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Source: Rangeland Ecology and Management, 67(5) : 573-583

Published By: Society for Range Management

URL: https://doi.org/10.2111/REM-D-13-00016.1

Rangeland Ecol Manage 67:573–583 | September 2014 | DOI: 10.2111/REM-D-13-00016.1

Acceptance, Acceptability, and Trust for Sagebrush Restoration Options in the Great Basin: A Longitudinal Perspective

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Abstract

In surveys of residents in three urban and three rural locations in the Great Basin we examined the social acceptability of six management practices showing promise for restoring sagebrush-dominated rangelands. Unlike most studies of range management perceptions that have relied on single measurements, we used longitudinal data from a questionnaire mailed in 2006 to residents that were resurveyed in 2010. Overall, 698 respondents comprised the panel. Respondents' self-reported levels of knowledge about the health and management of Great Basin rangelands *decreased* from 2006 to 2010. In both years, mean acceptance was greater for the use of prescribed fire, grazing, felling, and mowing, but relatively low for chaining and herbicide use. Overall, acceptability ratings were similar in 2006 and 2010 but individually about half of the acceptance responses differed between years. Practices were more acceptable to respondents who expressed greater concern about threats posed by inaction, except that the threat of wildfire was negatively associated with acceptance for prescribed burning. Acceptance was not significantly related to concern about overall health of Great Basin rangelands, or to self-reported knowledge level. Rural/urban residence and general attitudes toward environmental protection were sometimes influential, but more so in 2006 than in 2010. By far the best predictor of acceptance was trust in agencies' ability to implement the practice. In both years respondents were more likely to judge a practice acceptable than to trust agencies to use the practice. Positive or negative change in trust level was the most significant predictor of change in acceptability judgment from 2006 to 2010. Results suggest that efforts to increase acceptance of practices among Great Basin stakeholders should focus on activities designed to build trust rather than simply providing more or better information.

Key Words: fuels reduction, mail survey, public perceptions, wildfire risk

INTRODUCTION

Large fires are historically common in many ecosystems, but more recently their severity and extent, coupled with a growing wildland–urban interface, have driven up costs of suppression, devastation to private property, and rehabilitation, especially in sagebrush and ponderosa pine–dominated ecosystems (Keane et al. 2008). In sagebrush regions of the Great Basin, a number of factors—including the invasion of nonnative grasses and expansion of woody species—have converged to cause landscape-level ecosystem changes (Shinneman and Baker 2009; McIver and Brunson 2014). Some of these changes include altered fire regimes, changes in soil fertility, loss of forage production, and changes in wildlife habitat (Miller and Tausch 2001). At the same time, expanding urban areas have increased pressure on rangelands to accommodate demands for resource and amenity values, while heightening residents' exposure to wildfire and other range management issues. The values and expectations of urban residents are often in conflict with those of traditional resource-based users in range and forest landscapes (Shindler et al. 2011). Thus, land managers face a complex and interrelated set of ecological, economic, and social challenges while working to create land management strategies that are both ecologically sound and socially acceptable (Kaufmann et al. 1994; Loomis 2002; Shindler et al. 2002).

The Great Basin is one of the most sparsely populated regions in the lower 48 United States, with about 5 million people living in an area covering more than 60 million ha (Torregrosa and Devoe 2008). The regional economy has been based largely on federal contracts and employment, mining, livestock, and energy production (Soulard 2006); extractive land uses have been the norm. However, the states of Nevada, Utah, Idaho, and to a lesser extent Oregon, have had some of the nation's fastest-growing populations. Much of that growth has occurred via in-migration to metropolitan areas (Bend, Boise, Reno, and Salt Lake–Ogden–Provo) along the edges of the basin, while the region's interior remains largely in public ownership and is characterized by widely dispersed resource-dependent communities. The sagebrush steppe is said to be among the most imperiled ecosystems in North America (Mac et al. 1998; Davies et al. 2011), with more than half of the original habitat invaded by exotic annual grasses (West 2000) and more than 350 sagebrush-associated plants and animals identified as species of conservation concern (Suring et al.

This is Contribution Number 82 of the Sagebrush Steppe Treatment Evaluation Project (SageSTEP), funded by the US Joint Fire Science Program, the Bureau of Land Management, the National Interagency Fire Center, and the Great Northern Landscape Conservation Cooperative. Additional support was provided by the Utah Agricultural Experiment Station, which has approved this research as journal paper number 8641.

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Manuscript received 27 January 2013; manuscript accepted 12 February 2014.

2005). Conversion of native sagebrush to exotic annual grasslands also has economic and social consequences due to an increase in catastrophic wildfire and resultant firefighting and restoration costs, as well as the potential loss of land-use opportunities if species such as greater sage-grouse (*Centrocercus urophasianus*) are listed as federally threatened (Garcia 2005). With about 70% of sagebrush habitat in the Great Basin under federal management, the restoration of sagebrush lands is a top priority for the Bureau of Land Management (BLM) and the Forest Service.

