INFLUENCES ON EFFECTIVE LOCAL WILDFIRE MITIGATION PROGRAMS

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ABSTRACT

The purpose of this research is to identify key components of community wildfire risk reduction programs and potential influences on the adoption of these program elements. Community wildfire programs have been developed to educate and encourage property owners to adopt "vegetation management" practices such as creating defensible space around structures, landscaping with fire-resistant plants, and removing potential wildfire fuels such as trees and shrubs. The analyses are based on a survey conducted by investigators from Louisiana State University in conjunction with the U.S. Forest Service. This survey was distributed to wildfire mitigation program managers listed on the National Wildfire Programs Database website. A Principal Component Analysis (PCA) was conducted on the data returned from this sixty-nine-item survey. A range of socioeconomic variables was gathered from the 2000 Census Bureau and was used along with a fire history variable created from data extracted from the survey to examine the extent to which the variables are associated with program development.

Five factors were identified from the PCA as being indicators of key components of risk-reduction programs. Local programs with these elements are assumed to have a greater capacity for effectively reducing or mitigating wildfire risks to communities within the wildland-urban interface (WUI). The factors are more local regulations and codes, larger numbers of public education, vegetation disposal, risk assessment activities and fewer reported problems with program funding. These factors were regressed with demographic variables selected for each survey respondent's geographic area. Several different demographic variables were found to be significantly associated with the selected factors. These are population density, property value, wealth, percent of homeownership, percent of population with a college degree, and population change. Formulation and implementation of these desirable program components were found to be associated with slower growing, less densely populated communities, and those with wealthier and better educated residents.

INTRODUCTION

Following particularly destructive fire seasons in the years 1999 and 2000, the United States Fire Service, National Park Service, U.S. Fish and Wildlife Service, Bureau of Land Management, Bureau of Indian Affairs, and National Association of State Foresters developed the National Fire Plan, a unified national strategy for wildfire risk reduction aimed at coordinating and improving the agencies' fire-management policies. The Plan had two specific objectives (GAO 2001). The first goal was to reduce fire hazard on public lands. By creating a cohesive and coordinated plan, policymakers hoped that wildfires could be better managed, thus protecting federal lands as well as the communities developing at the Wildland-Urban Interface (WUI). This objective would be accomplished by not only suppressing fires, but also by creating proactive fire management policies and relying on communities and local knowledge to help mitigate wildfire risk. Furthermore, the National Fire Plan expressed the importance of restoring "healthy forests in fire-adapted ecosystems" and "reducing the levels of hazardous fuels on forests and rangelands" (Dombeck, Williams, and Wood 2004). The second goal was to provide "economic benefit to rural communities and workers" (Mosely and Toth 2004). State, county, and local wildfire mitigation programs began to develop as a result of the implementation of the National Fire Plan. As a federal policy response to wildfires, the National Fire Plan was more flexible than those policies that had come before it.

Local wildfire mitigation programs developed at the county level are created, to some extent, in response to the needs and demands of individual communities, however these programs must abide by different, and often contradictory, state and local laws, regulations, and codes. The programs often differ in areas ranging from management style to public outreach to imposed rules and regulations. A variety of local, contextual factors may influence the specific goals and objectives of community risk mitigation efforts. Program development and success may be affected by past experience with wildfire. Communities that have lived through recent large-scale fires may be more likely to build robust, more active risk reduction programs. Other factors that affect implementation of key program components may include demographic characteristics of the community ranging from wealth to property value to population density. If these demographic variables are in fact limiting or restricting the development of wildfire mitigation programs, state and federal agencies may need to consider investing more financial resources and technical assistance to encourage some communities to take steps to reduce their wildfire risks. Further, program developers will have to tailor wildfire mitigation programs so that they meet the needs and restrictions of the communities the programs have been created to serve.

It is not feasible to devise direct measures of wildfire risk reduction program effectiveness. Every wildfire risk mitigation program has been designed to meet the needs and goals of a specific jurisdiction. This has created a heterogeneous makeup of wildfire risk mitigation programs. One educational outreach activity that might be very successful in altering resident behavior in one county may not be effective in a neighboring county. Because it is impossible to place a value on wildfire risk mitigation program activity, no standard measurement of program effectiveness has been created. For this reason the assumption was made that more active, developed programs have more capacity to successfully alter stakeholder behavior and mitigate wildfire risk. In order to conduct empirical analyses concerning the risk reduction programs, measures of level of program development are gathered and examined as indicators of program capacity for effectiveness.

Thus, this research examines one main research questions:

What factors may influence formulation and implementation of key program components and outreach activities?

Specifically, is there a significant association between community demographic attributes and type of program development?

Also, is recent experience with a major wildfire a community attribute that is associated with specific types of local risk reduction efforts?

CHALLENGES OF MITIGATING WILDFIRE RISK

Wildfire Policy History

In the summer and early fall months, it is not uncommon to turn on the television and to see forested areas and communities ravaged by fires and homes destroyed by flames. These images are poignant and moving. Year after year citizens across the United States must play witness to the destructive power of wildfires. Wildfire prevention and mitigation is not an easy task. Beginning in 1905 and continuing through most of the twentieth century, the United States Fire Service developed and subscribed to a policy focused on wildfire suppression. Regardless of the forest type, the nationwide fire suppression policy advocated a “10 a.m.” rule, which stated that managers were to have wildfires under control by 10 a.m. the day following the fire ignition (Dellasala 2004). This broad, large-scale policy was implemented nationwide and “focused attention on wildfire suppression while failing to focus attention on wildland fuel reduction” (Busenberg 2004). The results of this policy were far-reaching and destructive. Although many fires have anthropogenic origins, fires are also a natural, integral part of many forests’ growth cycles. This policy disrupted the natural fire cycle of many fire-dependant forests and ecosystems (Forest Management 2002). Furthermore, this policy implementation led to “massive fuel buildup that greatly increased the risk of damaging high-intensity fires in American wildlands” (Busenberg 2004). By the latter half of the 20th century the fire suppression policies began to be called into question. Research indicated that many areas that had experienced wildfires had seen benefits such as renewed native flora, improvement to fauna’s native habitat, and a reduction in the number of pests and invasive plant species (Gorte 2006). With the understanding that fires could provide benefits to ecosystems came the realization that the fire suppression policy could not continue to exist in its current state.

Wildfires are not contained within jurisdictional boundaries, so wildfire mitigation efforts must be coordinated amongst agencies at the federal level as well as state, county and local levels. Every forest across the county is unique with its own combination of wildfire risk factors, including vegetation types, fuel conditions, climate, and terrain. Although all of these factors contribute to wildfire risk, only the fuel conditions and vegetation types can be controlled to mitigate wildfire risk (DOA 2002). It would be impossible to have a successful wildfire mitigation program created and implemented by the federal government and implemented uniformly throughout the country for several reasons. First, for a wildfire policy to be effective, it must "be specific to local forest conditions and adaptable to new information about the natural environment and to changing social concerns" (Dombeck, Williams, and Wood 2004).

Another important reason for a more decentralized policy approach for wildfire risk reduction is that the tactics for risk reduction often involve sensitive issues of property rights and the necessity to educate property owners to understand and practice long-term fuel management. A policy created and implemented by the federal government mandating the creation of defensible space, new land use regulations, chipping and slashing, and other wildfire mitigation tactics would, no doubt, be met with resistance from landowners concerned about property rights, local governments concerned about budgetary constraints, and other stakeholders for a variety of reasons. Instead of a command-and-control policy mandating certain wildfire mitigation activities, the federal government decided to create a flexible policy response to the growing wildfire problem. The policy solution was the National Fire Plan.

The creation of the National Fire Plan deemphasized the role of the federal government and began to place more responsibilities on individual states. The National Fire Plan requires coordination among not only federal agencies, but also among individual states (David 2001). With states in the western part of the county seeing an increase in rapid population growth, mostly occurring in the Wildland-Urban Interface, it has become more important for individual states and local governments to reduce the risk of wildfires (Yung 2007). By providing resources to individual states and local governments, the federal government provided these entities with resources to begin building their own infrastructure and means of fighting wildfires.

There are many different approaches to mitigating wildfire risk in a community. The tactics are employed by wildfire risk mitigation programs in the hopes to meet the goals of the National Fire Plan. One of the most important goals of every wildfire mitigation program is wildfire prevention. With many wildfire risk mitigation programs faced with budgetary constraints, wildfire prevention became increasingly important since “the least expensive fire is one that never starts” (Strategic Issues Panel 2004). By getting residents involved in this effort and creating a sense of personal responsibility amongst community members, wildfire mitigation programs are able to build cooperation and achieve the goal of wildfire mitigation and prevention while at the same time minimizing their cost. A key to creating community unity and responsibility is educating the residents about land-use planning, what preventative measures they can take to reduce their risks to wildfires, and effective emergency response (Gilbert 2006).

Community involvement becomes even more important when one considers the various obstacles that wildfire risk mitigation programs face. One obstacle that programs across the country face is the need to comply with federal policies regarding clean air and water and the protection of endangered species. There are key legislative acts, such as the Clean Water Act, Clean Air Act, and the Endangered Species Act, which mandate proper procedures and limit what action can be taken that may adversely affect the environment in some way. Before managers can begin prescribed burns or other fire mitigation activities that may violate federal policy, they must coordinate with federal agencies such as the Environmental Protection Agency, the Department of the Interior, and various state agencies that have been delegated environmental quality responsibilities (Davis 2006). One method employed by wildfire mitigation programs that circumvents the need to coordinate with federal agencies is promoting private landowners to participate in what is known as "vegetation management." This strategy includes the requirement of defensible space, proper landscaping, and the removal of potential wildfire fuels.

Defensible space is an area around a structure or neighborhood that has been trimmed and landscaped in a manner that leaves an area, usually about 100 feet in all directions, devoid of flammable vegetation and debris. Most agencies and wildfire mitigation programs encourage the creation of defensible space because it not only hampers the spread of wildfires and saves structures, but also creates a relatively safe space in which firefighters can work (Monroe 2004). The creation of defensible space, however, is not enough to mitigate wildfire risk.

Introducing the concept of fuel treatment and removal will go a long way in preserving structures and communities. If wildfire risk mitigation programs can encourage homeowners to protect their own property by eliminating possible fuels from the land, it will save individual programs hours of work and considerable resources in the long run.

Another strategy employed by wildfire risk mitigation programs is community education about landscaping techniques and vegetation types that will reduce wildfire risk or restrict the size and spread of fires. Many ecosystems have been negatively affected by the introduction of exotic plant species. These “exotic grasses, noxious weeds, and other alien species…[complicate] fire-suppression activity” (Dombeck, Williams, and Wood 2004). It has been estimated that these alien plant species account for over a quarter of the understory cover in some forests and therefore alter the natural fire structure of the forests (Keeley 2006). By educating the public about this growing problem and introducing the concept of planting fire-resistant, native plant species, the community will be unified in the common goal of restoring fire-resistant ecosystems.

