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Different interest group views of fuels treatments: survey results from fire and fire surrogate treatments in a Sierran mixed conifer forest, California, USA

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Abstract. The present paper discusses results from a survey about the acceptance of and preferences for fuels treatments of participants following a field tour of the University of California Blodgett Forest Fire and Fire Surrogate Study Site. Although original expectations were that tours would be composed of general members of the public, individual tour groups ultimately were much more specialised, with tours made up of individuals from five distinct groups including foresters, environmentalists, entomologists, the Natural Resource Conservation Service, teachers, and high school or undergraduate students. This proved fortuitous as most studies of 'public' perceptions to date have been of general members of the public and little work has been done assessing the views of groups who may have more specific knowledge or interest in fuels treatments. Such assessment is perhaps long overdue given the importance of understanding characteristics of different audience segments in developing effective outreach programs. Analysis showed that group membership was in fact the key element in differences in survey responses with significant differences found between groups on overall acceptability of treatments, treatment preferences based on different land ownership and management types, and which variables were most important in determining treatment preferences.

Additional keywords: attitudes, group differences, Sierra Nevada, social acceptability, social construction.

Introduction

Since 2000, the National Fire and Fire Surrogate (FFS) Study has established 13 field sites across the United States where the ecological and fire behaviour effects of different fuels treatments are being assessed (Stephens and Moghaddas 2005; Youngblood *et al*. 2005, 2007). In at least one location, Blodgett Forest Research Station, public field tours were given of the treatments after they were completed. Although not originally part of the Blodgett study design, we decided to take the opportunity afforded by the tours to gain a better understanding of tour participants' views of the treatments. We felt it of particular interest given that most studies of public views of fuels treatments take the form of surveys or focus groups where there is no assurance that the respondent has a clear idea of what the treatment looks like and its purpose other than via a brief description. So we developed a brief two-page survey that was provided to each group at the end of their tour.

Initial expectations were that tour participants would consist primarily of general members of the public or individuals with a limited or fairly general knowledge of wildfire issues. However, the final composition of the participants was much more specialised. Ultimately, individual tour groups were made up of individuals from five distinct groups: foresters, environmentalists, entomologists, the Natural Resource Conservation Service, and education (teachers, and high school or undergraduate students). Although not what was originally expected, this proved fortuitous as most studies of 'public' perceptions are of general members of the public and little work has been done assessing the views of groups who may have more specific knowledge or interest in fuels treatments. Such assessment is perhaps long overdue given the importance of understanding characteristics of different audience segments in developing effective outreach programs (Monroe *et al*. 2006) and, in fact, analysis showed that this group membership was the key element in differences in survey responses.

Literature review

Very few studies have looked at the effect of field tours on opinions of fuels treatments. Toman *et al*. (2004) took a subset of mail survey respondents on an on-site visit of prescribed fire sites and provided them with a short questionnaire to assess their reactions to seeing the treatment. The authors found that although respondents indicated that the visit had improved their acceptance of prescribed fire, there was in reality no change between their pre- (mail survey) and post-visit responses on specific questions. The authors provided several possible reasons for the lack of actual change including: small sample size, the lack of resource professionals at the site with whom visitors could discuss the practices, and the fact that participants already had a high degree of familiarity with and acceptance of prescribed fire.

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Several academic fields provide insight for how the public receives new information and underlying reasons for diverse views and for the lack of change when new information is provided. Work in the field of adult learning has shown that, for adults, prior experience and knowledge will colour how they receive new information (Toman *et al*. 2006). One explanation for this is the notion of biased processing, a phenomenon identified in psychological studies whereby individuals process new information through the lens of existing knowledge, attitudes, or values. To maintain cognitive consistency, new information is interpreted to fit established values: information that confirms existing beliefs is given high credibility and information that contradicts it is discounted. In general, the stronger the prior attitude, the more likely new information will be processed in a biased manner (Nickerson 1998).

A study by Teel *et al*. (2006) that examined whether biased processing influenced how individuals responded to new information about a natural resource issue found confirmation for this phenomenon. Their study of how students interpreted new information on drilling in the Arctic National Wildlife Refuge, Alaska, found that attitudes did not change with the provision of new information and respondents interpreted information that supported their opinion more positively than information that did not. Therefore members of our tour groups who have existing knowledge and opinions of a fuels treatment might be expected to interpret new information to support those views.

But how can one understand the diversity of views in response to the same landscape and information? One explanation is that nature is a socially constructed concept. Although ecological and biological dynamics may take place independently of human interaction, the relative importance that is placed on those dynamics will vary according to individual and group values, beliefs, and culture (Greider and Garkovich 1994). In fact, literature exploring perceptual bias suggests that apparent biased response to the same information may not necessarily be a result of discounting certain information but of simply applying different evaluative criteria (Gerber and Green 1999).

How different constructions of nature affect views of appropriate land management is demonstrated in work examining differences in indigenous and European views of the landscape and use of fire. In the United States, recent decades have provided growing evidence that Native Americans were active burners of their landscape. For the northern California Yurok tribe, the landscape was seen as the basis of subsistence indigenous existence, where fire was used as part of an active management effort to ensure that a diverse array of food, building, and spiritual materials were available. For professional foresters, the landscape was seen for most of the last century as a source of a single commodity – timber – where fire was best excluded (Huntsinger and McCaffrey 1995). In Australia, although both Aboriginals and Europeans burn the landscape, Aboriginals have been shown to burn more extensively and informally with burning undertaken with implicit ecological purpose, as part of daily life and guided by stories from the Dreamtime. By contrast, Europeans burn explicitly for ecological purposes using a specialised and highly regulated approach that is guided by science. Aboriginals see the more limited burning that occurs under this approach as leaving the land 'dirty' (Lewis 1989).

