

DOCUMENTING ROCK ART
IN
DINOSAUR NATIONAL MONUMENT

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ABSTRACT

In 1988 and 1989 comprehensive documentation of twenty-two rock art sites in Dinosaur National Monument was undertaken to establish baseline information for the long-term monitoring of these sites. Procedures used included still photography, scale drawings, video photography, photogrammetry, and standardized written descriptions.

Documentation for each site was compiled in a notebook format for use by park personnel during monitoring phases. Analyses of the rock art and the kinds of situations in which they are placed suggest that the images were used to influence the behavior of aboriginal visitors to the site.

ACKNOWLEDGEMENTS

The successful completion of this project relied upon the skills of many people. Alan Smith took all of the hundreds of photographs needed for this project, used some of his own equipment not affordable with the National Park Service funding available, hand processed the film, and drafted the photographic methods section in this report. The artistic talent of Mary Johnson was invaluable in the construction of drawings used in this report as well as those used by the park staff for their long-term monitoring of these sites. We found it necessary that both scale drawing and photography be used in the documentation of the rock art sites. Anne Wolley Vawser compiled data for the site forms, conducted the mapping of all sites, organized the format of documentation for the park's monitoring program, and drafted and edited numerous portions of this report. Without her involvement this project would not have been completed in a timely manner. Photogrammetric

documentation was conducted by Dave DeVries of Hammon, Jensen, Wallen and Associates, Inc. From Dave we learned a great deal about the potential use of this process for documenting rock art.

Dave Whitman (Chief of Interpretation) and Jim Truesdale (Archeologist) of the park staff were instrumental in organizing the site priorities and logistics. Their knowledge of the park's archeological resources and the management responsibilities relative to these sites helped us immensely in putting this project into perspective. The voluntary assistance of Katie Askeris during our field work in 1989 is greatly appreciated. We also want to thank Don Toney of the U.S. Fish and Wildlife Service and staff of the Jones Hole Fish Hatchery for their assistance and accommodations while working in the Jones Hole area of the park.

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INTRODUCTION

Aboriginal use of what is now Dinosaur National Monument has been of interest to explorers, local ranchers, and archeologists for over a century, while professional archeological investigations in this area have been recorded since the 1930s. The remains of stone structures and rockshelters occupied by prehistoric peoples are well known and documented in the Monument; however, one of the more visible aspects of the archeological record here is the rock art (i.e., petroglyphs and pictographs). This report details the 1988-1989 documentation of some of the sites in the Monument that have rock art as a component (Utah Project No. U88-NA-185N).

The content of rock art panels and their placement on the Colorado Plateau is well documented, but not well understood. As a part of the archeological record, however, the study of rock art enables us to look at a dimension of the social and economic life of aboriginal peoples. The art can be used with other lines of evidence to better understand how their cultural systems operated.

Like any archeological remains (e.g., stone tools, ceramics, and structures), rock art requires detailed documentation of observations. For obvious reasons, given the nature of rock art sites, this work must be conducted, for the most part, in the field. This report, in addition to describing some of the rock art in the monument, describes those methods of documentation that best provide the various kinds of information needed for rock art site management and preservation.

The initial intent of this project was to establish a set of baseline information about the current status of specific rock art sites in the monument. This information was to be used in a systematic program to monitor impacts and rates of deterioration to rock art at these sites. Therefore, site-specific documentation was provided to the Monument specifically for this purpose. All documentary materials, including site history, condition, and status, were placed in a separate notebook for each site. Each notebook contains (1) site forms and any other pertinent notes; (2) a Rocky Mountain Region Archeological Site Status Evaluation (NPS) form; (3) a determination of eligibility or National Register status documentation form; (4) black-and-white prints and color slides of the site, its topographic context, and the rock art, along with a photographic catalogue; (5) photogrammetrically produced prints and plotted maps for some sites; (6) camera-ready reproductions of scale drawings and sketches with clear mylar overlays (overlays were provided for documenting impacts or newly discovered elements during on-site field monitoring); (7) site maps; and (8) a video tape in VHS format with a catalogue of images and views. A field monitoring packet and associated forms have been added to this notebook by park managers (see Appendix A).

The sites and areas of the Monument in which documentary work was conducted were chosen by the Monument's Resource Management personnel prior to fieldwork in 1988 and 1989 (Figure 1). There are seventy-five known rock art sites in the Monument.

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Eight archeological sites were visited between September 12 and 21, 1988, in various parts of the Monument. The following year (September 8-22) fourteen sites were recorded in the Jones Hole area. Each of these sites is briefly described in this report.

The first section of this report briefly describes the environment, the culture history of the Monument and its vicinity, and the history of archeological work conducted within the Monument. A full description of the documentary methods and procedures used, alternatives, and methodological recommendations make up the second portion of this study. It is intended that this discussion be

used not only as a reference as to how this project was conducted, but also as a reference for those interested in implementing rock art recording programs.¹

A description of each site documented is provided and includes reference to earlier records of the rock art and, where applicable, other archeological remains. Any changes in site condition are also assessed in the descriptive section to demonstrate the need for ongoing documentation of impacts to these sites. In the final portion of the report is a discussion of the rock art in the Monument in light of what is known about the prehistory of the area and rock art on the Colorado Plateau.