Active restoration of at-risk sagebrush communities requires management interventions that promote the success of native shrub and bunchgrass communities while reducing conifer encroachment and cheatgrass invasion (Shindler et al. 2011; McIver and Brunson 2014). Practices such as prescribed burning, mowing, mastication, and herbicide application create visible impacts and potential environmental changes that may be viewed unfavorably by some citizens (Shindler et al. 2002). To gain public support for such activities, land managers with the BLM, Forest Service, and other agencies have sought to persuade citizens of the need for restoration, and that active manipulation of rangelands is the best way to achieve it. However, these agencies have traditionally seen mixed success in garnering public support for management programs (Satyal 2006; Wilmot and Brunson 2008). Effective restoration of rangeland ecosystems will require consideration of citizens in the region and their acceptance of specific management practices, as well as confidence in the agencies to effectively implement them.

This study focuses on social acceptability—the tendency within a particular segment of the public to agree that a management practice is likely to lead to a favorable change in conditions. "Acceptability" is an attribute of a management practice or landscape condition; "acceptance" is a psychological judgment by an individual that can be aggregated to produce a measure of acceptability (Shindler et al. 2002). Social acceptability is multidimensional, depending on factors such as personal experience, relationships with organizations or individuals, values associated with a specific place, perceptions of risk, and even aesthetics (Stankey and Shindler 2006). We measured the social acceptability of six practices that have potential for restoring sagebrush ecosystems in the Great Basin that are threatened by annual grass invasion or conifer encroachment, and explored how acceptability may change over time. We also identified social and psychological factors that can influence individual judgments of acceptance and therefore affect social acceptability.

Few studies examine citizen perspectives on land management or perceptions of management agencies in rangeland ecosystems (Brunson and Tanaka 2011). Furthermore, most studies of this kind rely on a cross-sectional design, taking a snapshot of a single community or limited region at one point in time. The study presented here is longitudinal (2006–2010) in design and uses panel data from a survey of communities across the Great Basin. Longitudinal panel studies resurvey the same group of individuals (the panel) at two or more points in time (Menard 2002), enabling the researcher to more confidently make generalizations about the target population and track changes over time (Frees 2004).

No other study has taken a comprehensive, longitudinal look at communities across the Great Basin. The closest analogue is a recent longitudinal survey of residents in seven US states—including one area of the Great Basin near Salt Lake City—completed by Shindler et al. (2009). They looked at changes in public acceptance of fuel management practices, as well as trust in management agencies (among other factors) between 2002 and 2008. Similarly, Brunson and Evans (2005) used longitudinal data collected from a rural area outside of Salt Lake City to determine the impact of an escaped prescribed fire on the acceptance of fire as a management tool. Shindler and Toman (2003) also conducted a longitudinal study focused on public attitudes toward fire management programs on federal lands in eastern Washington and Oregon between 1996 and 2000.

Research has shown that trust and confidence in rangeland and forest management agencies are key factors in people's acceptance of management practices (e.g., Winter et al. 2004; van Kooten et al. 2006). Research suggests citizens' trust in agencies is influenced by their knowledge of management practices (Shindler et al. 2009), agencies' perceived competence to safely implement practices (Brunson and Evans 2005), transparency in agency communications (Wagner and Fernandez-Gimenez 2008), and the sincerity of agency communications and decision-making processes (Vaske et al. 2007). Siegrist and Cvetkovich (2000) argue that trust in authorities has greater influence on acceptance when an individual lacks knowledge about a potential hazard, but other studies have shown that knowledge, while sometimes influential, may be less important than more subjective or emotional responses (Brunson and Shindler 2004). The latter study found no relationship between acceptability judgments for fuels reduction and general environmental concern, but other researchers have found such a relationship when measuring acceptability of timber harvest practices (Ribe 2002; Ford et al. 2009). Beliefs about natural resource management often differ between urban and rural residents (e.g., Kleiven et al. 2004; Racevskis and Lupi 2006); we have seen such differences in our survey as well (Shindler et al. 2011). However, Brunson and Shindler (2004) concluded that for fuel-hazard reduction, geographic variability in beliefs reflected fire histories, land type, and other factors besides rural/urban differences.

Hypotheses

We tested six hypotheses concerning factors that previous studies have suggested could influence individual acceptance of proposed restoration and/or fuels management practices, and thereby social acceptability of those practices. To evaluate the importance of these factors in engendering *change* in acceptance—a potentially critical goal for land managers seeking to use a particular practice—we also tested whether changes in acceptance were linked to changes in the independent variables in hypotheses 1–3 and 6 below:

- H1: A restoration/fuels treatment is more likely to be judged acceptable if the individual has a higher level of concern about threats posed by inaction, such as wildfire risk, cheatgrass invasion, juniper encroachment, or overly dense sagebrush.
- H2: A restoration/fuels treatment is more likely to be judged acceptable if the individual believes the current condition of the natural environment is unhealthy.

- H3: A restoration/fuels treatment is more likely to be judged acceptable by individuals who report they are better informed about the management and condition of natural environments in the Great Basin.
- H4: A restoration/fuels intervention is *less* likely to be judged acceptable if the individual holds beliefs that favor environmental protection over human uses.
- H5: Acceptability of restoration/fuels treatments is associated with the individual's geographic location (state, rural vs. urban area).
- H6: A restoration/fuels treatment is more likely to be judged acceptable if the individual trusts land managers' ability to implement that treatment safely and effectively.

METHODS

This longitudinal panel study used a mail-back questionnaire sent to a random sample of residents in urban and rural communities in the Great Basin in 2006 and again in 2010. Communities included the region's three largest cities of Boise, Reno, and Salt Lake City, and rural areas in Elko and White Pine counties in Nevada, Lake and Harney counties in Oregon, and Beaver and Millard counties in Utah. To maintain continuity, questions from the 2006 survey (Shindler et al. 2011) were replicated in the 2010 version.

