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Status of Wildland Fire Prevention Evaluation In The United States

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INTRODUCTION

Whether the nemesis be fire, flood, or famine, most of us agree that "an ounce of prevention is worth a pound of cure." In the case of protecting our forests from fire, some observers go even further: Pyne (1984) states "an ounce of prevention is worth several pounds of fire damages and fire suppression expenses." The wisdom and economic efficacy of preventing fires have been recognized from the beginning of organized forest fire control in America (Adams 1912, Gisborne 1942). Pyne's (1984) insightful treatise on fire prevention identifies three major activities: establishment of suitable objectives, execution, and evaluation of success. The study described here addressed all three, but its focus was upon the latter—evaluation. The objectives were to determine how wildland fire management agencies in the United States assess the effectiveness of their prevention efforts and to develop recommendations for evaluation procedures.

BACKGROUND

Early efforts to assess prevention effectiveness were characterized by this 1937 account: "The occurrence of man-caused fires this season... when compared with last year's record, indicates that prevention efforts are beginning to take effect" (Anon. 1937). However, it takes only a moment of reflection to realize that even a precipitous decline in wildfire occurrence from one year to the next may not signal a prevention success. Consequently, as early as the 1940's appeals were being made for development of more scientific prevention evaluation methods (Jemison 1940, Buck *et al.* 1941). Quite logically, the usual response to these appeals was to apply the rapidly developing fire danger measurement technology to fire occurrence data to produce a statistically normalized occurrence rate.[1] Following development of the first national fire danger rating system (Nelson 1964), Haines *et al.* (1970) found "excellent associations on a total-season basis" between the spread component of this system and the probability of a fire day. Once this association was determined for a fire protection unit, statistical control for the influence of spread index produced a normalized fire occurrence rate and range. Deviations from the expected range signaled the influence of factors other than weather, such as a new or intensified prevention campaign.

Other adaptations of fire danger rating to fire occurrence data followed, including the first attempt to actually incorporate a measure of fire risk (the probability of a fire start) into a fire danger rating system (Deeming *et al.* 1972, 1977). However, there is no evidence that any of the schemes to statistically reduce the influence of weather upon fire occurrence ever gained widespread field use. Instead, field people continued to report prevention successes upon the basis of pronounced reductions in observed fire occurrence (McNamara 1971, Loomis *et al.* 1974, Carroll 1975). By 1975, in the report of a national assessment of prevention research needs, the following statement characterized the status of prevention evaluation: "Little attention has been given to systematic analysis of fire prevention programs. Most analyses are based on a reduction in number of fires only" (Anon. 1975). A few years

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[1] *Fire control literature from the 1950's contains several examples of these applications: Lindenmuth 1951; Lindenmuth and Keetch 1950, 1953; Crosby 1953, 1954; Keetch 1957.*

later, Wetherill documented the status of operational prevention evaluation in USDA Forest Service Region 8 by surveying all ranger districts in the region. On 83 of the 105 districts, prevention evaluation consisted of "observing reductions in number of fires" (Wetherill 1982). Five districts reported that they received feedback from target groups while "consideration of weather factors and number of fires," "informal discussions," "guesswork," and "trust" were each mentioned once. "Rigorous evaluation" was reported by one district which was participating with research in an evaluation study. As a sociologist specializing in program evaluation, Wetherill (1981) recommended that prevention be evaluated upon the basis of expected immediate effects which, for many activities, are not declining fire rates. (This approach to evaluation may be particularly suited for prevention education programs wherein effects upon fire occurrence may show up several years later.) Wetherill and others developed a procedure for evaluating mass media prevention programs based on expectations other than reduced fire occurrence (Howell *et al.* 1983), but, once again there has been no rush to implement the procedure by field personnel.

Other research activity related directly or indirectly to prevention evaluation was summarized recently by Simard and Donoghue (1987) and will not be repeated here. However, it should be noted that refinement of fire occurrence prediction schemes is continuing and that research related to the influence of weather and other factors on fire occurrence is increasing the amount of variability explained by causal models. There remains, however, a critical need: to determine the nature and extent of evaluation currently employed in wildland fire prevention by protection agencies across the United States. This information is needed to direct future research efforts towards developing a model *that will be used* by field personnel to quantitatively and accurately evaluate prevention programs.

METHODS

The study consisted of three major tasks. Task one was to survey all wildland fire management agencies in the United States to determine the status of fire prevention evaluation methodologies and tools currently in use. This task was divided into two phases. The first was to make a brief telephone contact with all identifiable agencies with wildland, person-caused fire prevention programs in the United States. The second phase was to collect more detailed information about reported evaluations. This phase was completed by mailing a questionnaire to each respondent who reported evaluation activity during the telephone contacts.

Task two was to compare reported evaluations with some standard from the evaluation literature.[2] An evaluation model was developed for this purpose; it will be described presently. Task three was to develop evaluation procedures for field use. Completion of this task relied upon results of the tasks one and two analyses.

Telephone Contacts

The purposes of telephone contacts were to (1) determine if anyone, at any organizational level, was attempting (or had recently attempted) any kind of prevention evaluation; (2) collect basic information about the nature of the person-caused fire problem, the prevention program, the evaluations, and the opinions of prevention specialists about various aspects of prevention and its evaluation; and (3) obtain referrals to other individuals/organizations who might be involved in prevention evaluation. Organizational directories were used as the source for identifying fire managers and staff in the following agencies:

USDA Forest Service
National Park Service
Fish and Wildlife Service
Bureau of Indian Affairs
Bureau of Land Management
Each of the 50 states
Virgin Islands and Puerto Rico
Department of the Army
Department of the Navy
Department of the Air Force
U.S. Marine Corps
Army Corps of Engineers
Tennessee Valley Authority

[2] *A review of the extensive literature pertaining to program evaluation and evaluation research is beyond the scope or purpose of this paper. Interested readers should review Rossi and Wright's (1984) succinct assessment of evaluation research.*

The usual procedure was to contact the highest level fire manager or prevention specialist who could be identified from the directory, explain the nature of the study, and either ask for referrals within the agency or inform the official that we would be contacting persons at lower organizational levels. In some instances, the person contacted at one level informed us that no evaluation efforts were being made within his/her organizational jurisdiction, so no further contacts were attempted.