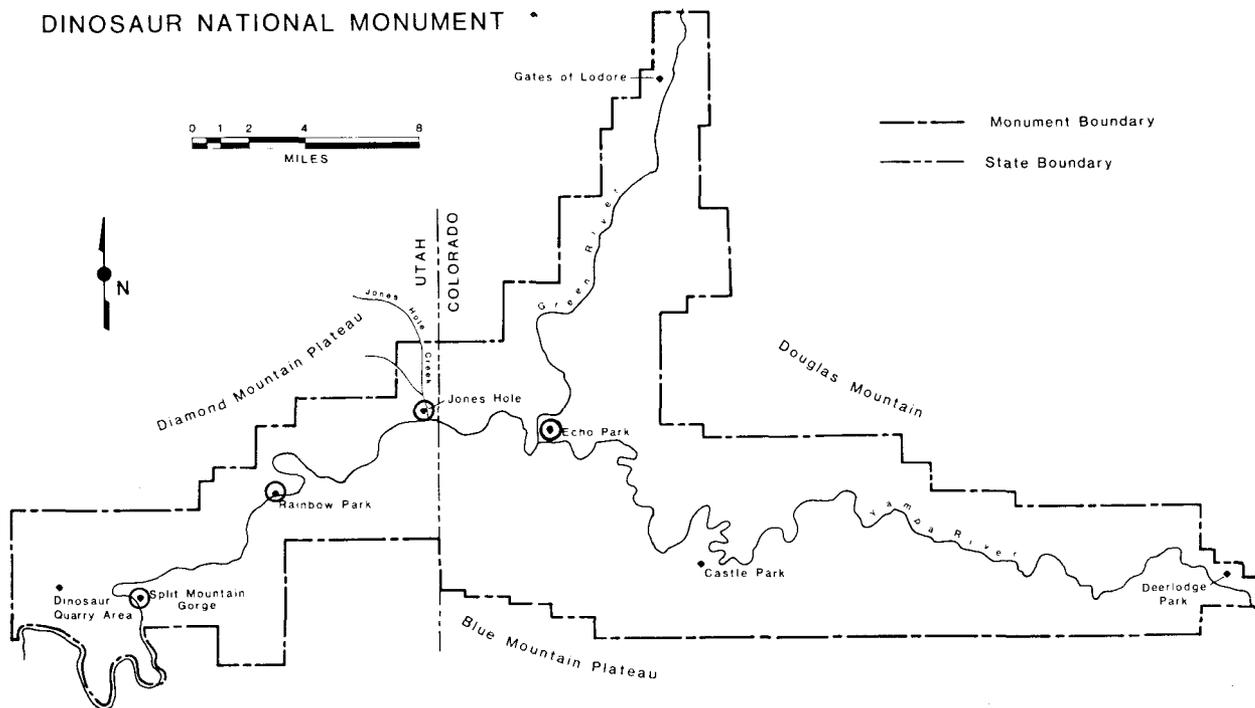


Figure 1. Dinosaur National Monument. Circled locations show general areas of site documentation.

