

FOURMILE CANYON: LIVING WITH WILDFIRE



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The most devastating wildfire in Colorado's history in terms of property loss began on Labor Day, September 6, 2010. The Fourmile Canyon Fire was located just 5 miles west of downtown Boulder, CO, in a wildland-urban interface (WUI) zone with homes located on steep slopes and in dense ponderosa pine and Douglas-

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A survey of homeowners was conducted to understand the behaviors and attitudes of residents who live in high fire-risk areas concerning wildfire.

fir forest. The fire, fueled by high winds, burned 6,181 acres (2,501 ha), mostly on private land, and destroyed 169 homes. The Fourmile Canyon Fire will likely garner much attention as landowners and land managers turn their efforts to trying to understand how such devastation can be avoided or minimized in the future.

The location of the fire within the WUI prompted much predictable response from the public. References to irresponsible homeowners who chose to live in a tinderbox and then expected the government to rescue them when a fire broke out were common. But is that really an accurate characterization of the individuals who



Aerial view of the Fourmile Canyon area. Steep slopes, dense ponderosa pine and Douglas-fir forest, and mixed land ownership characterize this wildland-urban interface zone near Boulder, CO. Photo: Joe Amon, The Denver Post.

live in the area evacuated during the Fourmile Canyon Fire? In this article, we summarize the results of a prior survey of homeowners in the area to gauge their awareness of, and response to, fire risk in their neighborhoods.

Living Among the Trees

We conducted a survey of homeowners in Boulder County in 2007, 3 years before the Fourmile Canyon Fire, as part of a larger effort to understand the behaviors and attitudes of residents who live in high fire-risk areas. Among the 127 survey respondents who live in the Fourmile Canyon Fire evacuation zone, 9 lost their homes and 2 others suffered significant property damage. The survey summarized here describes a population that had an awareness of wildfire risk and their need to take responsibility for reducing that risk on their property.

The Costs of Fire

The Fourmile Canyon Fire outside Boulder has been characterized as the most destructive fire in Colorado's history. The majority of the property damage and loss from the fast-moving and dramatic fire occurred in the first hours of the week-long fire (Miller 2010; personal correspondence with Eric Philips, Boulder County Wildfire Mitigation Coordinator), and losses are largely associated with the destruction of 169 homes (Bounds and Snider 2010). Insurance claims for losses topped \$217 million. Fire suppression costs totaled approximately \$10.1 million, though U.S. Department of Homeland Security, Federal Emergency Management Agency assistance grants will likely defray the total cost of local fire-suppression efforts (Udall 2010). The full cost associated with clean-

up and recovery and the extent to which grants will defray costs to the county have yet to be determined.

Mountain Communities and Fire

Dramatic wildfires and the losses suffered by those living in high fire-risk areas often capture the headlines during the wildfire season, and those living in the WUI

Most of the survey respondents knew about the risk when they made the decision to purchase a home in a high fire-risk area.

become the subjects of study after major wildfire events. However, it is less common for studies to collect data on property owners' attitudes, beliefs, and mitigation activities before a major wildfire event, as this one did in Boulder County, CO.*

With the largest number of developed square miles of land in the WUI in Colorado (57.1 square miles or 147,889 km²), Boulder County is one of the top Colorado counties at risk of wildfire. Boulder County also has a large amount of undeveloped land that has the potential to dramatically increase future wildfire losses as more individuals choose to live in these high fire-risk areas.

However, Boulder County has an active wildfire mitigation pro-

*The survey area included Larimer County, the county to the north of Boulder County, but this article focuses only on respondents in Boulder County in the area evacuated during the Fourmile Canyon Fire.

gram to inform property owners of existing risk and to encourage fuel reduction through mitigation cost-sharing programs. In 2010, Boulder County received more than \$100,000 in American Recovery and Reinvestment Act funds to develop a county-level Community Wildfire Protection Plan (CWPP). In addition to the county-wide CWPP being developed, five of the communities in the area affected by the Fourmile Canyon Fire—Fourmile Canyon, Lefthand Canyon, Gold Hill, Sugarloaf, and Sunshine Canyon—had completed their own CWPPs. While the establishment of CWPPs does not imply any specific level of completed mitigation, it does reflect an organized community-level effort to evaluate conditions and develop plans among property owners, local government, local fire authorities, and the Colorado State Forest Service to reduce fuels and prepare for a wildfire event.