Community Social-Ecological Resilience Building

When a community is affected by a disaster, whether natural such as a hurricane or earthquake, or anthropogenic such as an oil spill or a nuclear explosion, the extent to which that community will recover will vary from complete, rapid recovery to slow, partial recovery. Social-Ecological resilience “refers to the link between human and natural systems and how societies adapt to risk posed by catastrophic natural events and/or the degradation of environmental resource” (Reams et al. 2006). More than that, Social-Ecological Resilience refers to a community’s ability to recover and adapt to change in order to avoid future environmental disruptions or permanent alterations from their current state (Peterson 2000). One natural disaster that annually threatens and savagely destroys communities is wildfires.

When humans move into an area they will inevitably alter the landscape for a variety of reasons including the need to ensure their safety or comfort. By taking control of ecosystems, humans are benefiting from the services ecosystems provide, such as clean water and renewable resources. They are enjoying these benefits and controlling ecosystems to the point that the natural cycle of growth, development, decay and eventual reorganization has often been affected (Western 2001). With more people moving into previously uninhabited wildland areas and developing communities on the edge of these pristine yet vulnerable areas, smart development of the wildland-urban interface (WUI) is becoming a much more important consideration. The people in these areas are benefiting from the natural systems and gaining control of these areas in order to maximize their benefits. By controlling these ecosystems, human interference has affected the natural cycle of growth, development, decay, and eventual reorganization. More people living at the wildland-urban interface means that suddenly there are more communities that are highly vulnerable to environmental hazards such as wildfires, and in need of effective wildfire management policies and practices.

Natural systems are by their very nature resilient. They have adapted to the climate and hazards of a particular area and can recover from most natural disasters in an efficient and effective way. Western forests, for example are not devastated by a wildfire, but instead depend on the natural process to increase forest health by recycling nutrients, improving soil productivity, and deterring the invasion of invasive species

(Gorte 2006). These natural systems are said to be ecologically resilient. A forest ravaged by fire is not irreversibly destroyed. It can suffer the disturbance of a wildfire and revert back to its previous state.

Walker suggests that system development is cyclical. A natural system will go through a period of growth and development. During this phase, coined the Fore Loop by Walker, the systems will experience rapid growth and conservation. Inevitably the system will be subject to a disturbance. If the disturbance is big enough, it will force the system to enter into the Back Loop. In this part of the cycle the system begins to reorganize itself. Once the system has reorganized itself, it will begin the adaptive cycle once more. Walker and Salt argue that "the longer [a system] persists [in the Fore Loop] the more efficient it becomes in using the resources, and in so doing it eventually locks those resources up. As this occurs, the [system] becomes less resilient, and more vulnerable to shocks and disturbances" (Walker and Salt 2006). All systems must go through the adaptive cycle. Systems that are more resilient, however, will have the ability to quickly endure the Back loop and return to the growth of the Fore loop (Walker and Salt 2006). This cycle is summarized below in Figure 1.

This concept can be applied to social systems as well. A social system that is "resilient" is one that can endure disturbances or changes as well as quickly recover and reorganize from destructive events. Wildfire mitigation programs seek to simultaneously minimize wildfire risk and build resilience in the area. These resilience-building programs seem to have several attributes in common. The first commonality is that these programs promote and facilitate the sharing of information as well as encourage self-organization within a community.

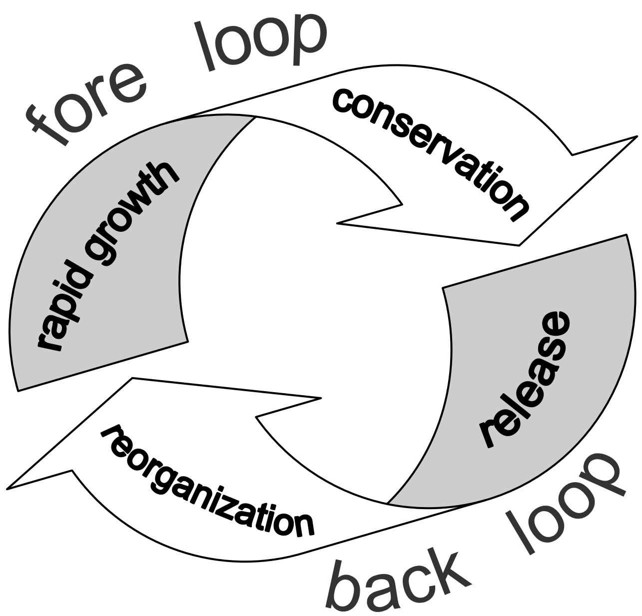

Figure 1: The Natural System Adaptive Cycle (Walker and Salt 2006)

Secondly the policies being created by the programs reflects sound scientific principles concerning the natural ecosystem and strengthen the community's ability to monitor and analyze the changes in natural resources and the ecosystem. Another shared characteristic is that these programs allow for and encourage input from stakeholders in the community and are flexible and able to change in light of new information. Furthermore, these programs promote improvement of scientific and technical knowledge and provide a means of distributing this newfound knowledge (Olsson 2004).

Strategies to Reduce Wildfire Risk

Natural ecosystems provide communities with many services that are frequently vital for human survival. Yet human activities often transform ecosystems to the point where the system can no longer provide the necessary services. Inescapably the two, humans and ecosystems, are at odds. In order to protect ecosystems from inevitable negative human impact, laws and regulations must be created. The creation of these restrictions, however, is often met with a lot of resistance from property owners. One of the most fundamental rights in this country is a property owner's right to do with his land what he chooses to do. The fifth amendment of the Bill of Rights states that "no person shall…be deprived of life, liberty, or property, without due process of law; nor shall private property be taken for public use, without just compensation" (U.S. Constitution, amend. 5). This means that property owners cannot be stripped of their rights to use their land without due process. With an increasing number of communities developing at the Wildland-Urban Interface (WUI), it has become imperative to create management policies, regulations, and programs to protect existing ecosystems and to mitigate the risks and effects of wildfires on communities and property. Although new policies, regulations, codes, and programs are intended to protect homeowners and their property, these actions are often seen as infringement on landowner rights and are met with resistance and conflict from landowners.

One of the most common policy actions promoted by wildfire mitigation programs and local governments is the creation of defensible space, the "area between a house and an oncoming wildfire where the vegetation has been modified to reduce the wildfire threat and allow fire fighters to safely operate" (Smith and Rebori 2001). This action is seen as a proactive measure that leads to firefighter safety and house survivability (Smith and Rebori 2001). This seemingly simply action however, has not been embraced by property owners. There may be many varying reasons why homeowners resist creating defensible space. Some homeowners may see the destruction of vegetation as unnatural and aesthetically unappealing, and others still "express themselves and what they value in the managed relationship of house structure and vegetation in the landscape" (Nelson, Monroe, and Johnson 2005). Other factors that may affect homeowner decisions regarding defensible space are a denial that they could be affected by wildfires, the cost of implementation, and lack of knowledge about how to properly create defensible space (Smith and Rebori 2001). There are many different reasons why property owners may not want to remove the vegetation from the land, but whatever the reason, the results are the same. Wildfire risks are elevated without the creation of defensible space.

Defensible space is just one example of a policy intended to protect homeowners which has not been embraced and has, in fact, been met with a lot of resistance. In order to address homeowner resistance, wildfire mitigation program managers must focus on public education as well as wildfire risk identification. According to one researcher, "risk perception is important because if an individual deems the risk low the person is less likely to act to reduce exposure" (McCaffrey 2004). Furthermore management policies "should be flexible and community-based that tailor resource management schemes to specific places and situations" (Olsson. 2004). By creating policies that are specific to a certain area, the policy will tackle the issues most important to that particular community and ecosystem.

Another strategy often employed by wildfire risk mitigation programs is the use of prescribed burns to control vegetation and restore historical fire cycles. Although fire is a natural part of many forest ecosystems, with the prolonged fire suppression policy many forests are still experiencing unnatural forest conditions. The wildfire suppression policy led to a buildup of fuel and an increase in understory vegetation, stand density and ladder fuels. The policy also increased the number of dead or down trees in forests across the country (Platt 2006). It is estimated that ‘‘190 million acres [79.89 million hectares] of Federal forests and rangelands in the United States, an area almost twice the size of California, continue to face an elevated risk of catastrophic fire due to unnatural, densely packed forest conditions” (Healthy Forests Restoration Act 2003, 2006). These unnatural forest conditions are what lead to severe, high-intensity fires that destroy forests and communities. For this reason it is important to take the steps necessary to restore the forests to the pre-suppression conditions. One way that fire mitigation programs are doing this is by reducing the accumulated fuels through the use of prescribed burns. Because fires of any size are unpredictable, even the prescribed burnings that are closely monitored can quickly burn out of control. Several times prescribed burns monitored by the Forest Service burned out of control leading to unintended damage to ecosystems and communities. After every accident, public and political reactions led to the temporary suspension of prescribed burns as wildfire mitigation tactic (Busenburg 2004). Many residents are wary of prescribed burns for this reason. One study found that “homeowners who were more certain that prescribed burns could be controlled had a more positive attitude” towards fuel management approaches (Vogt 2005). For the most part, however, communities and residents have many concerns regarding the use of prescribed burns. They are worried that the burns will get out of control and cause damage to their homes and many also object to the air pollution caused by these burns (Busenburg 2004). Similar to the use of defensible space as a wildfire risk mitigation tactic, prescribed burns is a tactic that faces a lot of controversy from local governments and communities.

DATA AND METHODS

Data

Data for these analyses were used from two different sources. The first set of data was gathered from an existing survey that had been distributed to wildfire risk mitigation program managers and administrators. The second set of data was collected from the 2000 U.S. Census Survey, as well as from the aforementioned survey. The first set of data was derived from a survey created and distributed by investigators from Louisiana State University in conjunction with the U.S. Forest Service. This survey was distributed to administrators or officials of wildfire risk reduction programs listed on the National Wildfire Programs Database website (www.wildfireprograms.com). These surveys aimed to collect information about the obstacles faced by the administration, the scope of the program, and investigate the types of activities utilized for wildfire mitigation (Reams et al. 2005). This was the second of two surveys that had been sent out to this specific group of people. A total of ten broad questions were asked in the survey. These ten questions then provided a list of possible answers, and the program managers and administrators were asked to check all the answers that apply. In total the survey had sixty-nine areas for response. The survey questions were based on previously identified program characteristics. The objectives of the state and local wildfire risk mitigation programs generally fell into four broad categories: education, hazard assessments and mapping, homeowner assistance, and implementation of regulations (Reams et al. 2005). Managers were also asked about what obstacles possibly affected their programs and what aid they received from various federal and state agencies. The managers were further asked whether or not the area had experienced a wildfire and if so, how many years ago. The wildfire history response was used as an explanatory variable. Under each broad category there was a list of activities. Managers were asked to check all the activities that applied to their program and were provided with space to add activities specific to their program.

