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Workshop on Wilderness Fire

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Proceedings—Symposium and Workshop on Wilderness Fire

Missoula, Montana, November 15-18, 1983

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FOREWORD

The Wilderness Fire Symposium held November 15-18, 1983, in Missoula, Mont., can be described in one word: *exciting!* Since its very inception, people have been excited. As I write these words almost a year later, people are still excited about wilderness fire management.

Credit for the initial concept of having such a symposium belongs to William C. Fischer, Research Forester at the Intermountain Fire Sciences Laboratory in Missoula. Bill spent many long hours developing and writing the recently published "Wilderness Fire Management Planning Guide."[1] One day as we were discussing the concept of using fire in wilderness, Bill suggested that we should pause to assess wilderness fire management inasmuch as we had been practicing it for 10 years or more. I said, "Let's do it!" And so we did.

I then formed a program committee chaired by Dr. Bruce Kilgore and consisting of Robert Mutch (both Bruce and Bob were pioneers in wilderness fire), Bill Fischer, and me. This early planning took place in January 1982. Bruce became a prime mover from that moment on. None of us at that time realized either the work involved or the size of the program that would evolve. We were excited, however, and that excitement spread to the estimated 700 people in attendance. More than 600 people registered; their names and addresses are listed at the end of the proceedings.

The symposium was one of a series planned to terminate the highly productive Fire Effects and Use Research and Development Program, conducted by Forest Service Research at the Intermountain Station's Intermountain Fire Sciences Laboratory located Northwest of Missoula, Mont.

Our goal was to openly discuss how well we have managed wilderness fire and current concerns. We wanted to discuss these issues in an open forum, with attendees contributing. During my opening remarks at the symposium, I pointed out that either topic--wilderness or fire--was apt to be controversial; and when we combine them, we are doubly assured of having plenty of controversy.

That we did! The arguments are continuing to this day. Our goal was to get them out into the open and to deal with them professionally. I suspect that as the issues of allocation and classification of wilderness are resolved, we will hear more debate about management of wilderness. What we have heard so far is probably just the tip of the iceberg.

One management controversy that has already arisen is whether to use deliberate, scheduled ignitions in wilderness. William A. Worf, retired Recreation Director of the U.S. Forest Service, Northern Region, pointed out that we did not present the cons of using scheduled ignition in wilderness. I therefore invited him to present his views in a paper to be included in the proceedings. In addition, I decided to include the views of Robert C. Lucas and Bruce M. Kilgore, who reviewed Worf's paper. I suppose the process could have continued *ad infinitum*. These papers point out the complexities of wilderness fire management. I suspect that such controversy extends to many other wilderness issues.

Processing papers for this proceedings revealed a frustrating inconsistency in the terminology used to describe wilderness fires. We felt that uniform terminology would facilitate communication among the various Federal resource agencies, State and Province organizations, universities, conservation groups, industry, consultants, and research organizations. I therefore asked Bill Fischer to include his well-thought-out lexicon ("Wilderness Fire Terminology") in this proceedings, and we tried to use it throughout the proceedings even though we did not intend to press for universal adoption. Our hopes were dashed because each agency had its own terminology and good reasons for adherence to its usage. We ended up deferring to definitions used within an agency.

To facilitate communication in this proceedings and to eliminate reader confusion, we shall list some of the most common terms coined by the Forest Service, National Park Service, and Bill Fischer.

We caution readers to heed the official terminology of their respective agencies, and we urge the agencies to strive for literal and consistent meanings. Perhaps over the next decade a clearly understood and uniform terminology will evolve.

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[1]Fischer, William C. Wilderness fire management planning guide. Gen. Tech. Rep. INT-171. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, 1984. 56 p.

Types of fire	Forest Service term	Park Service term	Fischer's term
Fires ignited by lightning or other natural forces (volcanoes) that are permitted to burn under prescribed conditions.	Fires with unplanned ignition	Prescribed natural fires	Fires with unscheduled ignition
Fires ignited by trained professionals under prescribed conditions.	Fires with planned ignition	Prescribed burns	Scheduled ignition
Unwanted fires started either by natural forces or people (arson or carelessness).	Wildfires	Wildfires	Wildfires

I thank Dr. Bruce Kilgore and the members of the program committee: Gerry T. Baertsch, our general manager; the many speakers and authors; and the many attendees and their supporting agencies. Bruce's energy and attention to detail were particularly important to the successful completion of the symposium and publication of the proceedings. This symposium will serve as a milestone in his future research in wilderness fire management. Bill Fischer deserves further acknowledgment for his outstanding poster session. It added immeasurably to the value of the meeting. I personally thank Gail Hallesy and Patricia Proebstel who did far more than type papers. Their assistance was invaluable.

