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A Program Evaluation of the Town of Woodside, Plumas County Fire Safe Council, and Mountain Communities' Fire Safe Council Defensible Space Projects

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**A Program Evaluation of the Town of Woodside, Plumas County Fire Safe Council, and
Mountain Communities'
Fire Safe Council Defensible Space Projects**

By

Mandeep Gill

A Thesis Quality Research Project
Submitted in Partial Fulfillment of the
Requirements for the
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in

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Background

California is one of the most fire-prone regions in the world, with every passing year becoming more hazardous. With a tremendous amount of loss and damage occurring every year due to wildfires, property owners must prepare their homes and structures to withstand fires as much as possible. The best way to achieve this is by building and retrofitting homes with fire-resistant materials and creating defensible space around the property (Cal Fire, n.d.). Although it is the best way to protect one's property, it is often times difficult for property owners to do so because of financial or physical limitations, or because it is not the homeowner's priority.

The town of Woodside, Plumas County Fire Safe Council, and the Mountain Communities Fire Council received funding through the city budget and grants from Cal Fire, The Forest Service, and PG&E to assist residents in creating defensible space. The research examined the question, did the programs provided by the town of Woodside, Plumas County Fire Safe Council, and the Mountain Communities Fire Council achieve their goals, and what can be learned from them? To answer the question, information was collected about the mitigation programs in the California jurisdictions of Woodside, Plumas County and San Bernardino County's Mountain Rim communities. It examined the problem of fire damage mitigation in the WUI in these areas, described the implementation of these mitigation programs, collected data about their implementation as displayed in the Findings section, and evaluated the effectiveness of these programs based on the data as discussed in the Analysis section.

Recent Fire History in California

Wildfires in California are not a new phenomenon, they have been occurring since prehistoric times. In past years, fires have spread quickly due to poorly maintained electrical infrastructure, lightning storms, and human-caused fires. California's ecosystem is the reason for these fast-spreading fires. The state has "fire-happy" native shrubs and trees, strong winds, frequent

droughts, invasive grasses that encourage fires, climate change, and people living in rural regions of the state that are prone to fires (Borenstein, 2020).

Fires in the state are getting significantly worse with time, global warming being one of the most prominent causes of the trend. Since 1972 California has seen the burning of its lands increase by fivefold (Borenstein, 2020). In 1972 the five-year average of area burned was 236 square miles, in 2019 it increased to 1,394 square miles (Borenstein, 2020). In 2020 five of the ten largest fires occurred in California, and seventeen of the largest twenty since 2000 (Earth Observatory, 2020). The August Complex, the Dixie Fire, SCU Lightning Complex, and Creek Fire are all within the top five worst fires in the history of California, and all these fires occurred in 2020 and 2021 (Cal Fire, 2021). A total of 2.7 million acres burned across these four fires, 3,339 structures were damaged or destroyed, and 2 people lost their lives (Cal Fire, 2021).

Cal Fire and The California Fire Safe Councils

Cal Fire is responsible for protecting over 31 million acres of privately-owned wildlands in California and is required to serve all State Responsibility Areas (SRAs) and some Local Responsibility Areas (LRAs) for fire protection purposes. SRAs are regions that the state of California is responsible for financially in cases of wildfires, while LRAs are regions where local governments are responsible. While most LRAs have municipal fire service, some contract with CalFire for fire protection services. The Office of the State Fire Marshal (OSFM), which has been a part of the Cal Fire team since 1995, evaluates materials used for buildings against fire safety standards, and enforces laws that are fire-related for state-owned and operated buildings. While Cal Fire and OSFM have many other responsibilities, the purpose of this paper is to focus on those responsibilities that pertain to residential development in high fire risk regions in the state (Cal Fire, n.d.).

The California Fire Safe Council (CFSC) is a non-profit corporation that was formed by Cal Fire. The purpose of the CFSC when it was originally formed was to provide knowledge to residents about the dangers of wildfires and how best to mitigate them. Eventually, it evolved into a nonprofit that provides grants to assist with wildfire prevention. Some of the activities that the grants support include the creation of defensible space, education, and community fire resilience planning. Since its inception, there have been over 900 grants worth over \$100 million provided through CFSC (CFSC, n.d.).

Building in Fire Risk Regions in California

In 1992 Assembly Bill 337 was passed as a result of the 1991 Oakland Hills fire, which had caused 2,500 homes to be destroyed and \$2B in damages (Cal Fire, 2016). AB 337 required Cal Fire and local fire authorities to identify very high-risk fire hazard severity zones and wildland-urban interfaces (WUIs) (Cal Fire, 2016). When a structure is in a WUI area it means that it is in or next to regions that are prone to wildland fires (FEMA, n.d.). AB 337 led to new requirements for fire-resistant roofing materials on new construction, and defensible space clearances at a minimum of 30 feet around structures in the WUI (Cal Fire, 2016).

The 2013 California Building Code put forth requirements for structures in Fire Hazard Severity Zones (FHSZ) or WUI areas. Cal Fire and local agencies were tasked to map out the regions that are considered to be in WUIs and FHSZ. When new construction is occurring in one of these areas, or a 50% or greater damaged building is being repaired, it must be in compliance with the standards of the California Building Code to reduce ember related disaster. Ideally, this would lead to less destruction from wildfires (Cal Fire, 2016).

Cal Fire lists three ways in which losses from a fire can be mitigated in a WUI: 1) building construction methods that will reduce the chance of building ignition, 2) defensible space around the structure, and 3) identification of regions that will lead to disastrous losses (Cal

Fire, n.d.). Building construction requirements include non-combustible roofs, and fire-resistant designs for exterior walls, exterior doors, eaves, porch ceilings, exterior decks, stairs, underfloor, and appendages (County of Santa Cruz, n.d.). Structure underfloor vent openings and attic vents must be resistant to flame and embers, and windows need to be twenty-minute rated through glass block or have one tempered pane (County of Santa Cruz, n.d.).

Cal Fire required mapping of regions which would indicate structures in “Fire Hazard Severity Zones” (FHSZ) in a range of moderate to very high. Factors that are taken into consideration include fire weather, fuel, and slope. The maps predict which areas are the greatest source of concern due to potentially severe wildfires, and the mitigation steps help with mitigating the losses that can occur due to their location. Depending on where a structure falls within the mapping, there will be actions the owner must take to ensure increased safety from wildfires (Cal Fire, n.d.).

