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EFFECTS OF FIRE ON CULTURAL RESOURCES IN MESA VERDE NATIONAL PARK

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-- February 9, 1993 --

A meeting of archeologists, ecologists, and fire managers was held in Mesa Verde National Park (MVNP) on October 20-21, 1992, to evaluate and predict the effects of fire on cultural resources in the Park. Our ultimate goal is to develop a risk model -- incorporating parameters of potential damage to sites and artifacts, vegetation/fuels conditions, and weather conditions -- that will be useful to managers in predicting and managing fire effects. This report addresses the first component of the risk model, viz the differential susceptibility of various types of cultural sites and materials to damage from high-intensity fires, as determined by a group of experts having experience in evaluating fire effects. The workshop participants are listed at the end of this report.

The group focused on three general questions: (1) What are the major types of cultural sites and materials in MVNP, and what are the direct and indirect effects of high-intensity fire on each type? (2) What kinds of monitoring and damage evaluation should be conducted before, during, and following future high-intensity fires in MVNP? (3) What kinds of pre-suppression activities can be taken to reduce damage to cultural resources by high-intensity fires? We focused only on high-intensity fires because these are potentially the most damaging and difficult to control. Following is a summary of conclusions and recommendations for further studies:

I. EFFECTS OF FIRE ON DIFFERENT KINDS OF CULTURAL RESOURCES

Workshop participants identified several types of historic and prehistoric cultural sites in the Park. These are listed below in approximately descending order of susceptibility to direct damage by fire. Additional details and evaluation of fire impacts on these kinds of cultural resources can be found in the assessment of the Long Mesa fire (Eininger 1990) and the annotated bibliography compiled by Duncan (1990).

A. Sites with high vulnerability:

1. **Native American historic structures:**
These include sweat lodges, corrals, and similar structures. Wooden structures are destroyed by fire with little trace left. Protection during the fire is nearly impossible. Many of these structures are sacred sites for the people who use or used them.

2. **Alcoves and cliff dwellings:**
Combustible materials -- e.g., packrat middens, wooden beams, corn cobs -- are destroyed by fire with little trace left. Many alcove sites are relatively protected from fire because they are surrounded by expanses of bare rock with no fuel. However, organic materials can be ignited by firebrands or by heating from an intense fire burning all around the alcove.

3. **Rock art panels:**

These are not well documented in MVNP, but studies elsewhere (e.g., Noxon and Marcus 1983a,b) indicate that exfoliation occurs during high-intensity fire. Rock art panels probably cannot be protected very effectively during fire, although Doug Scott was aware of some experimental attempts to reduce fire damage.

4. **Scarred trees:**

Several old trees have been located in the Park that were scarred by Native Americans, probably Ute people, who stripped off the bark for food at some unknown time prior to Park establishment in 1906. These trees could be killed by high-intensity fires and their tree-ring record lost.

B. Sites with moderate vulnerability:

1. **Euro-American historic structures:**

Most of these structures are associated with Park management, e.g. the Recreation Hall and Museum on Chapin Mesa. Some of these may be defensible during moderate-intensity fires, but several cannot be protected from high-intensity fire.

2. **Lithic scatter with shallow hearth:**

This site type may be under-recorded in the Park. Effects of fire are not well understood. Future dating of lithic and ceramic materials by archaeomagnetic and thermoluminescence methods probably would be impaired, but other adverse effects on lithic materials probably are not significant (see discussion below under "Deeply buried pueblos"). Fossil pollen appears unaffected by fire on the surface; effects on buried macrobotanical and faunal materials are unknown.

C. Sites with low vulnerability:

1. **Deeply buried unexcavated pueblos:**

Fire produces discoloration and oxidation of surface ceramics and lithics. Eininger (1990) summarizes what is known about these effects and the temperature thresholds at which they occur. At very high temperatures (ca 600 C), carbon may be burned out of sherds, leading potentially to misidentification in the future. Fire also accelerates decompostion of sandstone blocks, which could create future difficulty in recognizing the sites on the basis of surface components. However, deep structures probably are unaffected by the fire since heat rarely penetrates more than a few centimeters even in intense fires.

Fire apparently has little or no impact on the research value of deeply buried sites except in two circumstances. The first is buried pueblos with large trees growing on or adjacent to the site; the roots may burn during a high-intensity fire and carry the heat down into the buried structures, and the charred roots remaining in the soil may confuse future charcoal dating and interpretation. The second potential effect of surface fire on deep structures occurs immediately below large logs that smolder for a long time, driving the heat as deep as 20 cm into the ground at that localized point.