A second group of agencies and organizations that we identified as potential sources of information about prevention evaluation included fire prevention cooperatives, "keep green" associations, county fire protection agencies, and forest industries. A third group consisted of other members of the fire service "community" such as the National Fire Protection Association, the National Fire Academy, the Fire Service Training Department at Oklahoma State University, Tri-Data Corporation, Pan-Educational Institute, and several other private organizations and individuals involved in various fire protection activities. In all, more than 400 individuals were contacted; 354 were sufficiently involved in prevention of person-caused wildland fires to be interviewed. These 354 individuals constituted the universe for the study.[3]

In an effort to maximize the number of evaluations discovered during the telephone contacts, we used a liberal definition of evaluation to screen the respondents: "Any effort, no matter how modest or uncomplicated, to determine or estimate if your prevention program is having any effect upon wildfire occurrence or anything that might lead to an occurrence." So defined, 121 of the 354 respondents (34 percent) indicated that prevention was being, or recently had been, evaluated at their organizational level. These respondents were asked a series of questions about their prevention program and its evaluation. They also constituted the population to which we mailed a questionnaire asking for more detailed information.

[3] *This group is referred to as a "universe" because it contains all of the individuals we could identify as potential prevention evaluators.*

Mail Survey

The primary purpose of the mail survey was to collect information about existing or recent evaluations that would allow their comparison with a model that we derived from the evaluation literature. We wanted a model that contained a great deal of detail so that the chance of overlooking some aspect of evaluation would be minimized. After reviewing several, the model we derived is based upon suggestions from Morris and Fitz-Gibbons (1978), Kosecoff and Fink (1982), Weiss (1972), Austin (1982), and Wetherill (1978); it breaks the evaluation process into 12 major tasks (see Appendix A—Evaluation Model). Items in the mail survey questionnaire were designed to coincide with the tasks in the evaluation model (see Appendix B—Mail Survey Questionnaire). The 12 tasks—which are not necessarily sequential—and their corresponding questionnaire items are as follows:

Task 1 —Identify who wants the evaluation: Items 3, 18, and 19.

Task 2 —Determine the focus or purpose of the evaluation: Items 5 and 16.

Task 3 —Formulate the evaluation questions or program goals that will be the criteria for evaluation: Items 4 and 12.

Task 4 —Establish yardsticks for determining how much progress toward each goal marks success: Items 6 and 13.

Task 5 —Decide what must be measured: Items 1, 4, 11, and 13.

Task 6 —Describe the program being evaluated: Items 1 and 2.

Task 7 —Choose a measurement instrument: Items 7 and 7a.

Task 8 —Choose an evaluation design: Items 7a and 7c.

Task 9 —Choose a sampling strategy: Items 9 and 9b.

Task 10 —Collect data: Items 7b, 7c, and 8.

Task 11 —Analyze and interpret results: Items 10a, 14, and 15.

Task 12 —Report results: Items 14 and 17.

Each of the 12 tasks was subdivided into more specific tasks or operations to facilitate comparative analysis (Appendix A).

RESULTS

Telephone Contacts[4]

In addition to locating prevention evaluation activities, the telephone contacts also determined who was performing evaluations, where they were being performed, which prevention programs were being evaluated, and what (if anything) was wrong with current evaluation methods.

Over half of the persons contacted were employed by the USDA Forest Service. Remaining personnel were nearly equally divided between the 50 State protection agencies and other Federal agencies. However, the largest proportion of reported evaluations (47 percent) was in the State agencies (table 1). Only 35 percent of Forest Service respondents reported evaluation activities.

Table 1.—*Agency affiliation of telephone respondents and reported evaluation activity, United States, 1989*

Agency	Respondents[1]	Reported evaluation activity	
	Number	*Number*	*Percent*
Forest Service	185	65	35
States	89	42	47
Other Federal	73	13	18
Total	347	120	35

[1] Data were incomplete for some respondents.

[4] *Results from the telephone contacts have been reported elsewhere but will be summarized here for the sake of continuity. See Paananen* et al. *1990.*

Geographically, the highest percentage of respondents (51 percent) reporting evaluations was in the Pacific Northwest (table 2). The Northern and Pacific Southwest regions followed with 41 percent each. The lowest proportions of respondents reporting evaluations were in the Southwestern region (21 percent), the Southern region (24 percent), and Alaska (22 percent) (see table 2).

Table 2.—*Geographic location of telephone respondents and reported evaluation activity, United States, 1989*

Location (regions)[1]	Respondents	Reported evaluation activity	
	Number	*Number*	*Percent*
Northern	34	14	41
Rocky Mountain	26	7	27
Southwestern	29	6	21
Intermountain	29	11	38
Pacific Southwest	42	17	41
Pacific Northwest	47	24	51
Southern	67	16	24
Eastern	63	23	37
Alaska	9	2	22
Total	346	120	35

[1] Coincide with Forest Service regional boundaries.

At the individual level, the "typical" (or modal) respondent to the telephone interview was between 46 and 55 years old, had a college degree, had been employed by his/her agency about 20 years, but had been in his/her present position less than 5 years (table 3). A minority (41 percent) came to their present positions from one that was not directly fire connected. In their replies to a series of opinion statements about prevention evaluation, nearly 9 out of 10 respondents agreed that more accurate evaluation methods are needed. However, about two-thirds felt that research often produces evaluation methods that are too complex for field use, and about half thought that experience is more important than science in assessing prevention effectiveness, although many added that both are needed. According to three-fifths of the respondents, prevention should reduce total fire management costs, if it is to be judged as effective, but two-fifths felt that prevention can

be effective without lowering fire occurrence. Nine out of 10 felt that the influence of weather must be considered when assessing prevention effectiveness.

