

LONG MESA FIRE

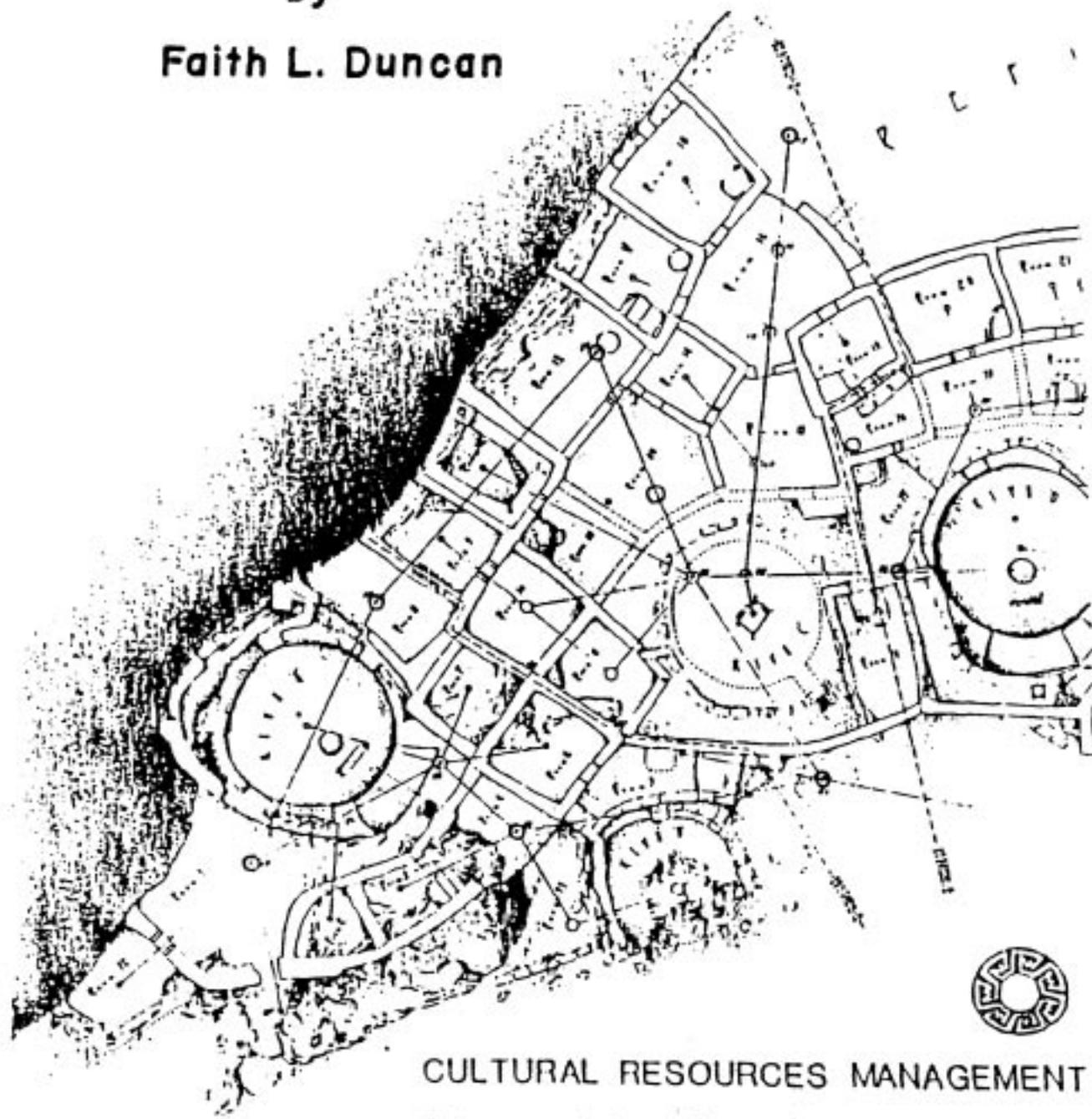
FIRE EFFECTS AND
CULTURAL RESOURCES:

1989

An Annotated Bibliography

by

Faith L. Duncan



CULTURAL RESOURCES MANAGEMENT

Mesa Verde National Park

FIRE EFFECTS AND CULTURAL RESOURCES:

AN ANNOTATED BIBLIOGRAPHY

Compiled and Annotated
by

Faith L. Duncan

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FIRE EFFECTS AND CULTURAL RESOURCES

Please note that those citations not available for annotation are marked NAC: Not Available for Citation.

Ahler, Stanley A., P.R. Picha, R.D. Sayler, R.W. Seabloom
 1990 Effects of Prairie Fire on Selected Artifact Classes.
 Paper presented at Annual Meeting, Society for
 American Archaeology, April 18-22, 1990, Las Vegas.

- Evaluation of ten categories of artifacts during prescribed burns in prairie habitats for: 1) whether there was loss of diagnostic artifactual information, 2) whether the fire was sufficient to entirely remove artifacts from the record, and 3) whether there was sufficient damage to materials to transform them from one analytic category to another. Fire related impacts to artifacts on the surface were found to be substantial in some categories, fire effects in subsurface settings were negligible, thermal alteration was significantly less severe than in burned samples from cultural contexts. Such alterations could be used to support arguments for cultural versus natural fire effects in multiple site contexts at Knife River Village National Historic Site (KNRI).

Ahler, Stanley A., P.R. Picha, R.W. Seabloom, and R.D. Sayler
 1989 Impacts of Prescribed Burning on Selected Cultural Resources. Paper presented at Plains Anthropological Conference, October 19-21, 1989, Sioux Falls.

-See Ahler et al 1990.

Anderson, Bruce A.
 1985 Archaeological Considerations for Park and Wilderness Fire Management Planning. Proceedings, Symposium and Workshop on Wilderness Fire, September 15-18, 1983, Missoula. General Technical Report INT-182, Intermountain Forest and Range Experiment Station, Ogden, pp. 145-147.

- Review of legal mandates protecting cultural resources at state and federal levels and discussion of potential conflicts between fire management programs and cultural preservation programs, particularly during fire suppression activities. Use of cross-trained personnel and accurate archaeological survey information in the La Mesa Fire, Bandelier National Monument is discussed.

Ayers, James A.

1988 Post-fire Assessment of Historic Sites, Yellowstone National Park. Report on file, Rocky Mountain Regional Office, National Park Service, Denver.

- Compilation of information and assessment of extent, age, and nature of historic dump features at 12 previously recorded sites in Yellowstone National Park. Evaluation of the cultural associations, integrity, and information potential of each area after the fires of 1988, including evaluation of the sites for National Register for Historic Places potential. Fire effects are summarized and recommendations for mitigation and nominations noted.

Barbetti, M. A. Wintle, and K. Flude

1978 Preliminary Archaeomagnetic and Thermoluminescence Measurements in the Search for Ancient Fireplaces in the Koobi Fora Formation, Northern Kenya. IN The Karari Industry: Its Place in East African Prehistory, J.W. K. Harris, PhD Thesis, Department of Anthropology, University of California, Berkeley, pp. 556-583.

-NAC

Bayer, Catherine

1979 The Chalone Creek/South Pinnacles Prescribed Burn, Initial Archaeological Investigations. Report on file, Folsom District, Bureau of Land Management, Hollister,

- Unprovenienced artifacts representative of five prehistoric artifact classes were placed in surface plots stratified by vegetation and fuels during a prescribed burn to examine fire effects. Conclusions included the following: 1) stratification of the sample did not affect the results, 2) visibility of the ground surface was improved after the burn, 3) there was shattering of one chert sample and differential smudging of some of the other artifacts. Recommendations for further research.

Bellomo, Randy

1989 Identifying Traces of Natural and Humanly Controlled Fire in the Archaeological Record: the Role of Actualistic Studies. Paper presented at the Society for American Archaeology Meetings, April 18-23, 1990, Las Vegas.

- Experimental camp fires, tree stump fires, and grass fires were examined to determine the potential for scientific techniques (oxidation traces, archaeomagnetism, ionized residual magnetism, backfield coercivity, and paleointensity) for identifying unequivocal traces of fire in archaeological deposits where obvious features or traces such as charcoal and ash have not been preserved, and for discriminating between natural and humanly

controlled fires in these contexts. Archaeomagnetic readings reflected past fires most equivocally; on site composition, three dimensional configuration, and spatial association were reliably used to discriminate between natural and cultural traces of fire.

Bennett, Peter S. and Michael Kunzmann

1985 Effects of Heating on Artifacts: a Brief Report of Work Conducted at Western Archaeological Center, Tucson. Report, on file, National Park Service Co-operative Studies, University of Arizona, Tucson.

- Eight artifact material classes of a standardized surface to volume ratio were experimentally altered in a muffle furnace at temperatures approximating the soil surface during low (vegetation) density prescription fires. Weight loss was found to be a function of time and temperature. This was measured by the loss of free water, and other materials were used to judge temperature effects. Inorganic materials such as stone or ceramic experienced no weight loss below 500 degrees C, provided they were on or below the soil surface and of small size. Bone exhibited charring, and hide and fibers would be consumed. Removal of sensitive artifact material classes from proposed prescribed burn areas with anticipated temperatures over 400 degrees C is suggested.

Biswell, Harold H.

1989 Cultural Resources, IN Prescribed Burning in California Wildlands Vegetation Management. University of California Press, Berkeley, pp. 213-220.

- Literature review of impacts of wildland and prescribed burning and fire suppression techniques on a variety of cultural materials. Legal mandates (National Historic Preservation Act) protecting cultural resources and results of experimental studies to simulate threshold temperatures comparable to prescribed fire applications (See Bennett and Kunzmann, Welch and Gonzales, Pidanick, Parkman, Foster) are discussed. Recommendations include: 1) determine fire history of site areas to see if multiple fire effects are likely, and 2) include archaeologists in the planning and suppression process to protect sites from land disturbance activities and increased vandalism.

1980 Correspondence to Peter Gaidula, consisting of comments on "Trial by Fire" (paper by (Kelly and Mayberry 1979). On file, Cultural Resources Division, California Department of Forestry, Sacramento.

- Damage of long term fire suppression policies and high fuel loads discussed. Recommends prescribed burning with cool fires (See Kelly and Mayberry) to lower these fuel conditions, and suggests experimental work be done at Cuyamaca Rancho State Park.

Black Hills National Forest

1990 Policy statement: Use of Archaeologists on forest fires, 2360/5100, in reply to correspondence between Forest Supervisor and Archaeologist. On file, Custer Ranger District, Black Hills National Forest, Custer, pp. 1-3.

- Reply to questions concerning the qualifications, responsibilities, training, and on site practices and procedures for archaeologists; archaeologist is supervised by forest supervisor on small fires and integrated into Plans section of fire organization on project fires; step test scores of 40-44 for archaeologists recommended; duties include the identification of cultural resources and bringing problems to the attention of fire supervisor; report standards and procedures of Forest to be used if archaeologist is from some other agency or region.

Bleed, Peter and Marlene Meir

1980 An objective test of effects of heat treatment of flakable stone tools. American Antiquity 45(3): 502-507.

- Experiments with chert tiles in muffle furnaces heated to 350 and 400 degrees C indicated that the number of flakes increased, as did the overall length of the flakes from each tile; hinge fractures were not less common on the heat treated specimens than controls.

Boynton, Mike

1988 An aerial overview of the Fire Suppression effort on the Mendocino National Forest. Paper, presented at the Society for California Archaeology Meetings, 3/23-25/88, Redding.

- Discussion of 78,000 acre Mendenhall and 25,000 acre Snow Mountain Complex Fires(1987), both of which were ignited by lightning and burned from the Mendenhall Lookout and Snow Mountain areas downslope to the Elk Creek and Stonyford watersheds, respectively. Burned habitats included mixed Red Fir-Jeffrey pine forests, lower elevation grassland, and sage communities. For post-fire rehabilitation survey results see Greenway 1990.

Brett, Linda

1988 The Fire Next Time: Lessons in cultural resource protection. Paper, presented at the Society for California Archaeology Meetings, 3/23-25/88, Redding.

- Discussion of lightning-caused, 13,500 acre Sequoia National Forest fire(1987) that burned in chaparral(75%) and coniferous forest(25%) communities. Archaeological surveys were being conducted in the area at the time the fire struck. An unspecified number of new sites and larger site areas for previously recorded sites were determined through post-fire archaeological surveys.

Buchanan, Les

1989 Fire effects on cultural resources, Guadalupe RX burn area. Report, on file, Jemez Ranger District, Santa Fe National Forest, Jemez Springs, pp. 1-3.