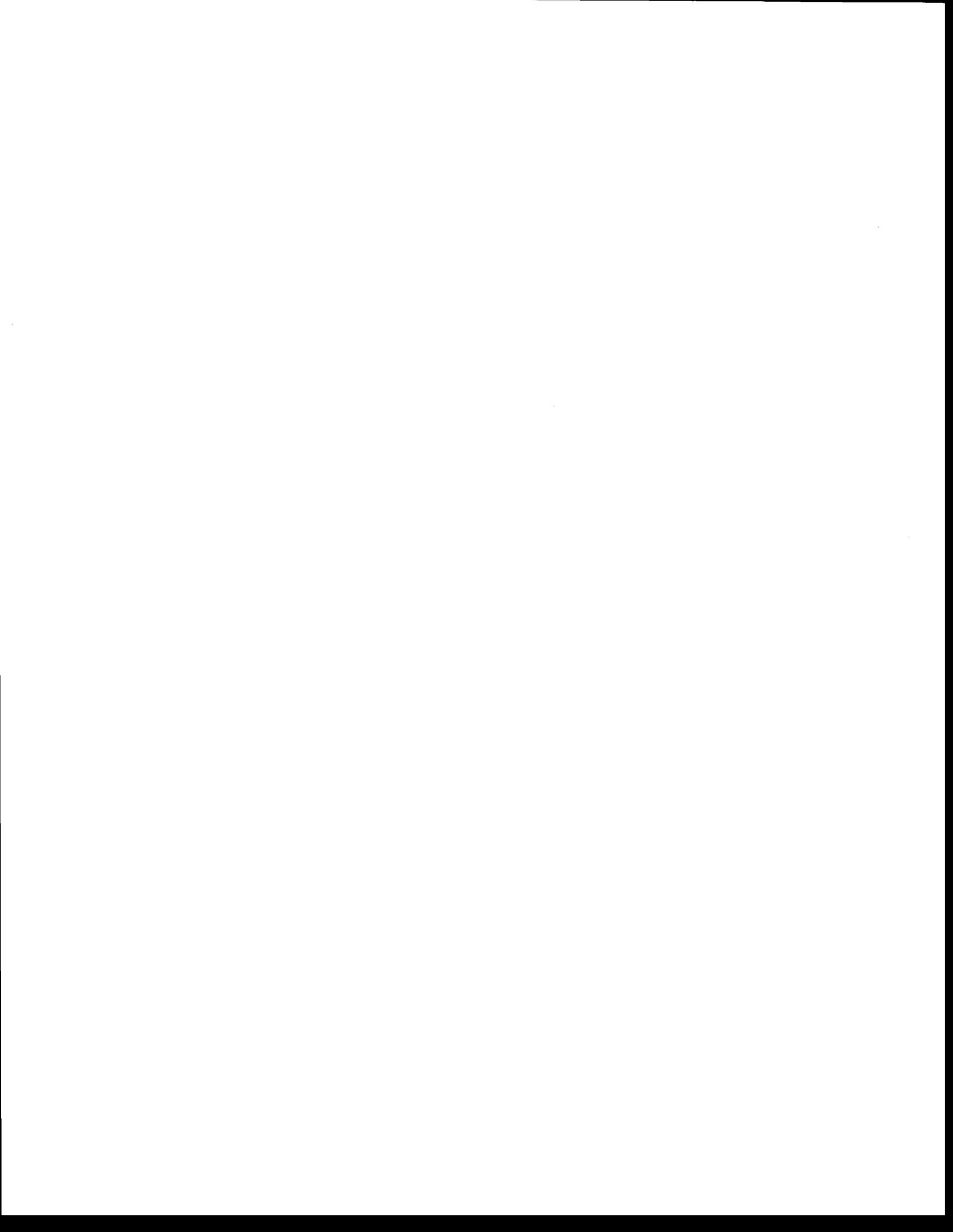
ENVIRONMENTAL BACKGROUND

Dinosaur National Monument consists of 211,141 acres surrounding the confluence of the Green and Yampa Rivers at the easternmost extension of the Uinta Mountains in northwest Colorado and northeast Utah (see Figure 1). Elevations range from 4,750 (1448 m) to 9,006 ft. (2745 m) at Zenobia Peak. Physiography of the Monument ranges from rugged mountainous areas to semiarid bench and plateau lands above the river canyons. This plateau and canyon country exhibits a geologic timetable from the Tertiary Period back to the Precambrian Period, although not all geological periods are represented between these extremes.

The Monument is characterized by a semiarid climate with dry, hot summers and dry, cold winters. Elevations below 6,000 ft. (1829 m) receive approximately 7-9 inches (18-23 cm) of annual rainfall. Higher elevations (6,000-9,000 ft., 1829-2743 m) generally receive between 11-14 inches (28-35.5 cm). Daily maximum and minimum temperatures

during the summer range between 45 to 100 degrees F. Temperatures during the winter months occasionally fall below minus 10 degrees F at night.

Vegetation in the lower elevations and plateaus consists primarily of grasses, sagebrush, pinyon, and juniper. Mountainsides and steep protected slopes exhibit an abundance of Ponderosa pine, Douglas fir, and mountain mahogany. Ungulates common to the area include mule deer in large numbers, bighorn sheep, which were probably more common until the early 1930s, antelope, and a few small bands of elk. Native mammalian predators include coyote, bobcat, and fox. Mountain lion are also present, but are far less common now than in the past. Numerous species of small mammals and birds inhabit the Monument. Agricultural activities in the area and over one hundred years of livestock grazing have altered the distribution and abundance of many plant species.



ARCHEOLOGICAL OVERVIEW AND CULTURAL HISTORY

Dinosaur National Monument lies within the Uinta Basin Section of the northern Colorado Plateau. Surrounding culture areas include the High Plains Culture area to the north and east, and the Great Basin Culture area to the west and south (Jennings 1974). The following sections constitute a brief chronological overview of archeological remains within the Monument and surrounding area. Other overviews of the area have been compiled by Truesdale (1989), La Point (1987), and Grady (1984).

PALEO-INDIAN PERIOD

Little is known about human occupation in the area of the Monument during the Paleo-Indian period. The Clovis (Llano) Complex (10,000 to 9000 B.C.) is characterized by fluted lanceolate projectile points and specialized hunting of mammoth. No sites dating to the Clovis period have been excavated in the area of the Monument; however, Hall (1982:95) reports that points characteristic of this period have been found in the Skull Creek drainage south of the Monument. La Point (1987) also reports a Clovis point recorded by Gardner (1981) on Cross Mountain, east of the Monument. Clovis points have also been found in surface contexts in the area of Rangely (Conner and Langdon 1989).

The Folsom Complex (9000-8500 B.C.) is characterized by somewhat smaller and more finely made fluted projectile points and the hunting of extinct longhorned bison (*Bi-*

son antiquus). Although there are several well-documented Folsom sites in Colorado, few are found in northwest Colorado. Isolated Folsom point fragments have, however, been discovered along the Green River in southwestern Wyoming (Frison 1978), near Roosevelt, Utah (Berry 1975), and along the White River Drainage in Rio Blanco County, Colorado (Gordon et al. 1981). Folsom points were also recovered from two multicomponent sites in the Little Snake Resource Area, which includes Moffat and Routt Counties (La Point 1987). No Clovis or Folsom materials have been recorded within the Monument to date.

The Plano Period Complex (8500-5000 B.C.) is characterized by a shift from the hunting of large Pleistocene fauna toward the hunting of more modern species and a wider range of smaller animals. A number of named point types is characteristic of the period, including Agate Basin, Hell Gap, Alberta, and Cody. Near the termination of the Plano Complex, a distinct morphological change occurs in Paleo-Indian projectile points that is characterized by parallel oblique pressure flaking and a diminution of the shoulder and stem. These point types include Lusk, Pryor Stemmed, and Frederic Angostura points (Frison 1978).

There is greater evidence for Plano occupation in the area of the Monument than for the other Paleo-Indian periods. Dated components include deposits at the Pine Springs Site along the Green River in southern Wyoming, where Agate Basin and other

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Plano points were associated with radiocarbon dates of $11,830 \pm 410$ B.P. and $9,695 \pm 195$ B.P. (Sharrock 1966:21). Cody Complex materials were also present at the Pine Springs Site. Scottsbluff and Eden points associated with a mass bison kill at the Finley Site near Rock Springs were dated to $9,026 \pm 118$ B.P. and $8,950 \pm 220$ B.P. (Frison 1978).