According to the California Building Code, spark arrestors are mandated in buildings. It was determined that due to local climatic conditions, chimneys attached to an appliance or a fireplace that burns solid fuels will need to have a spark arrester, along with all new buildings that are built next to hazardous vegetation (the City of Daly City, n.d.).

California Defensible Space Requirements

California requires 100 feet of defensible space on all property, which is a buffer between a building and the trees, grass, shrubs, or any other wildland materials. The purpose of defensible space is to protect any structure on a property and to help protect firefighters who may be defending a structure. Trees, grass, shrubs, and other wildland materials provide fuel to fires to cause further destruction (Cal Fire, n.d.).

Enforcement of Defensible Space in California

Cal Fire is responsible for defensible space inspections, and they have the authority to issue citations to property owners who do not have the necessary defensible space around their structures. Unfortunately, Cal Fire is unable to inspect properties at an impactful level due to limitations of resources. In 2018, 6% of WUI structures were inspected, well short of the goal to inspect 33% of WUI structures. This led to AB 1516 being proposed, which would require Cal Fire to inspect 33% of structures to ensure that owners were abiding by the defensible space requirements. Governor Gavin Newsom did not support the bill, as it would require additional inspectors to be hired, leading to millions of dollars in cost. Due to the lack of support, it was agreed upon that fire safe councils, Native American tribes, and California Conservation Corps would assess communities to ensure that there are appropriate amounts of defensible space. While these groups would not be allowed to cite property owners, they would be able to send information to Cal Fire on those who were not following guidelines, and Cal Fire would issue the citations (Britschgi, 2019).

Weed Abatement Enforcement Within California

There are weed abatement programs across the state at the local level that enforce defensible space requirements. Generally, the goal of the programs is to create voluntary compliance so that they may not only protect their properties, but also avoid fines from the city for not meeting requirements.

Santa Clara County's Weed Abatement Program encourages voluntary compliance, but if residents do not comply, they will issue citations. The most common way to receive a notice for weed abatement is if an inspector sees the hazard in person, but the county may also receive complaints from neighbors and recommendations from the jurisdiction's fire department or public works department. An inspector verifies the hazard, photographs the property, and records

where it is located using GPS. Each jurisdiction within the county will hold a public hearing to consider abatements on the properties that are not in compliance, and property owners may raise objections to the weed abatement requirements. Once a weed abatement program is approved, the county will be authorized to perform inspections of any property in question to determine if the property has been cleared of hazards. The county will notify the property owner of any necessary work for weed abatement, and the owner will have 15 days to complete the work. If an owner has not completed the necessary work, the county will send a contractor to complete the work at the property owner's expense. The charges incurred are included as a special assessment on the property tax bill (Santa Clara County, n.d.).

Sacramento's Weed Abatement Program exists to address safety and enforcement issues in the city, but not to be a service. About 7,400 property owners are notified each year to keep their property clean of dirt, refuse, rubbish, and weeds. Property owners need to maintain their property either through a private contractor or do the work themselves. If a property does not comply with the standards, it will be subjected to enforcement by the city. The city will hire a contractor to abate the property and the owner will be required to pay the fee for services. Notices are mailed out in the spring and inspections begin after April 15th, with inspections being performed on a complaint basis (the City of Sacramento, n.d.).

Santa Rosa's Weed Abatement Program has an ordinance on underdeveloped properties, all developed properties that have over ½ acres of space, and all properties in the WUI. The Santa Rosa Fire Department will conduct inspections to determine whether a property needs to practice weed abatement measures, and if property owners do not comply, they may be subjected to a violation and fine. Homes that are located within the Tubbs and Nuns Fire rebuild areas are considered underdeveloped land and must comply with the weed abatement ordinance (Santa Rosa Fire Department, 2020).

Defensible Space Assistance Programs in California

Mountain Rim Fire Safe Council (MRFSC), Plumas County Fire Safe Council, and the town of Woodside each offer abatement programs to create defensible space for residents, which will be evaluated in this paper. The first that will be considered is Mountain Rim Fire Safe Council's Abatement Assistant 2020 program. The Abatement Assistant 2020 program was developed to assist in creating defensible space for residents in San Bernardino County's mountain communities, which includes Old Waterman Canyon, Crestline, Erwin Lake, Fawnskin, Green Valley Lake, Lake Arrowhead, Running Springs, Big Bear Lake, Big Bear City, Sugarloaf, and Baldwin Lake. The program is set to run from 2021 to 2024, with a total of 48,000 habitable structures, 250 acres, and 145 square miles in the region that this program encompasses (L. Dyberg, personal communication, March 15, 2022).

The objective detailed by MRFSC was to supplement property owners' efforts in meeting defensible space requirements in parallel with providing fire safety awareness among the community. Council members found that homeowners understand the importance of defensible space but often times struggle to create it due to financial or physical limitation, or they do not make it a priority. Offering as little as a 5% subsidy encourages property owners to take part, therefore this program should raise participation in the overall task of defensible space in the county (L. Dyberg, personal communication, March 15, 2022).

Plumas County Fire Safe Council (PCFSC) created the Senior/Disabled Defensible Space Assistance Program in 2014 and has continuously had funding for it since then. The primary goal is to create defensible space for seniors and those with disabilities, as it is often times difficult for this group to make the needed abatements on their own, along with providing education on defensible space (M. McCourt, personal communication, March 15, 2022).

The town of Woodside has offered the Defensible Space Home Hardening Matching Fund to residents since 2014 and is self-funded by the city itself. The goal of the program has been to create and maintain defensible space for residents, regardless of income, and to increase awareness of the importance of defensible space. The community of Woodside is in a heavily wooded region which makes it a high fire hazard zone, leading to this program being created.

Literature Review

Importance of Defensible Space

Syphard, Brennan, and Keeley (2014) analyzed the role of defensible space from all fires in San Diego County from 2001-2010. They reviewed 1,000 destroyed and 1,000 surviving structures from these fires, and found that structures were more likely to survive if they had defensible space directly adjacent to them. The most effective distance was 16 to 58 feet, and those with more than 100 feet did not provide any extra support and protection. However, the extra distance would be beneficial for firefighters and it would help keep them safe. The authors suggest that the best long-term solution for protecting structures will be to have an emphasis on defensible space, building design, community education, and land use planning that is proactive in limiting exposure to fire (Syphard, Brennan, and Keeley, 2014).

