No Need to Reinvent the Wheel: Applying Existing Social Science Theories to Wildfire

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Introduction

Social science research on fire has only recently begun to gain critical mass under the sponsorship of the National Fire Plan. Previous to that, there were only a handful of studies on the topic in the 1980s and the 1990s. However, there is no need to completely reinvent the scientific wheel to begin to understand social wildfire dynamics. There is much that can be learned from existing disciplines. Natural hazards research can provide insight into the dynamics of mitigation and key variables that may influence mitigation decisions and responses to an actual event such as risk perception, past experience, and post-fire blaming tendencies. The field of Diffusion of Innovations in turn suggests reasons why wildfire mitigation efforts, particularly the creation of defensible space as a preventive practice, might be adopted only slowly, while also suggesting the usefulness of trigger events, change agents, and interpersonal networks in overcoming the inherent difficulties. Taken together, these two fields can provide context and a starting framework in which to place current wildfire issues and offer insight into ways to increase wildfire mitigation.

This chapter will examine the general theories that have developed to understand human responses to natural hazards and to the adoption of mitigation measures and new technologies. Information on these topics is also presented in chapters by Shindler and Daniel in this volume. The first section will focus on the natural hazards research field and how it informs understanding of human response to wildfires. The second section will discuss components of the Diffusion of Innovations field that shed light on factors that foster or inhibit adoption of mitigation measures. The final section discusses how these two seemingly distinct areas are actually quite connected.

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Natural Hazards Research

Social science research on other natural hazards has been going on since before World War II. Decades of research on earthquakes, hurricanes, floods, and other hazards have identified a broad framework of dynamics and variables that play a role in shaping human response to a hazard. Because an integral part of the current fire problem is the human–hazard interaction, much from this work can provide insights. Understanding human response to destruction is a broad and diffuse area of study. Research has examined different parts of the disaster process (from long-term prognostication to aftermath) from the perspective of a variety of disciplines and theories, from physics to sociology, and from mathematical calculations to psychological tests. Although the natural hazards field is used for the primary framework of this chapter, research in numerous fields has relevance for understanding social response to natural hazards. Two of these related fields of study—disaster research and risk analysis—merit a brief discussion. Although each field emerged from different disciplines and with a different focus, increasing convergence with natural hazards has meant that clear lines of distinction between the three fields can be hard to draw.

Disaster research grew out of sociology and military funding and examines the recovery process after a disaster. Originating from the study of a 1917 munitions explosion in Halifax, Nova Scotia, most disaster research studies looked at human response to human-caused hazards and were done by sociologists and political scientists (O'Riordan 1986). The field came into its own after World War II when the military, seeking to understand social response under stressful conditions, funded a great deal of research into potential public responses to wartime disasters. Basic methodology was developed in the early 1950s by the National Opinion Research Council with a focus on use of theories of collective behavior and social organization (O'Riordan 1986; Quarantelli 1994 [1988][1]). Over time, increasing emphasis was given to natural hazards, although the emphasis remained not on how to change or decrease exposure to a natural disaster but only on how to respond to one once it had occurred (Cook 1997).

Risk analysis grew primarily out of engineering and the need to establish reliability and safety standards for new technologies such as nuclear reactors. The initial heavy emphasis in the field on probability theory (Kasperson et al. 1994 [1988]; Kirby 1990) proved problematic, as results of such probability-based risk analyses often did not match the more contingent, experiential risk assessment of the public. As a result, risk analysis broadened its area of study in the 1980s to include notions of communications and

perception theory, social/political embeddedness, and ethics (Kasperson et al. 1994 [1988]; Plough and Krimsky 1990 [1987]). This brought the field into closer alignment with natural hazards research as more work began to be done to understand what influenced lay people's risk assessment (Plough and Krimsky 1990 [1987]).

Natural hazards research came out of geography with a focus on understanding human adjustments to natural hazards. Developed from an effort to understand a practical problem—why flood damage continued to rise despite all the dams and levees that were built under the 1936 Flood Control Act—the field has maintained a strong bent on finding practical means and appropriate public policy to mitigate the damage caused by natural hazards (Mitchell 1993). Rather than understanding organizational response to a disaster or calculating risk, natural hazards research takes a behavioral approach to understanding individual adaptation (O'Riordan 1986). Fundamentally, the field attempts to understand why certain adjustments are favored over others and to explain the mechanisms that affect adoption of mitigation measures and policies (Mileti 1994 [1989]; Mitchell 1993).

Over time, perception became the primary variable to explain the difference between theoretical and actual adjustments (Whyte 1986). By examining how individuals perceived hazards and potential adjustments differently and identifying which factors influenced differences in perception and choice, researchers hoped to shed light on behavior that had previously been seen merely as maladaptive (Palm 1990; White 1994 [1973]). Two categories were identified that most influenced how an individual responded to natural hazards: factors that affected an individual's awareness and perception of the hazard, such as how long they had lived in the area and past personal experience with the hazard; and factors that influenced how that knowledge translated into action, such as availability of adequate resources to act, sense of control, and the salience of the hazard in comparison with other daily concerns (Burton et al. 1993 [1978]; Palm 1990). Despite the expanded list of explanatory variables to consider, the questions initially asked in the early flood analyses have remained central to current hazards research. These are to identify: 1) the nature of the physical hazard; 2) the type of adjustments already made; 3) the theoretical range of available adjustments; 4) reasons for the differences in adjustments that are chosen; and 5) how changing public policy influences choice of adjustments (Mitchell 1993; White 1994 [1973]). In its own way, natural hazards work for several decades has been using the model for wildfire social science research proposed in this book: incorporating biophysical, sociocultural, and sociodemographic variables as part of its base list of questions.

