. Wildfires that cause loss of life and residential property in the wildland-urban interface are a growing problem (National Fire Plan, 2003; USDI, 2002; National Park Service, 2001). The numbers of incidents occurring in the wildland-urban interface have been increasing, resulting in greater property losses and fire suppression costs (National Fire Plan, 2003; National Commission on Wildfire Disasters, 1994).
Various reports about wildfire risk authored by government scientists, consultants, and wildfire fighting agency managers have focused on fire suppression (National Commission on Wildfire Disasters, 1994). Typical results have attached numeric and descriptive labels to wildland-urban interface areas regarding weather, fuel loads, mountain slope and other factors that could pose obstacles to fire fighting efforts. Government reports have also described the wildfire problem in terms of watershed degradation, air pollution, reduced timber sales, diminished recreation opportunities, and wildlife extirpation (National Commission on Wildfire Disasters, 1994). Most solutions have focused on management options for regional and national officials, and better descriptions of physical characteristics of wildfire risk. However, these proposed solutions could fail by not taking into account expected actions by local residents, property owners and local emergency managers. The wildland-urban interface property owners, as well as the fire fighters who risk their lives to save the owners and their homes from wildfire destruction, are absent from most of these studies. Research on wildfire problem awareness from a stakeholder approach is limited but growing (McCaffery, 2002; Fried, 2002; Winter & Fried, 1999; Kuypers, 1995).

Some deficiencies in these studies leave gaps that should be filled by scholarly research. Kuypers (1995), Fried (2002), and McCaffery (2002) focused solely on property owners while investigating risk assessment and willingness to pay for risk mitigation. They omitted other stakeholders such as local fire fighters who are responsible for fire mitigation, prevention, and suppression in wildland-urban interface areas. A typical wildfire hazard assessment process (USDI, 2002) employed select fire agency managers to conduct the assessment in Kyle Canyon. What is not known is whether the area’s property owners, not just residents, and front-line fire fighters were included in the
assessment. The assessment was silent about how they perceive the potential for a wildfire, if they think that they should be concerned about it, who they believe should bear the responsibility for mitigating wildfire hazards, what they consider as the possible ways to mitigate the risk of wildfires, and what costs they think they should bear to implement mitigation measures.

The scarcity of information about the issues enumerated in the above paragraph is problematic. Risk researchers assert that the disparity between what experts do and what makes sense to everyday people is usually the reason that the public rejects technical rationality (Slovic, Finucane, Peters, & MacGregor, 2004). This being the case, the analysis of how each group of stakeholders defines the wildfire problem and possible solutions could reveal that wildfire hazard mitigation policy initiatives might fail to be implemented, even though the experts in the wildfire management agencies advocate them aggressively (Lazo, Kinnel, Bussa, Fisher, & Collamer, 1999).

The literature implies there will be differences in how various groups will report perceived risk, but it is not specific to the wildland-urban interface. The first research question raised by these literature gaps is: What do property owners and fire fighters report the chances of a wildfire occurring? Additionally, it would serve the wildfire risk assessment field to explore the dimensions that influence how stakeholder groups develop and express concern about wildfire risk. The second research question raised by deficiencies in the literature is: How do the property owners and fire fighters self-report their concern about wildfire risk? Scholarly studies so far have not focused on who is responsible for wildfire risk mitigation and what this means at the policy formulation level. The paucity of information in this area raises the third research question: To whom do the property owners and fire fighters assign responsibility for wildfire risk mitigation?
The literature implies that there will be differences in how various groups will select wildfire risk mitigation methods. To resolve some information gaps in the literature, the fourth research question pursued in this study is: What methods will property owners and fire fighters select to mitigate the wildfire risk? The literature also implies that there will be differences in how various groups will report their willingness to pay for implementing wildfire risk mitigation methods. The dearth of information in the wildfire literature prompts the fifth and final research question: What are property owners and fire fighters willing to pay to implement wildfire risk mitigation methods in Kyle Canyon?

This investigation fills some gaps in the literature by involving more than one set of stakeholders in seeking the answers to the aforementioned key questions about wildfire risk. The purpose of this study is to evaluate whether the risk, communication, and economics disciplines can provide a framework for examining decisions that local stakeholders make about wildfire hazards. First, the risk literature reveals that there are dynamic social and experiential domains that guide people in making risk decisions. Second, the interpersonal, organizational, and mass communication literatures establish that peoples' relationships, social structures with which they identify and interact, and the information that they obtain from the mass media are essential components in the decision-making process. Finally, the economic literature demonstrates how people behave when asked to make choices to optimize their utility.

The perspectives of all three disciplines, and possibly others, could be valuable and beneficial to understand stakeholder wildfire risk decisions. No single perspective alone, nor even any two of them, appears to provide a sufficient answer. Therefore, this study explores whether high-consequence wildfire risk decision-making requires attention to different perspectives on values held by a broader range of stakeholders than have
traditionally been included. The analytical approach uses a community named Kyle Canyon as a useful example of how similar approaches could be applied to other types of natural hazards in the United States.

Kyle Canyon, Nevada, is listed as a priority community-at-risk in the National Fire Plan due to its potential for loss of life and property from wildfire (Federal Register Vol. 66, No. 160 August 17, 2001). A local wildfire hazard assessment also showed that Kyle Canyon is exposed to high risk of life and property destruction by wildfires (USDI, 2002). Kyle Canyon is located on Mount Charleston in the Toiyabe National Forest, has approximately 300 homes, and is intermixed with forest vegetation consisting of grasses, shrubs, and mature trees. Various characteristics of the houses, canyon, forest, view, and weather, among others, are expected to influence buyers when purchasing a home (Taylor & Smith, 2000; Palmquist, 1989) in Kyle Canyon. State Route 156, a dead-end road, is the only access route to and from the higher elevations of the Kyle Canyon subdivisions (Clark, 1996). If a wildfire starts in the lower portion of the canyon, shaped like a chimney with a narrow, uphill slope, it can direct heat and blazing embers into the subdivisions. The possible conduction of heat and embers creates great potential for a catastrophic fire such as the one seen in the Cerro Grande fire in Los Alamos, New Mexico in 2000 that destroyed nearly 300 homes (National Park Service, 2001).

The remaining parts of this dissertation include Chapter 2, the literature review, which explores relevant scholarly materials that serve as the research foundation for examining local stakeholders' decision-making about wildfire risk mitigation in Kyle Canyon, Nevada. Chapter 3, the methods section, describes the established procedures to examine both the resident and non-resident property owners' and fire fighters' decisions to determine how they reported their perceptions of risk assessment, concern level,
assignment of responsibility, choice of mitigation methods, and payment for those methods. Chapter 4, the results section, presents the survey data collection and analysis results from the data collection activity that occurred through the months of July and August 2004. Chapter 5, discussion, compares the results against the hypotheses and prior literature about how fire fighters and property owners make decisions about mitigating the wildfire hazard in the five uppermost subdivisions of Kyle Canyon, Nevada. Chapter 6, conclusions and recommendations, indicates that the research problem in this study was satisfied by the results that were obtained and analyzed.
CHAPTER TWO

LITERATURE REVIEW

The literature review presented in this study contains a multi-disciplinary array of topics that are directly and indirectly related to making wildfire risk decisions. Four prominent sets of relevant works are those that: 1) provide a general background on wildfire, 2) concern the experts and non-experts attributed to making wildfire risk decisions, 3) focus on five types of decisions that answer wildfire risk questions, and 4) explore relationships between the experts, non-experts and five decisions. Together, these categories serve as the research context to understand wildfire risk decision-making concepts. The following sections examine the pertinent literature for each category. The integration of the experts’ and non-experts’ and five decisions’ literatures frame the hypotheses for this study. Finally, conclusions drawn from the literature review demonstrate how this study can contribute to the scholarly literature about wildfire risk.

Wildfire Background

Wildfire is an indigenous element in many ecosystems (Pyne, 1997). Wildfires occur annually in Nevada’s portion of the Great Basin, which includes Kyle Canyon, and are usually sparked by weather conditions (Hubbard, 1980) with occasional ignitions caused by human activities (Yamagai, Daniels, Carroll, Bliss, & Edwards, 2004).

There have been two recent lightning-caused wildfire incidents that threatened Kyle Canyon. The Lost Cabin Fire in 2002 and the Robbers Fire in 2004 threatened to advance
into the canyon but were stopped by wildfire suppression teams. No life or property losses occurred (Kourim, 2005).

Overall, the United States has suffered life and property losses from wildfires for over a century due to a policy of suppressing wildfires (Busenberg, 2004b). Federal agency wildfire suppression costs for the years 2000 through 2003 totaled over $5.2 billion (National Fire Plan, 2003). Wildfire suppression contributes to fuel buildup that sets the stage for larger, hotter, and more destructive fires than would have occurred if supporting mitigation policies had received greater emphasis than policies that mandated total fire suppression (Skinner & Chang, 1996; Rice, 1987). Numerous government reports describe the wildfire problem (National Commission on Wildfire Disasters, 1994) yet fail, in most cases, to involve appropriate stakeholders in the data collection and analysis processes. Bryan (2004) argues that collaboration among stakeholders facilitates shared ownership of problems and solutions in natural resource issues. However, research on the wildfire problem from a stakeholder approach is limited (McCaffery, 2002; Fried, 2002; Winter & Fried, 1999; Kuypers, 1995).

Characteristics That Shape Wildfire Risk Decisions

Three sets of literature are reviewed in this section. The risk, communication and economics disciplines provided relevant works for review.

Analysts often define risk as the probability that an outcome will occur times the consequence it produces (Kammen & Hassenzahl, 1999). An alternate definition is the chance of an adverse outcome to human health, quality of life, or the quality of the environment (Graham & Wiener, 1995).

Unlike risk, uncertainty refers to the lack of knowledge about specific factors,
parameters, or models surrounding a hazard (EPA, 1997). Uncertainty includes: 1) parameter uncertainty involving measurement errors, sampling errors, or systematic errors; 2) model uncertainty which is uncertainty due to the necessary simplification of real-world processes, misspecification of model structures, model misuse, or use of inappropriate surrogate variables; and 3) scenario uncertainty that includes descriptive errors, aggregation errors, errors in professional judgment, or incomplete analysis. Underestimating the likelihood or consequence of an event can lead to incomplete risk analysis, contributing to uncertainty (Hoffrage, Lindsey, Hertwig, & Gigerenzer, 2000).

The ability to understand risk and its associated uncertainty can be compromised even when people such as fire fighters and wildland-urban interface property owners face familiar hazards (Slovic, Fischoff, & Lichtenstein, 1979). Several social and demographic variables such as education and income (Burton, Kates, & White, 1978), age (Miletí, 1975), duration of residence in the community (Baker, 1977), and site preferences (Bridges, 1983) correlate with people's ability to understand risks such as wildfire.

Bradshaw (1988) and Winter and Fried (2000) report that risk perception gaps exist between those technical experts who have wildfire experience and knowledge about wildfire behavior and others who do not. People's initial beliefs about risk structure the way they interpret new evidence about risk (Nisbett & Ross, 1980). New evidence reported by technical experts that is consistent with those initial beliefs is interpreted as reliable and informative. According to Nisbett and Ross, inconsistent reporting produces dismissal and the labeling of any new evidence as erroneous. Differences in the approaches of how technical experts portray risks to the public have marked effects in risk perception (McNeil, Pauker, Sox, & Tversky, 1982).
The technical risk approaches that follow prescribed procedures, such as fault-tree diagramming or conducting benefit cost analyses, lack the dimension of human experience (Kasperson et al., 1988). There are social constructs, consisting of personal experience, community values and norms, and historical occurrences, among others (Liberatore, 1995), that influence how people perceive risk, magnify it, and minimize it. In the attempt to win the acceptance of risk, it is apparent that trust between laypersons and technical experts plays a dominant role (Slovic, 1993). As an example, the Three Mile Island nuclear reactor accident in 1979 showed that injury, deaths, and property damages were not realized impacts in that incident (Heising & George, 1986). Heising and George contend the mistrust following the incident produced societal effects like strict regulations, decreased reactor use, public outcry against nuclear power, and a diminished role of nuclear energy as a power source.

Some researchers assert that dialogue and education shared among laypersons and experts may provide the basis for trust and renewed perspectives on risk (Slovic, 1986). Negative impacts from incidents that destroy trust are more pronounced than positive impacts from incidents that build trust (Lichenberg & MacLean, 1992). According to Lichenberg and MacLean, errors, fears, and mistrust are obstacles to regaining trust once it is destroyed.

Considering the increased attention being paid to the study of risk in the United States, it is surprising that so little empirical research has actually been conducted on the topic of wildfire risk, especially from the perspectives of property owners and front-line

\[^{1}\text{Negative revelations in a local newspaper that data were falsified in characterizing the water infiltration effects on the potential nuclear waste storage site at Yucca Mountain, Nevada, weakened the credibility of the Department of Energy's assessment on the safety of the site (Greenspun, 2005). Fenton (1989) argues that a catalyst for negative media exposure comes from special interest groups who use the legal system and the media to promote their distrust about hazards and to influence policy decisions about risks in order to thwart risk management efforts.}\]
fire fighters. Busenberg (2004a) recommends that a systematic method to solve the problem of rising wildfire risk levels should be implemented on a national level through adaptive policy design. According to Busenberg, this design approach involves iterative and cyclic phases of policy application, evaluation and learning for developing permanent policies so that policy equilibrium can be achieved gradually. Very few studies so far have taken even the first step of focusing on wildfire risk perception by affected stakeholders and what this problem means to them (McCaffery, 2004; McCaffery, 2002; Winter & Fried, 2000; Fried, Winter & Gilles, 1999; Winter & Fried, 1999; Kuypers, 1995; Fried, 1994).

Communication

It is unknown whether communication limitations exist among Kyle Canyon property owners and fire fighters that could hinder the understanding of wildfire risk. This literature section examines interpersonal communication, organizational communication, and mass communication as they relate to wildfire risk.

Communication occurs when people use language and symbols to transmit meanings and decode the meanings of language and symbols that others transmit (Cronkhite, 1986). It can take place face-to-face, in person, through some medium, and with many others in groups and organizations. According to Cronkhite, to determine whether communication is successful, the message must be sent, received, understood and acknowledged. The following describes the way that interpersonal communication facilitates the understanding of wildfire risk.

People spend the bulk of their time in relationship maintenance processes, rather than entering or exiting relationships (Duck, 1988). It takes energy to keep merely casual
relationships together. The central tool that people use in maintaining relationships is everyday talk (Duck & Pond, 1989). Duck and Pond assert that conversation with another person serves as an evaluation tool to confirm the status of the relationship.

Conversations among the stakeholders might affect the perception of wildfire risk (Lin & Salwen, 1995). The behavior that takes place during those conversations might influence the importance or urgency of the messages concerning wildfire risk.

There are interactive and non-interactive behaviors used in both strategic and routine ways that serve to maintain relationships (Newton & Burgoon, 1990). These behaviors vary based on the type of relationship and its stage of development, which includes doing favors, giving and seeking advice, and offering jokes and sarcasm (Guerrero, Elvoy, & Wabnick, 1993). These behaviors can occur individually or simultaneously to maintain the relationship, prevent or minimize transgressions, or even exact retribution against a transgressor (Roloff & Cloven, 1994). Observation of these types of interactions during communications about wildfire risk among the stakeholders could help to assess the types and levels of relationships that exist and the potential for successfully overcoming interpersonal communication barriers.

