DEFENSIBLE SPACE FEATURES: IMPACT OF VOLUNTARY VERSUS MANDATORY PROGRAMS ON A HOMEOWNER'S ATTITUDES AND ACTIONS

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Abstract.—Our research examined homeowner responses to local efforts that encourage mitigation of wildland fire risks on private property. We were specifically interested in whether there were different attitudes toward, and different compliance responses to, voluntary versus mandatory programs aimed at managing vegetation for fire risks. We chose four sites for the diversity of their wildland fire policies and the presence of flammable vegetation, residential housing, and sizeable population. The mandatory policy communities were Oakland, California, and Ruidoso, New Mexico. The voluntary-compliance communities were Grand Haven, Michigan, and Larimer County, Colorado. A mail survey of homeowners revealed that the communities with local ordinances requiring vegetation management had higher levels of mitigation activities and homeowners there perceived mandatory mitigation to be more effective than voluntary programs at reducing risks. Homeowners living in the mandatory-policy study areas were also more likely to be motivated by laws and to support mandatory approaches than those living in the voluntary-program areas. Several risk-mitigation practices directed at vegetation and structures were on many homeowners' "to-do" lists, including enclosing porches and converting non-roof building materials and landscaping to fire-resistant materials; these plans may suggest homeowners' intent to undertake future projects to reduce wildfire risk. The paper concludes with a discussion about education and policy implications.

1.0 INTRODUCTION AND BACKGROUND LITERATURE

Many components of fire risk management in the wildland-urban interface (WUI) require action by local communities and individual property owners. According to some observers, too much emphasis is placed on federal and state policies aimed at motivating local jurisdictions to mitigate wildfire risks while more attention should be paid to what is actually happening at the local level (Steelman and Kunkel 2004). Natural hazards researchers have shown that it is difficult to encourage changes at the local level, yet this is where the greatest control over mitigation can be exercised (Burby and May 1998).

There are generally few local incentives to respond to a wildfire hazard since existing policies and practices tend to shift pre-disaster mitigation measures and the post-disaster recovery burden to state and national taxpayers (Davis 2001, Plevel 1997). However, recently enacted federal and state policies provide some strong incentives for local jurisdictions to manage the risks associated with wildland fire (USDA Forest Service and U.S. Department of Interior 2000, Western Governors' Association 2001), leading to an array of local policies, laws, and programs. Our research sought to understand what impact these programs might have on defensible-space practices at the household level.

We identified defensible-space programs that had different approaches to reducing wildfire risks and losses but had similar goals and target outcomes. The general focus of defensible-space programs is to encourage property owners to manage vegetation to decrease their fire risk and impacts and to make their buildings more fire-resistant. We wanted to examine differences in outcomes between programs where defensible space is mandatory (meaning the community adopted a required homeowner program

and/or a local ordinance was in place) and programs where it is voluntary (meaning a community may or may not have administered a program and homeowners could practice defensible space at their own volition). We also tried to identify and understand factors (i.e., motives, perceived effectiveness) that influence homeowner acceptance of, and compliance with, local government policies about defensible space.

2.0 METHODS

To address the research problem, we sent a mail survey to homeowners in four study communities selected to target the primary variables of interest: voluntary vs. mandatory policies, and incentives vs. no incentives (Tables 1 and 2). Both policies and incentives were largely directed at vegetation even though the building codes are enforced. Sites were also selected for the presence of WUI with flammable vegetation (fuels), significant residential housing (by density, including high-value real estate), and sizeable population levels (permanent residents, vacation homes, tourists). Local officials who manage wildfire programs and services collaborated on selecting the geographic area of homes for each study site.

2.1 Community Profiles and Existing Wildfire Mitigation Policies

Larimer County-Front Range, CO, operates a grant-funded yard waste facility that offers free disposal and chipping services to county residents (an incentive). A full-time wildfire specialist offers on-site consultation to builders to recommend vegetation management actions that will comply with the County's defensible-space guidelines. These vegetation management services are voluntary. The County requires that new construction in the County's wildfire hazard area comply with wildfire hazard mitigation regulations. These regulations include provisions for fire-resistant construction and vegetation management to create defensible space around the new buildings. No such requirements apply to existing structures. We did not ask homeowners in the survey whether their house was new or existing.

