

Risk Perceptions and Wildfire Evacuation

A case study of wildfire experience in southern California

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Surprisingly few residents evacuate their homes when a wildfire threatens. California is consistently identified as one of the states most vulnerable to wildfire due to prolonged heat waves and drought. The goal of this study was to measure the perceptions of California residents about wildfire risk, as well as their information-seeking behavior and other decision-making processes during and after actual wildfire threats. This field study surveyed residents who had experienced wildfires between 2012 and 2013. The main findings from this survey are presented here and are intended to inform future experimental laboratory studies on evacuation behavior and attitudes, as well as to aid scientists at the US Geological survey and elsewhere in more effectively communicating with the public.

Executive Summary

This study surveyed residents of the evacuation zones and nearby areas for the Cold (November 2012), Lookout (October 2012), Madison (April 2013), Mills (June 2013), and Powerhouse (May/June 2013) wildfires in southern California.

Wildfires are typical in this region due to high temperatures and long periods of drought. Debris flows—fast channels of soil and rock—are also more common after a wildfire, making southern California particularly susceptible. Despite these dangers, evacuation rates during wildfire threats are lower than recommended by natural hazards professionals. Increased protective behaviors both before and during wildfires are also desirable.

Our study supplements extensive existing research on wildfire risk perception and behavior. We were primarily interested in recording the factors that influence southern Californian residents' likelihood of evacuation, their evacuation plans, and their perceptions regarding the probability of subsequent wildfires and debris flow events.

The findings from our survey confirmed that evacuation rates are lower than expected given these residents' regular experience with wildfire threats. A range of psychological rationalizations can explain

Resident Quote:
I had evacuated my family two previous times unnecessarily. Decided to wait and watch.

this finding, which involve thoughts such as “I’ve evacuated before and nothing bad happened, so why evacuate this time?” and “My house was damaged in the past, so it’s unlikely to happen to me again!”

On a more positive note, there were several factors that consistently increased residents’ protective behaviors. Receiving an official warning to evacuate, such as from a Reverse 911 call or a door-to-door visit, was highly effective. Residents also found it easier to decide to evacuate if they had up-to-date information about whether the fire would reach their neighborhood, as well as if they had previously made an evacuation plan. Policies that enable and encourage such resources, as well as those that

educate about the increased threat of debris flows, must continue to be developed.

We plan to test these effective factors in an experimental setting using the HazSim simulation game (see ‘Future Directions’, Page 5). From this simulation, we will be able to make more definitive conclusions about the ways that these factors influence evacuation rates and other protective behaviors.

Demographics

Surveys were sent to residents by mail. Out of 3000 participants who were sent the survey, 201 responded (a typical response rate).

The average age of respondents was 61 years old, and over 70% of respondents were between the ages of 50 and 80. The average number of years lived in respondents’ current home was 26 years, and the average number of people living in respondents’ home was 2.5 people.

48 residents evacuated during the studied wildfires, while 149 did not (4 did not answer the question). Importantly, 151 residents—equivalent to about 75% of respondents—had never experienced previous damage due to a natural hazard. These numbers suggest that the combination of living in a high-risk area on the one hand and experiencing little personal threat on the other has decreased residents’ perceived need for protective behaviors.

Residents’ Likelihood of Evacuation

Residents’ likelihood of evacuation served as the most informative outcome variable, as it was significantly influenced by the following predictor variables: whether or not residents had received a warning, whether or not the fire eventually went on to reach their neighborhood, and their location. Residents’ likelihood of evacuation was also somewhat predicted by whether or not they had prior evacuation plans. For this reason, likelihood of evacuation is the main outcome variable summarized in this report.

Residents' Likelihood of Evacuation (cont'd)

A quick summary:

- For those with no evacuation order, no previous fire or evacuation history, and no damage from the present fire: 7.0% chance of evacuation.
- For those who received an evacuation order, but had no previous fire or evacuation history, and no damage from the present fire: 25.5% chance of evacuation.
- For those who received an evacuation order, had evacuated from 2 previous fires, but had no damage from the present fire: 43.8% chance of evacuation.