Such differences in social constructions of nature can occur at different scales and can change over time. Within the forestry profession over the last century "fire has been deemed as an adversary, a deliberate management tool, and an inevitable natural occurrence. ... The symbols of the profession and the symbols' meanings have changed over time, reflecting changing self-images and changing definitions of appropriate relationships with others and with the natural environment. The forest and fire—the world that is there—have not changed" (Greider and Garkovich 1994).

In examining the cognitive models that informed the thinking of 48 forester managers, Richardson *et al*. (1996) found groups that saw the landscape through four different lenses that were shaped by cultural values (wilderness), personal history (direct economic relationship with the land), professional training (timber management), and institutional factors (middle to upper-level management experience). Examining what shaped homeowner views of defensible space, Nelson *et al*. (2005) found that having a natural landscape was highly valued by most study participants but that what was considered *natural* varied, particularly in terms of whether a lawn was seen as natural. Individuals can thus see the same landscape and come to different conclusions about what is natural, what constitutes acceptable management, and which elements are most important in determining that acceptability.

Methods

Study site and treatment description

The study was undertaken at the University of California Blodgett Forest Research Station (Blodgett Forest), one of the sites in the FFS Study. Located in the north-central Sierra Nevada, ~20 km east of Georgetown, California, Blodgett Forest encompasses 1780 ha of mixed conifer forest including sugar pine (*Pinus lambertiana* Dougl.), ponderosa pine (*Pinus ponderosa* Laws.), white fir (*Abies concolor* Gord. & Glend.), incense-cedar (*Calocedrus decurrens* [Torr.] Floren.), Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), and California black oak (*Quercus kelloggii* Newb.). Although fire was a common ecosystem process in the area before the 20th Century (Stephens and Collins 2004), for the last 90 years the area at Blodgett Forest has been repeatedly harvested and subjected to fire suppression, reflecting a management history common to many forests in California (Laudenslayer and Darr 1990; Stephens 2000) and elsewhere in the western US (Graham *et al*. 2004; Stephens and Ruth 2005).

Four different treatments were implemented on the Blodgett FFS site: a control (no change) treatment, mechanical harvest only, mechanical harvest followed by prescribed fire, and prescribed fire only. Each treatment unit was at least 15 ha in size. Control units received no treatment during the study period (2000–05). Mechanical harvest-only treatment units had a two-stage prescription; in 2001, stands were crown-thinned, followed by thinning from below to maximise crown spacing with the goal to produce an even species mix of residual conifers. (For specifics of treatments, please see Stephens and Moghaddas 2005.) Following the harvest, ~90% of understorey conifers and hardwoods between 2- and 25-cm diameter at breast height (DBH) were masticated in place and the material left on site. Mechanical plus fire treatment units underwent the same initial