Table 1.—WUI sample site scheme.

	Voluntary policies	Mandatory policies
With incentives	Larimer County – Front Range, CO	City of Ruidoso, NM
	• New home-building focus • Selective insurance incentives • Home risk assessments • Wildfire risk – high	• Mandatory vegetation management regulations • Cost-share arrangements • Wildfire risk – high
Without incentives	Grand Haven Township, MI	City of Oakland, CA
	• Firewise education by MSU Extension in partnership with township fire department and state forestry • Wildfire risk – low to moderate	• Mandatory vegetation management regulations • Tax assessment • Wildfire risk – high

Table 2.—Local wildfire safety law (requirements).

Coded by local policy at the time of the study:	Voluntary Policies (VP)		Mandatory Policies (MP)	
M=Mandatory; P=Partially Mandatory; N=No local requirements	Larimer Cty., CO	Grand Haven Twp., MI	Ruidoso, NM	Oakland, CA
Fire-resistant construction materials for all new homes	M	M	M	M
Fire-resistant landscaping and vegetation for all new homes	M	N	M	M
Fire-resistant landscaping and vegetation for existing homes	N	N	M	M
Annual fire department inspection of landscaping for fire safety	N	N	P*	M

* Re-inspections are required every 5 years, not annually.

The City of Ruidoso, NM, is a small village in southeastern New Mexico with about 9,000 permanent residents and a large seasonal population. Ruidoso was listed by New Mexico State Forestry as one of the "Twenty Most Vulnerable Areas" facing a high level of wildfire risk (Steelman and Kunkel 2004). In 2002, the Ruidoso Village Council passed a mandatory fuels-management ordinance in the highest risk areas of the city. The ordinance is actively enforced and offers incentives such as enhanced yard waste disposal and cost-share options for property owners who are willing to thin vegetation beyond the minimum standards.

Grand Haven Township and nearby area, MI, has no mandatory regulations, but township fire department officials recently partnered with Michigan State University Extension to develop defensible-space guidelines and education materials specifically for WUI homeowners along the fire-prone shoreline of Lake Michigan. Residents and fire officials are primarily concerned about the limited ingress and egress of the older lakeshore subdivisions and the highly combustible dune grass that is often the initial target of ignition sources, sometimes related to human recreational activities.

The City of Oakland, CA, has a long-standing mandatory defensible-space ordinance. The ordinance was enhanced in 2003 by a voter-approved property tax assessment proposition that created and funds a wildfire Prevention District covering more than 22,000 homes/parcels in the Oakland Hills area. The District has full-time staff members that inspect each property at least once per year. The inspections are meant to determine property owner compliance with state and local wildfire hazard-mitigation laws. The District also has an education/outreach program, enhanced yard waste disposal services, and a program to offset the costs of complying with mitigation on city-owned land (e.g., rights-of-way).

2.2 The Survey

The mail survey was sent to a sample of homeowners in each of the study communities. The survey was designed to allow us to analyze the influence of scenario-specific factors and social characteristics on respondents' attitudes towards, understanding of, and acceptance of mitigation policies and practices, and on their wildland fire hazard abatement practices. Scenario-specific factors were as follows: wildfire mitigation policy versus no policy, mandatory versus voluntary policy, and incentives versus no incentives. Social characteristics were demographics, social trust, general beliefs about policy outcomes, and attitudes towards humans' roles in ecosystem management.

The questionnaire design and content were influenced by qualitative analysis of focus-group data collected in an earlier phase of this research (Winter et al. 2009). We also reviewed other questionnaires created by social science researchers such as Bruce Shindler of Oregon State University and Alan Bright of Colorado State University. We made additional efforts to review the literature for concepts and scales pertaining to opinions and judgments about policies and incentives. A copy of the questionnaire can be requested from the first author.