The failure to maintain minimal acquaintances among stakeholders could pose a barrier to communication (Duck, 1988). Communication about wildfire risk could be limited if the property owners do not talk among themselves to make decisions about ways to protect their community from wildfire. Efforts by fire fighters to convey information to elicit decisions from property owners about wildfire risk could fail if they miss the opportunity to develop relationships with property owners and talk with them about the risks. The inability for the fire fighters and property owners to develop even superficial relationships with each other is likely to create formidable barriers in
communicating wildfire mitigation strategies (Duck & Pond, 1989). Decisions required of fire fighters to select and of property owners to accept a strategy would be made on incomplete information.

In addition to interpersonal communication barriers, the information gaps between property owners and fire fighters who face risk decisions could increase if they are receiving communication about wildfire risk from organizations that have defective communication processes. Similarly, erroneous mass communication messages might also prevent the understanding of wildfire risk. Both of these topics will be discussed in this chapter's section titled: Relationship Among Experts and Non-Experts and Five Decisions.

Although the study of interpersonal communication in the United States is extensive, it is remarkable that virtually no empirical research has actually been conducted on the topic of interpersonal, peer-to-peer communication with regard to wildfires risk. The interpersonal communication topic spans the range of relationships from acquaintances to intimate couples. Yet, there were no studies discovered thus far that have focused on the role that interpersonal communication plays in how affected stakeholders develop and express understanding about wildfire risk and what this means descriptively and conceptually.

Economics

The positive economic theory (Stiglitz, 1986) assumes that people who face choices between two or more bundles of goods express preferences for one good over another. Experts and non-experts are assumed to be able to as well. Stiglitz's second assumption is
that people make choices and act on those choices in a manner that attempts to maximize their level of satisfaction or utility. In other words, people demonstrate rationality because they know what they want or need.

People exhibit consumer sovereignty because they are best able to make choices that affect their own welfare (Hanley, Shogren, & White, 1997). For these reasons, individuals are assumed to be able to assign a value to non-market goods. Non-market goods in this study consist of, but are not limited to, weather, view, forest vegetation, and wilderness. The contingent valuation method as used in this study then assumes that people understand the good in question and will reveal their rational preferences in the hypothetical market the same as they would in the real market. The contingent valuation method is favored to obtain data about wildfire risk reduction decisions (Fried, Winter, & Gilless, 1999). Variable levels of information about wildfire risk are likely to lead people to express willingness to pay preferences in variable ways (Gardner, Cortner, & Widaman, 1987). This rational choice model as used in this investigation complements the utility theory model.

The economic model known as utility theory posits that situations with negative outcomes, such as wildfire destruction of property and lives, can lead individuals who seek optimal utility to pay a monetary value to avoid the outcome (Winter & Fried, 2000; Freeman, 1993). Researchers refer to this value as willingness to pay for risk reduction, also known as risk mitigation.

Risk mitigation itself is a public good because it results in the sustainability of a community along with economic viability (Reddy, 2000). With public goods, such as maintaining a wildfire-free ecosystem, decision makers in the wildfire management agencies impose the optimal utility associated with risk mitigation efforts that they
undertake and promote, yet they seem to fail to recognize or choose to ignore the underlying assumptions that deal with uncertainty (Schulze, 1993). Wildfire risk mitigation strategies are typically issued at the national level (National Fire Plan, 2003). Reddy (2000) counters that effective strategies occur when locals who have good knowledge of local circumstances have the freedom to devise them without oversight. While positive economic initiatives can facilitate effective strategies, market failures can mute their effectiveness.

It is unknown whether there is a market failure in the wildfire risk reduction initiatives known as free riding (Andreoni, 1988)—obtaining services whose costs are underwritten by others and not the beneficiaries—because the few hundred property owners at Kyle Canyon happen to receive extraordinary benefits in wildfire risk mitigation and suppression services that are provided by local, state, and federal resources. The economic distinction between private and public goods is the concept of excludability of consumption (Stroebe & Frey, 1982). Stroebe and Frey argue that non-excludability induces free riding. Violations of building codes, land use regulations and fire codes constitute free riding (Reddy, 2000). Other examples are uninsured people receiving indigent health care at county hospitals, unlicensed drivers operating unregistered vehicles on highways maintained by the fees collected through motor vehicle registration and licensing, and property owners with vacant land in the wildland-urban interface that they neglect to reduce potential fuel loads that threaten nearby structures if a fire ignites (Hazari & Kumar, 2003). Fair-play theory (McDermott, 2004) maintains that people incur an obligation to obey the law when a society provides them benefits and free riding is morally wrong. Levels of available information provided through visual and verbal cues about conforming to free-riding behavior contribute to the
growth of free riding (Carpenter, 2004). Therefore, ignorance of wildfire prevention campaigns by a few can affect the growth of free riding in Kyle Canyon. Increases in a group’s size also contribute to more free riding (Brunner, 1998). Clark County’s immigration of transplanted residents increases the size of the group that is likely to seek out the public goods afforded by Kyle Canyon (Clark, 1996) and Carpenter argues that this will result in increased free riding. The Hispanic group size within the population has increased significantly (census.gov, n.d.), but it is unknown whether cultural and sociological differences between Hispanics and other ethnic groups will affect the incidence of free riding (Burlando & Hey, 1997). Sanctions for violation of wildfire risk mitigation standards provided through group pressure, such as homeowner associations, could compel existing and potential free riders to cooperate with group standards (Fehr & Gachter, 2000).

The three literature reviews above relate how the perspectives of risk, communication, and economics play a role in shaping how experts and non-experts make decisions about wildfire risk. The following section reviews the literature pertinent to making five decisions.

**Five Types of Wildfire Risk Decisions**

This investigation examined what, if any, influences the experts and non-experts had upon five decisions that characterize how the social construction of problems and solutions (Liberatore, 1995) can facilitate the understanding of wildfire risk decision-making. These five decisions are decisions made by the respondents who: a) report the chances of wildfire occurrence, b) report concern about wildfire risk in Kyle Canyon, c) assign wildfire risk mitigation responsibility, d) select mitigation methods, and e) report
payment preferences for implementing wildfire risk mitigation methods. The following subsections describe these decisions' pertinent literature and the deficiencies in the wildfire risk literature for each decision.

**Chances of Wildfire Occurrence**

Parallel operations that exist between two risk analysis systems—the rational system and the experiential system—serve as integrated guidance tools in risk management (Slovic, Finucane, Peters, & MacGregor, 2004). The rational system uses logic, reason, algorithms, and scientific reasoning to quantify risk. The experiential system relies on human instincts, fight-or-flight responses to danger stimuli, and intuitive reactions.

The interplay between the two risk analysis systems serves as the foundation for the recognition-primed decision making model (Heath, 2003). This model relies on backward mapping of experiences and coupling those with the current situational awareness that requires a decision, incorporating experiential benefits and risks. Thus, perceptions are vital to evaluating risk. The uncertainties associated with risk influences people to a) minimize their perception of a risk and opt to ignore it, such as choosing not to wear a seatbelt in a car, or b) to magnify it so much that they avoid it altogether, such as refusing to fly in an airplane and driving long distances (Slovic, 1982).

Further, Flynn, Slovic, & Mertz (1994) concluded that white males who are affluent, educated, and conservative report lower perceptions of risk than females and males of other races when evaluating risk situations. The possession or lack of expertise plays a role in risk decision-making as well (Slovic, 1993). Another attribute that influences individual risk perception is known as the worldview, which consists of the collective effects of social, cultural, and political attitudes or judgments that individuals make about complex problems (Dake, 1991). Some identified worldviews are fatalism, hierarchy,
individualism, egalitarianism, and technological enthusiasm. These worldviews have been linked with the ability to predict risk perception (Slovic, 2000; Jenkins-Smith, 1993).

The literature lacks empirical research conducted specifically on the wildfire chances topic, especially from the perspectives of property owners and front-line fire fighters. Slovic (2000), Flynn, Slovic, & Mertz (1994), and Jenkins-Smith (1993) provide insights into the general risk perception realm through different disciplines. Yet, very few studies so far have focused on wildfire risk perception by affected stakeholders and what this means descriptively and conceptually (McCaffery, 2004; McCaffery, 2002; Winter & Fried, 2000; Fried, Winter & Gilles, 1999; Winter & Fried, 1999; Kuypers, 1995; Fried, 1994). It is unknown whether established risk perception theories hold true in the wildland-urban interface. The next section examines the literature covering peoples’ concern about risk.

Concern About Wildfire Risk

Departing from the conventional view of risk as a function of probability and consequences, Slovic (1997) approaches it from the risk-as-a-game perspective. This subjective and value-laden perspective follows socially negotiated rules within a risk problem’s context. According to Slovic, people exhibit subjectivity when they make judgments about how much risk is too much. Activities such as devising dose/response models, selecting exposure limits, choosing toxicology endpoints, and using particular risk measurement tools and methods are examples of subjectivity. In the wildland-urban interface, establishing low, moderate, high, and extreme fire danger categories, setting fire prescriptions for fuel reduction burning, and the National Fire Danger Rating System that uses mathematical indices in its components are examples of subjectivity. In
developing and expressing concern about risks, people reflect values associated with risk assessments in choosing death rates, life expectancy, and number of deaths anticipated for a given hazard (National Research Council, 1989). As an example, immediate deaths from accidents are not considered equivalent to deaths that occur from chronic long-term disease. In the wildland-urban interface, the risk of loss of commercial logging stands due to wildfire is not equivalent to the risk of long-term herbivore food source reduction (Shochat, Wolfe, Patten, Reinking, & Sherrod, 2005). Subjectivity and values can influence both the framing and the perception of risk information provided to people who are expected to make decisions about wildfire risk concerns.

The framing of risk information that is provided to the public could influence the decisions that people make about hazards they face and the concern they express about them. For example, preferences changed when people were asked to choose between lives lost or lives saved in a simulated risk scenario (Tversky & Kahneman, 1981), or when the improvement of environmental quality was compared with the restoration of a degraded environment (Gregory, Lichtenstein, & MacGregor, 1993). Favorable preferences changed to unfavorable given the opposite scenario. Differences in how risks are framed for the public have marked effects in how those risks are perceived (McNeil, Pauker, Sox, & Tversky, 1982). For example, framing a risk situation to sound as if a large positive gain will be realized, versus a small chance that there could be a negative outcome, produced major variances in decision making by several groups (McNeil, Pauker, Sox & Tversky, 1982).

Multiple dimensions in technical risk assessments can act as filters to a non-expert’s interpretation of an expert’s presentation of a technical risk assessment (Cohen, 1985). There were no studies located thus far that reviewed how these multiple dimensions
constitute the person's overall concept of wildfire risk and their ability to express concern about it. These dimensions, or attributes, that support what is known as Thompson and Dean's (1996) contextual conception of risk, serve as a set of tools which risk assessors can use to characterize risk to property owners and fire fighters, rather than relying on conventional technical approaches.

The wildfire risk literature is effectively silent in discussing how property owners and fire fighters express concern about wildfire risk. The responsibility for taking action to mitigate the concern caused by risk is covered in the next literature review section.

*Wildfire Risk Mitigation Responsibility*

Globally, there are two general approaches to risk management (Fiorino, 1989). According to Fiorino, the French model supports less public participation and positive central control of risk, permitted by high levels of trust among citizens for the government's experts who manage risk. Conversely, Americans distrust scientists, industry, and government, demonstrated by interventions in administrative processes, questioning experts, and litigating what they perceive to be acceptable risk management outcomes (Jasanoff, 1986).

The general systems theory (Forrester, 1961) proposes that cause-and-effect relationships among a system's elements can manifest as self-reinforcing mechanisms, preventing departure from existing paradigms unless a lever can be applied to change the paradigm. Heavy accumulation of fuel in wildfire-prone areas and increased wildfire risks in the wildland-urban interface (National Fire Plan, 2003) are the result of the American policy paradigm of total fire suppression, which was based on the theories of bounded rationality, punctuated equilibrium, and self-reinforcing mechanisms (Busenbarg, 2004b). According to Busenbarg, bounded rationality means that selective filters are used to make
decisions, leading to the failure to account for available and comprehensive information. Punctuated equilibrium theory maintains that critical events, such as the September 11, 2001, tragedy, result in major policy reforms in government systems. For example, that critical event led to the creation of the Department of Homeland Security, the largest government reorganization since the creation of the Department of Defense in 1947 (Kettl, 2004). Several critical wildfire disasters have resulted in some policy shifts within the United States, yet they tend to be government-focused and fall short in the areas of property owner and front-line fire fighter involvement (National Fire Plan, 2003).

Wildfire risk mitigation in Nevada has been in the public arena for over 17 years after the 1987 Nevada Legislature, pursuant to Senate Bill 584, requested the Nevada Association of Counties to prepare recommendations for the prevention and suppression of wildfires and the restoration of burned areas (Resource Concepts, 1988). Recommendations for restructuring agency authority for wildfire management within the Nevada Division of Forestry, implementation of state fire-safe development standards for the urban wildland interface, area-specific fuels management plans, and statewide site specific rehabilitation plans that were recommended to the Nevada Legislature have not met with much success when measured against the spectacular wildfire seasons experienced since the study's debut. For example, the Clark County Code Title 13, Fire and Fire Prevention, addresses merely smoking in forest areas, its lawful and unlawful occasions, and the misdemeanor penalties for violating code section 13.16.010. There are no apparent wildfire prevention ordinances, although urban structural fire protection receives comprehensive treatment in the code.

Despite the increased efforts to revise wildfire risk policies in the United States, little to no empirical research has apparently been conducted on the wildfire risk mitigation
responsibility topic, especially from the perspectives of property owners and front-line fire fighters. Those individuals or groups assigned the responsibility for mitigating wildfire risk are assumed to employ generally accepted methods to accomplish the risk mitigation goal. The next subsection reviews pertinent mitigation methods literature.

Selection of Mitigation Method

Pyne (1996, 1975) established the foundation for understanding the issues surrounding wildland-urban interface fire risk and mitigation. American fire management policies dictated total fire suppression when wildfires ignited until the mid-1990s when wildfires that were burning within a prescription were allowed to burn out. This policy contributed to a huge buildup of fuels in the wildland-urban interface. Busenberg (2004a) argues for an approach a) taken over a long time, b) that employs multi-year fuel reduction experiments, c) covering large geographic areas involving states and multi-state regions, and d) to analyze short- and long-term effects in these areas. Results should provide a way to learn about the effectiveness of these experiments and encourage the adaptation of public policies about fuel management over time.

The centerpiece for wildfire risk mitigation is fuel reduction (Busenberg, 2004a). To avoid extreme wildfires, land management agencies assess fire risk to select fuel treatment methods such as prescribed fire (National Fire Plan, 2003). The National Fire Plan (2003) describes several methods to reduce fuels, three of which appear in the survey questionnaire for this study: prescribed burning, trimming, and thinning. Prescribed burning consists of the deliberate ignition of fires under specified parameters to remove fuels that could propagate and sustain a wildfire. Trimming means the removal of brush and small trees from the landscape to prevent a fire from being carried through those fuels into inhabited areas and tree crowns. Thinning is a technique that removes
trees so that their canopies are greater than ten feet from each other, thereby preventing the transfer of fire through the crowns.

Research conducted in Portugal (Fernandes & Botelho, 2004) showed that in extreme weather conditions, prescribed burning reduced the potential intensity of a wildfire occurring by 96%. Despite commonly held beliefs that prescribed burning harms trees and forest duff, Fernandes and Botelho demonstrated that only 10% of the prescribed burns had those effects.