For their sponsorship and generous support of the symposium, I thank administrators in the Washington Office of Forest Service Research and in the Intermountain Station; and also the Center for Continuing Education, University of Montana; the National Park Service; the Prescribed Fire and Fire Effects Working Team, National Wildfire Coordinating Group; and the Ecology and Fire Management Working Groups, Society of American Foresters.

With these comments I submit these proceedings to the wilderness fire management community. *It has been fun! . . . and exciting!*

JAMES E. LOTAN
Research Forester

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Section 4. Park and Wilderness Fire Management Planning

ARCHEOLOGICAL CONSIDERATIONS FOR PARK AND WILDERNESS FIRE MANAGEMENT PLANNING

Bruce A. Anderson

ABSTRACT: Land managers are becoming increasingly aware that cultural resources are a fragile and nonrenewable part of the environment that must be protected. Legislation has been enacted at the Federal and State levels to protect these resources. There is potential for conflicts between the goals of fire management programs and cultural preservation programs because fire may damage the resources and suppression may do even greater damage. Archeological surveys and collaboration between archeologists and the fire management team can mitigate this damage.

INTRODUCTION

Only in recent years have many managers realized that cultural as well as natural resources are vulnerable to wildfires, not only to the fire itself but from suppression activities. Fire effects are obvious on historic structures such as standing buildings; however, effects on archeological remains can be subtle and not easily recognized. Most land-managing agencies have cultural resource specialists (archeologists, historians, or historic architects) on their staffs, and these professionals should be consulted during the fire management planning process. In this discussion, I present some suggestions that may facilitate such a collaborative effort.

POLICIES AND MANDATES

Archeological resources can include sites, artifacts, and other data that can be used to reconstruct the varying life ways of an area's past inhabitants. These resources are a limited, fragile, nonrenewable part of the environment; when disturbed, the scientific information they provide is often lost forever. Because of the fragile nature of archeological and historical resources, there has been an ever increasing concern for their protection and preservation. This concern is clearly set forth in a number of acts:

Paper presented at the Wilderness Fire Symposium, Missoula, Mont., November 15-18, 1983.

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1. The Antiquities Act of 1906 (Public Law 59-209, 34 Stat. 225; 16 U.S.C. 431-433);

2. The Historic Sites Act of 1935 (Public Law 74-292, 49 Stat. 666; 16 U.S.C. 461-467);

3. The Reservoir Salvage Act of 1960 (Public Law 86-523, 74 Stat. 220; 16 U.S.C. 469-469c);

4. The Historic Preservation Act of 1966 (Public Law 89-665, 80 Stat. 915; 16 U.S.C. 470);

5. The National Environmental Policy Act of 1969 (Public Law 91-190, 31 Stat. 852; 42 U.S.C. 4321-4347);

6. The Archeological and Historic Preservation Act of 1974 (88 Stat. 174);

7. The American Indian Religious Freedom Act of 1978 (Public Law 95-341, 92 Stat. 469);

8. Archaeological Resources Protection Act of 1979 (Public Law 96-95, 93 Stat. 721; 16 U.S.C. 470);

9. The National Historic Preservation Act Amendments of 1980 (Public Law 96-515, 94 Stat. 2987).

Most States also have legislation affecting archeological resources. In some States, programs for the investigation, protection, and recovery of archeological resources have been established and are active. Most States have historic preservation officers who review the State's varying projects and programs to see that cultural resources are addressed. Also, these offices direct and conduct State-wide surveys of historic properties and maintain a listing of those properties.