Kramer, et al. (2019) mapped 8,722 buildings that were destroyed from 1985 to 2013 due to wildfires. They found that 82% of the buildings destroyed in this timeframe were located in the WUI, with an overwhelming majority, 78%, of the destructive wildfires being in the very high hazard class (86%). The Tubbs fire was an exception to this finding. The authors suggest that it is important to understand the impact of agricultural vegetation, structures, vehicles and landscaping concerning fire behavior. In their research it is emphasized how important it is to have fuel reduction in the home ignition zone, community education, fire-resistant landscaping, and building materials, increased research into wildfire risk in highly dense regions of development, and development in proximity to high fire risk regions (Kramer, et al., 2019).

Wildfire risk reduction is primarily focused on fuel reduction efforts and actual characteristics of a home, along with homeowner mitigation efforts. Syphard, et al. (2012) address the factor of home location and arrangement in wildfire destruction. They developed a data set of 5,500 structures that were destroyed in Southern California from 2001 to 2012, and

determined the main factors leading to property loss in these homes. They found that the arrangement and location of the buildings strongly correlated to wildfire damage. Low to intermediate structure densities had a high risk of fire, along with regions that have a history of frequent fires. They also concluded that if a building was surrounded by herbaceous vegetation there was a higher risk than woody types of fuel (Syphard, et al., 2012).

Kolden and Henson (2019) evaluated how Montecito, California benefited from pre-fire mitigation tactics during the 2017 Thomas Fire. Although the fire was severe, only seven homes were destroyed by the wildfire, and firefighters point to mitigation activities being the reason that the damage was not worse. The city fire marshal and wildland fire specialist greatly reduced potential loss by working with property owners to ensure that defensible space was created, and making sure that buildings were constructed of noncombustible material. They did this by removing living and dead trees, limbing up of trees, and replacing landscaping with less flammable vegetation. The Montecito Fire Protection Department (MFPD) also incentivized property owners to reduce woody material by offering to pick up any waste that they had. The MFPD worked with Southern California Edison to remove dead and dying trees near electric power infrastructure. Residents who did not work in conjunction with the MFPD also made efforts to improve defensible space around their homes independently. The researchers found that residents felt a sense of duty in wanting to protect each other, which led to a high level of engagement with defensible space-related initiatives (Kolden and Henson, 2019).

Penman, et al. (2019) evaluated the impact of defensible space in 27 forest fires from New South Wales, Australia between 2001 and 2009. The study examined 309 houses that were destroyed or damaged and 618 homes that were not damaged. They determined the best model for positive effects of vegetation touching the house and the negative effects of distance to nearby buildings and amount of nearby water. They found that risk could be greatly reduced if

there is a nearby waterbody, having ample separation between homes, and managing defensible space (Penman, et al., 2019).

Hakes, et al. (2017) considered past studies about defensible space. They mention that a NIST investigation of Witch Creek and Guejito fires showed that homes with vegetation within 30 feet had been destroyed at a rate of 67%. Homes that did not have vegetation within the 30 feet were destroyed at a rate of 32%. When there is defensible space there is protection from direct flame contact and radiant heat (Hakes, et al., 2017).

Rahman and Rahman (2019) discussed the importance of defensible space, fire resistant trees landscaping, ground cover, and current ignition zone distances from structures in Canada, the United States, and Australia. They found defensible space to be one of the most cost-effective ways to protect a home. The study details plants and trees that should be considered when landscaping a home and creating defensible space (Rahman and Rahman, 2019).

Kornakova and March (2017) emphasized the importance of defensible space, but also that there needs to be an improved understanding of the activities of defensible space. They proposed that urban designers, urban planners, architects, and landscape architects all need a clearer understanding of what will and will not help protect property through defensible space. Through their research, they found that officials and leaders in the fire community view defensible space as two dimensional and that it is important to view it on a site-by-site basis, with consideration of particular characteristics of each site that are natural and human-made (Kornakova and March, 2017).

The Questionability of Defensible Space

Syphard and Keeley (2019) researched what factors contributed to buildings surviving and what led to losses in fires in California within the years of 2013 to 2018. They found that defensible space was required at a minimum of 100 feet around structures, and some locations even

required it at 200 feet. However, based on case studies, it was revealed that, in most instances, defensible space was much less than the required amounts. When reviewing data available on how helpful specific construction measures were for protecting buildings from wildfires, they found that there is not much data available at all, and most of the recommendations are based on theoretical logic. Data was obtained from Cal Fire that mapped the most important factors concerning 40,000 buildings surviving or being destroyed in fires from the years 2013-2018. They found that eaves, windowpanes, and vent screens were consistently at the top of the list for why a structure did or did not survive, and that defensible space made up only a small portion of the factors that led to a structure surviving or not. The most important factor was structural material, and once defensible space is appropriate in conjunction with home hardening, the greatest likelihood of creating a safe structure is through fire resistant construction materials (Syphard and Keeley, 2019).

Caldararo (2018) argued in his paper that defensible space is not as important as officials are trying to make it seem. He pointed to the Cleveland National Forest Fire in 2003 in San Diego County as an example. In that case 2,800 homes were destroyed, and there was no statistical difference between the homes that had defensible space and those that did not. He suggested that clearing space is not a viable solution to protect homes from loss, but to limit building homes outside of the “urban core” and increasing penalties for those who cause fires would be more effective (Caldararo, 2018).

Resident Perspective of Defensible Space Practice

Nelson, et al. (2004) conducted interviews with homeowners in Minnesota and Florida to determine their perspectives on defensible space. Each respondent was shown 11 photographs that depicted a range of landscape types and were asked what they do and do not like about each of them. They were also asked how likely they were to use the land around their home and how

they would manage it. Based on the responses from the interview, the homeowners preferred having a natural feel to their yard and surrounding vegetation. Those that lived in Florida were more likely to be okay with lawn spacing for their pets and recreational use, but overall the respondents preferred the natural look of vegetation versus clearing it out for defensible space. The desire for privacy, seclusion, and wildlife were the main reasons for wishing for the vegetation not to be disturbed. Additionally, while respondents believed that maintaining vegetation would help mitigate the risks of a wildfire, they believed that fire retardant materials for home construction were more effective (Nelson, et al., 2004).

