TECHNICAL NOTE

Attitudes, Knowledge, and Perception of Fuel Reduction among Involved Publics in the Southern Appalachians: Implications for Responsive Communication

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ABSTRACT

An understanding of how identifiable groups perceive fuel reduction will help forest managers develop formal and informal communication strategies responsive to each group's concerns. This study identified three opinion segments on the basis of their attitudinal and behavioral characteristics about fuel reduction in the southern Appalachians and further described them on the basis of general forest use attitudes and behaviors ($n = 640$). A Let Nature Take Its Course segment was preservation oriented and supported fuel reduction only to the extent that it was thought to enhance biological diversity. More trusting of federal land managers, they should be approached through natural history and hiking clubs with messages emphasizing effects on nongame species. A Management for Human Benefits group was most supportive of fuel reduction and was concerned about availability of game and nongame species. More trusting of state land managers and strongly supportive of fuel reduction, they should be approached with messages about human benefits of fuel reduction. A Visually Appealing segment tended to evaluate fuel reduction mostly on the basis of aesthetic impacts. This amorphous group is more likely to object to fuel reduction on the basis of aesthetic issues, such as charring, downed timber, and loss of rhododendron and mountain laurel. Each group should be approached through a different channel, by forest managers from agencies it most prefers, with message content emphasizing perspectives on forest management already salient to the group.

Keywords: southern Appalachian Mountains, prescribed fire, mechanical fuel reduction, communication strategies, knowledge, attitudes

An understanding of the perceptions of prescribed fire and mechanical fuel reduction among concerned publics will help managers develop communication strategies that are responsive to the values and attitudes of interested publics. A study by Haines et al. (2001) reported that negative public opinion about fuel reduction methods and their use in close proximity to residential development were the two top-ranked constraints to using these techniques in the Southeast. Their work demonstrated the need to study public perception of fuel reduction. Several studies of public support and knowledge of fuel reduction have been conducted in the Pacific Northwest (Shindler and Neburka 1997, Toman et al. 2004, 2006), but little is known about the southern Appalachian region (Figure 1), although one study is available located in the northern Appalachians using the theory of planned behavior demonstrating a relationship between the public's knowledge of wildfire mitigation and perceived behavioral control (Bates et al. 2009).

Communication with stakeholders about fuel reduction techniques in southern Appalachian forests is an important and strategic part of forest management. On the basis of previous studies, managers creating communication strategies must be concerned about source credibility, characteristics of the person receiving the messages, channel of delivery, situational factors, and message content (Ajzen 1992, Shindler and Neburka 1997, Shindler and Toman 2003, Brunson and Shindler 2004, McCaffrey 2004, Toman et al. 2006).

However, managers do need to be cautious about using research results, because people who have not formulated opinions about a topic will still answer survey questions only on the basis of the information in the wording of the question. For instance, Bishop (2004) has demonstrated that asking people about President George W. Bush's social security initiative yielded significantly greater levels of support from Republicans than when an identical question was asked about a social security initiative without reference to President G.W. Bush. Bishop (2004) described numerous other public opinion polls with similar malleability.

Numerous studies have shown that interest and involvement with a topic are the best predictors of participation in social science research. Likewise, public opinion polls based on random samples with aggressive follow-up procedures to encourage high participation rates provide distorted results in terms of levels of respondents' awareness of and involvement with issues (Heberlein and Baumgartner 1978, Martin 1994, Bishop 2004, Groves et al. 2004). Considering that fuel reduction in southern Appalachian Mountains is far less salient to the general public than social security, it seems counterproductive to survey people *uninvolved* with forests and their use.