- Discussion of the major characteristics of prescribed burns that affect cultural resources including fire intensity, heat/soil penetration, residence time, and fire line construction. Recommends monitoring these characteristics to refine prescriptions within limits tolerable to archaeological resources.

Bureau of Land Management, Arizona State Office

1989 Instruction Memorandum No. Az-90-52, Requirements for Cultural Resource Inventory of prescribed burn areas. On file, Arizona State Office, Phoenix, pp. 1-2.

- List of fire effects guidelines developed with Arizona SHPO. Recommends complete data review in areas of potential effect, judgmental survey within proposed burn areas where existing data suggests potential for cultural properties (wooden structures, fragile rock art panels and friable stone features), Class III inventories in areas of direct surface disturbance or where heat is expected to exceed 900 degrees F or intensities are over 400 BTU/sec/ft, and waivers of these requirements if the conditions meet those specified by Section 106, general Programmatic Memorandum of Agreement.

Burgh, Robert F.

1960 Potsherds and forest fires in the Pueblo country. Plateau 33:54-65.

- Applied ethnographic information to examine the effects of firing atmosphere, mineral inclusions, pigments, slips, and temper on historic ceramics from Southwestern pueblos. Results of experimental work done under Dr. Watson Smith that consisted of refirings (muffle furnace) of "100's" of sherds from Awatovi excavations included. Experiments confirmed Anna Shepard's results indicating reversal of pigments by placing charcoal in furnace to absorb oxygen. Suggests the application of pigment alteration studies to determine past extent and occurrence of forest fires in Four Corners area.

California Department of Forestry, Region V

1983 Draft Memorandum of Understanding between the CDF and the California Department of Parks and Recreation, DPR, Region II regarding prescribed Burning Cooperation. On file, CDF Division of Cultural Resources, Sacramento, pp. 1-4.

- Summary of the cooperation (in the form of policy, personnel, and chain of command) between CDF, which carries out prescribed burning programs and DPR, which manages it's park lands with prescribed burning. CDF concentrates it's efforts along park boundaries, whereas interior projects will be performed under the statewide Park system Environmental Impact Report process (See 1981, for example).

1981 Final Environmental Impact Report, Chaparral Management Program. On file, CDF Division of Cultural Resources, Sacramento, pp. 1-142.

- Recommendations for mitigating impacts of prescribed burning program on cultural resources included notification of the Regional Officer of the California Archaeological Site Survey of the proposed project, inspection of the area for existence of these resources after record search for National Register sites, California Historic Landmark sites, and California Inventory of Historic Resources sites, protection of such sites if burn practices could harm them (including survey markers), mitigation of proposed impacts to include, avoidance, leaving specific areas unburned, supervision of burn crews to decrease vandalism, and marking of areas to be avoided by machinery and hand lines.

Colton, Harold S.

1951 Hopi pottery firing temperatures. Plateau 24(2): 73-76.

- Summary of ethnographic studies of 23 pottery firings by seven Hopi potters; temperature range 720-885 degrees C, with temperatures elevated by the addition of coal to fire; comparable data collected by Anna O. Shepard at four New Mexico pueblos indicated ranges of firings from 625-770 degrees C and 825-940 degrees C.

Connor, Melissa A. and Kenneth P. Cannon

1989 The mountains burnt: Forest fires and site formation processes. North American Archaeologist 10(4): 293-310.

- Examination of wildland fire effects at three locations within Yellowstone National Park (1988) and Grand Teton National Park (1979). Surface and excavated sites in mountainous habitats, and site formation processes affected by forest fires discussed. The latter include sharp boundaries of vegetation mosaics due to spot fires and erratic fire behavior, morphological changes to stone and bone artifacts and ecofacts within 2-3 cm of the ground surface, or charred, zone specific oxidized soil features such as downed tree ghosts and crescentic cross sections, and depositional features including ash lenses and pockets noted.

Connor, Melissa A. and Kenneth P. Cannon
 1990 Forest fires as a site formation process in the Rocky Mountains of northeastern Wyoming. Paper, presented at the Society for American Archaeology Annual Meeting, 4/18-22/90, Las Vegas, pp. 1-28.

- See Connor and Cannon 1989

Crespin, Bruce
 1981 Environmental Assessment Supplement - Cultural Resources, North Pinnacles Prescribed Burn. Environmental Assessment #CA-010-1-52, ARR #CA-019-S-FS-127, on file, Folsom District, Bureau of Land Management, Hollister, pp. 1-4.

- Summary of the significance and evaluation of the pre-prescribed burn impact of fire on thirteen prehistoric archaeological sites on BLM, NPS, and private lands. No adverse impact to rock shelters and associated middens, bedrock mortar sites, temporary campsites, and a base camps noted. Found no significant impact on historic homesteads, since " they have been burned before and have low fuel loads around them". Mitigation measures suggested include the following: 1) stationing suppression personnel on non-site areas to prevent vandalism and ground disturbance, 2) no on site suppression activities on six sites, and no bulldozing fire lines within the Pinnacles National Park due to NPS policies, and 3) post-burn cultural resources survey to be conducted by BLM archaeologists to assess fire impacts, future management and rehabilitation needs, and to record newly exposed sites.

Cummings, Linda Scott
 1989 Pollen and Macrofloral analysis at nine sites in Grand Teton National Park, Wyoming: 1988 Field Season. Report, on file, Midwestern Archaeological Center, National Park Service, Lincoln, pp. 430-453.

- Applied pollen and macrobotanical analysis of archaeological deposits affected by the wildland fires in Grand Teton National Park (1988), focused on economic data from features and several black organic layers. The latter were determined to be deposits representing the inundation of meadows. Only one case of charred seed fragments suggestive of a past burn episode was noted.

Davidson, Dale, BLM District Archaeologist, Monticello, Utah
 1990 Personal communication, concerning experiments with prescribed fire effects on two large archaeological sites located on Alkali Ridge National Landmark area conducted by Bruce Lauthan and Julie Howard (BLM Resource area archaeologists, Moab). Notes from experiments and artifacts and paint chips, on file, Monticello District

Office, Bureau of Land Management.

- Results of final district wide prescribed burn on 225 acres of landmark and other lands(1987) that had been a chained in the 1950's and was sagebrush reported. Original vegetation was Pinyon-Juniper woodland and burning used to reduce old Pinyon-Juniper windrows in area, standardize all vegetation into the same successional stage, and encourage multiple use of the National Landmark Boundary area. Artifacts were placed in plots(5) from the ground surface to 8" deep and included ceramics, lithics of quartzite, chert, and groundstone, 13 heat sensitive paint chips were placed in each plot (except Plot B, which was located within a Pueblo I period masonry room). Plots A-C were located on a Pueblo I site and at no time did the temperatures reach over 300 degrees C in subsurface depths. Plots D and E were located in a Pueblo II period site and only in Plot D did temperatures reach over 300 degrees C at 8 inches below ground surface. Air temperature at surface varied between 100 and 1300 degrees C during the burn.

Donaldson, Bruce

In Progress Theoretical effects of fire on artifact classes.
 Research paper, on file, Apache-Sitgreaves National
 Forest, Springerville, pp. 1-12

- Application of 1) fire history records in Ponderosa pine forests and 2) experimental studies on temperatures tolerances of wood, lithic, and ceramic artifact classes in similar habitats to the management of cultural resources in proposed prescribed burn areas. Graph illustrating compiled relationships between artifact depth in relation to soils plotted against temperature. Critical thresholds for three artifact classes plotted in relation to temperature means and ranges.

DuBois, Robert L.

1979 Archaeomagnetic dating of two hearths in the La Mesa Fire area, IN Appendix H, Final Report (Draft) The La Mesa Fire Study: Investigation of fire and fire suppression impact on cultural resources in Bandelier National Monument, Traylor et al. Editors. Report, on file, Southwest Cultural Resources Center, National Park Service, Santa Fe, p. 189.

- Report on three archaeomagnetic samples removed from two hearths from a masonry field house site. All three samples exhibited mid-14th century dates.

Eininger, Susan

1990 Long Mesa Fire 1989, Archaeological survey and post fire assessment. Report, on file, Research and Cultural Resources Management Division, Mesa Verde National Park, Mesa Verde, pp. 1-63.

- Results of the archaeological survey and post-fire assessment for the 2600 acre Long Mesa Fire(1989) which was ignited by lightning and which burned pinyon-juniper woodlands, oak brush, and grassland communities. Descriptions of the cultural and natural resources of the burn area, fire behavior, suppression activities, project research design, and methodology of the survey is included. 165 of the previously recorded 194 sites were relocated and 23 new sites were identified. Of the latter, all are PII-PIII Anasazi occupations of the Ackman, McElmo, and Mesa Verde Phases, and included 3 field houses, 16 habitations ranging from 3 to 15 rooms each, and 2 small alcove habitations.

-188 site evaluations indicated that 74% sustained some damage during the fire, with 26 of the sites categorized as severely damaged (vegetation stripped from surface, soil and rock oxidized, spalling prevalent, and artifacts scorched, those with wooden features destroyed).

-Damage assessment of cultural resources due fire suppression activities and fire and heat exposure included the following: 1) minor damage to building stone at two surface pueblos, 2) difficulty monitoring dispersed suppression activities by archaeologists, 3) reduction of impacts by hand-cut fire lines and vandalism through the presence of monitors.

-Fire and heat impacts were visible on surface artifacts, architectural remains, and cultural fill. At least 162 of the sites occurred within previously recorded fire boundaries, 29 within the 1972 Rock Springs Burn and 133 sites in the 1934 Wetherill Mesa Burn. Fire intensity, including temperature and duration was variable and no accurate estimates of these conditions were available during the fire. Visible impacts to artifacts included: 1) discoloration and scorching on surface lithics, particularly on the edges, 2) discoloration and partial obscuring of surface treatments and designs on ceramic sherds, 3) spalling and oxidization of architectural stone, 4) projected effects on organic remains, botanical macrofossil, pollen and dating potential (carbon 14, thermoluminescence, archaeomagnetic, and tree ring samples).

-Recommendations based on this study included the following: 1) erosion control measures needed for 19 surface sites due to vegetation loss and soil alteration, 2) stabilization work needed at 15 sites due to direct impacts of the fire or natural weathering, including 7 alcove sites that need water diversion work, 3) further testing of the skewing of thermoluminescence dates

on refired ceramics with chronologically diagnostic Mesa Verde collections, 4) evaluation of the dendrochronological significance of structures likely to be damaged by future fires, 5) possible rerouting of a historic fire road which crosscuts slab features within one surface pueblo site, 6) a series of recommendations for fire procedures. These recommendations included the following items: cultural resources training for fire crew bosses, standard fire training, standard safety equipment, and site base maps for archaeological monitors (focusing these individuals on high density site areas in which ground disturbance is expected from suppression), maintenance of a list of trained individuals at the park and local interagency level, the presence of an archaeological liaison officer in the fire management team, increased communication between monitors and crew bosses, confinement of mop up activities to smaller, more manageable areas to allow archaeologists lead time to examine the ground surface before the crews complete their work, a standardized system of flagging and photographing fire effects, fire conditions, archaeological sites and other procedures impacting sites, monitoring of vehicle turn around areas and parking areas.

-Future fire effects studies need to address how slurry effects natural sandstone outcrops and artifacts, how high fuel loads within site perimeters can be reduced, and a compilation of fire-related cultural resource studies.

Eisler, David, D. Parrella, and L. Spencer

1978 Report on the investigation and analysis of cultural resources, Young's Butte Fire, Paulina Ranger District, Ochoco National Forest. Report, on file, Supervisor's Office, Ochoco National Forest, Prineville, pp. 1-65.

- Summary of archaeological survey of 1000 acres affected by wildfire (1978) and assessment of the effects on archaeological sites and their components. Damage to cultural materials was assessed as minor: thermal fracturing of lithics, including complete disintegration of basalt boulders due to rapid cooling, impacts of suppression activities, soil disturbance from tree stump uprooting, increased vandalism due to increased visibility of sites after the fire, were the main impacts noted. Four of the eleven new sites recorded were found to be eligible for the National Register, and recommendations for further archaeological investigations, including trail rerouting, and controlled surface collections were suggested.

Elliott, Michael L.

1989 Guadalupe prescribed burn, Cultural resources inventory, Jemez Ranger District, Santa Fe National Forest, Report #1989-10-019. Archaeological Report 88-11, Jemez Mountains Research Center, Albuquerque, pp. 1-26.