Coping stages—The defining book of traditional natural hazards theory, *The Environment as Hazard* (Burton et al. 1993 [1978]), identifies four, generally sequential, societal stages of coping with hazards: loss absorption, acceptance, reduction, and change. Movement from one stage of coping occurs when a threshold has been crossed. The first stage, loss absorption, takes place when the effect of a hazard is small enough to impose few costs to society and adaptations are unconsciously made to absorb any costs. Once the effect of a hazard begins to exceed a society's natural absorptive capacity, an awareness threshold is reached and the affected group begins to accept the natural event as a hazard and to make conscious adjustments. At first these are fairly passive; the hazard is recognized but little is done to alter it other than devising ways of spreading the costs (often referred to as bear and share). At this point, bearing the cost is preferable to the effort and uncertainty of trying to make any changes. When the costs of the hazard become too large, the action threshold is crossed and efforts are made to actively reduce the costs by modifying the hazard or changing human behavior. Such action to reduce human vulnerability to a hazard is commonly referred to as mitigation. The final coping method occurs only in extreme cases when the cost of the hazard has become so extreme, despite mitigation efforts, that complete change, of land use or living methods, is required; e.g., prohibiting development of floodplains or buying out property in such areas. Most cultures and societies, particularly highly developed ones, are resistant to such large-scale change and to occur it is generally necessary to have a concurrent institutional or societal change (Burton et al. 1993 [1978]).

Mitigation—The tools for mitigation are diverse and can be broken into four, generally sequential, categories: redistribution, engineering and technology, regulation and policy, and culture (Mileti 1994 [1989]). Redistribution efforts do not try to change the hazard but work to increase ability to both absorb the losses—through the creation of reserve funds and of disaster-assistance organizations such as the Red Cross—and to redistribute the cost across a population larger than that directly affected, through insurance and governmental and charity disaster relief. Once damage levels reach an action threshold, more active measures directed toward minimizing hazard damage come into play, although this shift by no means eliminates the need for or use of redistributional mechanisms. Usually the first active mechanisms are structural: larger-scale engineering and technological efforts to prevent or diminish the effect of the hazard by shifting its location, its timing, or the process that creates it. These can be directed toward changing the nature of the hazard in some manner (dams, levees, fuel load reduction) or toward preventing or reducing potential loss

(warning systems, building material improvements, retrofitting). In the United States, such measures, until fairly recently, have been the preferred means of trying to mitigate a hazard.

Over time, environmental modification alone has generally been found to be insufficient to mitigate hazards, usually for two reasons. First, structural solutions often actually exacerbate the problem by encouraging settlement of hazardous areas, such as floodplains and high fire-hazard areas, as they become seen by the public as "protected" (Mileti 1994 [1989]). Second, structures do not completely eliminate a hazard but often merely raise the hazard threshold—there may be fewer hazardous events overall, but when they do occur it will be because they overwhelm the safeguards, so they will be bigger and more damaging (Rossi et al.1982). Fire suppression can be seen as an example of a large-scale government attempt to modify the environment to minimize a hazard. Similar to the construction of dams and levees for floods, fire suppression has, rather than reducing the problem, only served to raise the bar by creating a higher fuel load and lowering the sense of risk for individuals who build structures in fire-prone areas (Beebe and Omi 1993).

Once the limits of such structural fixes are recognized, efforts move toward nonstructural efforts to modify human behavior to avoid the hazard and reduce vulnerability. Nonstructural tools include direct use of policy incentives; regulatory mandates such as land use planning, building codes, and local ordinances; and more indirect efforts to shift cultural norms and rules. Land use planning is used to redirect or control development in hazardous areas, such as flood-plain zoning or requiring subdivision plans to include adequate fire service access. Building codes help increase ability to withstand a hazard and include structural (e.g., nail spacing—particularly relevant for hurricanes and earthquakes) and material (such as fire-resistant roofs) requirements. Local regulations can help control activities, such as vegetation clearance ordinances, that may contribute to a hazard (Burby et al. 1999; Mileti 1994 [1989]; Sorensen and Mileti 1987).

Cultural norms and rules are more nebulous to describe and certainly harder to control, but can have a significant influence on both the creation and mitigation of hazards. In the case of the wildfire hazard, cultural norms often thought to be important include societal perceptions of fire as the enemy, different views of acceptable resource-management practices, what a "natural" landscape looks like, and notions of individual choice, private property, and responsibility.

While the structural and nonstructural categories provide a neat division, in reality the two are not as easily separated. For instance, defensible space is a combination of both types of mitigation. Changing building and vegetation characteristics (roof material, enclosed porches, fire-resistant vegetation) are both, in essence, modifications to the environment and so might be considered structural. However, to occur on a meaningful scale they also require changes in human behavior, both to actively manage the vegetation and to accept what might initially be considered less aesthetically pleasing characteristics (non-wood shingle roofs, more open vegetation).

Natural hazards studies have identified several key variables and dynamics that are often important in understanding how people respond to a natural hazard before, during, and after an event. The following section will provide a brief discussion of several of these variables and how they may apply to wildfire; more detailed discussion of many of them can be found in subsequent chapters.

SALIENCE—Part of the difficulty in changing human behavior lies in the fact that modern lives are complicated and natural hazards generally have low salience compared to other concerns (Neil 1989); doing anything about a hazard tends to be relegated to the "I'll think about it tomorrow" category. Daniel (this volume) discusses the low salience of wildfire and other natural hazards as public concerns, citing their relatively low fatality rate when compared to health, technological, and other hazards, such as automobile accidents. Low placement of wildfire on the list of hazards is also discussed by Shindler (this volume). Palm (1994 [1981]) found that knowledge that a person was buying a home within one-eighth of a mile (.20 km) of California's Hayward Fault had no consistent effect on either the decision to buy or on the purchase price; other factors, such as other location considerations and style of house, were more important. These findings are also reflective of the fact discussed further by Daniel (this volume) that individuals balance both the perceived risk and benefit of where they live, and the higher the perceived benefit the greater the risk tolerance (Slovic et al. 1987).

