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Hands-on Learning

Its Effectiveness in Teaching the Public about Wildland Fire

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ABSTRACT

This study evaluated workshops for the adult public featuring experiential learning about wildland fire. Participants used hands-on activities to investigate fire behavior and ecology and to assess hazards in the wildland-urban interface. Effectiveness was examined using a pretest, a posttest following the program, and another posttest 30 days later. Participants' knowledge increased following the program, and their attitudes and beliefs became more supportive of fire management. These changes were still evident a month later. Hands-on activities can help adults become better informed about wildland fire and more positive about fire management.

Keywords: communication; education; policy; public perceptions

Many ecosystems in North America depend on fire, but management use of fire cannot succeed without public consent. Furthermore, hazard reduction and increased safety in the wildland-urban interface require widespread understanding and active participation by the public. This article describes the effectiveness of an outreach program that

used informal workshops and hands-on activities to help the adult public learn about fire behavior, ecology, and management. The research questions were:

- Does a workshop with hands-on activities contribute to increased knowledge about wildland fire among adult members of the public?
- Does this approach contribute to

more positive attitudes and beliefs about fire management in adults?

Fire Policy, Fire Messages

Since the early 20th century, the dominant wildland fire policy in the United States has been to suppress all wildland fires. Natural resource professionals have been reasonably successful at excluding fire from many landscapes. As a result, however, some fire-dependent forest communities have been altered. Species composition has changed, forest density has increased, and the likelihood of severe fire has increased in some forest types (Agee

Above: The "matchstick forests" activity, used in public workshops, shows the effect of slope on fire spread.

Table 1. Items used to measure workshop participants' knowledge, attitudes, and beliefs about fire ecology and management on the pretest, posttest 1, and posttest 2.

Knowledge items

1. What characteristics of a tree or its location might help it survive a wildfire?
 - a. Slope is approximately flat
 - b. Bark thickness of approximately 2 cm (0.8 inches)
 - c. Tree spacing 60 trees per acre
 - d. Long needles
 - e. All of the above
 - f. None of the above
2. Fires burning upslope tend to preheat fuels, burning faster than a backing fire.
 - Basically true
 - Basically false
 - Not sure
3. Crown fires are more intense and kill more trees than surface fires.
 - Basically true
 - Basically false
 - Not sure
4. Forest fires influence the kinds of trees that grow in the northern Rocky Mountain forests.
 - Basically true
 - Basically false
 - Not sure
5. Fires influenced by steep slopes burn faster downhill.
 - Basically true
 - Basically false
 - Not sure
6. If the agency managing the ponderosa pine forests around your community reduces the number of trees and reduces the brush, the fire risk to homes within the urban interface will be decreased.
 - Basically true
 - Basically false
 - Not sure
7. Asphalt roofs are considered safe roofs for homes built within a wildland setting.
 - Basically true
 - Basically false
 - Not sure
8. What were the average years between fires in ponderosa pine forests prior to European settlement?
 - a. 5–60 years
 - b. 60–110 years
 - c. 110+ years
9. Choice of building materials, design, and landscaping can help reduce risk to homes from wildland fire.
 - Basically true
 - Basically false
 - Not sure
10. Pretend you work for the rural fire department and your job for the summer is to assess fire risk to people's homes in the event that there is a wildland fire. You just assessed a home in a forest setting, the time of year is August, and the weather has been hot and dry. Your observations include the following. Circle which ones you would include in a discussion with the homeowner regarding possible improvements. There may be more than one answer.
 - a. The home is placed mid-slope on a 20-degree hill.
 - b. Trees and shrubs are spaced approximately 5 feet apart.
 - c. The lawn is green.
 - d. The roof is asphalt shingles.
 - e. Pine needles and leaves are overflowing in the rain gutter.

(continued on page 23)

1993). Resource managers believed they were doing the right thing because excluding fire protected property and lives, but they underestimated fire's critical ecological role in forest development. To remedy this problem, fire "inclusion," through prescribed fire and wildland fire, has been part of wildland fire policy for the past quarter century (USDI and USDA 1995).

An intensive, successful information campaign accompanied the policy of fire exclusion from public lands. Smokey Bear, one of the most recognized faces worldwide with his famous slogan "Only you can prevent forest fires," contributed to a public perception that all wildland fires are bad and should be extinguished. Resource man-

agers recognize Smokey Bear's effectiveness in preventing human-caused wildfires, but they find now that they need to increase public acceptance of the role of natural fire and prescribed fire in achieving healthy, sustainable forest ecosystems.