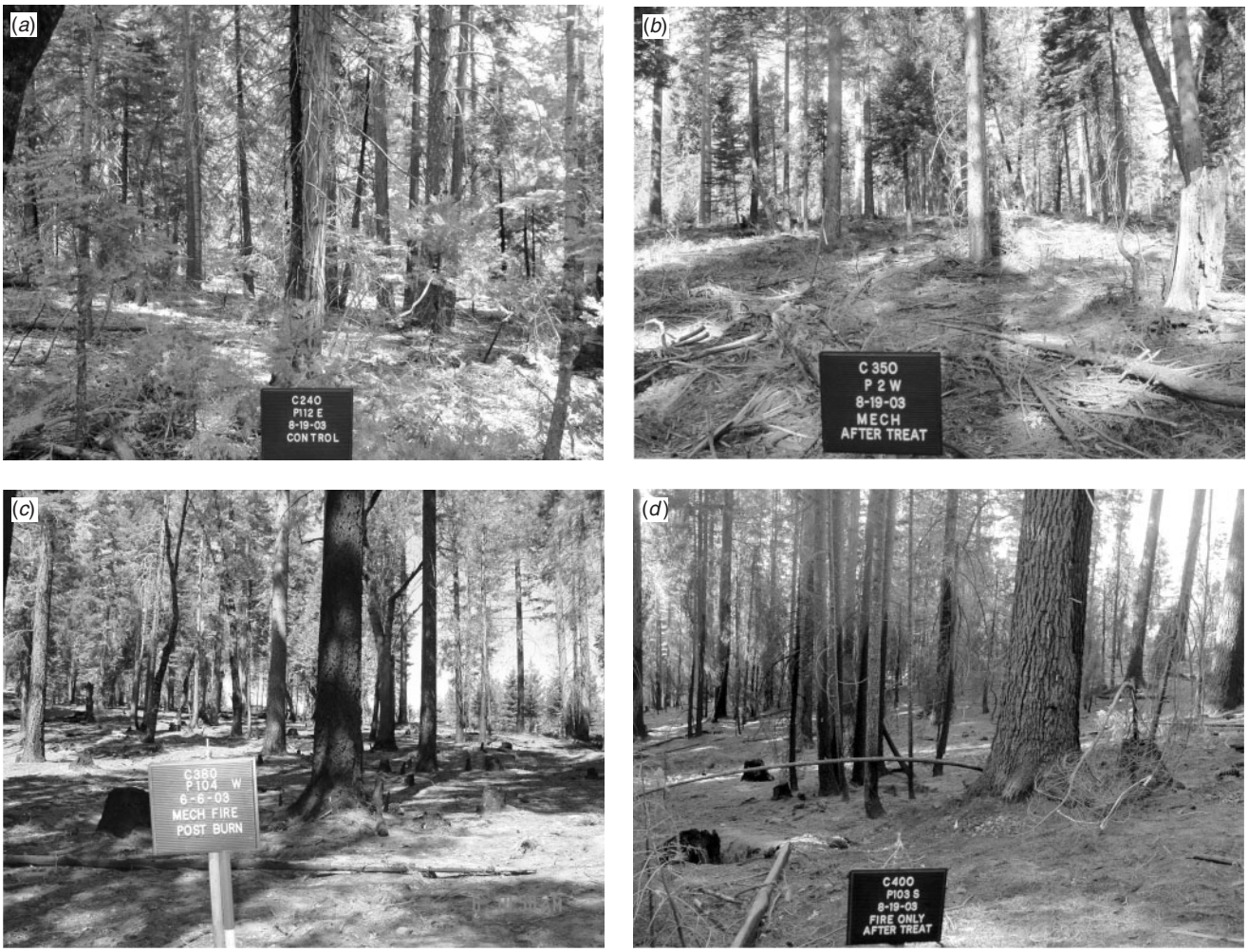

Fig. 1. Four different treatments that tour groups visited. (*a*) Untreated; (*b*) mechanical harvest; (*c*) mechanical harvest followed by prescribed fire; (*d*) prescribed fire.

treatment as mechanical-only units and were then burned using a backing fire (Martin and Dell 1978). Fire-only units were burned with no pretreatment using strip head-fires (Martin and Dell 1978), one of the most common ignition patterns used to burn forests in the western US. All prescribed burning was completed over a short period (23 October 2002–6 November 2002) with the majority of burning being done at night because relative humidity, temperature, wind speed, and fuel moistures were within predetermined levels to produce the desired fire effects (Kobziar *et al*. 2006). Subsequently, each treatment was evaluated for its fire hazard reduction potential (Stephens and Moghaddas 2005).

Survey methods and data analysis

Tour members were first taken to the untreated control unit, then a mechanical harvest-only unit, a mechanical harvest plus fire unit, and finally, a fire-only unit (Fig. 1). The same mechanical harvest (Unit 350), mechanical harvest plus fire (Unit 380), and fire-only (Unit 400) stop points were used for all tour groups. All tours took place after treatments had been fully implemented. Twelve tours were given by the coauthors of the present paper, with one tour being given by the Blodgett Forest Research Manager who was familiar with the treatments and who had attended previous tours. Owing to tour logistics, two control sites (Units 10 and 240) were used but both had similar stand structure, fuel loads, species composition, and management history (Stephens and Moghaddas 2005). As a semiarid forest environment, units viewed during the 18-month tour period did not change dramatically. Trees generally retained scorched needles, and forbs, grasses, and brush remained virtually absent from the understorey in all active treatments; regrowth of brush was not noted until the summer of 2004 (S. L. Stephens, pers. comm., January 2007). At each stop, roughly 20 min were spent explaining the treatments; this was followed by a question and answer period that lasted until all questions had been answered, usually 20–40 min. As the tours were all held concurrently with post-treatment data collection, it was not possible to give tour participants results relating to the ecological or fire hazard reduction effects of the treatment. There is no specific data on what percentage of individual group members asked questions, though all questions from each group were answered before moving to the next treatment unit. A total of 13 tours were hosted from May 2003 to November 2004, starting the first year after all treatments were completed.

Table 1. Demographics of those who took the survey at Blodgett Forest by group (percentage within group)
For, Foresters; Env, Environmentalists; Ent, Entomologists; NRCS, Natural Resource Conservation Service; Ed, Teachers and high school or undergraduate students

	For ($n = 49$)	Env ($n = 29$)	Ent ($n = 43$)	NRCS ($n = 20$)	Ed ($n = 56$)
Gender					
Female	20.5	29	22	44	43
Male	79.5	71	78	56	57
Age[A]					
Under 35	22.5	11	15	28	71
35–54	60	57	61	39	25
Over 54	17.5	32	24	33	4
Education[A]					
Some college or less	0	11.5	0	17	54.5
Bachelor's degree	62.5	27	7	39	20
Graduate or professional degree	37.5	61.5	93	44	25.5
Income[A]					
Under US$25K	5	30	8	0	44
US$25–49K	34	7	13	23.5	21
US$50–74K	26	41	29	35	15
US$75–99K	13	11	24	18	6
≥US$100K	21	11	26	23.5	14

[A] χ^2 significant at $P < 0.001$.

At the end of the tour, participants were asked to voluntarily fill out a two-page survey. The survey addressed five basic questions: general acceptability of each treatment method, whether the tour had changed their opinion of any of the methods, whether the chance to see the treatments or to discuss them was more important in shaping their opinion, treatment preferences based on land ownership or management goals, and what variables (such as reducing fire hazard, effect on wildlife habitat) were most important in their determination of treatment preference. For the land ownership question, respondents were asked to rank the four treatments in order of preference of use for each of three different land management and ownership types: private timber, US Department of Agriculture (USDA) Forest Service (FS), and the US Department of Interior (USDI) National Park Service (NPS). Questionnaires were collected on-site except in one instance where, owing to group size and time constraints, they were mailed back in pre-addressed stamped envelopes. As only 4 of 169 surveys were returned by this group, they have been excluded from this analysis as was one group of only four individuals from the general public. Tour members were unaware that they would be asked to fill out the survey until all questions from the tour group had been answered and the tour had ended.