We obtained public information (name, mailing address, location address, home value) from local or county tax assessors for all properties in each study community that met the selection criteria. The selection criteria included specific WUI areas in each community, occupied homes, permanent residents, and seasonal residents; exclusion criteria included businesses, vacant land, land with hunting sheds only, and apartments. Once the list was obtained from each assessor, we drew a simple random sample of properties with homes to receive the survey.

Based on pre-test response rates, a sample size of 1,500 was deemed appropriate for Larimer County, CO, and Ruidoso, NM, given the size of the communities and their WUI area. Furthermore, past research in Colorado had had lower response rates than had California or Michigan sites. A sample of 1,000 was selected for Grand Haven, MI, and Oakland, CA. The project budget determined the total sample size of 5,000.

Questionnaires were mailed on April 10, 2008, with a personalized cover letter and a business reply envelope. Reminder postcards followed about a week later. A second mailing was sent to nonrespondents on May 9, 2008. Press releases were also sent to local newspapers in April and May to coincide with when homeowners received the survey. Seasonal homeowners were not likely to see announcements that appeared in the local newspapers. Almost 1,800 completed surveys were returned from a possible 4,802 (sample size minus bad addresses) for a 37.4-percent response rate. Larimer County had the highest response rate, 42.2 percent, Grand Haven's was 39.9 percent, Ruidoso's was 37.5 percent, and Oakland had the lowest rate, 27.5 percent.

A nonresponse study was completed in June 2008. In Oakland, we made phone calls to nonrespondents rather than sending another mailed survey in order to use multiple methods to test for nonresponse bias; mail surveys were used for the other sites. The nonresponse study found the following biases:

1. In Oakland and Larimer County, people who had not previously responded to the survey gave significantly higher ratings than previous respondents to the likelihood of wildfire occurring.
2. In Oakland, nonrespondents to the main survey had significantly more positive attitudes toward two measures: a visit by an official to show how to manage vegetation, and an ordinance that requires vegetation management.

These results are the reverse of what is often expected—that those who do not respond are less active or less concerned about wildfire.

Frequencies were prepared in tables for a basic review of patterns. We analyzed the data with a series of parametric tests to test similarities or differences in attitudes (effectiveness of actions) for the range of site factors. We calculated mean scores on interval attitudinal data for voluntary policy (estimating a composite mean for Colorado and Michigan sites) and mandatory policy (estimating a composite mean for New Mexico and California) and then applied an independent sample t-test. ANOVA tests with post-hoc testing were used to test across the four sites. The hypothesis of the research was that mandatory policies yielded greater acceptance and compliance than voluntary policies.

3.0 RESULTS

Homeowners were asked which of 11 defensible-space practices existed on their property (Table 3). They were asked to indicate whether each practice did not pertain to their house and/or lot, already existed when they purchased the property, had been undertaken for wildfire safety, had been undertaken for other reasons, or had not been undertaken (yet). Few respondents across the four study sites indicated that vegetation or home features were not applicable to their property, although firewood stacked near a building was less common in Oakland. In the columns marked "action not necessary because already existed when purchased," most practices yielded a single-digit percent, suggesting that few homeowners found themselves in that situation or that vegetation management requires ongoing or frequent effort. The exception was fire-resistant roofs; between 17 percent of homeowners (Grand Haven Township) and 31 percent of homeowners (Ruidoso) had fire-resistant roof materials.

The column marked "my household took this action primarily for wildfire safe reasons" shows the extent of mitigation actions by Larimer County, Ruidoso, and Oakland homeowners. Each location had high levels of vegetation maintenance and roof replacement. Grand Haven Township residents appeared to perform vegetation management for reasons other than wildfire safety. Finally, vegetation management beyond keeping the roof and gutters free of debris were on many homeowners' lists of features not yet addressed. These items could be considered a "to-do" list or intended behavior, with particular attention to converting nonroof building materials and landscaping to fire-resistant materials and enclosing porches.

Table 3.—Features of properties and actions to protect homes from wildfires.