In addition to these dated deposits, evidence of extensive use of the area during this period is also represented in surface finds. A Hell Gap and a Scottsbluff point were discovered in isolated surface contexts in the Red Wash area just south of the Monument (Larralde and Nickens 1980), and another isolated Hell Gap point was found in the Seep Ridge area to the south (Larralde and Chandler 1981). In addition, an isolated Agate Basin point is reported from the Craig area (Hansen 1978), and an Alberta point was recovered near Vernal, Utah (Hauck et al. 1979:20). Within the Monument itself, Scottsbluff points (Cody Complex) have been recovered from the earliest occupation units at Deluge Shelter (Leach 1970a:205) and from site 5MF132 in Brown's Park (Eddy 1980). Points of this type were also found in the eastern portion of the Monument (Breternitz 1970:160).

ARCHAIC PERIOD

On the Colorado Plateau the Archaic period is also referred to as the Desert Culture or the Desert Archaic Culture. Human activities during this period are often viewed as an adaptive response to the warming trend that occurred near the end of the Pleistocene. This climatic change resulted in the loss of

Pleistocene megafauna and their replacement with modern faunal forms. The subsistence economy during this period consisted of a specialized adaptation to the constraints of living in a semiarid environment. The economic specializations practiced in this region were seed-gathering and the use of traps and snares to catch small animals, reptiles, and birds. Communities are believed to have been made up of small kin groups practicing a semisedentary lifestyle (Jennings 1974).

Schroedl (1976) has attempted to identify distinct phases of the Archaic on the Colorado Plateau. He identifies four phases dating from around 6300 B.C. to A.D. 500. The Black Knoll Phase (6300 to 4200 B.C.) is the earliest phase identified and is represented at Hell's Midden (5MF16) and Deluge Shelter (42UN178) in the Monument. Material culture associated with this phase includes Pinto and Elko points as well as Northern Side-notched points. Leach (1970a:210) reports points similar to Pinto Basin or stemmed, indented types from Level 14 at Deluge Shelter.

Schroedl (1976) dates the Castle Valley Phase to between 4200 and 2500 B.C. Between 4200 and 3000 B.C. there is either a clear decrease in population size and/or intensity of occupation. Between 3000 and 2500 B.C., the population increased and then declined. Projectile points associated with this phase include such named side-notched points as Hawken, Sudden, and Rocker Base.

The Green River Phase (2500-1300 B.C.) follows this population decline and is characterized by Gypsum points, which appear around 2500 B.C. and become the domi-

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nant type by 1800 B.C. (Schroedl 1976). The San Rafael Side-notched point type also appears during this period. Leach (1970a) reports several stemmed corner-notched points comparable to Duncan points from Level 12 at Deluge Shelter. Associated bone in the same level dated to 1680 B.C. and 1470 B.C., using two different methods. Duncan and other McKean Complex materials date to around 2500 B.C. to 1500 B.C. in the Northwest Plains. Duncan and Hanna points are also reported by Jennings and Wade (1970) from Lowel Springs in the eastern Monument, and Truesdale (1989) reports a radiocarbon date of 3,500 B.P. for site 5MF2637 in Echo Park.

The Dirty Devil Phase dates from 1300 B.C. to A.D. 500. Elko series points found in Level 11 at Deluge Shelter (Leach 1970a) are placed in this phase. Charcoal from a hearth in the same level, however, dated to 1890 ± 210 B.C. Elko-eared points were also recovered from undated Levels 10 and 9 at the site. Elko Corner-notched points were recovered along with several other point types from Level 8, where an associated rock-lined hearth contained charcoal dating to 1310 ± 120 B.C. This date coincides with the Dirty Devil Phase. The occurrence of Elko points at Deluge Shelter continues on into undated Levels 7 and 6, with Rose Springs points also appearing in Level 6. The introduction of points associated with the use of bow and arrow (Rose Springs and East Gate points) marks the end of the Dirty Devil Phase in Schroedl's (1976) scenario. Rose Springs points also occurred in Level 5 at Deluge Shelter along with previously occurring Elko points and Uncompahgre Complex points and charcoal from a feature dating to A.D. 325 ± 95 (Leach 1970a:280).

In addition to the deposits at Deluge Shelter, there is extensive evidence of Archaic occupation in and around the area of Dinosaur National Monument. Excavations at the Maxon Ranch Site near the Flaming Gorge Reservoir resulted in the recovery of diagnostic Archaic artifacts dated to 6,480 B.P. (Harrel and McKern 1986). Dated Archaic occupations have also been documented at the Ely Caves in Jones Hole (Sheets 1968), at sites along the Echo Park Road (Truesdale 1989), and at Thorne Cave in Cliff Creek Canyon, just south of the Monument (Day 1964). Various studies of the Douglas Creek area (Wenger 1956; Creasman and Jennings 1977; Creasman 1981) have produced radiocarbon evidence of extensive habitation late in the Desert Archaic period. Surface evidence in the form of diagnostic projectile points has also indicated Archaic occupations in Utah in the Seep Ridge area (Larralde and Chandler 1981), the Red Wash area (Larralde and Nickens 1980), and the Clay Basin to the northwest of the Monument (Lindsay 1982).