Secondly a range of socioeconomic variables that may be associated with specific components of wildfire risk mitigation programs was gathered (Table 1). These variables, gathered from the 2000 Census survey at the state and county level, were percent population change, population density, population total, percent of home-ownership, median value of owner-occupied housing units, wealth per capita, percent of population with a high school degree or higher, and percent of population with a bachelor's degree or higher. A final variable was created that measured the years since a major wildfire had occurred in or near the community or jurisdiction of the respondent. This variable was created by extracting data from the survey and creating a categorical variable. If the area had experienced a fire in the past ten years, the category equaled '1'. If the area had experienced a wildfire more than ten years ago but less than twenty years ago, the category was set to '2'. The final category, '3', was for areas that had not experienced a wildfire in the area in over twenty years.

Table 1 **Community Attributes**

Variable Name	Description	Variable Type	Source
PFCAT	Years since last wildfire	Categorical	Survey
POPDENS	Persons per square mile		2000 Census Survey
POPCHG	% Population change from April 1, 2000 to July 1, 2005	Continuous	2000 Census Survey
PROPVALU	Median value of owner-occupied housing units	Continuous	2000 Census Survey
COLLEGE	% Population age 25+ with a bachelor's degree or higher	Continuous	2000 Census Survey
OWNHOME	% Owner-occupied housing units	Continuous	2000 Census Survey
WEALTH	Per capita income	Continuous	2000 Census Survey

Statistical Methods

In order to derive indicators of program development, a principal component analysis was conducted on the sixty-nine items in the survey. The data reduction technique used for this analysis was a rotated Principal Component Analysis (PCA). In order to have interpretable factors that incorporated the majority of the variables, the PCA was set to create seven factors. Furthermore, an orthogonal varimax rotation was run so that the rotated factor pattern could be examined. All analyses were conducted with the Statistical Analysis Software (SAS 2004).

Once the PCA was conducted and the seven factors were created, the factors were labeled based on commonalities. In order to label each factor, the rotated factor pattern was examined. Those variables most heavily weighted in a particular factor were assigned to that factor. Once the variables were appropriately assigned to each factor, the factors were interpreted based on which variables contained each factor. After the factors were properly labeled, a Pearson Product Correlation was conducted in order to verify the relationships between the collected variables and each factor. A GLMSelect procedure was run on factors representative of specific program components against the community-attribute variables collected. In addition to testing the significance of each demographic variable against the factors, the two-way interactions between all the demographic variables were tested. The regression analyses were done with a backward stepwise selection procedure (GLMSelect) to identify which variables were associated with each factor. Because this is an exploratory analysis, the variable selection criterion was based on the AIC criterion (Akaike criterion). This criterion is keeps variables in the model that may have a p-value greater than .05 because "selection stops at the step where the next step would yield a model with a larger value of the criteria" (SAS Institute Inc.). Variables selected in the models with this criterion were considered important to the exploratory model though the p-value did not always reach the usual type I error rate of .05.

Assumption of Normality was tested on the residuals by examining the Shapiro-Wilks statistic (Proc Univariate SAS 2004). In order to test the assumption of Homogeneity the residuals were plotted on the predicted values and examined for random scatter.

RESULTS AND DISCUSSION

Results

The Principle Component Analysis was orthogonally rotated and the rotated factor pattern was created. The rotated factor pattern table was examined and the variables were assigned to each factor based on which factor the variables loaded heaviest. Once the table was examined, the factors were assigned names.

Empirical Definition of the Underlying Dimensions of the Survey

Principal Component 1: Local Regulations / Codes

The first factor was identified as "Local Regulations / Codes." This underlying dimension was measured by questions in the survey that asked about what regulations or codes by which the surveyed area must abide. This factor contained the variables associated with zoning, building codes, fire codes, land codes, and new and existing regulations for the surveyed area. All the variables that loaded in this factor were specific and focused on particular kinds of regulations or codes. They were restricted to local codes and regulations. After rotation the variance of the "Local Regulations / Codes" factor was 6.50 which explained 10.1 percent of the variance.

Principal Component 2: Comprehensive Education

The second factor was clearly identified as "Comprehensive Education." The survey measured underlying components regarding the educational activities a given program or area employed. These may include public exhibits, demonstrations, school programs, radio/television/print media, workshops, and teacher education concerning risk reduction tactics. Topics may include how to create and maintain defensible space and how to practice effective vegetation reduction and fuel management. The "Comprehensive Education" factor had a variance of 5.26, which was 8.21 percent of the total variance.

Principal Component 3: Removed Vegetation Disposal

The survey respondents were asked to identify the specific types of assistance they provide to community residents. The PCA identified a subset of services that include the disposal of vegetative materials after the property owner had cleared out or removed trees, shrubs and other plants that could be considered fuel for a wildfire. These services include chipping and disposal of the material often picked up regularly as part of a municipal waste disposal or recycling program. Thus, the underlying dimension was labeled as "Removed Vegetation Disposal" and included free or cost-sharing chipping and slashing of plants and trees after removal from private yards and free or low-cost disposal of the removed plant material. This factor also contained several education variables including brochures and community meetings. Unlike the education variables which loaded in factor two, the educational component in this factor suggests a more passive, hands-off approach to education. This factor accounted for 7.72 percent of the total variance. The variance of this factor was 4.94.

Principal Component 4: Broad Planning and Regulation

The fourth factor included variables that dealt with the use of new or existing comprehensive community growth plans, defensible space regulations, and other relavent state or county-level regulations. These variables, although similar to factor one, differed in that they were much broader. This factor was identified as "Broad Planning and

Regulation" and measured 7.11 percent of the variance. The variance for this factor was equal to 4.55.

Principal Component 5: Risk Assessment

Factor five measured the underlying dimension in the survey that dealt with the use of quantitative risk assessments to determine risk for individual properties as well as communities. The survey asked questions regarding what kinds of services the wildfire programs provided to the population. This factor, unlike the third factor, identified a service that focused specifically on assessing the risk of wildfire in a neighborhood or community. Factor five was identified as "Risk Assessment" and included variables that measured the offering of risk assessments and prescribed fuel removal for individual properties and analyses of fire risks facing the larger community. This factor had a variance equal to 4.35 and explained 6.79 percent of the variance.

Principal Component 6: Regulatory Obstacles

There were many questions asked in the survey regarding the obstacles wildfire program managers face when trying to meet their program goals of community risk reduction. The PCA loaded the obstacles regarding regulations into one factor, identified as "Regulatory Obstacles." The responses that loaded together were reported constraints on vegetation management efforts arising from environmental regulations, tree protection ordinances, proximity to public or federal land restricting the use of fuel treatment, and other such obstacles. The sixth factor had a variance equal to 4.04 and accounted for 6.31 percent of the total variance.

Principal Component 7: Budgetary Obstacles

The principal component analysis identified the seventh factor as measuring obstacles regarding levels of program funding and budgetary resources. The seventh factor, identified as "Budgetary Obstacles," loaded variables that dealt directly with these kinds of obstacles. The obstacles that loaded heaviest in this factor were lack of qualified personnel, lack of technical help, and apathy from the public. This factor had a variance equal to 3.79, accounting for 5.92 percent of the variance.

Table 2 **Rotated Factor Pattern**

Variable Name	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7
EEXHIBIT	.	0.68968	.	.	.	.	.
EWEBSITE	.	.	.	.	.	.	.
ERADIO	.	0.37745	.	.	.	.	.
ESOFTWAR	.	0.70334	.	.	.	.	.
EBROCH	.	0.33260	0.51015	.	.	.	.
EDEMO	.	0.45376	0.42199	.	0.36819	.	.
ESCHOOLS	.	0.69673	.	.	.	.	.
ECOMMEET	.	.	0.45480	.	0.38553	.	.
EAWARDS	.	0.39069	0.32690	.	.	.	.
EWORKSHO	.	0.72970	.	.	.	.	.
EPROBS	.	.	.	.	.	.	.
ASSIST	.	.	.	.	0.74356	.	.
PROPRISK	.	.	.	.	0.74356	.	.
PROPTRT	.	.	.	.	.	.	.
CHIPSLAS	.	.	0.80017	.	.	.	.
DISPSLAS	.	.	0.64752	.	.	.	.
STATELEV	.	.	-0.49374	.	.	.	.
COUNTY	.	.	.	0.76345	.	.	.
LOCAL	0.66148	.	.	.	.	.	.
REGSUBD	0.82199	.	.	.	.	.	.
FIRECODE	0.78267	.	.	.	.	.	.
BLDGCODE	0.76560	.	.	.	.	.	.
ZONING	0.74493	.	.	.	.	.	.
LANDCODE	0.62060	.	.	.	.	0.34231	.
DISCLOSE	0.55936	.	.	.	.	.	.
STATEREG	.	.	.	0.62503	.	.	.
DSNEW	.	.	.	0.73991	.	.	.
DSALL	0.82869	.	.	.	.	.	.
DSRETRO	.	.	.	0.61766	.	.	.
WFPLAN	0.59132	.	.	.	.	-0.40016	.
STAFFPOS	0.35967	.	.	0.49183	.	.	.
CPFEDS	.	0.51832	.	0.35336	.	.	.
CPSTATE	.	.	.	0.49550	0.42985	.	.

(Continued from previous page)

CPCOUNTY	.	.	.	0.48213	0.34959	.	.
CPLOCAL	.	.	.	0.58348	.	.	.
GIS	.	.	.	0.56565	.	.	.
WFMODELS	.	0.62388	.	.	.	0.33207	.
NFPA	.	.	.	0.33708	.	.	.
RAOTHER	0.33209	.	.	.	.	.	.
OBUGET	.	.	.	.	.	.	.
OSTAFF	.	.	.	.	.	.	0.54554
OTECH	.	.	.	.	.	.	0.57615
OAPATHY	.	.	-0.40184	.	0.33971	.	0.46105
ORESIST	.	.	.	.	.	0.69434	.
OENFORCE	.	.	.	.	.	0.75636	.
OENVREGS	.	.	.	0.32839	.	0.61569	.
OFEDLAND	.	.	.	.	.	0.42145	.
OTREES	0.38302	.	.	.	.	0.41521	.
OLOWCOOP	0.44859	.	.	.	0.37104	.	.
OINPUT	.	.	.	.	.	0.66386	.
WORKSHOP	.	0.60320	.	.	.	.	0.34317
TEACHRED	.	0.63195	.	.	.	.	0.50929
OUTREACH	.	0.35743	.	.	0.33413	.	.
WEBSITES	.	.	.	.	.	.	.
DEMOS	.	0.47063	0.32956	.	0.34871	.	.
MEETINGS	.	.	.	.	0.41406	.	0.34083
HOMERA	.	.	.	.	0.64662	.	.
PRESCRIP	.	.	.	.	0.51122	.	.
COSTSHAR	.	.	.	.	0.42273	.	0.39472
FREETRT	.	.	.	.	.	.	0.51716
CHIPPING	.	.	0.82619	.	.	.	.
SLASHDIS	.	.	0.71093	.	.	.	.
REGSNEW	0.55699	.	.	.	.	.	0.35339
REGSEXIS	0.42998	.	.	0.34429	.	.	0.42665

Values less than 0.312 are not printed.