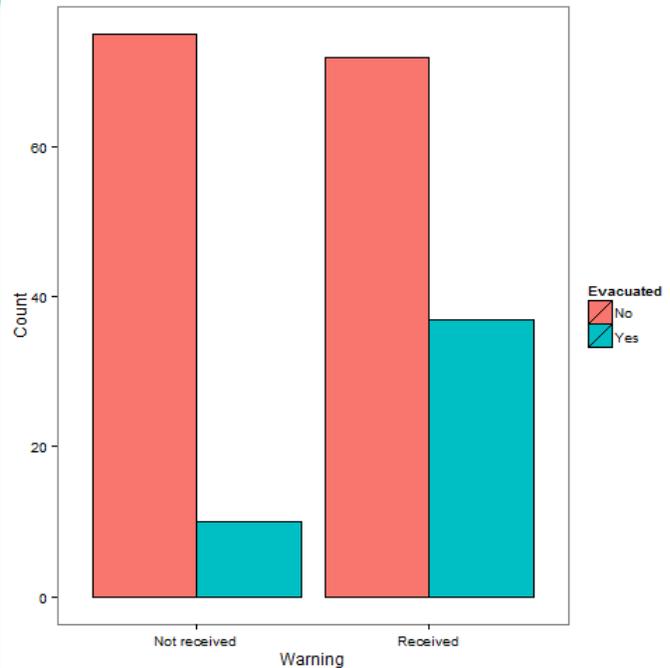
In sum, residents who got evacuation orders were more likely to evacuate. While those who had experienced personal damage due to a previous natural hazard were less likely to evacuate (Fig. 3, Pg. 4), those with previous evacuation experience were more likely to evacuate during the present fire. Further research will need to be conducted to determine whether the evacuation-inducing nature of past evacuation experience can override the evacuation-reducing nature of past damage with regard to residents' decision-making during subsequent wildfire threats.

Resident Quote:

I could see the fire beginning to crest the hill 1.2 mile to the west, as soon as I went outside. At that point, the fire seemed completely out of control, so it wasn't inconceivable that it would reach our neighborhood.

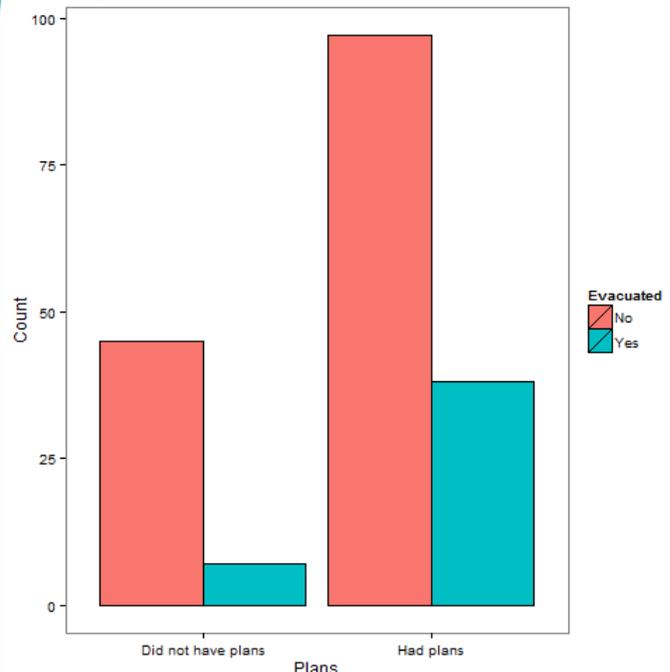
Receiving an evacuation warning (Fig. 1; Fig. 5, Pg. 4) and having created an evacuation plan prior to the present wildfire (Fig. 2) were both correlated with higher evacuation rates. Policies which increase officials' visibility during a threat (e.g., coming door-to-door, generally being on the streets) and educational programs which encourage the creation of evacuation plans will continue to improve this result.

Fig 1. Likelihood of evacuation vs. receiving a warning



Residents were more likely to evacuate if they received a warning. Results from the Pearson's Chi-squared test were **significant**. P-value < 0.001**

Fig 2. Likelihood of evacuation vs. having evacuation plans



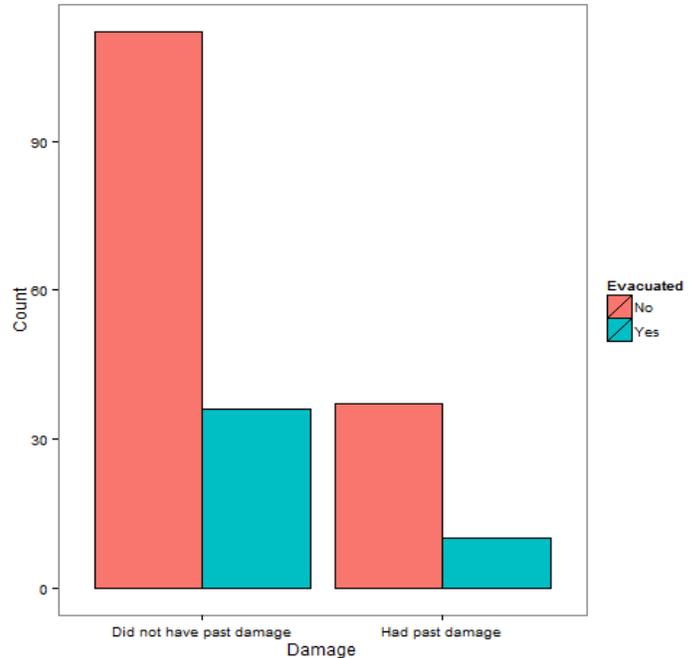
Residents were slightly more likely to evacuate if they had evacuation plans. Results from the Pearson's Chi-squared test were marginally **significant**. P-value is equal to 0.056*