KNOWLEDGE AND INFORMATION—Access to information is clearly important in shaping response to a hazard. Inadequate, inaccurate, or incomplete information can inhibit ability to develop a clear understanding of a hazard and alternative ways of limiting its impact. Studies have shown that as scientific knowledge increases the accuracy of probability estimation also rises (Mileti 1994 [1989]). Several recent fire studies show that the more accurate the understanding of the causes of the fire hazard and of the ecological impacts of different fuels treatments the more acceptable the associated mitigation practice (Blanchard 2003; McCaffrey 2002; Shindler et al. 2003). However, provision of information, while necessary, is by no means sufficient in decisions to mitigate as other important factors, such as risk perception, come into play (McCaffrey 2004).

RISK PERCEPTION—Perceived risk is how serious the threat is deemed to be coupled with the "subjective probability of experiencing a damaging environmental extreme" (Mileti 1994 [1989]). Although important, it is a particularly difficult variable because it is extremely subjective, with level of perceived risk influenced by a variety of considerations. For instance, how people calculate the likelihood of an event can be shaped by mental strategies used to make the hazard feel more manageable, such as denying the risk outright ("it won't happen to me"), or assuming that a structural adjustment, such as levees or fire breaks, provides complete rather than partial protection (McCaffrey 2004; Mileti 1994 [1989]; Mileti and Sorensen 1987; Slovic et al. 1990 [1979]). Gender, ethnicity, education, income, and political preference have all been found to influence risk perceptions, with the group with the lowest risk-perception scores made up of better-educated, white males with high incomes and conservative leanings (Slovic 1999). Raish et al. (this volume) describe differences in fire knowledge, use, and concerns based on cultural, ethnic, and racial variations. Studies also have found links between worldviews (fatalistic, hierarchical, individualistic, etc) and risk perception (Slovic 1999). While it seems logical that higher risk perception would be closely tied to increased mitigation, studies of other hazards have not found a consistent relationship between the two; in some cases there is a significant positive relationship and in others there is no relationship. Within fire studies the effect of risk perception is equally mixed (McCaffrey 2004).

Studies have also shown that certain qualitative characteristics of the hazard itself may factor into an individual's risk estimation. A grouping of characteristics labeled "Dread Risk" (controllability, catastrophic potential, and fatal consequences) was found to be fairly predictive of level of perceived risk. A second grouping labeled "Unknown Risk" (degree to which hazard is unknown, unobservable, has delayed harm, and is new) was found to have less effect (Slovic 1997). Other qualitative characteristics shown to have influence are the voluntariness of exposure to the hazard and the number of people exposed. Collectively known as the psychometric paradigm, the usefulness of these sets of variables in understanding hazard response is disputed, with some researchers arguing that it explains only a small portion of the variance of perceived risk and that affect[2] is more influential (Sjoberg 2000), while others have field tested the paradigm and found it to provide useful insight (Trumbo 1996). Certainly on the surface the model gives some idea why wildfire, a historically controllable phenomenon that affects a discrete area and kills relatively few people, with fairly low dread and unknown characteristics, does not seem to inspire a

(See Daniel [this volume] for more detailed discussion of this paradigm and of risk perception.)

EXPERIENCE—It is often thought that at least those who have experienced a disaster will be more likely to take mitigation steps, but natural-hazards work has not always found experience to have a constant or predictable effect. Studies indicate that, while experience can sometimes increase risk perception and mitigation efforts, its influence generally only lasts for a relatively short period immediately following the event (Sims and Bauman 1983). In some cases, experience may also have a negative effect as individuals decide to do nothing because "lightning doesn't strike twice in the same place" or out of a sense of fatalism about whether their efforts can make a difference. The few relevant fire studies show a similarly mixed result (McCaffrey 2004).

MITIGATION EVALUATION—Once enough factors align to lead an individual to investigate alternatives, various factors then influence the process of choosing and implementing mitigation adjustments. After a range of adjustments has been identified, individuals often engage in two general types of evaluation—cost-benefit and implementation feasibility. The cost-benefit analysis includes consideration of the financial cost of adjustments and their estimated return over a relevant time frame, as well as sociocultural and personal considerations, such as how well the adjustment conforms with personal beliefs and societal traditions, mores, and laws (Kates 1994 [1971]).

Implementation capacity includes consideration of the environmental and technical feasibility of an adjustment; how well it fits with the site and current land use; and the availability of necessary skills, tools, and materials (Kates 1994 [1971]). Wealth is a consistent consideration: in general it has been found that relatively high levels of resource wealth are necessary for mitigation programs to be initiated at either an individual or a societal level (Tierney 1993). Less material wealth is believed to lower the awareness threshold (as there is less absorptive capacity) but to increase the action threshold (as there are fewer resources to invest in mitigation). Greater material wealth, however, means the mitigation action threshold is lowered rather than raised as there is less tolerance for loss. Greater wealth also means this stage is quite persistent as there are the resources to maintain the mitigation measures and the cost of the next stage, radical change, is generally quite high (Burton et al. 1993 [1978]).

Finally, larger-scale social, political, and power issues that may affect the decision maker's implementation capacity will also come under consideration (Mileti 1994 [1989]). Often a key variable is the presence of external incentives to act. This generally takes the

policy and regulations that either encourage or discourage adoption of mitigation measures. At the local level many items, such as education and transportation, are much higher on the agenda than working to minimize potential damage from a potential hazard and, in fact, local planners often have good incentives, such as increased revenue from property taxes, to encourage intensive development in high-hazard areas. Nor does the federal government's tendency to provide substantial post-disaster assistance provide local governments with a positive incentive to be active in mitigation planning (Burby et al. 1999). Certainly the historic federal policy of fire suppression has enabled local governments to effectively ignore wildfire as a hazard needing any mitigation-planning consideration. State governments, for their part, can be important players as they have enough hazard exposure to have the incentive to do something, the ability to provide leadership, and the mandates that are often necessary for local communities and individuals to put hazard issues on their planning radar screen (Berke 1998).

