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Firewise Landscaping: Homeowner Knowledge, Behaviors and Educational Preferences

Kendal Beauvais, Rowan Grassi, Frederick Gleasman

Undergraduate Capstone Report

2023

Abstract

Although wildfire is a natural process in fire-adapted forests, it poses growing socioeconomic and health threats. Urban development and expansion into the wildland-urban interface (WUI) has heightened wildfire exposure, putting tens of thousands of homes at risk in Montana alone. The Firewise USA program was created to reduce the risk of home ignition and loss in the WUI. The program encourages WUI homeowners to engage in mitigation efforts such as using Firewise landscaping strategies to create a defensible zone around their homes and using building materials that decrease overall ignition risk. Despite strong evidence that Firewise mitigation strategies are effective, there is a lack of knowledge about the best methods for educating homeowners about Firewise strategies and the factors preventing homeowner adoption of Firewise behaviors. We assessed homeowners' interest in opportunities to learn about Firewise landscaping and their knowledge and usage of Firewise strategies through a social survey administered to neighborhood council leaders located in the WUI in Missoula, Montana. All defensible space activities had an average perception of being either moderately or extremely effective by respondents. Respondents' two most commonly done defensible space activities were cleaning roof surfaces or gutters at 79%, and removing dead limbs, leaves, or other debris within 100 feet of the residence at 76% of total responses. The most preferred method of education was information distribution via email at 24% of total selections, followed by tours of the Firewise garden at the University of Montana (22%) and educational programs or videos (20%). Our findings can contribute to the development of Firewise education and awareness programs in Missoula County.

Introduction

Wildfire encroachment into urban areas is a costly threat that is becoming more common as development expands into wildland settings (Caton et al., 2016; Theobald & Romme, 2007). At the same time, past fire suppression, current warming of the climate, and extended dry seasons have increased wildfire vulnerability in the West (Schoennagel et al., 2017; Westerling et al., 2006). Although wildfire is a natural ecological process in many fire adapted-forests (Covington & Moore, 1994; Merriam et al., 2022), the economic and cultural threat to losing homes or whole communities is becoming a growing concern in areas where homes are bordering wildland environments, also known as Wildland-Urban Interface (WUI) locations.

In recent years wildfires have increased significantly both in burn area and frequency across many ecoregions, particularly in the Western US (Dennison et al., 2014). Along with this, in recent years the amount of homes in WUI communities have been growing rapidly. For instance, from 1990 to 2010, WUI communities in the United States grew by 33%, with an increase of 12.7 million homes (Radeloff et al., 2018). The combination of an increased

number of homes in the WUI and number of wildfires has led to a large number of homes with high risk of ignition. In Montana alone 120,000 homes are at moderate to high fire risk (Barrett, 2022). Despite common perception, home ignitions in wildfire events are generally not due to direct contact with the flame front, but rather embers that are blown through the air and come into contact with flammable material on or close to the home (Maranghides & Mell, 2010).

In an attempt to reduce the impact of wildfires on residents in the WUI, a program called Firewise USA was created by the National Firewise Protection Agency (NFPA) to provide “a collaborative framework to help neighbors in a geographic area get organized, find direction, and take action to increase the ignition resistance of their homes and community and to reduce wildfire risks at the local level” (Firewise USA, 2022). Despite the clear importance and benefit of having homeowners implement Firewise strategies, there is little information about the most effective methods to educate the public about them, as well about homeowners’ current level of knowledge and or use of Firewise behaviors. Limiting ignition from ember contact is one of the best approaches to protect one’s home and is a central goal of Firewise landscaping. Firewise landscaping strategies include breaking the 100 foot area surrounding the home into three zones with different approaches and goals employed within the different zones (Firewise USA, 2022). Overall, the suggested practices aim to clear space for firefighting access and remove any high-ignition-risk materials within direct proximity of the home.

The first zone, also known as the Immediate Zone, lies within the first five feet surrounding the home. To protect the home in this zone, it is recommended that homeowners conduct home maintenance including clearing gutters, changing building materials (e.g., using a nonflammable roof), planting fire-resistant plant species, and moving any fuel and firewood away from the home. The Firewise garden in Missoula places an emphasis on using native fire-resistant species, although alternatives include keeping a well-watered lawn or other vegetation. The second zone falls in the area of 5-30 feet surrounding the house. Practices in this area focuses on thinning vegetation and minimizes the risk of the house igniting if part of the property does. Actions recommended in this area include removing ladder fuels, planting fire-resistant species, and clearing debris piles. The final zone is located from 30-100 feet surrounding the home. The goal of this zone is to lessen the spread of fire across the property and provide easy access for emergency personnel. All these actions reduce ember exposure and increase resistance, therefore reducing the likelihood of home ignition during a nearby wildfire.