Bright and Burtz (2006) mailed questionnaires and conducted telephone surveys with residents in Minnesota to determine their attitudes towards defensible space. Participants lived in WUI regions that were susceptible to fires. They grouped their respondents into two different groups, I/P and N/C. I/P were those individuals had a strong orientation towards freedom to build near and in the WUI, and preferred little to no government intervention. N/C was not individualist and were community-oriented. They supported the government's responsibility to protect residences from wildfires, and somewhat disagreed that the responsibility was in the hands of the homeowner. The survey led to the conclusion that the N/C group was more open to defensible space practices. They valued defensible space due to it reducing fire damages to their homes, making firefighter's jobs easier, and the aesthetic appeal of defensible space. The I/P group found defensible space to be less effective than the N/C group, expressing that they would not be willing to create defensible space to comply with their neighbors, community leaders, and the Forest Service, and were even less likely to comply because of family and the local fire department. Overall both groups had positive perceptions of defensible space (Bright and Burtz, 2006).

Monroe and Nelson (2004) evaluated public perception concerning wildland fire and defensible space. The results of their interviews showed that a majority of homeowners who participated were well aware of their risks from wildfire, and most of the interviewees stated that they had taken action to reduce the risk of the wildfires. When determining the sources residents trusted for information about fires, most responded that they trusted public agencies, neighbors, and their personal experience. Monroe and Nelson deduced that homeowners did not make fire protection a priority when considering their homes, rather they prioritized wildlife habitat, privacy, and recreation. They did not want to obstruct nature to protect their homes, and they stated that they would rather take on the risk of their home being destroyed (Monroe and Nelson, 2004).

Absher, Vaske, and Lyon (2013) sent a questionnaire to property owners in Colorado with three questions about defensible space in general and 10 specific defensible space activities. The familiarity with defensible space was reported to be moderate to extreme, and residents understood that defensible space would be very beneficial in protecting their homes. A majority also indicated that they believed that defensible space activities would make their homes look better. Most participants stated that they would conduct more defensible space actions the following year, but a majority still did not want to cut down or trim trees (Absher, Vaske, and Lyon, 2013).

Ryan (2019) surveyed residents to understand their knowledge and attitude towards creating defensible space in the Northeast Pine Barrens. The participants in the survey lived within the WUI and expressed a low to a mid-level understanding of wildfire risk to property. Even though they expressed low to a mid-level understanding of risks, they still participated in defensible space strategies. Those that had more natural surroundings were more likely to thin trees and vegetation. A challenge that Ryan found, which has been evident in other studies as

well, is that residents wish to retain mature trees. Ryan suggested that forest managers may want to create defensible space strategies that will respond to public safety, ecological, and aesthetic goals (Ryan, 2019).

Warziniack, et al. (2019) conducted a study about responding to spatial spillover in communities. They wanted to determine how to respond to neighbors who typically do not conduct defensible space strategies. An assessment was completed by wildfire professionals and a self-assessment by homeowners. Based on the assessments, the authors found that homeowners are more willing to conduct mitigating strategies if their neighbors also do. Therefore, if a resident were to convince a couple of key neighbors to create defensible space, then more residents would comply (Warziniack, et al., 2019).

McCaffrey, et al. (2011) surveyed Utah, Idaho, and Oregon to examine homeowner actions concerning reducing vulnerability to fires. The sample they used focused on homeowners who have taken action. They discovered that respondents overwhelmingly knew their homes were at risk, but they did not think it was high risk. The reason they believed it was not high is because of the mitigating actions they conducted, such as clearing vegetation and trimming trees. Based on the survey results, a common deterrent to defensible space was that homeowners wanted to retain the natural aesthetics. The authors found that the respondents did not necessarily believe that fire mitigation and protection is a government responsibility. They indicated that they would like education on what they should do to mitigate fire risks, and they would conduct necessary clean up (McCaffrey, et al., 2011).

Edgeley, Paveglio, and Williams (2020) sought to determine how residents supported or opposed regulatory and voluntary wildfire management in rural Wyoming and Utah communities. They discovered that residents had varying levels of opposition to regulations, typically linked to a negative experience with existing regulations. They found that residents

were more willing to support regulations that were unique to their community and allowed them to act at the local level. The rural communities preferred to govern efforts themselves, and to determine what most benefited their unique community. Residents expressed that if they were offered tax breaks and a reduction in insurance premiums, they would be more willing to adapt to regulations and suggestions for fire safety. The two communities heavily supported being able to first independently convene to determine what their community needed, then to bring in other trusted organizations and government to approach the issue. Additionally, residents showed a desire for more education rather than regulatory approaches. The issue with this is that education does not necessarily translate into action. The authors suggest developing community-led efforts to help protect these vulnerable communities, such as developing the resident's skill and knowledge regarding reducing forest fuels through workshops (Edgeley, Paveglio, and Williams, 2020).

Miller, Field, and Mach (2020) conducted interviews with state and local leadership to understand why communities do not participate in wildfire preparedness programs. They concluded that defensible space requirements are not realistic without proper financial assistance. While there has been some recent legislation in California promoting home hardening and defensible space through funding, it would not be nearly enough to make an impactful difference. Residents oftentimes do not perform defensible space precautions because they do not believe that they can afford the efforts (Miller, Field, Mach, 2020).

Assistance from Outside the Fire Community and Localities

Ritchett (2020) conducted an online survey through the Pacific Northwest International Society of Arboriculture to determine the role that arborists can play to mitigate wildfire risk.