The challenge of changing people's perceptions about wildland fire has been recognized for at least 40 years (Davis 1959 as cited by Mutch 1976). Mutch voiced a need for imaginative educational materials to tell the public about fire's ecological role. However, conservation education was often viewed as merely "a nice thing to do" or was initiated only after a severe, destructive fire (USDA-FS 1998). Educational programs did not take prece-

dence over other public land management responsibilities; therefore, programs were implemented only in addition to managers' existing duties.

In one of the earliest studies to examine adult knowledge, attitudes, and beliefs about wildland fire, Stankey (1976) recommended that managers educate and involve the public, make gradual changes in policy, and provide communications programs aimed at many different audiences. These recommendations continue to be supported by more recent studies (Manfredo et al. 1990). Public messages about fire should include the ecological role of fire plus all aspects of fire management: fire prevention, suppression, prescribed burning, and wildland fire for resource benefit (Gardner et al. 1985). Stenberg (1982) found a correlation between knowledge of fire effects and support for or opposition to various fire policy statements. Taylor and Daniel (1984) indicated that fire education programs do not need to be extremely intensive nor expensive to be beneficial.

In 1995, the US Departments of Agriculture (USDA) and Interior (USDI) recommended that "a clear message about the important role of fire as a natural process and an understanding of policies concerning wildland fire and the urban interface" be communicated to the general public (USDI and USDA 1995, p. 12). Most of the materials and programs developed in response to this recommendation target students. Our research investigated the effectiveness of adapting one of these programs, called FireWorks, for use with adult audiences.

FireWorks (Smith and McMurray 2000) was developed by the USDA Forest Service Rocky Mountain Research Station, with support from the Northern Region and the Bitterroot Ecosystem Management Research Project. The program targets students in grades 1 through 10. FireWorks has two objectives: to increase understanding of wildland fire and to increase skill in science, mathematics, and critical thinking. The 36 activities in FireWorks use interdisciplinary, hands-on investigations to introduce students to principles of combustion in wildland

fuels, characteristics that enable plant and animal populations to survive fire, historic fire regimes in different kinds of forest, change in forest communities over time, and people's influences on forests and wildland fire. To convey the diversity of fire regimes within a geographic area, FireWorks focuses on three kinds of forest that occur in the Rocky Mountains and Intermountain area: ponderosa pine, lodgepole pine, and whitebark pine.

The objectives of FireWorks are consistent with the goals, management direction, and messages of the interagency National Wildfire Coordinating Group (NWCG 1999) and follow the recommendations of the Conservation Education Task Force (USDA-FS 1998). Hundreds of teachers have attended FireWorks workshops, and the program has been used by thousands of students—mainly in the northern Rocky Mountains, Intermountain Region, and Alaska. Thomas and others (2000) found that use of FireWorks increased knowledge about wildland fire in seventh-graders and improved student attitudes toward their teachers and learning environment. This project assesses the effectiveness of workshops using hands-on activities from FireWorks to help adults learn about fire behavior, ecology, and management.

"Teaching" Adults

An informed, motivated citizenry is essential in public decisionmaking processes affecting the environment (Stankey 1976). The National Environmental Policy Act (NEPA) requires public involvement for fuel treatment and forest restoration projects and development of fire management plans. Effective public involvement relies on understanding and trust from members of the public. To gain public trust regarding fire management, it is important to narrow the knowledge gap between scientists, managers, and the public (Yankelovich 1991). Furthermore, increased adult understanding of wildland fire is needed to raise awareness and begin the process of "working through" available information, so that decisions will not be dominated by impulsive or emotional first responses (Yankelovich 1991).

Table 1 (continued). Items used to measure workshop participants' knowledge, attitudes, and beliefs about fire ecology and management on the pretest, posttest 1, and posttest 2.

Attitude items

1. A real estate agent shows you a newer home (2–3 years old) on 3 acres of forested ground within a heavily forested area on flat ground. The house has a metal roof and cedar siding. The landscaping is composed of junipers 5–10 feet tall; the grass appears to be 6–12 inches tall; and there are large ponderosa pine trees, some of which are near the house. The agent seems confident that the house would survive a wildfire event. What is your response to the situation?
• Strongly agree • Agree • Neither • Disagree • Strongly disagree • Not sure
2. Forest fires have beneficial effects on the natural environment.
• Basically true • Basically false • Not sure
3. Severe fires are less likely to occur in pine forests that have experienced occasional surface fires than in forests unburned for many decades.
• Strongly agree • Agree • Neither • Disagree • Strongly disagree • Not sure
4. The agency managing the ponderosa pine forests around your community wants to decrease the number of trees and reduce brush to protect forest habitat and its inhabitants. Please indicate your response.
• Strongly agree • Agree • Neither • Disagree • Strongly disagree • Not sure
5. If you knew that there was a 2,000-acre prescribed fire within a mile of your town, how concerned would you personally be about each of the following things?
 - a. That some homes might be endangered
• Not at all • Somewhat • Moderately • Very • Extremely
 - b. That some wild animals might lose their food supply
• Not at all • Somewhat • Moderately • Very • Extremely
 - c. That smoke might pollute the air
• Not at all • Somewhat • Moderately • Very • Extremely
 - d. That many large trees might be killed
• Not at all • Somewhat • Moderately • Very • Extremely