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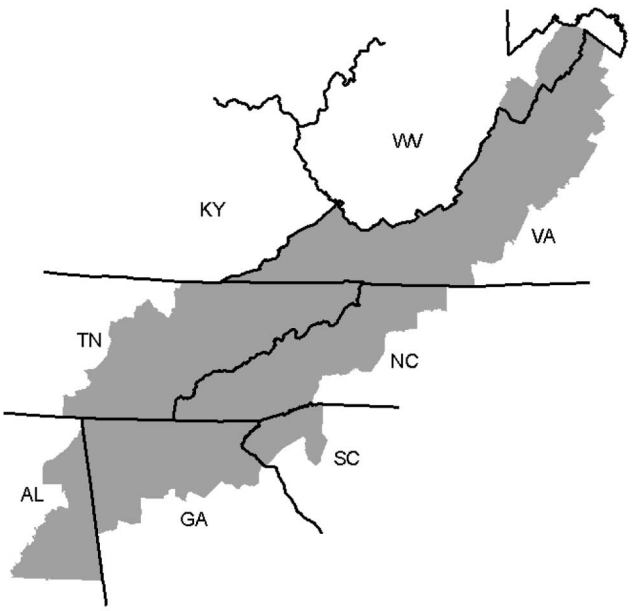

Figure 1. The southern Appalachian region.

In the field, natural resource managers often address special interest groups or individuals, not large swaths of the general public. The effectiveness of managers' interactions with people or groups is not likely to be a function of their knowledge of what percentage of the general population holds a particular belief. What is important is that stakeholders have varying opinions and that managers are able to readily recognize and constructively respond to these variations. Segmentation studies, often used in marketing, identify clusters of people on the basis of their differing beliefs, attitudes, and behaviors toward a topic (in this study, fuel reduction). Our experience has been that this style of reporting is far more user friendly and intuitive to managers than the widely used numerical beta weights that document the strength of relationships between variables in regression and path analysis.

Therefore, the purpose of the study was to identify segments of stakeholders in terms of their evaluations of fuel reduction in the southern Appalachian Mountains and then to describe more general attitudes, beliefs, and preferences related to forest resources. These two activities in combination provide managers with the ability to explain their fuel reduction activities to different opinion segments in ways specifically meaningful to each group.

Methods

Sample Population

Purposive sampling was used to limit data collection to publics with strong potential to be involved with the topics of forest management and fuel reduction. Three types of potential respondents were approached (Table 1). This sampling strategy is not intended to produce nor does it produce accurate population parameters. The study is only meant to identify types of groups and their associated beliefs and behaviors.

Initial contact was made by regular mail or Internet survey. All homeowners were contacted by mail. On-site recreationists were given a choice of mail or Web-based survey, and clubs and organizations were contacted strictly through an e-mail invitation to complete a Web-based survey. One reminder was sent to potential participants in e-mail or postcard format. The final sample size was 640, adequate for a segmentation study because sample size is based on having enough observations to describe each cluster or segment, not the entire sample (Evans and Berman 1994, Myers 1996). Hierarchical cluster analysis with Ward's method was used to identify meaningful segments on the basis of attitudes toward fuel reduction (Milligan and Cooper 1987). Then, additional tests for differences (analysis of variance [ANOVA]) among more general attitude and behavioral variables were made, with the segment membership as the independent variable. These tests further describe each subgroup in ways that would help managers further refine communication strategies. All means are reported in the ANOVA tables as *z*-scores to make comparisons of values from scales with different ranges more readily interpretable. With categorical variables, cross-tabulations with chi-square tests for relationships were made. The tables report observed and expected distributions, chi-square test for significant relationships, and phi coefficient to document effect sizes.

Table 1. Types of respondents approached to participate in this study.

Survey group	Technique used
Homeowners	People who lived within census blocks overlapping US Forest Service land received the survey by mail.
Recreationists	People participating in hiking, equestrian activities, mountain biking, hunting, fishing, camping, climbing, picnicking, and Revolutionary War reenacting were approached on public forest lands and given a choice of mailed survey or e-mailed survey.
Interest groups	Conservation, preservation, hiking, and hunting clubs were approached through e-mail.

Measures

The segments of interested publics were identified by asking a series of questions about the acceptability of changes that occur because of fuel reduction. Questions about the acceptability of changes from fuel reduction were collected from previous studies (Shindler and Neburka 1997, Toman et al. 2004, 2006). Additional questions were constructed and pretested on the basis of recent findings from research specific to the southern Appalachians on ecological effects of fuel reduction (soil, water, insects, nongame species, game species). Additional questions measured attitudes toward property damage, human uses, and aesthetics on a five-point disagree-neutral-agree scale, with a "don't know" option. A knowledge test with a response format of "disagree, " "not sure, " and "agree" was used to measure relevant knowledge about forests. Questions dealt with known effects of fuel reduction on fuel levels and later intensity of fires, historic levels and types of vegetation in the southern Appalachians relative to today, and ecological effects of forest fires. Each test question was scored −1 for wrong answers, 0 for not sure, and +1 for a correct answer. A total score was calculated for each respondent. Eight photographs illustrating forested areas recently subjected to fire, chainsaw felling of shrubs (mechanical treatment), a combination of both methods, or neither were also rated by respondents in terms of acceptability on a bipolar 5-point scale from −2 to 2. Scales were reduced through exploratory factor analysis to composite variables.