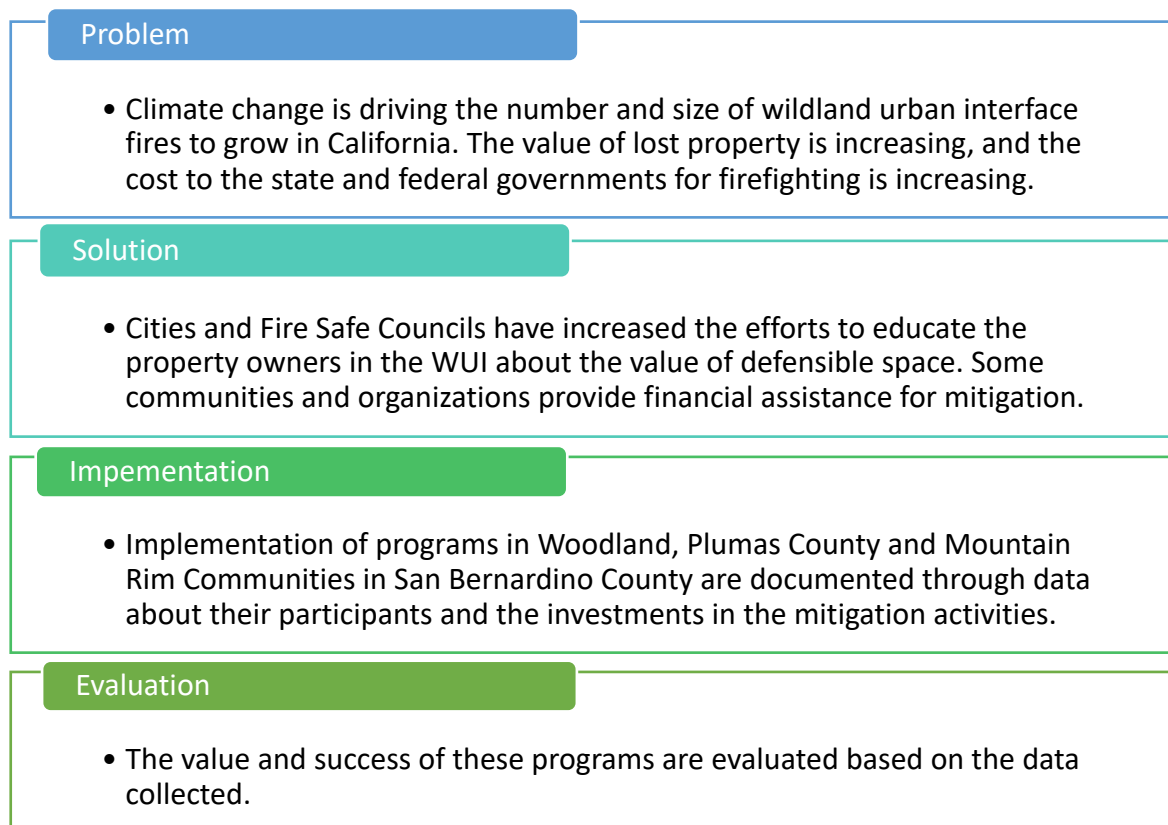
Homeowners cite many reasons for not practicing defensible space strategies, such as lack of capacity, expertise, and equipment. Ritchett suggests that arborists have the potential to assist

homeowners in the efforts to create defensible space, and that there were a small number of arborists who already assist with wildfire risk assessment. There is an equal number of arborists who do not currently assist with wildfire risk but would be open to helping (Ritchett, 2020).

Methodology

The methodology used in this research project is a program analysis. The Background and Literature Review describe the problem of managing damage in the residential areas within the WUI. The solution to the problem is the development of mitigation programs for WUI areas in three selected areas of California, which are described in the Background and Literature Review, as well. The Implementation of the mitigation programs is documented through data collection displayed in the Findings section. The Analysis provides the evaluation of these programs' implementation.

Figure 2. Program Analysis Logic Model



Data was obtained from the town of Woodside, Plumas County Fire Safe Council and the Mountain Rim Fire Safe Council, along with the US Census, to analyze the success of each program. Data collection for Woodside included the number of homes in the city, the number of

applicable residents, and the number of clients for the wildfire safety program that they have had in the years 2017, 2019, 2020, and 2021. The percentage of low-income households in the city were considered, population increase overtime, education, and values of homes.

For Plumas County Fire Safe Council's Seniors/Disabled Abatement Assistance Program, data collection included the number of homes in the county, the number of residents that are eligible, number of clients for the assistance program in the years 2014, 2015, 2020, 2021. Factors considered were percentage of seniors and disabled in the county, population trends over the course of the program, education and the values of homes.

Data collection for Mountain Rim Fire Safe Council consisted of the number of homes and structures in the region, the number of eligible property owners, and the number of clients in the abatement program since its inception. Population trends over the course of the program, education and the values of homes were also considered.

Findings

Implementation The Plumas County's Senior's/Disabled Defensible Space Assistance program and Mountain Rim Communities of San Bernardino's Abatement Assistance 2020 program was implemented by the Fire Safe Councils in both communities, while in Woodside the town itself executed the program.

Plumas County

Eligibility and Services

Property owners are required to submit an application to benefit from the program, and if they are approved, there will be up to \$1,500 worth of work paid for. Financial assistance is based on a cost share basis for a single resident making less than \$46,453 and couples who make less than \$53,089. When PCFSC initially started the service, property owners were required to make a copay, but they removed that condition (M. McCourt, personal communication, March 15, 2022).

Funding and Marketing

Funding for the program has been through Cal Fire, The Forest Service, and PG&E. Currently the funding is through Cal Fire, which provided \$419,132 over a course of three years, which ends in 2023. The method through which PCFSC promoted the program was primarily through advertisements in the local paper, however that was not very successful. A majority of the property owners that participate find out about the offerings through word of mouth or are repeat clients (M. McCourt, personal communication, March 15, 2022).

Woodside

Eligibility and Services

Any of the 2,500 homes in the town of Woodside are eligible for this program in which up to 50% of the cost is reimbursed to property owners. Originally there was a \$1,000 reimbursement

to residents, but now the town offers up to \$3,000. Property owners are expected to find their own contractor for the work necessary but will receive the reimbursement from the city.

Replacement of wood shake roofs with non-wood shake roofs, installation of non-combustible ember resistant vent screens and or chimney spark arrestors, and installation of an approved seismic gas shut off device - a valve that will shut off gas automatically during an earthquake - are also eligible for reimbursement through this program (K. Bryant, personal communication, March 16, 2022).

Funding and Marketing

Funding for the program is through the town of Woodside itself. Woodside partners with firefighters, who do the inspections of properties to ensure that they are up to date with defensible space requirements. Additional ways in which property owners are educated about the offerings of the program are through homeowner's association meetings, occasional targeted outreach, and a town newsletter (K. Bryant, personal communication, March 16, 2022).

Mountain Rim Communities

Eligibility and Services

Eligibility is tied to a seasonal inspection conducted by the San Bernardino Fire Department in which property owners are issued a citation for infractions of defensible space requirements. Alongside the citation, a postcard is provided to the property owner that details information on the program. If there is a circumstance in which it is urgent for there to be action, they will do so before the citation is issued. Once they have been issued the citation, the property owner is to complete an application for the program, and based on income, they will be offered monetary assistance. Property owners are given 30 days to fix any issues that the fire department notices, although many of the residents do not live in the region full time, creating an open-ended

extension for those who are in the program (L. Dyberg, personal communication, March 15, 2022).