In order to develop effective fire-risk mitigation programs for homeowners, it is important to know which Firewise behaviors homeowners perform, and to what degree. In one Colorado study, most homeowners surveyed (50%-80%) activities in zones 1 and 2, such as mowing tall grass, cleaning out gutters, and thinning undergrowth close to the house (Absher et al, 2013). The average number of defensible activities homeowners completed was 6.22 out of 13 activities surveyed. In an Idaho study, similar activities received between 45% and 90% participation, and the average homeowner completed 5.5 activities out of the 13 surveyed (Paveglio & Kelly, 2018). Other surveys concur that the behaviors that homeowners are most likely to perform are low cost and low effort (Brenkert-Smith et al., 2012; Ergibi & Hessel, 2020; Bright & Burtz, 2006). However, studies have also revealed that residents view their activities as more effective than wildfire professionals do, and that they do not accurately characterize factors that affect key fire-risk on their properties like driveway width and tree density (Meldrum et al., 2015). Furthermore, some homeowners are completely unaware of fire risk or that they live in a fire prone area (Olsen et al., 2017; Champ et al., 2009). Additional complications can arise when residents are aware of Firewise, but

unwilling to implement certain behaviors, either due to aesthetic choices, a perceived lack of impact, or barriers like cost (Paveglio & Kelly, 2018).

Although the type and number of Firewise actions are relatively consistent when performed, whether or not homeowners know about Firewise is more variable. One Canadian study revealed that 77% of respondents had not heard of their local Firewise program (Ergibi & Hesseln, 2020). Conversely, 75% of respondents in a Colorado study were moderately to extremely familiar with Firewise knowledge (Absher et al., 2013). By finding the gaps in what residents do and know, educators can better tune their outreach strategies. As the Missoula WUI is fire-prone, it is also of interest to know how effective residents view their preventative measures to be.

Promoting use of firewise strategies is complicated, in part because actions vary even within communities by demographic groups. Previous studies have revealed that income influences homeowner behaviors around fire-risk mitigation. For instance, people with incomes under \$50,000 are more likely to remove debris from around their properties, while those with incomes over \$75,000 are more likely to renovate their homes by installing flame resistant siding, decking, and roofing (Absher et al., 2013). Other demographic factors, such as age, may impact which activities a homeowner will perform or the types of information they have been exposed to (Olsen et al., 2017). Whether or not a resident is full time or seasonal has been demonstrated to influence mitigation behavior, as seasonal residents may have lower familiarity with wildfires and less time to engage in Firewise behaviors (Bright et al., 2006; Wolters et al., 2017; Paveglio & Kelly, 2018). There is also evidence that long-term property owners are more experienced with Firewise behaviors, as they would have more awareness of the threat that wildfires can pose. (Olsen et al., 2017). Additionally, whether or not the homeowner has experienced a local fire event (a wildfire, evacuation, or prescribed burn) may affect how knowledgeable they are and what actions they take (Wolters et al., 2017).

While there is evidence that different demographic groups vary in their adoption of Firewise approaches, there is little information about the extent to which approaches to Firewise education may need to vary by demographic group. Individual experiences and beliefs influence people's actions and interpretation of information. Thus, to effectively reach people within WUI neighborhoods, there is a need to understand educational preferences and develop approaches which recognize diversity. Delivery of information influences learner motivation (Klein, Noe, & Wang, 2006) and thus, when a demographic group is provided information in a way that is not received well, they are unmotivated to put it into practice. When unmotivated, it is unlikely that the audience will consume the material or make use of information provided. For this reason, the correct mode of educational outreach needs to be known or later efforts could serve only as a waste of resources. In addition, there is evidence that message clarity was an important factor influencing behavior change (Bright et al., 2006). Providing information in the desired format can enhance message clarity by limiting perceived simple distractions or annoyances. Thus, the removal of distractions facilitates a clearer message lending itself to behavioral change. Ultimately, understanding the mode of education each demographic group in the community prefers increases the likelihood of action and helps with strategic resource allocation.

The science behind Firewise has been thoroughly researched, but the primary reason it is not common practice among those who need it most is due to a lack of instruction (Brenkert-Smith et al., 2012). But as wildfires become an ever-greater threat to those living in the WUI, the need to educate at-risk communities greatly outstrips the amount of research evaluating the best approaches. Most studies appear to be focused on current behaviors and general perceptions instead of determining the most effective ways to educate people.