The mail-back survey methodology followed standard recommendations by Dillman (1978), including a three-wave protocol. All 339 respondents to the original 2006 survey were resurveyed in the summer of 2010. A total of 698 surveys were received, for an overall adjusted response rate of 59% after accounting for respondents who had moved out of the study region or were deceased. This response level is considered sufficient for a descriptive study of this nature (Needham and Vaske 2008). Given the time that had passed since the initial survey, it was impractical to contact nonrespondents by phone to test for nonresponse bias. Instead, panel members (those who responded to both surveys) were compared to nonmembers (those who only responded to the 2006 survey) to look for differences that could impact the sample's representativeness. Looking at responses to key questions in the 2006 survey, few significant differences were found between the two groups (based on an independent samples *t* test). Most notably, panel members tended to be more educated than nonmembers.

Data analysis focused primarily on significant changes in panel members' response to quantitative questions replicated between the 2006 and 2010 surveys. Following Vaske (2008), ordinal variables with response categories on a Likert scale (i.e., strongly disagree to strongly agree) were treated as continuous variables, allowing the application of parametric statistical tests. The use of Likert items as continuous variables in statistical analysis has been controversial throughout the 80 yr since they were first introduced, but Norman (2010) has shown that parametric statistics are robust to violations of assumptions, especially when samples are large, as in this case.

Paired *t* tests were used to examine changes in panel respondents' answers to questions over the study period. An exception was the measure of acceptance, which was not a true Likert-type item and therefore use of parametric statistics was inappropriate. The item called for respondents to rate each practice on the following categorical scale: 1) This practice is a legitimate tool that land managers should be able to use whenever they see fit; 2) This practice should be done only infrequently, in carefully selected areas; 3) This practice should not be used because it creates too many negative impacts; 4) This is an unnecessary practice; or 5) I do not know enough about this practice to offer a judgment.

To test hypotheses about the influence of psychological and locational factors on acceptance levels, dichotomous logistic regression was used. The dependent variable was whether respondents chose complete acceptance (number 1 above) vs. any other selection, with "don't know" responses excluded. We used this fairly restrictive definition of acceptance because any other response, even limited acceptance, would likely require significant effort on managers' part to improve public perceptions before activities could be implemented.

Independent variables were Likert items measuring self-reported knowledge, choices ranging from 1=not informed to 5=very informed (H1); an overall rating of the condition of Great Basin environments, choices ranging from 1=very unhealthy to 4=very healthy (H2); agreement or disagreement about potentially relevant threats to sagebrush ecosystems that a particular practice might address (e.g., threat of juniper encroachment was a relevant influence for felling and chaining but not for mowing or livestock grazing), choices ranging from 1=strongly disagree to 4=strongly agree (H3); agreement/disagreement about the threat posed to rangelands by overgrazing by livestock, choices ranging from 1=strongly disagree to 4=strongly agree (H4); preferred policy balance between environmental protection and economic growth, where 1=highest priority to "maintaining natural conditions, even if there are negative economic consequences," 4="environmental and economic factors should be given equal priority," and 7=priority to "economic considerations, even if there are negative environmental consequences" (H4); rural/urban residency, a dummy variable where 0=rural and 1=urban, and state of residence (H5); and a four-point Likert scale measuring how much respondents trust federal agencies to use each practice on rangelands in the Great Basin, choices ranging from 1=no trust to 4=full trust (H6). Many survey items allowed participants to choose a "don't know" response; these responses were removed from the dataset for all statistical analyses.

RESULTS

Respondent characteristics were similar across all six study sites. In 2010, panel members reported a median age of 61 yr and 44% said they were retired. Most participants were long-term residents of their community (a median of 30 yr). Rural residents comprised 58% of the panel and urban residents 42%. Twenty percent lived in Oregon, 15% in Idaho, 30% in Nevada, and 35% in Utah. Among urban respondents 62% had graduated from college, whereas 33% of the rural respondents had done so. As is common for surveys in rural areas and on natural resource topics (Jacobson et al. 2007), males were overrepresented (79%) in the sample. To test for potential gender bias, an independent samples *t* test was used to

Table 1. Frequency distribution of acceptance ratings for restoration/fuels-reduction practices, 2006 and 2010.

		Acceptance level (%)	
Management practice	Response	2006	2010
Livestock grazing	A legitimate practice for use at any time	57	61
	Use practice only infrequently	24	24
	Do not use due to negative impacts	6	6
	Practice is not necessary	4	5
	I know too little to make a judgment	9	5
Prescribed fire	A legitimate practice for use at any time	40	42
	Use practice only infrequently	42	41
	Do not use due to negative impacts	7	8
	Practice is not necessary	5	5
	I know too little to make a judgment	6	4
Felling	A legitimate practice for use at any time	34	36
	Use practice only infrequently	35	36
	Do not use due to negative impacts	11	10
	Practice is not necessary	9	9
	I know too little to make a judgment	11	9
Mowing	A legitimate practice for use at any time	32	29
	Use practice only infrequently	35	41
	Do not use due to negative impacts	9	8
	Practice is not necessary	10	13
	I know too little to make a judgment	15	10
Chaining	A legitimate practice for use at any time	22	23
	Use practice only infrequently	29	34
	Do not use due to negative impacts	17	17
	Practice is not necessary	17	16
	I know too little to make a judgment	15	10
Herbicide application	A legitimate practice for use at any time	18	19
	Use practice only infrequently	36	35
	Do not use due to negative impacts	19	21
	Practice is not necessary	16	17
	I know too little to make a judgment	11	9

look at differences in response to key questions in the 2010 survey between male and female panel members. Most significant, female respondents rated themselves as being less informed and less involved in range management issues, which may help explain why they were underrepresented. Jacobson et al. (2007) suggest salience is one factor affecting the involvement of female respondents in surveys about natural resource–related topics.