Property owners receive 10% to 100% funding for the work necessary on their property depending on income, with those that have a household income of up to \$250,000 receiving 10% in funding. The original goal was to serve 350 parcels out of 52,000 parcels in the community over a three-year period, with service beginning in 2021 and set to be completed in fall 2023. Clean up would include removing dead trees, debris, and weeds. Leftover woody chips would be used for erosion control on the property first and then for other selected areas in the region, while anything not used would be gathered for green waste collection (L. Dyberg, personal communication, March 15, 2022).

Funding and Marketing

Funding for the program has been through a grant from Cal Fire. To create awareness of the program, MRFSC allocated 2.6% of their budget beginning in fall and winter of 2020 to promote it through their website, brochures, emails, banners and Facebook. The primary way in which MRFSC communicated with property owners was through a 3,000-email address list (L. Dyberg, personal communication, March 15, 2022).

Data

Plumas County Fire Safe Council's Seniors/Disabled Defensible Space Assistance

Figure 3. Clients in Plumas County

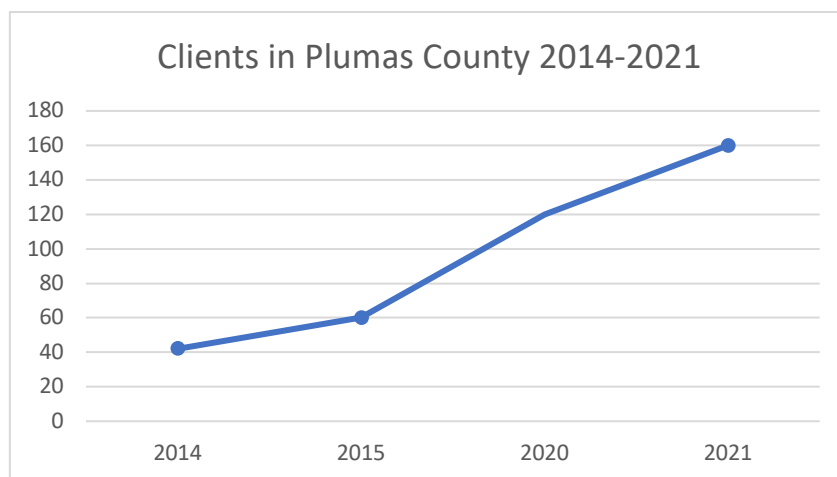
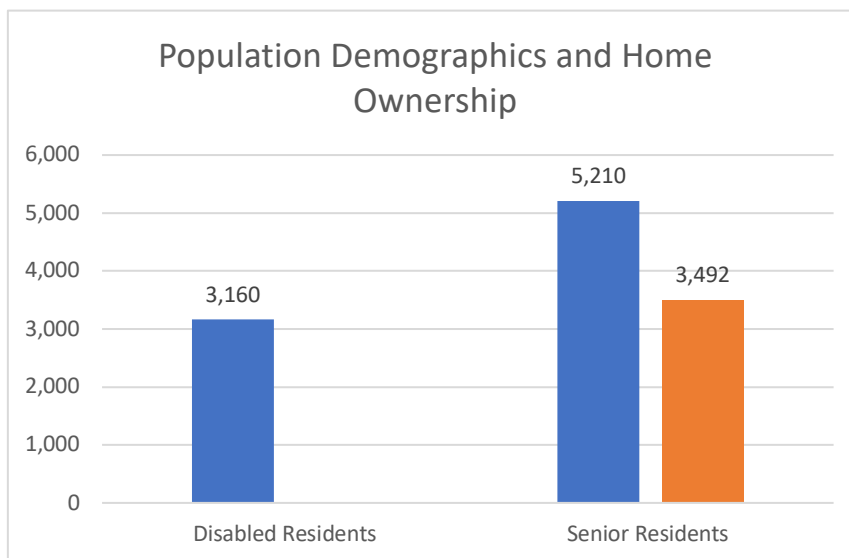


Figure 3 details the number of clients that were served between 2014 and 2021, with data for 2016 to 2019 unobtainable. In 2014, the year that the program was first offered, there were a total of 42 clients served through the program, purely through an advertisement displayed in the local paper. In 2015 there were 60 clients served, in 2020 there were 120 clients served, and in 2021 there were 160 clients served. After 2014 clients were obtained from a mixture of advertising in the local papers and word of mouth (M. McCourt, personal communication, March 15, 2022).

Plumas County Fire Safe Council did not detail what their original goal for number of participants in the program was, however their representative did state that they generally would like to see an increase in the number of clients that are benefiting from the program (M. McCourt, personal communication, March 15, 2022). There was no detailing offered of whether these property owners were seniors or disabled residents, therefore it would not be possible to discern if one group benefited from the program more than the other.

Figure 4. Population Demographics in Plumas County

There was a population of 18,807 in Plumas County in 2019. Based on the US Census 2014-2018 American Community Survey 27.7% of residents in Plumas County are 65 years and over, and 16.8% of the population has some type of disability. Those with disabilities reported to have hearing difficulties, vision difficulty, cognitive difficulty, ambulatory difficulty, self-care difficulty, and independent living difficulty (*Plumas County Housing Study, 2020*).

There is a total of 12,304 detached single-family homes in Plumas County. Based on California averages, 70% of residents 65 years or older own a home. Using this statistic, it was determined that about 3,492 homes in Plumas County are estimated to be owned by seniors. It was not possible to determine the amount of homes owned by disabled residents, therefore it is not included in this figure (*Plumas County Housing Study, 2020*).