EVACUATION—Evacuation during natural disasters is a rather drastic experience for people who may encounter potentially life-threatening risks. Evacuation orders are usually made by law-enforcement personnel and can be either mandatory or voluntary, depending on how imminent the threat. Several studies have identified circumstances where people are more likely to evacuate (Fischer et al. 1995). In general, people tend to evacuate when they are told to do so by emergency officials, when they are contacted frequently by proper officials, when past warnings or evacuation orders were accurate, when affected people have children at home, and if evacuation messages are specific or clearly disseminated. Perry (1979) found that people who have survived past disasters are less likely to evacuate. It was also found that people living in urban areas are more likely to evacuate than those in rural areas (Fischer et al. 1995).

SOCIAL COHESION—Social cohesion often emerges during and immediately after a natural disaster (Kaniasty and Norris 1995; Siegel et al. 1999). A natural disaster can lead to the disappearance of social barriers among people or groups in the community, generating social solidarity (Barton 1970). This cohesion can help a stricken community to effectively tackle issues during the disaster and later enhance community recovery efforts. It is reported, however, that participation in social cohesiveness varies with a combination of factors: ethnicity, educational level, personal networks, and the extent of damage (Kaniasty and Norris 1995). It has also been found that social cohesion is usually observed during or in the wake of disaster; it disappears once social structures return to the form that existed before the disaster struck (Siegel et al. 1999; Sweet 1998). This phenomenon was also found during a preliminary analysis of a study on the social impacts of the

2000 and 2001 wildfires in the western U.S. (See chapters in this volume by Carroll and Cohen and by Burchfield.)

BLAMING AND SOCIAL DISINTEGRATION—Blaming behavior is often observed among victims after natural disaster. Although the primary agents of natural disaster are natural forces, victims are likely to disregard those elements. Instead, they often blame a government entity for the damage. Rochford and Blocker (1991) point out that victims of the Tulsa (Oklahoma) flood (1986) blamed the Army Corps of Engineers for the flood damage. Carroll et al. (2004) found that homeowners who incurred property damage during the Butte Complex fires in California (1999) attributed the damage to a backfire started by the California Department of Forestry and Fire Protection in spite of the fact that there was no record of such a backfire. These cases suggest that victims need to find human agents so that they can assign responsibility to their damage. Blame and/or responsibility is often placed on government institutions in natural disasters because governments are expected to protect the public from any disaster (Hans 1990; Hans and Ermann 1989; Nigg and Tierney 1993).

Blaming behavior may increase a sense of fatalism about the effect of individual mitigation efforts in decreasing future damage, as victims shift their attention from their own efforts to governmental responsibility. In relation to wildfire, such a shift could have a long-term impact on fire mitigation efforts, given the importance of local cooperation and of homeowners maintaining adequate defensible space (Cohen and Saveland 1997).

Blaming behavior can lead to several post-disaster problems. It may lead to hostility and decreased trust in the relevant government entity. It may also lead to social disintegration, hindering community recovery. The Buffalo Creek flood (West Virginia) in 1972 disrupted the local social fabric, traumatized the community, fragmented social cohesiveness, and generated enduring changes in the community (Erikson 1994). Often a seed of disintegration existed within a community before the disaster; in such circumstances, there is disagreement on the interpretation of the disaster and the proper role of local residents and organizations in responding to it (Couch and Kroll-Smith 1985; Kroll-Smith and Couch 1990). Victims are motivated to sue the people or organizations perceived to have caused the disaster (Couch and Kroll-Smith 1985; Picou and Rosebrook 1993). The ensuing dispute over who is responsible for the damage, what should have been done to prevent it, and who should pay for compensation often triggers the emergence of disparate groups and coalitions within the impacted community (Aronoff and Gunter 1992). Social disintegration tends to occur in reaction to hazards where damages emerge gradually or sporadically, with

spatially different impacts thus providing little focal point for community identity (Couch and Kroll-Smith 1985; Soliman 1996).

Social disintegration also affects a community's quality of life. The effect may be temporary or permanent. Dyer et al. (1992) found that the Exxon Valdez oil spill disrupted established earning patterns, increased psychological stress, and led to a decline in social support systems and subsistence activities, such as fishing; understandably, those directly connected with fishing business suffered the most psychological distress (Dyer 1993). Ultimately, it was found that people suffered more from social and cultural disruption than from immediate financial loss (Dyer 1993; Dyer et al. 1992; Picou 1990). Thus, there appear to be links among blaming behavior, social disintegration, and quality of life. There is little reason to think that people who are impacted by wildfire will not bear similar negative affects. (For more detailed discussion see Carroll and Cohen [this volume]).

RECOVERY—How a disaster-stricken community recovers may depend on that community's preexisting assets and capacities—social, physical (Patterson 1999), and human. Arnoff and Gunter (1992) found that factors such as homogeneous population, pre-disaster cooperative atmosphere, and capacity to negotiate through the existing political system enabled people to recover from disaster effectively. Patterson (1999) points out that the greater the extent of a community's vertical networks—access to external support and connections with state or federal governments—the greater likelihood of a quick recovery. In addition, effective disaster recovery may require agencies to penetrate communities and accurately communicate with local people (Kulis 1981). These findings highlight the importance not only of educating the public about risk and mitigation of wildfire, but also of encouraging them to enhance their community's social and human capital. (For more detailed discussion see Jakes and Nelson [this volume.])