FORMATIVE PERIOD

The Formative stage in northwestern Colorado is traditionally marked by the appearance of horticulture and the establishment of a sedentary or semisedentary lifestyle. The cultivation of maize associated with a semisedentary lifestyle, the use of pithouses as well as masonry dwellings, a distinctive rock art style, and ceramic gray wares are characteristics often used to define the "Fremont culture," an archeological construct that is increasingly being viewed as inhibiting the assessment of variability observed in archeological remains assigned to this period (Simms

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1986, 1990; Sharp 1989, 1990). Nevertheless, there remains some utility in discussing the "Fremont complex" as a time in which subsistence activities throughout much of northern and central Utah can be viewed as adaptive processes, conditioned by variable sets of relationships, between very basic environmental differences.

The Fremont, when viewed as a "culture" or "people," has been divided into five regional groupings on the basis of variable "culture traits" (Marwitt 1970, 1986). This regional differentiation in material remains most likely reflects adaptation to variations in the resource structure of each area. Although assumptions about Fremont ethnicity have little support, two of the regional groupings, Uinta and San Rafael, are usually assigned to the Monument area as Fremont "variants" that are differentiated primarily by ceramics and variation in architectural styles. The Uinta Fremont date to between circa A.D. 500 to A.D. 1000 (Lindsay 1986, Marwitt 1986). Architectural characteristics include shallow, saucer-shaped pit dwellings, or surface structures with randomly placed postholes and off-center firebasins, or dwellings with four-post roof supports and clay-rimmed firepits. The San Rafael Fremont are believed to date between circa A.D. 700 and A.D. 1250 and are characterized by Emery Gray pottery, slab-lined pit structures, and both wet-laid and dry-laid masonry (Lindsay 1986, Marwitt 1986).

One of the largest known Fremont sites in the area is Caldwell Village, located just southwest of the Monument. Excavations at this village site revealed over 22 pithouses and other features (Ambler 1966). Other

Fremont sites have been documented in the Seep Ridge (Larralde and Chandler 1981) and Red Wash (Larralde and Nickens 1980) areas of Utah. Many of the archeological sites identified in the Monument have been defined as Fremont on the basis of artifact assemblages, dated buried deposits, or rock art style. Excavated Fremont sites in the Monument include Deluge Shelter (Leach 1970a) and Ely Caves (Sheets 1968) in Jones Hole; Boundary Village (Leach 1966) in the Cub Creek area (this site lies just outside the Monument boundary); Hell's Midden, Mantle Cave and Marigold Cave (Burgh and Scoggin 1948; Burgh 1950; Lister 1951) in Castle Park; and various other sites throughout the Monument (see Breternitz 1970). Gunnerson also identified many Fremont sites in and around the Monument in the Cub Creek area (Gunnerson 1957, 1969), and Truesdale (1989) recently identified several of the sites along the Echo Park Road as dating to the Fremont/Formative period.

LATE PREHISTORIC/ PROTOHISTORIC PERIOD

A post-Formative period in this area is believed to date between A.D. 1200 and A.D. 1300. Simms (1990) suggests a post-Fremont "Late Prehistoric" period after the fourteenth century as more appropriate. This period generally represents a focus on a subsistence pattern based on greater residential mobility, a decrease in horticultural activities, and the exploitation of a greater variety of seasonal resources (cf. Liestman 1985; Simms 1990). Whether climatic change or disruption by Numic speaking peoples, or both, conditioned change in the archeological record remains

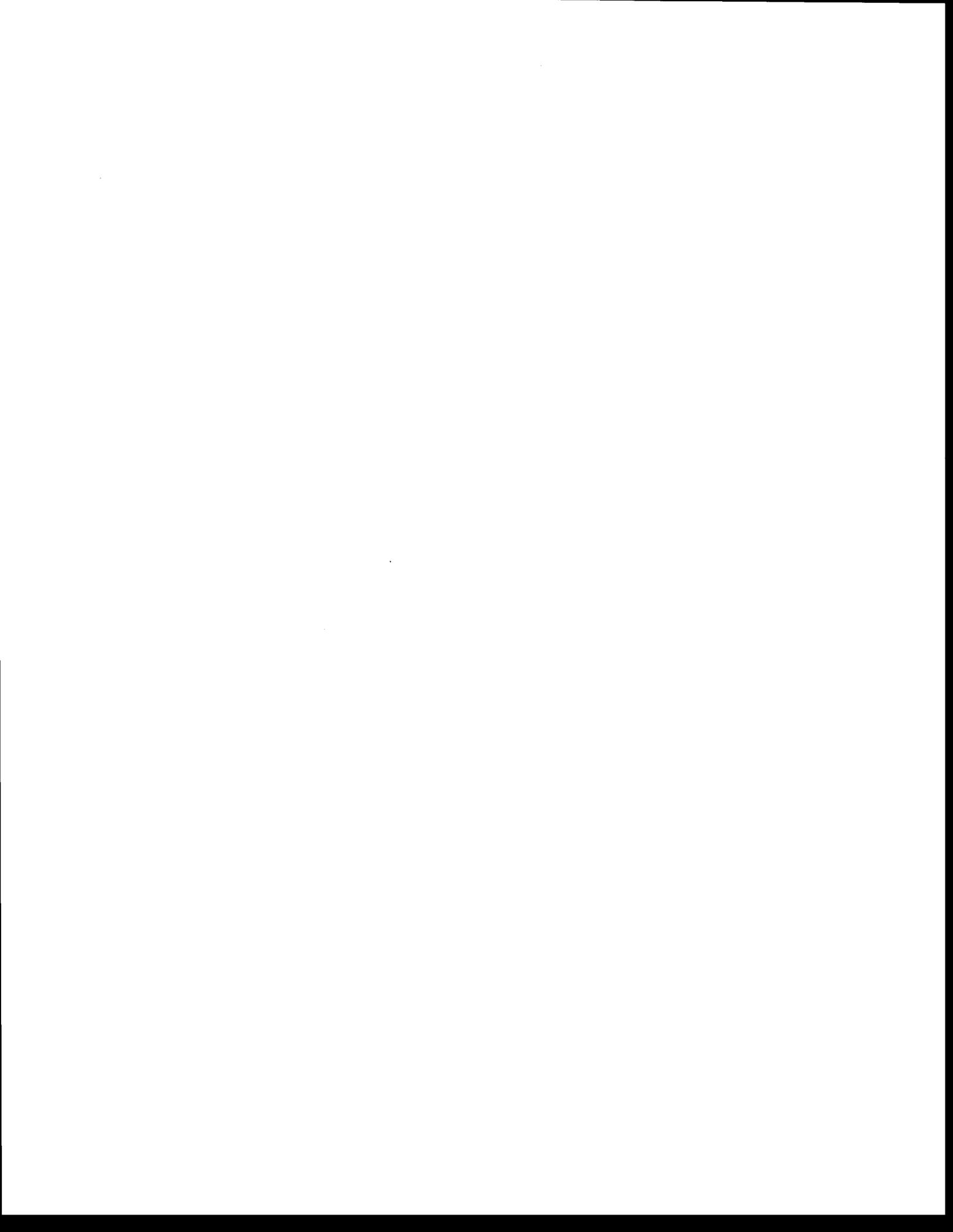
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problematic (see e.g., Lindsay 1986; Simms 1990).