Woodside

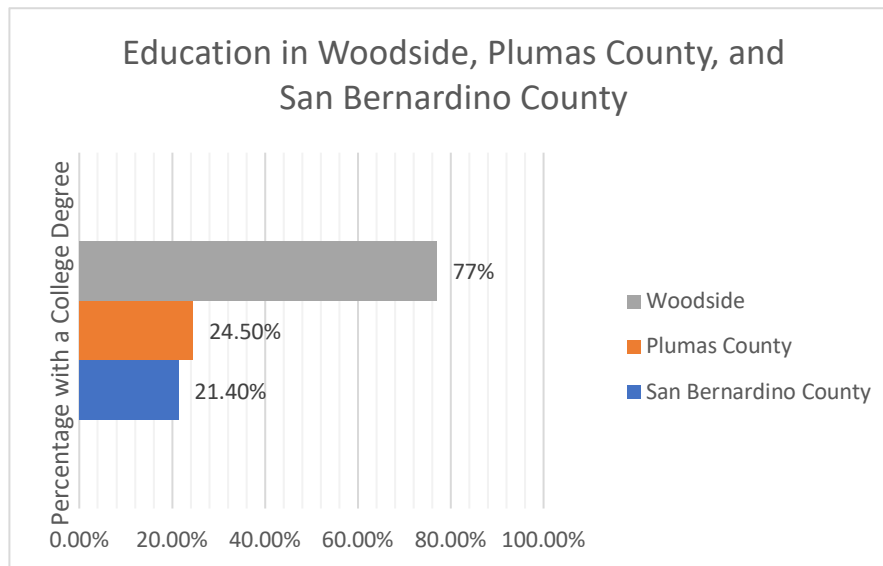
Figure 5. Clients in Woodside



Figure 5 represents the number of clients that have been served under the Defensible Space Home Hardening Matching Fund since 2017. There were 99 clients in 2017, 132 in 2019, 178 in 2020, and 230 in 2021. There are 2,500 homes in Woodside, all of which are eligible for this program. Residents were informed of the program through firefighters that conduct inspections of properties to ensure that they are meeting defensible space requirements. The city also does occasional outreach through the town newsletter and community home owners association meetings. The monetary benefit residents receive has increased from \$1,000 to \$3,000 over time (K. Bryant, personal communication, March 16, 2022).

*Mountain Rim Fire Safe Council***Figure 6. Clients in Mountain Rim Communities**

Figure 6 details the amount of homes that have been served through the Weed Abatement Assistance 2020 program in the Mountain Rim communities. The program was designed to cover 250 acres of land, 145 square miles, with 48,000 habitable structures on this land. Those with a higher income that make up to \$250,000, are also eligible for this program, so it is not strictly for low income households. The original goal for the program was to assist 350 property owners over the course of the program. In the first year alone of inspections and abatement there were 386 homes cleared. The project manager for this program estimates that by between 2021 and 2023 there will be a total of 550 homes served (L. Dyberg, personal communication, March 15, 2022).

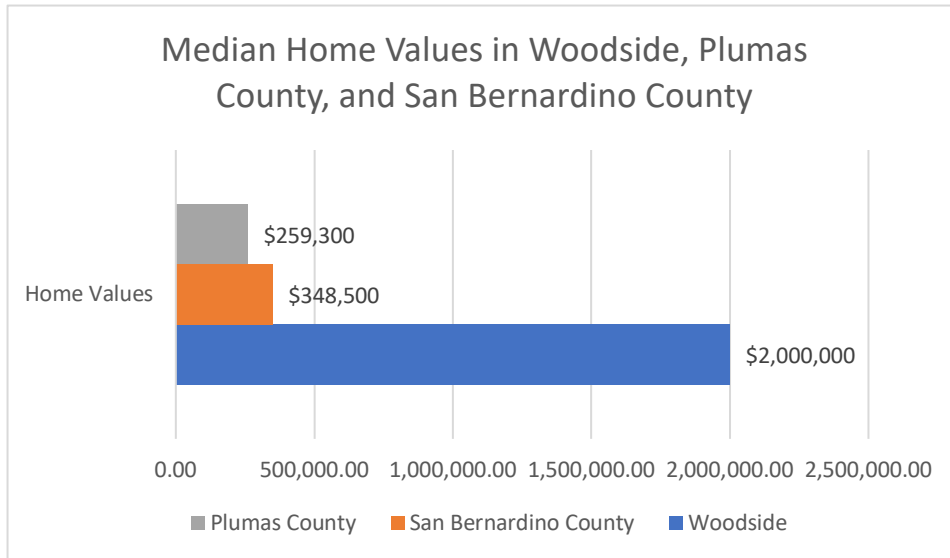
*Education***Figure 7. Education Levels in Woodside, Plumas County, and San Bernardino County**

To determine whether education has a correlation with success of the program data was obtained from the US Census. Based on the census 77% of Woodside’s population has a college degree or higher, 24.5% of Plumas County’s population as a college degree or higher, and 21.4% of San Bernardino County’s population has a college degree or higher. If one were to consider the county Woodside is located in, San Mateo County, there is a 52.1% college degree or higher completed percentage (American Community Survey, 2018).

Based on statistics, rural communities tend to be less educated than urban communities (Economic Research Service, 2021). San Bernardino County and Plumas County are both in generally rural regions, which would correlate with why they are less educated than the town of Woodside, which is in an urban community. Woodside being located in Silicon Valley, which is considered the 3rd most educated region in the country, also would indicate that it would have a higher education percentage as a city (Deruy, 2017).

Home Values

Figure 8. Home Values in Woodside, Plumas County, San Bernardino County



Home value correlation to each of the program’s success is to be considered. Woodside has a higher value for home value at a median value of \$2 million, while San Bernardino County has a median home value of \$348,500 and Plumas County has a median home value of \$259,300 (US Census, 2021). Rural housing is statistically proven to be worth less money than one in an urban region (Hopulele, 2019). Due to San Bernardino County and Plumas County being located in generally rural regions it can be expected that the home values would be less there than in Woodside. Silicon Valley is the most expensive region to live in in the United States, due to this it would also be expected that Woodside would be an expensive city to own a home in (Loudenback, 2019).

Analysis

Plumas County Fire Safe Council

Based on the findings Plumas County Fire Safe Council has increased the number of clients year over year. Between 2014 and 2015 itself there was a 42.8% increase in the number of homes that benefited from the program. From 2015 to 2020 there was a 100% increase in homes benefiting, and from 2020 to 2021 there was a 33.3% increase of clients. Overall, there was a 381% increase of property owners benefiting between 2015 and 2021.

In California, 70% of seniors own a property, based on this statistic it was determined that approximately 3,942 properties in Plumas County are owned by seniors (Levin, 2019). Out of the 3,942 properties that are eligible 1.07% of them were abated in 2014, 1.52% in 2015, 3.04% in 2020, and 4.06% in 2021. Data was not available for what percentage of disabled residents own properties in California, or in the United States, therefore this number was not considered.

Plumas County had two major wildfires in the past two years, the Dixie Fire and the North Complex fire. Due to the two wildfires, accessibility was limited to many properties, with the sheriff's department blocking access to streets that led to homes. If access was not restricted to the homes there may have been a larger number of properties assisted through the program (M. McCourt, personal communication, March 15, 2022).