Table 3.—*Selected characteristics of all respondents to the telephone survey and of those reporting evaluations, United States, 1989*

Characteristic	All respondents (n=354)	Respondents reporting evaluations (n=121)
	—— Percent ——	
Age:		
Less than 35 yrs	9	11
36-45 yrs	37	42
46-55 yrs	45	42
More than 55 yrs	8	6
Education:		
Less than college degree	22	24
College graduate	61	62
Post-graduate	17	14
Agency tenure:		
Less than 10 yrs	12	11
11-20 yrs	38	47
21-30 yrs	40	33
More than 30 yrs	10	9
Tenure in present position:		
Less than 5 yrs	52	53
6-10 yrs	29	28
11-15 yrs	15	16
More than 15 yrs	4	3
Came from fire-connected position	41	53

The majority of the 121 respondents reporting evaluations were evenly divided between the 36-45 and 46-55 age groups, were college graduates, had been employed by their agency 11-20 years but in their present positions less than 4 years, and came from fire-connected positions (table 3). These respondents reported that the most frequent targets of their prevention programs were industrial fires, recreationist fires, and debris-burning fires—about half reported evaluations of programs aimed at each of these fire causes. Least likely targets were arson fires (12 percent), children-caused fires (8 percent), and smoker fires (7 percent).

Mail Survey

As noted above, the primary purpose of the mail survey was to compare reported prevention evaluation with the evaluation model we derived from the literature (see Appendix A). The survey questionnaire was, therefore, composed of items intended to produce data that would allow both quantitative and qualitative comparisons (see Appendix B). The questionnaire was mailed to the 121 respondents who reported evaluations during the telephone contact. After mail and telephone follow-ups, 109 forms were returned, a response rated of 90 percent. However, five forms were not sufficiently complete to allow quantitative analysis of their results; consequently, analysis was based upon 104 completed questionnaires.

Survey Results

Responses to the survey questions were analyzed first by noting whether or not the evaluation task to which each question related was being accomplished by each respondent. For example, the first task in the evaluation model is to identify who wants the evaluation. Questions 3, 18, and 19 were intended to elicit that information. Analysis of the responses to those questions revealed that 95 percent identified who initiated the evaluation, 83 percent indicated that evaluation results were reviewed by others in the organization, and 75 percent reported that others were familiar with the evaluation procedures (responses to questions 3, 18, and 19 respectively; n=104). Therefore, an average of 84 percent of the reported evaluations included task 1 of the model. Complete results for all items in the questionnaire are shown in table 4. Prevention evaluators seemed to be doing a good job of identifying who wanted evaluation (task 1), why evaluations were performed (tasks 2 and 3), what was evaluated or measured (tasks 5 and 6), and whether or not the evaluated prevention program was effective (tasks 11 and 12). The weakest parts of the reported evaluations were those having to do with how they were conducted, or the measurement of the criterion variables (tasks 7, 8, 9, and 10). The poor showing of the reported evaluations vis-a-vis the model on these tasks suggests a lack of objectivity in current prevention evaluations. We will elaborate on this result presently.

Table 4.—*Comparison of reported evaluations with the evaluation model, United States, 1989*

Tasks in the evaluation model	Percent reporting (n=104)	
	Item	Mean
Task 1—Identifies who wants the evaluation:		85
a. Identifies decisionmakers (3)[1]	95	
b. Specifies intended audience (18)	83	
c. Determines who wants to know about the evaluation (19)	75	
Task 2—Determines the focus or purpose of the evaluation:		71
a. Determines what decisionmakers really seek and how they expect to use results (5)	100	
b. Determines what decisions will be based on the evaluation (16)	41	
Task 3—Formulates the evaluation questions or program goals		82
a. Formulates specific evaluation questions (12)	66	
b. Identifies goals and objectives (4)	99	
Task 4—Establishes yardsticks for determining how much progress toward each goal marks success:		61
a. Determines what information will provide evidence of program merit (6)	49	
b. Determines what constitutes success/attainment of program goals (13)	74	
Task 5—Decides what must be measured:		87
a. Selects independent, intervening, and dependent variables (1,4,11)	91	
b. Develops indicators to measure the extent to which goals are achieved (13)	74	
c. Defines and quantifies input and intervening variables (1,11)	87	
Task 6—Describes the program being evaluated:		77
a. Specifies the nature of the program (1)	100	
b. Precisely describes the program and its alternatives (2)	55	
Task 7—Chooses a measurement instrument:		23
a. Describes the instrument that is developed, adapted, or purchased to measure change (7)	38	
b. Describes how threats to validity and reliability are considered (7a)	8	
Task 8—Chooses an evaluation design:		16
a. Describes the design in terms of nonexperimental, quasi-experimental, or experimental (7a)	3	
b. Specifies to whom the instrument will be administered and when (frequency) (7c)	30	
Task 9—Chooses a sampling strategy:		51
a. Describes the sampling scheme (9)	51	
b. Plans data collection and analysis (9b)	51	
Task 10—Collects data:		45
a. Establishes deadlines (not reported)		
b. Validates/pilot tests instrument(s) (7b)	18	
c. Administers instrument(s) and scores them (8)	75	
d. Organizes and records data for analysis (7c)	30	
e. Monitors information collection method(s) (8)	75	
f. Documents data collection method(s) (7c)	30	
Task 11—Analyzes and interprets results:		74
a. Documents analytical techniques (10a)	42	
b. Compares results to criteria (14)	82	
c. Makes judgments (15)	96	
Task 12—Reports results:		84
a. Plans the report (not reported)		
b. Chooses the method of presentation (17)	85	
c. Assesses the results of the evaluation (14)	82	

[1] Numbers in parentheses refer to items in the survey questionnaire.