	Percent (%) who selected each response																			
	1. Not a feature of my home or property				2. Action not necessary, as already existed when purchased home				3. My household took this action primarily for wildfire safety reasons				4. My household took this action primarily for other reasons				5. Have not done this to my home or property			
Vegetation to House Features	VP[a]		MP[b]		VP[a]		MP[b]		VP[a]		MP[b]		VP[a]		MP[b]		VP[a]		MP[b]	
	CO	MI	NM	CA	CO	MI	NM	CA	CO	MI	NM	CA	CO	MI	NM	CA	CO	MI	NM	CA
Roof and rain gutters kept free of leaves/needles/twigs	21	28	12	4	5	4	6	4	24	3	30	23	45	62	49	66	5	3	4	4
Overhanging/dead branches removed w/in 10 feet of roof	11	9	7	9	8	3	8	6	49	9	53	61	16	60	22	19	16	20	11	5
Green veg. area maintained at least 30 feet around house	14	15	24	11	7	9	8	12	42	6	29	42	13	43	16	23	24	27	23	11
Trees/shrubs thinned w/in 30-50 ft. of house	7	11	8	8	8	4	9	6	51	7	54	52	9	42	14	20	25	37	15	14
Shrubs/lower tree branches that could carry flames from ground into crown are removed	4	10	9	7	5	3	7	5	52	8	58	52	9	32	14	15	30	47	12	22
Dead veg./leaves/needles cleared at least 30 feet from home	3	5	2	4	4	1	4	3	57	11	65	58	16	58	20	28	21	25	9	7
Yard is landscaped with fire-resistant vegetation	29	26	28	14	6	2	8	8	11	4	14	23	6	15	8	18	49	54	42	37
Firewood/lumber stacked at least 30 feet from all buildings	12	27	22	42	3	2	4	3	52	8	39	27	10	35	13	5	22	28	22	23
House has a fire-resistant roof	5	8	4	8	24	17	31	26	43	12	35	42	19	55	24	17	8	10	6	7
House materials are fire-resistant	23	20	23	17	8	8	16	18	14	6	13	22	6	27	7	8	50	39	40	35
Underside of deck enclosed to keep debris from collecting	29	30	27	38	7	6	13	10	11	4	15	9	7	26	11	13	46	35	34	30

[a] "Voluntary Policies." [b] "Mandatory Policies."

Homeowners were asked to rate the effectiveness of the 11 actions in reducing the risk of severe damage to their house if a wildfire were to occur in their neighborhood. The data in Table 4 do not take into account whether or not each respondent actually undertook these practices. Homeowners living in the mandatory-policy study sites gave higher ratings to the effectiveness of most actions compared to homeowners living in voluntary-policy study sites. Respondents' from mandatory and voluntary sites gave similar ratings for three fire safety actions, all of which were generally perceived as effective: firewood and lumber are stacked at least 30 feet from all buildings, house construction materials (e.g., siding, porches, decks) are fire-resistant, and a green vegetation area is maintained at least 30 feet around the house.

Table 5 provides insight into homeowners' motivations for taking or not taking defensible-space actions. Homeowners living in the mandatory policy study areas were more likely to be motivated by laws. About 42 percent of Oakland homeowners and 29 percent of Ruidoso homeowners were partly motivated by local vegetation management programs. There were indications that insurance can have a small influence on homeowners' actions; 10 percent of homeowners in Ruidoso and 5 percent in Larimer and Oakland were motivated by insurance companies. In Larimer County and Grand Haven Township, very few respondents were motivated by laws (which more than likely did not exist unless the home was new and the building codes required fire-resistant materials for new construction). Almost half of the Grand Haven Township homeowners took no action, whereas almost 9 out of 10 homeowners in the other three study site areas took action on at least one of the 11 practices.