Fire retardant slurry could affect standing walls if it is dropped directly on the walls during suppression activities. The weight of the slurry could knock down walls, and geologist Mary Griffits has suggested that the slurry may be incorporated into sandstone rock where it hastens decomposition.

2. **Lithic scatter:**

Fire may discolor lithic materials somewhat, but apparently does not reduce their research value in any significant way.

3. **Check dams:**

Fire apparently has little or no effect on check dams.

Indirect Effects of Fire

In addition to the direct effects of a fire burning over or through a site, there may be several indirect effects either immediately or months afterwards. We have little data on these effects in MVNP, but they have been studied in other areas. Potentially important indirect effects of fire include the following:

1. Rodent populations may increase in response to increased succulent vegetation following the fire; rodent burrowing may disturb artifacts and alter their positions.

2. Bare soil exposed by fire is vulnerable to erosion and redeposition during the time period before vegetative cover becomes re-established. These processes may remove artifacts or bury them.

3. Insect and microbial activity may increase after fire. Potential effects on cultural materials are unknown.

4. Application of fire retardant slurry during suppression activies may affect cultural artifacts, but details are lacking at present. The University of California at Riverside is conducting studies of slurry effects in Joshua Tree National Park; the contact person is Bob Moon. The phosphorus in the retardant also may influence post-fire plant growth and composition in unknown ways, since phosphorus is a limiting plant nutrient in most ecosystems.

II. MONITORING

The participants agreed that it would be valuable to have a standardized format for documenting and assessing effects of future high-intensity fires in MVNP and possibly also in other southwestern Park units having significant cultural resources. More work is needed to decide exactly which information should be recorded and in what format. The Western region of the National Park Service and Region 3 of the U.S. Forest Service both have fire evaluation forms that might be used as a starting point. Tom Gavin and Charisse Sydoriak plan to organize a follow-up workshop soon to develop a suitable assessment/documentation format.

Some of the ideas about a standard approach to post-fire documentation that were suggested at this meeting include the following:

(1) We need a consistent, systematic set of descriptive data, using standardized vocabulary and a consistent level of recording, to permit adequate assessment of effects and comparison between Parks and between fires. More specifically, we need standardized burn severity ratings, and data on soils, vegetation, slope, aspect, and presence of water.

(2) The post-fire inventory should utilize state-of-the-art technologies for locating affected sites, including GIS, GPS, aerial photos, and overlay mapping.

(3) Most of the cultural assessment following the Long Mesa fire was based on surface materials. We need to look for fire effects at depth also.

(4) "Burned log areas" should be looked for and documented in addition to evaluation of fire intensity at the site in general.

It also was agreed that additional study of the effects of the 1989 Long Mesa fire should be made. The inventory that was conducted (Eininger 1990) employed accepted methods and provided much valuable information, but it involved little assessment of fire effects at depth, and it did not address all of the components that would be included in a standardized documentation such as that recommended by the group.

III. PRE-SUPPRESSION OPPORTUNITES FOR REDUCING FIRE DAMAGE

We started with the assumption that high-intensity wildfires will occur in MVNP in the future: given the climate, fuels, and topography of the Park, occasional uncontrollable fires are inevitable even with a fire policy of complete suppression. See Erdman (1970) and Omi and Emrick (1980) for discussions of fire history and future fire potential in the Park. Below is a list of things that can be done before the next uncontrollable fire occurs to minimize its damage to individual sites and materials when it does occur.

Some of actions that we identified are expensive; others may not be feasible in the near future. Rather than embarking on a crash program to "harden" all cultural resources against fire, we suggest that Park managers should incorporate these steps into their long-range planning and do each one at an opportune time. It also is important to recognize that some damage to sites will occur even without fire: natural processes of weathering and erosion have been occurring for centuries in MVNP and will continue to occur regardless of our actions. The suggested pre-suppression activities are listed below in approximately descending order of urgency as perceived by the workshop participants.