Response frequencies and percents for each fixed response question in the mail survey are shown in Appendix C. Some of the questions asked during the telephone contacts were repeated for purposes of data continuity and will not be discussed here. Questions 3, 18, and 19 pertain to who decided to evaluate prevention and who in the organization was involved in the evaluation. It does not appear that evaluation was imposed by supervisors in most instances, as the responding fire prevention specialist made the decision to conduct evaluation in more than two-thirds of the cases (see question 3). However, supervisors and other staff were knowledgeable about evaluations in most instances, as reported in responses to questions 18 and 19.

The heavy reliance on fire occurrence as an evaluation criterion is evident from responses to questions 4 and 5. Nearly 90 percent reported that number of fires was the criterion upon which prevention effectiveness was judged, and almost three-fourths identified determination of whether or not fire occurrence was declining as a purpose of evaluation. The responses to question 6a were even more indicative of the importance of fire occurence; 48 out of 52 (92 percent) who set prevention goals did so in terms of reduced occurrence. At the same time, the number of people reached was considered in nearly half of the evaluations (question 4), and determination of whether or not attitudes were improving was a major purpose of about the same proportion (question 5).

Questions 7 through 11 mainly dealt with the mechanics of evaluation—tasks 7-10 in the model. These steps were the weakest features of reported evaluations; response frequencies to questions 7-11 were generally below 50 percent. Statistically, evaluations did not appear to be very sophisticated; only 24 respondents (23 percent) reported using techniques other than percentages and means in their evaluations (question 10a).

About 80 percent of the respondents reported that weather was considered in their evaluations while about half indicated consideration of nonphysical factors, such as use levels and populations (question 11a). However, judging from responses to questions about evaluation methods, it is quite likely that such considerations were more subjective than objective.

The final questions, 12-19, had to do with the presentation, distribution, and use of evaluation results. More than 70 percent of the respondents reported that results were not used to answer questions and make decisions about prevention (question 12), and more than 80 percent did not pass final judgment on success of prevention solely on the basis of evaluation results (question 14). Evaluation results were distributed within the organization, usually in verbal form (question 17), and assessment of prevention success was usually a shared activity (question 15).

Further examination of the mail survey results consisted of noting differences in evaluations by different agencies, locations, prevention program types, and evaluation criteria.[5] As indicated above, State fire protection agencies appeared to be ahead of the USDA Forest Service and other Federal agencies in prevention evaluation. States were most likely to set specific goals or targets for prevention, use a measurement instrument in evaluation, use statistical techniques in analysis of results, consider the influence of other factors upon the outcome of evaluation, base decisions about prevention upon the outcome of evaluation, and report evaluation results (see table 5). Differences between agencies on the other evaluation activities reported were too small to note. Neither did discernible regional differences emerge from this examination.

The type of prevention program evaluated made a difference in the frequency of several specific evaluation activities (see table 6). Results indicated that mass media programs were being subjected to the most rigorous evaluations, with school programs a close second. Also, general prevention programs appeared to discourage systematic evaluations; the "mixed" type received the lowest percentage of responses for

[5] *Since our respondent selection procedure produced a population of prevention evaluators—rather than a probability-based sample—tests of statistical inference are not appropriate for the data produced by the survey (see Blalock (1960), pages 89-90).*

Table 5.—*Comparison of evaluations reported by States, Forest Service, and other Federal agencies, United States, 1989*

Evaluation activity	Agency			
	States (n=38)	Forest Service (n=55)	Other Federal (n=11)	All agencies (n=104)
			Percent	
Sets goals/targets	58	47	36	50
Uses measurement instrument	55	29	18	38
Uses statistical techniques	53	36	27	41
Considers other factors	87	69	64	75
Bases decisions upon outcome	51	36	18	40
Reports results	100	76	82	86

five of the six evaluation activities (table 6). We wanted to compare evaluations in terms of the criteria used to measure prevention effectiveness, but since nearly all (89 percent) respondents reported "number of fires" as the primary criterion, we were unable to make this comparison.

Table 6.—*Comparison of evaluations by prevention program type, United States, 1989*

Evaluation activity	Prevention program type[1]			
	Mass media (n=35)	School (n=16)	Mixed (n=43)	All types (n=94)
		Percent		
Set goals/targets	71	62	35	53
Uses measurement instrument	46	56	26	38
Draws a sample	60	50	42	50
Uses statistical techniques	49	50	35	43
Answers specific questions	71	93	62	68
Bases decisions upon outcome	59	31	33	41

[1] Ten evaluations of other prevention program types are omitted because of their small numbers—six law enforcement programs, one personal contact program, and three "other" types.

Qualitative Assessment

While answers to the fixed response questions in the survey form did not provide much detail about the evaluations, several of the questions were open-ended (6a, 7a, 9b, 12a, 13, 16a, and 20; see Appendix B). Also, respondents were invited to remit copies of tests, measuring instruments, recording forms, and the like (see question 7a, Appendix B). The open-ended responses and the submitted documents allowed us to go beyond a simple tally of frequencies and look at the substance of the reported evaluations. A total of 111 evaluations were examined: 109 for which questionnaires were returned plus two for which respondents sent examples of evaluation methods but did not complete a questionnaire.

The typical evaluation activity reported was a rather subjective assessment of fire occurrence trends; 69 of the respondents (62 percent) reported this type of evaluation. Although some of these assessments included examination of other data recorded on individual fire reports, the bottom line for these evaluations was the trend in fire numbers. As one respondent in this group stated, "...if fire causes have reduced, and this can be attributed to a particular prevention activity, they appear to have been successful." Some of the respondents in this group felt that the low fire load in their management unit did not justify a more sophisticated evaluation; others stated their dissatisfaction with this level of evaluation.

Another group of 13 evaluations also was based upon fire occurrence, but the analysis was somewhat more rigorous. These evaluations differed from those in the first group by the extent of fire data analysis. Several respondents in the second group attached detailed tables or graphs of fire occurrence for multiyear periods, some compared occurrence between protection units, and some calculated fire occurrence rates in terms of area protected. Evaluation activities in this group were more likely to have explicit goals, like a stated reduction in total fire numbers or those from a specific fire cause following initiation or intensification of prevention.