Factor Selection

Although this is a preliminary survey, the principal component analysis revealed several factors that may be used to indicate more highly developed risk mitigation programs, with a greater capacity to achieve their program objectives. The factors that are most indicative of better-developed, more active programs are the factors measuring more local regulations / codes, greater effort for public education, assistance with vegetation disposal, use of risk assessments for individual properties, and fewer reported problems with program funding.

These five factors, of the original seven factors, are specific components that were isolated by the researcher for further examination. Areas that have developed many different codes and regulations are areas that are taking steps to prevent destruction of lives and property. These codes may require a variety of standards useful in reducing or mitigating wildfire risk such as size requirements for defensible space, rules governing signage for street names and addresses, and building codes requiring safer construction materials. Programs that have a strong education and public outreach component are striving to alter the behaviors of stakeholders by providing them with information that will aid in wildfire mitigation and prevention. Another goal of these programs is to provide services and assistance to property owners. Two factors were identified that reflect differing types of services. The first component was the disposal of removed vegetation, often as part of local household refuse and recycling programs. The second type of assistance provided to property owners that is indicative of active or better developed wildfire mitigation programs is the use of systematic, empirical risk assessments for individual properties and for the larger community. This component is representative of an active and engaged program that makes efforts to engage the surrounding stakeholders. Lastly the budgetary obstacle factor must be considered as a restrictive factor. Program activity and development are hindered by budgetary constraints. Thus, programs whose administrators reported fewer problems with funding may be considered more stable, with a greater capacity to achieve program goals of reducing or mitigating risks from catastrophic wildfires.

Not all the identified factors were included in analysis for further examination. The factors Broad Planning and Regulations and Regulatory Obstacles are elements that were measured in the survey, but these factors are not necessarily factors that indicate program activity or desirable program elements. Broad Planning and Regulation is a factor that includes many variables that are out of the control of the wildfire mitigation program in question. Many of the regulations and comprehensive plans are required by or created by the state or county and are not the responsibility of the local wildfire mitigation program. For this reason this factor does not represent local program development or activity. The second factor that is being excluded from further analysis is the factor Regulatory Obstacles. These are not standard throughout the country. Some states, like California, have set up strict ordinances or regulations that must be followed when managing a wildfire mitigation program. Other states are not as strict, allowing programs to develop and perform with more freedom. Regulatory obstacles can range from federal land restrictions to local tree ordinances and any number of environmental regulations. Because these obstacles are out of the control of wildfire mitigation programs, it is impossible to use this factor as an indicator of program development or success.

Regression Analyses

Once the factors were identified and labeled, analysis could begin to examine the association between community attributes and the factors selected to examine specific program components. Several demographic variables were found to be strongly associated with the first factor, Local Regulations / Codes. The overall p-value of the model was significant at .0077. Population Density was found to be significant (p= .0413) and the variable was found to be negatively correlated with the factor. The demographic variables Property Value and Wealth were also kept in this model (p= .0021 and .0661 respectively). Property Value was found to be positively correlated with Local Regulations / Codes while Wealth was negatively correlated with this factor (Table 3).

The second factor, Comprehensive Education, also had three demographic variables that were retained in the model using the AIC criterion. These variables were Population Change (p-value= .0969), Population Density (p-value= .0439), and Percent of Homeownership (p-value= .1586). Population Change and Population Density were negatively correlated with the Comprehensive Education factor, whereas the demographic variable Percent of Homeownership is positively correlated. The p-value for the overall model was .0269 (Table 4).

The third retained factor, Removed Vegetation Disposal, had two demographic variables retained in the model. The overall model had a p-value of .0389. The two variables kept in the model using the AIC criterion, Population Change (p-value= .0192) and Population Density (p-value= .1695), were positively correlated with the factor Removed Vegetation Disposal (Table 5).

Risk Assessment was the next factor considered and two demographic variables were retained when regressed against this factor. This model had a p-value of .0912. The first demographic variable was Population density (p-value= .0596), which was found to be negatively correlated with the factor. The second demographic variable retained by the AIC criterion was the variable Percent of the population with a College

Education (p-value= .1220) and was found to be positively correlated with this factor (Table 6).

The final factor, Budgetary Obstacles, had one demographic variable returned This variable, Wealth (p-value= .0404), was negatively correlated with the final factor. The overall model had the same the same p-value of .0404 (Table 7).

Regression Analyses on Selected Factors

Table 3 **Regression Analysis for Local Regulations and Codes**

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.171798	0.490656	-0.35	0.7279
POPDENS	1	-0.545645	0.259710	-2.10	0.0413
PROPVALU	1	7.264814	2.229907	3.26	0.0021
WEALTH	1	-0.036937	0.019607	-1.88	0.0661

Table 4 **Regression Analysis for Comprehensive Education**

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-1.409718	1.300412	-1.08	0.2841
POPCHG	1	-0.037360	0.022033	-1.70	0.0969
POPDENS	1	-0.543397	0.262082	-2.07	0.0439
OWNHOME	1	0.026418	0.018427	1.43	0.1586

Table 5 **Regression Analysis for Removed Vegetation Disposal**

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.535532	0.230859	-2.32	0.0248
POPCHG	1	0.053648	0.022099	2.43	0.0192
POPDENS	1	0.360096	0.257980	1.40	0.1695

Table 6 **Regression Analysis for Risk Assessment**

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.672574	0.514805	-1.31	0.1979
POPDENS	1	-0.533546	0.276235	-1.93	0.0596
COLLEGE	1	0.031268	0.019848	1.58	0.1220

Table 7 **Regression Analysis for Budgetary Obstacles**

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.934892	0.480355	1.95	0.0576
WEALTH	1	-0.041981	0.019917	-2.11	0.0404

The categorical variable PFCAT was created in order to determine if fire history would affect the development efforts of specific programs. The thought was that those areas that had recently suffered a fire would have stakeholders that were more cooperative and wildfire mitigation programs that were more active in educating the public and providing services. Surprisingly, this community characteristic was not found to be significant for any of the selected factors.

This is a preliminary exploratory analysis with a limited sample size; however the assumptions of Normality and Homogeneity were tested. The model is considered to meet the assumption of normality if the p-value is greater than or equal to .05. If the p-value is less than this value, the data does not meet the assumption of normality. The assumption of normality was not met for the factor Comprehensive Education (p-value= .0132). The factors whose p-values were not significant enough to reject the assumption of normality were Local Regulations / Codes, Risk Assessment, and and Budgetary Obstacles. These factors had p-values of .2184, .0996, and .7640 respectively. The assumption of homogeneity was tested by examining residual plots. Although there were no glaring violations of the assumption, and all the data tended towards random scatter, the small sample size affects the homogeneity of the residuals.

Discussion

The analysis conducted in this paper is intended to explore characteristics of communities and their association with specific program components. Although this a preliminary analysis, there is a lot of information that can be gleaned and used to provide researchers with direction and more specific research questions to develop more focused, targeted surveys of program managers and stakeholders. In particular information can be extracted from this data analysis regarding the demographic characteristics that may limit specific program components.

Population Density

The demographic variable found to be significantly associated with four of the five factors was Population Density. This variable indicates whether a community is more urban, rural, or suburban. Highly developed, urbanized areas will have much higher population densities than areas that are far removed from cities. Suburban areas or areas that are being developed as vacation locations at the Wildland-Urban Interface will have lower population densities. According to the regression analyses, this demographic variable has a negative relationship with the factors Local Regulations / Codes, Comprehensive Education, and Risk Assessment. This means that areas with lower population densities tend to have stronger education components and also provide more risk assessment services to the stakeholders in the area. Moreover, these less dense areas are likely to have a population more apt to accept restrictions in the form of regulations and codes. Another reason why less densely populated areas may have more regulations and codes is that there simply may be fewer people to resist or to contend with the local or county governments proposing new regulations.

Conversely, it was found that the factor Removed Vegetation Disposal was positively correlated with population density. In more densely populated areas, usually urban or suburban areas, the wildfire mitigation programs are providing disposal services for removed vegetation. These services may be in conjunction with municipal refuse and recycling programs already in existence. These urban and suburban areas probably have existing infrastructure that facilitates the implementation of a vegetation disposal service. This factor also contained variables that represented a more passive, hands-off approach to education. It may be that administrators of wildfire mitigation programs in densely populated areas cannot provide the same level of face-to-face contact, individualized risk assessment services, and instructive workshops with community residents as those offered by programs in less densely settled areas.

Wealth

The second demographic variable that was found to be statistically associated with two factors, Local Regulations / Codes and Budgetary Obstacles, was the variable measuring community wealth. Wealthier areas are seeing fewer regulations and codes created in the vicinity, as well as fewer budgetary obstacles facing wildfire mitigation programs. It is logical that the wealth of a community appears to be an important factor influencing the implementation of key program components. Without adequate staff or technological support it becomes very difficult to have a functioning, successful wildfire mitigation program. Even if there were no obstacles from imposed regulations and codes, the landowners or nearby stakeholders, inadequate funding would likely hamper the capacity of a program to effectively reduce wildfire risk.

Property Value

Surprisingly, the value of property within a community was found to be strongly and positively associated with more local regulations. The factor Local Regulations / Codes was found to be negatively associated with wealth and positively associated with property value. Usually it is thought that property value and wealth will behave similarly, however this was not the case. Further research and a more robust sample size would have to be collected in order to explore this finding. Finding that the property value was strongly and positively associated with more local regulations indicates that areas with higher property values have accepted restrictions placed on them in the form of regulations and codes. This finding suggests a tendency among stakeholders to use more direct regulatory approaches to manage wildfire risk in more affluent communities. For example, insurance companies in California, facing dramatically increasing losses in recent years, have implemented the "Fair Plan" initiative that requires insurance policy holders to abide by stringent defensible space standards and building codes, as required by state law and local ordinances.