Finally, most Federal agencies have their own policy statements regarding cultural resources management. The U.S. Department of the Interior, National Park Service, has assembled a guideline entitled "Cultural Resources Management: NPS-28," which directs managers how to best care for cultural resources. This detailed comprehensive guide presents step-by-step approaches for all aspects--archeological, historic, and preservation--of

cultural resources management. It must be remembered, however, that the National Park Service is unique because it is directed to preserve many of the best of the Nation's cultural treasures and has a different mandate for resource use.

STATE OF KNOWLEDGE

The focus in this section is on cultural resources and fires within specific park and wilderness areas. For several years researchers have discussed the role of Indian fires and their influence (Halbrook 1944; Burgh 1960; Stewart 1956, 1963; Reynolds 1959; Lewis 1973; Dobyns 1981; Barrett and Arno 1982; Pyne 1983). Although this question is extremely important to developing a knowledge of fire history and in determining the role of fire and of human influences before European settlement, it does not consider the effects of fire on the cultural resources themselves. Studies on direct effects are somewhat limited; they should become more numerous now that prescribed burning has increased (Switzer 1974; Racine and Racine 1979; Eisler and others 1978; Kelly and Mayberry 1979; Scott 1979; Traylor and others 1979; Manual 1980; Koxan and Marcus 1983; Welch and Gonzales 1982). A drawback to some of these reports is that much of the information is based on observation and speculation rather than on tested results. These reports, however, are the only literature on fire effects and thus, when used to formulate planning, can be important. Finally, an excellent and more extensive source of information is the numerous reports on archeological surveys and excavations throughout the United States. Generally, these can be obtained through State universities, museums, or from other archeological research institutions. Most Federal agencies maintain cultural resource references for the areas they are concerned with or have staff archeologists maintain work libraries for relevant areas. Although these reports probably will not specifically concern fire-related situations, they can be extremely useful for fire management planning.

PROBLEMS

We need to be aware of potential conflicts between fire programs and other interests, and care should be taken not to destroy important archeological or historic resources (Parsons 1977). During any fire the four basic sources of damage to cultural resources are fire intensity, duration of heat, heat penetration into the soil, and the use of heavy machinery for fire suppression. The most significant threat to archeological resources is from heavy equipment used during the suppression activity (Traylor and others 1979). In known cultural resource areas bulldozers and graders should be monitored and directed by archeologists during the construction of firelines, fire roads, fire camps, and heliports and during followup rehabilitation operations like clearcutting, contour grading, and reseeding.

The most important source of information is the archeological survey. The more we know about any area's resources, the better the management plans will be for that area. A complete ground survey and inventory with detailed maps of sites, features, and environmental data are the best sources of information. For areas where a 100 percent survey is not possible, sample surveys, literature searches, assessments, and overviews should be completed to provide a baseline of information for making informed decisions. Often, however, cultural resource investigations are given such low priorities that they do not receive adequate funding. Even though there are laws, rules, regulations, and guidelines (mentioned previously) that call for cultural resource inventories, without the funds and available staff to deal with these requirements, often nothing gets accomplished. I realize that no agency will ever have all the funds needed to accomplish all of its goals, but managers should reevaluate priorities given for basic resource information. To ensure that cultural resource information is provided, funding should be appropriated by those requiring the information.

Another problem is scheduling, sequencing, and phasing the cultural resources work to be accomplished for planning needs. Sufficient lead time must be given to the cultural resources managers to provide the necessary information for those preparing fire management plans. If there is proper sequencing, the cultural resource information available can be used in the planning process. Also, by multistage phasing of the research to be accomplished, the information base can be built upon (as funding does become available), and the information previously gathered will not have to be acquired again. Staging the research also allows for reevaluation of what is needed as the work is being done. All of these aspects should be part of any effective cultural resources management program.

I also see communication problems in many agencies. Too often managers do not communicate well amongst themselves on how to accomplish the necessary work. Occasionally, people become so caught up in their own goals, research, needs, and ideals that they lose track of other important issues. If a combined team approach can be used to achieve agreement about the task at hand, we will be much closer to accomplishing the desired results.