There was multiple use costs observed when hikers and mountain bikers reacted adversely to prescribed burning effects in New Mexico (Hesseln, Loomis, Gonzalez-Caban & Alexander, 2003). Reduced visitation to forest areas due to adverse reactions could affect small, local economies dependent upon tourist revenues. It is uncertain whether prescribed burning is a cost-effective tool for the U.S. Forest Service's multiple use management of national forests.

There were concerns that developed about the contribution that prescribed burning made to the overall annual pollutant emissions for an airshed in Texas (Dennis, Fraser, Anderson & Allen, 2002). For criteria pollutants, it appeared that the contribution was small. However, fine particulate matter from wildfires and prescribed burns represented a significant portion of the airborne pollutant emission inventory in Texas, a concern raised by clean air advocates and regulators from the Environmental Protection Agency. This poses a policy dilemma for counties like Clark County, Nevada, that have concentrated emissions in the urban area and persistent concerns about particulate matter.

Some researchers argue that the intense forest fires that ignite today are the result of human intervention in forest ecology, especially the reduction of herbivores (Caldaro, 2002). Although a general understanding about natural fire developed over the last 50
years, it is because of increased human dominance in the history of fire that Caldaro suggests that prescribed burns, under most circumstances, should not be employed. Shochat, Wolfe, Patten, Reinking & Sherrod (2005) evaluated whether prescribed burning had any effect on bird nesting. The Shochat team found that prescribed fires had short-term effects such as altering food abundance and affecting habitat attributes, yet influenced bird-nesting success positively due to a post-fire increase in arthropod biomass, a food source for birds.

A wildfire risk management simulation projected out over 200 years used the Missouri Ozarks landscape (Shange, He, Crow, & Shiffley, 2004) and demonstrated that a combination of coarse, woody debris reduction, wildfire suppression, and prescribed fire revealed effective control of fuel loading and fire risk. Over another 200-year forecast, researchers (He, Shang, Crow, Gustafson & Shifley, 2004) using the LANDIS fuel model showed that 10% of the landscape receiving simulated intensive coarse fuel reduction maintained low fuel loads for most of the simulation period. The results matched with empirical knowledge of the study area’s fuels. This model has also been used in other landscapes.

What remains to be explored is how the various mitigation methods can be employed with support from property owners and fire fighters. Prescribed fire, for example, receives little support because of fires like Cerro Grande. In 2000, the Cerro Grande fire started as a prescribed fire that escaped, burning over 40,000 acres and destroying almost 300 homes. A secondary hazard was created by the fire’s heat, melting the soil and leaving a glazed surface that sheds and does not absorb water (Fortner, 2000). As a result, there is a high probability that a flash flood hazard with high consequences can occur after a rainfall from the nearby mountains and canyons. Government reports discuss other
methods, but comparative studies of methods on which to base decisions are lacking in the scholarly literature with the exception of a few recent efforts (Shange, He, Crow, & Shiffley, 2004; He, Shange, Crow, Gustafson & Shiffley, 2004). After the selection of a method or methods, the next step is their implementation. There are costs assumed to be associated with doing the mitigation work. The next subsection reviews the pertinent literature related to payment decisions linked with the work.

**Payment Preferences for Implementing Wildfire Risk Mitigation Methods**

In brief, a consumer’s willingness to pay (WTP) is an expression of a preference of money that a person would pay to realize the optimal utility from a good; A willingness to accept (WTA) is an expression of a preference of money that a person would accept as compensation for deterioration of the good (Mitchell & Carson, 1989).

The contingent valuation method (CVM) researchers (Gordon & Knetsch, 1979) acknowledge that WTA decisions about preferences and the amounts that people indicate are significantly greater than WTP decisions about preferences and amounts, and the researchers have explored some assumptions about this phenomenon. First, CVM assumes that people in hypothetical scenarios give higher WTA values because they see the property right, or the ownership of the good, associated with the scenario as either implausible, illegitimate, or both; Yet, this decision construct is tempered when actual cash is offered (Bishop & Heberlein, 1979).

Second, respondents to CVM surveys who are uncertain or indecisive about the good in question, or are risk-averse generally, provide lower WTP and higher WTA amounts than when they are certain, risk neutral, or have abundant time to plan (Hoehn & Randall, 1987). The media attention on catastrophic wildfires in the western United States and any
experiences that Kyle Canyon property owners have had could contribute to risk-averse perceptions of the wildfire hazard and influence a low expression of WTP in this study, although fire fighters' WTP might be higher because they embrace risk situations, and their payment scheme as non-owners might be in the form of taxation, use fees, or other. Third, prospect theory helps to explain why people view the same dollar value, X=Y, prefer X more than Y, when X is a known loss and Y is only a possible gain (Kahneman & Tversky, 1979). People who are risk-averse will accept the loss when the likelihood of receiving the gain is uncertain. This choice contrasts with expected utility theory (Schoemaker, 1982) where people seek to optimize their state of being by making choices that benefit, rather than detract from, that state.

Fourth, for public goods with several close substitutes, or other things that could be chosen, the elasticity of the substitution between the good being valued and all other goods in the economic system will be large, and WTP and WTA will be close; Yet, if the substitution is small relative to income elasticity, then WTP and WTA can have wide differences (Hanemann, 1999). It is difficult for respondents in this investigation to make a substitution because the non-fire state existed at the time of the survey administration and the writing of this study; however, the future state of experiencing a wildfire is uncertain.

The federal government's rules for using CVM as a method for placing values on environmental damages require the use of the dichotomous choice (DC) method (Arrow, Solow, Portney, Leamer, & Schuman, 1993). However, there is a likelihood that an overestimation of WTP will occur when using the DC method and that such overestimation will be greater than the WTP obtained in the open-ended (OE) format, where study respondents are free to specify any amount (Brown, Champ, Bishop, &
McCollum, 1996). Choosing WTP from a fixed amount might be indicative of a warm-glow bias about environmental goods, or a feel-good response because of altruistic motives to protect the environment, and, in this case, a bias in favor of the mitigation of wildfires (Ibid.). Fried, Winter, and Gilles (1999) seem to be the only researchers who examined what this investigation covers. In that investigation, the authors used an OE method to obtain WTP for wildfire mitigation.

The OE method used in a CVM study estimated the public’s WTP to improve Mono Lake, California, where water quality WTP produced higher correlations of the same variables than DC questions did after the initial survey and a follow-up survey conducted nine months later (Loomis, 1989). While there are those who have suggested that the OE format yields protest responses (Desvouges, Smith, & McGivney, 1983), where respondents deliberately attempt to skew the results by entering zero or fail to answer the questions, others are reappraising its use (Bennett & Tranter, 1998). They suggest that the OE format is useful for exploratory and pilot studies like this one (Hanley & Milne, 1996).

What needs exploration in the literature is empirical research on the topic of wildfire risk mitigation willingness to pay, especially from the perspectives of property owners and front-line fire fighters. No studies so far have focused on willingness to pay by property owners and fire fighters comparatively, only on property owners (McCaffery, 2004; McCaffery, 2002; Winter & Fried, 2000; Fried, Winter & Gilles, 1999; Winter & Fried, 1999; Kuypers, 1995; Fried, 1994).

The five foregoing subsections reviewed the pertinent literature that relates to making wildfire risk decisions. Those decisions comprise a systematic series of steps. The next section integrates the literature from the experts and non-experts section and this section
concerning five decisions. This investigation explores how a framework of analysis involving the risk, communication, and economics disciplines can facilitate the understanding of wildfire risk decisions through examination of the relationships among the experts, non-experts and five decisions.

Relationships Among the Experts and Non-Experts and Five Decisions

Some impractical issues surface when land management agencies attempt to integrate a multitude of management objectives: there are many stakeholders who have complex social, political, and ecological issues that interact and conflict (Ananda & Herath, 2003). Public forums, comment processes, risk assessments, and surveys fail to quantify the systematic tradeoffs that are required to mitigate conflicts among the objectives, stakeholders and their variable interactions. Such failures make policy decision-making a challenging job that cannot be controlled (Ananda & Herath, 2003). This investigation provides an empirical baseline of information from which policy makers can initiate a dialogue with various stakeholders about wildfire risk decisions. This section integrates the experts’ and non-experts’ and five decisions literatures to frame the hypotheses examined in this study. The integration involves examining what, if any, influences exist among the stakeholders and the five decisions they make about: 1) reporting wildfire chances, 2) reporting concern about wildfire risk, 3) assigning wildfire risk mitigation responsibility, 4) selecting wildfire risk mitigation methods, and 5) reporting preferences for paying to implement wildfire risk mitigation methods. The following subsections explore each decision’s relationship with the stakeholders.
Wildfire Chances Decisions
and Stakeholders

Social factors affect how people and institutions frame problems (Liberatore, 1995). What is known about risk and uncertainty with respect to wildfire is that property owners often discount, dismiss, or ignore risk as described by Davis (1988), who also illustrated that many property owners are not aware of wildfire risks. They frequently ignore fire prevention ordinances and building code sections. Davis (1990) also argued that property owners in the wildland-urban interface moved to the site because of the forest amenity value, and quite naturally, they try to maintain that value. He concluded that property owners don’t realize or choose to downplay that the site has wildfire hazards.

The idea that mass communication can influence people significantly was demonstrated clearly on October 30, 1938, when War of the Worlds aired on the Columbia Broadcasting System (CBS) Mercury Theater on the Air (Cantril, 1940). More than one million people were severely frightened or panicked. It seems that creating positive public opinion about wildfire mitigation through mass communication would be a goal of wildfire management agencies in order to influence property owners and firefighters to take mitigation actions seriously (Linsky, 1986). Any obstacle to influencing public opinion would thwart that goal. However, influencing public opinion through the media could be viewed negatively as government exerting social control (Beniger, 1987).

The content of media messages can influence shifts in public opinion (Fan, 1988). The instruments of mass communication may be possible channels through which property owners and firefighters could either send or receive consistent messages about wildfire mitigation in Kyle Canyon. A combination of media exposure and interpersonal
communication could amplify these influences and facilitate the process that people use to draw conclusions about issues (Allen & Waks, 1990).

A concept known as the exchange model describes a co-opted relationship between government and the various media that constitute the mass communication providers (Sigal, 1973). The model explains that, through the media, the government has a powerful voice when necessary to influence people and, from the government, the media receives important content to deliver its products to the public (Williams, 2005). Similarly, the attitudes of property owners and fire fighters about wildfire could have been shaped over six decades by the Ad Council’s Smokey Bear campaign proclaiming, “Only you can prevent forest fires” (Ad Council, n.d.).

**Hypothesis 1: Chances of Wildfire Occurrence**

This investigation examined the null hypothesis first to establish a baseline in the wildfire risk literature for further scholarly inquiry. If mass communication’s influence has overridden social factors and affected the decisions that property owners and fire fighters make about the chances of a wildfire occurring, then:

H₀: There are no differences in how property owners and fire fighters report the chances of a wildfire occurring in the next ten years.

The results from testing this hypothesis will provide a viewpoint to examine the results of the next decision about wildfire concern.

**Wildfire Concern Decisions and Stakeholders**

Wildfire suppression agencies performed a wildfire risk assessment on Mt. Charleston (U.S. Department of Interior, Bureau of Land Management, USDA Forest Service, Nevada Division of Forestry, & Clark County Fire Department, 2002). However, this
assessment failed to account for property owners’ concerns and seemed to marginalize the front-line fire fighters by including only upper management people in fire fighter organizations. If property owners’ and fire fighters’ concerns are unaccounted for, it is unknown whether they would be willing participants in wildfire risk mitigation efforts.

To promote positive public opinion about wildfire risk mitigation and to allay concerns, wildfire management agencies could follow a model similar to the 60-year old Smokey Bear effort (Rogers & Storey, 1987). The central principle of such campaigns is reform – making people’s lives better (Palmgreen & Clark, 1977; Paisley, 1989). Hornik (1989) describes several barriers in information campaigns that can result in people not adopting a new behavior after gaining knowledge from a campaign, due to: a) lack of the necessary financial resources to change, b) lack of individuals’ time or expertise to act, c) failure to conform to community social norms, and d) deficiencies in individuals’ experiences, problem-solving skills and personality traits like ingenuity and resourcefulness.

The benefits of wildfire risk mitigation campaigns are illustrated in the National Fire Protection Association program known as Firewise (National Fire Protection Association, 1991). Nevada has implemented a Firewise initiative called the Great Basin Fire Prevention Association’s Living with Fire program, which has been adopted by the Mount Charleston and Kyle Canyon residents through establishing a local chapter of the state program called the Mount Charleston Firesafe Council. It is assumed that community members will speak with a unified voice to promote Firesafe Council initiatives related to wildfire risk.

Noelle-Neumann (1984) describes the spiral of silence as a condition under which people conclude that their opinion is in the minority, resulting in few who will speak out
because of negative peer pressure from the majority, whom they perceive would reject their position. People generally use the media to assess whether they are in the minority or majority on issues and behave according to the concept of spiral of silence (Rimal, 1991). According to Rimal, if the majority position isn’t promoted, then a barrier to communication about wildfire risk mitigation could exist because people will not bring the topic up in informal conversations or in formal settings. There is some evidence to suggest that there is a relationship between the anxiety of rejection by peers and the lack of willingness to voice an opinion about a controversial issue (Lin & Salwen, 1995). Lin & Salwen’s climate of opinion concept describes how people gauge where they stand on an issue. If their opinion seems to be in alignment with the majority opinion, people are more likely to speak out in public to support issues such as wildfire risk mitigation.

_Hypothesis 2: Concern About Wildfire Risk_

This investigation examined the null hypothesis first to establish a baseline in the wildfire risk literature for further scholarly inquiry. If the information campaign and communication through the media and with each other have been effective, then:

\[ H_0: \text{There are no differences between property owners' and fire fighters' conclusions about whether property owners should be concerned about wildfire.} \]

The results of testing this hypothesis leads to the next hypothesis about the decision to assign responsibility for wildfire risk mitigation to mitigate the concern.

_Assigning Wildfire Risk Mitigation Responsibility_ 

Decisions and Stakeholders

Property owners and homeowner associations have been identified as having wildfire risk mitigation responsibility (NFPA, 1991). Several other organizations have
overlapping responsibility for wildfire risk mitigation, prevention, suppression, and recovery activities. The organizations responsible for these tasks are the U.S. Forest Service, Nevada Division of Forestry, Bureau of Land Management, and Clark County Fire Department.

Organizational Communication

There is a tendency for organizations to attempt to maintain homeostasis (Fitch, 2004). In doing so, an organization, as a system, institutes processes, rules, and procedures to protect itself from entropy. The unintended effects of this organizational behavior could erect barriers to communication, and in the instance of this research, organizational communication about wildfire risk mitigation responsibility.

Organizational communication analysis draws from other social science disciplines to illustrate the roles that people play in the communication process (Rogers & Argawala-Rogers, 1976). According to Rogers and Argawala-Rogers, gatekeepers hold positions where they can control information flow within the organization. In this study, property owners' and fire fighters' various organizations of many types could be experiencing inconsistent messages from their gatekeepers about wildfire risk mitigation responsibility.

Opinion leaders are sought out for assistance to help other organization members form their own opinions about issues (Rogers and Argawala-Rogers, 1976). Those researchers also explain how liaisons bridge the information flow from one organization unit to the others. Because property owners and some fire fighters are not full-time residents of Kyle Canyon, they likely rely on opinion leaders and liaisons that they trust to provide accurate information about wildfire risk mitigation responsibility.
Also, people referred to as cosmopolites bring external information into the organization from their extensive contacts outside of the organization (Leaderman & Stewart, 1991). The local fire fighters and Firesafe Council members of the Kyle Canyon community rely upon a paid full-time rural fire coordinator from the Clark County Fire Department to provide that external information about wildfire risk mitigation responsibility, coming from his primary organization that has its own organizational communication processes.