Residents' Likelihood of Evacuation (cont'd)

Our data suggest that residents were not more likely to evacuate if they had experienced damage from a previous natural hazard (Fig. 3). This is consistent with the “gambler’s fallacy”: that is, the belief that a rare occurrence (in this case, personal damage) is unlikely to happen to them again during subsequent trials (i.e., wildfire threats). Strengthening the factors that increase residents’ evacuation rates—such as the presence of officials during a threat—can minimize this negative effect.

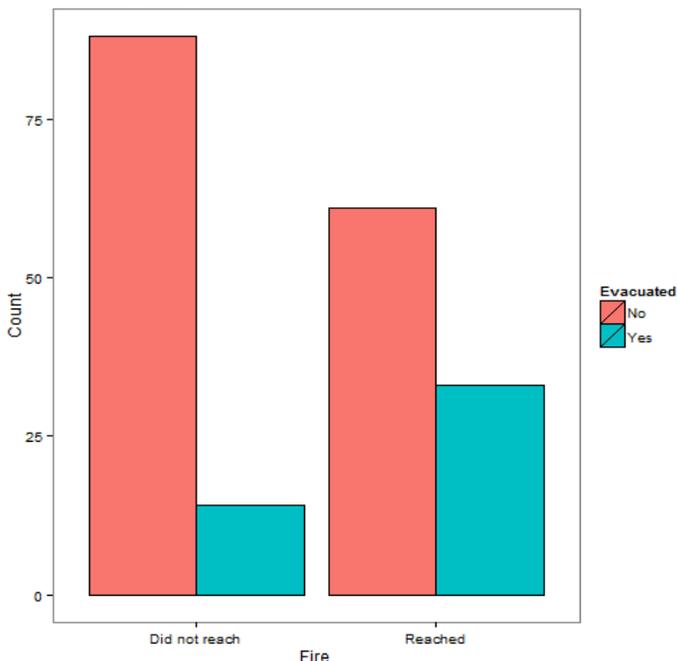
As another example, residents seemed to have a good grasp of whether their homes were in danger. Those living in closer proximity to the fire were more likely to evacuate (Fig. 4), as were those living in towns identified as locations for the fire (Fig. 5). Together, these two findings indicate that the residents were quite well informed of their own risk. The causes of residents’ fairly accurate risk perceptions should be examined further. Potential reasons include timely evacuation warnings as well as up-to-date media reports.

Fig 3. Likelihood of evacuation vs. experience of previous damage due to a natural disaster



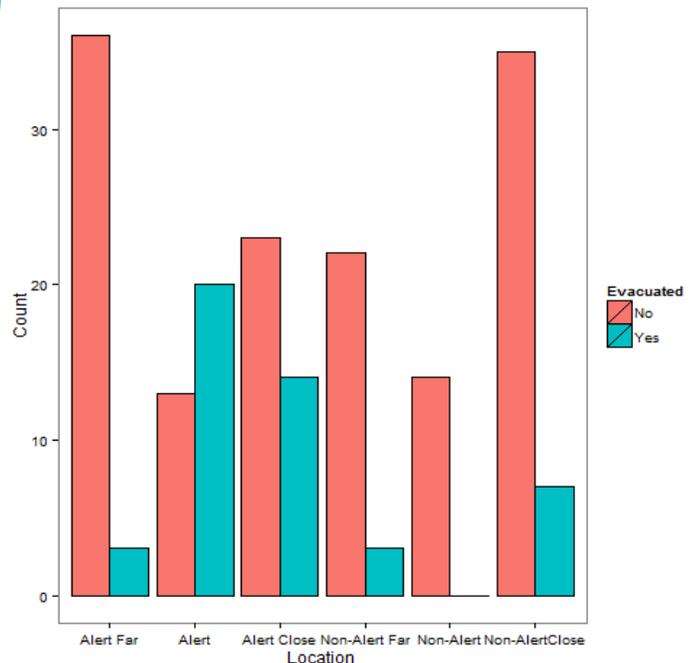
Residents were **not** more likely to evacuate if they had previously experienced damage to their home due to a natural disaster. Results from the Pearson's Chi-squared test were **not significant**. P-value is equal to 0.82