- Results of archaeological survey in 600 acre proposed prescribed burn area summarized. Six previously recorded sites relocated and reexamined, 118 new sites and 27 isolated artifacts recorded. Four sites were not considered significant due to previous or historic disturbance and were not considered eligible for nomination to the National Register. Avoidance recommended for nine sites containing wooden features and structures, and one prehistoric pueblo site listed on the National Register. Hand cut fire lines and fire retardant chemicals (foam) suggested for the latter site. Piling of fuels on site areas and features forbidden to lessen the impacts of heavy fuel loads on sites.

Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station

1989 Effects of forest fires and burn programs on archaeological resources. Archaeological Sites Protection and Preservation Notebook, Technical Notes I-8, Vicksburg, pp. 1-6.

- Review of literature on fire effects to cliff faces, open sites, specific artifact categories and on experimental studies of fire effects. Conclusions included the following: 1) wildland and prescribed burns have the potential to be harmful to cultural resources 2) the adverse effects of wildland and prescribed burns on cultural resources will be lessened by light fuels, cool combustion temperatures, and sparse understory vegetation, and 3) prescribed burning may be used effectively to control vegetation on archaeological sites for this reason.

Fenn, Dennis B., R.E. Kelly, and Kathleen Davis

1980 Research proposal: Evaluation of effects of controlled burning and wildfires on surface archaeological resources. Proposal, on file, Western Regional Office, National Park Service, San Francisco, pp. 1-7.

- For the initial draft of this study see Fenn et al 1978, for preliminary work see Kelly and Mayberry 1979, and for results see Bennett and Kunzmann 1985.

Fenn, Dennis B., R.E. Kelly, and M.C. Kolipinski

1978 Draft Research proposal: Evaluation of effects of controlled burning and wildfires on surficial archaeological resources. Proposal, on file, Western Regional Office, National Park Service, San Francisco, pp. 1-7

-See Fenn et al 1980 for revisions, and Bennett and Kunzmann for results.

Ford, Richard I.

- 1979 Ethnobotanical consequences of the La Mesa Fire, Bandelier National Monument, IN Appendix B, The La Mesa Fire Study: Investigation of fire and fire suppression on cultural resources in Bandelier National Monument, Traylor et al, Editors. Southwest Cultural Resources Center, National Park Service, Santa Fe, pp. 137, 145-150.

- Reports on plant identifications from 15, one liter soil/macrofossil samples removed from excavated features at 3 sites. Evidence of Ponderosa pine, Pinus edulis, Juniper, and Zea mays was noted from these samples.

- Burned specimens were examined to determine the degree of burning. The research design addressed three questions: 1) could archaeological versus recently burned plant material be distinguished?, 2) what was the extent of damage to plant remains from the La Mesa fire?, and 3) what procedures should be used for assessing fire damage? Archaeological charcoal was found to have no relative textural or color differences, whereas modern charcoal was more varied in color and much harder in texture. The fire minimally penetrated the soil column, affecting only the uppermost ground litter plant samples. No fire effects on archaeological specimens were anticipated. Studies of past fire effects should include examining artifacts or building stone, and fire scars, snags, and past fire history in site areas. An accurate inventory of all plants contributing to the litter layer must be made by archaeologists to determine changes in fuels and heat transfer during fires.

Foster, Daniel G.

- 1989 CDF and the Laupenheimer Case: A Response to Ron May. Society for California Archaeology Newsletter 23(4).

- ~~Response and critique to Ron May, who suggested that the California Department of Forestry (CDF) did not properly address the cumulative effects of its timber harvesting plans during its review under a program certified as equivalent to the California Environmental Quality Act process. Does not believe that the CDF prescribed program EIR and Initial Study is flawed.~~

- 1986 Correspondence with Harold Biswell about the effects of prescribed fire on cultural resources, 3/6/86, 8/1/86, on file, California Department of Forestry, Cultural Resources Division, Sacramento.

-See Biswell 1989.

1981 A Cultural resources inventory and management plan for Cuyamaca Rancho State Park, San Diego County, California, Volume 1. Report, on file, California Department of Parks and Recreation, Sacramento, pp. 1-97 and Appendices.

- Compendium of site descriptions (elevation, horizontal extent, site type, recorder, date recorded, brief description and location) for all known sites in the State park boundaries and management decisions regarding sites and the State prescribed burn program (location of site in relation to corresponding burn unit, whether impacts of burn will be adverse or not, whether past archaeological testing has supported an avoidance decision). Exclusion to partial exclusion (either by removal of sites from burn units to non-burn areas, or construction of hand line around perimeter of site) from burning is recommended for the following: 1) wooden structures or features, 2) large, highly significant prehistoric sites with multiple features, 3) those sites that may be vandalized or in which visitation will increase after burning, 4) sites where soil erosion is likely to take place after burning.

1980 Cuyamaca Rancho State Park, East Mesa Prescribed Burn Program, Cultural Resource Inventory, Preliminary Report Number 2. On file, Department of Parks and Recreation, Sacramento, pp. 1-12.

- Results of a Phase 2 archaeological survey of five burn parcels (Phase 1 burns in December, 1979 had affected one site: fire effects included blackening and fracturing of ground stone and pot sherds, and increased exposure of the site surface). Twenty-two new sites recorded and exclusion recommendations made for each area. Twenty sites previously recorded were flagged and hand lines were placed around them. Nine additional sites recorded after 20 acres had burned and the burn was out of prescription. Those sites with midden, exposed artifacts, or which were not visible due to dense chaparral were excluded from the burn. Removal of heavy fuels before burning was recommended for some sites and rerecording was conducted at several sites.

Fox, Richard A.

1983 1983 Archaeological investigations at Custer Battlefield National Monument. Report, on file, Midwestern Archaeological Center, National Park Service, Lincoln, pp. 1-59.

- Results of a preliminary survey within an area of unspecified acreage that was burned over from a human-caused ignition (1983). The grassland was dissected by numerous ravines containing brush and trees and the fire was confined to the ground. The burn was

hot and fast and did not penetrate to the clumped root balls of the grasses and forbs. Suppression consisted primarily of fire retardant drops and structural protection near the Visitor's Center, parking areas, and modern cemetery. Objectives of the survey included: 1) the disposition of human remains in the Deep Ravine area, which were not located by the survey, 2) marker/burial correlations, the results of which equivocal and require subsurface testing, and 3) artifact patterning and distribution (direction of fire, troop movements), which appears to have been influenced by vandalism and collection of metal objects such as cartridges in marked grave areas. A more intensive archaeological sampling program and further research has been recommended based on the survey results.

Foxx, Teralene S.

1984 La Mesa Fire Symposium. Proceedings, LA-9236-NERP, Los Alamos National Laboratory, 10/6-7/81, pp. 1-172.

- See Traylor et al 1979 for considerations of cultural resources. Volume includes chapters on fire ecology of the area and the effects of the fire on Ponderosa pine recovery, water relations, geomorphologic conditions, soil nitrogen content, chemical quality in surface waters, aquatic invertebrates, small mammals, wildlife habitat, and avifauna.

Franke, Paul R.

1934 Archaeologist-Naturalist Annual Report, 7/9-26/34. On file, Mesa Verde National Park, pp. 2-4.

- Summary of 11 new sites recorded during post-fire surveys on 9/27/34 and collections made in nine sites in the Upper portions of Long Canyon and two sites on Wetherill Mesa affected by Wetherill Mesa(1934) wildfires.

Gates, Gerald

1988 The forest investigation strategy: a test by fire. Paper, presented at the Society for California Archaeology Meetings, 3/23-25/88, Redding.

- Report of 5,400 acre Modoc National Forest fire (1987) which was caused by lightning on state lands and spread to mixed pine forest with a manzanita-dominated lower story. 240 acres of the 300 acres of burned National Forest lands were archaeologically inventoried before timber salvage projects. 19 new sites were recorded and 2 previously recorded lithic scatters re-examined. Fire line construction damage was limited to less than 5% of site areas. Fire effects noted included smoke blackened patina on obsidian artifacts.

Grand Canyon National Park Fire Management Committee
 1978 Recommendations for Implementation of 1978 Fire
 Management Plan, U.S. Government Memorandum Y14.
 On file, Grand Canyon National Park, pp. 1-4.

- Recommends three separate management recommendations for cultural resources, based on site density, fuel loads, and vegetation composition of three implementation zones for prescribed burning. Archaeological clearances required for Zone C where burn effects may be mitigated by use of fire breaks, water saturation and chemical retardants (four sites, two of which would be monitored with thermocouples-See Jones and Euler).

Green, Dee F.

1980 Managing fire effects: Cultural Resources, II C-2,
 National Interagency Fire Training Center,, U.S.F.S.,
 2/7/1980, pp. 1-12.

- Outline reviews qualities of prehistoric and historic cultural resources, the nature of archaeological inquiry, fire effects to these resources, and recommendations to protect and lessen the impacts of fire on archaeological sites.

Greenway, Greg

Personal communication, Forest Archaeologist, Mendocino
 National Forest.

- Results of post-fire surveys for 1987 wildfires indicated that several archaeological sites were impacted by bulldozer lines. Surveys were confined to rehabilitation areas.

Hanes, Richard

1990 Chapter VIII: Archaeological and historical values.
 Chapter VIII, Bureau of Land Management Fire Effects
 Handbook, H-9217-1, pp. 1-11.

- Definition of cultural resources, principles and processes of fire behavior and effects on specific artifact material classes and dating techniques (based upon literature review). Discussion of burn area preparation, mechanical suppression impacts, and erosion and looting. Management recommendations include: 1) cultural resource considerations in fire planning, 2) the use of fire for maintaining historic plant communities and minimizing wildfire damage, 3) methods to monitor fire effects. Summary of artifact material class tolerances based on experimental and prescribed burn conditions.

Harris, Arthur H. and Linda S.W. Porter

1979 Identification of faunal remains from LA 16114 in the La Mesa Fire, IN Appendix E, The La Mesa Fire Study: Investigation of fire and fire suppression on cultural resources in Bandelier National Monument, Traylor et al, Editors. Southwest Cultural Resources Center, National Park Service, Santa Fe, pp. 171-172.

- Identification of a leg bone shaft of a Sylvilagus sp. and possible long bone or antler fragment of a medium sized Artiodactyla from an excavated site.

Hendrick, Dave

1979 Analysis of the soils from sites on the La Mesa fire area, IN Appendix D, The La Mesa Fire Study: Investigation of fire and fire suppression on cultural resources in Bandelier National Monument, Traylor et al, Editors. Southwest Cultural Resources Center, National Park Service, Santa Fe, pp. 160-168.

- Report of standard soils tests conducted on bulk samples from surface and stratigraphic excavation contexts. The nitrogen percentages and salt (and thus, electrical conductivity) content were elevated in burned surface contexts compared to subsurface deposits as nitrogen volatilizes in the atmosphere during burning of the soils. Neither ion exchange, nor organic content reflected changes due to burning. Some burned samples contained less silt and clay than paired control samples.

Horne, Stephen

1979 Correspondence with Henry Bass, California Office of Historic Preservation, concerning the impacts of prescribed burning in Los Padres National Forest, with Forest Management Plan section that addresses cultural Resources, on file, Los Padres National Forest, Goleta, pp. 1-4.

- Reviews legal mandates for archaeological inventory and pre-project mitigation for impacts of wildfires (erosion, burning wood structures, smoke, access, suppression), fuel break and road construction and maintenance, water development, helispot development, and prescribed fire to cultural resources.

James, Charles D. III

1988 Fires on the Plumas: CRM Fire and follow up strategies. Paper, presented at the Society for California Archaeology Meeting 3/23-25/88, Redding.

- Reported on the impacts of 40,000 acre Clark Fire(1987) which was caused by lightning and burned through Jeffrey Pine and White Fir forests downslope to sagebrush communities between the Diamond Mountain Escarpment and Reno, Nevada. 10-12 archaeological sites were damaged by bulldozer line construction and 120 new sites were discovered in post-fire surveys. Fire impacts noted included potlidding of basalt artifacts.

Johnson, Ann M. and Kerry A. Lippincott

1989 1988 Post-fire archaeological assessment, prehistoric sites, Yellowstone National Park. Report, on file, Rocky Mountain Regional Office, National Park Service, Denver, pp. 1-65.

- Summarizes the effects of the 440,000 acres of Yellowstone Complex Fires (1988) on archaeological resources by identifying the locations and nature of archaeological, historical, and architectural sites, relocating previously recorded resources (four sites not relocated), evaluating the effects of the fires on the resources (direct fire effects noted at 14 prehistoric and five historic locations, two isolated occurrences) (vandalism and natural disturbances noted at nine prehistoric and one historic site and four isolated occurrences), and providing recommendations for short and long term research within the park.

-Three different fire behaviors observed by archaeologists: 1) slow moving grass fires, 2) slow moving duff and litter fires with fire spread due to downed snags, and 3) rapidly moving, crowning fires with greater intensity, higher flame lengths and more total consumption of above ground fuels.