The wildfire management agencies could be generating miscommunications within their organizations, resulting in a limited flow of information about wildfire risk mitigation responsibility from within, let alone when it is shared with the public at large (Johnson & Johnson, 1994). Hafen (2004) identified several examples of miscommunication, something that can occur with people as well as within organizations: a) an erroneous translation of information could occur that the sender did not intend, b) senders could distort or withhold information to buttress their own agenda and impose it on the receiver, c) jargon could confuse organization members and the public, and d) members could fail to accept an accurate message because they suspect bias or distrust the sender. According to Hafen, limitations in communication processes could include a lack of feedback; interference with a message’s transmission; excessively vague, inaccurate, inflammatory, emotional, positive, or negative language; and message receivers who are inattentive, listening passively, or not listening at all.

The dark side of organizational communication (Gortner, Mahler, & Nicholson, 1987) can pose additional barriers: engaging in win-lose struggles, emphasizing organizational power, using threats, promoting hidden agendas, exploiting or isolating others, and denigrating differences in others while promoting the organization’s superiority. It could
be instructive for government officials to assess their organizational communication (Downs, 1988) about wildfire risk mitigation responsibility in myriad dimensions.

Hypothesis 3: Assignment of Responsibility for Wildfire Risk Mitigation

This investigation examined the null hypothesis first to establish a baseline in the wildfire risk literature for further scholarly inquiry. If multiple agencies that have wildfire risk mitigation responsibility to communicate effectively internally and externally with the property owners and fire fighters, then:

\[ H_0: \text{There are no differences between property owners' and fire fighters' assignment of responsibility for wildfire risk mitigation.} \]

The result of testing this hypothesis leads to the next hypothesis about carrying out the responsibility through the decision to select mitigation methods.

Selecting Mitigation Methods Decisions and Stakeholders

Nevada has implemented a Firewise initiative (National Fire Protection Association, 1991) called Living With Fire that promotes wildfire risk mitigation methods through building construction tips, establishing defensible space, fire-resistant landscaping, hazard assessment, hazard reduction, and fuels management (Great Basin Fire Protection Association, 1999). The Kyle Canyon risk assessment recommended the implementation of this program (U.S. Department of Interior, Bureau of Land Management, USDA Forest Service, Nevada Division of Forestry, & Clark County Fire Department, 2002).
Fuels Management

Brunson and Shindler (2004) assert that activities to implement fuels management practices require land management agencies to ensure the social acceptability of these practices. They argue that merely increasing knowledge about fuels treatment is not sufficient. Brunson and Shindler believe national policies that drive agency work programs can be in conflict with local needs and concerns. Messages communicated through public outreach efforts are likely to be more effective by targeting local priorities in the specific local context than relying on the efficiency of using standardized national resources (Ibid.).

Methods

Some researchers view the use of prescribed fire as reasonable if it is applied frequently to preempt vegetation maturation and wildfire ignition (Yoder & Blatner, 2004a). They recommend a complementary fuel management technique, namely, mechanical thinning, to help reduce risks in successive prescribed burn periods if it can be used as a supplemental treatment in the first prescribed burn period. These researchers caution fuel management project managers that employ prescribed burning in fuel reduction efforts to recognize that there is a trade-off of one risk for another, especially as fuels mature, in the potential for prescribed fires to escape (Yoder & Blatner, 2004b).

Site visits to prescribed burn areas might influence the acceptance of this fuel reduction method (Toman, Shindler, & Reed, 2004). The visits did contribute to Toman, Shindler, & Reed's respondents' support for prescribed burning as a treatment method because they could see evidence of a controlled treatment method and lower residual fuel levels than prior to the burn. This study suggested that site visits represent an emerging area for studying information exchange and how learning can take place during outreach.
activities. Personalized contact seems to be key in the public’s educational process and a way to increase support for wildfire risk management and mitigation (McCaffery, 2004).

Strohmaier (2000) contends that a professional ethic is needed for using prescribed burning as a management practice because prescribed fire affects individual animals. This construct could serve as a barrier to employing prescribed fire if taken up as a cause by activist groups.

**Policy Priorities**

Researchers (Dombeck, William, & Wood, 2004) argue that the wildland-urban interface and watersheds that supply municipal water systems should be the priorities of fuel management programs. These programs would employ a multi-method approach to thinning trees, removing brush, and applying prescribed fire. Just as local governments adopt zoning ordinances for floodplains, Dombeck, William, and Wood (2004) recommend that they should do so as well for fire-prone areas within their jurisdictions using policies drafted so they do not negatively impact soil integrity, watersheds, or water supplies.

Dellasalla, Williams, Williams, and Franklin (2004) caution that while active management of fuels in the wildland-urban interface is warranted, it should be tempered by adopting a do-no-harm philosophy modeled after the Hippocratic oath. They maintain that today’s national wildfire crisis became critical because of applied resource policies that were based on poorly understood or unforeseen consequences and ignorance of warning signs that trouble was happening. While conventional fire policies emphasize wildfire risk reduction and landscape health, Dellasalla, Williams, Williams, and Franklin (2004) are proponents of a third policy option that promotes ecological integrity, restoration, and maintenance.
One policy example is at work in Flagstaff, Arizona. This city has a long-term objective to promote socially acceptable programs that preserve forest health, reduce wildfire risks, promote vegetation diversity, and provide a local source of bioenergy (Farnsworth, Summerfelt, Neary, & Smith, 2003). Coordinated fuel-removal programs that are promoted as free firewood events draw over 200 people per event, resulting in the removal of 362 m$^3$ of wood in a half-day. Since the program’s inception after a severe 1996 wildfire season, over 2,471 acres have been treated successfully with solid public support.

**Hypothesis 4: Selection of Mitigation Methods**

This investigation examined the null hypothesis first to establish a baseline in the wildfire risk literature for further scholarly inquiry. If the various levels of government and their associated wildfire risk mitigation program advocates have been consistent in communicating the ways and means to accomplish fuel reduction and mitigate wildfire risk, then:

$H_0$: There are no differences between property owners’ and fire fighters’ selection of mitigation methods.

The result of testing this hypothesis leads to the assumption that the employment of mitigation methods incurs costs. The next hypothesis is designed to elicit the respondents’ decision about their preference for paying those costs.

**Preferences for Paying to Implement Mitigation Methods Decisions and Stakeholders**

There are four axioms upon which the rational choice model rests (Kreps, 1990), where $Q_i$ is a good: 1) reflexivity, which means for all $Q_i, Q_i \geq Q_i$, every good or service is
as good as itself; 2) completeness, which means between two levels of a good or service, $Q_i$ and $Q_j$, either $Q_i \geq Q_j$ or $Q_j \geq Q_i$, people can compare and rank all levels of goods or services; 3) transitivity, which means if $Q_i \geq Q_j$ and $Q_j \geq Q_k$, then $Q_i \geq Q_k$, an individual’s preferences are cyclical; and 4) continuity, which means for any level of good or service $Q_i$, if one can describe $A(Q_i)$ as the ‘at least as good set’ and $B(Q_i)$ as the ‘no better than set,’ then $A(Q_i)$ and $B(Q_i)$ contain their own boundary points and are closed, meaning that no good or service is absolutely necessary and that any good or service can be traded for another good or service. Property owners and fire fighters are assumed to follow this rational choice model for this study.

**Contingent Valuation Limitations**

Researchers (Powe & Bateman, 2003) describe various difficulties and practical concerns related to CVM responses that vary when the position of a particular survey question changes in relation to the position of other questions. The central theme is that whole and part evaluation responses depend on the CVM questionnaire design. A top-down design elicits values for the whole environmental good, such as what people would pay to save the ocean, followed by the elicitation of values for the parts of the good, such as what people would pay to save dolphins. A bottom-up design elicits the parts’ values first, then the whole’s values. This investigation uses the bottom-up design by eliciting preferences for individual wildfire mitigation methods and associated monthly payments, and then elicits a summary annual payment for all mitigation methods. The reason for this approach is that the Cerro Grande fire and other fires might have had adverse effects on people when they consider prescribed burning as a mitigation method. Rather than let that adversity affect the whole response, or annual payment, at the outset, it is prudent to
identify it in advance as a method that people do not prefer, if that is the case (Fried, Winter, & Gilles, 1999).

Other criticisms of CVM studies are that a) people lack familiarity with the goods being valued, b) there is no incentive to be accurate in providing responses, and c) there is no consequence for being inaccurate (Niewdijk, 1995). Niewdijk contends that people cannot have values for something they don’t know exists. This investigation poses concrete questions about wildfires that respondents are assumed to know have occurred in the Kyle Canyon area. It is assumed that respondents are familiar with the hazard.

Duncombe, Robbins, and Stonecash (2003) investigated whether senior citizens as a voting block could thwart public services funding initiatives. The CVM survey conducted by Duncombe, Robbins, and Stonecash revealed that it is too difficult to evaluate how aging impacts preferences as various surveyed groups react to changes in their financial circumstances. Roughly 25% of Clark County residents are senior citizens (www.census.gov). It is unlikely that a block of respondents, such as the ones surveyed in Duncombe, Robbins, and Stonecash’s study, would skew this investigation’s results.

A review of the 1993 NOAA panel (Arrow, Solow, Portney, Leamer, & Schuman) guidelines that require in-person interviews to obtain expressed preferences in CVM surveys concluded that it would be extremely costly to use the results in damage assessment or regulatory purposes (Portney, 1994). Portney also examined the enormity of the task of performing benefit/cost analyses when the entire U.S. population has probably been affected in either a beneficial or injurious way by some federal program at some point in their lives. He asserts that it would be difficult to determine who could benefit or lose. Acknowledging these potential limitations, it must be noted that this investigation used a mail survey to obtain preferences because of resource shortfalls.
What is not known is whether Kyle Canyon property owners and fire fighters support the use and inevitable costs of three proposed wildfire risk mitigation measures (U.S. Department of Interior, Bureau of Land Management, USDA Forest Service, Nevada Division of Forestry, & Clark County Fire Department, 2002).

Hypothesis 5: Willingness to Pay

This investigation examined the null hypothesis first to establish a baseline in the wildfire risk literature for further scholarly inquiry. If the rational choice economic model holds true, then

$H_0$: There are no differences between property owners’ and fire fighters’ self-reported willingness to pay for wildfire risk mitigation.

The result of testing this hypothesis concludes the series of steps that illustrate one way that wildfire risk decisions evolve. The next section summarizes some conclusions about the wildfire risk decision-making process.

Conclusions From the Literature Review

The mixed, inconclusive evidence mentioned in the works above and the rarity of scholarly material concerning wildfire risk decision-making from a stakeholder perspective provides the motivation for this study. The study’s goals are to obtain useful information for various stakeholders to make informed decisions about wildfire risk mitigation strategies and to expand the scholarly literature pertaining to wildfire risk decisions. This investigation contributes to the scholarly literature by comparing the decisions made by two stakeholder groups, property owners and fire fighters, who represent proxies for non-experts and experts, respectively.
The property owners are assumed to have property rights associated with their land parcels and any improvements. Volunteer fire fighters who respond to wildfires are assumed to adhere to their standard training program’s three principles for prioritizing their fire fighting actions: life safety, property conservation, and incident stabilization.

Several conclusions may be drawn from the literature review. First, there are very few studies that cover relevant stakeholder perception of wildfire risk to adequately link with wildfire risk decisions. Second, studies that have addressed the influences of interpersonal, organizational, and mass communication, and the role each plays in wildfire risk decisions do not provide a basis for any significant conclusions. Available empirical evidence is thin and diverse. This literature review described how communication could facilitate the understanding of wildfire risk among the stakeholders. The communication literature does not give any guidance about how relevant stakeholder groups will describe wildfire risk to others. This investigation will provide baseline data for future scholars to conduct studies in these areas. Third, the policy options promoted by: 1) Busenberg (2004a, 2004b) to reduce fuels, 2) the Farnsworth, Summerfelt, Neary, and Smith (2003) case study of using biomass energy products as one fuel management tool, and 3) the Dombeck, William, and Wood (2004) study that recommended fuel reduction priorities are all currently being discussed on the national level. Fourth, there is an opportunity through this study to show how multi-disciplinary viewpoints and collaboration with relevant stakeholders in environmental and natural resource issues (Bryan, 2004) could serve as a model to achieve shared ownership of wildfire risk decisions in the United States.

Each of these conclusions is linked and forms the beginnings of a platform upon which to build a scholarly repository of information about wildfire risk decisions. The
existing literature lacks sufficient empirical evidence that has undergone rigorous scrutiny
to comprise a field of study. This investigation provides material to begin filling those
gaps. The next chapter describes the methods used in this study to obtain some needed
empirical evidence.
CHAPTER THREE

METHODS

This chapter explains the methods used to investigate wildfire risk decisions. Historically, there are few established methods of conducting investigations in this area. The rare works that did exist provided relevant material that focused solely on the property owners. The methods designed for this study included subjects who were fire fighters as well as property owners, and they each were categorized as residents and non-residents, respectively, for analysis. This design approach was established to determine how respondents decided to report their perceptions of wildfire risk, concern level, assignment of responsibility, choice of mitigation methods, and payment for those methods by stakeholders.

The research problem is to evaluate how the disciplines of risk, communication and economics provide the means to understand how property owners and fire fighters make wildfire risk decisions. This is a descriptive, non-experimental study that describes the characteristics surrounding the experts and non-experts and the relationships among these variables (Williams & Monge, 2001) based on the self-reported decisions of property owners and fire fighters.
Subjects and Design

The Clark County, Nevada, Assessor’s Office provided a list of all 403 property owners of record as of May 2003 who owned land parcels in the five subdivisions of Kyle Canyon, Nevada, that include Old Town, Rainbow, Echo, Cathedral, and Lower Kyle Canyon. These property owners were selected in order to obtain a comprehensive response from one complete set of stakeholders in Kyle Canyon. The Clark County, Nevada, Fire Department provided a list of all 138 volunteer fire fighters listed in their database as of July 2004 who were members of the volunteer fire companies operating in Kyle Canyon and other surrounding towns on and near Mt. Charleston. This second set of stakeholders was selected because they are front-line fire fighter professionals known to respond to wildfires in and around Kyle Canyon and a group whose perspectives have been absent from previous studies.

The survey questionnaire (Appendix A) is adapted from the methods of McCaffery (2002), Fried (2002), Winter and Fried (1999), and Kuypers (1995). Each scholar’s work served as a guide in piecing various portions of what constitutes the complete survey in this investigation. McCaffery (2002) conducted a survey of Incline Village, Nevada, property owners to identify the factors that foster positive attitudes about wildfire mitigation efforts, including defensible space, prescribed burning, and thinning. However, there was neither a valuation investigation like this study employed nor an examination of fire fighters as stakeholders. Fried (2002) and Winter and Fried (1999) used a contingent valuation method (CVM) survey to study property owners’ preferences for wildfire risk mitigation in Michigan. Kuypers (1995) investigated property owners’ valuation of various wildfire mitigation methods on the eastern coast of Florida. These three efforts focused solely on the property owners. This dissertation expands upon those
investigations by including front-line fire fighters as survey respondents and then comparing their responses to the property owners’ responses.