CASE STUDY

In June 1977, a wildfire in Bandelier National Monument burned over 15,000 acres (6 070 ha) before the fire was contained. Because of the extensive cultural resources in the Monument, archeologists from the Southwest Cultural Resources Center, Santa Fe, N. Mex., were sent to work with the fire crews. The National Park Service Division of Natural Resources realized the suppression

activities were potentially dangerous to the archeological resources and suggested including archeologists in the fire-fighting scheme. This was the first such collaboration, and initially the fire bosses were apprehensive about archeologists working directly on the firelines. Later, however, they appreciated the efficiency of the arrangement in order to simultaneously suppress the fire and protect the cultural resources. Archeologists were most useful during fireline construction, when they guided crews away from sites, but they were also useful in other ways. By working day and night with the line crews, they were able to guide overhead teams (not familiar with the rugged terrain) to rendzvous points with other crews, to provide detailed maps of the area, and even to give interpretive talks to the line crews during lulls in the suppression activities. When the fire was finally contained, they also worked with the mopup crews.

Following the fire, researchers (Traylor and others 1979) studied the effects of the fire and the suppression activities on the cultural resources in Bandelier National Monument. This research was designed to:

1. Survey all areas affected by fire suppression within the Monument boundaries.

2. Survey two wildlife transects established before the fire and to complete the resource data for those areas.

3. Excavate selected sites burned by the La Mesa Fire to obtain data on the specific effects of the fire on artifacts and the sites themselves.

4. Submit a report on the findings with recommendations for actions in future fires where cultural resources are endangered.

Because a complete site inventory was lacking for Bandelier, the survey added to the data base. Of the 99 archeological sites surveyed, about two-thirds (58) had been burned in varying degrees. Some sites were burned heavily because of dense surface vegetation; others served as natural fire-breaks due to an absence of vegetation (Traylor and others 1979; Fiedler 1979). Surface artifacts and stone (used for original site construction) were affected by the fire, and materials were slightly displaced. The major destruction to cultural resources, however, was caused by heavy machines. Only two sites were damaged during the initial construction of the cat lines, but later widening and rehabilitation of those lines (when archeologists were not present) caused six additional sites to be destroyed and seven others to be significantly damaged. During mopup minimal damage occurred on three sites where burning roots were dug out of rubble mounds. When the survey was completed, four excavation sites were selected to determine subsurface damages to artifactual and ecofactual materials. Samples were taken from controlled levels and sent to consultants. These included tree rings, pollen, flotation, soil, faunal, archeomagnetic, carbon 14, obsidian, and thermoluminescent materials. Damage ranged from very light to severe. Some effects, such as soil erosion, may not be known for years to come. Results of specific tests on the materials mentioned helped reveal the effects the fire had on both the surface and surface materials. Measurements of thermoluminescent values for pottery revealed dates 24 percent lower than expected for LA 16,097 (the most severely burned excavated site, as compared with only 10 percent lower at LA 16,114 [a moderately burned site]). Obsidian was also greatly affected, as only 35 percent of the examined burned sample edges revealed measurable hydration rinds, whereas 70 percent could be measured from unburned samples. Pollen is destroyed at 570° F (300° C), so surface pollen was definitely affected; however, subsurface pollen grains were protected.

Although this study did not benefit from previous survey information or comparative prefire data, two points were made clear: (1) archeologists working in cooperation with firefighters can prevent needless site destruction and (2) a fire as intense as the La Mesa Fire has a definite adverse effect on surface artifacts and architectural features.

Recommendations based on this study include:

1. It is essential to keep communication lines open at all times and to all factions involved.

2. Contingency plans should be established by area resource managers indicating resource priorities and permissible policy.

3. Resource base maps showing archeological site locations should be given to archeologists and fire bosses on the firelines.

4. When numerous cultural resources are threatened by a fire, archeologists can and should be present to help mitigate fire suppression or rehabilitation impacts on those resources.

5. Priority should be given to monitoring heavy equipment through all aspects of the suppression efforts.

6. All archeologists serving on the fire should have completed certified courses on fire behavior and hold a current red card.

7. Line archeologists should be equipped with appropriate standard safety equipment.

8. Special flagging should identify archeological sites.

9. A photographic record should be kept of all fire suppression and archeological activity.

10. A liaison officer should coordinate all activities of line archeologists with fire bosses.

We cannot forget that during a wildfire the highest priorities are safety and controling the blaze; therefore, if the fireline cannot be diverted, cultural resources may have to be sacrificed. In most cases, however, damage can be averted.