-Fire effects to specific artifact material classes observed included the following: 1) spalling of granite boulders, 2) opalization of obsidian flakes in contact with burning soil surfaces 3) feathering and step fracturing on flake edges 4) charring to total combustion of wood, bone, and other organic materials, 5) obsidian fracturing due to thermal shock (producing shatter), 6) spalling of obsidian flow/source surrounded by heavy fuels, 7) bulldozer line construction through two sites, 8) ground surface damage due to rehabilitation, including raking and peeling of soil surface, compaction, increased vandalism, felling and cutting of hazard trees. Inability for archaeologists to survey West Yellowstone and northeast entrance bulldozer cuts before rehabilitation also caused increased ground surface damage.

-Conclusions of the study included the following: 1) fire did not seriously damage prehistoric sites, 2) the obsidian flow had been damaged by at least one previous wildfire, 3) historic sites exhibited the greatest damage by fire, 4) fire suppression impacts to sites were lessened due to the limited use of bulldozers and other heavy equipment, 5) vandalism by fire fighters at historic

sites was documented by ground disturbance with Mcleods in bottle dump areas, and 4) vandalism by park visitors was noted on several prehistoric sites made more visible and accessible by fire.

-Short term recommendations included the following: 1) vandalism should be curtailed by educating fire fighters, staff, and the public, 2) a "no collection" policy should be instituted for professional archaeologists if increased public access to sites persists, 3) increased communication between cultural and natural resource officials could serve to decrease site impacts, 4) archaeological inventories for all burned areas should be conducted before regrowth obscures the site surfaces, 5) all 1988 produced bulldozer and hand lines should be surveyed before rehabilitation takes place so that the latter do not further damage sites.

-Long term recommendations include the following: 1) incorporation of an archaeological element into the FMP 2) relocation of sites recorded on 1958-159 surveys, 3) initiation of systematic surveys within the park using a sampling strategy, 4) a problem oriented research program to address the significance of the Obsidian Cliff site and it's research potential, 5) a refocusing of research on park history and prehistory.

Johnson, Jessica S. et al

1988 Effects of firing temperature on the fate of naturally occurring organic matter in clays. Journal of Archaeological Science 15:403-414.

- Consistently older than expected radiocarbon dates of ceramics has indicated the presence of older geological carbons (lignite, bituminous coal, anthracite) in sedimentary clays; experimental firings of low and high organic clays produced quantitative measures of the residual carbon; residual carbon was even found in samples that had reached temperatures between 800-1000 degrees, temperatures that exceed the traditional range of most ethnographic cases (See Shepard and Colton). Both oxidizing and reducing atmosphere tests indicated organic burn out is dependent on the original organic component in the clay. Older organic materials are the last to burn out during firing. Organic burn out was found to be independent of firing atmosphere, and may be a pyrolytic process as well as combustive process.

Johnson, Jim

Personal Communication, Forest Archaeologist, Lassen National Forest

- Discussion of the effects of the 30,000 acre Lost Fire (1987) which was caused by lightning and burned through Jeffrey and Ponderosa pine woodlands and through lava rock (malpais) habitats. One site damaged by cat lines and one or two historic structures consumed by fire, including a fire tower that had National register

nominations in progress. Only a few new sites were discovered during post-fire timber salvage archaeological surveys. The areal extent of previously recorded sites increased due to better visibility.

Jones, Ann Trinkle and Robert C. Euler

1986 Effects of forest fires on archaeological resources at Grand Canyon National Park. North American Archaeologist 7:243-254.

Jones, Tom

1986 Correspondence concerning impacts to three archaeological sites located during the Deer Fire(1986), Sierra National Forest, to Larry Swan. Letter, on file, Mariposa Ranger District, pp.1.

- Report of impacts by bulldozer construction of fire lines, safety zones, and back firing areas by an archaeologist assigned to fire fighting (See Nelson 1986, Swan 1989).

Kelly, Roger E.

1989 The Arrowhead and tin can factor: Effects of fire on heritage resources, TFM Module IV, Fire Effects Training, 5/10/89, Seattle, pp. 1-6.

- Outline for training includes topic covered in 1987 and 1984a, b papers.

1987 To Burn or not to burn: The Challenge of Cultural Resources. Paper, presented at Kings River Community College, "Introduction to Fire Effects Class", Reedley, pp. 1-6.

- Contains literature review, experimental test plot results, summary of effects on artifacts, soils and historical features, fire history information, suppression impacts, and technical co-operation between fire managers and cultural resource managers.

1984a Spurious and real relationships of field and laboratory data in fire effects studies. Paper, presented at Society for American Archaeology Meetings, 4/14 -16/84, Portland, pp. 1-6.

- Contains literature review on fire effects, post-fire studies, experimental tests, anthropogenic burning, and environmental assessments. Recommends continuing experimental field (soil analysis, artifact plots) and laboratory research, co-operation with suppression teams, research on anthropogenic burning patterns, and compliance surveys for prescribed burn areas. Request for comment on a draft regulation from Interagency Archaeological

Resources Division, Western Region, NPS, entitled " Waiver of federal Agency Responsibilities under National Historic Preservation Act (Federal Register 3/23/84, pp. 10944-45).

1984b References dealing with aboriginal terrain fires and effect of fires upon archaeological resources. Bibliography, on file, Western Regional Office, National Park Service, San Francisco, pp. 1-3.

- List of 52 references on fire effects, anthropogenic burning, fire ecology and history (See this bibliography).

1981 Tentative results of research regarding fire impacts upon archaeological resources: Western Region, N.P.S. Paper, presented at Yosemite National Park, Prescribed Fire Workshop, 9/29/81, pp. 1-6.

- Contains literature review of fire effects on cultural resources and NPS research design (See Kelly and Mayberry, Bennett and Kunzmann) and experimental results, literature on anthropogenic burning, fire suppression effects, and fire training for archaeologists. Review of pertinent sections of NPS-18 (Chapter 2, p.2, Chapter 7, p.3, Chapter 16, p.3). Discussion of prescribed fires in Grand Canyon which were not suppressed in unsurveyed areas as long as they burned within prescription conditions.

1980 Correspondence: Artifactual and non-artifactual materials for laboratory tests. U.S. Government Memorandum to Peter Bennett, Western Archaeological Center, Tucson, pp. 1-2.

- Results from surface test plot(1), Lake Eleanor prescribed burn, Yosemite National Park, indicated artifacts only smudged. Seven artifact material classes to be used in temperature and duration experiments in muffle furnace discussed. The latter research used to test the hypothesis that higher combustion surface temperatures alter diagnostic features of artifacts rendering them unusable for research.

Kelly, Roger E. and Jim Mayberry

1979 Trial by fire: Effects of NPS Burn programs upon archaeological resources. Report, on file, Western Regional Office, National Park Service, San Francisco, pp. 1-6.

- Summary of research to examine the effects of fire temperatures (via thermocouples and plastic tent stakes) on diagnostic attributes of archaeological materials. Test plots (6) in

prescribed burn areas, Yosemite and Sequoia-Kings Canyon National Parks, were monitored for fire behavior characteristics. Plots were stratified by habitat and contained artificial artifact material classes, and in one case an actual archaeological site. Paired laboratory muffle furnace tests were used for each artifact class, and characteristics of friability, weight, color change, trademarks, patterns, morphology change, and composition were recorded. Results indicated that cool combustion temperatures (under 500 degrees) generated by sparse understories, light fuels or duff/litter have minimal effects on diagnostic artifact characteristics, whereas larger fuels, longer duration, and greater intensities of the fire front will create more adverse effects not demonstrated in the burns.

Keter, Thomas

1987 Travis Fire, Rehabilitation report, cultural resources. Report, on file, Six Rivers National Forest, Eureka, pp. 1-3.

- Report on the 16,000 acre Travis Fire(1987) which was ignited by lightning and burned through serpentine barrens, interior oak woodlands, grassland, and old growth conifer forests communities. 20% of burned area had been surveyed by archaeologists for an earlier land exchange and timber sales, and a team of archaeologists flagged those recorded sites for avoidance during the fire line construction; 20-30 new sites located in post-fire rehabilitation surveys. Historic homesteads and associated features received structural protection through archaeological accompaniment of bulldozer operators both during the fire and during rehabilitation measures. No further mechanized modification and only hand built water bar construction was requested for line that had impacted five prehistoric sites. Recommendations included: 1) rechecking all archaeological site locations after rehabilitation, 2) removing flagging from same, 3) notifying BLM and CDF archaeologists that cultural resources on their properties need to be checked for fire impacts.

Keyser, James D.

1983 Prescribed Fire Management, Unit IIB3: Visual and Cultural resources, N.A.R.T.C. Training Course, 2/28-3/4/83, Marana, pp. 1-8.

- Outline and review of the nature of cultural resources found on public lands, their values and preservation, the state on knowledge on the effects of fire on cultural resources and integrating these data into protective measures for prescribed management activities.

Kunzmann, Michael

- 1979 Correspondence and description of melting temperatures of plastic stakes to be used during prescribed burn plot experiments. U.S. Government Memorandum, in possession of compiler.

-See Kelly and Mayberry 1979.

Linderman, Carol, Archaeologist, MacKenzie Ranger District, Willamette National Forest

- 1990 Effects of fire on obsidian artifacts. Paper in progress, personal communication with author

- Examination of hydration rind measurements of 55 samples of South American obsidian which were placed in an area to be prescribed burned to reduce logging slash. Fire intensity, flame length, and rate of spread were figured during the burn. Duff pins were used to examine the location of artifacts and the changes in duff composition following the burn. Artifacts located 10 cm below the ground surface were not affected by the burn (See Origer 1990).

Lissoway, John

- 1990 Fire line Officer's briefing statement regarding cultural resources. On file, Bandelier National Monument, Los Alamos, pp. 1- .

-NAC

- 1986 Fire and Resources Management: Cultural Resources Management, Unit III-C, N.A.R.T.C. Training Course, 3/17-28/86, Marana, pp. 1-23.

- Outline and review of how catastrophic fires in the Western United States have promoted the integration of cultural resources management planning in parks and wilderness areas, and the importance of such resources as sources of information about the past and their contribution to modern society in resources management planning.

Lissoway, John and Judith Propper

- 1988 Effects of fire on cultural resources. Paper, presented at Effects of Fire in Management of Southwestern Natural Resources Symposium, 11/14-17/88, Tucson, pp. 1-10.

- Review of the nature of cultural resources, legal mandates for their protection, review of the direct effects of fire and fire management activities on cultural resources in six fires (See

Switzer, Pilles, Traylor et al). Outline of planning stages for managers, checklist of minimizing impacts of the wildfires and considerations in prescribed fires, call for documentation of fuel conditions around archaeological resources.

Manuel, Don

1980 Prescribed burning and its effects on cultural resources within the Diablo and Sierra de Salinas Mountain Ranges, Interior Central Coast, California. Report, on file, Folsom District, Bureau of Land Management, Hollister, pp. 1-2.

- Summary of proposed 10% random stratified survey to be conducted in area of proposed prescribed burn in order to formulate a predictive, site sensitive model. Summary of required archaeological work as part of environmental assessments prior to prescribed burning.

Martin, Buddy

1983 Natural Resources Management Plan and Environmental Assessment, Mesa Verde National Park. On file, Resource Management Division, Mesa Verde, pp. 1-79 with Appendices.

- Sections addressing a proposed research burn on Moccasin Mesa in order to facilitate fire effects research on natural and cultural resources. Fire management objectives included initiating long term research on cultural resources impacted by fire. Three management zones identified: protected zones with fire exclusion, back country zones with existing fire exclusion where projected prescribed fire research was to take place, and modified suppression zones where certain small fire would be allowed to burn under prescriptive guidelines. The latter would not be allowed to burn until after adequate research into the fire effects on archaeological sites had been conducted.

Mayberry, Jim

1979 Report and discussion, Prescribed fire test plots I and II, Yosemite and Sequoia-Kings Canyon National Parks. Report, on file, Western Regional Office, National Park Service, San Francisco, pp. 1-7.

- Summary of fire effects of prescribed burning in mixed conifer habitats on surface and subsurface artifacts (obsidian, chert, marine shell, bone, prehistoric ceramics, contemporary porcelain, historic glass). Slight smudging was observed on chert, shell, bone, porcelain, and glass located on the surface. No indication of change in subsurface artifacts noted in Yosemite plots. In SEKI the test plots were located in Sequoia gigantea and White fir

groves with dense duff covers. Smudging was present on obsidian, prehistoric ceramics, marine shell, and obsidian samples. (See Origer for results that suggest that obsidian hydration readings can be altered as a result of temperatures produced by fire between 200 and 500 degrees F).