Acceptance of Management Practices

Social acceptability results are shown in Table 1. For all six practices, a majority of respondents believed there can be situations where their use is appropriate. However, only one practice, livestock grazing to reduce fine fuels, was rated acceptable for use whenever managers see fit. In general, practices that use naturally occurring agents such as herbivory or fire gained greater acceptance than mechanical or, especially, chemical practices. Comparison of frequency distributions suggests that social acceptability remained fairly constant between 2006 and 2010, with perhaps a slight increase for livestock grazing and slight decreases for mowing and chaining. However, when acceptance was compared at the individual level (Table 2), we found that judgments shifted considerably within respondents. For four of the practices—mowing, felling, chaining, and herbicide application—more than half of respondents changed their judgment from fully acceptable to less than fully acceptable, or vice versa.

Knowledge of Conditions

Respondents were asked to rate their own knowledge about the management and condition of natural environments in the Great Basin. The mean rating in 2006 was almost exactly at the midpoint, 3.03; in 2010 the mean had fallen slightly but significantly to 2.81 ($t=-6.24$; $P<0.001$).

Perceived Threats to Rangelands

Respondents were asked to indicate their level of agreement regarding whether certain processes or conditions posed a threat to rangeland health (Table 3). Nearly all of the potential threats received mean scores at or above the four-point scale midpoint of 2.50, suggesting that a majority of respondents view the listed processes or conditions as potential threats. The greatest perceived threat was invasive plants, followed by development, off-highway vehicles (OHVs), and impacts to

Table 2. Percentage of panel whose acceptance responses differed between 2006 and 2010.

Practice	No longer acceptable	Just as acceptable	Has become acceptable
Livestock grazing	17	64	19
Prescribed fire	21	57	22
Felling	24	50	27
Mowing	30	43	27
Chaining	27	45	28
Herbicide application	32	44	24

riparian systems. There were several noteworthy changes over the study period, including significantly *increased* ratings for juniper encroachment, wild horse overpopulation, and dense sagebrush (though ratings of the threat posed by these items remained relatively low). Ratings of impacts from development, OHV use, wildfire, and riparian impacts *decreased* slightly but significantly over the study period. It should be noted that while these effects are statistically significant, effect sizes are small and they did not lead to meaningful shifts in agreement or disagreement.

Balance Between Protection and Use

Respondents were asked to rate their beliefs about how range managers should make tradeoffs between environmental protection and economic growth using a seven-point scale, where higher scale values indicated a preference for favoring economic growth. In both years the mean response trended slightly to the environmental end of the spectrum (2006: 3.59 ± 0.047 SE; 2010: 3.74 ± 0.046 SE). The slight but statistically significant shift in mean reflects that fewer people chose the most protectionist choices (1 and 2), opting for more neutral (4) responses in 2010.

Trust in Agencies to Implement Practices

In a separate question about trust (Table 4), respondents used a four-point scale to answer the question, "How much do you trust federal agencies like the BLM or Forest Service to use these practices?" Mean trust levels for all practices laid somewhere near the scale midpoint, i.e., between "limited trust" and "moderate trust." As with acceptability, trust ratings remained consistent across the study period, with only slight increases for chaining and livestock grazing.

Predictors of Acceptance

To test hypotheses 1–6, we performed logistic regression analyses for both years of the survey, where the dependent variable distinguished between those individuals who indicated full acceptance of a treatment vs. those who indicated partial or no acceptance. We used a stepwise regression procedure that only retained variables in the model if their coefficients were statistically significant at $\alpha = 0.05$. We opted to develop separate models for each year, rather than a single model with survey year as an independent variable, to determine whether the factors influential upon acceptance differed across years. They did: more predictors were statistically significant in 2006 (Table 5) than in 2010 (Table 6). When originally presented with the task of judging acceptability of the six practices, responses were predicted by at least four variables and sometimes as many as six. By far the most influential predictor was trust, which was also the only variable that appeared in all six models for both years. The sole practice for which trust was *not* the primary predictor was livestock grazing, where acceptance was more strongly predicted by the respondent's level of concern about overgrazing. In 2010 the best models included only two or three variables, as trust took on even more importance in explaining acceptance. As indicated by values for R^2, the models explained as little as 18% and as much as 42% of the total variability in acceptance. For all practices except chaining and herbicide application, the smaller models from 2010 had greater explanatory power than the more complex models produced for 2006.