Individual tour groups were made up of individuals from five distinct groups including (1) foresters, (2) environmentalists, (3) entomologists, (4) the Natural Resource Conservation Service, and (5) teachers and high school or undergraduate students. Specifically, foresters were represented by three tour groups from the Oregon Department of Forestry, the California Forest Soils Council, and the California Forest Pest Council. Environmentalists attended three tours organised by the Sierra Nevada Forest Protection Campaign (Sierra Forest Legacy) and the American River Conservancy. Entomologists attended in a single group of scientists from the International Union of Forest Research Organisations (IUFRO). Three educational groups attended from undergraduate classes from the University of California, Berkeley, and California Polytechnic College, San Luis Obispo, and a group of California primary and secondary school teachers. Finally, one tour group from the Natural Resource Conservation Service (NRCS) attended as part of their annual meeting.

Of the 293 surveys handed out during the survey period, 191 were returned for a 65% response rate. Data were analysed using the SPSS 11.0 statistical software package (Chicago, IL) with initial summary of frequencies. χ^2 was used to identify any significant relationships ($P < 0.05$ unless otherwise noted) between questions and respondent characteristics. For significant relationships, Cramer's V was calculated to measure the strength of the association. In several cases when the data was too sparse to fully meet the distribution assumptions of the χ^2 test, the Monte Carlo approximation of the Exact test was also applied. When the Exact test was used, confidence intervals of significant results are reported in the tables.

Results and discussion

Demographic characteristics

Other than the education group, where the majority had less than a bachelor's degree, over 80% of each group had a bachelor's or higher, with most of the entomologists (93%) indicating they had a graduate level degree (Table 1). A substantial portion of environmentalists (61%) and NRCS (44%) participants also indicated they held a graduate degree. Unsurprisingly, the majority of the education group was under 35. The majority of foresters, entomologists and environmentalists were 35–54 years old. The education and NRCS group had the largest proportion of females (43%) whereas less than 30% of the remaining three groups were female. For income levels, the education and environment groups had the highest proportion of low income

Table 2. Acceptability of treatments at Blodgett Forest by group (percentage)
No significance was found between group membership and acceptability of those treatments that included prescribed fire, so they are not included in the table. For, Foresters; Env, Environmentalists; Ent, Entomologists; NRCS, Natural Resource Conservation Service; Ed, Teachers and high school or undergraduate students

	For	Env	Ent	NRCS	Ed
Mechanical harvest (χ^2 conf. interval[A] = 0.000–0.001, Cramer's V = 0.238)					
Completely acceptable	40	11	37	40	20
Somewhat acceptable	42	30	35	35	47
Neutral	9	15	12	10	27
Somewhat unacceptable	9	26	9	15	6
Completely unacceptable	–	18	7	–	–
Untreated (χ^2 conf. interval[A] = 0.000–0.002, Cramer's V = 0.234)					
Very acceptable	9	11	25	5	7
Somewhat acceptable	7	21	12.5	17	13
Neutral	14	18	17.5	–	24
Somewhat unacceptable	49	43	30	22	48
Completely unacceptable	21	7	15	56	7

[A] χ^2 significance using Monte Carlo Exact Test Approximation, 99% confidence interval based on 10 000 sampled tables.

respondents, whereas the entomologists were skewed towards the higher income level. One notable difference between groups is where the entomologists lived. All of the members of the other four groups came from the surrounding region – either California or Oregon. Members of the entomology group, who were attending a conference sponsored by the International Union of Forest Organisations, hailed from a much wider area. Only one-third of the entomologists came from California or Oregon with the remainder coming from across the US as well as New Zealand, Canada, Belgium, and Czechoslovakia.

Demographic variables were statistically related to responses in a few cases but in a less comprehensive or consistent manner than group membership. In fact, given the strong correlation found between the demographic variables and the five groups, it is likely that in most cases the finding is a reflection of or confounded by group membership. For example, education was significantly related with views on acceptance of mechanical harvest. Those with more education were more likely to find the practice completely acceptable but also were more likely to find it somewhat to completely unacceptable. The two groups with the highest education levels were entomologists (who were more likely to find it acceptable) and environmentalists (who were more likely to find mechanical harvest unacceptable) (see Table 2). Although being able to tie specific views to demographics factors may appear to provide a straightforward means of understanding public views, if demographic factors are not significant, not consistent in their effect, or simply reflections of other more dominant issues, then care needs to be taken in attributing too much importance to demographic variables.

Treatment acceptability

Overall, there was a clear preference for using prescribed fire as some part of the treatment process, with 89% finding use of prescribed fire alone (PF) somewhat to very acceptable and 83% finding mechanical harvest followed by prescribed fire (MPF) acceptable; ~57% of all respondents found either treatment very acceptable. Mechanical harvest alone (MH) was only very acceptable to 29% but somewhat acceptable to another 40%. Conversely, the untreated site was not acceptable to 40% and completely unacceptable to 18%. These responses are similar to those found in surveys of the more general public where roughly 80% of respondents have found mechanical harvest or use of prescribed fire a somewhat to fully acceptable management tool (Blanchard 2003; Brunson and Shindler 2004; Winter *et al*. 2005).