DEVELOPING NEW LEGISLATION AND CHANGING POWER STRUCTURE—Severe disaster damage often stimulates demand for the passage of new legislation. For example, after a series of earthquakes in Southern California, new legislation that required strict building codes for homeowners was passed to prepare for future earthquakes (Alesch and Petak 1986). Similarly the Healthy Forest Restoration Act was rapidly passed by Congress immediately after the 2003 Southern California fires, despite the fact that much of the land burned was chaparral and so will not be directly affected by the Act.

Disasters can also change power structures within a stricken community. Severe damage brought about by Hurricane Agnes in Wilkes-Barre, Pennsylvania, instigated the reorganization of local governments and changed the local power structure and flood-mitigation policies (Wolensky

1983). Residents who were impacted by the Three Mile Island nuclear accident became politically active in the wake of the accident (Goldsteen and Schorr 1991; Schorr 1982; Walsh 1981). Because of the emergence of new political coalitions, local power structures became more pluralistic, making the community more politically diversified (Goldsteen and Schorr 1991).

EVOLVING NATURAL HAZARDS PERSPECTIVES: VULNERABILITY—In the early 1980s, political economists began to criticize the natural hazards field for ignoring the social, political, economic, and historical context within which an individual makes a decision. Hazards were seen to be less a result of individual choice than of the "ongoing organizational values of society and its institutions" (Mitchell 1993:197). This political economy critique led to the development of the "vulnerability thesis" (Hewitt 1997; O'Riordan 1986). The thesis contends that most natural hazards are a result of structural inequalities that push less powerful people into marginal, more environmentally sensitive areas where, in order to meet subsistence demands, they overuse the land, straining the system's resiliency and contributing to more frequent and severe natural hazard events (Hewitt 1997; Mitchell 1993; O'Riordan 1986; Palm 1990). This view argues that as those most affected are also those with the least ability to make adjustments and decisions that affect their safety, trying to understand individual response does little to resolve the problem (Hewitt 1997; O'Riordan 1986). Instead, the most effective actions to minimize the danger of a natural disaster need to be directed toward modifying the context of the situation (Hewitt 1997).

Although developed mostly in a Third World context, partial support for the model's applicability in the United States can be found in the higher death rates amongst the old and poor during heatwaves as well as the difficulties these groups have in large-scale evacuations. How useful vulnerability is in thinking about the wildfire hazard is uncertain, given that in some areas it is not the poor and marginal who are being forced to live in high-hazard areas but more well-to-do people who are choosing to live there.[3] Rodrigue (1993) suggests that the problem lies in the conflation of vulnerability (capacity to evade, withstand, or recover from a disastrous event) and risk (actual exposure to hazard damage). In the Third World context this causes little confusion, because those most exposed to the hazard are also the most vulnerable. When looking at homes built in Southern California or the Oakland hills, however, the conflation is problematic: it is those best able to withstand and recover from a wildfire that are, voluntarily, the most exposed to risk. In these areas, Rodrigue argues, vulnerability is diffused throughout society through insurance and government emergency services; in effect the costs are "broadly socialized" while the benefits, such as views and natural

setting, are narrowly "privatized." Rodrigue's separation of vulnerability and risk seems apt, given that hazards work done in developed countries emphasizes the notion of risk perception rather than that of vulnerability.

The political economy/vulnerability critique adds the valuable recognition of the need to examine the social and historical influences underlying the natural hazard and potential mitigation activities. However, its emphasis on the macro-level concerns tends to discount the role individuals have in shaping structures (Palm 1990). Ironically, the vulnerability thesis, while arguing to protect the vulnerable, also tends to treat individual humans as pathetic and weak and reinforces the need for experts, although this time experts in empowerment rather than technology (Hewitt 1997).

Another difficulty with the political economy perspective in relation to wildfire is its tendency toward focusing on larger-level institutional structures as the central problem. This is no doubt a useful focus in Third World countries where government structures often significantly affect an individual's access to basic livelihood resources. However, in developed nations with their more-developed resource base, institutional structures are less central to hazard creation and are also rarely the primary factor inhibiting mitigation. For instance, studies in the U.S. have found that mitigation efforts are not limited for lack of federal and state level interest and support (Rossi et al. 1982). Rather it is behavior at the local level—government and individual—that has the most effect on whether or not mitigation takes place. Rossi et al. (1982) found that local decision makers' concern for natural hazards was low, as they preferred to rely on traditional responses where the federal government primarily bore the cost through structural mitigation and post-disaster relief. Certainly a large part of resolving the fire problem will require the active involvement of local communities and individuals, from homeowners to planners. However, larger-level institutional structures cannot be discounted; congressional funding issues and conflicting internal and interagency priorities are an important part of the wildfire story.

More recently, hazards researchers have begun to explore ways of integrating the traditional focus on individual behavior with the political economy emphasis on societal level issues (Mitchell 1993). Two of the frameworks proposed are quite similar. Hewitt (1997) calls his integrative model the "human ecology of disaster." Along with the traditional focus on physical factors and individual risk adjustments and the political economy focus on vulnerability and structural context, Hewitt adds a middle level of intervening or contingent variables that are not directly related to the hazard. These are important because "both institutional and cultural phenomena may buffer or focus damage, without being tied to specific vulnerabilities or agents of damage" (Hewitt 1997:29). This idea, that a hazard may result from actions that have nothing to do with the hazard, is an important point. As Pyne (1997) notes, the original policy of fire suppression was not exclusively shaped by a desire to protect life and property but also by a desire to protect timber resources for production purposes and to legitimate the agency's existence. More recently, community access to National Fire Plan funds for mitigation has been shaped by the intervening variable of the state government and how it has decided to administer the funds. As a result, some states may be better prepared for a wildfire as communities with better access to funds are expected to have stronger ability to mitigate the wildfire hazard (Steelman et al. 2004).