Self-reported knowledge about Great Basin rangelands (H1) did not appear in any of the models. Overall perception of environmental condition (H2) was a predictor of acceptance levels for livestock grazing but not for any other practice. Our measures of utilitarian vs. environmental beliefs (H4)—concern about overgrazing and preferred balance between environment and economy—predicted acceptance of every practice but prescribed burning in 2006, and predicted acceptance of grazing, chaining, and herbicide application in 2010. Locational factors (H5) did not influence acceptance for most

Table 3. Mean level of agreement that specific processes or conditions pose a threat to rangelands, 2006 and 2010. Paired *t* tests of a Likert-type measure, 1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree ("don't know" responses excluded).

Threat	2006 Mean	2010 Mean	*t*	*P*	Effect size (*d*)[1]
Invasive plants	3.38	3.38	0.151	NS[2]	0.01
Development	3.08	2.91	−4.638	≤0.01	0.20
OHV impacts	2.97	2.87	−3.382	≤0.01	0.11
Riparian impacts	2.92	2.84	−2.241	0.025	0.09
Juniper encroachment	2.66	2.81	3.213	≤0.01	0.16
Overgrazing	2.77	2.81	0.994	NS	0.04
Wildfire	2.85	2.77	−2.072	0.04	0.09
Wild horse overpopulation	2.57	2.74	4.517	≤0.01	0.18
Overly dense sagebrush	2.37	2.50	3.379	≤0.01	0.15

[1]Effect size is a measure of the strength of a relationship between two variables, and can be used to determine practical significance, or which statistically significant relationships are of greatest importance. Vaske (2008) suggests a Cohen's *d* value of 0.2 suggests a minimal relationship, 0.5 a typical relationship, and 0.8 a substantial relationship.
[2]NS indicates not significant; OHV, off-highway vehicle.

Table 4. Trust in agencies' ability to implement restoration practices. Paired *t* test of mean responses to a Likert-type item ranging from 1=no trust to 4=full trust. ''Don't know'' responses were excluded.

Management practice	2006 Mean	2010 Mean	*t*	*P*
Livestock grazing	2.67	2.76	2.284	0.023
Prescribed fire	2.66	2.71	1.243	NS[1]
Felling	2.75	2.81	1.339	NS
Mowing	2.76	2.81	0.944	NS
Chaining	2.47	2.60	2.837	0.005
Herbicide application	2.36	2.42	1.587	NS

[1]NS indicates not significant.

Table 5. Significant predictors of acceptance for six restoration/fuels-reduction practices in 2006. Final logistic regression models using a stepwise procedure with the dependent variable being the probability that a practice is acceptable for use anywhere. Coefficients are unstandardized.

Variable	*B*[1]	SE	*P*
Livestock grazing ($R^2 = 0.334$) ($n = 573$)			
Perceived condition: rangeland health	0.53	0.157	0.001
Threat of wildfire	−0.44	0.213	0.039
Threat of nonnative plant invasion	0.61	0.292	0.036
Threat of overgrazing	−1.38	0.228	< 0.001
Economy/environment balance	0.34	0.092	< 0.001
Trust in agencies' ability to use	1.14	0.208	< 0.001
Prescribed burning ($R^2 = 0.251$) ($n = 587$)			
Threat of wildfire	−0.38	0.192	0.045
Threat of nonnative invasion	0.77	0.280	0.006
Threat of juniper encroachment	0.49	0.204	0.017
Trust in agencies' ability to use	1.54	0.195	< 0.001
Felling ($R^2 = 0.261$) ($n = 565$)			
Threat of wildfire	−0.51	0.198	0.010
Threat of juniper encroachment	0.75	0.214	< 0.001
Threat of overgrazing	−0.78	0.204	< 0.001
Economy/environment balance	0.28	0.088	0.001
Rural/urban	0.60	0.219	0.006
Trust in agencies' ability to use	1.28	0.201	< 0.001
Mowing ($R^2 = 0.184$) ($n = 528$)			
Threat of overly dense sagebrush	0.73	0.206	< 0.001
Threat of overgrazing	−0.49	0.199	0.019
Economy/environment balance	0.20	0.089	0.028
Trust in agencies' ability to use	1.23	0.215	< 0.001
Chaining ($R^2 = 0.316$) ($n = 534$)			
Threat of overly dense sagebrush	0.73	0.234	0.002
Economy/environment balance	0.40	0.103	< 0.001
Rural/urban	0.94	0.273	0.001
Trust in agencies' ability to use	1.50	0.226	< 0.001
Herbicide ($R^2 = 0.305$) ($n = 551$)			
Threat of overly dense sagebrush	1.20	0.272	< 0.001
Threat of overgrazing	−0.53	0.252	0.038
Economy/environment balance	0.32	0.114	0.004
Rural/urban	0.59	0.298	0.047
Trust in agencies' ability to use	1.43	0.245	< 0.001

[1]*B* indicates an unstandarized regression coefficient.

practices: no differences in acceptance were found between states, and the only differences between rural and urban respondents were that rural residents were more likely to find felling and chaining completely acceptable in 2006, and felling completely acceptable in 2010.