The survey questionnaire (Appendix A) consists of five sections. The first section asks the respondents to report on a scale of 1 – 10 (Kuypers, 1995; Birkett, 1986) the chances of a wildfire occurring in Kyle Canyon and whether Kyle Canyon property owners should be concerned about it. The second section asks respondents to assign wildfire mitigation responsibility to five categories of potentially responsible parties. The third section asks respondents if they would permit the application of three mitigation methods—trimming, prescribed burning, and thinning—to their property or adjacent property. The fourth section asks respondents about their willingness to pay for these three methods and the monthly and annual amounts they would pay. The fifth section asks demographic questions.

In addition to wildfire risk and demographic questions, this design adapted select questions from McCaffery (2002), Fried (2002), Winter and Fried (1999), and Kuypers (1995) in order to compare the responses obtained in this study to theirs. This design used a bottom-up design to elicit values for part of the environmental good and wildfire mitigation methods, which was followed by the elicitation of values for the whole good and the wildfire mitigation result (Powe & Bateman, 2003). This research is prospective, or ex ante, which means it takes place before a wildfire incident occurs. The respondents to this survey are property owners and fire fighters, and are either residents or non-residents, respectively. One assumption is that fire fighters have expertise in wildfire risk mitigation and wildfire suppression. Another is that property owners might express their preferences differently than residents who could be tenants with no property rights. Only property owners were selected for survey administration, no tenants were selected.
The open-ended (OE) method used in CVM estimates of willingness to pay (WTP) to improve water quality in Mono Lake, California, water quality produced higher correlations between the results of an initial survey and those of a follow-up survey conducted nine months later than any dichotomous choice (DC) questions did (Loomis, 1989). While there are those who have suggested that the OE format yields protest zero responses and non-responses as mentioned in Chapter 2 (Desvouges, Smith, & McGivney, 1983), others are reappraising its use (Bennett & Tranter, 1998). They suggest that the OE format is useful for exploratory and pilot studies like this one (Hanley & Milne, 1996). With only one similar study to compare results, this investigation also uses the OE method to observe whether its use produces similar outcomes or not, serving as a guide for future researchers. The uncertainty in expressing a preference is the reason that this Kyle Canyon investigation uses a WTP format rather than a WTA format. The inability for this investigation to provide compensation due to wildfire losses also influenced the decision to use the WTP format.

Variables

Based on the literature review, the variables that are predicted to have an effect on the five decisions are: those who are assumed to have expertise, fire fighters, and those who are assumed to lack expertise, property owners. The five decisions that are predicted to be affected by the experts and non-experts are: reported chances of a wildfire occurring, reported concern about wildfire, assignment of responsibility for mitigation efforts, reported selection of mitigation methods, and reported willingness to pay amounts.
Hypotheses and Analysis

Hypothesis 1: There are no differences in how property owners and fire fighters report the chances of a wildfire occurring in the next ten years.

The first survey question was designed to elicit the responses about wildfire chances occurrence. The statistical tools used to understand the responses were descriptive statistics (Williams & Monge, 2001) that describe the chances of wildfire occurrence choices, analysis of variance (ANOVA) (Morgan et al., 2004) between the two groups, and multiple regression (Winter & Fried, 1999) of wildfire chances choices.

Hypothesis 2: There are no differences between property owners’ and fire fighters’ conclusions about whether property owners should be concerned about wildfire.

The second survey question was designed to elicit the responses about concern. The statistical tool used to understand the responses is descriptive statistics, illustrating the distributions of responses (Williams & Monge, 2001) about concern that Kyle Canyon residents should have about wildfire.

Hypothesis 3: There are no differences between property owners’ and fire fighters’ assignment of responsibility for wildfire risk mitigation.

The third survey question was specifically designed to elicit the responses addressing the assignment of responsibility. The statistical tools used to understand the responses were: descriptive statistics (Williams & Monge, 2001) comparing the assignment of responsibility, analysis of variance (ANOVA) (Morgan et al., 2004) about the assignments of responsibility, and multiple regression correlation (Winter & Fried, 1999) of how the responsibility was assigned.

Hypothesis 4: There are no differences between property owners’ and fire fighters’ selection of mitigation methods.
Hypothesis 5: There are no differences between property owners’ and fire fighters’ self-reported willingness to pay for wildfire risk mitigation.

Survey questions four through eight were specifically designed to elicit responses about the choice of methods, monthly WTP amounts and annual WTP amounts. Statistical tools used to understand the responses were: descriptive statistics (Williams & Monge, 2001) comparing how the respondents selected the methods and indicated their willingness to pay for those methods on a monthly and annual basis, analysis of variance (ANOVA) (Morgan et al., 2004) among method selections to determine WTP, and multiple regression correlation (Winter & Fried, 1999) among the mitigation methods and their WTP reported amounts.

Procedure

A single survey instrument collected data for this study. The survey was administered by mail to each person in the sample, comprising the two groups: Kyle Canyon property owners and Clark County volunteer fire fighters. No Kyle Canyon property tenants were selected for survey administration. A copy of the instrument is attached in Appendix A. After obtaining Institutional Review Board (IRB) protocol approval, the survey was pilot-tested with 12 environmental science masters’ degree students. After obtaining their 7- to 12-minute range for completion rates, a facilitated discussion on their impressions, question comprehension, question wording, and question ordering took place. As a result, the original eight-page questionnaire was scaled down to a single-page, two-sided format by assessing strictly the survey’s reliability and prospective validity. This change required seeking another protocol approval from the IRB that was granted.
Materials

The only material utilized in this study was the questionnaire. The results were analyzed using the SPSS software applications (Morgan et al., 2004).

Survey Instrument

The single-page, two-sided questionnaire, informed consent sheet, cover letter, and outgoing and business-reply envelopes were printed at the University of Nevada, Las Vegas Reprographics Center. Assistants folded documents, stuffed envelopes, sealed them and affixed outgoing postage and mailing labels. The mailed surveys, that included the total of 541 property owners and volunteer fire fighters, were deposited at a local U.S. Post Office. Returned surveys were delivered to the UNLV Department of Environmental Studies for collection and analysis, costing $0.37 for each returned survey plus an additional $0.25 per survey that was a UNLV handling charge. All expenses were paid for with the investigator’s personal funds. Expenses totaled $1,005.00.

Computer Applications

For analysis, SPSS 12.0 was used. It is a common off-the-shelf analytical application that uses data from electronic files to generate tables, charts, and plots of distributions and trends, descriptive statistics, and other statistical analyses.

Validity and Reliability

The survey elicited the responses of assessing the chances of wildfire occurring in Kyle Canyon, concern about wildfire, assignment of responsibility for mitigating wildfire, mitigation method selection, and willingness to pay for the methods. The
comparison between what the survey was asking and what these results represent are assumed to be truthful conceptions of the respondents' answers, thus, valid responses. Application and reapplication of these measures under conditions replicated precisely should yield the same results, demonstrating external reliability.

This study was designed to obtain understanding about how certain groups of people make decisions about wildfire risk, expressed concerns about it, assigned responsibility for risk mitigation, chose wildfire risk mitigation methods, and how they valued those methods. The design identified fire fighters as a targeted group of respondents that was not studied previously in relationship to the customers whom they serve—the property owners. Further, this study was designed to examine how these two groups, make decisions and whether there are discrete differences about wildfire risk decisions, if such differences exist. This contribution to the literature will serve as a baseline from which other future investigators can draw.
CHAPTER FOUR

RESULTS

The survey data collection and analysis results are in this chapter. Data collection occurred through the months of July and August 2004. Of the 541 surveys mailed to Kyle Canyon property owners and Clark County volunteer fire fighters, there were 107 responses by the end of August via business-reply mail, establishing a 19.8% return rate. The U.S. Postal Service returned approximately twenty surveys deemed undeliverable. There was no accounting for those surveys that were undelivered or those not returned.

Descriptive Statistics

There were 70 male respondents (65.4%) and 37 female respondents (34.6%). Thirty-two respondents claimed primary residence in Kyle Canyon (29.9%). Respondents who are now or who have ever been members of a fire fighting organization numbered 35 (32.7%). Respondents' income categories are listed in Table 2 Respondent Household Income Category Results.
Table 1. Respondent Household Income Category Results

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of Respondents</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - Did not report</td>
<td>23</td>
<td>21.5</td>
</tr>
<tr>
<td>1 - Under $15,000</td>
<td>4</td>
<td>3.7</td>
</tr>
<tr>
<td>2 - $15,001 to $30,000</td>
<td>3</td>
<td>2.8</td>
</tr>
<tr>
<td>3 - $30,001 to $45,000</td>
<td>8</td>
<td>7.5</td>
</tr>
<tr>
<td>4 - $45,001 to $60,000</td>
<td>10</td>
<td>9.3</td>
</tr>
<tr>
<td>5 - $60,001 to $75,000</td>
<td>8</td>
<td>7.5</td>
</tr>
<tr>
<td>6 - $75,001 to $100,000</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>7 - $100,001 to $150,000</td>
<td>13</td>
<td>12.1</td>
</tr>
<tr>
<td>8 - Over $150,000</td>
<td>23</td>
<td>21.5</td>
</tr>
<tr>
<td>Total</td>
<td>107</td>
<td>100</td>
</tr>
</tbody>
</table>

The first survey question asked respondents to estimate the chances of a wildfire incident occurring in Kyle Canyon within the next ten years on a scale of 1 to 10. On this scale, 1 indicates a very small chance of wildfire occurring while 10 indicates a belief that it is very likely to happen. Respondents' answers are listed in Table 3. Table 3 shows over 50% estimate the chance at 9 and 10, on the very likely end of the scale.

Table 2. Assessed Chance of Wildfire Occurrence

<table>
<thead>
<tr>
<th>Scale Choice</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No response</td>
<td>3</td>
<td>2.8</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1.9</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0.9</td>
</tr>
<tr>
<td>5</td>
<td>11</td>
<td>10.3</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>5.6</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>9.3</td>
</tr>
<tr>
<td>8</td>
<td>19</td>
<td>17.8</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>8.4</td>
</tr>
<tr>
<td>10</td>
<td>46</td>
<td>43</td>
</tr>
<tr>
<td>Total</td>
<td>107</td>
<td>100</td>
</tr>
</tbody>
</table>
The second survey question asked respondents if property owners in Kyle Canyon should be concerned about wildfire. The respondents were asked to provide either a “yes” or “no” response. Two respondents did not answer, while 105 (98.1%) responded affirmatively with a “yes.” There is no tabular representation of these data.

The third survey question asked respondents to assign responsibility for protecting residents and property to five groups on a scale of 1 to 10. On this scale, 1 indicates the least responsibility and 10 indicates the most responsibility for each group. Table 4 displays the responses for each group. Table 4 shows there are trends toward placing responsibility with the government agencies, and less with property owners and homeowners' associations. The scale choice number 6 received the least emphasis among all the categories of responsible parties. Future scholars may find this anomaly of interest to study. The approximate 30% drop in responses to the homeowners' association category is likely due to misunderstanding of the question. Margin comments on the surveys indicated repeatedly that there were no homeowners' associations in Kyle Canyon.
Table 3. Frequencies and Percentages of Responsibility Assignment

<table>
<thead>
<tr>
<th>Frequency; % rounded</th>
<th>Least</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>Most</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owners</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>22%</td>
<td>1%</td>
<td>11%</td>
<td>9%</td>
<td>9%</td>
<td>40%</td>
<td>104</td>
</tr>
<tr>
<td>Hmwnrs Assoc.</td>
<td>19%</td>
<td>4%</td>
<td>4%</td>
<td>2%</td>
<td>11%</td>
<td>3%</td>
<td>2%</td>
<td>8%</td>
<td>7%</td>
<td>18%</td>
<td>15%</td>
<td>73</td>
</tr>
<tr>
<td>Clark County</td>
<td>n/a</td>
<td>2%</td>
<td>2%</td>
<td>5%</td>
<td>13%</td>
<td>5%</td>
<td>8%</td>
<td>18%</td>
<td>3%</td>
<td>44%</td>
<td>43%</td>
<td>102</td>
</tr>
<tr>
<td>State of Nevada</td>
<td>2%</td>
<td>5%</td>
<td>5%</td>
<td>1%</td>
<td>10%</td>
<td>4%</td>
<td>10%</td>
<td>15%</td>
<td>10%</td>
<td>43%</td>
<td>42%</td>
<td>102</td>
</tr>
<tr>
<td>Federal Govt.</td>
<td>5%</td>
<td>3%</td>
<td>3%</td>
<td>n/a</td>
<td>9%</td>
<td>6%</td>
<td>6%</td>
<td>9%</td>
<td>11%</td>
<td>47%</td>
<td>48%</td>
<td>101</td>
</tr>
</tbody>
</table>

The fourth survey question asked respondents if they would be willing to allow the use of prescribed burning on their property or adjacent properties for reducing a wildfire hazard. The respondents were asked to provide either a “yes” or “no” response. Forty-eight (44.9%) respondents answered “yes,” while 59 (55.1%) answered “no.” The results are displayed in Table 4.

The fifth survey question asked respondents if they would be willing to allow the use of chainsaws and other machines to trim trees and remove underbrush on their property or adjacent properties for the purpose of reducing a wildfire hazard. The respondents were asked to provide either a “yes” or “no” response. Ninety-two (86%) respondents answered “yes,” while 15 (14%) answered “no.” The results are displayed in Table 4.

The sixth survey question asked respondents if they would be willing to allow thinning of trees on their property or adjacent properties for the purpose of reducing a wildfire hazard. The respondents were asked to provide either a “yes” or “no” response. The results are displayed in Table 4. Table 4 shows that seventy-two (67.3%) respondents answered “yes,” while 35 (32.7%) answered “no.”
Table 4. Selection of Mitigation Methods

<table>
<thead>
<tr>
<th>Survey Questions for 4 Through 6 Descriptives</th>
<th>Yes</th>
<th>Valid %</th>
<th>No</th>
<th>Valid %</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>AllowTrimming</td>
<td>91</td>
<td>89.2</td>
<td>11</td>
<td>10.8</td>
<td>102</td>
</tr>
<tr>
<td>AllowThinning</td>
<td>71</td>
<td>69.6</td>
<td>31</td>
<td>30.4</td>
<td>102</td>
</tr>
<tr>
<td>AllowPrescribed Burning</td>
<td>47</td>
<td>45.2</td>
<td>57</td>
<td>54.8</td>
<td>104</td>
</tr>
</tbody>
</table>

The seventh survey question asked multiple sub-questions about mitigation methods, willingness to pay for the selected method, the amount by month respondents would be willing to pay, and if they were not willing to pay, if it was because they believed the methods had no value. Twenty-three (21.5%) respondents indicated they are willing to pay for the prescribed burning method, while 84 (78.5%) indicated they were not willing to pay. Additionally, 14 (13.1%) respondents indicated that prescribed burning had no value to them. Table 5 reveals the supporting descriptive statistics for the amounts respondents would be willing to pay monthly for prescribed burning. Table 5 shows that the median and mode reflect there are trends for not paying anything.
Table 5. Prescribed Burning Method Monthly Payments, N=107

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>$3.80</td>
</tr>
<tr>
<td>Standard Error of Mean</td>
<td>$1.12</td>
</tr>
<tr>
<td>Median</td>
<td>$0</td>
</tr>
<tr>
<td>Mode</td>
<td>$0</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>$11.53</td>
</tr>
<tr>
<td>Variance</td>
<td>133.05</td>
</tr>
<tr>
<td>Skewness</td>
<td>3.32</td>
</tr>
<tr>
<td>Standard Error Skew</td>
<td>.23</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>10.78</td>
</tr>
<tr>
<td>Std. Error Kurtosis</td>
<td>.46</td>
</tr>
<tr>
<td>Range</td>
<td>$50</td>
</tr>
<tr>
<td>Minimum</td>
<td>$0</td>
</tr>
<tr>
<td>Maximum</td>
<td>$50</td>
</tr>
</tbody>
</table>

Fifty-three (49.5%) respondents were willing to pay for the trimming method, while fifty-four (50.5%) were not. Additionally, six (5.6%) respondents indicated that trimming had no value to them. Table 6 reveals the monthly amounts and supporting descriptive statistics for the amounts respondents would be willing to pay for trimming. Three outliers indicating $1,000 monthly payments were eliminated. Outliers of large magnitude because of improperly completed surveys can be removed on an ad hoc basis (Mitchell & Carson, 1989). Table 6 shows that the median and mode reflect there are trends for not paying anything.
Forty-three (40.2%) respondents were willing to pay for the thinning method, while sixty-four (59.8%) were not. Additionally, twelve (11.2%) respondents indicated that thinning had no value to them. Table 7 reveals the supporting descriptive statistics for the amounts respondents would be willing to pay for thinning. Two outliers indicating $1,000 a month were eliminated (Mitchell & Carson, 1989). Table 7 shows that the median and mode reflect there are trends for not paying anything.
The eighth and final survey question asked the respondents the total amount that they would pay this year to reduce a wildfire risk using the methods they identified. Table 8 reveals the supporting descriptive statistics for the amounts that respondents would be willing to pay given all mitigation methods they selected. No outliers were removed. Table 8 shows that the median and mode reflect there are trends for not paying anything.
Inferential Statistics

Hypothesis 1: There are no differences in how property owners and fire fighters report the chances of a wildfire occurring in the next ten years.