A third group of 18 evaluations was characterized by the subjective consideration of other

criteria as well as fire occurrence. The most common evaluation criteria reported by respondents in this group were knowledge and attitudes. However, there was no evidence provided to show if *objective* measures of these criteria were employed. For example, one respondent indicated that awareness and changing attitudes were measured in school programs, but when asked if any kind of test, measurement instrument, etc. was used, his response was "no." Another reported the limited use of pre-tests and post-tests to measure changes in level of knowledge with elementary students "a number of years ago," but the tests were not included with the survey form.

The final group of evaluations consisted of the most objective, systematic, and potentially adaptable examples submitted. The 11 cases (10 percent) included in this group represented the state of the art in prevention evaluation as far as results of this study are concerned. Five of the cases employed a weather normalization system, three employed a fire "preventability index," and three systematically assessed criteria other than fire occurrence.

Weather normalization.—While fire managers readily acknowledge the influence of weather-related factors upon both ignition and spread of wildfire, only five respondents reported attempts to systematically factor out this influence when analyzing fluctuations in fire occurrence. Three Wisconsin Department of Natural Resources employees reported the use of a technique based upon the relationship between cumulative ignition components and number of fires by cause (Meyer and Dupor 1986). Historical fire and weather data were used to establish a base from which deviations and, ultimately, trends could be observed. The fourth example of weather normalization was reported by the State of Nebraska where it has been used to evaluate the effect of employing a statewide prevention specialist. This system was based upon a cumulative fire occurrence/fire hazard rating index. Finally, one respondent reported (but did not fully describe) a procedure that had been in use 12 years wherein the energy release component of fire danger rating was used as a basis for determining industrial fire precaution levels.

Preventability index.—In recognition of the fact that different wildland fire causes respond differently to prevention efforts, a California national forest had assigned a degree of prevention difficulty to each of the 30 specific causes in its reporting system. In its application, a composite preventability index was derived for a given land unit (a watershed, for example) on the basis of several years of fire occurrence records. Reduction goals were set, prevention activities were targeted on specific fire causes, and progress was monitored on a year-to-year basis. Although the rating system was acknowledged as having a judgmental (or, actually experiential) basis, and did not take into consideration some variables that influence occurrence, it was seen as a "...simple first step measure of prevention program effectiveness" by the three respondents who reported its use.

Other systematic assessments.—Although several respondents indicated that they obtained feedback from target audiences, only two submitted documented evidence pertaining to how feedback was recorded. In one case, elementary teachers were asked to evaluate prevention presentations to their classes by completing a form provided by the agency. Presentations were rated on a Likert-type scale[6], so quantification was possible. The second case in this category was the only example of a pre-test/post-test knowledge assessment that we received. Used in conjunction with an adaptation of the national "Learn Not to Burn" program, the test covered all aspects of the instruction as it was presented in elementary schools in southeastern Oklahoma. Finally, coordinators of the national wildland fire prevention program originally known as "Smokey and the Pros" developed an evaluation technique that, although subjective, has been applied systematically. In the example submitted to us, each prevention activity and product was rated on a 3-point scale in terms of 10 attributes, the

[6] *Such scales employ five fixed responses generally ranging from "strongly agree" to "strongly disagree" (Babbie 1989).*

scores were totalled and then multiplied by two weighting factors— "geographic applicability" and "efficiency co-efficient." The resulting composite score was used to rank-order prevention activities and products employed with each of the sports teams participating in the national program.

RECOMMENDED PREVENTION EVALUATION PROCEDURES

The final task for this study was to develop recommended prevention evaluation procedures. Before doing so, however, it seems appropriate to present our interpretation of the results of this study and to state some conclusions upon which our recommendations are based.

Results of this study produced no clear indication that prevention evaluation in the field has changed very much in the past several years; the majority of evaluations reported to us relied primarily upon observance of raw fire occurrence data. Furthermore, it is obvious that a significant gap exists between the availability of evaluation technology and its use. We found very limited use of weather normalization procedures, for example, even though respondents almost unanimously agreed that weather must be considered in assessments of prevention effectiveness. Procedures described in the general evaluation literature, such as pre-test/post-test measurement of knowledge in conjunction with education programs, were used even less frequently. Our major conclusion is that unavailability of evaluation techniques is not the primary reason for the lack of progress in field usage.

What, then, are some possible reasons for stagnation in prevention evaluation? Our results suggest several:

1. *Low person-caused fire loads.* A number of the fire managers and administrators we contacted by telephone stated that their jurisdictions did not experience a sufficient number of fires to justify any evaluation beyond an annual cursory examination of occurrence data.

2. *Perceptions about evaluation.* A majority of the telephone respondents had the opinion that evaluation methods developed by research often are too complex for field use and that experience is more important than science in deciding if prevention is effective. Perceptions, whether true or false, define reality for their holders.

3. *Evaluation criteria.* The evaluation literature stresses the importance of selecting measurable, attainable objectives; the objectives, in turn, become the criteria for evaluation. Wetherill (1981) has argued that reducing fire occurrence is not a realistic *objective* for many prevention programs, although it may be the eventual *goal* of all prevention. If one accepts this argument, it follows that fire occurrence may not be the best criterion for evaluating a prevention program or activity.

4. *The nature of the evaluation task.* The difficulty of evaluation based upon analysis of fire occurrence and variables assumed to influence occurrence varies directly with the strength of the cause and effect relationship between the prevention action and the occurrence of fire. For example, the impact of enacting a law requiring railroads to install spark arresters on locomotives has been evaluated with a high degree of confidence; conversely, the impact of intensified law enforcement upon arson fires is demonstrably more difficult to assess (Simard and Donoghue 1987). Our finding that prevention aimed at industrial fires, recreationist-caused fires, and debris-burning fires was more often evaluated than prevention aimed at arson fires and smoker-caused fires is additional support for this conclusion.