The Town of Woodside

The program set forth by the town of Woodside has seen an increase in the number of property owners participate in their program year over year. Between 2017 and 2019 there was a 33.3% increase of property owners participating in the program, between 2019 and 2020 there was a 34.8% increase, and between 2020 and 2021 there was a 29.2% increase. Between 2017 and 2021 there was an overall increase in participants by 132.3%. There are 2,500 homes in Woodside that are eligible for their program. In 2017 3.96% of the homes in Woodside

participated in the program, in 2019 5.28% of them participated, in 2020 7.12% participated, and in 2021 there were 9.2% of property participation.

In 2017 property owners were receiving \$1,000 in reimbursement, however in recent years the available funds increased to \$3,000. Due to the increase in funds that property owners were eligible for, more of them applied to participate in the program, which in turn led to a higher percentage of participation (K. Bryant, personal communication, March 16, 2022).

Mountain Rim Fire Safe Council

The goal that Mountain Rim Fire Safe Council put forth for their program was to provide weed abatement to 350 properties. In 2020 they abated 386 properties, which is +110.3% of their overall goal achieved in one year. They expect to abate 550 properties between 2021 and 2023, which, if met would be a total of 936 properties abated. This would be +267.4% of their overall goal.

There are 48,000 habitable structures that are eligible in the region that the Weed Abatement Assistance 2020 program encompasses. The goal was to service 0.73% of the properties in the region, but in 2020 they were able to abate 0.8% of the properties. If they achieve their expected outcome of 550 properties between 2021 and 2023, they will have abated 1.15% of the properties in the region, and an overall percentage of 1.95% abated of properties in the applicable area.

Consideration of Education and Home Values

Woodside is considerably wealthier than Plumas County and San Bernardino County. 77% of its residents have a college degree of some sort, which in turn leads to higher income potential and possibility to purchase a home with a higher home value than those living in rural regions such as Plumas County and San Bernardino County, where education levels are 24.5% and 21.4%, respectively. The median home value in Woodside is \$2,000,000, whereas in San Bernardino

County it is \$348,500, and in Plumas County it is \$259,300, which equates to a 474% greater value than San Bernardino County and a 671.3% greater value than Plumas County. Wealthier neighborhoods tend to be better maintained than those in rural regions and have a higher budget for city run projects (Dempsey, 2016).

The Plumas County Fire Safe Council is able to only offer their program to seniors and residents with disabilities, and the Mountain Rim Fire Safe Council is only able to offer their program to property owners that are issued a citation. Woodside, on the other hand, is able to offer their program benefits to any resident living in the city. Thus, Woodside's program is more accessible due to there being no restraints on who may use the program. Based on the data that was collected it shows that Woodside is a more successful program due to it having a higher percentage of served property owners, however this may be misleading due to the fact that the other two programs don't have the same accessibility as Woodside's.

Evaluation

Based on the data provided it can be considered that all three programs have been a success in their own right. All three programs saw a positive trend in the number of clients participating year over year and are projecting to see further increases in the number of clients that will benefit from the programs. Each program was also able to provide education to each of the property owners that they served, which satisfied goals to increase resident awareness of defensible space.

While each of these programs saw a positive trend, it should be considered whether it is successful in maintaining long term defensible space. The short-term goal of each program was satisfied but the long-term goals of maintaining defensible space in the community is yet to be seen. Due to Mountain Rim Fire Safe Council allowing only one year of participation in the program, residents may revert to defensible space being a low priority project. Plumas County Fire Safe Council and Woodside do not have the same limitation; therefore, property owners are

able to participate for a longer period of time if desired. Due to Plumas County Fire Safe Council and the town of Woodside offering their programs as an option for maintenance for existing clients they are better able to ensure that defensible space in ongoing.

Limitations

Current limitation to the program evaluation for Mountain Rim Fire Safe Council's Weed Abatement Assistance 2020 program is that it is ongoing, therefore it is not possible to determine whether they were successful yet. Difficulties may arise for the program to be carried out in the coming years that may not have in the initial year, and there is not a number yet for the amount of properties that will be served by this program over the coming years.

For the Plumas County Fire Safe Council's Seniors/Disabled Defensible Space Program there were limitations on access to data. There was not a concrete number available for the number of homes in Plumas County that are occupied by seniors and disabled residents, therefore an estimate had to be used to determine how many properties were eligible. While an estimate was possible for seniors, it was not possible for determining how many properties may be owned residents with access and functional needs. Additionally, Plumas County Fire Safe Council did not provide data for years 2016, 2017, 2018, and 2019, therefore it was not possible to determine whether there was a lapse in the positive trend between those years.

Areas for Further Study

There are opportunities for further evaluation in each of these programs since they are ongoing. Since Mountain Rim Fire Safe Council's program has an expected completion year of 2023 it would be best to evaluate it once more at the completion of the program. A question to further evaluate is whether or not these programs have long term success rates after a property owner has participated in them. If defensible space is maintained for a short time after the property owner benefits from the program, it may not be considered an overall success. Future research might investigate how long the defensible space strategies were maintained in these communities.

Conclusion

In the past decade, especially the past five years, California has seen destructive wildfires increase at an alarming rate, leaving property in a vulnerable state. Maintaining defensible space is one of the best ways to ensure that a property owner will be able to protect any structures on their property and lives in the case of a wildfire. Defensible space requirements set forth by California can be difficult for many homeowners to maintain, often times because of financial and physical limitations. Many cities, counties, and fire safe councils in the state offer programs to assist those who may find it difficult to keep their homes protected.

The purpose of this study was to determine whether or not three defensible space programs were successful in California. Plumas County's Fire Safe Council's Seniors/Disabled Defensible Space Program, the town of Woodside's Defensible Space Home Hardening Match Fund, and Mountain Rim Fire Safe Council's Weed Abatement Assistance 2020 were evaluated to conclude whether they have reached their goals. Each of the programs has been successful thus far, but are worthy of an additional evaluation of whether or not the programs have long term success rate of maintaining defensible space.

Based on the findings of this evaluation, each of the programs saw a positive trend in the number of clients who participated in the benefits of the program. Plumas County has seen an increase of 381% between 2014 and 2021 in participants in the program, the town of Woodside has seen a 132.3% increase between 2017 and 2021 in participants in the program, and Mountain Rim Fire Safe Council has seen their goal of 350 properties to be abated surpassed, hitting 110.3% of their goal.

The best way in which a program such as the ones evaluated in this study may be successful is increasing awareness among residents, whether they are current property owners or will be future ones. Each of the representatives that was interviewed for

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this research mentioned that they need all of the publicity and word of mouth they can get to continue their programs.

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