Belief items

1. I believe suppressing forest fires increases the chances of a very large fire occurring.
• Basically true • Basically false • Not sure
2. I believe periodic forest fires would have beneficial effects on habitat for animals such as elk and woodpeckers.
• Basically true • Basically false • Not sure
3. If a surface fire burned through a forest with underbrush, fallen needles, and tree seedlings, indicate your predictions.
 - a. Heat from the fire would destroy Douglas-fir buds.
• Strongly agree • Agree • Neither • Disagree • Strongly disagree • Not sure
 - b. Growing space for ponderosa pines would increase.
• Strongly agree • Agree • Neither • Disagree • Strongly disagree • Not sure
 - c. The potential for future large wildland fires would be reduced in that area.
• Strongly agree • Agree • Neither • Disagree • Strongly disagree • Not sure
 - d. Roots growing within the duff layer would be protected from the heat.
• Strongly agree • Agree • Neither • Disagree • Strongly disagree • Not sure

There is no single, universal definition that describes adult learners. Adults typically take on learning as a secondary role after fulfilling primary roles of parent, spouse, employee, or community leader (Polson 1993). They have a rich experience base to draw on as well as different developmental changes and tasks. Their lives are complex and diversified, with many variables affecting learning processes (Knowles 1980; Smith and Pourchot 1998).

An effective adult educator considers these characteristics when planning outreach and educational programs. The learning environment should make people feel comfortable both physically and mentally, and everyone must be respected, accepted, and supported. The information presented should be accessible, using clear language and avoiding jargon (Knowles 1980), and it should be relevant and applicable to real situations (Jackson

Activities Used in Public Workshops

“Will It Burn?”

Participants ignite three kinds of wildland fuels—conifer needles, buds, and roots—and compare their burning properties. They explain their observations in terms of the Fire Triangle (oxygen, heat, and fuel).

“Fire Triangle in Wildlands”

Participants view a three-minute video titled *Three Kinds of Fire*, which displays properties of surface, crown, and ground fires. Matrices of matches are constructed as physical models of forests with different densities and arrangements of trees, then burned to investigate the effects of slope and tree density/arrangement on crown fire spread.

“Forest Communities”

Participants examine cross sections from three tree species (ponderosa, lodgepole, and white-bark pines). They use their observations to describe fire history in each forest type and characteristics that enable some species to survive wildland fire.

“People in Fire’s Homeland”

Participants apply what they know about fire behavior and fuels to assess the safety of homes in the wildland-urban interface.

and MacIsaac 1994). Both active participation and reflection during learning processes are essential for successful adult learning. Adult educators are facilitators or mentors more than teachers; they guide but do not dominate the learning process (Jackson and MacIsaac 1994; Smith and Pourchot 1998). Experiential learning can capitalize on the knowledge and experience that adults bring to a subject.

The scientific literature on adult education can be summarized in three guidelines:

1. Connect the learner’s existing knowledge, experiences, beliefs, and attitudes with a new set of knowledge, experiences, beliefs, and attitudes.

2. Place the responsibility of what is learned on the learner and accentuate self-directed learning.

3. Encourage learners to transfer learning from the instructional context (e.g., workshop environment) to an application context (e.g., applying fuel breaks around the house).

Methods

The target population for this research was rural communities of the northern Rocky Mountains and Intermountain area. We contacted leaders of existing community organizations (Lions Club, Volunteer Fire Department, and Xi Beta Iota Club) in three rural communities of northern Idaho to recruit workshop participants. These groups represented a variety of demographic characteristics. The communities were chosen because of their historical dependency on timber products, close proximity to forested lands, and proximity to Forest Service offices. All three communities had experienced effects from wildfires or prescribed burning, including smoke inversions, decreased access, and forest restrictions.

Four activities from the FireWorks program (Smith and McMurray 2000) were selected for the workshops, based on their importance for understanding wildland fire, applicability to rural communities, and the time available (see “Activities Used in Public Workshops”).