5. *Organizational policies and priorities.* Most of the evaluations reported to us were conducted by field-level prevention specialists/technicians on their own initiative rather than in response to agency policy or management directive. Typically, the specialist made the decision to conduct an evaluation, planned and executed the evaluation, and made the decisions regarding the success of

the prevention program. When evaluation is treated as an *individual* responsibility, rather than as an *organizational* responsibility, its continuity often suffers. We encountered instances where evaluation had ended with the transfer of the evaluator, even though the vacated position had been filled.

6. *The perceived role of prevention.* Although this study produced no hard evidence that prevention, as one of the major functions of fire protection, suffers from inequalities in resource allocation, several respondents to the telephone contacts complained "off the record" about declining commitment and dollars for prevention. Others noted that prevention is the first activity cut in a budget downturn. The interagency task force cited earlier (Anon. 1975) noted "...a basic lack of commitment to wildfire prevention by management" and illustrated their conclusion with a recitation of inequities in resources allocated to the different fire management functions. Prevention evaluation cannot be expected to flourish in such an environment until it becomes sufficiently rigorous to be used as the primary basis for decisions about resource allocation.

During the course of the study we did not discover prevention evaluations that can be recommended for immediate adoption. However, we did find examples of evaluation procedures that can be put to immediate use by most fire management agencies.

1. *All analyses of fire occurrence should provide for normalizing the influence of weather.* The widespread failure to employ weather normalization in the analysis of fire occurrence trends is inexplicable. For small fire protection units (*e.g.*, counties, districts), proven procedures are readily available, easy to use, and can account for up to half of year-to-year differences in occurrence (Simard and Donoghue 1987). These procedures could be incorporated into fire management planning and evaluation immediately if top managers would issue a directive.

2. *All prevention education programs should be evaluated by the administration of "before-and-after" knowledge tests.* Simple knowledge tests should be administered to the recipients of prevention education programs prior to, immediately following, and several weeks after the presentation. The content of the program should be the basis for constructing a test. Tests can be written, oral, or, in some instances, performance. If assistance in test construction is needed, local educators can be enlisted to help.

Beyond these immediate actions, other steps could be taken to end the inertia that seemingly has gripped prevention evaluation for many years.

1. Renew efforts by research to develop fire occurrence and economic models for explaining variation in occurrence and determining optimum program mixes for fire management systems. Significant progress in these areas has been made in recent years, and even greater accomplishments are possible in the near term (Simard and Donoghue 1987).

2. Initiate an effort to develop procedures for evaluating prevention that may not produce a measurable reduction in fire occurrence in the short term. The diversity in fire causes and prevention activities suggests the need for diverse evaluation procedures. Whereas some prevention activities directly intervene in the causal pathway that results in a fire start, many do not. The search for valid, reliable evaluation criteria for these activities must extend beyond fire occurrence, even as our ability to explain and predict occurrence steadily improves. The general evaluation literature contains numerous examples of procedures and techniques that should be pilot tested to determine their applicability for evaluating selected types of prevention programs.

3. Intensify efforts to transfer prevention evaluation technology to the field. Apparently, existing transfer mechanisms are not providing an effective linkage between research and application of evaluation technology. Several alternatives should be considered including "how to evaluate prevention" handbooks, special evaluation workshops, and field demonstrations. Fire management must be convinced that valid, reliable evaluation results can be produced.

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APPENDIX A

Evaluation Model

Task 1 — **Identify who wants the evaluation.**
- a. Identify the decisionmakers.
- b. Specify the intended audience.
- c. Determine who wants to know about the program.

Task 2 — **Determine the focus or purpose of the evaluation.**
- a. Determine what decisionmakers really seek from the evaluation and how they expect to use the results.
- b. Determine what decisions will be based on the evaluation.

Task 3 — **Formulate the evaluation questions or program goals that will be criteria for evaluation.**
- a. Formulate specific evaluation questions.
- b. Identify goals and objectives.

Task 4 — **Establish yardsticks for determining how much progress toward each goal marks success.**
- a. Determine what information will provide evidence of program merit.
- b. Determine what constitutes program success/attainment of program goals.

Task 5 — **Decide what must be measured.**
- a. Select independent, intervening, and dependent variables.
- b. Develop indicators to measure the extent to which goals are achieved.
- c. Define and quantify input and intervening variables.

Task 6 — **Describe the program being evaluated.**
- a. Specify the nature of the program.
- b. Precisely describe the program and its alternatives.

Task 7 — **Choose a measurement instrument.**
- a. Describe the instrument that is developed, adapted, or purchased to measure change.
- b. Describe how threats to validity and reliability are considered.

Task 8 — **Choose an evaluation design.**
- a. Describe the design in terms of nonexperimental, quasi-experimental, or experimental.
- b. Specify to whom the instrument will be administered and when (frequency).

Task 9 — **Choose a sampling strategy.**
- a. Describe the sampling scheme.
- b. Plan data collection and analysis.

Task 10 — **Collect data.**
- a. Establish deadlines.
- b. Validate/pilot test instrument(s).
- c. Administer instrument(s) and score them.
- d. Organize and record data for analysis.
- e. Monitor information collection.
- f. Document data collection method(s).

Task 11 — **Analyze and interpret results.**
- a. Document analytical techniques.
- b. Compare results to criteria established for the evaluation.
- c. Make judgments based on analysis.

Task 12 -- **Report results.**
- a. Plan the report.
- b. Choose the method of presentation.
- c. Assess the result of the evaluation.

APPENDIX B

Mail Questionnaire

Fire Prevention Evaluation - 1989

1. According to our previous contact with you, your primary prevention activities have been

_____

_____

Is this still correct? (Circle your answer)

1. YES —> If yes, skip to Question 2.
2. NO

1a. What are your primary prevention activities?