This Late Prehistoric/Protohistoric period marks the appearance of the ancestors of the historic Ute and Shoshonean people. Emigration of populations other than Numic speakers (e.g., "Fremont") from this area can not be ruled out, but neither can the possibility that the Fremont were genetically related to Numic speaking peoples. It is generally believed that these latter groups did not practice horticulture, but hunted bison, deer, and antelope and gathered numerous types of wild plants. The presence of wickiups, trade beads, pottery, and equestrian rock art is considered indicative of Ute or Shoshone occupation in this area.

The number of documented archeological sites indicating Ute or Shoshone occu-

pation of the area surrounding the Monument is rapidly increasing. At least five Ute burial sites have been documented in the area, three of them near Roosevelt (Hauck 1975; Fike and Phillips 1984) and two from eastern Uintah County (Fike and Phillips 1984). A collapsed cedar pole structure believed to date to this period was also found near Roosevelt (Berry 1975). Tusayan sherds associated with a tipi ring and hearth were also recorded in the Red Wash area (Chandler and Nickens 1979). Other late period sites have been documented in the Clay Basin (Lindsay 1982) and Natural Buttes areas (Hauck et al. 1979). A brief Ute-Shoshone occupation was documented within the Monument by Sheets (1968) at the Ely Caves in Jones Hole, and Ute-Shoshone use of the Split Mountain/Red Wash area is indicated by the presence of horses on several rock art panels at site 42UN1244.



HISTORY OF ARCHEOLOGICAL INVESTIGATIONS IN THE MONUMENT

Archeological investigations in Dinosaur National Monument began as early as the 1930s and have involved archeological survey, excavation, and various other documentation activities (Brown 1937; Burgh and Scoggin 1948; Lister 1951). The documentation of rock art sites in the Monument was one of these activities, with the first known report of rock art sites dating to 1939-1940. This section contains a brief outline of the history of archeological research in the Monument, with special emphasis on rock art documentation.

In 1933 F. Martin Brown conducted the first known archeological work in the Monument when he excavated three rockshelters and made collections at two shelters in the Castle Park area in association with the Penrose-Taylor Expedition (Brown 1937). Late in 1939 Charles Scoggin and others conducted an archeological reconnaissance in the same area, and during 1940, Scoggin and Edison Lohr surveyed the Castle Park area and excavated Mantle's Cave (5MF1) and Hell's Midden (5MF16) (Scoggin 1940). Scoggin's report of that winter's work marks the earliest known reference to rock art in the Monument. He notes:

Petroglyph panels on favorable exposures of rock are most abundant at the mouth of Hell Canyon, but isolated examples of geometric and zoomorphic figures, both painted and pecked, may be found at most of the accessible places where

the vertical exposure of the canyon walls lends itself to the execution and protection of primitive art (Scoggin 1940:3).

Even at this early date of recording Scoggin notes that many of the panels have been impacted by the application of chalk and flour, and by gun shot. He also reported that he took photographs, made scale drawings, and took notes about techniques observed at several of the panels (Scoggin 1940:4).

During 1941, Scoggin undertook an extensive archeological reconnaissance of the Monument and vicinity. In his report of the over 70 sites he visited in the Monument, he mentions only one which contained rock art (Scoggin 1941:19). The following year Gordon Baldwin, Scoggin, and Frank Setzler examined numerous sites along the Yampa and Green Rivers that were to be inundated by proposed dam construction. They mention several rock art panels that they recommended be extensively documented, including site 5MF88 in Pool Creek Canyon (Baldwin 1947; Baldwin et al. 1942:4). During the summer of 1947, Robert Stirland documented archeological sites in the Jones Hole area while employed as a Fire Control Aide (Stirland 1947). Stirland recorded 19 sites during the summer, nine of which contained either petroglyphs or pictographs or evidence of eroded pigments (red and yellow). He recorded several of the rock art elements with either photographs or sketches, which he included in his report.