Additionally, research seems to be site specific and sparse, reducing the applicability of past studies to western Montana. It is for these reasons we aim to gain a better understanding of homeowner knowledge, behaviors, and educational preferences in Montana to help guide future outreach and provide better instruction. We aim to fill the gap in the literature that is how to effectively reach and educate said communities. We intend on asking these questions:

- To what extent do residents feel that implementing Firewise behaviors is effective at reducing fire risk to their homes?
- Which Firewise behaviors do residents already implement?
- To what extent are homeowners already aware of what Firewise landscaping is?
- What Firewise educational activities are preferred by residents of WUI neighborhoods in Missoula County?

By improving our understanding of human dimensions here in Missoula, new techniques for outreach can be developed in communities of concern. Our research seeks to contribute the Firewise literature by creating a social toolkit highly tuned for Missoulians within WUI neighborhoods. In the future, other researchers or local governments can apply our data to better inform their communities on how to become more Firewise.

Methods

Survey Development

A survey was conducted to gauge homeowner knowledge and preferences around Firewise defensible space activities. As this study is using human subjects, approval was obtained from the University of Montana's Institutional Review Board (Appendix 2). Formatting was done on Qualtrics, a web-based survey tool to conduct survey research, evaluations, and other data collection activities, and questions were structured in reference to Absher et al 2013, Bright & Burtz 2006. To limit survey fatigue we opted to have a shortened length and the survey consisted of 18 questions in total. Survey completion time was less than 20 minutes.

Survey questions (Appendix 1) focused on knowledge and use of Firewise strategies and perceived effectiveness of Firewise actions. Questions addressed which landscaping strategies homeowners implement, how effective they see them as, and if they will implement them in the future. Survey questions also asked about preference for different educational programs. Responses included the Firewise Demonstration Garden, local events (events held at the garden, classes, community days, etc), through electronic communication (including emailed newsletters and website accessibility), social media specific outreach in the form of accounts or posts, and pamphlets attainable through the mail or at local hardware/landscaping stores. Homeowners were given the option to choose no interest in education. Along with questions relevant to these focuses, demographics including age, income level, education, residence status, and previous experience of a fire event were collected. The demographic questions were placed at the end of the survey to limit possible discomfort preventing responses regarding these questions. Expert consultation on survey format and phrasing was sought from Janet Stevens, a University of Montana social scientist.

Survey Distribution

Distribution was done via email through the help of Kalina Pritchard, our point of contact for the Missoula City Neighborhood Councils. The Missoula County Office of Emergency Management provided point of contact information, along with a list of WUI neighborhoods. The survey was sent to 144 members of the neighborhood leadership councils

in Missoula, and we received 149 responses. To separate out those in the non-WUI neighborhood from those in the WUI designated neighborhoods, zip code was asked. The survey was collected anonymously, participation was voluntary, and questions had the option to be skipped. Before release of the survey, format on both mobile devices and computers was tested to ensure limited user error and accessibility issues. After two and a half weeks the survey was closed.

Data Analysis

Data analysis was performed with input and assistance in the Statistical Package for the Social Sciences (SPSS) from John Baldrige, part of the Bureau of Business and Economic Research at the University of Montana. The data was extracted directly from Qualtrics into a SPSS file, then evaluated for spam responses and any survey issues. Using descriptive analysis in SPSS, responses were compared based on demographics, frequencies of each response were found, and average linear trend was observed. Due to the nature of distribution, nonresponse was unable to be calculated. Percentages of each response were calculated out of the total number of responses.