Beliefs about the importance of potential threats to rangeland health (H3) predicted acceptance for all practices in 2006 and all but one of the practices in 2010, although coefficients were relatively small. In 2006, individuals who were concerned about nonnative plant invasion, juniper encroachment, or overly dense sagebrush canopies were more likely to find practices acceptable that could potentially reduce those threats. For example, concern about the threat of dense sagebrush canopy predicted acceptance of mowing, used to thin sagebrush stands, while persons concerned about juniper encroachment were more likely to accept felling and burning, designed for juniper control. Respondents who were more concerned about wildfire were less likely to find prescribed burning acceptable, as shown by the negative sign of the regression coefficient. Surprisingly, people concerned about wildfire were also less likely to find livestock grazing and felling acceptable even though these practices also have the potential to reduce wildfire hazard. In 2010, fewer threats were predictors of acceptance but at least one threat measure was a significant predictor for every practice except livestock grazing.

Influences on Improved Acceptance

If managers believe a practice could be useful for achieving a restoration result, they may wish to increase the practice's social acceptability through information campaigns or trust-building efforts. To inform such efforts, we measured whether individuals whose judgments became more positive from 2006 to 2010 were more likely to have also changed their responses to independent variables that are potentially influenced by managers' actions (self-reported knowledge, beliefs about environmental condition, concern about threats, trust). For this analysis we first classified respondents into two groups: those who had made a positive shift in acceptance for a given practice (i.e., from "do not use" to "use only infrequently" or from "use only infrequently" to "use at any time"), and those whose acceptance level was unchanged or decreased. Then we measured whether individuals had changed their responses to the knowledge, condition, threat, and trust variables, and created a new variable that was the difference between the 2006 and 2010 response. (A positive value for these variables would indicate that during those years the respondent felt more knowledgeable, believed rangeland condition was less healthy,

Table 6. Significant predictors of acceptance for six restoration/fuels-reduction practices in 2010. Final logistic regression models using a stepwise procedure with the dependent variable being the probability that a practice is acceptable for use anywhere. Coefficients are unstandardized.

Variable	B[1]	SE	P
Livestock grazing ($R^2 = 0.417$) ($n = 416$)			
Perceived condition, range health	0.51	0.220	0.021
Threat of overgrazing	−1.96	0.333	< 0.001
Economy/environment balance	0.42	0.136	0.002
Trust in agencies' ability to use	1.57	0.285	< 0.001
Prescribed burning ($R^2 = 0.271$) ($n = 424$)			
Threat of wildfire	−0.89	0.243	< 0.000
Threat of juniper encroachment	0.74	0.261	0.005
Trust in agencies' ability to use	1.87	0.282	< 0.001
Felling ($R^2 = 0.320$) ($n = 401$)			
Threat of juniper encroachment	1.58	0.287	< 0.001
Threat of overgrazing	−0.77	0.279	0.006
Rural/urban	0.75	0.301	0.012
Trust in agencies' ability to use	1.49	0.298	< 0.001
Mowing ($R^2 = 0.195$) ($n = 385$)			
Threat of overly dense sagebrush	0.59	0.241	0.009
Trust in agencies' ability to use	1.42	0.286	< 0.001
Chaining ($R^2 = 0.273$) ($n = 381$)			
Threat of juniper encroachment	1.17	0.318	< 0.001
Economy/environment balance	0.35	0.140	0.014
Trust in agencies' ability to use	1.49	0.310	< 0.001
Herbicide application ($R^2 = 0.242$) ($n = 385$)			
Threat of juniper encroachment	0.79	0.329	0.017
Economy/environment balance	0.33	0.140	0.019
Trust in agencies' ability to use	1.59	0.310	< 0.001

[1]B indicates an unstandarized regression coefficient.

believed the threat was greater, or became more trusting of agencies.) Finally, we used t tests to compare mean values for the change variables between those individuals who became more accepting of a practice and those who had not. Thus, for example, if the mean change in concern about the threat posed by nonnative invasive plants was significantly larger for people who found prescribed burning more acceptable in 2010 vs. those who did not, this would suggest that acceptability of prescribed burning could be increased through education about the threats to sagebrush ecosystems posed by cheatgrass.

This analysis (Table 7) revealed that changes in belief and trust responses, more often than not, were positive for those individuals whose acceptance levels grew more positive, but negative for those whose acceptance levels were stable or more negative. For all six practices, individuals whose acceptance levels for a practice increased were also likely to have become more trusting of agencies to use that practice. However, while knowledge, condition, and threat differences were in the predicted direction, there were few statistically significant influences. Increased acceptance of mowing was associated with increased concern about the threats posed by wildfire and nonnative plant invasion, and increased acceptance of herbicide application was associated with increased concern about nonnative invasion.

DISCUSSION

Social acceptability is an aggregate measure of perceptions within a group of relevant persons and is measured at a group level, whereas acceptance is an individual-level measure. Public land managers wishing to understand public perceptions and influence those perceptions should consider both.

This study found relatively little change over a 4-yr period in the social acceptability of six range management practices that may be useful for improving the health of sagebrush ecosystems and reducing hazards posed by large-scale wildfire. Surveys of residents at selected locations across the Great Basin region found a slight increase in the number of persons who believe these practices are suitable for use wherever managers believe they may be helpful, but the differences were minuscule. More importantly, with the exception of livestock grazing to reduce fine fuels, there is no practice for which more than half of the individuals surveyed offered their unconditional acceptance. If public rangeland managers wish to use these practices more widely, they will need to look for ways to increase their social acceptability.