More Highly Educated Residents

The percent of residents who attained a college degree is another variable that may influence specific program components of community wildfire mitigation programs. This demographic variable was found to be positively associated with the factor Risk Assessment. By identifying the risks associated with living in an area and explaining how those risks can be mitigated or reduced, the hope is that stakeholders will alter their behavior and reduce the risk of wildfires. This component of wildfire mitigation programs seems to be stronger in areas with a more educated populous. The implication is that wildfire mitigation program administrators see the benefit of risk assessment in educated areas. The analysis indicated that those programs in areas with a less educated populous do not provide the same service.

Percent of Homeownership

Another demographic variable that was found to be significant is Percent of Homeownership. This demographic variable was found to be positively associated with the factor Comprehensive Education. That is to say, those communities with more homeowners, as opposed to renters, tend to have a stronger educational component in their wildfire mitigation programs. Areas with a high percent of homeowners are more likely to be areas that experience little population flux. These are areas where people have made an investment and settled down. In these areas the educational outreach seems to be stronger and more developed, with residents being educated about how to prevent wildfires in hopes of altering their behavior. This is a demographic variable that may act as a limiting or restricting factor when wildfire mitigation programs are considering developing a strong education component.

Population Change

The last demographic variable that was found to be significant for selected factors was the variable Population Change. The demographic variable was found to be significant and negatively associated with the factor Comprehensive Education and positively correlated with the factor Removed Vegetation Disposal. Areas that are experiencing rapid population growth are most likely urban or suburban areas instead of rural areas. These rapidly-growing communities may have few resources available to invest in wildfire mitigation programs. The communities may simply be unable to invest the resources necessary to create educational components when meeting the demands of rapidly-increasing populations requiring resources for the development of infrastructure and other critical needs. These areas may only be able to provide services, such as disposal of removed vegetation or dispersal of brochures, because there is already an existing infrastructure or because it the most cost-effective method of wildfire risk mitigation. Conversely, areas that have stable, slow-growing populations are associated with wildfire mitigation programs that have a stronger educational component. This suggests that wildfire mitigation programs in these stable areas see more incentive to invest time and resources into educating the public about how to mitigate wildfire risk.

The demographic variables that appeared as significant for the selected factors (Population Density, Property Value, Wealth, Percent of Homeownership, Population Change, and Percent of College Graduates) can all be viewed as possible indicators of wildfire mitigation programs that are most highly developed and active. Of these community attributes, there are four attributes for which data is more readily available and easily obtained. These variables are Population Density, Property Value, Wealth and Percent of people with a college degree. The data analysis suggests that areas that are wealthier, with higher property values, a more educated populous and are less densely populated are the areas that have more developed wildfire mitigation programs with desirable program elements. Because wildfire mitigation programs were created with the intent of providing communities with a flexible, customizable solution that will mitigate the risk of wildfires, it is imperative that relevant community characteristics that may affect program development be identified. If these community characteristics can be identified, it will help the state and federal government, the entities providing the local communities with resources and assistance, to distribute resources more efficiently.

CONCLUSIONS

This analysis utilized an existing survey and extracted information that would be useful for examining specific components of wildfire mitigation programs. By using a principal component analysis to identify the underlying survey factors, the data were easier to manipulate and interpret. Moreover the principal component analysis allowed for easy identification of specific components. These programs are assumed to have a greater capacity for effectiveness and success in altering stakeholder behavior and ultimately reducing or mitigating wildfire risks facing Wildfire-Urban Interface (WUI) communities. Not only did the principal component analysis prove useful in this analysis, but by being able to identify key components of programs, researchers can create more focused, targeted surveys. For example, the PCA differentiated between regulatory and budgetary obstacles. Previously the researchers were not making a distinction between obstacle types. One question was asked in the survey regarding different obstacles managers of wildfire risk mitigation programs might face. By identifying different types of obstacles, more specific, better developed questions can be asked regarding obstacles. Future research may concentrate on the identified areas and ask more appropriate questions that will allow for better information to be acquired. With better developed surveys more useful information can be extracted from these programs that can be used for improvement of newly-created programs, regular systematic evaluations, and possibly policy changes.

In addition to the PCA, a regression analysis was conducted in order to gain insight into key community attributes that may affect program development and ultimate effectiveness in meeting program goals and objectives. This data analysis suggests that fire history plays a minimal role, if any, in influencing program and stakeholder behavior. For this reason it is imperative that the community characteristics that are associated with active wildfire mitigation programs are identified. Identifying these characteristics can be very useful in creating or improving policies and distributing resources. Each community in this country is different, with a unique socio-economic makeup. By isolating a few key demographics that can be used to flag communities that might need more attention either through extra resources or additional technical assistance from state or federal agencies, more wildfire mitigation programs will be successful in meeting the most important goal of all, avoiding or limiting the large-scale, devastating effects of catastrophic wildfire.

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APPENDIX A: SURVEY DISTRIBUTED TO ADMINISTRATORS

A Survey of State and Local Wildfire Risk Reduction Efforts

We understand that one of the goals of your program is to reduce hazardous vegetation on private property for the protection of life and property in Wildland Urban Interface (WUI) communities.

Name and location of your wildfire hazard mitigation project/program/law: ______________________

____

____

Administrator name, email and phone: ______________________________________

Approximate date program created and/or regulation adopted: ______________________

1. Is *public outreach and education* an objective of your program? ______________________

Do you conduct any of these related activities? (Check all that apply)

_______ Exhibits at public events
_______ Website information
_______ Radio/television/print media
_______ Software/videos
_______ Defensible-space/firesafe landscaping brochures
_______ Demonstration homes/gardens/trails
_______ School programs by fire officials
_______ Neighborhood/community meetings
_______ Community awards/recognition
_______ Firewise workshops for public officials, developers, and builders

_______ Other (Please specify): ____

Comments/Obstacles: ____

____

____

2. Is *assistance to property owners* an objective of your program? ______________________

Do you offer any of the following services? (Check all that apply):

_______ Individual home risk assessments
_______ Prescriptions for homeowners
_______ Property treatment – free or cost-share
_______ Slash chipping
_______ Slash disposal
_______ Other assistance activities (Please specify): ______________________________

Comments/Obstacles: ____
____
____

3. Is *implementation of regulations* to manage vegetation an objective of your program? ________

If so, what level of jurisdiction is the law or regulation?

______ State
______ County
______ Local
______ Other (please specify) ______________________________

Please indicate the type of regulatory mechanism(s)used:

______ Subdivision/development regulations
______ Fire code
______ Building code (fuels treatment/defensible space, specifically)
______ Zoning
______ Land Use code
______ Real Estate disclosure for wildfire hazard
______ State guidelines
______ Other (please specify) ______________________________

What requirements do you implement? (Check all that apply):

______ Defensible-space regulations for new construction
______ Defensible-space regulations for all structures
______ Defensible-space regulations for retrofit structures

Means of enforcement: ______________________________________
____

Comments/Obstacles: ____
____

4. Has a *wildfire protection plan* been developed for your jurisdiction? ____________

If yes, briefly describe key components: ______________________________
____

Do you have a staff position dedicated to wildfire mitigation implementation? ____________________

____

Do you participate in *collaborative planning* for risk reduction? ____________________

If so, what agencies or groups are involved? ____________________

____

5. **Is *the designation of high-risk areas* an objective of your plan/program?**____________________

Do you use the following tools? (Check all that apply)

________ GIS Hazard Risk Maps

________ Fire Behavior Models

________ NFPA 1144/NFPA 299

________ Other risk assessment tools (Please specify):____________________

6. **Please take a look at this list of potential obstacles to risk mitigation programs. Do you face one or more of these challenges? If so, on a scale of 1 – 5, please indicate the extent to which each is an obstacle.** (If an item is not an obstacle, please leave it blank.)

1	2	3	4	5
(slight obstacle)	**…**	**…**	**…**	**(major obstacle)**

________ Budget constraints

________ Lack of qualified personnel

________ Need for technical help with GIS or risk models

________ Public apathy

________ Property owner resistance to vegetation management

________ Inadequate enforcement of regulatory requirements

________ Compliance with environmental regulations

________ Legal appeals to planned fuels treatments on adjacent public lands

________ Tree protection ordinances

________ Inadequate cooperation among agencies and/or private stakeholders

________ Inadequate public input into fire policy and/or priority setting

________ Other (Please specify) ____________________

Comments/Obstacles: ____________________

____

7. **From your experience, what is the *most effective* program, or group of program elements for reducing wildfire risk on private land?** ____________________

____

8. How do you rank the following in terms of *cost-effectiveness* for reducing wildfire hazard in your area (leave blank if not a tool currently using):

1	2	3	4	5
(low cost-effectiveness)	...	...	...	(highly cost-effective)

_________ Workshops for fire professionals, local officials, and developers
_________ Classroom/teacher education
_________ Public education campaigns (All residents)
_________ Publications/videos/websites for homeowners (defensible space/landscape guides)
_________ Demonstration projects (fuels modifications/defensible space)
_________ Neighborhood/community meetings
_________ Individual home risk assessments
_________ Prescriptions for homeowners
_________ Cost/share assistance for homeowners' fuels treatments
_________ Free-of-charge fuels treatments for homeowners
_________ Chipping of slash for homeowners
_________ Slash disposal assistance for homeowners
_________ Regulation for fuels treatment in new developments
_________ Regulation for fuels treatment around existing homes

Comments: ____

____

9. What are the sources of funding for your wildfire mitigation program? ____________________

____

____

10. Has your community experienced a fire in the past? ______________ **If yes, please provide the year** _________ **and acreage burned** ______________ **.**

Comments: ____

____

____

Thank you very much for your input. Please submit the survey to Margaret Reams, Ph.D., Associate Professor, LSU Department of Environmental Studies, mreams@lsu.edu, (225) 578-4286 (fax), (225) 578-4299 (voice)

APPENDIX B: SELECTED SAS OUTPUT

The FACTOR Procedure
Initial Factor Method: Principal Components

```
Scree Plot of Eigenvalues
     |
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  12 +
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     |
     |
     |       1
     |
  10 +
     |
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     |
   8 +
     |
E    |
i    |
g    |
e    |
n    |
v  6 +
a    |         2
l    |
u    |
e    |
s    |
     |          3
   4 +            4
     |
     |             5
     |
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65

                                             Number
```

Eigenvectors							
	1	**2**	**3**	**4**	**5**	**6**	**7**
EEXHIBIT	0.12840	-0.07994	0.07094	-0.07695	0.07783	0.19009	-0.23848
EWEBSITE	0.07680	0.00865	-0.04120	-0.00830	-0.04454	-0.10094	-0.01607

