

Effects of Fire on Cultural Resources at Mesa Verde NP

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On Oct. 20-21, 1992, twenty-five archeologists, ecologists, and fire managers met in Mesa Verde National Park (MVNP) to evaluate and predict the effects of fire on the park's cultural resources. Our 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 in Mesa Verde and similar parks in the southwest. This report addresses the first component of the risk model, namely the differential susceptibility of various types of cultural sites and materials to damage from high intensity fire effects.

Three general questions were: (1) What are the major types of cultural sites and materials in MVNP and what are the direct and indirect effects of high intensity fires on each type? (2) What kinds of monitoring and damage evaluation should be conducted before, during, and following high intensity fires? (3) What kinds of pre-suppression activities can be taken to reduce damage to cultural resources?

We focused only on high intensity fires because these are potentially most damaging and difficult to control. Following is a summary of our conclusions and recommendations for further studies.

Effects of Fire on Different Kinds of Cultural Resources

These several types of historic and prehistoric cultural sites identified 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 that occurred in MVNP in 1989 (Eininger 1990, Fish 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 and leave little trace. Protection during fire is nearly impossible. Many of these structures are sacred for the people who use or used them.

2. Alcoves and cliff dwellings: Combustible materials—e.g. packrat middens, wooden beams, corn cobs—are consumed by fire. Many alcove sites are relatively protected from fire because they are surrounded by expanses of bare rock with no fuel. But

organic materials can be ignited by firebrands or spontaneous combustion through pre-heating from an intense fire burning all around the alcove.

3. Rock art panels: Rock art occurs in MVNP, but no known panels were within the boundaries of the Long Mesa fire. A comprehensive inventory of rock art panels within MVNP does not exist and undocumented panels may have been affected by the fire. Studies in upper Salt Creek in the Needles District of Canyonlands NP indicate that exfoliation of the rock face occurs during high intensity fires (Noxon and Marcus 1983 a,b). Prevention measures include clearing brush from areas around the rock face. Other methods, including application of a stone strengthener (organo-silicon compounds in a ketone carrier), also may help prevent exfoliation (Grisafe and Nickens 1991).

4. Scarred trees: Several old trees in the park were scarred by Native Americans, probably Ute people, who stripped the bark for food some 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 in moderate intensity fires, but several cannot be protected from high intensity fires.

2. Lithic scatter with shallow hearth:

Due to its ephemeral nature and the emphasis on structural features, this site type may be under-recorded within MVNP. As the effects of fire are strongest at the surface, artifacts here will be vulnerable to damage by fire. Surficial lithic materials within the Long Mesa fire boundary showed color alteration due to heating. This would not impair analysis of their technological attributes or their function based on morphology. Studies on silica-rich stone suggest that low fire temperatures are responsible for minor morphological change in surface cherts at Long Mesa. Beyond about 700F (350C) stone will spall, crack, and shatter (Mandeville 1973; Purdy and Brooks 1971). In a hotter fire or on a different type of stone, the potential exists for changes to stone artifacts that impair morphological analyses.

Due to the increased luster associated with heating of cherts, heating probably would impair microwear analysis, as it would im-

pair blood residue analysis. However, as neither of these analyses are routinely successful on surficial material, this is not a serious loss.

Effects of fire on a shallow hearth are more problematic. Common archeological analyses of hearths include studies of the way the hearth was made, their pollen, faunal, and macrobotanical contents, and dating techniques such as radiocarbon, thermoluminescence, and archeomagnetic dating. The study of hearth construction does not appear to be affected by fire.

Effects of fire on hearth contents have been studied. Fish (1990) conducted a study on effects of fire on pollen and found that even the surface samples marked by ash and charcoal from the Long Mesa fire yielded abundant, identifiable pollen. She found that pollen grains that appeared to be fire-altered by the Long Mesa fire "were darkened to a yellowish-brown color and would not absorb the stain used to enhance microscope viewing. Walls of these grains were thickened or swollen and fine morphological features were obscured, although identifications were still possible" (Fish 1990:2-3). Shipman and others (1984) document the effect of fire on bone, showing color change and calcining in surficial bone at lower temperatures. Ashing occurs at high temperatures. Calcined surficial bone was observed within the Long Mesa fire boundary. Ford (1990) found the Long Mesa fire did no damage to ethnobotanical material from hearths within the fire boundary. Thus, almost counterintuitively, it appears that wildfires such as the Long Mesa and La Mesa fires have little impact on study of the contents of shallowly buried hearths.

The third factor affecting the research potential of these hearths is dating. Although not studied as a result of the Long Mesa fire, wildfire burning over a shallow hearth probably would affect the potential for use of thermoluminescence and archeomagnetic dating. That wildfire affects both analyses was demonstrated in studies after the La Mesa fire in Bandelier NM (Rowlett and Johannessen 1990; DuBois 1990). No controlled studies on the effect of wildfire on radiocarbon dating exist. However, inclusion of recent charcoal from a wildfire into a radiocarbon sample would result in significantly younger date.

C. Sites with low vulnerability:

1. Deeply buried unexcavated pueblos:

Fire produces discoloration and oxidation of surface ceramics and lithics. Eininger (1990)

Alcove containing a small Anasazi stone building. The Long Mesa fire in 1989 burned the forest above and around this alcove, but did minimal damage to the archeological site because of the lack of fuel directly within the alcove.