CONCLUSION

This paper has provided some considerations regarding cultural resources that should be made in park and wilderness fire planning. Some of the items discussed are most useful for planning, some are best for prescribed burning itself, others involve prevention and actual fire fighting and suppression activities. The time is appropriate for fire managers and cultural resource managers to begin working together. Through a combined concentrated effort, cultural resources can be saved for the enjoyment of future generations. These fragile, nonrenewable, finite resources are too valuable to be lost forever.

REFERENCES

Barrett, Stephen W.; Arno, Stephen F. Indian fires as an ecological influence in the Northern Rockies. J. For. 80(10): 647-651; 1982.

Burgh, Robert F. Potsherds and forest fires in the Pueblo country. Plateau. 33: 54-56; 1960.

Dobyns, Henry F. From fire to flood: historic human destruction of Sonoran Desert riverine oases. Anthropological Papers No. 20. Socoro, NM: Ballena Press; 1981. 222 p.

Eisler, David; Parrella, David; Spencer, Lee. Report on the investigation and analysis of cultural resources, Young's Butte fire, Paulina Ranger District, Ochoco National Forest. Prineville, OR: U.S. Department of Agriculture, Forest Service, Ochoco National Forest; 1978. 134 p.

Holbrook, S. Burning an empire. New York: MacMillan & Co; 1944. 229 p.

Kelly, Roger E.; Mayberry, Jim. Trial by fire: effects of NPS burn programs upon archeological resources. In: Proceedings, 2nd conference on scientific research. San Francisco, CA: U.S. Department of the Interior, National Park Service, Western Regional Office; 1979: 603-610.

Lewis, Henry T. Patterns of Indian burning in California: ecology and ethnohistory. Anthropological Papers No. 1. Ramona, CA: Ballena Press; 1973. 101 p.

Manuel, Don. Prescribed burning and its effects on cultural resources within the Diablo and Sierra de Salinas mountain ranges of the interior central coast of California: initial investigations. Folsom, CA: U.S. Department of the Interior, Bureau of Land Management, Folsom District; 1980. 15 p.

Noxon, John S.; Marcus, Debora A. Wildfire--induced cliff-face exfoliation and potential effects on cultural resources in the Needles District of Canyonlands National Park, Utah. Southwestern Lore 49(2): 1-8; 1983.

Parsons, David J. The role of fire in park management. Parks. 2(1): 1-4; 1977.

Pyne, Stephen J. Indian fires. Nat. Hist. 92(2): 6-11; 1983.

Racine, Charles H.; Racine, Marilyn M. Tundra fires and two archaeological sites in the Seward Peninsula, Alaska. Arctic. 32(1): 76-79; 1979.

Reynolds, R. D. Effect of natural fires and aboriginal burning upon the forests of the central Sierra Nevada. Berkeley, CA: University of California; 1959. 262 p. M.A. thesis.

Scott, Douglas D. Don't burn that wickiup. Montrose, CA: U.S. Department of the Interior, Bureau of Land Management, Montrose District; 1979. 8 p. Unpublished report.

Stewart, Omar C. Fire as the first great force employed by man. In: Thomas, W. L., ed. Man's role in changing the face of the earth. Chicago: University of Chicago Press; 1956: 115-133.

Stewart, Omar C. Barriers to understanding the influence of use of fire by aborigines on vegetation. Proc. Tall Timbers Fire Ecol. Conf.; 1963: 117-126.

Switzer, Ronald R. The effects of forest fire on archaeological sites in Mesa Verde National Park, Colorado. Artifact. 12(3): 1-8; 1974.

Traylor, Diane; Hubbell, Lyndi; Wood, Nancy; Fiedler, Barbara. The La Mesa fire study: investigation of fire and fire suppression on cultural resources in Bandelier National Monument. Santa Fe, NM: U.S. Department of the Interior, National Park Service, Southwest Cultural Resources Center; 1979. 159 p.

Welch, Pat; Gonzales, Tirzo. Research design: prescribed burn impact evaluation upon cultural resources. LMDA and Thing Mountain chaparral management projects. U.S. Department of the Interior, Bureau of Land Management, California Desert District, El Centro Research Area; U.S. Department of Agriculture, Forest Service Descanso Ranger Station; 1982. 7 p. Unpublished report.