When the unit of analysis is shifted to the individual level, a different story begins to emerge. For four of the six practices we studied, more than half of the survey panel's acceptance responses differed between 2010 and 2006. Almost half of the judgments changed for prescribed burning and livestock grazing—practices the general public is most likely to know something about. Because some people grew less accepting and a roughly equal number grew more so, social acceptability overall appears to be relatively stable. Yet the analysis shows important changes in individual acceptability judgments that are not reflected at the aggregate level—the impression of stable levels of social acceptability over the study period is not entirely accurate. This instability in acceptance at the individual level suggests there are opportunities for managers to influence social acceptability if they understand what drives individual acceptability judgments.

Based on a review of previous literature on social acceptability and attitudes toward land management practices, we developed six hypotheses about potential influences on acceptance. H1 predicted that knowledge level would be associated with acceptance, but the analysis did not find any relationship. Simply increasing general public knowledge about the issues surrounding management of Great Basin sagebrush landscapes is unlikely to have any effect on acceptance. We also hypothesized that people who believed the region's environmental health is impaired would be more likely to accept the use of specific restoration practices (H2). Except for livestock grazing, we did not find such a relationship. It is unlikely that social acceptability can be influenced by efforts to raise public concern about the region's overall environmental health.

We did find evidence that acceptance is linked to people's concern about specific threats to rangeland environments, specifically those related to changes in the types or density of

Table 7. Difference in mean change in selected social–psychological variables between individuals whose acceptance increased from 2006 to 2010 vs. those whose acceptance levels did not increase.

Variable undergoing change	*n*	Mean		*t*	*P*
		Neutral/negative shift	Positive shift		
Livestock grazing					
Self-reported knowledge level	568	−0.24	−0.21	−0.32	NS[1]
Perceived condition, range health	441	−0.05	0.04	−1.00	NS
Threat: wildfire	549	−0.06	−0.01	−0.50	NS
Threat: nonnative plant invasion	473	−0.04	0.11	−1.55	NS
Threat: juniper encroachment	365	0.13	0.24	−0.86	NS
Trust in agency to use practice	534	0.02	0.34	−2.97	0.003
Prescribed fire					
Self-reported knowledge level	589	−0.23	−0.27	0.45	NS
Perceived condition, range health	449	−0.04	−0.01	−0.38	NS
Threat: wildfire	564	−0.04	−0.14	0.91	NS
Threat: nonnative plant invasion	496	−0.03	0.14	−1.78	NS
Threat: juniper encroachment	378	0.12	0.24	−0.98	NS
Trust in agency to use practice	480	−0.05	0.36	−4.63	< 0.001
Felling					
Self-reported knowledge level	538	−0.23	−0.25	0.19	NS
Perceived condition, range health	423	−0.03	−0.10	0.82	NS
Threat: wildfire	522	−0.05	−0.10	0.55	NS
Threat: nonnative plant invasion	463	0.01	−0.01	0.19	NS
Threat: juniper encroachment	359	0.14	0.21	−0.67	NS
Trust in agency to use practice	502	−0.07	0.48	−5.54	< 0.001
Mowing					
Self-reported knowledge level	502	−0.20	−0.24	0.38	NS
Perceived condition, range health	403	−0.02	−0.03	0.10	NS
Threat: wildfire	489	−0.09	0.13	−2.11	0.035
Threat: nonnative plant invasion	429	−0.05	0.18	−2.47	0.014
Threat: juniper encroachment	341	0.11	0.28	−1.60	NS
Trust in agency to use practice	445	−0.12	0.44	−5.39	< 0.001
Chaining					
Self-reported knowledge level	514	−0.22	−0.28	0.70	NS
Perceived condition, range health	407	−0.08	0.05	−1.49	NS
Threat: wildfire	502	−0.06	−0.07	0.09	NS
Threat: nonnative plant invasion	447	−0.02	0.09	−1.12	NS
Threat: juniper encroachment	348	0.09	0.28	−1.87	NS
Trust in agency to use practice	459	0.02	0.40	−3.57	< 0.001
Herbicide application					
Self-reported knowledge level	528	−0.22	−0.25	0.33	NS
Perceived condition, range health	411	−0.04	0.01	−0.59	NS
Threat: wildfire	511	−0.07	0.07	−1.40	NS
Threat: nonnative plant invasion	455	−0.03	0.19	−2.36	0.019
Threat: juniper encroachment	352	0.12	0.21	−0.84	NS
Trust in agency to use practice	472	−0.07	0.64	−6.74	< 0.001

[1]NS indicates not significant.

dominant plant species (H3). In other words, a person who is more concerned about the threat posed by juniper encroachment is more likely to accept the use of felling or prescribed fire to reduce juniper cover. However, this effect was more pronounced in 2006 than when we repeated the survey in 2010, suggesting that efforts to increase awareness of such threats may be less useful now than they were in the past. Further evidence against the value of public awareness campaigns comes from the finding that, with a few exceptions, people whose acceptance increased from 2006 to 2010 were no

more likely than other respondents to report increased awareness of the threats to sagebrush ecosystems.

In fact, our respondents tended to rate themselves as less knowledgeable about rangeland issues in 2010 than they had 4 yr earlier. This study does not allow us to determine why knowledge ratings have decreased, but one possible explanation is that citizens are becoming more aware of the complexity of rangeland issues and realize they may actually know less about the issues than they originally perceived. An alternate explanation is that they were not paying as much attention to rangeland issues in 2010, especially after 2 yr of worldwide economic distress. This second explanation appears to be supported by another of our findings, which is that acceptability judgments were influenced by fewer factors—i.e., reflected less cognitive complexity (Stanovich 2013)—in 2010 than they had been in 2006. This suggests that even if public awareness campaigns could influence acceptability, it may be more difficult to gain people's attention than it was previously.