Participants’ knowledge, attitudes, and beliefs were measured at the beginning of the workshop (pretest), immediately after completion of the FireWorks activities (posttest 1), and one month after the workshop (posttest 2). Survey questions were selected from those used in previous fire educational programs (e.g., Stankey 1976; Stenberg 1982) and the FireWorks curriculum (Smith and McMurray 2000).

We piloted the workshop and survey twice with agency employees (with levels of fire expertise varying from none to extensive) and then revised it. The final survey consisted of 18 ques-

tions about fire and four questions about demographics (gender, age, time in area, and educational level). Ten of the questions about fire measured knowledge, five determined attitudes toward fire management, and three assessed beliefs about wildland fire. We built on Fishbein and Ajzen’s (1975) definition of attitudes (learned, resulting in a favorable or unfavorable evaluation of an object and actions that are consistent with that evaluation) and beliefs (representing information about an object and linking an object to some attribute). The 18 survey items used in this study are presented in *table 1*. Posttest 1 differed slightly from the pretest in wording and order of questions and included six questions assessing the workshop format and activities. Posttest 2 was taken from the pretest and posttest 1. The surveys were designed to be completed in about 10 minutes.

Six two-hour evening workshops were conducted on weeknights between May 25 and July 14, 2000. At each workshop, the presenter welcomed participants and described the project. Then participants completed the pretest. After the pretest, they viewed a 12-minute video, *Managing Wildland Fire—A Matter of Choice*, then broke into small groups. The groups participated in the four FireWorks activities in round-robin fashion. Refreshments were available during the activities. The same presenter and activity facilitators hosted all six workshops to ensure consistency between workshops and minimize any effects due to different presenters.

Results

A total of 61 participants attended the workshops. The number of participants attending the individual workshops ranged from four to 19, with an average attendance of 10. All 61 participants completed the pretest and posttest 1 at the beginning and end of the evening workshop and 30 days later were sent posttest 2. Fifty participants returned posttest 2, an 82 percent return rate. Analyses were performed on the responses of the 50 participants who completed all three surveys. These participants included 17 women and

33 men. Their ages ranged from 18 through 68 years, averaging 45. All participants had completed high school; 65 percent had attended at least some college. Length of residence in the community ranged from one year to 55 years, averaging 20 years.

Mann-Whitney U Wilcoxon Rank Sum tests (Zar 1984) were used to determine if knowledge, attitudes, and beliefs varied significantly with age, education, or gender. No statistically significant effects were found (for all demographic descriptors $p > 0.05$), so surveys were not stratified by demographic characteristics.

Survey responses to “knowledge” questions were marked as “correct” or “incorrect,” and the number of correct answers was recorded. Responses to questions about attitudes and beliefs were evaluated as “supportive” or “not supportive” of fire management and the number of supportive responses was recorded. Data were analyzed using Friedman tests (Statistical Package for Social Science Software 10.1 for Windows), which provided mean rank values for the pretest, posttest 1, and posttest 2. Significant differences were further analyzed using a Multiple Comparison Analysis (Hochberg and Tamhane 1987). Differences between mean ranks were considered statistically significant at $p < 0.05$.

Participants demonstrated significantly greater knowledge about wildland fire on posttest 1 than on the pretest, and they retained a majority of this information 30 days after the program (fig. 1). At the end of the program and 30 days afterward, participants’ attitudes were significantly more supportive of fire management than they were at the beginning of the workshop. Participants’ beliefs about fire management were also significantly more supportive at the end of the program; the strength of this support declined significantly in the following month but remained significantly greater than at the start of the workshop.

Responses to the questions about the program format and activities show that people enjoyed the workshops. Many responded that they “enjoyed the hands-on applications.” Several positive comments pertained to specific demon-