Fig 4. Likelihood of evacuation vs. fire eventually reaching neighborhood



Residents were more likely to evacuate for a fire that would eventually go on to reach their neighborhood. Results from the Pearson's Chi-squared test were **significant**. P-value is less than 0.0001**

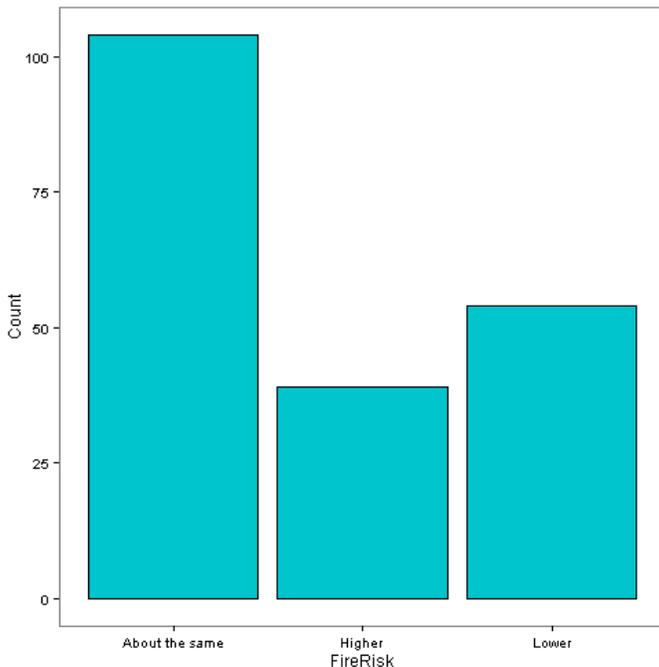
Fig 5. Likelihood of evacuation vs. location



Residents’ likelihood of evacuation was correlated with their location. Results from the Pearson's Chi-squared test were **significant**. P-value is less than 0.01**

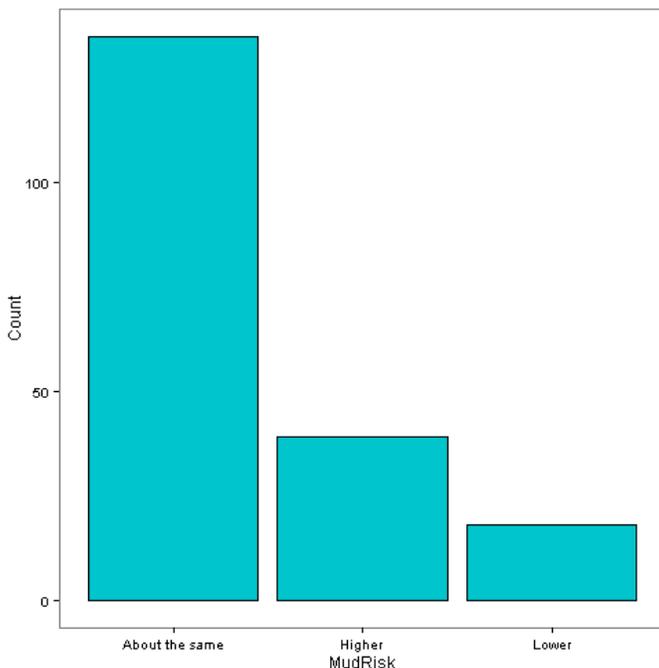
Residents' Risk Knowledge

Fig 6. What is the probability of another wildfire within the next 2 years?



The majority opinion among residents was, incorrectly, that both the probability of another wildfire and the probability of a debris flow event were about the same in the next two years as compared to before the current wildfire. Risk managers should be sure to communicate the increased risk of a debris flow after a wildfire to residents.

Fig 7. What is the probability of a debris flow within the next 2 years?



Future Projects

Results from this analysis are being used to inform the design of a wildfire and debris flow simulation game using the HazSim program developed at the University of Pennsylvania. From the data presented in this report, we have identified potential independent and dependent variables to test in our experimental follow-up study. Included among the independent variables are the types of sources residents use most often as they seek out information about wildfires, such as: online news sources, Twitter feeds, information from family and neighbors, Reverse 911 calls, etc.

Potential Independent Variables:

- Recent fire season history
- Simulated personal fire experience
- Requirement to list evacuation plan
- Electronic fire updates
- Types of evacuation warnings

Potential Dependent Variables:

- Choice of whether to evacuate
- Home protection actions
- Perception of likelihood of fire reaching home
- Level of worry
- Attribution of responsibility to protect neighborhood

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