To further describe each segment, a range of questions was asked about general forest management, perceived awareness of and

knowledge of southern Appalachian forests, attitudes about balancing economic and environmental values in forest management, education level, recreation activity participation, membership in clubs, and economic dependence on forestry. These questions were designed to help further interpret results from the cluster analysis and help forest managers find groups and construct messages responsive to their existing perspectives. When composite variables were used, Cronbach's α test for reliability is reported in the tables in parentheses. Results are described in terms of low, moderate and high scores. "High," "moderate," and "low" were added to the ANOVA table means to enhance interpretation, but attention should be paid to the superscripts (a, b, c), because some moderate scores may be significantly different from one but not both of the "high" or "low" scores.

Results

The Segments

The first segment identified through cluster analysis was labeled Let Nature Take Its Course (LNTC). Reminiscent of preservationist values, this group is characterized by little acceptability of anthropogenic change except for increasing diversity of nongame fauna and flora. This group found moderately acceptable an increase in dead standing and downed trees—possibly because it creates diverse habitat for nongame species. They were low to moderately knowledgeable about historical ecology of the southern Appalachians, causes of forest fires, and outcomes of fuel reduction. For the visual preference scales, they found less acceptable forest floors relatively free of ground plants and preferred forests with moderate to thick stands of mountain laurel and rhododendron.

The second segment was the Management for Human Benefits (MHB) grouping. This group was the most knowledgeable about historical ecology and forest fires and their effects. Fuel reduction techniques were acceptable for outcomes that included improving habitat for game and other species, reducing rhododendron and wildflowers, increasing dead and downed material, visible signs of fire, preventing damage to structures, and making it easier to walk through the forest. Photographs rated as acceptable included those with open and deep visual penetration and those that had visible signs of being burned and/or subjected to mechanical fuel reduction.

The third segment, Visually Appealing (VA), was composed of people who tended to have the lowest knowledge test scores on historical ecology, fire, and fuel reduction techniques. This group found least acceptable outcomes that include residual burn marks, increased standing dead material, and increased nongame habitat. The remaining outcomes (soil and water quality, amount of rhododendron/mountain laurel, prevention of damage to property, and mobility through the forests) of fuel reduction techniques were moderately acceptable compared with the other two segments. Preferences for all management techniques depicted in the photographic scale were lower than the other two groups. This group seemed to judge fuel reduction based mostly on aesthetics.

Description of the Three Segments

After respondents were clustered into three segments based on their evaluations of fuel reduction, differences in respondents' broader attitudes, values, types of involvement, and preferences related to southern Appalachian forests were identified. These analyses allow forest managers to construct messages about fuel reduction that are responsive to the values and interests specific to each segment. Table 2 presents data on differences in attitudes toward general forest management, participation in wildland recreation activities, and perceptions of the health of southern Appalachian forests and the degree of attention paid to these issues.

Let Nature Take Its Course Segment

Management of Forests

The LNTC segment reported low support for economic and utilitarian use of the forest and low support for active management of forests, found forests with effects of fire less enjoyable, yet preferred federal management over state management. LNTC tended to prefer limited management and tended to believe that forests managed through prescribed fire or accidental fire would be less enjoyable to visit.

Recreation Activities Involvement

The LNTC segment reported low preferences for recreation activities involving hunting deer, turkey, bear, and fishing. They also exhibited low preference scores for driving to view scenery and recreational vehicle (RV) camping. This group tended to prefer recreation activities such as camping, backpacking, kayaking, canoeing, mountain biking, wildlife watching, photography, birding, enjoying wildflowers, collecting edible berries/herbs/mushrooms, trail running, geocaching, and orienteering (Figure 2).