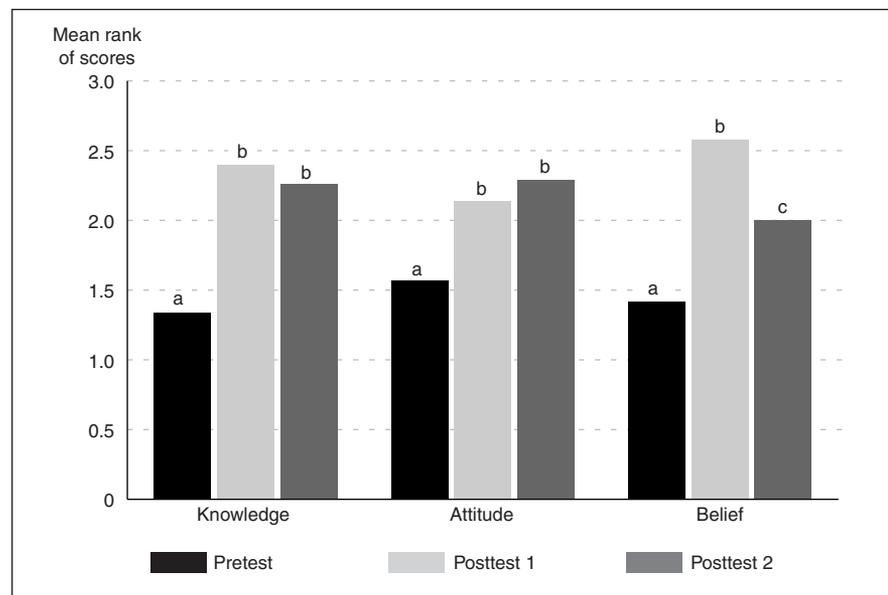


Figure 1. Mean rank of scores from three survey times (before, immediately after, and one month after workshop). Higher values for the “attitude” scale indicate more positive attitude toward fire management practices. Higher values for the “belief” scale indicate more positive beliefs about fire management. Within each scale, bars labeled with different letters had significantly different mean ranks ($p < 0.05$).

strations and materials used in the activities. Participants appreciated that the workshops were participatory and provided information pertinent to community issues. They agreed unanimously that the facilitators were helpful in the learning process, and many indicated that they would participate in similar workshops in the future.

Discussion

This study demonstrated that hands-on learning is an effective method for reaching adult audiences with information on wildland fire. Participants were more knowledgeable about fire behavior, ecology, and management—as well as more supportive of fire management—after the program. Hands-on learning techniques can help adults better understand wildland fire ecology and management issues. If these learning opportunities are available prior to public participation activities where alternative actions are being considered and management decisions are made, the public will be better informed and thus public involvement processes may be more successful and public support for management actions may increase. Although this research focused on fire, the techniques of hands-on learning in a workshop

format may improve communications with the public in regard to many natural resource ecology and management issues; numerous educational “trunks” are available to environmental educators (see, for example, the list of trunks in Montana at www.thenaturecenter.org/trunkguide.htm) and could be adapted for workshops with adults.

Although knowledge gain was associated with more positive attitudes and beliefs about fire management in this study, it does not necessarily follow that the knowledge gain *caused* the changes in attitudes and beliefs. Previous environmental education research indicates that increased knowledge does not consistently promote positive attitudes, although the two are sometimes strongly associated (e.g., Bradley et al. 1999; Kuhlemeier et al. 1999). Many authors warn that successful dialogue with the public requires much more than information (e.g., Weber and Word 2001); it requires an environment of respect and trust, where all participants can speak and be heard. The informal structure and hands-on activities used in this study provided such an environment and also gave participants the experience of observing, questioning, discussing, and solving problems together—good practice

for the more complex issues that arise in fire and land management planning.

Limitations

The workshops for this study were held during a challenging summer for fire management in the western United States. The Cerro Grande fire in Los Alamos, New Mexico, occurred in early May 2000, when we were beginning the workshops. Posttest 2 was sent out during July and August, when large fires were burning in Montana and Idaho. Media coverage about the summer's fires may have affected participants' knowledge, attitudes, and beliefs about fire management.

The research goals of our study and the surveys themselves may have affected the reliability of our results. The introduction to the workshops included a brief description of the project supporters and workshop facilitators, informing participants that their responses would be used for research. This may have caused some individuals to respond differently than they would in a purely informational workshop. The survey questions were taken from previous surveys and the FireWorks curriculum. We assumed the questions measured what they were intended to measure: knowledge, attitudes, and beliefs.

Recommendations

As fire managers reach out to the public, they need tools that will help them communicate fundamental concepts about fire behavior, fire's role within ecosystems, and fire management. Hands-on learning from the FireWorks program is one such tool that can be used to reach adult audiences in small, rural communities. Agencies conducting fire management should support educational outreach for adults with programs that would complement established prevention programs. We recommend small programs for workshops with adults, 30 to 45 minutes long. This length would allow one activity to be presented effectively. Many community groups that meet weekly or monthly for 1 to 2 hours seek this kind of short program for members. Hands-on workshops could also be presented in public

campgrounds throughout the summer and could be provided in partnership with extension foresters and volunteer fire departments (urban and rural), through continuing education programs and through outfitter and guide associations.

Future research should evaluate retention of information and changes in attitudes and beliefs over a time greater than one month. Such evaluation should be conducted at a time of year when the media are not covering the topic daily.

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