No difference was found between groups for the general acceptability of the treatments that included prescribed fire, but there were significant differences for acceptability of mechanical harvest and no treatment (Table 2). As might be expected, the forester, entomologist, and NRCS groups found mechanical harvest alone an acceptable method, with roughly 40% finding it fully acceptable and another 35–40% finding it somewhat acceptable. The education group also found MH generally acceptable although they leaned towards somewhat acceptable (47%) or neutral (27%). Less than 16% of these four groups found MH an unacceptable practice, with no respondents in three groups finding it completely unacceptable. Comparatively, 18% of environmentalists found it completely unacceptable. For no treatment, entomologists were most likely to find it very acceptable (25%) and environmentalists somewhat acceptable (21%). NRCS participants had relatively strong opinions on the no-treatment option with no members indicating a neutral opinion (compared with 14 to 24% of the other four groups) and over half of the group judging it a completely unacceptable option.

Changes in opinions

Touring the treatments did not have a strong positive or negative effect on views related to mechanical harvest, with most (63%) saying the tour did not change their views and roughly equal portions of the remainder saying it had either a positive or negative effect. Touring had the most positive effect on views of prescribed fire (for the MPF treatment, 44% said they had a

Table 3. General treatment preference rankings for three different United States land management types (percentage)

Treatment ranking	Prescribed fire	Mechanical harvest	Mechanical + prescribed fire	Untreated
National Park Service land				
Most preferred	57	5	29	10
2nd most preferred	21	21	36	26
3rd most preferred	13	44	29	11
Least preferred	9	30	6	53
Forest Service land				
Most preferred	32	14	50	4
2nd most preferred	29	29	38	4
3rd most preferred	32	45	8	14
Least preferred	7	11	4	78
Private timber land				
Most preferred	16	35	49	1
2nd most preferred	25	31	37	7
3rd most preferred	50	29	11	8
Least preferred	9	4	3	84

more positive view and only 11% a more negative view; for PF, 33% indicated a more positive view and only 6% a more negative view). For the untreated area, touring had a strong negative effect on those whose opinions changed, although most (74%) indicated that their views had not changed.

Mechanical harvesting was the only treatment where group membership was significantly related with whether the site visit changed opinions. Touring the mechanical harvest treatment had the strongest effect on the education group, half of whom did not change their view, whereas 38% had a more positive view and 13% a more negative view. Touring had the least effect on NRCS respondents, where 84% indicated their view had not changed and 11% indicated a more positive opinion. Twenty one percent of foresters and entomologists indicated a more positive view whereas 12 and 14% (respectively) indicated a more negative view. The only group where touring the mechanical harvest treatment did not have a stronger positive than negative effect were the environmentalists, where rather notably zero members of the group indicated a more positive view and 37% indicated they had a less positive opinion.

Treatment preferences for different land ownership and management

Overall, participants appear to recognise the role of different ownership and management goals in treatment choices as distinctly different preference patterns were evident for the three land management types. The clearest preferences were for USDI-NPS land, where prescribed fire was the preferred method, alone as first choice and combined with mechanical harvest as second choice (Table 3). This matches findings from a study at Grand Canyon National Park, which found that fire was the preferred primary vegetation manipulation tool within the park (Muleady-Mecham *et al*. 2004). Although untreated was least preferred of the four, it was not a strong preference as only half of respondents ranked it fourth.

Preference patterns were generally similar for USDA-FS and private timber land, with a slight leaning towards mechanical harvest for private timber as a preferred method and towards use of prescribed fire for the Forest Service. For both private timber and FS land, mechanical harvest plus prescribed fire was the preferred treatment for half of respondents. The second-preferred treatment was distributed fairly evenly between the three active treatments, whereas the third-ranked treatment was more varied with prescribed fire ranked third for private timber and mechanical harvest ranked third for the FS land. Both of these land types had roughly 80% of respondents rank no treatment as least preferred. These findings parallel Toman and Shindler's (2003) study in Oregon where 75% of respondents chose selective thinning followed by prescribed fire as the preferred treatment for build up of dead trees in the Blue Mountains. Only 18% of our respondents indicated that their rankings would change if the treatment was on land within 1 mile (1.6 km) of their house; two-thirds indicated their rankings would not change, and the remainder were not sure.

The group differences in treatment rankings for different land ownership are particularly interesting, indicating both that different groups of the public have different preferences and that even within groups preferences are not uniform. For all land types, there were no significant differences between groups for MPF, which, as discussed earlier, was the overall preferred treatment for all land types. For the remaining three treatments, there were significant differences between groups. For the no-treatment option, the rankings were so strongly weighted towards its being the least preferred treatment that the rankings were collapsed into two groups: the top three rankings (1–3) and the last (4) (Table 4). For FS and private timber land, not treating the land was the least preferred option for a vast majority of all but the environmental group, with 100% of foresters ranking it least preferred for both land types and only 40–46% of the environmental group ranking it least preferred. For NPS land, not treating the land was a more acceptable option to foresters with only 65% ranking it last.