May, Ronald V.

1989 Conservation law and archaeology. Society for California Archaeology Newsletter 23(3).

- Letter and commentary concerning the court case *Lauphenheimer v. State of California* (1988) 200 California App. 3d.440. , in which, May claims, the state wide EIR for CDF's prescribed burn program "glossed over CEQUA issues on a mega scale and vaguely committed to mitigation as needed."

Mesa Verde National Park

1980 Environmental Assessment, Fire Management Plan, Mesa Verde National Park. On file, Resource Management Office, Mesa Verde, pp. 1-63 and Appendices.

- Discusses necessary fire management research required before the implementation of the plan, including: 1) determining the effects of heat of varying intensities on cultural materials of various types both in surface and subsurface contexts, and 2) determining the depths of heat penetration into soils from varying fuel types and loadings.

McIntyre, Mike

1988 The Ruby Fire and CRM planning. Paper, presented at the Society for California Archaeology Meetings, 3/23-25/88, Redding.

- Reported on the estimated 9,000 acre Ruby Fire(1987) which was a human ignition that burned through chaparral habitat. No new sites were recorded. Archaeological survey during rehabilitation phases included assessing the impact of bulldozer lines on sites, assess the impacts of proposed culvert placement and seeding on sites. Erosion was a major problem with soil creep several feet thick covering bedrock mortar features and middens.

Murry, Robert E.

1983 Pollen analysis of Anasazi sites at Black Mesa, Arizona. Master's Thesis, Department of Anthropology, Texas A & M University, College Station, pp. 1- .

-NAC

National Park Service

1988 Management Policies, U.S.D.I., National Park Service,
General Printing Office, Washington, D.C..

- Chapter 4 is a review of fire management programs, wildfire prevention and suppression, and prescribed fires. Chapter 5 is a review of the types and characteristics of cultural resources, and addresses fire detection and suppression techniques developed to protect these resources. Chapter 6 is a review of fire and cultural resource management policies.

1980 Draft Fire Management Guideline, NPS-18. On file,
Resource Management Division, Mesa Verde National
Park, pp. 1-5.

- Sections address suppression of management fires if they threaten cultural and natural resources, and the appropriate contents of fire management plans. Four major considerations for research, include determining natural and historic conditions, and the effects of the fire on historic and archaeological resources.

National Park Service, Fish and Wildlife Service, Bureau of Land Management, Bureau of Indian Affairs

1989 Final report and recommendations of the Fire Management Policy Review Team and summary of public comments,
Federal Register 54(115): 25660-25678.

- Discussion of Yellowstone Complex fires (1988) and fire fighting efforts in relation to protection of historic structures, and controversies over "light on the land" suppression techniques and their effectiveness.

Nelson, Charles

1986 Archaeological survey report, Deer Fire, Kings River Ranger District, Sierra National Forest. On File,
Mariposa Ranger District, Sierra National Forest, pp. 1-3.

- Documentation of impacts reported (See Jones 1986) in one area of the Deer Fire(1986). Previous archaeological surveys had been completed for the impacted area during timber sales. A prehistoric and historic site not impacted by the fire line construction were recorded.

Nichols, Tom

1979 Correspondence, regarding fire intensity and fire behavior of two test plots during prescribed burns, Sequoia and Kings Canyon National Park. Correspondence, on file, N2219, Sequoia and Kings Canyon National Park, Three Rivers, pp. 1-3.

- Summary of fire behavior at two locations within Sequoia-Kings Canyon National Park during control burning within archaeological test plots I and II (See Mayberry).

Noxon, John S. and Deborah A. Marcus

- 1983a Wildfire induced cliff face exfoliation and potential effects on cultural resources in the Needles District, Canyonlands National Park, Utah. Report, on file, American Indian Rock Writing Research Company, Monticello, pp. 1-16.

- Reports impacts of 200 acre Four Faces Fire(1981) started by an accidental human ignition. Discusses effects on Cedar Mesa Sandstone outcrops (carbon blackening, spalling) and likely impacts on cultural resources such as rock art panels and masonry cliff dwellings. Causes for exfoliation include: 1) irregular cliff face/parent rock expansion-contraction ratios during rapid heating and cooling phases of fires, 2) trapped cliff face moisture conversion to steam and steam pressure during active burning.

- 1983b Wildfire-induced cliff face exfoliation and potential effects on cultural resources in the Needles District, Canyonlands National Park, Utah. Southwestern Lore 49:1-8.

See Noxon and Marcus 1983a

Nusbaum, Jesse L.

- 1934 Correspondence to Archaeologist/Naturalist Paul Franke, Mesa Verde National Park. Letter, on file, Naturalist's Correspondence File, 740-02.4, Mesa Verde National Park, pp.1-2.

- Suggestions for locating fire-affected sites and artifacts after the Wetherill Mesa(1934) wildfire and recommendations for a complete post-fire survey of area.

Origer, Thomas M.

- 1990 Correspondence regarding obsidian hydration rind measurements on 54 specimens that were examined before and after they were subjected to prescribed burning on the Willamette National Forest. Report, on file, Anthropological Studies Center, Sonoma State University, Rohnert Park, pp. 1-5.

- See Carol Linderman, Personal Communication.

1979 Correspondence and summary of twelve obsidian hydration readings from prescribed burn plots in Sequoia-Kings Canyon National Park and Yosemite National Park, and five samples of unknown origin. Report, on file, Cultural Resources Facility, Anthropological Studies Center, Sonoma State University, Rohnert Park, pp. 1-2, and pp. 1-3, respectively.

- Nine of twelve obsidian samples (See Mayberry and Nichols) submitted from prescribed burn areas (See map, Nichols) appeared to have no visible hydration band on the indicated test faces.

Parkman, E. Breck, Editor

1981 Cuyamaca Rancho State Park, A Cultural Resources inventory and management plan for prescribed burning, Volume 2, Part 1. Report, on file, California State Department of Parks and Recreation, Sacramento, pp. 1-159.

- Summary of fire history of Park, list of questions concerning direct and indirect fire effects on specific cultural features and artifacts. Tabular presentations of preliminary cultural resource recommendations for the prescribed burn program on 252 recorded sites within Park boundaries, based on the following criteria: 1) site type, 2) nature of the deposits, 3) on-site fuel volumes, 4) relative potential for vandalism, and 5) vulnerability of site components. In 156 of the 239 sites burning was not believed to adversely impact the resource, and 83 of 239 are not recommended for burning, 13 of 239 needed further work before decisions are made, nine of 239 needed re-recording before decisions are made, and four sites needed mitigation before burning.

Pidanick, Bill

1982 Prescribed fire/cultural artifacts, investigating the effects. Pacific/Southwest Log :4-5.

- Reports on results of experimental plots (2) placed in one high intensity (chamise chaparral) and on moderate intensity (not reported) prescribed burn units (1982) by Gonzales and Welch. Material classes included prehistoric ceramics, ground stone, worked and unworked lithics, historic bottle glass, marine shell, and animal bone. 20% of the artifacts recovered from the high intensity burn exhibited surface damage versus 10% in the moderate intensity burns. Subsurface deposits remained undamaged; subsurface temperatures were 41 degrees C versus ground surface temperatures at 430 degrees C.

Pilles, Peter J.

1987 Memorandum of Agreement' used to provide clearances for prescribed burns, Coconino National Forest, Arizona, with correspondence to Roger Kelly, WRO, and with the Agreement with State Historic Preservation Office on projects not needing archaeological clearances. Report and letters, on file, Western Regional Office, National Park Service, San Francisco, pp. 1-9.

- Archaeological clearance of prescribed burn fire lines requiring the lines to be built around wooden structures, but not requiring survey or inventory of the area to be burned.

1984 The Effects of forest fires on archaeological sites. Paper, presented at Society for American Archaeology Annual Meeting, 4/14-16/84, Portland, pp. 1-11.

- Review of literature on fire effects; summary of the Radio and Jacket Fires (1977) totalling 5,127 acres, the former a human ignited blaze and the latter a lightning strike ignition. The Radio Fire burned from Ponderosa pine and fir forests downslope through oak woodland, pinyon-juniper, and chaparral communities. The Jacket Fire burned through pinyon-juniper forests. Archaeological surveys conducted during rehabilitation phase/tree removal in the Radio Fire located 165 new sites (densities of 23 sites per square mile) dating between A.D. 900 and 1200 and one historic site. Mitigation through excavation occurred at four sites including two masonry pueblos, and two masonry lined pithouses. 12 new sites were located in 64 acres by post-fire surveys in the Jacket Fire area, totalling 120 sites per square mile, eight of which were masonry pueblos and four were sherd/lithic scatters which date from A.D. 1066 to 1130.

1982 Prescribed fire management and cultural resource management. Paper presented at Prescribed Fire Management Training Course, National Interagency Fire Training Center, 5/4-5/82, Marana, pp. 1-11.

- Reviews the characteristics of cultural resources, the relevance of archaeology to modern society, the positive and negative effects of controlled burning on cultural resources (See Pilles 1984, Traylor et al 1979, Switzer 1974, Crespín 1981), how cultural resource evaluations are made and how these evaluation should be integrated into prescribed burning plans. Recommendations for contingency planning, as well as mitigating visual impacts is reviewed.

-The 645 acre Wallace Fire(1979) which originated from human ignition burned in dense young Ponderosa pine thickets. The burn area was completely surveyed by archaeologists before timber salvage and ten masonry pueblos, two pithouse sites, and two

sherd/lithic scatters were located that dated to A.D. 950-1066 recorded. Densities of 29 sites per square mile were found in the burn area.

-Damage to sites was summarized by sections on rehabilitation (grading, berm construction, seeding), suppression activities (bulldozer cuts, hand lines, increased visitation by fire fighters, damage by fire retardants, and mop-up activities. Fire effects on cultural resources included complete combustion of historic wooden structures, alteration of pigments, glazes and carbonization of organic material in sherds, spalling, cracking, or breaking of stone artifacts, spalling and scorching of pictographs on sandstone, thermal fracturing of quarry sites, and erosion. Mitigation of sites indicated subsurface heat transfer and damage did not reach beyond 5 cm below ground surface, except where stumps and roots transferred heat below this level and baked and oxidized surrounding soils. Thermoluminescence and obsidian hydration dated samples were skewed due to the fire. Surface samples of pollen were destroyed in areas that reached over 300 degrees C. Enhanced visibility from all three burns added 10 new sites to the area, suggesting that intensive surveys in this region will characteristically "miss" 5-7% of the sites.

-Recommendations include incorporation of archaeologists in the fire organization, especially in cases where heavy equipment is used during suppression, increasing the training of fire fighting personnel, standardizing a unique flagging code for cultural resources, removal of high fuel loads (thinning, piling fuels) from areas of archaeological sensitivity, and control burning to reduce fuel loads.

Porter, Cris D.

1987 Archaeological survey for Annadel State Park Unit, Prescribed Fire Management Plan. Paper, Northern California Data Sharing Meeting of the Society for California Archaeology, 10/31/87, Davis, pp. 1-6.

-See Porter and Wilbur 1987.

1985 Archaeological survey, Upper Steve's Trail treatment area, Annadel State Park. Report, on file, California State Department of Parks and Recreation, Northern Region, Santa Rosa, pp. 1-4.

- Reports results of archaeological survey in proposed 185 acre prescribed burn area. Three prehistoric sites associated with the Annadel obsidian source/quarries were within the direct impact area of the burn. Controlled excavations at the former were recommended so that samples of obsidian could be removed for hydration readings

and then placed at known soil depths to 5 cms below the ground surface. A method of obtaining soil temperature readings at these depths was suggested.

Porter, Cris D. and Ray Wilbur

1987 Archaeological survey for Annadel State Park, prescribed fire management plan. Report, on file, California State Department of Parks and Recreation, Northern Region, Santa Rosa, pp. 1-12.

- Summary of the results from an intensive archaeological survey on 3,165 acres conducted to locate and record sites with fire sensitive elements that would be adversely affected by the prescribed management plan, and to make recommendations concerning their mitigation. Ten new sites recorded, including four historic basalt quarry complexes, one rhyolite quarry site, one cabin site, one prehistoric obsidian workshop/flake scatter, one prehistoric flake scatter and campsite, one prehistoric flake scatter and one isolated occurrence. Pre-burn treatments such as use of hand lines and avoidance at significant obsidian quarry sites, removal of fuels, piling and burning those from sites in off-site areas suggested.

Powell, David W.

1987 Wildfire effects on cultural resource sites and their management. Paper, presented at the Northwest Anthropological Conference, 3/87, Gleneden, pp. 1-5..