Perception of Forests and Attention to Issues

The LNTC segment tended to rate the forests of southern Appalachian Mountains as average in health. They perceived themselves as paying moderate attention to and being moderately informed about the forest conditions. This group rated economic rationales for forests lower than environmental reasons.

The Manage for Human Benefits Segment

Management of Forests

The MHB segment preferred that forests be used for economic and utilitarian benefits. They tended to disagree with statements about limiting human management of forests. They tended to disagree that forests managed by fire or accidentally changed by fire were less enjoyable. They were strongly supportive of government management of forests, but at the nonfederal levels.

Recreation Activities Involvement

The MHB segment was notably interested in hunting deer, turkey, bear, and fishing. They tended to prefer the entire range of outdoor activities listed in the questionnaire (Figure 3).

Perception of Forests and Attention to Issues

The MHB segment was generally positive about the health of southern Appalachian forests. Despite their involvement in a wide range of wildland recreation activities, they reported paying low attention to forest issues and considered themselves poorly informed about forest conditions. Relative to the other segments, they were high on valuing forests for their economic value.

The Visual Appealing Segment

Management of Forests

The VA segment was typified by moderate support for economic and utilitarian uses for forests and moderate limitations on management of forests. They expressed a dislike for forests modified by fire,

Table 2. Standardized mean difference comparisons of the three segments and response to management of forests, recreation preferences, perception of forest health, and attention paid.

Variable (reliability score)	LNTC	MHB	VA	*F*
Management of forests				
Uses of forests for economic and utilitarian benefits (0.84)	Low, −0.53[a]	High, 0.63[b]	Medium, 0.06[c]	58.17
Limit management of forests (0.65)	High, 0.45[a]	Low, −0.51[b]	Medium, 0.07[c]	46.07
Forests managed through fire or accidental fires are less enjoyable (0.69)	High, 0.34[a]	Low, −0.63[b]	High, 0.28[a]	57.90
Support for government management of forests (0.75)	Low, 0.41[a]	High, 0.59[b]	Low, −0.20[a]	46.98
Prefer federal government management over state (0.86)	High, 0.36[a]	Medium, −0.07[b]	Low, −0.31[b]	7.59
Recreation activity involvement				
Deer, turkey, bear hunting and fishing (0.87)	Low, −0.36[a]	High, 0.45[b]	Medium, 0.01[c]	35.67
Tent camping, backpacking, kayaking, canoeing, mountain biking (0.75)	High, 0.27[a]	High, 0.20[a]	Low, −0.49[b]	35.91
Wildlife watching, photography, birding, enjoying wildflowers (0.76)	High, 0.27[a]	High, 0.10[a]	Low, −0.42[b]	27.14
Recreational driving to view scenery and RV camping (0.68)	Low, −0.24[a]	High, 0.11[b]	High, 0.18[b]	10.62
Collecting edible berries, herbs, or mushrooms (0.78)	High, 0.04[a]	High, 0.21[a]	Low, −0.25[b]	9.73
Trail running, geocaching, orienteering (0.68)	High, 0.19[a]	High, 0.06[a]	Low, −0.33[b]	9.68
Perception of forest and attention to issues				
Rating of the health of southern Appalachian Forests	Medium, −0.002[a,b]	High, 0.14[a]	Low, −0.15[b]	3.74
Attention paid to forest issues or problems	Medium, 0.03[a]	Low, −0.38[b]	High, 0.31[c]	24.15
How well informed about forest conditions in southern Appalachians	Medium, 0.09[a]	Low, −0.45[b]	High, 0.29[c]	29.06
Priority given to environmental or economic conditions[d]	Low, −0.51[a]	High, 0.24[b]	High, 0.39[b]	53.21

LNTC, Let Nature Take Its Course; MHB, Management for Human Benefits; VA, Visually Appealing; RV, recreational vehicle.
[a,b,c] Means with different superscripts within a row are significantly different. Cronbach's α for the composite variables was in the acceptable range of 0.65–0.84.
[d] Based on a bipolar scale with a range from 1 to 7, with environmental values on the low end of the scale and economic values on the high end. Although there are statistical differences, the absolute means for all three segments fell on the environmental values end of the scale.