Table 4. Group difference in ranking no treatment as the least preferred option on three different land management types

For, Foresters; Env, Environmentalists; Ent, Entomologists; NRCS, Natural Resource Conservation Service; Ed, Teachers and high school or undergraduate students

Treatment rankings – untreated	% within group for each ranking category					χ^2 (sig.)	Cramer's V
	For	Env	Ent	NRCS	Ed		
Rank of 4 (least preferred option)							
National Park Service land	65	21	40	87.5	59	0.01	0.357
Forest Service land	100	40	73	100	78	0.00	0.456
Private timber land	100	46	83	86	87.5	0.00	0.429

Table 5. Group difference in treatment rankings for prescribed fire on three different land management types

χ^2 (sig.), from Monte Carlo Exact Test Approximation, 99% confidence interval based on 10 000 sampled tables. For, Foresters; Env, Environmentalists; Ent, Entomologists; NRCS, Natural Resource Conservation Service; Ed, Teachers and high school or undergraduate students

Prescribed fire treatment rankings	% within group for each ranking category					χ^2 (sig.)	Cramer's V
	For	Env	Ent	NRCS	Ed		
National Park Service lands							
Most preferred	54	69	61.5	12.5	62.5	0.000–0.000	0.403
2nd most preferred	29	–	23	–	28		
3rd most preferred	17	–	11.5	75	–		
Least preferred	–	31	4	12.5	9		
Forest Service lands							
Most preferred	12.5	60	30	37.5	34	0.000–0.002	0.321
2nd most preferred	42	7	41	–	28		
3rd most preferred	46	7	26	62.5	31		
Least preferred	–	27	4	–	6		
Private timber lands							
Most preferred	4	23	20	12.5	19	0.048–0.059	0.260
2nd most preferred	17	31	24	25	28		
3rd most preferred	78	15	52	50	44		
Least preferred	–	31	4	12.5	9		

Use of prescribed fire and mechanical harvesting are often seen as more controversial treatment options and this was shown in the more dispersed group responses, so categories were not collapsed for these two treatment types. For prescribed fire, the forester, entomologist, and education groups indicated that it was a more preferred option on NPS land and a less preferred choice for private timber land, whereas the NRCS group tended to see use of PF as a less-preferred option for all three land types (Table 5). The environmental group distribution is interesting, showing a fairly mixed response for its use on private timber lands but with responses divided between the highest or lowest rank for NPS and FS lands.

Mechanical harvest alone had the most diversity across groups, although all but the environmental group tended to favour middle rankings for its use (Table 6). The NRCS group interestingly ranked MH as either the first or second most preferred option for NPS land. Foresters ranked mechanical harvest lower for NPS land but favoured it for private timber lands. Notably for FS land, although no forester ranked MH fourth, 46% did rank it as the third-preferred option, which some might not expect of foresters. Similarly, given a tendency to see environmentalists as anti-logging, it is useful to note that for NPS and FS land, roughly a third of the group ranked it the second-preferred option and only a third ranked it as least preferred.

The Cramer's V for all of the significant relationships demonstrates a strong association between group membership and treatment rankings. The strength of this association gives further credence to the idea that, although the causality is uncertain, there is a strong connection between one's profession and views of appropriate land management.

Influences on rankings

Both the ability to see the treatments and the ability to discuss them with experts were seen by respondents as valuable aspects of the tour, with almost half saying they were equally important. Overall, respondents weighted seeing the treatments as slightly more important than discussing them. No significant difference between groups was found in these variables.

In terms of how different considerations influenced treatment preferences, forest health and fire hazard reduction were

Table 6. Group difference in treatment rankings for mechanical harvest on three different land management types
χ^2 (sig.), from Monte Carlo Exact Test Approximation, 99% Confidence Interval based on 10 000 sampled tables. Only two respondents chose the least preferred option for Private timber lands so it has been combined with the 3rd preferred option. For, Foresters; Env, Environmentalists; Ent, Entomologists; NRCS, Natural Resource Conservation Service; Ed, Teachers and high school or undergraduate students

Treatment rankings – mechanical harvest	% within group for each ranking category					χ^2 (sig.)	Cramer's V
	For	Env	Ent	NRCS	Ed		
National Park Service lands							
Most preferred	8	–	–	12.5	6	0.000–0.002	0.327
2nd most preferred	17	31	12.5	87.5	9		
3rd most preferred	48	31	50	–	53		
Least preferred	23	38	37.5	–	31		
Forest Service lands							
Most preferred	33	–	15	–	9	0.001–0.004	0.311
2nd most preferred	21	27	18	75	34		
3rd most preferred	46	40	59	25	41		
Least preferred	–	33	7	–	16		
Private timber lands							
Most preferred	48	8	35	50	34	0.022–0.030	0.291
2nd most preferred	39	15	31	37.5	31		
3rd or least preferred	13	77	35	12.5	34		

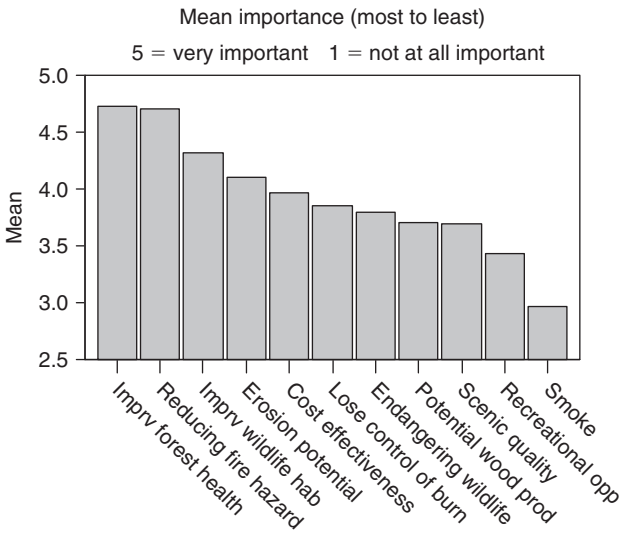

Fig. 2. Importance of issues considered when determining treatment preferences from survey at Blodgett Forest.