- Reports the direct impacts to prehistoric and historic sites in the 300 fires totalling 40,000 acres ignited by lightning in Wallowa-Whitman National Forest, Oregon(1986). High intensity burns on prehistoric sites cause displacement of artifacts through root and stump burning and erosion. These burns consume all wooden features and organic materials from historic dumps, and cause erosion. Suppression techniques, rehabilitation techniques, and post-fire management techniques are briefly reviewed. Recommendations included providing archaeological information and archaeologists to the fire management and rehabilitation teams, training for fire fighters on recognition of cultural resources, documentation/recording of wooden features for nominations to the National Register and institution of a data recovery program for deteriorated and destroyed historic sites.

Purdy, Barbara A. and H.K. Brooks

1971 Thermal alteration of silica minerals: An archaeological approach. Science 173:322-325.

-NAC

Racine, Charles H. and Marilyn M. Racine

1979 Tundra fires and two archaeological sites in the Seward Peninsula, Alaska. Arctic 32:76-79.

- Results of pre- and post-fire surface surveys of sites consisting of stone-lined pits affected by lightning-ignited, 958 square kilometer fires (1977) that burned in tundra grasses and forbs. Results indicated substantial caribou bone scatters, some artifacts which had been covered and incorporated into the vegetation mats were exposed and could be easily recorded. No fire effects on the materials were noted.

Raisch, Carol

1989 Guadalupe prescribed burn site protection assessment. Report #1989-10-019B, on file, Jemez Ranger District, Santa Fe National Forest, Jemez Springs, pp. 1-6.

- Archaeological survey for a 600 acre proposed prescribed burn to reduce slash accumulation in Ponderosa pine forest and pinyon-juniper woodlands. Results of review of fuel loading assessments at 124 archaeological sites visited by fuel managers and archaeologists. Concluded that by keeping temperatures below 600 degrees C and preferably below 400 degrees C, and avoiding all sites (47) containing wood features through fire line construction, foaming, or removal from burn plan was needed. 74 sites needed no protection and four new sites were recorded during the survey, one of which was slated for avoidance. A plan to examine fire effects on prehistoric masonry structures was proposed for a field house monitored by soil thermocouples. Artifacts were to be placed in five surface and subsurface areas with this structure. This project is presently awaiting proper prescription conditions (Raisch, Personal Communication, 1990).

Robinson, William J.

1979 Tree ring samples and dated fire scars on eight tree from the La Mesa Fire area, IN Appendix A, The La Mesa Fire Study: Investigation of fire and fire suppression on cultural resources in Bandelier National Monument, Traylor et al, editors. Southwest Cultural Resources Center, National Park Service, Santa Fe, pp. 140-144.

- Report on eight cross sections of Ponderosa pine cut in the summer of 1977. Fire years that appeared on more than half of the samples included A.D. 1797, 1806, 1822, 1842, 1870, 1878, and 1893; the range of the fire interval is 8-20 years, and the near cessation of scars since 1900 was unusual since this is too early for fire control management of the area. 15 Ponderosa pine tree-ring samples from 2 sites were also examined and there was no evidence of any fire damage on these samples.

Rock, James T.

1988 The Klamath's on FIRE!. Paper, presented at Society for California Archaeology Meetings, 3/23-25/88, Redding.

- Reported on the 280,000 acre Klamath Complex(1987) which was ignited by lightning and burned in Ponderosa pine forests, plantation, and wilderness areas. Post-fire rehabilitation surveys relocated previously recorded sites, recorded over 300 new sites, and one prehistoric (Shasta Complex) site was damaged by suppression activities.

Rogers, Ann Bennett, and Charla Meacham Francis

1988 Fire effects on prehistoric sites: hot today, gone tamale. Paper, presented at the Society for California Archaeology Annual Meeting, 4/23-25/88, Redding, pp. 1-6.

- Summary of the experimental examination of variables affecting site formation processes in wildfire areas. Report of post-wildfire program to assess soil stability in sites affected by hot, intense fires of the Mendenhall Complex (1987). Three characteristics examined included: 1) soil inundation from up slope sources, 2) soil wash downslope, 3) artifact and soil movements on sites; sites chosen were stratified by rehabilitation techniques (matting and seeding/ no application of erosion controls). Sites located below 5000 feet exhibited soil accumulation rates of 9 cm in stumpholes and downslope movement downslope of 20-30 cm.

Rowlett, Ralph M.

1986 Ancient Fires at Koobi Fora. Paper, presented at Conference in honor of J. Desmond Clark, The Longest Human Record, 4/12-16/86, Berkeley, pp. 1- .

- Results of thermoluminescence studies of two lens like features found during excavations at site FxJj 20, Karari Escarpment, Lake Turkana, Kenya. Temperatures attained by these fires and associated artifacts had not reached over 400 degrees C, suggesting that lightning strikes, isolated tree burnings, and small fireplaces may have existed in these locations.

Rowlett, Ralph M. and Sissel Johannessen

1979 Thermoluminescence response interference from the La Mesa forest fire, Bandelier National Monument, IN Appendix G, Final Report (Draft) The La Mesa Fire Study: Investigation of fire and fire suppression impact on cultural resources in Bandelier National Monument, Traylor et al. Editors. Report, on file, Southwest Cultural Resources Center, National Park Service, Santa Fe, pp. 178-188.

- Results from 12 samples taken to assess the damage to thermoluminescence values. Two surface sherds at two sites, and a single sherd from excavated deposits ranged from 13 -24% too low, one sherd gave a spurious high date from an excavated context, and the other five were well within reasonable range of the diagnostic temporal assignments. Fires may not cause skewing if confined to trees rather than undergrowth, and if they do not exceed 350-400 degree C ranges.

Rowlett, Ralph M., M.D. Mandeville, E.J. Zeller

1974 The Interpretation and dating of humanly worked siliceous materials by thermoluminescence analysis. Proceedings of the Prehistoric Society 40:37-44.

-NAC

Sayler, Rodney D., R.W. Seabloom, Stanley A. Ahler, Editors

1989 Impacts of prescribed burning on archaeological and biological resources of the Knife River Indian Villages NHS. Final report, on file, Knife River Indian Villages National Historic Site, North Dakota, pp. 1-125.

- Literature review, results of field studies, and burning experiments from 1988-1989 studies. Study objectives included the following: 1) determine the potential impacts on archaeological resources of KNRI from prescribed burning programs, 2) develop recommendations for a vegetation management/burning program since the park is charged with recreating the historic scene during the early 1800's. Impacts of prairie fires on ten archaeological material classes evaluated in experimental plots(4) in Oakville Prairie Natural History Area. Fire-related impacts to buried artifacts were negligible, but effects to surface exposed artifacts were significant depending on fire conditions, artifact type, and size (See Ahler et al 1990). A phased burning program that recognizes several categories of artifact densities and relative importance or sensitivity to burning was recommended, including the following: 1) the village sites not be burned until a thorough and professional collection of surface visible artifacts is completed to prevent data loss for future analysis, 2) archaeological sites in KNRI with moderate artifact densities be surveyed to determine whether surface collection is warranted to mitigate fire damage, and 3) burning and other vegetation management programs may begin as soon as feasible on other areas and portions of the park which have low artifact densities, or on sites not deemed significant or incompatible with the park's theme, or sites not susceptible to fire damage, 5) gradual logging, mowing, and site specific chemical treatment, and grazing may be used to manipulate problem areas in the area.

Scott, Douglas D.

1979 Don't burn that wickiup! A Value at risk Some considerations of cultural resources in fire management. Report for field operations, Montrose District, Bureau of Land Management, Montrose, pp. 1-11.

- Suggestions for fire management officers for the protection and preservation of cultural resources. Sections on the following topics: fire history and ecology in mixed coniferous forest, the types of sites and data to be destroyed by fire, description of the physical damage including lithics, ceramics, masonry, organic remains, rock art panels, wooden structures, metal, glass and other materials (lithics damaged during the Horsefly #3 Fire (1977) were located on the surface to 2 cm below ground surface), and the identification of seven specific areas where cultural resources deserve special protection (Sacred Mountain Planning Unit, prescribed burn units, Brushy Ridge/Monitor Mesa, wickiup sites, American Flats/Silverton wildfire affected areas, and dendrochronological sample sites). Recommendations include further protection of fragile wickiup sites, integration of archaeologists into fire management in wildland and prescribed burn situations, mapping of high risk areas noted above, and institution of a dendrochronological study to examine fire history.

Scott, Linda J.

1979 Pollen analysis of three sites in the La Mesa study area, IN Appendix C, Final Report (Draft) The La Mesa Fire Study: Investigation of fire and fire suppression impact on cultural resources in Bandelier National Monument, Traylor et al, editors. Report on file, Southwest Cultural Resources Center, National Park Service, Santa Fe, pp. 190-193.

- Report on 16 pollen samples from feature and floor excavations of two sites, and samples from stratigraphic soil columns from ground surface to 75 cm below the ground surface within the rooms. Only three samples had sufficient pollen for analysis, and each showed natural deterioration of grains not likely to have been from the fire. Surface samples in burned areas indicated numerous fresh grains from recent pollen rain since the fire. Surface pollen under moderately intense fire over 300 degrees C is likely to be destroyed. There is little correlation between the depths of the samples and their respective conditions. Comparisons of the pollen identified from near surface samples and stratigraphically lower deposits indicated an abundance of pine pollen in the upper samples, and more weedy species in the lower samples. Elevated pine counts in the upper sediments indicate pine was shedding pollen after the fire during the sampling period. The presence of less pine and weedy shrub and herb species in both upper and lower samples is inconclusive evidence for prehistoric economic pollen types or as indicators of past human disturbance in these sites.

Seabloom, R.W., R.D. Sayler, and S.A. Ahler
 1991 Effects of prairie fire on archaeological artifacts, Park Science 11(1):1-3.

See Sayler et al 1989 above.

Seymour, Gregory R.

1986 An Archaeological survey for the proposed Middle Peak prescribed burn at Cuyamaca Rancho State Park. On file, Department of Parks and Recreation, Sacramento, pp. 1-6 with site forms in Appendices.

- Five new historic sites were recorded and two prehistoric sites were updated, including the addition of a historic component to one site within a proposed prescribed burn area #12. One site with dense scatters of wood was excluded from the burn area.

Shepard, Anna O.

1939 Appendix A: Technology of La Plata pottery IN Archaeological Studies in the La Plata District, Southwest Colorado and Northwest New Mexico, Earl Morris, editor and author. Publication 519, Carnegie Institute of Washington, Washington, D.C.

- Summary of paste, temper, pigment type, petrographic, microchemical, and effects of firing methods on 3000 prehistoric sherds from 95 archaeological sites in the La Plata area. Refiring of sherds in electric furnace conducted at temperatures ranging from 750 to 1200 degrees. Pigment color differences noted at 950 degrees C and refractoriness occurred at 1150-1200 degrees.

1956 Ceramics for the Archaeologist. Publication 609, Carnegie Institution of Washington, Washington, D.C.

- Review and discussion of literature on the effects of heat on clay, nonplastic materials (temper agents), pigments, firing processes and the predictable effects of firing processes. The use of sherd pigment and color changes to estimate firing temperature is limited. Factors to be considered in this estimation include the following: 1) the original state of oxidation of the paste, 2) the major mineral groups that influence paste type 2) differential rate of color change upon heating, 3) post-oxidation sherd conditions where temperatures several hundred degrees greater than standard open firings and 4) the inverse relationship between porosity and firing temperature.

Shipman, Pat, G. Foster, and M. Schoeninger
 1984 Burnt bones and teeth: An experimental study of color, morphology, crystal structure and shrinkage. Journal of Archaeological Science 11:307-325.

- Effects of experimental, controlled heating (muffle furnace) on modern bones and teeth (mandible and astragalus) from sheep and goats. Examination of color, microscopic morphology, crystalline structure, and shrinkage between 20 and 940 degrees recorded for all samples. Five stages characteristic of set temperature ranges were determined based on color changes and microscopic morphology traits; heating of specimens over 645 degrees C affects hydroxyapatite, the major inorganic component of bones and teeth. An algorithm based on the percent shrinkage may be used to determine the maximum temperature reached by the bones. Differences in the maximum heating device temperature and the maximum specimen temperature suggest that distinguishing between cultural and natural fires must be prioritized in applied field studies of fire effects.

Silvermoon, Jon Massoglia

1987 Effects of fires on cultural resources: a review of the literature. Report on file, MacKenzie Ranger District, Willamette National Forest, pp. 1-6.