Did Homeowners Understand Wildfire Risks?

Survey Methods

We collected data from mail-in and on-line surveys. We used geo-coded data from the Boulder County Assessor's Office, geographic information system (GIS) software, and county fire hazard maps to develop a sample frame of privately owned residential properties containing a structure in Boulder County's WUI to identify survey recipients. In June 2007, we mailed letters of invitation to a total of 1,750 Boulder County addresses. Of these, 602 were not deliverable; 1,148 letters were successfully delivered. As an alternative to the traditional paper survey, participants had the option of completing a Web-based version of the survey. Three-hundred sixteen individuals com-

pleted the online survey, and 105 completed the paper survey. The overall response rate was approximately 37 percent.

To identify the respondents within the Fourmile Canyon Fire evacuation zone, we used GIS to map the boundaries of the evacuation zone onto a county map populated with location data points for the respondent addresses. We then used GIS to pull the unique survey identifier number of each respondent to the Boulder County survey within the evacuation zone. Among the 421 respondents to the Boulder County survey, 127 live in the Fourmile Canyon Fire evacuation zone. We discuss the results related to these respondents (hereafter “Fourmile respondents”) below and clearly note any results from the broader population of Boulder County residents.

Demographics

The average Fourmile respondent was 57 years old, and respondents were equally divided among men and women. Almost all of the respondents (96 percent) identified “white” as their racial group, and more than 75 percent were married. The Fourmile respondents were well educated: 86 percent had at least a college degree. Median income among Fourmile respondents was \$87,500. The average household size was 2 people, and only 19 of the 127 households (15 percent) had any children under age 18 living in the household. Most of respondents (64 percent) reported that they had household pets or nonincome generating livestock on their property.

Place of Residence

While some WUI areas in the United States have many sea-

sonal residents, respondents in the Fourmile Canyon Fire evacuation zone were primarily full-time residents (94 percent) and owners (98 percent) living in single family homes (99 percent). Approximately 25 percent of the respondents expected to move within the next 5 years, though plans to move were primarily related to the challenges of mountain living (travel and health concerns) rather than wildfire risk. Land parcel sizes ranged from less than $\frac{1}{4}$ acre (0.1 ha) to 37 acres (15 ha). Only a small portion of survey respondents (9 percent) live on land parcels that are less than $\frac{1}{4}$ acre (0.1 ha), while over half (52 percent) live on parcels between $\frac{1}{4}$ and 2 acres (0.1 and 0.8 ha), and nearly 40 percent live on parcels larger than 2 acres (0.8 ha) (mean = 7.89 acres or 3.52 ha).

Experience With Wildfire

At the time of the survey, over a quarter of the Fourmile respondents (26 percent) had evacuated their current residence at one time or another due to a nearby wildfire. Although 61 percent had experienced a wildfire within 10 miles (16 km) of their property, only a few respondents had first-hand experience with a wildfire on their property (9 percent), suffered fire- or smoke- related damages or losses (6 percent) or had prepared to evacuate without actually doing so (17 percent). Most of the Fourmile respondents (83 percent) said that they were somewhat or very aware of wildfire risk when they bought their current residence. Similarly, most respondents (83 percent) knew someone who was evacuated due to wildfire, and over a third of respondents (38 percent) knew someone whose residence was lost or damaged due to a wildfire.