the key variables that guided preferences (Fig. 2), with 80% of respondents rating each of the two concerns as a very important consideration. Concern about wildlife habitat, erosion, and cost effectiveness were also important, with ~80% finding them somewhat to very important. Least important were the issues around recreation and notably, smoke, where only 30% found each factor a somewhat to very important consideration. That smoke is the lowest-rated consideration may surprise many managers, who often contend with strong public objections to fuels treatments due to smoke concerns. However, the finding matches those from a study by Brunson and Shindler (2004) where smoke was of 'great concern' to 13–25% of residents surveyed in Arizona, Colorado, Oregon, and Utah and also matches findings from several studies where roughly one-third of respondents indicated that they or a member of their household had a health issue affected by smoke (McCaffrey 2002; Blanchard 2003; Toman and Shindler 2003; Winter *et al*. 2005). Although smoke is an important consideration for a small proportion of the population in the current study, it is likely a highly salient one for those individuals for whom it is health issue. Such individuals may be more likely to vocalise their concerns than the larger proportion of individuals for whom cost effectiveness and wildlife habitat are considered more important, but perhaps less salient, considerations.

For analysis between groups, the five-point scale was collapsed to three categories (important, neutral, unimportant). Although there was no significant differentiation between groups for the two most important issues of forest health and fire hazard reduction, there was for several other variables including cost effectiveness, recreation, and potential for wood products. Environmentalists and entomologists were much less likely to think cost effectiveness an important consideration, with just under 50% of these two groups rating it important compared with over 80% of the remaining three groups. In terms of recreation, environmentalists and foresters placed less emphasis on recreation with only one-third of these two groups rating it important, *v.* 53 to 63% of the remaining three groups. For wood products, foresters (77%) and entomologists (80%) were most likely to think it an important consideration, although more than half of the NRCS and education groups also judged it as such. Notably, environmentalists were rather split with 43% indicating it important, 18% indicating a neutral view, and 39% indicating it was unimportant. There was no significant difference between the groups for the importance placed on smoke. This reinforces the idea discussed earlier that active concern over smoke is more likely a result of personal health concerns than professional training and beliefs.

Conclusion

There is good acceptance of all three of the active treatments across groups. Participant rankings of treatment preference also are congruent with related findings on treatment effectiveness in reducing fire hazard at the study site[A]. These findings, combined with the fact that concerns about reducing fire hazard and increasing forest health were the key consideration in treatment preference, suggest that participants understand and value the role of different treatments in reducing fire hazard.

However, our results also show that views can vary significantly for different groups. Some of these groups may have a large amount of variability in their views, whereas others may be more consistent. The treatment rankings for different land management types demonstrate that although group membership influences how treatments are viewed, these views are not rigid but take context into account. For instance, environmentalists showed a clear preference across land types for use of prescribed fire over mechanical harvest, but did recognise management context, as much less emphasis was placed on use of prescribed fire on private timber lands.

The fact that different groups have different views of fuels treatments is not surprising. However, given that many outreach efforts tend to be developed for an undifferentiated audience, the findings are a useful reminder of the variability that exists and may provide one reason why many outreach efforts do not necessarily lead to stronger approval of a treatment method. What influences treatment acceptance and preferences will vary for different individuals and different groups as new information is fitted into already existing constructions of nature and appropriate management.

These findings support work done in other fields examining how individuals respond to new information and characteristics of effective communication programs that have found that effective outreach programs are tailored to the concerns and values of the specific audience (see Monroe *et al*. 2006 for a synthesis of this work relevant to fire outreach efforts). The differences we found between groups suggest that when objections to a fuel treatment are raised, they are likely due to the views of specific subsets of the public. However, although the present study clearly demonstrates that treatment acceptance and preference vary for different groups, it offers only limited insight into the values and constructions of nature that shape these differences. Future research to better understand these differences and the particular values that matter to each group would provide managers with valuable information to tailor outreach and management plans to take into account diverse values that exist within 'the public'.

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References

Blanchard BP (2003) Community perceptions of wildland fire risk and fire hazard reduction strategies at the wildland–urban interface in the North-eastern United States. MRP Thesis, University of Massachusetts, Amherst.

Brunson MW, Shindler BA (2004) Geographic variation in social acceptability of wildland fuels management in the western United States. *Society & Natural Resources* **17**, 661–678. doi:10.1080/08941920490480688

Gerber A, Green D (1999) Misperceptions about perceptual bias. *Annual Review of Political Science* **2**, 189–210. doi:10.1146/ANNUREV.POLISCI.2.1.189

Graham RT, McCaffrey S, Jain TB (Tech. Eds) (2004) Science basis for changing forest structure to modify wildfire behavior and severity. USDA Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-120. (Fort Collins, CO)

Greider T, Garkovich L (1994) Landscapes: the social construction of nature and the environment. *Rural Sociology* **59**(1), 1–24.

Huntsinger L, McCaffrey S (1995) A forest for the trees: forest management and the Yurok environment. *American Indian Culture and Research Journal* **19**, 155–192.