_____

_____

2. Of your current prevention activities, which have been subjected to evaluation? (Circle all that apply)

1. MASS MEDIA (radio, TV, signs, posters, etc.)
2. SCHOOL PROGRAMS/ACTIVITIES
3. LAW ENFORCEMENT
4. PERSONAL CONTACT
5. INFORMATION BOOTHS
6. NO SPECIFIC ACTIVITY (evaluated program as a whole)
7. OTHER (specify) _____

_____

_____

3. Who decided to evaluate your prevention activities? (Circle your answer)

1. I DID
2. MY SUPERVISOR
3. HIGHER LEVEL ADMINISTRATOR
4. OTHER (specify) _____
5. DON'T KNOW

4. What has been **observed** or **measured** to see if change is occurring? (Circle all that apply)

   1. NUMBER OF FIRES
   2. SUPPRESSION COSTS
   3. LEVEL OF KNOWLEDGE
   4. ATTITUDES
   5. SAFE OR UNSAFE ACTS
   6. NUMBER OF PEOPLE HEARING OR SEEING THE PREVENTION PROGRAM
   7. NUMBER OF ARRESTS OR CITATIONS
   8. OTHER (specify) _____

5. What would you say have been the **primary** purposes of evaluation? (Circle all that apply)

   1. DETERMINE IF FIRE OCCURRENCE IS DECLINING
   2. DETERMINE IF SUPPRESSION COSTS ARE DECREASING
   3. DETERMINE IF KNOWLEDGE AND/OR ATTITUDES ARE IMPROVING
   4. DETERMINE HOW MANY PEOPLE SEE OR HEAR THE PREVENTION MESSAGE
   5. OTHER (specify) _____

6. Have any specific goals or targets been set at the beginning of the evaluation period? (Circle your answer)

   1. NO —> If no, skip to Question 7.
   2. YES

      6a. What were the goals or targets?

      _____

      _____

      _____

7. Has any kind of test, measurement instrument, recording form or the like been used in evaluation? (Circle your answer)

   1. NO —> If no, skip to Question 8.
   2. YES

      7a. Briefly describe the document (or send us a copy, if available)

      _____

      _____

      _____

      _____

      _____

7b. If a test or other instrument has been administered, was it first pre-tested?

1. NO
2. YES
3. DON'T KNOW

7c. About how often has the test been administered or recordings made? (Circle your answer)

1. LESS THAN ONCE PER YEAR
2. ABOUT ONCE PER YEAR
3. ABOUT_____TIMES PER YEAR
   (enter no.)
4. OTHER (specify) _____
5. DON'T KNOW

8. Who has usually administered the tests/recorded the data? (Circle your answer)

1. I HAVE
2. MY SUBORDINATE(S)
3. MY SUPERVISOR
4. OTHER (specify) _____

9. Has any kind of sampling of data, people, or other populations or cases been done?

1. NO —> If no, skip to Question 10.
2. YES

9a. What was sampled? (Circle all that apply)

1. FIRES
2. TIME PERIODS (Days, Weeks, etc.)
3. PEOPLE
4. OTHER (specify) _____

9b. Briefly, how was the sample selected?

_____

_____

_____

_____

10. Have any statistical techniques been used in the analysis of test or measurement results?

    1. NO —> If no, skip to Question 11.
    2. YES
        10a. What techniques were used? (Circle all that apply)
            1. PERCENTAGES/PROPORTIONS/RATIOS
            2. MEANS OR AVERAGES
            3. CORRELATIONS
            4. SIGNIFICANCE TESTS
            5. OTHER (specify) _____

11. Has the possible effect of other factors upon the outcome of the evaluation been considered?

    1. NO —> If no, skip to Question 12.
    2. YES
        11a. What other factors? (Circle all that apply)
            1. WEATHER
            2. CHANGES IN USE
            3. CHANGES IN POPULATION
            4. CHANGES IN MY ORGANIZATION
            5. OTHER (specify) _____

12. Has the evaluation helped answer any specific questions about your prevention program or activities?
    1. NO —> If no, skip to Question 13.
    2. YES
        12a. What questions?

13. Briefly describe how results of the evaluation have been used to decide whether or not your prevention program is successful or effective.

14. Has the prevention program been judged as successful or effective?
    1. NO
    2. YES

15. Who makes the decision concerning the success or effectiveness of the prevention program? (Circle your answer)
    1. I DO (evaluator)
    2. MY SUPERVISOR
    3. HIGHER LEVEL ADMINISTRATOR
    4. STAFF DECISION
    5. OTHER (specify) _____

16. Have any other decisions about your prevention program been based upon or affected by the results of evaluation?
    1. NO —> If no, skip to Question 17.
    2. YES
       16a. What decisions?

       _____

       _____

       _____

17. How have evaluation results been reported within your organization? (Circle all that apply)

    1. REPORTED VERBALLY
    2. REPORTED IN WRITTEN DOCUMENT
    3. REPORTED BY LETTER OR MEMO
    4. OTHER (specify) _____
    5. NOT REPORTED

18. Who, in your organization, has reviewed the results of prevention evaluation? (Circle all that apply)
    1. MY SUPERVISOR
    2. OTHER PREVENTION SPECIALISTS
    3. FIRE STAFF OFFICER(S)
    4. HIGHER LEVEL ADMINISTRATOR
    5. OTHER(S) (specify) _____

       _____

    6. NO ONE

19. About how many other people in your organization are familiar enough with prevention evaluation to have completed this form? (Circle your answer)

    1. NONE
    2. ONE
    3. TWO
    4. THREE OR MORE
    5. DON'T KNOW

20. Please make any comments about prevention, prevention evaluation, or this survey.

_____

_____

_____

_____

_____

_____

Thank you for your cooperation.

Appendix C

Responses to Items in Mail Questionnaire

NOTE: All questions included in the mail survey are repeated here, but responses to open-ended questions were not tabulated. Multiple responses were allowed for several questions; therefore, percentages do not always total 100.

Question 1: According to our previous contact with you, your primary prevention activities have been: (Responses not tabulated).

Question 2: Of your current prevention activities, which have been subjected to evaluation?