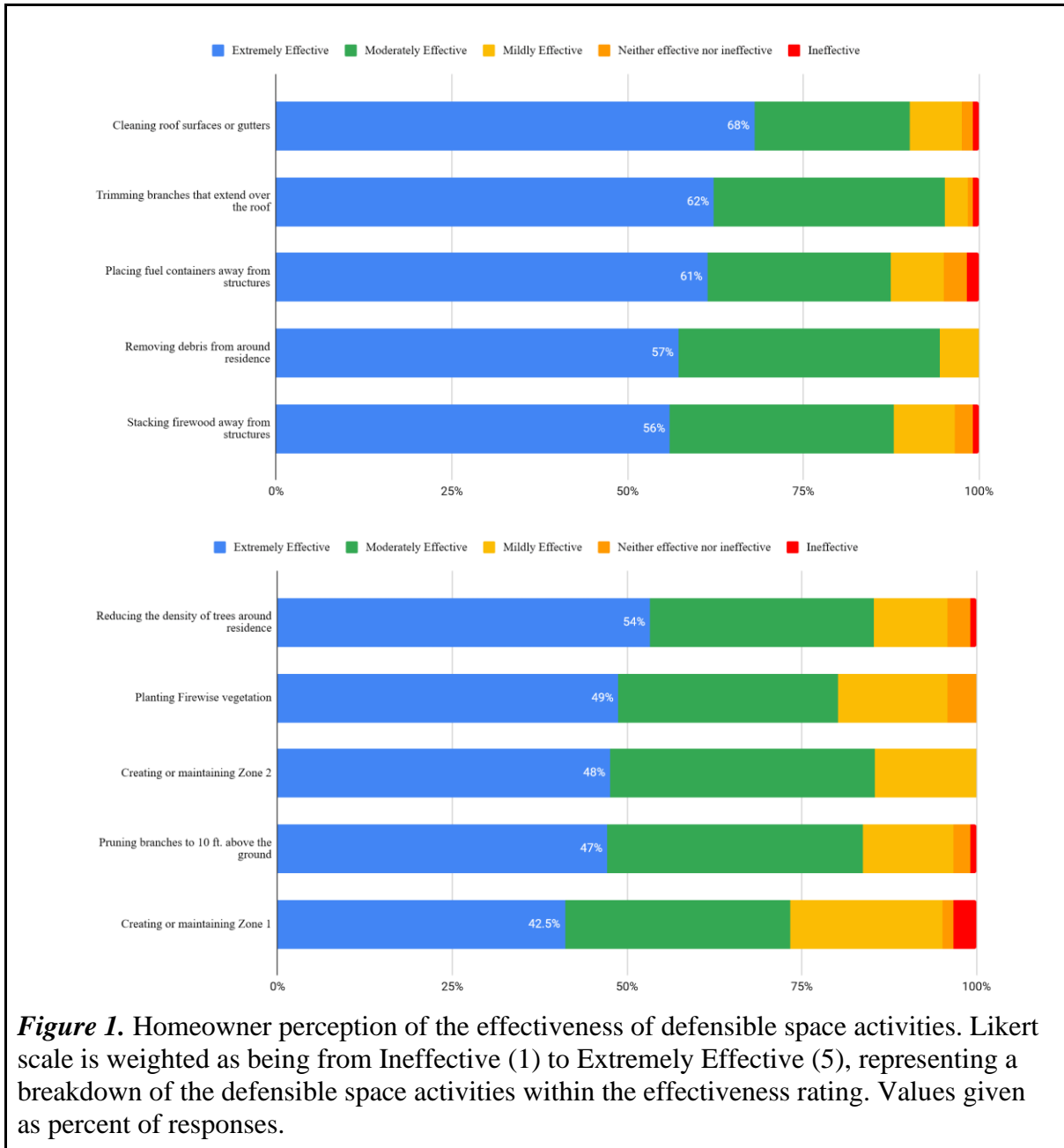
Results

Demographic Reporting

The demographics of our respondents were not normally distributed. The ages of respondents ranged from 22 to 90 years old, with a mean of 60 years old. Household income of 25% of our sample group was reported to be \$100,000-\$149,999. An additional 19% of respondents reported a household income of \$75,000-\$99,999. It should also be stated that 85% of respondents reported making \$50,000 or more yearly in their household. Regarding education, 88% of respondents had a bachelor's degree or higher. An additional 8.9% of respondents had alternatively received an associate's or gone to a trade or technical school. Out of the 122 respondents that chose to provide a zip code, the most commonly stated was 59801. This zip code received one third of total selections and given that the rest of the reported zip codes fall in the WUI, it is indicated that two-thirds of the respondents were in WUI neighborhoods.