Both property owners and fire fighters were asked to assess the chances of future wildfires. Simultaneous multiple regression was conducted to compare the chances reported by the two groups. There is no statistically significant difference between the chances reported by property owners and those reported by fire fighters. The results of this analysis fail to reject the null hypothesis.

Wildfire Chances reports were regressed against the combined Property Owner and Fire Fighter variables. Table 9 depicts the results of the regression model summary. If R-squared is zero, then Property Owner and Fire Fighter report the same chance of wildfire. The results for the adjusted R-squared show in general that Fire Fighter has slightly, but not statistically significant, differences in the expectations about future wildfires than Property Owner.

Table 9. Regression Model Summary for Wildfire Chances Estimate as a Function of Fire Fighter and Property Owner

<table>
<thead>
<tr>
<th>Wildfire Chances</th>
<th>Adjusted R-Squared</th>
<th>Standard Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wildfire Chances</td>
<td>.06</td>
<td>1.85</td>
</tr>
</tbody>
</table>

The Analysis of Variance (ANOVA) assessment depicted in Table 10 shows that the regression of Wildfire Chances simultaneously against the Property Owner and Fire Fighter variables is statistically significant, \( F = 3.11, p = .03, df = 3 \). This means, on average, that Property Owner and Fire Fighter have a detectable effect on Wildfire
Chances reports. Both Property Owner and Fire Fighter expect that there will be wildfires in the future. Though their individual decisions differ slightly on the categorical scale point choices, those must be viewed in the context of the descriptive statistics that demonstrate collective agreement about wildfire chances. More than a majority selected the 9 and 10 choice, or very likely.

Table 10. ANOVA: Wildfire Chances Estimate as a Function of Fire Fighter and Property Owner

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wildfire Chances</td>
<td>31.97</td>
<td>3</td>
<td>10.66</td>
<td>3.11</td>
<td>.03*</td>
</tr>
</tbody>
</table>

* significant at the p<.05 level.

The regression results are depicted in Table 11. The results show that both Property Owner, $t = 2.54$, $p = .01$, and Fire Fighter, $t = 2.25$, $p = .03$ are statistically significant for reported Wildfire Chances. This means that both groups are likely to agree on the chances of future wildfire occurrence.
Table 11. Regression Model Correlation for Fire Fighter and Property Owner Influence on Wildfire Chances Combined Effect

<table>
<thead>
<tr>
<th>Wildfire Chances as Dependent Variable</th>
<th>Unstandardized Coefficient</th>
<th>Standardized Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Beta</td>
</tr>
<tr>
<td>Property Owner</td>
<td>1.25</td>
<td>.30</td>
</tr>
<tr>
<td>Fire Fighter</td>
<td>1.04</td>
<td>.26</td>
</tr>
</tbody>
</table>

* significant at the p<.05 level  ** significant at the p<.01 level

Hypothesis 2: There are no differences between property owners' and fire fighters' conclusions about whether property owners should be concerned about wildfire.

The respondents were asked to provide either a "yes" or "no" response to the question about whether Kyle Canyon property owners should be concerned about wildfire. Two respondents did not answer the question, while the remaining 105 respondents (98.1%) did answer this question unanimously and affirmatively with a "yes." It would be superfluous to display these data. The results of this analysis fail to reject the null hypothesis.

Hypothesis 3: There are no differences between property owners' and fire fighters' assignment of responsibility for wildfire risk mitigation.

Both property owners and fire fighters were asked to assign levels of responsibility on a scale of 1-10 to five categories of actors who could mitigate the wildfire hazard. Simultaneous multiple regression was conducted to compare how two groups, Property Owner and Fire Fighter, assign responsibility for wildfire risk mitigation. There is a
statistically significant difference between the reported assignment of responsibility by Property Owner and the responsibility assignments reported by Fire Fighter. The analysis results justify rejecting the null hypothesis.

Table 12 depicts the results of the regression model summary. The adjusted R-squared shows that there are slight differences between Property Owner and Fire Fighter in assignment of responsibility to the categories of property owners, homeowners' associations, state of Nevada, Clark County and Federal Government.

<table>
<thead>
<tr>
<th>Table 12. Regression Model Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inferential Statistics</td>
</tr>
<tr>
<td>Property Owners</td>
</tr>
<tr>
<td>Homeowners' Associations</td>
</tr>
<tr>
<td>Clark County</td>
</tr>
<tr>
<td>State of Nevada</td>
</tr>
<tr>
<td>Federal Government</td>
</tr>
</tbody>
</table>

The results of the analysis of variance (ANOVA) are depicted in Table 13. The results reflect that, with respect to assigning responsibility for mitigating wildfire risk, the differences for Clark County, Nevada, $F = 3.78, p = .03, df = 2$, and the federal government, $F = 3.43, p = .04, df = 2$, are statistically significant, while those for property owners, homeowner's associations, and state of Nevada are not statistically significant. This means that Property Owner and Fire Fighter report that Clark County and Federal Government are most responsible for wildfire risk mitigation, but do not report responsibility in any significant way for the other groups.
Table 13. Regression ANOVA: Responsibility for Mitigation as a Function of Kyle Canyon Property Owner and Fire Fighter Combined

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Owners</td>
<td>.41</td>
<td>2</td>
<td>.20</td>
<td>.03</td>
<td>.97</td>
</tr>
<tr>
<td>Homeowners' Associations</td>
<td>8.09</td>
<td>2</td>
<td>4.04</td>
<td>.31</td>
<td>.72</td>
</tr>
<tr>
<td>Clark County</td>
<td>40.69</td>
<td>2</td>
<td>20.34</td>
<td>3.78</td>
<td>.03*</td>
</tr>
<tr>
<td>State of Nevada</td>
<td>17.80</td>
<td>2</td>
<td>8.90</td>
<td>1.4</td>
<td>.25</td>
</tr>
<tr>
<td>Federal Government</td>
<td>47.19</td>
<td>2</td>
<td>23.59</td>
<td>3.43</td>
<td>.04*</td>
</tr>
</tbody>
</table>

* significant at p<.05

The regression results are depicted in Table 14. The results show that only Fire Fighter is statistically significant for reported assignment of responsibility to Clark County, \( t = .69, p = .01 \) and to the federal government, \( t = 1.36, p = .03 \). Property Owner is not significant for any category which means that they might lack the information to make such a decision, could be ambivalent to which, if any, group is responsible, or possibly misunderstood the question. No statistically significant preference is apparent for Property Owner.
Hypothesis 4: There are no differences between property owners' and fire fighters' selection of mitigation methods.

Property owners and fire fighters were asked to choose among thinning, trimming, and prescribed burning mitigation methods. Simultaneous multiple regression was
conducted to compare how the two groups, Property Owner or Fire Fighter, select wildfire risk mitigation methods. There is a statistically significant difference between Property Owner reported method choice and those reported by Fire Fighter. The analysis results justify rejecting the null hypothesis.

Table 15 depicts the results of the regression model summary. The adjusted R-squared shows that slight differences exist in mitigation method selection reports for Thinning, Prescribed Burning and Trimming reported by Property Owner and Fire Fighter.

Table 15. Regression Model Summary for Three Mitigation Methods

<table>
<thead>
<tr>
<th>Methods</th>
<th>Adjusted R-Squared</th>
<th>Standard Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimming</td>
<td>-.01</td>
<td>.31</td>
</tr>
<tr>
<td>Thinning</td>
<td>.07</td>
<td>.44</td>
</tr>
<tr>
<td>Prescribed Burning</td>
<td>.05</td>
<td>.48</td>
</tr>
</tbody>
</table>

Table 16 depicts the results of the analysis of variance (ANOVA). The results reflect that, with respect to selecting wildfire risk mitigation methods, the reported choices are statistically significant for Thinning, F = 5.25, p = .01, df = 2, and Prescribed Burning, F = 3.72, p = .03, df = 2, while those for trimming are not. This means that fuel management approaches that propose to use thinning and prescribed burning methods would likely create mixed support and opposition among property owners and fire fighters.
### Table 16. Regression ANOVA: Selection of Mitigation Method is a Function of Kyle Canyon Property Owner and Fire Fighter Combined

<table>
<thead>
<tr>
<th>Method</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimming</td>
<td>.11</td>
<td>2</td>
<td>.06</td>
<td>.61</td>
<td>.54</td>
</tr>
<tr>
<td>Thinning</td>
<td>2.08</td>
<td>2</td>
<td>1.0</td>
<td>.525</td>
<td><strong>.01</strong></td>
</tr>
<tr>
<td>Prescribed Burning</td>
<td>1.76</td>
<td>2</td>
<td>.88</td>
<td>3.72</td>
<td>.03*</td>
</tr>
</tbody>
</table>

* significant at p<.05 ** significant at p<.01

The regression results are depicted in Table 17. The results show that Fire Fighter is statistically significant for selection reports for Thinning, $t = 2.82$, $p = .01$. Property Owner is not statistically significant for any method selection. This means that fuel management initiatives could be difficult to implement without support from property owners.
Table 17. Regression Correlation for Property Owner and Fire Fighter Influence on Selection of Mitigation Method Separately

<table>
<thead>
<tr>
<th>Property Owner</th>
<th>Unstandardized Coefficient</th>
<th>Standardized Coefficient</th>
<th>Standard Error</th>
<th>Beta</th>
<th>t</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Standard Error</td>
<td>Beta</td>
<td>t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimming</td>
<td>.01</td>
<td>.01</td>
<td>.11</td>
<td>1.06</td>
<td>.29</td>
<td></td>
</tr>
<tr>
<td>Thinning</td>
<td>.53</td>
<td>1.01</td>
<td>.06</td>
<td>.52</td>
<td>.6</td>
<td></td>
</tr>
<tr>
<td>Prescribed Burning</td>
<td>.02</td>
<td>.02</td>
<td>.15</td>
<td>1.63</td>
<td>.11</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fire Fighter</th>
<th>Unstandardized Coefficient</th>
<th>Standardized Coefficient</th>
<th>Standard Error</th>
<th>Beta</th>
<th>t</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Standard Error</td>
<td>Beta</td>
<td>t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimming</td>
<td>.02</td>
<td>.06</td>
<td>.03</td>
<td>.34</td>
<td>.72</td>
<td></td>
</tr>
<tr>
<td>Thinning</td>
<td>.26</td>
<td>.09</td>
<td>.27</td>
<td>2.82</td>
<td>.01**</td>
<td></td>
</tr>
<tr>
<td>Prescribed Burning</td>
<td>.07</td>
<td>.11</td>
<td>.07</td>
<td>.71</td>
<td>.47</td>
<td></td>
</tr>
</tbody>
</table>

** significant at .01

Hypothesis 5: There are no differences between property owners’ and fire fighters’ self-reported willingness to pay for wildfire risk mitigation.

Property owners and fire fighters were asked, in an open-ended question, how much they would be willing to pay monthly for wildfire mitigation methods. Simultaneous multiple regression was conducted to compare how the two groups, Property Owner or Fire Fighter, report willingness to pay for wildfire risk mitigation. There is no statistically significant difference between the reported willingness to pay monthly by Property Owner and Fire Fighter. The analysis results justify rejecting the null hypothesis in this case.
Table 18 depicts the results of the regression model summary. The adjusted R-squared shows that slight differences in monthly payment reports by Property Owner and Fire Fighter, but are not statistically significant.

Table 18. Regression Model Summary for Monthly Payments

<table>
<thead>
<tr>
<th>Methods</th>
<th>Adjusted R-Squared</th>
<th>Standard Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimming</td>
<td>-.01</td>
<td>$272.55</td>
</tr>
<tr>
<td>Thinning</td>
<td>-.02</td>
<td>$212.38</td>
</tr>
<tr>
<td>Prescribed Burning</td>
<td>-.01</td>
<td>$166.33</td>
</tr>
</tbody>
</table>

Table 19 depicts the results of the analysis of variance (ANOVA). The results reflect that, with respect to paying monthly for implementing wildfire risk mitigation methods, Property Owner and Fire Fighter do not report any statistically significant willingness to pay for trimming, thinning, nor prescribed burning. This means they might believe that others should pay, they already pay enough through tax assessments, or protest this question.

Table 19. Regression ANOVA: Monthly Payment for Mitigation Method is a Function of Kyle Canyon Property Owner and Fire Fighter Combined

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimming</td>
<td>$1.4 \times 10^5$</td>
<td>2</td>
<td>$7.1 \times 10^4$</td>
<td>.96</td>
<td>.39</td>
</tr>
<tr>
<td>Thinning</td>
<td>$6.2 \times 10^4$</td>
<td>2</td>
<td>$3.1 \times 10^4$</td>
<td>.69</td>
<td>.50</td>
</tr>
<tr>
<td>Prescribed Burning</td>
<td>$4.9 \times 10^4$</td>
<td>2</td>
<td>$2.4 \times 10^4$</td>
<td>.88</td>
<td>.42</td>
</tr>
</tbody>
</table>
Table 20 depicts the regression results. The results demonstrate that when Property Owner and Fire Fighter are considered separately, neither report statistically significant monthly payments for trimming, thinning, or prescribed burning.