Figure 2. Forest scene preferred by the Let Nature Take Its Course segment.

Figure 3. Forest scene preferred by the Management for Human Benefits segment.

whether purposive or accidental. They expressed low support for government management of forests and, when it was necessary, preferred state government management over federal.

Recreation Activities Involvement

The VA segment expressed high preference for recreational driving to view scenery and RV camping. They had low to moderate scores on all other wildland recreation activities (Figure 4).

Perception of Forests and Attention to Issues

The VA segment rated the health of forest low. They rated themselves high on attention paid to forest issues and how well informed they were about forest conditions, and they tended to prioritize economic forest values over environmental values.

Awareness and Support of Fuel Reduction

Cross-tabulation was used to examine the observed versus expected distributions of scores on categorical variables measuring

Figure 4. Forest scene least preferred by the Visually Appealing segment.

awareness of and support for fuel reduction for the three segments. Three questions addressed whether respondents had heard of prescribed fire or mechanical fuel reduction and then whether they supported fuel reduction (see Table 3).

Let Nature Take Its Course

For LNTC, perceived awareness of prescribed fire was high, whereas about half the segment was aware of mechanical fuel reduction. Support was mixed for fuel reduction, with almost twice as many respondents not supporting fuel reduction as would be expected.

Manage for Human Benefits

For MHB, awareness of prescribed fire was extremely high, and about three-quarters of the sample had heard about mechanical thinning. Almost the entire segment, approximately 95%, was supportive of fuel reduction.

Visually Appealing

About 80% of this segment had heard of prescribed fire, and 40% reported knowing about mechanical fuel reduction. About three-quarters of this segment was supportive of fuel reduction.

Club and Organization Membership

Types of organizational membership varied within each segment (Table 4). The questionnaire asked about timber product, hunting, historical/cultural preservation, environmental preservation, environmental conservation, hiking, and fishing clubs.

The LNTC segment was more likely than expected to be members of historic/cultural preservation groups, both conservation- and preservation-oriented groups, and hiking clubs. They were less likely than expected to be members of timber or forest product organizations or hunting and fishing clubs.

The MHB segment was more likely than expected to be members of timber or other forest products groups, hunting, historical/cultural preservation, environmental conservation, and fishing organizations. They were less likely than expected to be members of environmental preservation and hiking clubs.

The VA segment was characterized by lower than expected membership in all groups. Organizations that were politically oriented, such as the timber and forest products organizations and environmental preservation and environmental conservation groups, were much lower than expected in terms of reported membership.

Other Characteristics of Segments

There were a number of differences and relationships found among the three segments in terms of demographic differences (income, gender, and education level). Because these are not actionable by managers, they are not reported here, but they are available from the authors. The MHB segment was more likely than the other segments to have at least four college courses in biological sciences, suggesting that a more sophisticated scientific discourse is possible. The MHB segment was more likely than expected to be dependent on timber and special forest products. In terms of current residence, there were slight tendencies toward the LNTC segment living in cities and small towns, the MHB living in small towns and suburbs, and the VA segment living on farms or in the country.

Discussion

This project provides a look at knowledge, attitudes, and preferences related to fuel reduction in the southern Appalachians. Furthermore, it illustrates a different approach to analysis of social dimensions of fuel reduction studies that we believe is responsive to the strategic needs of forest managers. In contrast to linear statistics that report beta weights, segmentation analysis identifies discrete groups of people and describes them on the basis of their orientation to fuel reduction. Once meaningful segments are identified, more general data about forest related preferences, attitudes, and organizational affiliations allow forest managers the insight to construct messages specific to each group. Membership in clubs and place of residence then allow forest managers to locate these groups to deliver forest management messages.

For instance, the LNTC group is not supportive of fuel reduction, generally wants forests to be left alone, engages in a wide range of wildland recreation activities (but less so in hunting and fishing), and prefers the federal government, rather than state government, to manage forests. They can be located as members of historical/cultural groups, environmental preservation conservation groups, and hiking clubs. Thereafter, they should be approached, through environmental preservation organizations and hiking clubs, by federal level forest managers delivering messages about the role of fuel reduction on the status of nongame animals and native plants.