4.0 DISCUSSION

In recent years, social science research on wildfire has gained considerable attention. However, no previous studies have tested the influence or impact of mandatory policies on the acceptance of wildfire risk-mitigation policies and practices. Our findings show that mandatory programs drive some actions and lead to higher perceived efficacy of mitigation activities. In Oakland and Ruidoso, mandatory policies clearly encourage a greater proportion of homeowners to create defensible space and undertake fire-wise vegetation management than in the two study communities with voluntary programs. Oakland residents in particular have undertaken extensive wildfire mitigation activities as mandated by a long-standing program funded by property taxes. Ruidoso has recently begun to organize stakeholders and has designed a wildfire risk-mitigation program funded mostly by grants and local matching funds. Larimer County has a high wildfire risk but lacks a formal approach to encouraging homeowners to mitigate their fire risk—yet 81percent of respondents had voluntarily undertaken one or more defensible-space practices. Our results do not address how Larimer County homeowners might react to a mandatory policy for all homes. And finally, Grand Haven Township is an area with a history of wildfires (mostly caused by people) but with few local fire risk-mitigation programs, no wildfire ordinances except relating to new home construction, and the lowest levels of defensible-space practices among the study sites.

A very detailed set of questions about homeowner wildfire risk-mitigation actions revealed large differences in whether the actions applied to particular homeowners and whether homeowners had completed that action. For example, even though Oakland and Ruidoso each have a mandatory policy on fire-wise landscaping, homeowners in both communities still had not taken landscaping actions. Even in communities with mandatory programs, the majority of homeowners (64 percent in Ruidoso and 72 percent in Oakland) attributed their wildfire risk-mitigation actions to their own volition.

The findings about defensible-space actions also show that homeowners use different approaches to reduce risks to houses versus green vegetation. The actions related to thinning or maintaining vegetation (e.g., overhanging/dead branches are removed within 10 feet of roof; roof and rain gutters are kept free of leaves, needles, and twigs; green vegetation is maintained at least 30 feet around house) were more common than

Table 4.—Effectiveness of fire safety actions for risk reduction of severe damage to home by wildfire.

	Voluntary Policies (VP)					Mandatory Policies (MP)					Overall (MP vs. VP)	Overall (4 states)
	Larimer Cty, CO		Grand Haven Twp, MI			Ruidoso, NM		Oakland, CA				
Vegetation to House Features	Mean[c]	SD	Mean	SD	Mean (Total)	Mean	SD	Mean	SD	Mean (Total)	T-test	ANOVA df=3
Roof and rain gutters are kept free of leaves needles and twigs	3.8 [2,3,4]	1.09	3.5 [3,4,5]	1.11	3.7	4.0 [2,5]	0.97	4.0 [1,4]	1.03	4.0	6.61***	F=43.65***
Overhanging and dead branches are removed within 10 feet of roof	4.4 [2,3]	0.78	4.0 [3,4,5]	0.94	4.2	4.3 [2,4]	0.81	4.5 [2,3]	0.76	4.4	3.70***	F=14.77***
Green veg. area is maintained at least 30 feet around house	4.1 [2,3]	0.93	3.8 [3,4,5]	0.97	4.0	3.9 [2,4,5]	1.00	4.2 [2,3]	0.89	4.0	0.91	F=1.08***
Trees and shrubs are thinned out within 30-50 ft. of house	4.3 [2]	0.86	3.7 [3,4,5]	0.96	4.0	4.2 [2]	0.91	4.2 [2]	0.90	4.2	3.00**	F=9.62***
Shrubs and lower tree branches that could carry flames from ground into crown are removed	4.3 [2]	0.84	3.8 [3,4,5]	0.93	4.1	4.3 [2]	0.83	4.3 [2]	0.92	4.3	3.50***	F=12.94***
Dead veg. and leaves/needles cleared at least 30feet from house	4.4 [2]	0.77	4.0 [3,4,5]	0.89	4.3	4.4 [2]	0.77	4.5 [2]	0.76	4.4	4.04***	F=20.54***
Yard is landscaped with fire-resistant vegetation	3.6 [4]	1.10	3.5 [4]	1.06	3.6	3.7 [4]	1.13	4.0 [2,3,5]	0.92	3.8	4.17***	F=12.49***
Firewood and lumber are stacked at least 30 feet from all buildings	4.3 [2,3]	0.84	3.9 [3,4,5]	1.00	4.1	4.2 [2,5]	0.92	4.2 [2]	0.97	4.2	0.60	F=0.49***
House has a fire-resistant roof (e.g., asphalt shingles or metal)	4.6 [2]	0.70	4.3 [3,4,5]	0.83	4.4	4.5 [2]	0.75	4.6 [2]	0.68	4.5	2.41*	F=5.77***
House construction materials are fire-resistant	4.1 [4]	0.95	4.0 [4]	0.94	4.1	4.0 [4]	1.02	4.4 [2,3,5]	0.81	4.1	0.48	F=8.15***
Underside of deck is enclosed to keep debris from collecting	3.6 [4]	1.14	3.6 [4]	1.04	3.6	3.7 [4]	1.15	4.0 [2,3,5]	1.02	3.8	3.53***	F=8.05***