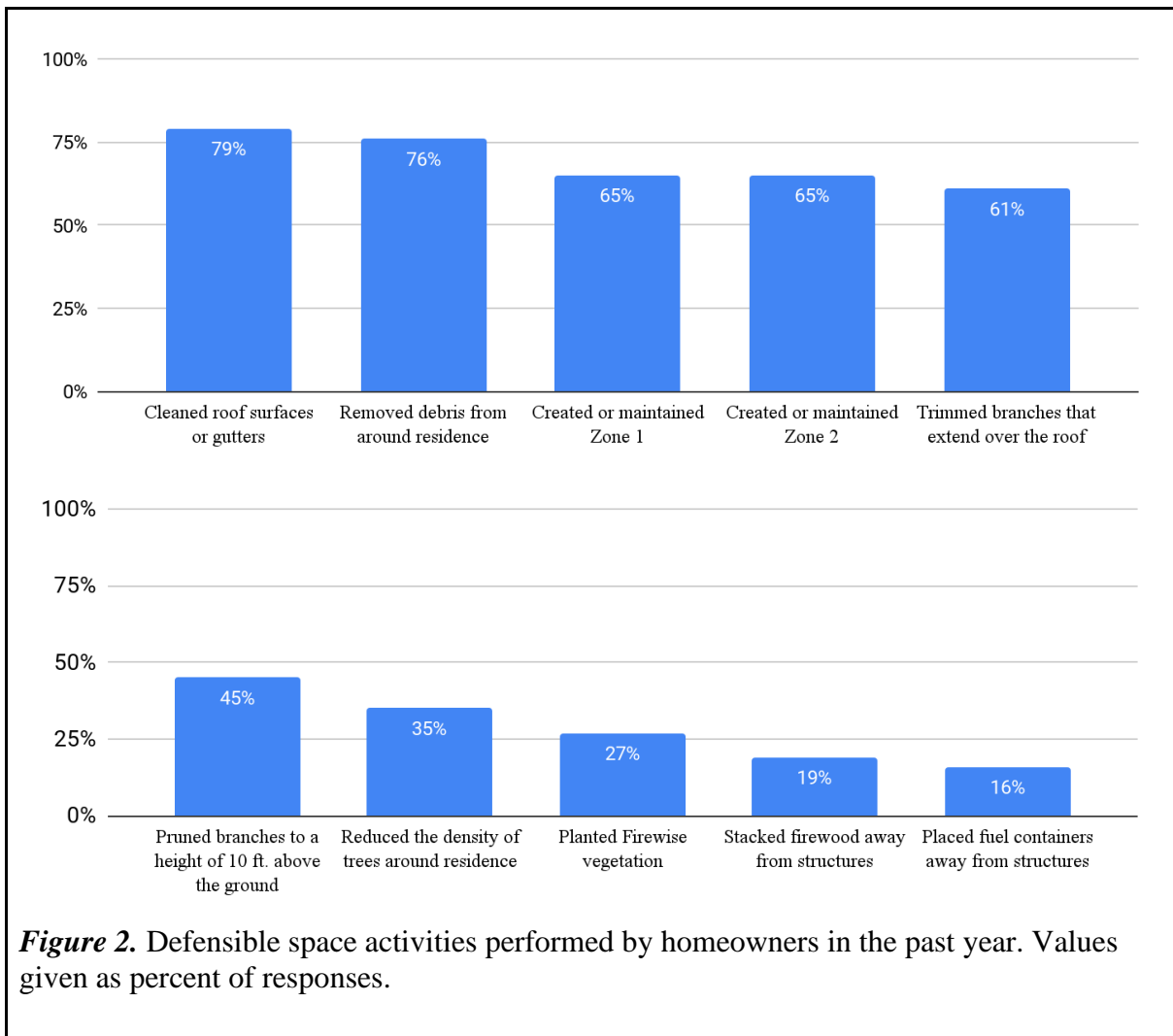
Perceptions

The views homeowners had on the effectiveness of defensible space activities varied, but trended toward "effective". The activity most commonly perceived as ineffective was creating or maintaining a 0-5 foot area of rocks or small, low vegetation within 5 feet of their home, with only 36.4% of responses choosing the ineffective rating for an activity (Figure 1). The next activity that was most commonly perceived as ineffective was placing fuel containers at least 30 feet from and uphill of all structures, which was deemed ineffective by 18.2% of respondents. Within the moderately effective and extremely effective ratings, all activities were within 5% of one another. Under a rating of neither effective nor ineffective, planting appropriate, fire-resistant (Firewise) vegetation around the residence was the most selected at 20.8%. The total count of responses for each activity fell between 116 to 124. Furthermore, with these counts the mean Likert rating for every activity was 4 or greater, placing the mean effectiveness of each activity as being "somewhat" to "extremely effective." When comparing ratings of activities that took place in each defensible zone, activities in zone 2 had 2.5% greater "extremely effective" rating compared to zone 1. Zone 1 also was evaluated to have much more "ineffective" selections by homeowners in comparison to zone 2 (Figure 1).



Current Implementation, Barriers, and Incentives

The defensible space activities used by homeowners in the last year varied by activity. Cleaning roof surfaces and gutters and removing debris within 100 feet of their residence were the two highest reported defensible space activities with ~79% of responses each (Figure 2). Activities relating to creating and maintaining the three zones around a structure ranged from 35% to 65%. Placing fuel and stacking firewood uphill of structures were the least performed activity in the last year, with each response being under 20%.



The largest barriers to implementing firewise behavior were reported as cost and inability to do the work. Similarly, financial methods were the highest motivators reported. This is in accord with which Firewise activities were most implemented, as the most commonly implemented activities were either no-cost or inexpensive (Figure 3). Other common barriers included aesthetic impacts, a lack of knowledge, and a lack of vegetation. The most common “other” response was that the respondent lived in an urban area, and therefore either was not in the WUI or did not have property that needed landscaping. Though only under 5% of respondents said that HOA or other regulations were a barrier, it is important to consider that local laws and regulations impact what individuals do and what they perceive can be done on their properties.