Palm (1990) also integrates the two approaches by starting with the individual and the household (which he terms the micro level) and then embedding that within the societal structure (macro level). Interactions between the two levels are then identified (meso level) to understand how structural factors influence individual actions, what dynamics either constrain or enable individual actions. One relevant meso-level factor Palm discusses is the notion of gatekeepers, individuals (such as a planner or fire marshal) who as a result of their position have the ability to make decisions that either constrain or enable an individual's adjustment choices.

Both authors present their framework in the context of looking at a web of relations. For Hewitt (1997) a natural hazard occurs as a result of a breakdown in the web of relations linking society and nature. For Palm, in emphasizing linkages between micro and macro "more attention is given to the 'web' within which individuals and collectivities live, and the impacts of this web on individual choice" (Palm 1990:156). This imagery is a useful visual acknowledgment of the complex interrelationships that influence human response to wildfire.

Diffusion of Innovations

Palm's reference to the notion of gatekeepers suggests a link with another relevant field of study: "Diffusion of Innovations." This field works to understand the process by which a new idea or technology is communicated and adopted. Primarily developed in rural sociology to understand why agricultural innovations were or were not adopted (Rogers 2003 [1983, 1995]), over time its rubric has been used to examine different points of the process—such as earliness of knowledge of an innovation, individual traits amenable to adoption, and network analysis—through the lenses of a spectrum of disciplines including rural sociology, education, public health, and marketing (Rogers 2003 [1983, 1995]). Rogers' book, Diffusion of Innovations, is the primary work that brings together studies in these diverse

areas in an effort to establish some level of general theory for the field. The book is credited with shaping and institutionalizing diffusion research in its current mode and has become an accepted base reference for the field (Fliegel 1993). Five areas will be briefly discussed here to illustrate how this broad field can inform our wildfire understanding: attributes of the innovation that influence adoption, the role of change agents, adopter traits and categories (innovativeness), stages of adoption, and communication.

An innovation's attributes are important because, by definition, an innovation is something new and so the risks and benefits of its adoption are unclear. Several characteristics of the innovation itself contribute to how much uncertainty is involved in the cost-benefit calculation surrounding its adoption. Rogers identifies five characteristics of the innovation itself that play a role in its adoption rate:[4] relative advantage, compatibility, trialability, complexity of the innovation, and observability of its effect (Rogers 2003 [1983, 1995]). Relative advantage, which has been found to be the best predictor of adoption rates, is essentially a cost-benefit analysis—the degree to which an innovation is seen as superior to the old idea. This can mean some type of economic or social advantage due to improved status (Fleigel 1993; Rogers 2003 [1983, 1995]). Compatibility refers to the degree that the innovation is consistent with the needs, experience, lifestyle, and previous values and ideas of the adopter (Rogers 2003 [1983, 1995]). Trialability, or divisibility for trial, is the degree to which the innovation can be tested on a limited basis. A successful trial increases likelihood of full-scale adoption as it decreases the uncertainty regarding its effectiveness (Rogers 2003 [1983, 1995]). Distributing free samples of a new product is a mass-marketing application of this notion (Fliegel 1993). Complexity is how difficult the innovation is to understand and use; innovations that are simple and easy to understand are usually more readily adopted (Fliegel 1993; Rogers 2003 [1983, 1995]). Observability is how apparent the benefits of the innovation are to others and reflects the finding that innovations generally are adopted less as a result of any type of formal or scientific information than of seeing the results of adoption by peers (Rogers 1987). Often these characteristics are interlinked; a successful trial will not only encourage adoption by the individual who did the test but also by others, as it increases the observability of the innovation's effectiveness. In general, relative advantage, compatibility, trialability, and observability are positively related to an innovation's adoption rate, whereas complexity is negatively related.

Based on these characteristics it is not all that surprising that wildfire's protective innovations, such as defensible space, have been slow to catch on, as they have few of the characteristics associated with rapid adoption. The goal of defensible space is for a structure to survive if a fire does occur.

However, structural survival might easily be attributed to chance rather than mitigation and makes proving the relative advantage of mitigation difficult. Similarly, short of starting a fire near your house and watching what happens, trialability is problematic. Defensible space also falls short in terms of compatibility on several counts. Many individuals hold norms that see a thick forest of trees as natural and desirable; removing any vegetation to create defensible space would go against these norms. Further, prescribed fire and salvage logging do not fit into many individuals' ideas of acceptable management practices. Finally, fire mitigation ranks high on the complexity scale. While on a certain level fire is a simple phenomenon, in the end how to successfully reduce its danger is a complex story involving several different management practices and cooperation of many individuals and agencies.

Change agents are often an important ingredient in successful innovation adoption and might well fit into Palm's gatekeeper category. Rogers describes a change agent as someone who provides "a communication link between a resource system with some kind of expertise and a client system" (2003:368). This description is almost tailor-made to describe the position of a fire chief active in promoting defensible space or community-wide fire planning and mitigation efforts. The role of the change agent is both to provide information and to create interest in and eventual adoption of an innovation by a specific population. In effect, a change agent is a gatekeeper of information on the innovation, and the type of information and manner of provision they choose to use can all influence an individual's perception of adjustment choices. While often professionally trained and affiliated with the change agency, change agents may also have less formal training. Several factors have been identified that facilitate a change agent's effectiveness. These include: frequency of contact with clients; whether the change agent's attitude and the innovation itself are oriented to meeting clients' needs not just the agency's; and whether the agent is of the same peer group as the clients, is credible, and encourages the client's ability to understand and evaluate innovations (Rogers 2003 [1983, 1995]).