[c] Scale where "1" is not effective, "3" is neutral, and "5" is very effective.

[2] Statistically different from Michigan; [3] Statistically different from New Mexico; [4] Statistically different from California; [5] Statistically different than Colorado.

* $p < .05$, ** $p < .01$, and *** $p < .001$.

Table 5.—Motives for defensible-space practices.

Motives	Voluntary Policies (VP)		Mandatory Policies (MP)	
	Larimer Cty, CO (%)	Grand Haven Twp, MI (%)	Ruidoso, NM (%)	Oakland, CA (%)
My household did not take any of the actions (refer to Table 3)	11.7	46.2	8.5	8.3
Voluntarily took one or more of these actions	81.1	39.0	64.2	72.3
Took one or more actions because it was required by law	7.4	0.9	29.0	42.1
My insurance company requires one or more of these actions	5.4	1.4	10.3	5.4
None of the above	4.3	15.3	7.4	4.1

converting landscape to nonflammable vegetation. Importantly, vegetation removal actions such as clearing dead vegetation, leaves, and needles at least 30 feet from a house and removing overhanging and dead branches within 10 feet of the roof were perceived as being almost as effective as the action that was rated most effective: having a house with a fire-resistant roof.

As communities work on the wildland-urban interface wildfire risk by creating or adjusting policies, they can select from the many housing and landscaping options in the 11 defensible practices studied here. Importantly, practices that are not made mandatory may need awareness-building through education and demonstration sites in order to show the benefits to homeowners and the broader community. Overall, this research found that local policies with mandatory provisions influence attitudes and actions toward fire-wise landscaping and home features.

5.0 LITERATURE CITED

Burby, R.J.; May, P.J. 1998. **Intergovernmental environmental planning: Addressing the commitment conundrum.** Journal of Environmental Planning and Management. 41(1): 95-110.

Davis, C. 2001. **The west in flames: The intergovernmental politics of wildfire suppression and prevention.** Publius. 31(3): 97-110.

Plevel, S.R. 1997. **Fire policy at the wildland-urban interface: A local responsibility.** Journal of Forestry. 95(10): 12-17.

Steelman, T.A.; Kunkel, G.F. 2004. **Effective community responses to wildfire threats: Lessons from New Mexico.** Society and Natural Resources. 17(8): 679-699.

USDA Forest Service and U.S. Department of the Interior. 2000. **Managing the impacts of wildfires on communities and the environment: A report to the President in response to the wildfires of 2000.** (National Fire Plan Executive Summary). Washington, DC: U.S Departments of Agriculture and Interior. Available at http://www.nevadarangelands.org/_downloads/Grazing%20Coalition/natl_fire_plan_exec_sum.pdf.

Western Governors' Association. 2001. **A collaborative approach to reducing wildland fire risks to communities and the environment: 10-year comprehensive strategy.** In Western Governors' Association, Key Issues in Brief. Available at www.westgov.org. (Accessed 25 July 2011).

Winter, G.; McCaffrey, S.; Vogt, C. 2009. **The role of community policies in defensible space compliance.** Forest Policy and Economics. 11: 570-578.