Table 20. Regression Correlation for Property Owner and Fire Fighter Influence on Monthly Payment for Mitigation Method Separately

<table>
<thead>
<tr>
<th>Property Owner</th>
<th>Unstandardized Coefficient</th>
<th>Standardized Coefficient</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Standard Error</td>
<td>Beta</td>
</tr>
<tr>
<td></td>
<td>-4.41</td>
<td>16.32</td>
<td>-.03</td>
</tr>
<tr>
<td></td>
<td>-5.13</td>
<td>14.06</td>
<td>-.05</td>
</tr>
<tr>
<td></td>
<td>12.52</td>
<td>12.15</td>
<td>.18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fire Fighter</th>
<th>Unstandardized Coefficient</th>
<th>Standardized Coefficient</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Standard Error</td>
<td>Beta</td>
</tr>
<tr>
<td></td>
<td>-119.28</td>
<td>88.28</td>
<td>-.19</td>
</tr>
<tr>
<td></td>
<td>-79.23</td>
<td>69.30</td>
<td>-.17</td>
</tr>
<tr>
<td></td>
<td>-34.53</td>
<td>60.61</td>
<td>-.10</td>
</tr>
</tbody>
</table>

Property owners and fire fighters were asked, in an open-ended question, what amount they would be willing to pay for mitigation methods annually. Simultaneous multiple regression was conducted to compare how the two groups, Property Owner or Fire Fighter, report annual wildfire risk mitigation payments. Table 21 depicts the results of the regression model summary. The adjusted R-squared shows that Property Owner
and Fire Fighter report slight differences in annual payment, but are not statistically significant.

Table 21. Regression Model Summary for Annual Mitigation Payment as a Function of Fire Fighter and Property Owner

<table>
<thead>
<tr>
<th>Annual Payment</th>
<th>Adjusted R-Squared</th>
<th>Standard Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.07</td>
<td>$433.66</td>
</tr>
</tbody>
</table>

Table 22 depicts the results of the analysis of variance (ANOVA) for annual wildfire risk mitigation method payments. The results reflect that reported annual payment for Property Owner and Fire Fighter is statistically significant, $F = 4.40$, $p = .02$, $df = 2$.

Table 22. Regression ANOVA: Annual Mitigation Payment as a function of Fire Fighter and Property Owner

<table>
<thead>
<tr>
<th>Annual Payment</th>
<th>Sum of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$1.6 \times 10^6$</td>
<td>2</td>
<td>$8.2 \times 10^3$</td>
<td>4.40</td>
<td>.02*</td>
</tr>
</tbody>
</table>

* significant at .05

The regression results are depicted in Table 23. The results show that reported annual payment for Fire Fighter is statistically significant negatively, $t = -2.23$, $p = .03$. Reported annual payment for Property Owner is not statistically significant. This means that fire fighters likely oppose annual payments and property owners express no apparent preferences.
Table 23. Regression Correlation for Property Owner and Fire Fighter Influence on Annual Payment for Mitigation Method Separately

<table>
<thead>
<tr>
<th>Annual Payment as Dependent Variable</th>
<th>Unstandardized Coefficient</th>
<th>Standard Error</th>
<th>Standardized Coefficient</th>
<th>Beta</th>
<th>t</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Owner</td>
<td>32.83</td>
<td>17.67</td>
<td>.19</td>
<td></td>
<td>1.86</td>
<td>.07</td>
</tr>
<tr>
<td>Fire Fighter</td>
<td>-224.30</td>
<td>100.59</td>
<td>-.23</td>
<td></td>
<td>-2.23</td>
<td>.03*</td>
</tr>
</tbody>
</table>

* significant at .05
CHAPTER FIVE

DISCUSSION

Introduction

The overarching research problem is to evaluate whether the risk, communication and economics disciplines provide a framework for examining the decisions that local stakeholders make about wildfire risk. The first research question evaluates whether the experts and non-experts predict or influence the respondents' reports of wildfire chances. The second research question examines whether the experts and non-experts predict whether property owners should be concerned about wildfire risk. The third assesses the way that respondents report their assignment of responsibility for mitigating wildfire risk to individuals; homeowners associations; and local, state or federal governments. The fourth research question studies whether the experts and non-experts predict the preferred wildfire mitigation methods and the fifth question studies whether the experts and non-experts influence the self-reported willingness to pay for the methods. General discussion follows.

Hypotheses

The null hypotheses that were tested are:

1. There are no differences in how property owners and fire fighters report the chances of a wildfire occurring in Kyle Canyon in the next ten years.
2. There are no differences between property owners’ and fire fighters’ conclusions about whether Kyle Canyon property owners should be concerned about wildfire.

3. There are no differences between property owners’ and fire fighters’ assignment of responsibility for wildfire risk mitigation.

4. There are no differences between property owners’ and fire fighters’ preference for mitigation methods.

5. There are no differences between property owners’ and fire fighters’ willingness to pay for wildfire risk mitigation.

The alternative hypotheses for the five null hypotheses were that differences existed.

Hypothesis #1

The results of analysis failed to reject the null hypothesis. Both property owners and fire fighters are significant for predicting reported wildfire occurrence chances. While only fifteen respondents returned surveys after the Robbers Fire, their choices were consistent with all other respondents and did not contribute to uncertainty.

Uncertainty is associated with making judgments about relative risk levels (Slovic, Fischhoff, & Lichtenstein, 1979). The social constructs through which respondents answered this survey questionnaire item varied (Liberatore, 1995). Residents of Kyle Canyon possibly estimated the risk more precisely because of: 1) their proximity to the hazard, 2) recent experience with wildfire either through the Lost Cabin Fire incident on the western slopes of Mt. Charleston in 2002 or the Robbers Fire incident north of Kyle Canyon in 2004, 3) realization that the Mt. Charleston volunteer fire company is not staffed around the clock, and 4) the effects of the public education efforts (Hoffrage, Lindsey, Hertwig, & Gigerenzer, 2000) undertaken by the local Firewise initiative.
Non-residents likely expressed optimistic bias, or, the it-can’t-happen-to-me mindset (Crank, 2004). Their experience with fire protection comes from their urban valley experiences when a 9-1-1 call prompts an under-six-minute response by 24-hour staffed fire stations (Baker, 1977; Bridges, 1983). Wildfires are something they only hear or read about, or watch the smoke plumes from afar (Slovic, Finucane, Peters, & MacGregor, 2004). They might recall the Ad Council’s Smokey Bear campaign as an occasional public service announcement through various media over the years (Rogers & Storey, 1987). Wildfire risk and hazard assessment is possibly a more a passive pursuit for them (Kasperson et al., 1988).

Hypothesis #2

The results of analysis failed to reject the null hypothesis. Respondents who answered the question about concern agreed unanimously that Kyle Canyon residents should be concerned about wildfire. There were no discriminating factors to consider other than two respondents who did not answer the question at all. It is likely that media coverage of catastrophic wildfires over the past several years had raised awareness levels among the respondents (Heath, 2003). Further, the July 26, 2004, Robbers Fire on the eastern boundary of Kyle Canyon alarmed residents and informed non-residents that the proximity of the fire posed a threat to Kyle Canyon. There were fifteen surveys returned after the Robbers Fire with no deviation from the other respondents’ answers, so it appeared that attitudes were in place (Allen & Waks, 1990) prior to the fire. This research hypothesis established that virtually all of the stakeholders comprehend the Kyle Canyon wildfire risk problem in a general way (Nisbett & Ross, 1980). The communications discipline subsets of interpersonal, organizational, and mass communication are assumed
to be the catalysts for this unanimity. Some common ground for explanation exists among Liberatore’s (1995) social construction of problems, Dake’s (1991) worldview concept, and Thompson and Dean’s (1996) contextual conception of risk. Linking these concepts with system dynamics (Forrester, 1961) thinking, could provide clarity in how to proceed with wildfire risk discussions in the United States. Future scholars should investigate this more fully.

Hypothesis #3

The results of analysis justify rejecting the null hypothesis. Those who claimed past or present membership in a fire-fighting agency assigned mitigation responsibility to Clark County and the United States Government specifically (Slovic, 1986). This result is likely due to the Fire Safe Council and Firewise initiatives provided through fire fighter training (NFPA, 1991). There were no differences in the way responsibility was assigned to individual property owners, homeowners associations, or the State of Nevada. Based on Davis’ (1989) contention that there is a dichotomy between experts and non-experts in wildfire risk estimation, there is an assumption that fire fighters expect more fires than property owners. However, the influence of Kyle Canyon residents who are also fire fighters on wildfire chances is not significant. There were numerous instances of respondents writing comments into the margins of the survey questionnaire that projected the air of being editorial commentary. Common themes (Rimal, 1991) included: high property tax payments that are inversely proportional to the low level of public safety services received, which writers viewed as inequitable, and that outsiders’ entrance and activities pursued in Kyle Canyon should be controlled by the Forest Service through monetary assessments like entrance and user fees to pay for wildfire mitigation and
suppression functions. Future scholars may learn more about these attitudes from efforts that will follow on from the recently initiated "Focus on the Forest: Mount Charleston Summit" that was held at the Mount Charleston Hotel on Feb. 22, 2005 to begin dialogue among various stakeholders who had a variety of social, environmental, legal, and other issues that drew the attention of local, state, and federal lawmakers (Clark County, n.d.).

Hypothesis #4

The analysis results justify rejecting the null hypothesis. Researchers place fuel reduction as the priority for wildfire risk mitigation (Busenberg, 2004a). The survey respondents answered variably when asked whether they would be willing to allow the use of prescribed burning, trimming, or thinning as fuel-reducing mitigation methods on their property or adjacent properties for the purpose of reducing wildfire hazards. The methods that respondents indicated they would allow, in choice frequency order, are: trimming, thinning, and prescribed burning. Respondents reacted adversely to prescribed burning (Fan, 1988), likely due to the press coverage of the Cerro Grande fire and others in the southwestern United States, although responses were not significant. However, fire fighters' preference for thinning is significant.

Hypothesis #5

The results of analysis justify rejecting the null hypothesis. Some respondents would allow the three mitigation methods but would not be willing to pay for them in this order: trimming, thinning, and prescribed burning. Other respondents would allow these methods and would be willing to pay for them in this order: trimming, thinning, and prescribed burning. There are no differences among variables and the respondents'
willingness to pay for mitigation methods. The property owners do not contribute significantly for predicting the payments for mitigation methods. Written comments in the margins ranged from doing the work themselves, to charging tourists entry fees, to reallocating tax money for mitigation (Hornik, 1989). Yet, the fire fighters’ preferences for annual payments for wildfire risk mitigation were significant negatively.

Summary

Respondents’ reports of wildfire chances lead to the conclusion that wildfires are very likely to occur in Kyle Canyon. There appears to be consensus that wildfire is a concern for Kyle Canyon property owners. The Clark County and Federal governments are identified as being most responsible for mitigating wildfire hazards in Kyle Canyon by fire fighters, a subset of stakeholders. Property owners were indifferent to the selection of mitigation methods, yet did express preferences that place prescribed burning at the bottom of the list. The payment scheme to accomplish the mitigation methods is significant for fire fighters. Perhaps collaboration among the stakeholders would facilitate clarity on this issue. Collaborative processes (Bryan, 2004) should improve stakeholder participation in decision-making and help to avert the inevitable tragedies of the commons (Hardin, 1968) that persist in the wildland-urban interface.

This evaluation enabled by the three disciplines of risk, communication and economics affords an integrated view of the explanations could be attached to the results that were obtained. The risk discipline shows that variable social and experiential domains produced variable decisions about reporting the chances of wildfire occurrence. The consensus about the reported concern for wildfire risk is likely due to the communication discipline’s influence, while interpersonal communication barriers are
assumed to be the reason that responsibility for wildfire risk mitigation was almost always assigned to government agencies, rather than identified with property owners or homeowners associations. Communication, especially through mass media, is probably the reason that respondents have an aversion to prescribed burning as a wildfire risk mitigation method (Fan, 1988) as free text comments indicate on the surveys. The economics discipline provides an explanatory base for examining the respondents’ reports. However, the property owners’ responses to willingness to pay questions were highly variable and only the fire fighters’ preferences were statistically significant. No comparison could be made with other studies given this dichotomy. The only other scholarly study (Winters & Fried, 1999) used in-person interviews to collect their data. That difference from this study that used a mail survey might indicate that survey design changes are necessary. In-person interviews are a requirement of the NOAA guidelines (1993), yet the resource demands that the guidelines impose are burdensome. The effects of adherence to the NOAA guidelines might be an area for future scholars to investigate.
CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to evaluate whether the risk, communication, and economics disciplines could provide a framework for examining the decisions that local stakeholders make about wildfire risk. This investigation can be used to fill some gaps in the literature by showing that the involvement of more than one set of stakeholders in wildfire risk decision-making can produce concrete answers to key questions from which environmental policies relevant for wildfire risk can be developed.

Environmental policy instruments usually focus on a single issue, in this case wildfire risk, yet their implementation could have secondary and tertiary effects on other environmental problems. Exploration of those possibilities might expose additional solutions by involving other stakeholder groups. Effective policy implementation is usually contingent on memoranda of understanding or agreement to create and maintain stability during the lifespan of the policy initiative. Balancing costs and benefits among the utility, justice, and equity models of administration, to name just a few, might encourage cooperation among the actors. Future research should continue contributing to the literature on wildfire risk, and other natural hazards as appropriate.

The first national assessment of natural hazards (White & Haas, 1975) found that no substantial body of knowledge existed and that state, local and voluntary agencies had no funding or coordination for hazard research efforts. White and Haas pointed out five methods of adjusting to hazards: relief and rehabilitation, insurance, warning systems,
technological aids like protective works, and land-use management. The 1975 assessment remains a guidepost for researchers, users and beneficiaries of its recommendations. Did it have any impact on current hazard, risk, and disaster policies? There are mixed and conflicting answers to that question. Busenberg's (2004a) adaptive policy design might provide a model to engage the entire community of natural hazards researchers. His bounded rationality argument holds true for wildfire risk, and seems to be applicable to other hazard scenarios as well. Two stakeholder groups provided valuable insight into five discreet questions about wildfire risk. Other questions pertaining to other natural hazards could be examined in the same manner as this study.

By involving property owners and fire fighters, it serves the analysis well to distinguish between residents and nonresidents for resolution of discrete differences between them. Similarly, the front-line fire fighters provide unique views on the issues explored in this research that previously remained the province of agency staff, laboratory researchers, consultants and academic theoreticians.

Because this is a baseline study, it provides one line of evidence toward the conclusions about wildfire risk decisions. This study adds to the results that Kuypers (1995) and Fried (1994) described although they focused solely on property owners, and did not distinguish between residents and non-residents, as they studied wildfire risk. This research departed from the dichotomous choice contingent valuation model that they both used by employing an open-ended elicitation of WTP.

This study's data align with the theories of Bradshaw (1988), Kuypers (1995), Fried (1994), Winter and Fried (2000), and McCaffery (2002). They provided the foundation and exploratory material for the survey questionnaire.
Future scholars may find it interesting to study the anomaly where the scale choice number 6 received the least emphasis among all the categories of assigning wildfire risk mitigation responsibility. Future scholars should also investigate linking many models (Dake, 1991; Liberatore, 1995; Thompson & Dean, 1996; Slovic, 1997; Heath, 2003; Bryan, 2004) with system dynamics (Forrester, 1961) thinking, more fully. Such research could provide clarity in how to proceed with wildfire risk discussions in the United States. The effects of strict adherence to the NOAA guidelines (1993) could be an area for future scholars to investigate. Future scholars may learn more about the attitudes of stakeholders by following up on the recently initiated “Focus on the Forest: Mount Charleston Summit” that was held at the Mount Charleston Hotel in Kyle Canyon on Feb. 22, 2005, to begin dialogue among various stakeholders.
James P. O'Brien  
Department of Environmental Studies  
Title of Study: Valuing Wildfire Risk Mitigation in Kyle Canyon, Nevada

Description of Study

1. Subjects: Two samples comprise this study. One sample is all property owners in the upper five subdivisions of Kyle Canyon, Nevada. The second sample consists of the members of the Nevada State Fire Fighters Association. Review of address lists for both samples indicates equitable selection. There are no known vulnerable populations involved. No participants will be paid.