Diffusion studies have emphasized defining the differences between those who adopt first and those who adopt later, tending to combine personality indicators of adoption into one trait to study innovativeness (Fleigel 1993). Defined as "the degree to which an individual or other unit of adoption is willing to adopt new ideas before other members of a social system do so" (Rogers 1987), innovativeness became the main dependent variable of diffusion research. This emphasis reflects finding that once a threshold of people using the innovation is achieved, a take-off or critical mass point is reached and societal pressures will take over and less active encouragement will be needed (Rogers 1995:340). Sociodemographically, those who are

more likely to adopt early tend to have a higher education and social status. In terms of personality characteristics, rationality, intelligence, abstract thinking ability, and positive attitudes towards education, science, uncertainty, and change are all positively related with innovativeness (Rogers 2003 [1983, 1995]). In terms of communication style, early adoption is positively related with social participation, exposure to mass media, and local interpersonal channels, active information seeking, and change-agent contact (Buttel et al. 1990; Rogers 2003 [1983, 1995]).

The innovation-adoption decision process has five generally sequential stages: knowledge, persuasion, decision, implementation, and confirmation (Rogers 2003 [1983, 1995]). The knowledge stage is where information is disseminated to increase awareness of the innovation. The persuasion stage is the point where individuals form a favorable or unfavorable opinion of the innovation. At the decision stage, an individual makes an active decision to adopt or reject the innovation. This is the point where characteristics of the innovation are most relevant as issues of trialability and relative advantage begin to be considered. It is at this point where trial by others and demonstrations "can be quite effective in influencing adoption by individuals, especially if the demonstrator is an opinion leader" (Rogers 1983:171). When the decision has been made and individuals enter the implementation stage, they begin seeking a great deal of information on the innovation, including how and why it will work. Finally, actual adoption is not the end of the process, as individuals seek confirmation that their decision to adopt was the right one. Without such confirmation discontinuance of use of the innovation is not uncommon.

How information is communicated is another important area affecting adoption rates. Different media channels are influential at different stages of the adoption process; using the wrong communication channel at the wrong stage has been associated with later adoption (Rogers 2003 [1983, 1995]). During the awareness stage, mass media is the most effective communication channel. However, once the persuasion stage has been reached, interpersonal communication channels, particularly with expert information sources, become the most influential method. Such two-way communication is most effective in reducing the inherent uncertainty of adopting a new innovation, as it allows for discussion and clarification. Not surprisingly, interpersonal communication is particularly important for complex innovations or ones that require continual monitoring (Fliegel 1993; Rogers 1987).

A key element in the communication process and how information "diffuses" is to what degree the individuals involved are similar (homophilous) or dissimilar (heterophilous) for one or more characteristics such as beliefs, values, status, occupation, and other demographic factors. Generally, ideas

spread easily through a homophilous group but when there are different levels of communication involved due to differences in social position, education, and/or technical training it is more likely that the new idea will be ignored, misunderstood, or considered suspect (Rogers 2003 [1983, 1995]). However, some level of heterophilous communication is necessary for innovations to truly spread (Rogers 2003 [1983, 1995]). This is particularly relevant when considering the change agent. If the change agent belongs to a different social group than the one he or she is working with (which has often been the case with college-trained agricultural extension workers) communication may be inhibited. In fact, change agent success is positively correlated with homophily with clients (Rogers 2003 [1983, 1995]).

This correlation is due in part to the finding that a change agent's effectiveness is directly related to their credibility. There are two types of credibility: competence and safety. The first is associated with level of expertise and knowledge regarding the innovation and the second with perceived trustworthiness. In general, heterophilous sources are seen as having competence credibility, whereas those from a similar background will be seen as trustworthy. This creates a rather fine line for a change agent to tread.

"An ideal change agent would have a balance of competence and safety credibility. A change agent might be homophilous with his or her clients in social characteristics (such as socioeconomic status, ethnicity, and the like) but heterophilous in regard to technical competence about the innovations being diffused" (Rogers 2003:385). This means that to some degree the change agent is also heterophilous with both groups, creating the potential for role conflicts and communication problems at one end or the other. This information is relevant for fire-management organizations to take into consideration when working with homeowners to encourage use of defensible space.

Preventive Innovations: Diffusion of Fire-mitigation Efforts

Both natural hazards and Diffusion of Innovations fields and their variants have important points to consider for studying wildfire. While there is little evidence of any hazards studies that have explicitly used Diffusion of Innovations, articles on how to encourage mitigation work often implicitly invoke the paradigm when they provide a list of steps that parallel those that the diffusion model has found to be most effective in encouraging adoption of innovations. In fact there are many congruities between Diffusion of Innovations and natural hazards theory. Perhaps most relevant to wildfire

is that both models address decision making in the face of uncertainty. Diffusion of Innovations has been described as "an uncertainty-reduction process" (Rogers 2003 [1983, 1995]) and hazards work focuses on understanding how individuals interpret and respond to the uncertainty created by a potential hazard event. Both also emphasize the importance of understanding how perceptions influence the process. "In other words, perceptions count. The individuals' perceptions of the attributes of an innovation, not the attributes as classified objectively by experts or change agents, affect its rate of adoption." (Rogers 2003:223)

In certain ways, much of traditional natural hazards work might be considered a subset of Diffusion of Innovations. Hazard mitigation is a particular type of innovation, one adopted to avert something most people would rather not think about. It is usually not something adopted due to its potential to improve one's life through increased income, knowledge, or comfort but rather to potentially protect one's current lifestyle. This fits into a specific Diffusion of Innovation category, that of a preventive innovation. The difficulty with this type of innovation is that it does little to decrease uncertainty and so tends to have a very slow adoption rate: "the undesired event may, or may not, occur if the innovation is not adopted. So the desired consequences of a preventive innovation are uncertain. Under such circumstances, the individual's motivation to adopt are rather weak" (Rogers 1983:171).