Eigenvectors							
	1	**2**	**3**	**4**	**5**	**6**	**7**
ERADIO	0.14124	-0.12148	0.07063	0.00920	0.07080	-0.02905	0.02187
ESOFTWAR	0.09236	-0.17364	0.09482	-0.16903	0.10056	0.19358	-0.11965
EBROCH	0.16478	-0.15073	-0.03402	0.06656	-0.04717	-0.03353	-0.10953
EDEMO	0.21181	-0.12193	0.03718	-0.05524	-0.07073	0.00411	-0.01412
ESCHOOLS	0.12710	-0.01499	0.21442	-0.09687	0.18491	0.14978	-0.06161
ECOMMEET	0.13225	-0.12100	-0.13130	0.09076	-0.07620	-0.05883	0.07225
EAWARDS	0.12991	-0.12565	0.11631	-0.16490	0.04121	-0.11629	0.04633
EWORKSHO	0.13851	-0.22735	0.12719	-0.12820	0.14932	0.04357	-0.08507
EPROBS	0.05970	-0.00557	0.06454	0.04145	0.08268	-0.00884	0.06953
ASSIST	0.15566	-0.06909	-0.21497	-0.02110	-0.20104	0.21465	0.10362
PROPRISK	0.15566	-0.06909	-0.21497	-0.02110	-0.20104	0.21465	0.10362
PROPTRT	0.11103	-0.06840	-0.07088	0.02997	0.10929	-0.01285	0.07180
CHIPSLAS	0.12374	-0.14631	-0.19121	0.01237	-0.06837	-0.26368	-0.08518
DISPSLAS	0.12552	-0.14475	-0.17385	-0.06945	-0.11691	-0.07838	-0.13973
STATELEV	-0.01128	0.08293	0.14690	0.06544	0.00216	0.18042	0.19156
COUNTY	0.12670	0.10259	-0.15748	0.12849	0.25099	0.05626	-0.04608
LOCAL	0.18477	0.14836	0.08454	-0.02818	-0.08664	-0.07031	0.07606
REGSUBD	0.13454	0.25277	0.04399	-0.11108	-0.09098	-0.14872	-0.00995
FIRECODE	0.13622	0.23729	-0.00907	-0.18688	0.05315	-0.03554	0.08740
BLDGCODE	0.22533	0.17349	-0.03445	-0.06979	-0.07458	-0.08654	-0.00636
ZONING	0.16077	0.18788	-0.02976	-0.18048	0.01188	-0.07059	0.01228
LANDCODE	0.07195	0.24496	0.03519	-0.08206	-0.15720	-0.05893	-0.21643
DISCLOSE	0.07787	0.18604	0.02379	-0.18631	0.00781	0.02216	-0.11571
STATEREG	0.07081	0.12561	-0.16161	0.12106	0.15814	0.09715	-0.21288
DSNEW	0.14640	0.11157	-0.13111	0.06232	0.28330	0.00759	0.01062
DSALL	0.12499	0.24686	0.02894	-0.17163	-0.09114	-0.09539	0.05343
DSRETRO	0.01663	0.13093	-0.22971	0.03965	0.19129	0.04935	-0.06120
WFPLAN	0.06128	0.14254	0.02427	-0.25538	0.02794	-0.01418	0.27696
STAFFPOS	0.12081	0.14950	-0.10245	0.10416	0.10009	-0.02259	0.18277

Eigenvectors							
	1	**2**	**3**	**4**	**5**	**6**	**7**
CPFEDS	0.16314	0.01359	-0.02136	-0.04611	0.10214	0.27576	-0.05675
CPSTATE	0.08284	-0.12277	-0.24038	0.01901	0.16175	0.02048	0.19738
CPCOUNTY	0.09791	-0.04501	-0.29804	-0.08156	0.09672	0.02685	0.07537
CPLOCAL	0.11374	-0.00348	-0.14923	0.14684	0.16113	0.03004	-0.03555
GIS	0.05481	0.01001	-0.14511	0.10276	0.22397	0.02219	0.04245
WFMODELS	0.17496	-0.04985	0.03181	0.01083	-0.02605	0.26859	-0.18153
NFPA	0.12025	0.02782	-0.01341	0.06547	0.10979	0.01054	-0.12247
RAOTHER	0.16788	0.01532	0.06223	0.02952	-0.08351	-0.05853	-0.08115
OBUGET	0.01763	0.09955	0.07813	-0.12644	0.02448	0.06003	0.15470
OSTAFF	0.01045	-0.00078	0.05307	0.34380	0.11790	-0.06635	0.08705
OTECH	0.00314	-0.04136	0.24807	0.14163	0.10688	-0.02958	0.11322
OAPATHY	0.00784	0.07280	0.07792	0.21666	-0.00438	0.09885	0.34219
ORESIST	0.05488	0.05651	0.10141	0.19166	-0.26002	0.20937	-0.05578
OENFORCE	0.08545	0.10599	-0.06981	0.21028	-0.22325	0.25020	-0.13400
OENVREGS	0.10300	0.16333	0.00501	0.30910	-0.03187	-0.11252	-0.05767
OFEDLAND	0.08991	-0.02625	0.04254	0.20772	-0.10962	-0.07107	0.00159
OTREES	0.13157	0.11416	0.02549	0.12945	-0.12651	-0.08030	0.03890
OLOWCOOP	0.17544	0.08328	-0.00776	-0.00558	-0.09194	0.06013	0.09519
OINPUT	0.04448	0.10739	0.05624	0.23416	-0.17210	-0.02712	-0.15510
WORKSHOP	0.11678	-0.08217	0.25387	0.03590	0.08318	-0.02517	-0.15373
TEACHRED	0.11445	-0.00202	0.29756	0.04157	0.25665	0.04566	-0.02565
OUTREACH	0.13901	-0.11996	0.08565	0.09829	-0.03127	0.08332	0.04474
WEBSITES	0.14804	-0.01192	0.03980	0.10207	-0.03807	-0.01806	0.03473
DEMOS	0.19345	-0.13151	0.16856	0.00221	-0.13012	-0.00881	0.02461
MEETINGS	0.09698	-0.06765	0.11990	0.11070	-0.12966	0.06461	0.17806
HOMERA	0.10332	-0.15609	-0.03524	-0.08142	-0.09967	0.07886	0.25297
PRESCRIP	0.11521	-0.02650	0.06143	-0.07605	-0.06371	0.20821	0.16903
COSTSHAR	0.12257	-0.10794	-0.01238	0.02532	0.05347	-0.06760	0.25974
FREETRT	0.00372	-0.11687	0.11951	0.10655	0.02958	-0.23347	0.09906

Eigenvectors							
	1	**2**	**3**	**4**	**5**	**6**	**7**
CHIPPING	0.12937	-0.21168	-0.06902	0.01229	-0.05587	-0.30437	-0.06728
SLASHDIS	0.14879	-0.19284	-0.06460	-0.06899	-0.06694	-0.18670	-0.05701
REGSNEW	0.20589	0.07428	0.11193	-0.01105	0.06291	-0.14746	0.01308
REGSEXIS	0.17198	0.10643	0.09768	0.10483	0.15514	-0.15041	-0.02871

Factor Pattern							
	Factor1	**Factor2**	**Factor3**	**Factor4**	**Factor5**	**Factor6**	**Factor7**
EEXHIBIT	0.41533	.	.	.	.	0.32023	-0.39431
EWEBSITE	.	.	.	.	.	.	.
ERADIO	0.45684	.	.	.	.	.	.
ESOFTWAR	.	-0.41816	.	-0.33265	.	0.32610	.
EBROCH	0.53298	-0.36298	.	.	.	.	.
EDEMO	0.68513	.	.	.	.	.	.
ESCHOOLS	0.41111	.	0.44500	.	0.34194	.	.
ECOMMEET	0.42777	.	.	.	.	.	.
EAWARDS	0.42021	.	.	-0.32451	.	.	.
EWORKSHO	0.44803	-0.54750	.	.	.	.	.
EPROBS	.	.	.	.	.	.	.
ASSIST	0.50349	.	-0.44615	.	-0.37177	0.36161	.
PROPRISK	0.50349	.	-0.44615	.	-0.37177	0.36161	.
PROPTRT	0.35915	.	.	.	.	.	.
CHIPSLAS	0.40024	-0.35234	-0.39682	.	.	-0.44420	.
DISPSLAS	0.40600	-0.34859	-0.36081	.	.	.	.
STATELEV	.	.	.	.	.	.	0.31673
COUNTY	0.40983	.	-0.32683	.	0.46414	.	.
LOCAL	0.59765	0.35727	.	.	.	.	.
REGSUBD	0.43518	0.60872	.	.	.	.	.
FIRECODE	0.44062	0.57145	.	-0.36777	.	.	.
BLDGCODE	0.72884	0.41778	.	.	.	.	.
ZONING	0.52003	0.45244	.	-0.35517	.	.	.
LANDCODE	.	0.58990	.	.	.	.	-0.35785
DISCLOSE	.	0.44803	.	-0.36665	.	.	.
STATEREG	.	.	-0.33541	.	.	.	-0.35198
DSNEW	0.47353	.	.	.	0.52387	.	.
DSALL	0.40430	0.59448	.	-0.33776	.	.	.
DSRETRO	.	0.31531	-0.47674	.	0.35374	.	.

Factor Pattern							
	Factor1	**Factor2**	**Factor3**	**Factor4**	**Factor5**	**Factor6**	**Factor7**
WFPLAN	.	0.34326	.	-0.50257	.	.	0.45793
STAFFPOS	0.39077	0.36003	.	.	.	.	.
CPFEDS	0.52770	.	.	.	.	0.46455	.
CPSTATE	.	.	-0.49888	.	.	.	0.32635
CPCOUNTY	0.31670	.	-0.61854	.	.	.	.
CPLOCAL	0.36790	.	.	.	.	.	.
GIS	.	.	.	.	0.41416	.	.
WFMODELS	0.56592	.	.	.	.	0.45247	.
NFPA	0.38897	.	.	.	.	.	.
RAOTHER	0.54303	.	.	.	.	.	.
OBUGET	.	.	.	.	.	.	.
OSTAFF	.	.	.	0.67657	.	.	.
OTECH	.	.	0.51484	.	.	.	.
OAPATHY	.	.	.	0.42638	.	.	0.56579
ORESIST	.	.	.	0.37719	-0.48084	0.35271	.
OENFORCE	.	.	.	0.41383	-0.41284	0.42148	.
OENVREGS	0.33317	0.39333	.	0.60828	.	.	.
OFEDLAND	.	.	.	0.40879	.	.	.
OTREES	0.42557	.	.	.	.	.	.
OLOWCOOP	0.56747	.	.	.	.	.	.
OINPUT	.	.	.	0.46081	-0.31825	.	.
WORKSHOP	0.37774	.	0.52687	.	.	.	.
TEACHRED	0.37021	.	0.61754	.	0.47460	.	.
OUTREACH	0.44962	.	.	.	.	.	.
WEBSITES	0.47884	.	.	.	.	.	.
DEMOS	0.62573	-0.31671	0.34983	.	.	.	.
MEETINGS	0.31368	.	.	.	.	.	.
HOMERA	0.33419	-0.37590	.	.	.	.	0.41828
PRESCRIP	0.37265	.	.	.	.	0.35076	.