- Review of studies on fire effects (See Eisler et al 1978, Racine and Racine 1979, Traylor et al 1979, Trembour 1979, Kelly and Mayberry 1979, Welch and Gonzales 1982).

Smith, Jack E.

1990 Impacts of wildfire on archaeological sites at Mesa Verde National Park. Paper presented at the Society for American Archaeology Meetings, 4/18-21/90, Las Vegas, pp. 1-6.

- Summary of post-fire archaeological survey and data compilation of 194 previously recorded sites within 2600 acre Long Mesa burn (1989). Summary of research questions addressing long term fire effects to cultural resources and their contexts, particularly the effects on land surface erosion. Summary of fire impacts included visual inspection of site specific and artifact specific changes, particularly sandstone spalling, discoloration, and fragmentation, chemical penetration and discoloration of sandstone by slurry, and discoloration and refiring of ceramics and discoloration, luster, crazing, and potlidding of lithic materials. Direct effects of fire considered to be relatively minor except in areas where heavy forest cover and fuels created extremely hot fires.

Smith, Jack E. and Ronald Crawford

- 1983 Cultural resource fire line locator course. On file, Division of Research and Cultural Resources Management, Mesa Verde National Park, 8/23-23/83, pp. 1-2.

-Outlines the physical remains and data bearing potential of cultural resources in relation to heat and suppression activities. Summarizes the major duties of a fire line locator and fire line archaeologist.

Spoerl, Patricia M.

- 1988 Management impacts on cultural resources: An assessment of Forest Service Research needs, IN Tools to manage the past: Research priorities for cultural resources management in the Southwest, J.A. Tainter and R.H. Hamre, editors. U.S.F.S. General Technical Report RM-164.

-NAC

Staff, Southwestern Cultural Resources Center

- n.d. Statement of implications of Fire Effects Study, La Mesa Fire, Bandelier National Monument, for prescribed burn programs, NPS. Report, on file, Bandelier National Monument, Los Alamos, pp. 1-2.

-See Traylor et al 1979a, b

Stehli, Irene

- 1979 Radiocarbon dates from the sites burned by the La Mesa Fire, IN Appendix I, Final Report (Draft) The La Mesa Fire Study: Investigation of fire and fire suppression impact on cultural resources in Bandelier National Monument, Traylor et al, editors. Report on file, Southwest Cultural Resources Center, National Park Service, Santa Fe, pp. 190-193.

- Report on four wood samples collected from two site excavations. Insufficient data was available to correlate the samples with the effects of the most recent burn. Pretreatment needed on all samples due to rootlet contamination and treatment of on sample with paraffin and gasoline. Escobas Mesa site: 50 B.C., Burnt Mesa Site: A.D.1530, A.D.1910.

Swan, Larry

- 1990 Draft Bulldozer supervisor training course, Unit on cultural resource protection, on file, Sierra National Forest, Shaver Lake, pp. 1-4.

-Outline for course to be offered in California, which reviews what a cultural resource is, what they look like, what values are associated with them, what a supervisor is supposed to do to protect such resources while working in suppression, rehabilitation, or other work, and how to co-ordinate with archaeological personnel.

1989a Fire/Archaeology Update, on file Sierra National Forest, Shaver Lake, pp. 1-2.

- Overview of the work accomplished in 1987 concerning policies, meetings, papers given, meeting and training courses that relate cultural resources and prescribed or wildland fire.

1989b Fire call list for archaeologists and other CRM specialists. Document, on file, all U.S.F.S., Region 5 Supervisor's Offices and Zone Emergency Operations Coordinators, pp. 1-14.

- List of 63 cultural resource personnel and their fire suppression availability, their location, and access to cultural resource records for ten National Forests within the state of California, (work and home phone numbers). Plans are to update this list on an annual basis and distribute it before each fire season (Larry Swan Personal Communication 1990).

1988a U.S.F.S. Region 5 Policy Letter: Cultural resource coordination with fire suppression and rehabilitation to all Forest Supervisors, on file, Sierra National Forest, Shaver Lake, pp. 1-2.

-Seven point plan to better co-ordinate cultural resource personnel during wildfire incidents, including maintaining a list of qualified employees (See Swan 1989), educate line officers on cultural resource considerations, educate bulldozer operators, strike team leaders, and overhead planning and operations personnel on cultural resources.

1988b Correspondence with Dick Wengert, Daniel Boone National Forest Supervisor concerning fire and cultural resources management documents with attached policy statement (See above), on file, Sierra National Forest, Shaver Lake, pp. 1-2.

-See 1988a

1987a Working paper, Fire Suppression and Cultural Resources, Region 5, U.S.F.S.. On file, Sierra National Forest, Shaver Lake, pp. 1-6.

- A How to Guide for better co-ordination and integration of archaeological concerns during fire suppression activities. Includes a list of concerns expressed by cultural resource personnel and responses to such concerns. Recommendations include: 1) gathering together the appropriate site location information, 2) finding local U.S.F.S. qualified to assist, 3) making sure information about cultural resources getting into the daily Incident Action Plans, 4) concentrating on bulldozer activity and fire camps as a first priority for impacts, and 5) making sure rehabilitation efforts are fully integrated with whatever site protection measures are recommended.

1987b Draft summary and Critique: Pacific Southwest Region
~~1987 Season, Integration of Cultural Resource Concerns~~
and fire suppression activities. On file, Sierra
National Forest, Shaver Lake, pp. 1-3.

- Summary of events during 1987 fire season and problems regarding cultural resources throughout the region. Recommendations include assuring integration of CRM personnel through a call list, pursuing education of forest staff on identifying cultural resources in escaped fire analysis, upgrading fire training for CRM personnel, training of Class I and II overhead teams on proper use of CRM personnel during fires, training the latter for integration into fire management teams, and widen the scope of what is considered emergency rehabilitation.

1985 Archaeological Survey Report, Gorda and Rat Creek Fires,
Los Padres National Forest, Monterey Ranger District. On
File, Sierra National Forest, Shaver Lake, pp. 1-9.

- Report of archaeological surveys within three "high sensitivity areas" impacted by fire suppression efforts during the Gorda and Rat Creek Fires (1985) which were started by lightning and burned over coastal prairie, scrub, chaparral and mixed coniferous forests. Five prehistoric midden sites were minimally impacted through soil compaction and increased access due to placement of the Pacific Valley fire base camp, a helicopter base, a catering service, a smaller fire camp and shower facilities, and heavy equipment parking. In the Gorda Fire area bulldozer lines had impacted a prehistoric and historic site and there had been reports of vandalism by fire fighters. One multi-component and one prehistoric site were recorded after the fire; in the Rat Creek area two prehistoric sites were severely impacted by bulldozer line construction, and a single new prehistoric site was recorded. Physical rehabilitation with archaeological monitoring is suggested for all the sites impacted, in particular blocking public and vehicle access to very accessible midden soils containing numerous artifacts, reseeding areas, construction of erosion control features. Shift plan maps of fire suppression activities included.

1982 Pyroarchaeology. Correspondence on past researchers doing fire effects studies, to Greg Greenway. Letter on file, Sierra National Forest, Shaver Lake, pp. 1-5.

- Review of literature (See Pilles 1984, 1987, Kelly 1979, Anderson 1985, Traylor et al 1979), summary of effects of fire, suppression and rehabilitation activities on cultural resources based on personal experiences

Swan, Larry and Charla Meacham Francis

1989 Fire and Archaeology, Abstract and Poster Session. Proceedings, Symposium on Fire and Watershed Management, 10/26-28/89, Sacramento. U.S.F.S. General Technical Report PSW-109, pp. 156.

- Summary of suppression history and methods (fuel loads, fuel intensity, suppression techniques) and rehabilitation phases (timber salvage logging, watershed rehabilitation, erosion management, and improved visibility and access) which impact archaeological resources in California National Forests.

Switzer, Ronald R.

1978 Fire Training Course: Archaeological site identification and avoidance procedures on project fires. On file, Superintendent's Files, Mesa Verde National Park, 8/2/78, pp. 1-5.

- Course objectives included: education about cultural resource protection and historic preservation, recognition of cultural resources, responsibilities of fire management teams to cultural resources, and practical field experiences in resource protection.

1974 The Effects of forest fire on archaeological sites in Mesa Verde National Park, Colorado. The Artifact 12:1-8.

- Summary of observances of fire effects from the 2,680 acre Moccasin Mesa Fire (1972) which was ignited by lightning and burned through Pinyon-juniper woodlands. Effects noted included the following: 1) reddening, cracking, spalling and disintegration of sandstone outcrops and building stone, 2) refired sherds that exhibited spalling and separation of the original coils, 3) sherd pigment and temper discoloration, 4) ash accumulation on soil surfaces four inches deep, 5) oxidation of soil surfaces, and 6) bulldozer line construction during suppression (totalling 35 acres of impact for the Park as a whole). Benefits derived from the fire is the reduction of brush that obscured access and visibility of archaeological sites.

- 1972 The effects of forest fire on archaeological sites in Mesa Verde National Park, Colorado. Report on file, Mesa Verde National Park.

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Tamez, Sonia

- 1988 CRM and the summer of fire. Paper, presented at the Society for California Archaeology Meetings, 3/23-25/88, Redding.

- Overview of fires and fire effects on cultural resources focusing on California and U.S.F.S., Region 5 during the fire season in 1987. Includes summary of Regional Planning and Historic Preservation suggestions. (See Forest Archaeologist's reports by James, Johnson, McIntyre, Brett, Boynton, Rock, Gates, Keter) Traylor, Diane
- n.d. Draft Statement of implications of the La Mesa Fire study for National Park Service Prescribed Burn Programs. Report on file, Bandelier National Monument, Los Alamos, pp. 1-2.

- Statement for fire management on the impacts of fire and fire suppression on cultural resources for service-wide distribution in relation to prescribed burn programs. The following recommendations reviewed: 1) literature searches, sample surveys, and other assessments are needed to determine if sites are within proposed burn areas, 2) the institution of a Section 106 Compliance must be completed for wooden features or structures that are on the National Register, 3) four sources of damage during fires are fire intensity, duration of heat, heat penetration of the soil, and the use of suppression equipment, 4) direct fire damage to artifacts is mainly confined to those located on the soil surface, 5) a controlled testing program is needed to determine how the characteristics mentioned in 3) above can be regulated to minimize impact to cultural resources.

- 1978 Effects of the La Mesa Fire on Bandelier's cultural resources. Draft report on file, Bandelier National Monument, Los Alamos, pp. 1-15.

- Summary of the work accomplished by archaeological teams called out to work with fire fighting crews during the La Mesa Fire (1977). Impacts of the fire in which archaeologists were not involved included fire line widening, rehabilitation and reseeded projects, all of which impacted cultural resources. Sample survey consisted of recording 100 sites in areas disturbed by machinery or fire camp placement. Forty-four sites were directly impacted by fire suppression techniques and by vandalism of fire fighters. Indirect

impacts included the piling of brush on sites so that they were obscured during the survey. Four prehistoric sites were tested and surface and subsurface collections were used to examine fire effects on specific artifact and material classes.

-Summary of the fire effects included the following: 1) fire intensity discoloring exposed stone, causing spalling, fire cracking, and increased friability of the tuff, 2) carbonization and oxidization of ceramic sherds, spalling of the pigments, 3) carbon patinas and shiny lusters on the basalt and obsidian, 4) thermoluminescence dates that were 10-24% lower than expected for excavated basalt and ceramic sherds (See Rowlett and Johannessen) 5) alteration of hydration rinds and alteration on obsidian (See Trembour), 6) pollen was destroyed at temperatures of 300 degrees C or more, and surface samples need to be taken directly after the fire to avoid wind contamination (See Scott).

-Management recommendations from the experiences on the fire included: 1) keeping communication lines open, 2) contingency plans need to address priorities of cultural resource protection and policy, 3) resource base maps should be available to fire management and cultural resource teams, 4) archaeologists need to be present during fire, fire suppression and rehabilitation phases that affect cultural resources, 5) bulldozer line construction, followed by placement of hand lines, helispots, fire camps, and mop-up areas are to be monitored in that order of impact, 6) archaeologists need to be red-carded, 7) a cadre list should be developed if no qualified archaeologists are available for fire duty, 8) an archaeological liaison officer should co-ordinate all line archaeologist's activities and to make sure all lines are covered, 9) line archaeologists should be briefed daily and they should be equipped with standard safety equipment, 10) special flagging should be used to cue teams to avoid cultural resources, 11) archaeologists should photograph fire suppression activities to record damage and avoidance of sites and maintain a fire record.

-Recommendations for future prescribed burning programs (See Traylor n.d.)