(1) **Document sites and artifacts that cannot be protected from high-intensity fire:** Several kinds of cultural resources -- including Native American historic structures, wooden beams in cliff dwellings, packrat middens, other ancient organic materials within alcoves, and scarred trees -- are highly vulnerable to wildfire, and cannot be effectively protected during fire. The only way to ensure that the information contained within them is not lost is to thoroughly document them prior to the occurrence of fire. The park already has a program of inventory and analysis of these kinds of cultural resources, but this program needs to be accelerated in order to catalogue the resources that exist and to analyze those that are most significant. We recommend the following specifc actions:

(a) Contract a qualified person(s) to inventory and estimate the approximate age of packrat middens throughout the Park; then contract the same or another person to perform a thorough scientific analysis of a sample (perhaps 25?) of the oldest middens. The oldest packrat middens contain one of the best records available of variation in climate and vegetation during the last 20,000 years (e.g., Betancourt et al. 1990), and the ancient ones obviously are irreplaceable.

(b) Locate and photograph the scarred trees throughout the Park. Then contract a qualified dendrochronologist to collect increment cores from all or a sample of them. The tree-rings can be used to determine the date when the tree was scarred, and -- since these generally are old trees -- the rings also contain a valuable record of climatic variation.

(c) Map, photograph, and describe Native American and Euro-American historic structures throughout the Park. This would be a good time also to evaluate whether any additional pre-suppression activities, such as localized fuel reduction, would be practicable at each site.

(2) **Reduce fuels selectively in localized, high-value areas:**
It is not feasible or necessarily even desirable to attempt to reduce fuel loads throughout the Park, since the potential fuels are so great and variable and because other resources (e.g., biological diversity and aesthetics) would be damaged by such an attempt. However, there are numerous opportunities to reduce fuels within small but highly significant areas, and thereby to reduce damage to cultural resources should a high-intensity fire occur. The inventory of sensitve cultural resources should include an evaluation of the feasibility and value of fuel reduction around each site. Once this has been completed, a risk analysis team -- composed of both cultural and fire personnel -- should review the list of sites and select the ones to receive local fuel reduction. The sites selected should be those having high cultural significance, high risk from fire, and a setting in which fuel reduction is feasible.

Fuel reduction may be accomplished mechanically, with prescribed burning, or by a combination of both. The existing hazardous fuel reduction program could be expanded to accomplish this objective. Following is a list of some of the kinds of localized fuel reduction activities that may be practicable:

(a) Removal of dead and down woody material, thinning of the forest canopy (e.g., 30-foot or 60-foot spacing), and thinning of brush around historic buildings and other structures.

(b) Removal of brush and trees from the vicinity of alcoves and cliff dwellings (this may need to be repeated periodically).

(c) Removal of trees growing in or adjacent to buried pueblos or hearths. (In addition to reducing potential damage from fire, removal of these trees would reduce mechanical damage to the sites from the tree roots even if fire never occurs.) Sites having standing walls would receive higher priority for this work than sites with only rubble on the surface.

(3) **Evaluate all of the existing sites and interpretive facilities in the Park, and assign each a priority rating for trying to save it in a high-intensity fire:**

Much of this kind of assessment has been done already by fire managers. It needs to be expanded to include all such structures in the Park, and the ranking system needs to be presented explicitly to all Park workers to reduce confusion and controversy during a large fire. Each type of cultural resource needs to be evaluated independently (e.g., all alcove cliff dwellings, all historic Park buildings) as well as in comparison with all other cultural resources in the Park. The assigning of a priority rank to each feature should be carried out by a risk assessment team composed of both cultural and fire people. Priorities should be determined on the basis of cultural significance and feasibility of defending it from fire. In many cases, value judgements will be called for; these should be stated explicitly by the risk assessment team and debated if necessary long before a large fire occurs and demands immediate decisions.

(4) **Build fire resistant features into new and existing Park buildings and**

interpretive structures wherever possible:

This is something that can be accomplished over many years; it need not all be done immediately. Fire personnel should be involved in planning all future construction and renovation, in order to build in fire resistant features wherever those features are consistent with the primary purposes of the structure. Some examples of the kinds of things that can be done are the following:

(a) When roof repairs become necessary, replace existing shake shingles with fiberglass or other reproductions that look similar but are vastly less flammable.

(b) When the curtains on the ruins shelters need replacement, use some sort of material for the new curtains that is fire-resistant. In the event of a high-intensity fire, the curtains could then provide some protection for the expensive interpretive features inside.

(c) Install sprinkler systems in or around highly significant but highly vulnerable structures.

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