Attitudes and Beliefs About Wildfire

We asked a series of questions to ascertain how concerned survey respondents were about a wildfire damaging their home, their health, their ability to earn income, their pets, their property, local water sources, and public lands near their home (table 1). We measured concern on a five-point scale (1 = “not at all concerned” and 5 = “extremely concerned”). Respondents expressed the highest level of concern for wildfire damaging their home (average rating = 3.47) and property/landscape (average rating = 3.42). Fourmile respondents also expressed a high level of concern that a wildfire would affect surrounding public lands (average rating = 3.27). The respondents were least concerned about a wildfire affecting their ability to earn income. This response is not unexpected as many respondents likely commute to the City of Boulder for work.

We included a series of 17 statements about wildfire in the surveys and asked respondents to rate how strongly they agreed or disagreed with each statement (table 2). In general, respondents disagreed with statements about not needing to take mitigation measures because they have insurance, firefighters would protect their home, or the risk of damage was not great. Respondents also seemed to understand that their properties were at risk to wildfire and that they needed to be responsible for reducing the risk. Although 89 percent of the respondents agreed or strongly agreed that wildfires are a natural part of the balance of a healthy forest ecosystem, they felt that wildfires should be suppressed in certain situations. Specifically,

the majority of Fourmile respondents agreed or strongly agreed that wildfires that threaten human life or property (91 percent and 82 percent, respectively) should be put out. Likewise, 73 percent of the respondents agreed or strongly agreed that saving homes during a wildfire should be a priority. We also asked respondents about some of the obstacles to taking action to reduce wildfire risk on their property. Few of the Fourmile respondents agreed or strongly agreed that time (5 percent) or money (13 percent) were obstacles to implementing mitigation measures.

The Known Risk of Property Damage

We asked respondents about factors they believed contributed to the chances of a wildfire damaging their property within 5 years (from 2007 to 2012). Respondents believed that fire ignitions in the form of weather-related natural starts (51 percent) and human activity (39 percent) were major contributors to the chances of a wildfire damaging their property within the following 5 years. Respondents also believed the con-

dition of surrounding properties, including vegetation on nearby national forest or national park land (28 percent), vegetation on neighbors' properties (23 percent), and vegetation on other nearby public land (19 percent) were major contributors to the likelihood of wildfire directly affecting their property. Interestingly, only 20 percent believed the vegetation on their own property was a major contributor and even fewer (9 percent) believed that the physical characteristics of their house or other buildings (e.g., roofing or siding materials) were major contributors to the chances of wildfire damage to their property within 5 years.

We also asked respondents to assess the likelihood of certain fire scenarios. Interestingly, while 41 percent of respondents acknowledged that it was not likely that they would be able to put a fire out themselves if it were to occur on their property, a full 52 percent felt that it was likely or very likely that the fire department would save their home. Indeed, only 28 percent thought it was likely or very likely that a wildfire would destroy their homes.

Despite the fact that so few thought it was likely that fire would destroy their homes, 69 percent thought it was likely or very likely that the landscape around them would burn. On the other hand, many acknowledged that it was likely or very likely that there would be some smoke damage (63 percent) or physical damage (51 percent) to their home if there was a wildfire on their property.

Taking Action

There are many measures that a homeowner can take to mitigate the risk of wildfire, from thinning vegetation to installing a fire-resistant roof. Based on Firewise recommendations and consultation with county wildfire specialists, we included a list of 12 wildfire risk-reducing actions in the survey (table 3). We asked respondents to indicate which mitigation actions they had undertaken on their property. Only 4 percent of the survey respondents reported not taking any of the listed actions. Therefore, it appears that wildfire risk mitigation is a matter of degree rather than an all-or-nothing course of action.

Table 1—Distribution of response to the question: “How concerned are you about wildfire damaging or affecting the items listed below?” The letter *n* indicates the number of respondents to each question.