Kobziar L, Moghaddas JJ, Stephens SL (2006) Tree mortality patterns following prescribed fires in a mixed conifer forest. *Canadian Journal of Forest Research* **36**, 3222–3238. doi:10.1139/X06-183

Laudenslayer WF, Darr HH (1990) Historical effects of logging on forests of the Cascade and Sierra Nevada ranges of California. In 'Transactions of the Western Section of The Wildlife Society 2632-23'. (USDA Forest Service: Washington, DC) Available at http://www.treesearch.fs.fed.us/pubs/20500 [Verified 12 March 2008]

Lewis HT (1989) Ecological and technological knowledge of fire: Aborigines versus park rangers in northern Australia. *American Anthropologist* **91**(4), 940–961. doi:10.1525/AA.1989.91.4.02A00080

Martin RE, Dell JD (1978) Planning for prescribed burning in the inland Northwest. USDA Forest Service, Pacific Northwest Research Station, General Technical Report PNW-66. (Portland, OR)

McCaffrey SM (2002) For want of defensible space a forest is lost: homeowners and the wildfire hazard and mitigation in the residential wildland intermix at Incline Village, Nevada. PhD Dissertation, University of California, Berkeley.

Monroe MC, Pennisi L, McCaffrey S, Mileti D (2006) Social science to improve fuels management: a synthesis of research related to communicating with the public on fuels management efforts. USDA Forest Service, North Central Research Station, General Technical Report NC-267. (St Paul, MN)

Muleady-Mecham NE, Lee ME, Burch BD (2004) A public opinion survey on wildland fire in Grand Canyon National Park. *The George Wright Forum* **21**, 12–21.

Nelson KC, Monroe MC, Fingerman Johnson J (2005) The look of the land: homeowner landscape management and wildfire preparedness in Minnesota and Florida. *Society & Natural Resources* **18**, 321–336. doi:10.1080/08941920590915233

Nickerson RS (1998) Confirmation bias: a ubiquitous phenomenon in many guises. *Review of General Psychology* **2**, 175–220. doi:10.1037/1089-2680.2.2.175

Richardson CW, Lee RG, Miller ML (1996) Thinking about ecology: cognition of Pacific Northwest forest managers across diverse institutions. *Human Organization* **55**, 314–323.

Stephens SL (2000) Mixed conifer and upper montane forest structure and uses in 1899 from the central and northern Sierra Nevada, CA. *Madrono* **47**, 43–52.

Stephens SL, Collins BM (2004) Fire regimes of mixed conifer forests in the north-central Sierra Nevada at multiple spatial scales. *Northwest Science* **78**, 12–23.

[A]The mechanical plus fire treatment was found most effective in reducing potential fire behaviour and effects followed by the fire-only and mechanical-only treatments. The control or no treatment did nothing to mitigate existing fire hazards (Stephens and Moghaddas 2005).

Stephens SL, Moghaddas JJ (2005) Experimental fuel treatment impacts on forest structure, potential fire behavior, and predicted tree mortality in a mixed conifer forest. *Forest Ecology and Management* **215**, 21–36. doi:10.1016/J.FORECO.2005.03.070

Stephens SL, Ruth LW (2005) Federal forest fire policy in the United States. *Ecological Applications* **15**, 532–542. doi:10.1890/04-0545

Teel TL, Bright AD, Manfredo MJ, Brooks J (2006) Evidence of biased processing of natural resource-related information: a study of attitudes toward drilling for oil in the Arctic national wildlife refuge. *Society & Natural Resources* **19**, 447–463. doi:10.1080/08941920600561140

Toman E, Shindler B (2003) Hazardous fuel reduction in the Blue Mountains: public attitudes and opinions. In 'Fire, Fuel Treatments, and Ecological Restoration: Conference Proceedings', 16–18 April 2002, Fort Collins, CO. (Tech. Eds PN Omi, LA Joyce) USDA Forest Service, Rocky Mountain Research Station Proceedings, RMRS-P-29. pp. 241–254. (Fort Collins, CO)

Toman E, Shindler B, Reed M (2004) Prescribed fire: the influence of site visits on citizen attitudes. *The Journal of Environmental Education* **35**, 13–17. doi:10.3200/JOEE.35.3.13-33

Toman E, Shindler B, Brunson M (2006) Fire and fuel management communication strategies: citizen evaluations of agency outreach activities. *Society & Natural Resources* **19**, 321–336. doi:10.1080/08941920500519206

Winter G, Vogt C, McCaffrey SM (2005) Community views of fuels management on the Mark Twain National Forest and comparisons to other study sites. USDA Forest Service, North Central Research Station, Survey Data Report. (Evanston, IL)

Youngblood A, Metlen K, Knapp EE, Outcalt KW, Stephens SL, Waldrop TA, Yaussy D (2005) Balancing ecosystem values: innovative experiments for sustainable forestry. USDA Forest Service, Pacific Northwest Research Station, General Technical Report PNW-635. (Eds CE Peterson, DA Maguire) pp. 315–321. (Portland, OR)

Youngblood A, Bigler-Cole H, Fettig CJ, Fiedler C, Knapp EE, Lehmkuhl JF, Outcalt KW, Skinner CN, Stephens SL, Waldrop TA (2007) Making Fire and Fire Surrogate Science Available: A Summary of Regional Workshops with Clients. USDA Forest Service, Pacific Northwest Research Station, General Technical Report PNW-727. (Portland, OR0029)

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