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Between 1947 and 1949 archeological testing took place at three sites. Burgh conducted additional work at Hell's Midden in 1947 (Burgh and Scoggin 1948), and Burgh, Herbert Dick, and others from the University of Colorado worked at the site until 1949 (Lister 1951). Marigold's Cave (5MF9) and the Sand Dune Site (5MF11), located between Red Rock Canyon and Marigold's Cave, were also excavated in 1949 (Dick 1949a; Burgh 1950). During 1949 and 1950, Herbert Dick supervised an archeological survey along the Yampa and Green River canyons (Dick 1949b, 1950). The Pats Hole area was investigated in 1949, and Dick sketched some of the elements from the petroglyph panels at 5MF87, 5MF88, and 5MF157 (Dick 1949a).

James Gunnerson conducted a reconnaissance for the Utah Statewide Archeological Survey (University of Utah) in 1954 and 1955, covering most of the Green River drainage in Utah. He recorded ten sites within the current Monument boundaries, most of which are in the Cub Creek area (Gunnerson 1957). Only one of the sites in the Monument that he recorded contained rock art. All of the sites recorded by Stirland in 1947 were re-examined and photographed by Bruce MacLeod in 1959. MacLeod noted that much of the rock art was eroding or fading and that many of the sites had been pothunted. MacLeod (1959) also identified five more sites in the area of Jones Hole (two of which contained extensive rock art and three of which were lithic scatters).

It was not until 1963 that archeologists from the University of Colorado under the direction of David Breternitz conducted a more extensive survey of the Monument lands.

The area south of the Yampa and Green Rivers and the extreme east and west sections of the Monument were surveyed during the 1963 field season (Breternitz 1964). The survey continued along the Yampa and Green Rivers and other Monument areas in 1964. Between 1963 and 1965 the University of Colorado recorded a total of 413 sites in the Monument and immediate vicinity, and excavated 22 of those sites (Breternitz 1965, 1970)². The first intensive rock art study in the Monument was undertaken in 1970. Burton (1971) completed a study of some of the petroglyphs and pictographs in the Monument and vicinity by grouping types of elements into classes and using statistical analysis to discuss the distribution of various rock art styles in time and space throughout the Monument.

In general, archeological work conducted in the Monument during the 1970s and 1980s was motivated by Monument development, and in many ways contrasted with the more research-oriented work of the decades before. Compliance-related projects completed in the last two decades are listed in Table 1. One of the three noncompliance related projects conducted in the Monument during this period was the discovery and excavation of a rockshelter in the Jones Hole area. Site 42UN1103 was determined to be in danger of destruction by vandalism during archeological reconnaissance by Adrienne Anderson in September of 1981. As a result, archeological salvage excavation was conducted later that month by Gregg Fox (Liestman 1985).

The second project not included in the compliance category involved the completion of a stabilization assessment of Mantle's Cave

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(5MF1) by Alpine Archaeological Consultants (Reed 1988). The site had been excavated during the 1930s and 1940s and appeared to be suffering deterioration from excavation units that were not backfilled, as well as from recent increases in recreational visitation. During investigation of the condition of the site, at least one prehistoric petroglyph was observed, in addition to one

possible prehistoric panel and five historic/recent panels.

The third project involved testing at Sand Canyon Shelter in 1988 for evaluation of the site's National Register significance. Truesdale (1990) found bone, shell, and stone artifacts in association with a hearth dating to $1,410 \pm 80$ B.P. at this site.

Table 1. Chronological listing of compliance-related archeological projects completed between 1970 and the present in Dinosaur National Monument.

Date	Investigator	Location and Work Accomplished
1972	David A. Breternitz	Reconnaissance of Gates of Lodore access road area; four sites recorded (Breternitz 1972).
1974	David A. Breternitz	Reconnaissance of Gates of Lodore access road, alternate "B" area; two sites recorded (Breternitz 1974).
1976	L. Anthony Zalucha	Survey of Dinosaur Quarry locale (Zalucha 1976).
1982	James Mueller	Survey of five campground leach fields; one site recorded (Mueller 1982).
1983	Catherine Smith	Survey of various fence lines and river campground areas; no sites recorded (Smith 1983).
1986	Catherine Smith	Survey of Echo Park flood plain prior to relocation of ranger cabin and road endangered by erosion. No cultural resources were recorded (Smith 1986).
1987	Joe Wieszczyk	Monitoring of trenching during utility line installation near the fee station. No materials were observed (Wieszczyk 1987).
1987	Mined Land Division	National Register assessment prior to backfilling of mine in Castle Park (Strait 1987).
1988	James Truesdale	Survey of fence alignment near the Josie Morris cabin in Cub Creek. Features and foundations were observed (Truesdale 1988).
1988	James Truesdale	Inventory of Echo Park Road. Previously recorded sites were relocated and 26 new sites were recorded (Truesdale 1989).



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Procedures used in documenting rock art sites in the Monument included still photography, field sketches and scale drawings, terrestrial photogrammetry, and video photography. Each of these methods are discussed below. The results of this project permit several suggestions that should be considered for any future rock art recording on the Colorado Plateau. These ideas are incorporated throughout this section of the report. Archival materials resulting from this work are curated at the Midwest Archeological Center.