| Affected Items | Responses | | | | | Average Rating |
|--|------------------------|-----|-----|-----|-----------------------|----------------|
| | 1=Not at all concerned | | | | 5=Extremely concerned | |
| Your house or other buildings on your property (n = 126) | 4% | 13% | 38% | 23% | 22% | 3.47 |
| Your property/landscape (n = 126) | 7% | 14% | 33% | 23% | 23% | 3.42 |
| Public lands near your home (n = 126) | 11% | 16% | 31% | 19% | 23% | 3.27 |
| Your health or your family's health (n = 126) | 24% | 21% | 26% | 14% | 15% | 2.76 |
| Local water sources (n = 125) | 24% | 22% | 33% | 11% | 10% | 2.62 |
| Your pets and/or livestock (n = 125) | 44% | 18% | 12% | 12% | 14% | 2.33 |
| Your ability to earn income (n = 124) | 56% | 18% | 13% | 7% | 6% | 1.89 |

Table 2—Distribution of response to wildfire statements. The letter *n* indicates the number of respondents to each question. Due to rounding, totals may not add to 100 percent.

| Statements | Responses | | | | | Average Rating |
|---|------------------|---------|-----------|------------|---------------------|----------------|
| | 1=Strongly Agree | 2=Agree | 3=Neutral | 4=Disagree | 5=Strongly Disagree | |
| You do not need to act to reduce the risk of loss due to wildfire because you have insurance. (n = 121) | 2% | 2% | 6% | 35% | 56% | 4.42 |
| You don't take action to reduce the risk of loss due to wildfire because, if a wildfire reaches your property, firefighters will protect your home. (n = 121) | 0% | 1% | 9% | 39% | 51% | 4.40 |
| You do not need to take action to reduce the risk of loss due to wildfire because the risk is not that great. (n = 123) | 2% | 5% | 8% | 29% | 55% | 4.30 |
| Your property is not at risk of wildfire. (n = 122) | 1% | 7% | 6% | 38% | 48% | 4.27 |
| You live here for the trees and will not remove any of them to reduce fire risk. (n = 123) | 1% | 3% | 8% | 49% | 39% | 4.22 |
| Managing the wildfire danger is a government responsibility, not yours. (n = 122) | 1% | 0% | 15% | 46% | 38% | 4.21 |
| Actions to reduce the risk of loss due to wildfire are not effective. (n = 121) | 1% | 2% | 13% | 46% | 38% | 4.19 |
| You don't take action because adjacent properties are not treated, leaving your actions ineffective (n = 122) | 1% | 4% | 12% | 41% | 42% | 4.19 |
| You do not have the time to implement wildfire risk reduction actions. (n = 123) | 1% | 4% | 17% | 44% | 34% | 4.07 |
| A wildfire is unlikely to happen within the time period you expect to live here. (n = 123) | 0% | 10% | 18% | 37% | 36% | 3.98 |
| You do not have the money for wildfire risk reduction actions. (n = 122) | 3% | 10% | 21% | 40% | 25% | 3.75 |
| With proper technology, we can control most wildfires after they have started. (n = 122) | 2% | 24% | 29% | 36% | 10% | 3.29 |
| Naturally occurring wildfire is not the problem; people who choose to live in fire-prone areas are the problem. (n = 121) | 6% | 19% | 31% | 29% | 15% | 3.28 |
| During a wildfire, saving homes should be a priority over saving forests. (n = 124) | 38% | 35% | 18% | 7% | 2% | 2.01 |
| Wildfires that threaten property should be put out. (n = 124) | 39% | 43% | 14% | 2% | 2% | 1.86 |
| Wildfires are a natural part of the balance of a healthy forest/ecosystem. (n = 122) | 44% | 45% | 10% | 1% | 0% | 1.67 |
| Wildfires that threaten human life should be put out. (n = 124) | 59% | 32% | 5% | 2% | 2% | 1.56 |

On average, Fourmile respondents implemented more mitigation measures (6.52) relative to the other Boulder County survey respondents (6.02), though the difference is not statistically significant. Within the 30-foot (9-meter) perimeter of the home, 72 percent of the survey respondents had removed dead or overhanging branches, the most frequently reported mitigation activity by Fourmile respondents. Installing fire-resistant siding and screening over roof vents were the two activities with the lowest reported frequencies.