Boulders that were cracked by sudden and intense heating in the Long Mesa fire of 1989. Prehistoric rock walls could be damaged by cracking and spalling of this kind.



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. Fire also accelerates decomposition of sandstone blocks. Accelerated rock decomposition could create future difficulty in recognizing sites on the basis of surface components. Deep structures probably are unaffected by fire, since heat rarely penetrates more than a few cm even in intense fires (Chandler et al. 1989).

Fire apparently has little impact on the research value of deeply buried sites except in two circumstances. First is buried pueblos with large trees on or adjacent to the site; the roots may burn in a high intensity fire and carry heat down into the buried structures (Wettestad 1988), and the charred roots remaining in the soil may confuse charcoal dating and interpretation. The second potential effect occurs immediately below large logs that smolder, driving the heat as deep as 20 cm into the ground at that spot (Connor et al. 1989).

Fire retardant slurry could affect standing walls if it is dropped directly on the walls during suppression activities. Slurry weight could knock down walls, and geologist Mary Griffiths suggests the slurry may be incorporated into sandstone rock where it hastens decomposition.

2. Lithic scatter: See discussion on surficial lithic material under section dealing with lithic scatter with shallow hearths.

3. Check dams: Fire apparently has little or no effect on check dams.

Indirect Effects of Fire

Several indirect effects may occur either immediately or months after a fire. Potential-

ly important indirect effects include:

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

2. Bare soil exposed by fire is vulnerable to erosion and redeposition during the time period before vegetative cover becomes re-established (Connor and Cannon 1991, Swanson 1981). These processes may remove artifacts or bury them.

3. Microbial activity may increase after fire (Bissett and Parkinson 1990). Potential effects on cultural materials are unknown, but probably result in short-term accelerated decomposition of organic materials.

4. Application of fire retardant slurry during suppression activities may affect cultural artifacts; details are lacking. The U/CA at Riverside is conducting studies of slurry effects in Joshua Tree NP, but results are not yet published. The phosphorus in the retardant also may influence post-fire plant growth and composition, since phosphorus is a limiting plant nutrient in most ecosystems.

Pre-suppression Opportunities 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, occasional uncontrollable fires are inevitable. See Erdman (1970) and Omi and Emrick (1980) for discussion of fire history and future fire potential in the park. Below is a list of things that can be done to minimize damage to individual sites and materials before the next uncontrollable fire occurs.

Some of the actions are expensive; others may not be feasible immediately. 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 at an opportune time. Some damage to sites will occur even without fire: natural processes of weathering and erosion have been occurring for centuries and will continue, regardless of our actions. Suggested pre-suppression activities are listed in approximately descending order of urgency.

(1) Document sites and artifacts that cannot be protected from high intensity fire. Several kinds of cultural resources are highly vulnerable to wildfire and cannot be effectively protected. The only way to ensure that information they contain is not lost is to document them thoroughly. The park already has a program of inventory and analysis of these kinds of resources, but the program must be accelerated. We recommend the following specific actions:

(a) Contract a qualified persons(s) to inventory and estimate approximate age of packrat middens; then contract the same or another person to perform a thorough scientific analysis of a sample of the oldest middens. These contain among the best records available of variations in climate and vegetation over the last 20,000 years (e.g. Betancourt et al. 1990); and they are, obviously, irreplaceable.

(b) Locate and photograph the scarred trees throughout the park. Then contract a dendrochronologist to collect increment cores. The tree rings will reveal the date the tree was scarred and a record of climatic variation.

Continued on page 30

(c) **Map, photograph, and describe** Native American and Euro-American historic structures and evaluate whether any additional pre-suppression activities, such as localized fuel reduction, would be practicable.

(2) **Reduce fuels selectively in localized, high value areas.** It is not feasible or necessarily even desirable to try to reduce fuel loads throughout the park; fuels are so great and variable and other resources would be damaged in the attempt. However, small but highly significant areas present opportunities to reduce fuels. The inventory of sensitive cultural resources should include evaluation of the feasibility and value of fuel reduction around each site. A risk analysis team then should review the list and select the sites for fuel reduction. They should have high cultural significance, high risk from fire, and a setting where fuel reduction is feasible.

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

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

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

(c) **Removal of trees growing in or adjacent to buried pueblos or hearths.** Sites having standing walls would receive higher priority for this work than sites with only rubble on the surface.

(3) **Evaluate all the existing sites and interpretive facilities and assign each a priority rating for trying to save it in a high intensity fire.** Much of this kind of assessment already has been done, but it needs to be expanded to include all such structures in the park. The ranking system must be presented explicitly to all park workers to reduce confusion and controversy during a large fire. Each type of cultural resource should be evaluated independently, as well as in comparison with all other cultural resources. The assigning of a priority ranking should be carried out by a risk assessment team of both cultural and fire people. Priority assignments will call for value judgments and these should be stated explicitly by the risk assessment team and if necessary debated long before a large fire demands immediate decisions.

(4) **Build fire resistant features into new and existing park buildings and interpretive structures wherever possible.** This can

be accomplished over many years. Fire personnel should be involved in planning future construction and renovation, to see that fire resistant features are built in wherever those features are consistent with the primary purposes of the structure. Examples follow:

(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 fire resistant material. In the event of a high intensity fire, the curtains then provide some protection for expensive interpretive features inside.

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

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