Homeowners most notably selected cost assistance and monetary incentives as the action that would encourage them to implement defensible space activities (Figure 4). At 35.6% money related choices were highest for selection, but other areas including assistance in implementation (18.2%) and one-on-one educational consult (13.0%) followed as other areas of likely incentivization.

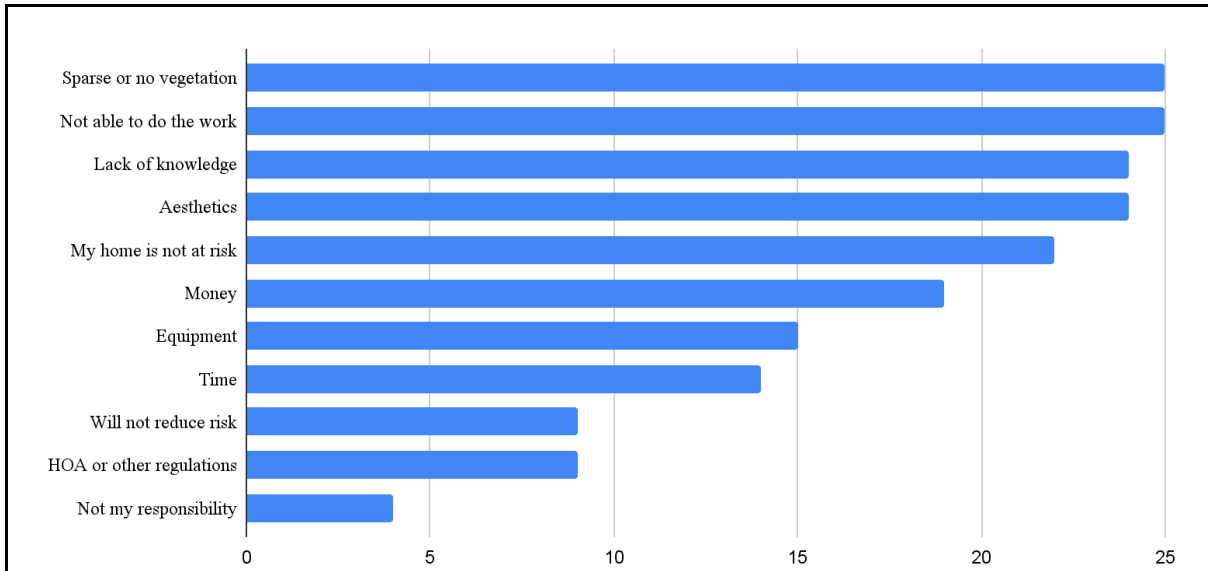


Figure 3. Barriers to implementing Firewise Activities. Values given as number of responses.