1984 Effects of the La Mesa Fire on Bandelier's cultural resources. IN, Teralene S. Foxx, compiler, La Mesa Fire Symposium Proceedings, LA-9236-NERP, pp. 97-102.

-See Traylor et al 1979a and b.

Traylor, Diane, L. Hubbell, N. Wood, and B. Feidler

1979a Preliminary Report, La Mesa Fire and Cultural Resources. Report, on file, Bandelier National Monument, Los Alamos, see pp. 110-150 in 1979b.

- Results of sample surveys in areas of direct impact by fire suppression during the 15,000 acre La Mesa Fire (1977) and the excavation of three sites within the burned area. 100 new sites were recorded, and a wide range of samples were taken to monitor the effects of the fire, including tests on datable materials such as obsidian (See Trembour), thermoluminescent (See Rowlett and Johannessen), Carbon 14 (See Stehli), and archaeomagnetic samples (See DuBois), as well as soil (See Hendrick), pollen (See Scott), floral (See Ford), faunal (See Harris and Porter) and tree ring specimens (See Robinson).

-The impacts of fire suppression and rehabilitation included three permanent detrimental effects: 1) destruction of architecture with resulting loss of internal information, 2) displacement of surface and subsurface artifacts, 3) destruction of artifacts.

-Suppression damage included shallow hand line construction (24 sites impacted), bulldozer line construction (complete destruction of eight sites and severe damage to seven others), artifact collection by fire fighters (the most common impact noted, particularly at drop points and lunch spots), and mop up activities (where chopping roots damaged three sites). The construction of helispots, back country drop spots, piled brush areas, and rehabilitation (repacking lines with soil, reseeding, leveling, and burning slash) also damaged cultural resources.

-For recommendations, see Traylor 1978.

1979b Final Report (Draft) The La Mesa Fire Study:
Investigation of fire and fire suppression impact on cultural resources in Bandelier National Monument. Report, on file, Southwest Cultural Resources Center, National Park Service, Santa Fe, pp. 1-161, and Appendices A-I. For Appendices see individual authors cited in 1979a.

- Review of the methodology and results of intensive foot survey conducted on all hand and bulldozer lines in paired fashion (burned and unburned sides). A random sampling technique on burned and unburned sites included surface collection of artifacts in areas of differing fire intensity. Poor site descriptions and map locations hampered relocation of all but three sites. 41 prehistoric multi-room sites, three lithic scatters several historic sites dating to the 1930's, and 15 isolated occurrences were noted on these lines. Selection of four prehistoric sites for excavation was based on accessibility, size, severity of the burn, and likelihood of obtaining samples for monitoring the effects of the burn. Three field houses with accompanying trash middens were completely excavated, and a fourth habitation site was tested for floor surfaces with burned hearth features. For recommendations see Traylor et al 1979a.

1983 The La Mesa Fire: Impact on cultural resources at Bandelier NM. NPS CRM Bulletin 6(4):5-7.

- Summary of the La Mesa Fire (1977), the effects of same on cultural resources, particularly the impacts of fire and fire suppression activities (See Traylor et al 1979) and recommendations for future situations (See Traylor 1978).

Tremaine, Kim

nd Work in progress: Bibliography A: Obsidian Studies in Archaeology and Bibliography B: Obsidian Hydration-Physical Chemistry. In possession of author, Anthropological Studies Center, Sonoma State University, Rohnert Park, pp. 1-64, pp. 1-16, respectively.

- Citations include studies of the application of obsidian hydration as a dating technique in a variety of cultural contexts (Bibliography A) and studies of the effects of heat, pressure, and moisture on obsidian and other glasses (Bibliography B).

1989 Obsidian as time keeper: An Investigation in absolute and relative dating. M.A. Thesis, Department of Anthropology, Sonoma State University, Rohnert Park, pp. 1-120.

- A review of the studies of glass surface reactions indicates many factors working together have been shown to effect both the mechanisms and rates of the reactions including the pH of the solution composition, glass surface area to solution volume, relative humidity, and temperature in experiments. Accelerated hydration experiments were used to test replication of these results. Variability in hydration rates was mainly due to non-standardized flake sizes and differences in solution composition; the applicability of condition specific rate constants to archaeological field conditions was called into question based upon these closed system, high temperature experiments.

Trembour, Fred N.

1979 Appendix F: A Hydration study of obsidian artifacts, burnt vs. unburnt by the La Mesa Forest Fire, IN The La Mesa Fire Study: Investigation of fire and fire suppression on cultural resources in Bandelier National Monument, Traylor et al, editors. Southwest Cultural Resources Center, National Park Service, Santa Fe, pp. 173-177.

- Experimental heating of hydrated South American obsidian at graduated temperatures of 170, 220, and 350 degrees C produced more tinting of the hydration rind from grey to violet in plain light,

reduction in rind brilliance in polarized light, increases and broadening of the interface line and travel of the line to deeper positions to a position 20% beyond original readings; obliteration of the rind occurred at 430 degrees C, first appearances of thermal crazing occurred at 540 degrees C, and at 760 degrees C melting and vasiculation of the samples occurred. Temperatures of these changes varied with the obsidian source samples. Surface obsidian artifacts (110) examined from the fire indicated 65% had obliterated hydration rinds, subsurface artifacts from mitigated sites exhibited 14 and 5% obliteration of the rinds, and sites not burned but which had surface samples collected(138) had only 30% obliterated rinds.

- Post-fire effects of Dutton Point wildfire (1976) on eight multi-room masonry structures and associated artifacts assessed. Little spalling and breakage of masonry and lithics was noted. Macroscopic examinations of 80 sherds from affected sites indicated fire temperatures below 700 degrees (no oxidation of carbon paints occurred). Smoke blackening was evident and variable among these same sherds. Paired laboratory washes of fire-damaged and undamaged sherds proved inconsequential to blackened conditions. Prescribed burn experimental study with buried paint sensitive plates proposed for pueblo site, but not conducted.

Tylecote, R.F.

1962 Metallurgy in Archaeology. Arnold Press. London.

-NAC

Welch, Pat and Tirzo Gonzales

1982 Research design, prescribed burn impact, evaluation upon cultural resources, LMDA and Thing Mountain Chaparral Management Projects. Report, on file, Cleveland National Forest, Escondido, pp. 1-9.

- Research design consisting of experimental plots (4) containing ten artifact material classes were subjected to prescribed burn conditions within chaparral habitats stratified by fuel loads and vegetation composition. Would temperatures achieved by prescribed burns impact prehistoric or historic artifacts or ecofacts? was research question posed by project. Evaluation of effects included assessment of changing erosion patterns, macroscopic evaluation of burn effects on artifact classes, obsidian hydration measurement alterations, and possibly microscopic and thermoluminescence work.

Wessel, Richard L.

1985 Assessment of the impacts to three archaeological sites in the Saugus Ranger District, Angeles National Forest. Report and Archaeological Reconnaissance Reports (ARR) on file, Supervisor's Office, Cultural Resource Section, Arcadia, pp. 1-31.

- Three sites (rock lined earth ovens, petroglyphs and associated midden, and rock lined pits) affected by the unauthorized construction of a fire line on the east side of the Annan Ranch prescribed burn area (1984) evaluated according to their potential significance, and the degree of the impacts caused by fire line construction. The integrity of the deposits and associated significance of the remains was found to be acceptable. 15 cubic meters of soil was disturbed from the earth oven site. Other loci and features were recorded at both the earth oven and petroglyph sites. Subsequent vegetation rehabilitation has mitigated the visual impacts to all three sites.

Wettstaed, James R.

nd Forest fires and archaeological sites: observations from the 1989 fire season in southeastern Montana. Article to be published, pp. 1-21.

- see Wettstaed 1988,1989.

1989 The Schiller Fire archaeology project: A Final Summary. Paper presented at the Plains Conference, 10/89, pp. 1-17.

- The results of post-fire (timber salvage/rehab) archaeological surveys after the 16,000 acre Schiller fire(1988). Three historic and 110 prehistoric sites were recorded, only 8% which could be relatively assigned chronological affiliations. One quarter of the sites were found on steep slopes over 25%, with most sites occurring on ridges. Unusually high site densities (one site/54 acres) were noted for the burn area, and increased visibility due to the burn, or the possibility of a local prehistoric trail were noted as possible explanations of such densities. Survey results support hypothesis that prehistoric subsistence in the area was a broad spectrum collecting strategy.

1988 Forest fires and archaeology on the Ashland District, Custer National Forest, Montana. Paper, presented at the Annual Plains Conference, 11/4/88, Wichita, pp. 1-18.

- Summary of the mitigation efforts during fire suppression of

large wildfires(1988) on the Ashland District, Custer National Forest. Assessment of the damage to previously known sites and newly recorded sites from the 16,000 acre Schiller fire. Suggestions for future mitigation and planning included structural protection of protohistoric and historic wooden buildings and features, pre-impact surveys of bulldozer lines, hand lines, and mop-up activities, and incorporation of archaeologists in overhead team duties such as planning.

Wettstaed, James R. and Halcyon LaPoint

1990 Short and long term effects on site preservation due to wildfires. Paper, presented at the Society for American Archaeology Meetings, 4/18-21/90, Las Vegas, pp. 1-26.

- Post-fire effects of wildfires (1988) on site formation processes and prehistoric sites in Custer National Forest are classified by short (fire damage, suppression damage, and erosion) and long term affects (blow downs, regrowth patterns, erosion by wind and water). The lack of sites dating to the Early Archaic Period and Altithermal Climatic Episode is explained by increased wildfire frequency, subsequent decreased forage availability for large mammals, and human depopulation of the Plains, or the physical destruction of site traces through increased fire intervals.

Whyte, Thomas R.

1990 An Experimental Study of Burned Fish Bones from Archaeological sites. Paper, presented at the Society for American Archaeology Meetings, 4/18-23/90, Las Vegas, pp. 1-10.

- Reconstruction of cooking patterns and subsequent disposal of animal remains in refuse pits from the Bessemer Site, western Virginia (A.D. 1220-1325) indicated differential burning of the pectoral fin spines from several families of fish. Experimental roasting of whole fish and the deposition of bones of boiled fish in open fires indicated that certain species of fish were roasted in late prehistoric period. Bone burning resulted from a combination of meat roasting and garbage burning. Fish and other small animals such as snake were roasted, consumed immediately, and the bones tossed into fires or gathered with other refuse and burned. A difference in disposal customs for two components of the site is suggested based on differential counts of burned faunal elements.

1984 Lithic artifact burning and archaeological deposit formation on three early archaic sites in east Tennessee. Master's Thesis, Department of Anthropology, University of Tennessee, Knoxville, pp. 1-75.

- Assessment of deposit integrity at three Early Archaic sites on the Cumberland Plateau, eastern Tennessee. Examination of site formation and disturbance processes, including past forest fires, trampling, and artifact breakage due to cryoturbation. Experimental studies on how these natural and cultural processes caused post-depositional artifact burning and breaking; application of information from cross-mended, burned, and subsequently broken chert artifacts in order to evaluate the extent of post-depositional deformation that occurred on sites. Results of the latter study indicate that the deposits have been homogenized to such a degree that most of the original patterning attributable to human behavior is distorted beyond recognition.

1983 Advantages and disadvantages of burned lithic artifacts in the study of archaeological sites. Paper, presented at the Southeastern Archaeological Conference, 11/3-5/83, Columbia, pp. 1-14.

- Review of literature on the incidental effects of natural and cultural fires on flaked stone artifacts and the potential of lithic artifact burning for studying archaeological site integrity and structure. Results of two experiments (specimens of Knox black chert at buried at differential distances and depths from a hearth in two types of soils, and a trampling experiment) in which lithic artifacts may have been incidentally burned and fractured. The relative distribution of burned lithics could be used to determine features and structures in sites, and to distinguish between natural and cultural fires and their associated patterning.

Wilbur, Ray

1988 The Burning question: Report on the effect of burn management projects on obsidian hydration rims. Paper, presented at the Society for California Archaeology Annual Meetings, 3/23-25/88, Redding, pp. 1-13, with Appendices of hydration readings.

- The effects of fire on hydration rims of 50 obsidian flakes from a prehistoric site compared before and after a controlled burn at Annadel State Park, California. 11 test plots used to place these specimens on ground surface, 5, 10, and 15 cm below ground level. Results were equivocal with rim micron differences being relatively small. The greatest percentage of flakes showing obliteration of the hydration rim were those buried at the 5 cm level rather than the surface. Experiments with heat sensitive sticks in the plots indicated that changes in the thickness of the rim may occur below temperatures of 540 degrees C. Further experiments recommended to enlarge the data base and enhance the mitigation of the effects of this activity during Park wide control burn programs.

Yellowstone National Park

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