In contrast, the MHB group is very supportive of fuel reduction and may require little attention. When attention is paid, it should be through state forest managers, and the MHB group can be contacted through hunting and fishing clubs, along with conservation groups. Timber product associations are another venue.

Forest managers may find the VA group somewhat puzzling. They seem confident that they are aware of forest conditions and are well informed, yet they are least likely to participate in wildland recreation activities and be members of all organizations listed in the questionnaire. These characteristics suggest they may not be attentive to information, as they already perceive themselves as well informed. VA will also be difficult to find, as they are not associated with formal organizations. Forest managers who receive complaints about the aesthetic appearance of areas after fuel reduction, rather than ecological concerns, may be interacting with someone from the VA segment. Explanations about how forest aesthetics will improve the year following fuel reduction should be an effective approach.

Table 3. Cross-tabulation of segments on awareness of and support for fuel reduction techniques.

Awareness and support	Segment observed (expected)			Chi-square	Phi
	LNTC	MHB	VA		
Have you heard about the use of prescribed fire?					
Yes	202 (193)	171 (159)	149 (169)	—[a]	
No	7 (16)	1 (13)	34 (14)		
Have you heard of mechanical fuel reduction?					
Yes	98 (109)	133 (96)	71 (98)	52.02[b]	0.31
No	95 (84)	37 (74)	102 (76)		
Do you support prescribed fire or mechanical fuel reduction?					
Yes	115 (149)	149 (119)	126 (122)	63.79[b]	0.35
No	82 (48)	8 (38)	36 (40)		

LNTC, Let Nature Take Its Course; MHB, Management for Human Benefits; VA, Visually Appealing.
[a] Because of a low cell size for the "No" response category, a violation of the assumptions of chi-square, no test for relationships is reported.
[b] $P < 0.01$.

Table 4. Cross-tabulation of segments on club and organization membership.

Club membership type	Segment observed (expected)			Chi-square	Phi
	LNTC	MHB	VA		
Timber or other forest products					
Yes	39 (54)	77 (42)	27 (47)	54.28[a]	0.31
No	176 (161)	92 (127)	159 (139)		
Hunting					
Yes	47 (71)	88 (56)	53 (61)	40.01[a]	0.26
No	169 (145)	84 (116)	134 (126)		
Historical/cultural preservation					
Yes	63 (54)	50 (44)	32 (47)	9.57[a]	0.13
No	151 (160)	121 (128)	153 (138)		
Environmental preservation					
Yes	128 (91)	66 (70)	46 (78)	48.86[a]	0.29
No	89 (126)	101 (97)	140 (108)		
Environmental conservation					
Yes	134 (118)	126 (95)	54 (101)	75.29[a]	0.36
No	82 (98)	48 (79)	131 (84)		
Hiking clubs					
Yes	85 (59)	35 (47)	37 (51)	25.47[a]	0.21
No	129 (155)	135 (123)	149 (135)		
Fishing					
Yes	52 (64)	70 (51)	50 (57)	14.94[a]	0.16
No	159 (147)	97 (116)	137 (130)		

[a] $P < 0.01$.

An additional step, when resources are available, is to conduct formative evaluations to test specific message content and delivery approaches. For instance, Cohn et al. (2008) evaluated the effectiveness of combinations of signage and verbal messages in gaining compliance with fire regulations in a US Forest Service area. Toman et al. (2006) compared one-way and interactive communication strategies with interested publics about fuel reduction.

In persuasive communication, source credibility is important if messages are to be believed. The three segments revealed differing preferences for state and federal management agencies. The data about memberships in clubs and organizations are particularly useful. One weakness of this study is our lack of attention to use of and involvement with social networking sites on the Internet. Increasingly, the Internet provides opportunities for anyone to rapidly produce his or her own content, disseminate it, and motivate other like-minded individuals through awareness to action (Shirky 2008).

By design, this study sought to describe the characteristics of a person (attitudes, knowledge, and preferences) that play a role in perceptions of fuel reduction. This segmentation approach provides descriptions of people, whereas earlier studies described interrelationships among two or more variables. In this study, we have shown how segmentation techniques help identify actionable differences among segments that are often hidden by linear statistics and averages of whole samples (Myers 1996).

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