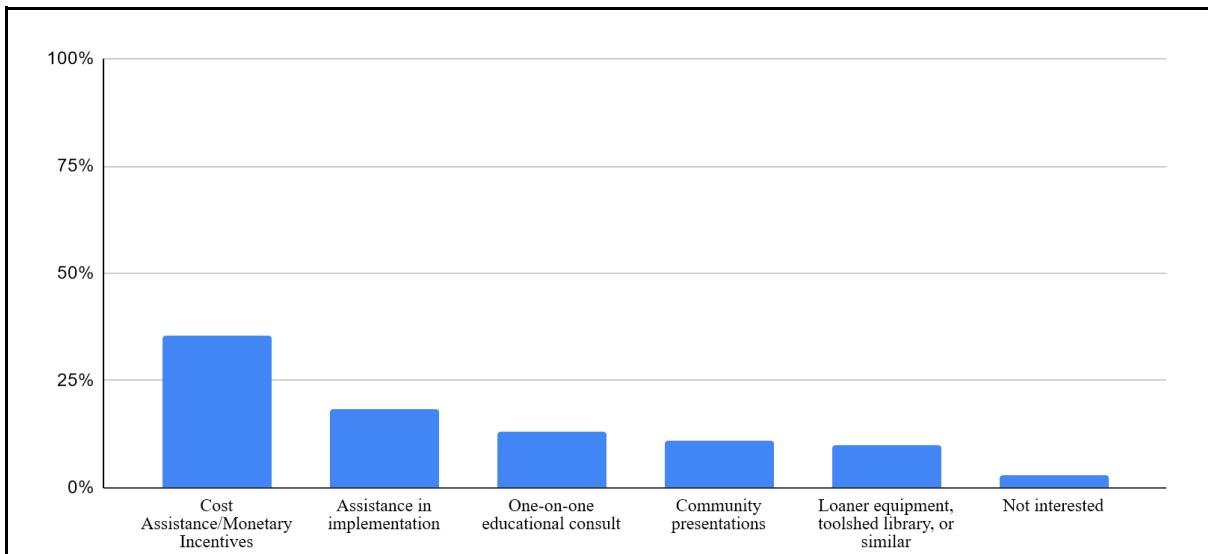
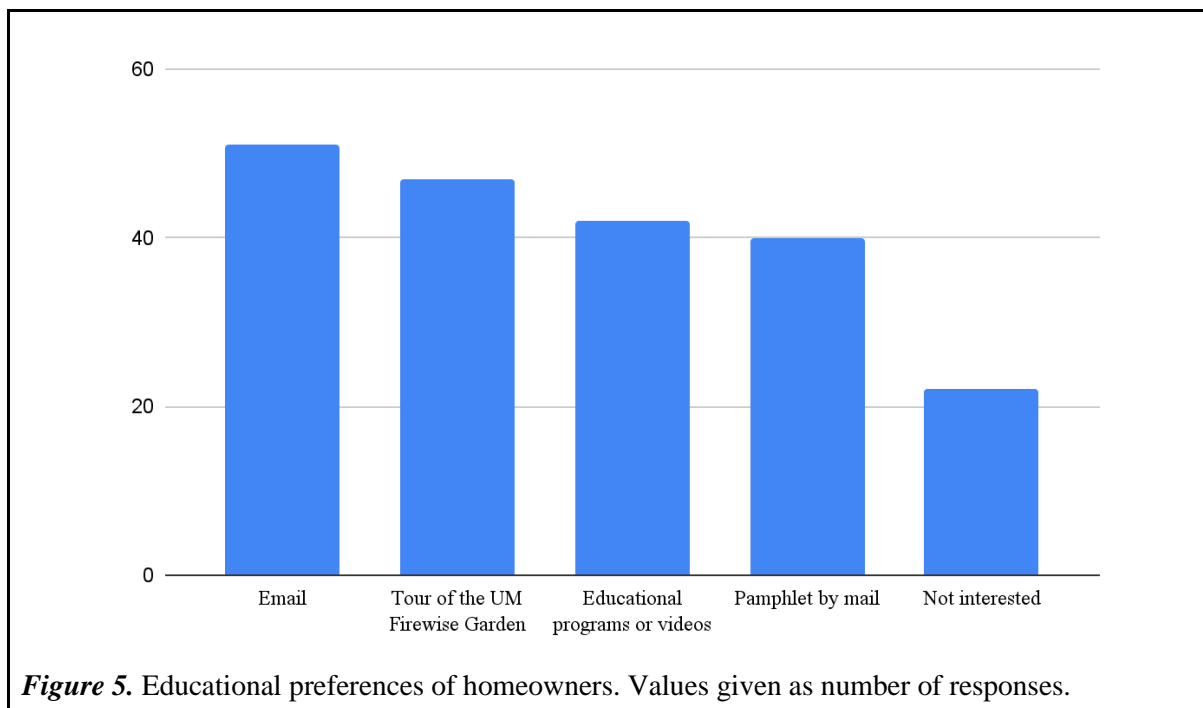


Figure 4. Actions that would encourage homeowners to implement defensible activities on their properties. Values given as percent of responses.

Educational Preferences

When polled, the vast majority ($\approx 90\%$) of respondents expressed an interest in expanding their Firewise knowledge, while 10.4% sought no additional information (Figure 5). A quarter of respondents wished to receive further education by receiving informative emails. About 19% requested a physical medium, pamphlets. Roughly 20% wished to receive a more traditional class on the subject either in person or remote. A surprising 22% wished for a tour of the University’s Firewise garden. The remaining 4.2% of preferred means of education were in the form of adding to the University lecture series, newspaper outreach, professional consultations, HOA distributions, tours of Firewise communities (not the garden), and lastly images that contrast the before and after of homes protected by Firewise strategies.



Discussion

Study Limitations

Due to time and distribution limitations, non-response bias could not be determined. This leaves potential for the our sample to be underrepresented or skewed without confirmation to the extent individuals were choosing not to respond. That being said, the most impactful limitation is that the survey reached an audience with a higher average income and education compared to the Missoula average. Of respondents that reported income, 25% indicated having a household income of \$100k-\$150k and 19% of respondents reported an income of \$75k-\$100k. This is much higher in comparison to the city average of \$43,600 for households and \$22,900 for individuals. Additionally, we found that 28.5% of respondents had a master's degree, and ~24% had a doctorate or other professional degree. Only ~11% of city residents have a doctorate or other professional degree. While this does create a biased response, it is important to consider that respondents are neighborhood council leaders and are therefore important and influential to the rest of the community.