Factor Pattern							
	Factor1	**Factor2**	**Factor3**	**Factor4**	**Factor5**	**Factor6**	**Factor7**
COSTSHAR	0.39646	.	.	.	.	.	0.42947
FREETRT	.	.	.	.	.	-0.39331	.
CHIPPING	0.41844	-0.50976	.	.	.	-0.51275	.
SLASHDIS	0.48128	-0.46439	.	.	.	-0.31451	.
REGSNEW	0.66596	.	.	.	.	.	.
REGSEXIS	0.55630	.	.	.	.	.	.
Values less than 0.312 are not printed.							

Variance Explained by Each Factor						
Factor1	**Factor2**	**Factor3**	**Factor4**	**Factor5**	**Factor6**	**Factor7**
10.462454	5.799343	4.307149	3.872826	3.419517	2.837858	2.733892

Pearson Correlation Coefficients
Prob > |r| under H0: Rho=0
Number of Observations

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7
POPCHG	0.22828 0.1147 49	-0.19723 0.1744 49	0.30796 0.0313 49	-0.10359 0.4787 49	-0.07924 0.5884 49	-0.00856 0.9534 49	0.21764 0.1330 49
POPDENS	-0.18429 0.2049 49	-0.29271 0.0412 49	0.14272 0.3279 49	0.07648 0.6015 49	-0.22422 0.1214 49	-0.23067 0.1108 49	-0.04006 0.7846 49
OWNHOME	-0.20180 0.1644 49	0.26559 0.0651 49	-0.19004 0.1909 49	-0.32156 0.0243 49	0. 09998 0.4943 49	0.16253 0.2645 49	0.11082 0.4484 49
PROPVALU	0.29574 0.0391 49	-0.16643 0.2531 49	0.11546 0.4295 49	0.18270 0.2090 49	0.12877 0.3779 49	-0.03713 0.8000 49	-0.19490 0.1796 49
WEALTH	-0.14716 0.3129 49	0.05987 0.6828 49	0.07695 0.5992 49	-0.12158 0.4053 49	0.18028 0.2151 49	-0.00862 0.9531 49	-0.29388 0.0404 49
COLLEGE	0.26984 0.0608 49	-0.01635 0.9112 49	0.03218 0.8263 49	-0.07516 0.6078 49	0.16065 0.2702 49	-0.03287 0.8226 49	-0.26771 0.0629 49
PFCAT	-0.08110 0.5599 54	0.00314 0.9820 54	0.19764 0.1520 54	0.05684 0.6831 54	-0.06537 0.6386 54	0.00354 0.9797 54	-0.12838 0.3549 54

The GLMSelect Procedure
Factor 1

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	11.65891	3.88630	4.49	0.0077
Error	45	38.94384	0.86542		
Corrected Total	48	50.60275			

Root MSE	0.93028
Dependent Mean	0.02286
R-Square	0.2304
Adj R-Sq	0.1791
AIC	-3.25528
AICC	1.00286
SBC	4.31200

Parameter Estimates					
Parameter	**DF**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	-0.171798	0.490656	-0.35	0.7279
POPDENS	1	-0.545645	0.259710	-2.10	0.0413
PROPVALU	1	7.264814	2.229907	3.26	0.0021
WEALTH	1	-0.036937	0.019607	-1.88	0.0661

The GLMSelect Procedure
Factor 2

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	3	9.14584	3.04861	3.36	0.0269
Error	45	40.87871	0.90842		
Corrected Total	48	50.02455			

Root MSE	0.95311
Dependent Mean	-0.01864
R-Square	0.1828
Adj R-Sq	0.1283
AIC	-0.87933
AICC	1.05135
SBC	6.68795

Parameter Estimates					
Parameter	**DF**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	-1.409718	1.300412	-1.08	0.2841
POPCHG	1	-0.037360	0.022033	-1.70	0.0969
POPDENS	1	-0.543397	0.262082	-2.07	0.0439
OWNHOME	1	0.026418	0.018427	1.43	0.1586

The GLMSelect Procedure
Factor 3

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	2	6.41201	3.20601	3.49	0.0389
Error	46	42.30419	0.91966		
Corrected Total	48	48.71620			

Root MSE	0.95899
Dependent Mean	-0.04667
R-Square	0.1316
Adj R-Sq	0.0939
AIC	-1.19978
AICC	1.03488
SBC	4.47568

Parameter Estimates					
Parameter	**DF**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	-0.535532	0.230859	-2.32	0.0248
POPCHG	1	0.053648	0.022099	2.43	0.0192
POPDENS	1	0.360096	0.257980	1.40	0.1695

The GLMSelect Procedure
Factor 5

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	2	5.13883	2.56942	2.52	0.0912
Error	46	46.82656	1.01797		
Corrected Total	48	51.96539			

Root MSE	1.00894
Dependent Mean	0.00177
R-Square	0.0989
Adj R-Sq	0.0597
AIC	3.77688
AICC	1.13645
SBC	9.45234

Parameter Estimates					
Parameter	**DF**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	-0.672574	0.514805	-1.31	0.1979
POPDENS	1	-0.533546	0.276235	-1.93	0.0596
COLLEGE	1	0.031268	0.019848	1.58	0.1220

The GLMSelect Procedure
Factor 7

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	1	4.46572	4.46572	4.44	0.0404
Error	47	47.24202	1.00515		
Corrected Total	48	51.70774			

Root MSE	1.00257
Dependent Mean	-0.03155
R-Square	0.0864
Adj R-Sq	0.0669
AIC	2.20971
AICC	1.09680
SBC	5.99335

Parameter Estimates					
Parameter	**DF**	**Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	0.934892	0.480355	1.95	0.0576
WEALTH	1	-0.041981	0.019917	-2.11	0.0404

The Proc Univariate Procedure
Factor 1 Resids

Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	**W**	0.968876	**Pr < W**	0.2184
Kolmogorov-Smirnov	**D**	0.075672	**Pr > D**	>0.1500
Cramer-von Mises	**W-Sq**	0.06448	**Pr > W-Sq**	>0.2500
Anderson-Darling	**A-Sq**	0.432555	**Pr > A-Sq**	>0.2500

The Proc Univariate Procedure
Factor 2 Resids

Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	**W**	0.943571	**Pr < W**	0.0132
Kolmogorov-Smirnov	**D**	0.106949	**Pr > D**	0.1248
Cramer-von Mises	**W-Sq**	0.131097	**Pr > W-Sq**	0.0428
Anderson-Darling	**A-Sq**	0.886663	**Pr > A-Sq**	0.0225

The Proc Univariate Procedure
Factor 3 Resids

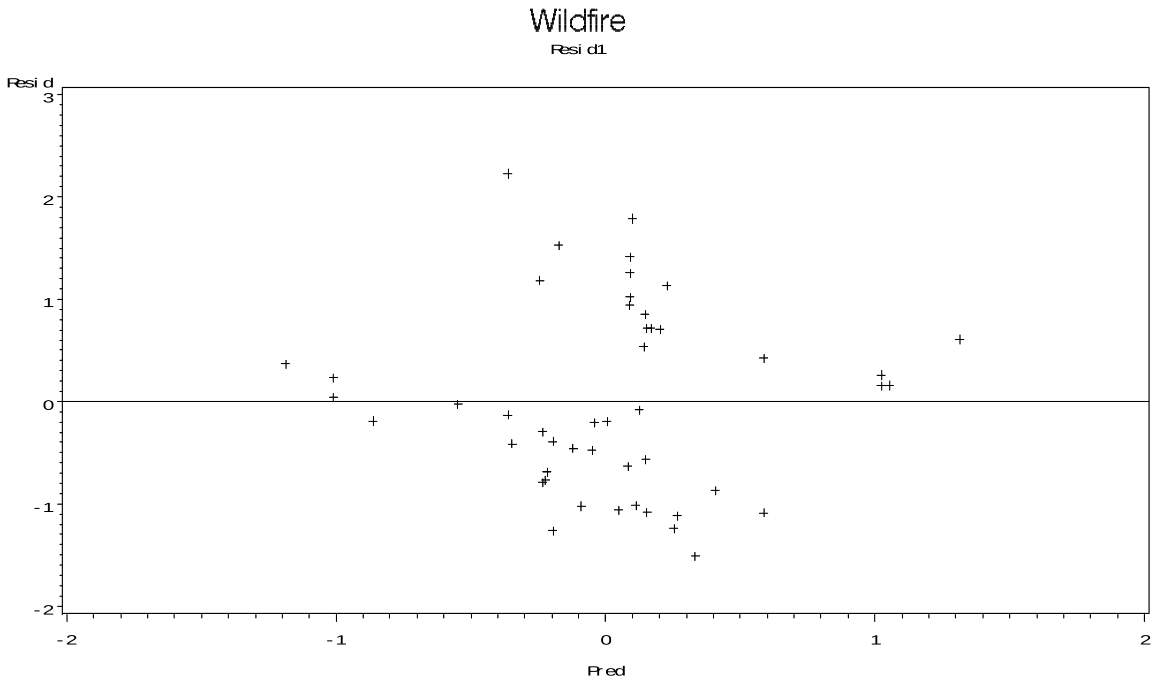
Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	**W**	0.940197	**Pr < W**	0.0150
Kolmogorov-Smirnov	**D**	0.120298	**Pr > D**	0.0760
Cramer-von Mises	**W-Sq**	0.113954	**Pr > W-Sq**	0.0747
Anderson-Darling	**A-Sq**	0.848509	**Pr > A-Sq**	0.0272

The Proc Univariate Procedure
Factor 5 Resids

Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	**W**	0.960532	**Pr < W**	0.0996
Kolmogorov-Smirnov	**D**	0.120102	**Pr > D**	0.0769
Cramer-von Mises	**W-Sq**	0.110828	**Pr > W-Sq**	0.0819
Anderson-Darling	**A-Sq**	0.659117	**Pr > A-Sq**	0.0840