Wildfire Risk Information Source

Outreach and education efforts are often key strategies to increase awareness and implementation of

wildfire risk reduction measures. However, when we asked Fourmile respondents to rate how strongly they considered five different factors in decisions to take action to reduce wildfire risk (1 = “not a consideration” to 5 = “strong consideration”), “lack of specific information about how to reduce risk” was the factor with the lowest average rating.

We asked respondents about two dimensions of wildfire risk information: sources of information and confidence in the accuracy of the information source. Interestingly, the local fire department was the most frequently reported source of information about wildfire risk (68 percent), and it was the informa-

tion source with the highest rating with respect to the confidence in the accuracy of the information. The second-most commonly reported information source was the media (43 percent). However, survey respondents did not express much confidence in the accuracy of information about wildfire risk provided by the media. Thirty-five percent of respondents reported neighborhood groups as an information source and respondents generally considered the groups to provide accurate information. Neighbors, friends, or family members were one of the more frequently reported information sources (39 percent), and respondents expressed a level of confidence in the accuracy of information similar to that provided by neighborhood groups.

Table 3—Percentage of Fourmile respondents that completed each wildfire risk mitigation action, based on 127 respondents.

| Mitigation Actions | Rate |
|--|------|
| In the 30-foot (9-m) perimeter of home or other structures: | |
| Removed dead or overhanging branches | 72% |
| Pruned limbs so the lowest is 6–10 feet (2–3 m) from the ground | 44% |
| Thinned trees and shrubs | 63% |
| In the 30–100-foot (9–30 m) zone: | |
| Removed dead or overhanging branches | 47% |
| Pruned limbs so that the lowest is 6–10 feet (2–3 m) from the ground | 44% |
| Thinned trees and shrubs | 44% |
| Maintenance fuel reduction actions: | |
| Mowed grasses | 68% |
| Cleared leaves and pine needs from roof and/or yard | 66% |
| Structural measures: | |
| Installed fire resistant roof | 61% |
| Installed fire resistant siding | 26% |
| Installed screening over roof vents | 29% |
| Installed clearly visible house number on house | 72% |

After the local fire department, the Colorado State Forest Service, USDA Forest Service, and Boulder County wildfire specialists received the highest ratings in terms of confidence in the accuracy of information provided; however, many fewer respondents reported having received information from these sources. Thirty-five percent of the Fourmile respondents received information from their county fire specialist about reducing wildfire risk, 32 percent received information from the Colorado State Forest Service, and 20 percent received information from the USDA Forest Service.

Conclusions

The survey results described in this article provide insight into the population within the Fourmile Fire evacuation zone before the events of September 2010. Clearly, word had gotten out among Fourmile respondents about wildfire risk, as most of the survey respondents in this area knew about the risk



Firefighters talk with a homeowner 5 days after the start of the Fourmile Canyon Fire. Their crew spent a good portion of their day talking with homeowners returning after evacuation, while continuing to monitor winds and watch fire movement to make sure homes were not threatened. Photo: Helen Richardson, The Denver Post.

when they made the decision to purchase a home in a high fire-risk area. Likewise, survey respondents expressed a fairly high level of concern that a wildfire would damage their home, landscape, and surrounding public lands. Most survey respondents also seemed to realize that a wildfire was likely within the time period they expect to live at their current residence. However, concern and awareness about wild-

fire risk do not necessarily translate directly into taking action. While very few respondents had done nothing to mitigate the risk of wildfire on their property, there appears to be plenty of room for improving mitigation rates.

References

Bounds, A.; Snider, L. 2010. At \$217M in damage, Fourmile Fire most expensive in Colorado history. Boulder Daily Camera (Boulder, CO). September 20.

Headwaters Economics. 2007. Available at: <<http://www.headwaterseconomics.org/wildfire/co.php>> (accessed 4 November 2010).

Miller, V. 2010. Map shows Fourmile Fire did most damage within hours. Boulder Daily Camera (Boulder, CO). October 12.

Udall, M. 2010. Mark Udall Newsletter Update: Fourmile Canyon and Loveland Fires. Available at: <<http://mark.udall.senate.gov>> (accessed 15 September 2010). ■