Of the Missoula residents polled, over three quarters clean their roof surfaces and gutters, and remove debris within 100 feet of their residence. They find these measures highly effective in combating home ignition. Another 65% clear the immediate vicinity around their residence (0-5 ft) free of flammable material only possessing rocks or small vegetation, but surprisingly this was ranked highest amongst their perceived ineffective methods. This is likely a result of the ease and low cost of these activities compared to the more extensive defense practices, despite expecting less of an impact on protecting their home when compared to the alternatives. Furthermore, many seemingly crucial strategies for preventing extreme structural and bodily harm such as placing gasoline over 30 feet away from one's house was the lowest action attested to. We question if this is due to a smaller population having fuel on their property in general, a lack of space to do so or do so securely, or a lack of knowledge. However, this displays some shortsightedness in the minds of those in the WUI or a lack of understanding about which of the Firewise activities are likely to be more effective in protecting their home.

This being said, there is a strong desire for further Firewise education among the majority of survey respondents, especially by having literature sent to them either by email, videos, or more traditional pamphlets. An interesting aspect to note is the clear interest in educational programs and in-person tours of the Firewise Garden at the University of Montana, a physical embodiment of the purpose and reason behind planting firewise plants. Even more interestingly, the planting of firewise vegetation was the defensible space activity more frequently seen as ineffective than most of the others listed. This reflects a likely gap in access and knowledge of what the Firewise garden is, but presents a great opportunity for outreach and education in order to add a new defensible strategy to homeowner toolkits, particularly among neighborhood council leaders. Additional comments from respondents revealed additional educational methods, including the creation of a University lecture series, newspaper outreach, professional consultations, information distribution through HOAs, tours of Firewise communities (not the garden), and images that contrast the before and after of homes protected by Firewise strategies.

Most studies report a gap between the amount of people who live in WUI neighborhoods and the number who believe they do. Our results show a similar trend. Only 60% of respondents (n= 89) believed they lived in a WUI neighborhood. Although 40 of the respondents that said they do not believe they live in a WUI neighborhood were correct and are located in the one neighborhood of Missoula not considered a WUI location, the remaining 49 respondents in this category likely misperceived the nature of their neighborhoods. The large number of folks in a WUI location who do not realize it is likely due to misconceptions of what a WUI neighborhood looks like. Many people commonly think that if an area is urbanized it cannot be in this interface, but that is inaccurate. This is particularly interesting when also looking at the number of respondents that have had some form of impact due to wildfire. Out of 202 selections (respondents could select more than one impact) there were 88 respondents that had experienced, or had a loved one experience a fire-related evacuation, property damage, or injury. For 40% of respondents selecting that they do not live in a WUI neighborhood or are unsure if they do, it was unexpected to see so many select that they had such close knowledge of fire. It should be noted that some of these selections likely included the experiences of loved ones that do not live in the same residence, but we would have expected that this would make respondents likely to be more aware of their neighborhood status.

Though past research often finds that those who were personally impacted or had loved ones impacted by a wildfire were more likely to be aware of what Firewise landscaping is. Our results show less of a clear pattern. The most commonly chosen response to experience with a wildfire was that 56% of our respondents had only experienced discomfort from the smoke of a wildfire. Second to that, 31% of respondents had experienced a prescribed/controlled burn within ten miles of their residence. Thus, the majority of our respondents were far from experiencing the direct threat of wildfire to their homes or that of a loved one, yet 76.5% of them had heard of Firewise landscaping. It is encouraging to see that such a large percentage of Missoula homeowners have some knowledge of this collection of defensible space activities. Part of this difference between our study and previous ones may be attributed to the fact that the respondents were neighborhood council leads, or that exposure to prescribed burning is so common here, a factor that was not commonly evaluated in other literature. Although this surprising result still leaves an estimated quarter of homeowners not knowledgeable of what Firewise landscaping is, our new found preferred ways of education may be able to help close the gap.

Future Implications

Our findings reflect the understanding of an older, educated, and wealthier demographic who are aware of Firewise practices; however, even among those with highest likelihood to implement Firewise behaviors, most still fall short of taking some of the most important steps like planting Firewise vegetation and creating the first 0-5 foot zone. Despite possible biases based on the demographics of our respondents, organizations like the Missoula County Office of Emergency Management along with other communities with similar demographics can gain a better understanding of their citizenry's Firewise knowledge and which educational methods they prefer. Future studies focusing on a broader and more representative of community members sample would further an overarching knowledge of homeowners in this topic, and could help create a framework that is more applicable across the United States. With this study, Missoula is one step closer to reaching our community and building a more resilient community in the face of wildfire.

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