2. Purpose, Methods, Procedures: The purpose for this study is to assess how the participants conceive of wildfire and possible risk that it poses; and to elicit the value they place on four methods of mitigating the risk of wildfire. The method will involve a mailed questionnaire that asks qualitative questions about wildfire as a possible problem; it asks for point and range estimates of wildfire risk; and it asks participants to estimate a monetary amount they would be willing to pay to mitigate wildfire risk.

3. Risks: There are minimal risks to participants. A respondent may feel some discomfort answering a question about income, ethnicity or a question about current efforts to mitigate wildfire hazards. The survey is completely confidential and many precautions will be taken so that one may not associate any names with the survey responses either during the survey or afterwards.

4. Benefits:
   a. Benefits to the respondent:  
      Respondents may learn something about risks from wildfire hazards and ways to protect oneself. Participants who require more information about this research project will be given a final report on request.
   b. Benefits to the researcher:  
      Potential contribution to the general body of knowledge about wildfire hazard risk reduction.

5. Risk-Benefit Ratio: While a respondent may feel discomfort answering some of the questions, no risks are anticipated. I believe that the benefits greatly outweigh any potential risks to participants. This belief is supported by past research experience with similar instruments at UNLV.

6. Costs to Subjects: Based upon a focus group’s review of the draft survey, the participants' costs will consist of about twelve to fifteen minutes of their time to complete the questionnaire and the time it takes to deposit the questionnaire in the mail for return to the investigator.
7. **Informed Consent**: A cover letter accompanying the questionnaire sent to each participant will address the minimum required elements of informed consent. Because the questionnaire will be returned for compilation, that act will constitute positive acceptance of informed consent. Anonymity will be encouraged in the cover letter. Records will be maintained for three years following completion of the project.

8. **Child/Youth Assent**: Children are not the subjects for this research project.
Title of Study: Valuing Wildfire Risk Mitigation in Kyle Canyon, Nevada: Three Essays
Investigator: James P. O'Brien, doctoral candidate
Protocol Number: 826S0603-211

Purpose of the Study
You are invited to participate in a research study. The purpose of this study is to learn what you think about wildfire, its risk, and what you might be willing to pay to prevent its effects.

Participants
You are being asked to participate in the study because you either own property in Kyle Canyon, or you have a background in fire fighting.

Procedures
If you volunteer to participate in this study, you will be asked to do the following: Complete and mail back a questionnaire that should take about 12 to 15 minutes of your time.

Benefits of Participation
There may be no direct benefits to you as a participant in this study. However, we hope to learn what you think about wildfire, any hazards that it might pose and ways that you might prefer to lessen those hazards.

Risks of Participation
There are risks involved in all research studies. This study may include only minimal risks. For example, you might become uncomfortable when answering some questions.

Cost/Compensation
There will be no financial cost to you to participate in this study. The study will take about 12 to 15 minutes of your time. You will not be compensated for your time. The
University of Nevada Las Vegas may not provide compensation or free medical care for an unanticipated injury sustained as a result of participating in this research study.

Contact Information
If you have any questions or concerns about the study, you may contact Dr. Helen Neill or James O’Brien, doctoral candidate at 702-895-4440.

For questions regarding the rights of research subjects, any complaints or comments regarding the manner in which the study is being conducted you may contact the UNLV Office for the Protection of Research Subjects at 702-895-2794.

Voluntary Participation
Your participating in this study is voluntary. You may refuse to participate in this study or in any part of this study. You may withdraw at any time without prejudice to your relations with the university. You are encouraged to ask questions about this study at the beginning or any time during the research study.

Confidentiality
All information gathered in this study will be kept completely confidential. No reference will be made in written or oral materials that could link you to this study. You will remain anonymous. All records will be stored in a locked facility at UNLV for at least 3 years after the completion of the study. After the storage time, the information gathered will be destroyed.

Participant Consent
You are not required to reveal anything about yourself. By returning the completed questionnaire, you will have indicated your consent to participate in an anonymous way.
Table 24. Historically Significant Wildland Fires

<table>
<thead>
<tr>
<th>Date</th>
<th>Name</th>
<th>Location</th>
<th>Acres</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 1825</td>
<td>Miramichi and Maine Fires</td>
<td>New Brunswick and Maine</td>
<td>3,000,000</td>
<td>Large Amount of Acreage Burned</td>
</tr>
<tr>
<td>October 1871</td>
<td>Peshtigo</td>
<td>Wisconsin and Michigan</td>
<td>3,780,000</td>
<td>1,500 Lives Lost in Wisconsin</td>
</tr>
<tr>
<td>September 1881</td>
<td>Michigan</td>
<td>Michigan</td>
<td>1,000,000</td>
<td>169 Lives Lost</td>
</tr>
<tr>
<td>September 1894</td>
<td>Hinckley</td>
<td>Minnesota</td>
<td>Undetermined</td>
<td>418 Lives Lost</td>
</tr>
<tr>
<td>September 1894</td>
<td>Wisconsin</td>
<td>Wisconsin</td>
<td>Several Million</td>
<td>Undetermined, Some Lives Lost</td>
</tr>
<tr>
<td>September 1902</td>
<td>Yacoult</td>
<td>Washington and Oregon</td>
<td>1,000,000 +</td>
<td>38 Lives Lost</td>
</tr>
<tr>
<td>April 1903</td>
<td>Adirondack</td>
<td>New York</td>
<td>637,000</td>
<td>Large Amount of Acreage Burned</td>
</tr>
<tr>
<td>August 1910</td>
<td>Great Idaho</td>
<td>Idaho and Montana</td>
<td>3,000,000</td>
<td>85 Lives Lost</td>
</tr>
<tr>
<td>October 1918</td>
<td>Cloquet-Moose Lake</td>
<td>Minnesota</td>
<td>250,000</td>
<td>450 Lives Lost</td>
</tr>
<tr>
<td>August 1933</td>
<td>Tillamook</td>
<td>Oregon</td>
<td>311,000</td>
<td>1 Life Lost, Same area burned again in 1939</td>
</tr>
<tr>
<td>October 1947</td>
<td>Maine</td>
<td>Maine</td>
<td>205,678</td>
<td>16 Lives Lost</td>
</tr>
<tr>
<td>1949</td>
<td>Mann Gulch</td>
<td>Montana</td>
<td>4,339</td>
<td>13 Smokejumpers Killed</td>
</tr>
<tr>
<td>Year</td>
<td>Location</td>
<td>State</td>
<td>Acreage</td>
<td>Remarks</td>
</tr>
<tr>
<td>------------</td>
<td>------------------</td>
<td>-----------</td>
<td>---------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1967</td>
<td>Sundance</td>
<td>Idaho</td>
<td>56,000</td>
<td>Burned 50,000 acres in just nine hours</td>
</tr>
<tr>
<td>September</td>
<td>Laguna</td>
<td>California</td>
<td>175,425</td>
<td>382 Structures Destroyed</td>
</tr>
<tr>
<td>1970</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1977</td>
<td>Sycamore</td>
<td>California</td>
<td>805</td>
<td>234 Structures Destroyed</td>
</tr>
<tr>
<td>November</td>
<td>Panorama</td>
<td>California</td>
<td>23,600</td>
<td>325 Structures Destroyed</td>
</tr>
<tr>
<td>1980</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1987</td>
<td>Siege of 87'</td>
<td>California</td>
<td>640,000</td>
<td>Valuable timber lost on the Klamath and Stanislaus National Forests</td>
</tr>
<tr>
<td>1988</td>
<td>Yellowstone</td>
<td>Montana and Idaho</td>
<td>1,585,000</td>
<td>Large Amount of Acreage Burned</td>
</tr>
<tr>
<td>1988</td>
<td>Canyon Creek</td>
<td>Montana</td>
<td>250,000</td>
<td>Large Amount of Acreage Burned</td>
</tr>
<tr>
<td>June 1990</td>
<td>Painted Cave</td>
<td>California</td>
<td>4,900</td>
<td>641 Structures Destroyed</td>
</tr>
<tr>
<td>June 1990</td>
<td>Dude Fire</td>
<td>Arizona</td>
<td>24,174</td>
<td>6 Lives Lost, 63 homes destroyed</td>
</tr>
<tr>
<td>October</td>
<td>Oakland Hills</td>
<td>California</td>
<td>1,500</td>
<td>25 Lives Lost, 2,900 Structures Destroyed</td>
</tr>
<tr>
<td>1991</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>August 1992</td>
<td>Foothills Fire</td>
<td>Idaho</td>
<td>257,000</td>
<td>1 Life Lost</td>
</tr>
<tr>
<td>July 1994</td>
<td>South Canyon Fire</td>
<td>Colorado</td>
<td>1,856</td>
<td>14 Lives Lost</td>
</tr>
<tr>
<td>July 1994</td>
<td>Idaho City Complex</td>
<td>Idaho</td>
<td>154,000</td>
<td>1 Life Lost</td>
</tr>
<tr>
<td>July 1994</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>August 1996</td>
<td>Cox Wells</td>
<td>Idaho</td>
<td>219,000</td>
<td>Largest Fire of the Year</td>
</tr>
<tr>
<td>June 1996</td>
<td>Millers Reach</td>
<td>Alaska</td>
<td>37,336</td>
<td>344 Structures Destroyed</td>
</tr>
<tr>
<td>July 1997</td>
<td>Inowak</td>
<td>Alaska</td>
<td>610,000</td>
<td>Threatened 3 Villages</td>
</tr>
<tr>
<td>----------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>----------------------</td>
</tr>
<tr>
<td>1998</td>
<td>Volusia Complex</td>
<td>Florida</td>
<td>111,130</td>
<td>Thousands of people evacuated from several counties</td>
</tr>
<tr>
<td>1998</td>
<td>Flagler/St. John</td>
<td>Florida</td>
<td>94,656</td>
<td>Forced the evacuation of thousands of residents</td>
</tr>
<tr>
<td>August 1999</td>
<td>Dunn Glen Complex</td>
<td>Nevada</td>
<td>288,220</td>
<td>Largest Fire of the Year</td>
</tr>
<tr>
<td>August - November 1999</td>
<td>Big Bar Complex</td>
<td>California</td>
<td>140,947</td>
<td>Series of fires caused several evacuations during a 3 1/2 month period</td>
</tr>
<tr>
<td>September - November 1999</td>
<td>Kirk Complex</td>
<td>California</td>
<td>86,700</td>
<td>Hundreds of people were evacuated by this complex of fires that burned for almost 3 months</td>
</tr>
<tr>
<td>May 2000</td>
<td>Cerro Grande</td>
<td>New Mexico</td>
<td>47,650</td>
<td>Originally a prescribed fire, 235 structures destroyed and Los Alamos National Laboratory damaged</td>
</tr>
</tbody>
</table>
1. What are the chances of a wildfire incident occurring in Kyle Canyon at some time in the next ten years? Please circle below on a scale of 1 to 10, where 1 indicates a very small chance of wildfire while 10 indicates that it is very likely to happen.

1 2 3 4 5 6 7 8 9 -10

Low Chance
High Chance

2. Should property owners in Kyle Canyon be concerned about wildfire? Please circle your answer.
   YES  NO

3. Different groups have responsibilities for protecting residents and property from wildfires in Kyle Canyon. On a scale of 1 to 10, where 1 indicates the group is the least responsible and 10 indicates that the group is the most responsible, how would you score each of the groups below?

1 2 3 4 5 6 7 8 9 10

Least Responsible

<table>
<thead>
<tr>
<th>Groups</th>
<th>Please write in your ranking of each group on a scale of 1 to 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Individual Property Owners</td>
<td></td>
</tr>
<tr>
<td>b. Homeowner Associations</td>
<td></td>
</tr>
<tr>
<td>c. Clark County Government</td>
<td></td>
</tr>
<tr>
<td>d. State of Nevada Government</td>
<td></td>
</tr>
<tr>
<td>e. U.S. Government</td>
<td></td>
</tr>
</tbody>
</table>

4. A study done in 2001 determined that in Kyle Canyon, a buildup of brush close to homes could cause them to burn if a wildfire passed through the area. One method of reducing this buildup of brush is by burning it under controlled conditions so that the upper level tree branches are not affected. This type of burning is called prescribed burning. Would you be willing to allow the use of prescribed burning on your property
or adjacent properties for the purpose of reducing a wildfire hazard? Please circle your answer.

YES  NO

5. Would you be willing to allow the use of chainsaws and other machines to remove underbrush and trim trees on your property or adjacent properties for the purpose of reducing a wildfire hazard? Please circle your answer.

YES  NO

6. Another factor that causes much damage to homes is when fire travels through the crown, or top part, of the tree canopy, causing burning branches and needles to drop on roofs and the ground igniting roofs and brush. Thinning the trees in those areas of dense canopy would limit crowning. Thinning is the process of reducing the number of trees on each lot so that the crowns of the remaining trees are at least 10 feet from one another. Would you be willing to allow thinning of trees on your property or adjacent properties for the purpose of reducing a wildfire hazard? Please circle your answer.

YES  NO

Please turn the page over to continue.

7. These three brush reduction methods cost money. Would you be willing to pay for one or more of these methods to reduce a wildfire hazard?

<table>
<thead>
<tr>
<th>Method</th>
<th>Would you pay for this method?</th>
<th>How much would you be willing to pay for it per month?</th>
<th>* If No, is the reason because this method has no value to you?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Prescribed Burn</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>b. Remove underbrush and trim trees</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>c. Thinning</td>
<td></td>
<td>$</td>
<td></td>
</tr>
</tbody>
</table>

8. Based on your responses to question 7, please enter the total amount that you would pay this year to reduce a wildfire risk using the methods you identified?

$________________________ per year

9. Please circle the income category that best describes your household income from all sources before taxes in 2003 (GROSS INCOME). We are defining household to mean yourself and those that live with you and share your income and expenses.
<table>
<thead>
<tr>
<th>Code</th>
<th>Income Category</th>
<th>Code</th>
<th>Income Category</th>
<th>Code</th>
<th>Income Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Under $15,000</td>
<td>03</td>
<td>$30,001 to $45,000</td>
<td>05</td>
<td>$60,001 to $75,000</td>
</tr>
<tr>
<td>02</td>
<td>$15,001 to $30,000</td>
<td>04</td>
<td>$45,001 to $60,000</td>
<td>06</td>
<td>$75,001 to $100,000</td>
</tr>
<tr>
<td>07</td>
<td>$100,001 to $150,000</td>
<td>08</td>
<td>Over $150,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. Are you now or have you ever been a member of a fire fighting organization? Please circle one.

   YES   NO

11. What is your gender? Please circle one.

   MALE   FEMALE

12. Is your primary residence in Kyle Canyon? Please circle one.

   YES   NO

13. Are there any other comments you wish to make?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

Thank you for your participation in this survey. Please return this survey in the attached envelope to

Jim O’Brien, graduate student in the Department of Environmental Studies, Greenspun College of Urban Affairs, University of Nevada, Las Vegas

4505 Maryland Parkway

Las Vegas, Nevada 89154
BIBLIOGRAPHY


Sciences.


Clark County. accessclarkcounty.com/Public_communications/MtCharlestonSummit.htm


homeowner. Minden, NV: Author.


mental models of ecosystems: Inferences for risk communication. 10 Risks: Health, Safety & Environment, 45(Winter), 45-64.


National Park Service. (2001). *Cerro Grande prescribed fire board of inquiry final*


VITA

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Committee Member, Dr. Vernon Hodge, Ph.D.
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