When considered in this light, it is not hard to see why fire-mitigation behavior has proven difficult to firmly establish. Preventive innovations generally have few of the innovation characteristics associated with rapid adoption rates. Relative advantage and observability are difficult to calculate because both are factors based on an uncertain future event (Rogers 1987). Yet preventive innovations are too important to be written off as too difficult to encourage. In this light, Rogers (1987) drew from the small proportion of diffusion studies on preventive innovations to identify factors that might increase likelihood of adoption of preventive innovations. The role of a trigger event, a cue-to-action that "crystallizes a favorable attitude into overt behavior change," appears to be particularly important in shifting an individual into adopting a preventive innovation (Rogers 2003 [1983, 1995]). Having a relative die in a car accident may push someone to finally start using their seatbelt routinely or, in the case of natural hazards, a flood may lead an individual to finally raise their house above normal flood levels.

But for the trigger event to have the desired effect, there first needs to be knowledge of the innovation. For this, the mass media has been found to play an important role in creating awareness of the problem and needed skills (Rogers 1987). With wildfires this may be problematic as a fire consuming houses makes for a better story and more likely coverage than a piece on defensible space and associated concepts of vegetation modification. For preventive innovations, interpersonal communication networks, important in any diffusion process, are particularly critical in creating localized incentives—supportive and peer pressure—to adopt (Rogers 1987). One study used mass media to recruit at-risk individuals into smaller instructional groups, which can provide the peer reinforcement that has been found most effective in changing behavior (Rogers 1987; Rogers 2003 [1983, 1995]). The study also found audience segmentation increased adoption by allowing use of messages tailored to the interests of the targeted group. In essence this is ensuring that the information is received by a homogeneous group, thereby facilitating its diffusion. Segmentation also allows the most effective message to be created to highlight the innovation's relative advantage to the target group, a key barrier to overcome with preventive innovations (Rogers 2003 [1983, 1995]).

Credibility of the information source or message provider is also particularly important with preventive innovations. If the source is seen to have ulterior motives or to be contradicting past practices it is likely to be given short shrift. During the energy crisis of the 1970s, the public paid little heed to efforts of power utilities and oil companies to encourage energy conservation, as they were seen to only profit from higher energy prices and to be contradicting previous efforts to encourage energy use (Rogers 1987). Certainly, this description sounds familiar when considering the current dilemma of federal agencies in trying to encourage support for a policy of letting wildfires burn under certain conditions and for the use of prescribed burning, given their historic singular emphasis on suppression.

Finally, while individuals likely have few immediate benefits or personal gain in adopting preventive innovations, many organizations often have strong incentives to discourage any innovation that changes public behavior (Rogers 1987). An obvious example is the long battle tobacco companies fought against anti-smoking campaigns. With wildfire an example can be seen in the loud and often effective resistance by the roofing industry to efforts by planning and fire agencies to ban wood shingle roofs. In addition, the internal "training, rewards, and professional values in many fields discourage prevention" (Rogers 1987:92). For example, the potential negative career impact of an escape provides little incentive to fire managers to increase their use of prescribed fire.

Conclusion

There is thus much that can be learned from existing disciplines in understanding current social wildfire issues. Natural hazards theory, with its concepts of sequential coping stages, action thresholds, and two phases of the reduction stage, technological and human behavior change, provides insight into why fire mitigation may be taking hold slowly. It also provides insights into key variables that influence individual mitigation decisions and responses to an actual event. Diffusion of Innovations in turn suggests reasons why wildfire mitigation efforts, especially defensible space as a preventive innovation, might be adopted only slowly, while also suggesting the usefulness of trigger events, change agents, and interpersonal networks in overcoming the inherent difficulties. Taken together, these two fields provide a great deal of insight into ways to increase wildfire mitigation.

Notes

1. For several books that feature reprints of key natural hazards articles, we have chosen to include both dates, with original publication date in brackets, as both are indicative of the article's enduring importance.
2. Affect: "a positive (like) or negative (dislike) evaluative feeling toward an external stimulus" (Slovic 1999:694).
3. It is important to note that not all individuals living in the residential wildland intermix (RWI) are wealthy. According to the Program for Watershed and Community Health, three to five million of the ten to fifteen million people living in the RWI do not have enough resources to meet basic economic needs (Lynn 2003).
4. Throughout his book, Rogers proposes such characteristics as general rules of thumb gleaned from examining dozens of diffusion studies. He openly acknowledges that they are by no means universal and, in the 1983 edition, for each generalization enumerates how many studies supported and how many did not support the generalization.

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Public Acceptance of Wildland Fire Conditions and Fuel Reduction Practices: Challenges for Federal Forest Managers

Bruce Shindler

Federal forest managers today are faced with unprecedented, complex challenges. Risks to our national forests, affected by years of fire suppression, drought, increased stand density, insect outbreaks, and human population growth at the wildland-urban interface present a technical challenge perhaps greater than any other confronted by our natural resource agencies (Grote 2000). Furthermore, the last two decades of forest management have been fraught with legal challenges and public protests, reflecting serious problems with public acceptance, a critical element to successful implementation of any action on the ground. Most recently, major wildfire events have attracted national media coverage, which can raise public awareness but also tend to exaggerate risks and distort information. Fire professionals in the western U.S. are experiencing this dilemma as they attempt to determine appropriate levels of salvage operations and rehabilitation in the aftermath of large fires in 2002, 2003, and 2005. Throughout all this, resource professionals are increasingly called on to manage forest ecosystems in ways that simultaneously sustain biophysical, economic, and social aspects of those systems (Clark 1999; Dombeck 1996).

Public acceptance has always been a major factor in the ability of federal agencies to effectively manage forests (Shindler et al. 2002), and is especially important now that the National Fire Plan (NFP) and the Healthy Forest Restoration Act (HFRA) have directed personnel to improve forest conditions through fuel-reduction activities. However, the stated goal of improving forest conditions is often debated and of some controversy. In the current sociopolitical climate the scrutiny of bureaucratic actions runs high and questions of trust and credibility are the subject of each decision. Over the last two decades (but particularly since Joint Fire Science Program and NFP initiatives), a substantial amount of research has been conducted

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