Public awareness campaigns are less likely to make a difference if acceptance is driven largely by factors outside managers' control: where people live (H5), or their fundamental beliefs about the environment and land use (H4). Our data do not show a strong locational signal—rural and urban respondents did differ in many ways, but those differences were not attributable simply to whether they live in an urban area and use public lands solely for recreation or in a small town surrounded by sagebrush whose economy is based on rangeland uses. This was an unexpected result. Beliefs about natural resource management often differ between urban and rural residents (e.g., Kleiven et al. 2004; Brunson and Evans 2005; Racevskis and Lupi 2006). In fact, in a previous analysis of the 2006 survey (Shindler et al. 2011) we found salient differences in acceptance between rural and urban responses. In this subsequent analysis, we believe the relative absence of a significant effect does not mean rural and urban residents view these practices the same, but rather that other influences, such as trust in agencies or beliefs about the threat posed by environmental change, are more influential upon acceptance. Our stepwise procedure loaded the more influential variables first; thus, these would have accounted for some of the variance typically reflected in rural/urban differences. We did find evidence that acceptance is governed by environmental orientation, which typically is a more deep-seated attitudinal orientation not easily changed by information (Steg and Vlek 2009). However this influence, too, was stronger in 2006 than in 2010.

By far the most significant influence on acceptance was trust in the abilities of land management agencies responsible for implementing range management practices. Willingness to accept a practice *in principle* does not necessarily mean people believe agencies can implement it safely or effectively. However, if our respondents believed a land management agency could implement a practice safely and effectively, we found they were more likely to believe that practice can be applied wherever managers want to use it. When respondents' trust in agencies increased from 2006 to 2010, so did their acceptance of the management practices we studied. Our results suggest there is room for improvement in trust levels, which on average hovered between "limited" and "moderate." Therefore it stands to reason that efforts to increase acceptability of a useful restoration or fuels-reduction practice should begin with efforts to increase citizen trust in land management agencies. The critical question is this: How?

The process used to make management decisions strongly influences how people view outcomes of those decisions and the agencies responsible for implementing them (Shindler et al. 2002). Judgments can change when the decision process is transparent, so that affected parties understand the rationale for implementation of a practice and the tradeoffs among potential outcomes (Gregory 2002; Allspaw 2004). A process that is viewed as fair and open can go a long way toward building trust and support for management programs.

Outreach programs create opportunities for true citizen–agency interactions when they include give-and-take discussion—rather than emphasizing unidirectional information flow—which can add positively to people's personal experience and build trust (Jamieson 1994; McCaffrey 2004; Toman et al. 2008). Such exchanges allow people to ask questions and better understand how new knowledge fits with previous experience. More traditional unidirectional methods force people to reconcile new information with old without the benefit of discussion, often leading to misconceptions (Toman et al. 2006).

Lack of trust can come from unfamiliarity with a practice (Shindler et al. 2009), as well as poor communication between agencies and the local community (McCaffrey 2004). Additionally, lack of trust can come from a more general perception that government agencies do not share citizens' goals, thoughts, or values (Vaske et al. 2007). Many organizations exist in the United States today that seek political advantage by creating and enhancing distrust in government in general, and these activities inevitably affect how people feel about government employees and organizations locally. However, trust in local governmental entities is also influenced by local performance (Wolak and Kelleher Palus 2010). Increasingly, advocates for environmental change also call for local action that can occur in spite of national or transnational inaction (Ostrom 2010).

IMPLICATIONS

Recent federal initiatives (e.g., the National Fire Plan and Cohesive Wildfire Management Strategy) have helped spur collaborative efforts in *forest* communities over the past decade (e.g., Paveglio et al. 2009; Leahy and Anderson 2010; Gordon et al. 2012). While there are a growing number of examples, we have seen comparatively less evidence of community–agency partnerships focused on fuel hazard reduction or sagebrush restoration in the region's rangeland communities. Managers in the Great Basin may have an opportunity to build on the experiences of forest communities, engaging citizens and taking a more active role in building the relationships and trust needed to garner greater support for restoration activities.

Although public perceptions of federal agencies and their activities depend to some extent on factors outside local control, agency personnel do have the capacity to positively influence those perceptions. Citizens in both rural and urban

areas of the Great Basin are unsure whether to support widespread use of restoration practices on public lands. Our results suggest that building trust among stakeholders, even more so than increasing citizens' knowledge and awareness, is an essential component of building support for restoration practices on public lands. Trust-building can be time-consuming and seems far from the day-to-day business of managing rangelands, but it may be one of the most important tasks a manager can do.

ACKNOWLEDGMENTS

Assistance with survey management and data entry was provided by Ilona Rosenfeld, Jeff Shindler, and Stacey Frederick at Oregon State University. Carolin Maier provided valuable feedback on early versions of this manuscript. This is Contribution Number 82 of the Sagebrush Steppe Treatment Evaluation Project (SageSTEP), funded by the US Joint Fire Science Program, the Bureau of Land Management, the National Interagency Fire Center, and the Great Northern Landscape Conservation Cooperative.

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