The Proc Univariate Procedure
Factor 7 Resids

Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	**W**	0.984587	**Pr < W**	0.7640
Kolmogorov-Smirnov	**D**	0.091731	**Pr > D**	>0.1500
Cramer-von Mises	**W-Sq**	0.04838	**Pr > W-Sq**	>0.2500
Anderson-Darling	**A-Sq**	0.271987	**Pr > A-Sq**	>0.2500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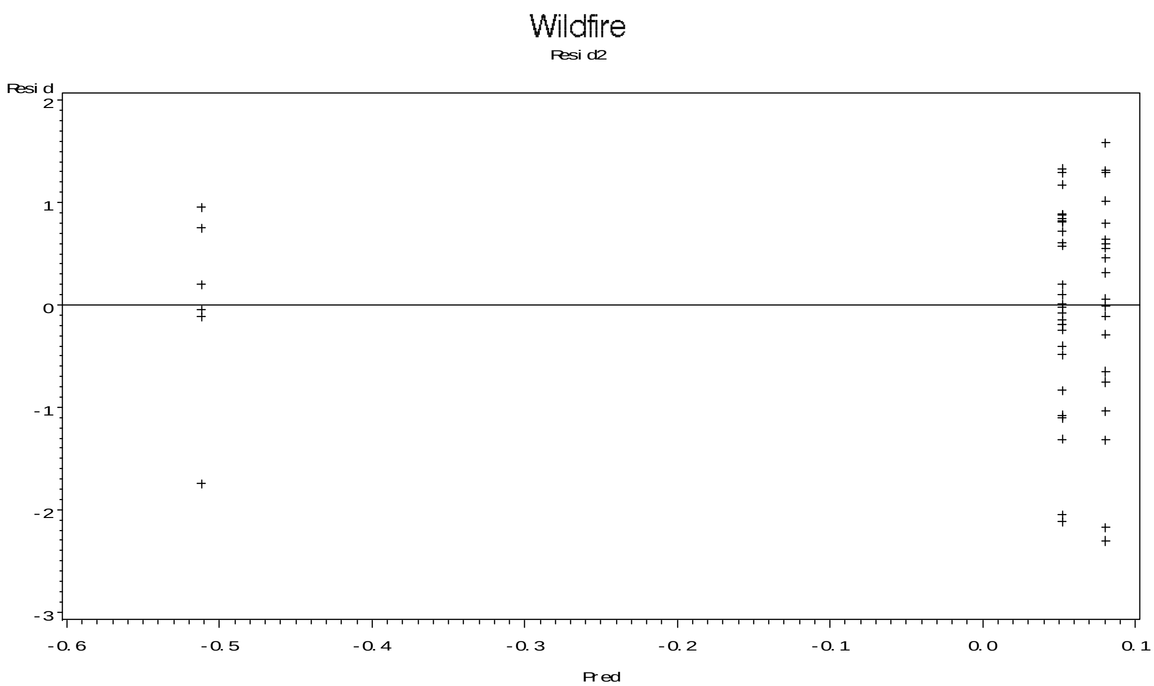
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Resid2
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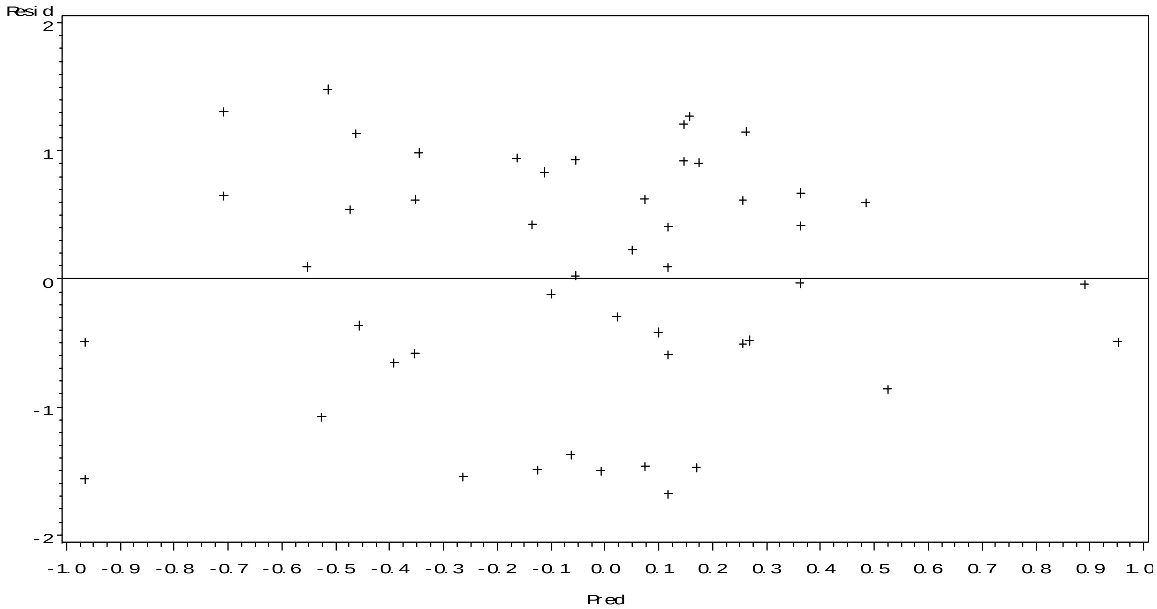
-0.4
-0.3
-0.2
-0.1
0.0
0.1
Pred

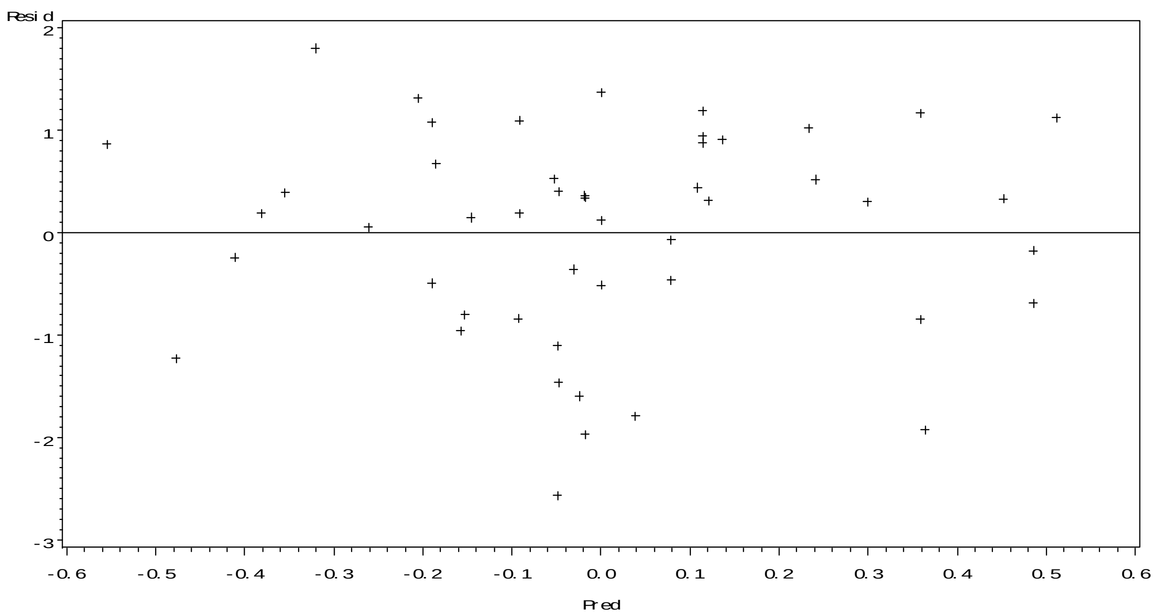
Wildfire

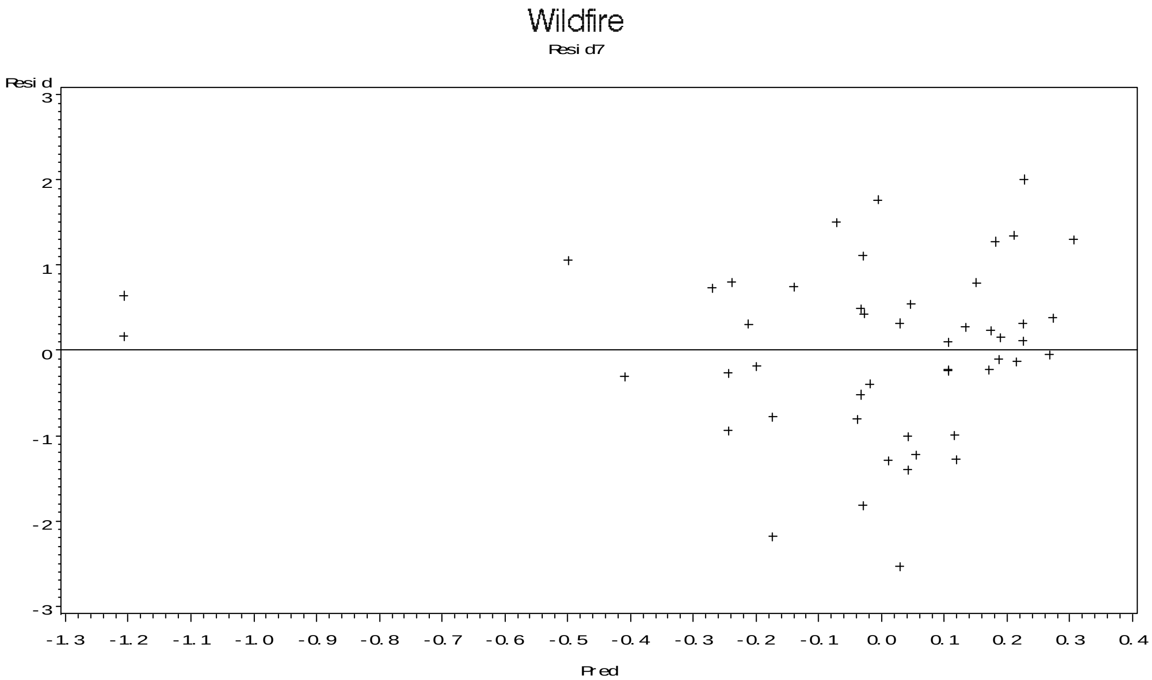
Resid3



Wildfire

Resid5





Wildfire
Resid7
Resid
3
2
1
0
-1
-2
-3
-1.3 -1.2 -1.1 -1.0 -0.9 -0.8 -0.7 -0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0.0 0.1 0.2 0.3 0.4
Pred

VITA

Kimberly Geaghan was born in Santiago, Chile, in February 1984 and moved to Baton Rouge, Louisiana, in March of the same year. She has lived in Baton Rouge since then and graduated from University High School in 2002. She graduated from Louisiana State University Magna Cum Laude with a Bachelor of Science in information systems and decision sciences and a minor in Spanish in May, 2006. In August of 2006 she began working on her master's degree in environmental sciences with a concentration in planning and management. She will receive her Master of Science degree in August, 2008.