Responses	Frequency	Percent (n=104)
Mass media	60	57.7
School programs/activities	63	60.6
Law enforcement	58	55.8
Personal contacts	60	57.7
Information booths	24	23.1
Smokey Bear	24	23.1

Question 3: Who decided to evaluate your prevention activities?

Responses	Frequency	Percent (n=104)
I did	71	68.3
My supervisor	17	16.3
Higher level administrator	17	16.3
Other	19	18.3

Question 4: What has been observed or measured to see if change is occurring?

Responses	Frequency	Percent (n=104)
Number of fires	93	89.4
Suppression costs	33	31.7
Level of knowledge	36	34.6
Attitudes	46	44.2
Safe or unsafe acts	19	18.3
Number of people hearing or seeing the prevention program	46	44.2
Number of arrests or citations	21	20.2
Other	13	12.5

Question 5: What would you say have been the primary purposes of evaluation?

Responses	Frequency	Percent (n=104)
Determine if fire occurrence is declining	77	74.0
Determine if suppression costs are decreasing	23	22.1
Determine if knowledge and/or attitudes are improving	50	48.1
Determine how many people see or hear the prevention message	36	34.6
Other	18	17.3

Question 6: Have any specific goals or targets been set at the beginning of the evaluation period?

Responses	Frequency	Percent (n=104)
Yes	52	50.0
No	52	50.0

Question 6a: What were the goals or targets?

Responses	Frequency	Percent (n=52)
Cost effectiveness	13	25.0
Raise public interest	13	25.0
Reduce person-caused fires	48	92.3

Question 7: Has any kind of test, measurement instrument, recording form or the like been used in evaluation?

Responses	Frequency	Percent (n=104)
Yes	39	37.5
No	65	62.5

Question 7a: Briefly describe the document (or send us a copy if available).
(Responses not tabulated.)

Question 7b: If a test or other instrument has been administered, was it first pre-tested?

Responses	Frequency	Percent (n=39)
Yes	19	48.7
No	20	51.3

Question 7c: About how often has the test been administered or recordings made?

Responses	Frequency	Percent (n=39)
Less than once per year	4	10.3
About once per year	16	41.0
About___times per year	5	12.8
Other	5	12.8
Don't know	9	23.1

Question 8: Who has usually administered the tests/recorded the data?

Responses	Frequency	Percent (n=104)
I have	45	43.3
My subordinate(s)	27	26.0
My supervisor	3	2.9
Other	25	24.0
No answer	4	3.8

Question 9: Has any kind of sampling of data, people, or other populations or cases been done?

Responses	Frequency	Percent (n=104)
Yes	52	50.0
No	52	50.0

Question 9a: What was sampled?

Responses	Frequency	Percent (n=52)
Fires	43	82.7
Time periods	30	57.7
People	29	55.8
Other	15	28.8

Question 9b: Briefly, how was the sample selected?
(Responses not tabulated.)

Question 10: Have any statistical techniques been used in the analysis of test or measurement results?

Responses	Frequency	Percent (n=104)
Yes	42	40.4
No	62	59.6

Question 10a: What techniques were used?

Responses	Frequency	Percent (n=42)
Percentages/proportions/ratios	26	61.9
Means or averages	21	50.0
Correlations	17	40.5
Significance tests	1	2.4
Other	6	14.3

Question 11: Has the possible effect of other factors upon the outcome of the evaluation been considered?

Responses	Frequency	Percent (n=104)
Yes	77	74.0
No	27	26.0

Question 11a: What other factors?

Responses	Frequency	Percent (n=77)
Weather	62	80.5
Changes in use	36	46.8
Changes in population	46	59.7
Changes in my organization	22	28.6
Other	14	18.2

Question 12: Has the evaluation helped answer any specific questions about your prevention program or activities?

Responses	Frequency	Percent (n=104)
Yes	30	28.8
No	74	71.2

Question 12a: What questions?
(Responses not tabulated.)

Question 13: Briefly describe how results of the evaluation have been used to decide whether or not your prevention program is successful or effective.
(Responses not tabulated.)

Question 14: Has the prevention program been judged as successful or effective?

Responses	Frequency	Percent (n=104)
Yes	16	15.4
No	88	84.6

Question 15: Who makes the decision concerning the success or effectiveness of the prevention program?

Responses	Frequency	Percent (n=104)
I do	66	63.5
My supervisor	45	43.3
High level administrator	23	22.1
Staff decision	18	17.3
Other	22	21.2

Question 16: Have any other decisions about your prevention program been based upon or affected by the results of evaluation?

Responses	Frequency	Percent (n=104)
Yes	62	59.6
No	42	40.4

Question 16a: What decisions?
(Responses not tabulated.)

Question 17: How have evaluation results been reported in your organization?

Responses	Frequency	Percent (n=104)
Reported verbally	60	57.7
Reported in written document	48	46.2
Reported by letter or memo	32	30.8
Other	18	17.3
Not reported	17	16.3

Question 18: Who in your organization has reviewed the results of prevention evaluation?

Responses	Frequency	Percent (n=104)
My supervisor	57	54.8
Other prevention specialists	46	44.2
Fire staff officer(s)	59	56.7
Higher level administrator	30	28.8
Others	13	12.5
No one	13	12.5

Question 19: About how many other people in your organization are familiar enough with prevention evaluation to have completed this form?

Responses	Frequency	Percent
None	13	12.5
One	12	11.5
Two	25	24.0
Three or more	44	42.3
Don't know	10	9.6

Doolittle, Larry; Donoghue, Linda R.
1991. **Status of wildland fire prevention evaluation in the United States.** Res. Pap. NC-298. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 26 p.

Presents findings of an assessment of the evaluation of wildland prevention efforts by all U.S. wildland fire management agencies, and offers recommendations for improvements in prevention evaluation techniques and procedures.

KEY WORDS: Fire prevention, evaluation, person-caused fire, telephone survey, mail survey, fire occurrence.