STILL PHOTOGRAPHY

A comprehensive photographic record is an invaluable component of rock art documentation. However, adequate photographic documentation is often difficult to obtain, due to lighting conditions and/or the nature and condition of the panel. It is often necessary to implement a variety of methods in the field and in the lab to maximize image quality and thereby enhance the visibility of rock art figures in the photographs. Important factors that figure into good documentation include lighting in the field, film types/formats, filters, film and paper development, and types of print paper. The following section outlines the procedures used during 1988 and 1989 to achieve the best possible photo documentation of rock art sites in Dinosaur National Monument.

1988 Equipment and Materials

During 1988 three camera and film formats were used in order to determine

which would be the most appropriate for rock art studies. The formats were 35mm, 6cm x 7cm (2 1/4in x 2 3/4in) and 4in x 5in. The criteria used for evaluation included the quality of the resulting image, the ease of use in the field, and the relative cost. The specific types of equipment used during the 1988 project are listed in Table 2.

Two types of scales were also used, a Folding Evidence Scale and an ABFO NO.2 Photomacrographic Reference Scale. Both are available from the Lightning Powder Company, Inc., 1230 Hayt, S.E., Salem, OR 97302-2121. The Folding Evidence Scale is a three-part, L-shaped, blue and white plastic scale. When unfolded, the scale has one leg which is 30 cm long and one leg which is 60 cm long. Each leg has centimeter markings along one edge and 10-cm-long bars of alternating white and blue along the opposite edge. The reverse side is marked in inches, 11 1/2 inches on the short leg and 23 1/2 inches on the long leg.

The ABFO NO.2 Photomacrographic Reference Scale is a one-piece, bilaterally symmetrical, L-shaped, plastic scale. Each leg has an outside dimension of 105 mm. The inside edge of each leg is 80 mm long and is marked in millimeters. There are alternating, 1-cm-long bars of black and white along the inside edges of each leg for the first 5 cm as measured from the point where the legs meet. The outer edge of each leg has five 1-cm-long blocks printed in 18 percent gray, which correspond to the first 5 cm of the inner edges. There are circles with crosshairs at the end of each leg and at the junction of the two legs.

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Table 2. Equipment used for photographic documentation during the 1988 field season.

Camera (quantity)	Lens (quantity)	Filter	Miscellaneous (quantity)
35 mm Nikon EF (2)	50 mm F1.8 Nikkor (2) 28 mm Soligor F2.8 (1) 80-200 mm Soligor F4.5 zoom (1)	Nikon L37c ultra-violet Tiffen #13 green Tiffen #15 yellow-orange Vivitar #02 orange Tiffen #23A red Tiffen Polarizer	
35mm Pentax K1000 (1)	45 mm F1.8 (1)	Tiffen #25 red	
Pentax 6 x 7 (1)	105 mm F2.4 Takumar (1) Takumar 55 mm (1)	Tiffen #15 yellow-orange Tiffen Polarizer	
Crown Graphic 4 x 5 (1)	135 mm F3.5 Optar (1)	Tiffen #1A Skylight Tiffen #13 green Tiffen Polarizer Wratten Filter A Red	Polaroid 545 film back (1) Graflex Film Pack Adapter No. 1234 (1) Lens Shades (2)

Note: Additional equipment used with all cameras included one Bogen 3033 Tripod with a 3055 ball type head and one cable release.

Film

The type of film used for rock art documentation has a significant bearing on the sharpness and contrast level of the resulting image. The choices of which color and black-and-white film types to use were based on which films would provide the most well-defined image and which had the best archival qualities. The following section outlines some of the characteristics of various films which became the basis for our film choices.

Slow films have better acutance, higher resolution, and more contrast than fast films.

("Acutance is measured edge definition... Resolution refers to the distinctness of separate details" [Vestal 1975:55].) The major factors that affect resolution and acutance are the size of the silver particles in the emulsion, the thickness of the emulsion and film base, and the developer formulation. Slow films have small silver particles and thin emulsions, yielding high resolution and acutance. Fast films have silver particles of varying sizes and thick emulsions which yield lower resolution and acutance. The increased contrast of slow films also adds to the apparent sharpness of the image. The above characteristics apply to both color and black-and-white film. Images

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on color film are made up of dyes which remain after the photosensitive silver compounds have been removed. "Color films currently manufactured fall into two broad classes. In the first class are those having silver bromide emulsions...but with no other components in the film" (Wall and Jordan 1975:388). In this first class, color dyes are introduced during a complex developing process. Kodachrome is the only film of this type which is currently available. "The second class of color films contains all of those in which color couplers are incorporated in the emulsion layers" (Wall and Jordan 1975:388). This class includes almost all other color negative and transparency films, excluding Kodachrome. Of the two classes of color film discussed above, the first, represented by the Kodachromes, exhibits finer grain, better resolution, and far superior archival properties under dark storage conditions.

Keefe and Inch (1984) predict that current Kodachrome films may be expected to last more than 50 years under dark storage conditions, while Ektachrome may be expected to last 11-20 years. The most current information on the archival qualities of color films and papers has been compiled by Wilhelm (1991). Based on Wilhelm's findings, Kodak Kodachrome can be expected to last more than 2 1/2 times as long in dark storage as the most stable of the E-6 films (Ektachrome, Fujichrome, etc.), and 2 2/3 times as long as the most stable of the color-negative films. However, repeated exposure to light severely shortens the life expectancy of any film, particularly Kodachrome. Even the least archival E-6 film tested by Wilhelm was twice as stable as Kodachrome under lighted conditions. Fujichrome films were the

most stable, at 5.2 times the life expectancy of Kodachrome when exposed to light.

Based on the above data, it was determined that Kodachrome would be the best choice for recording the original photographs of rock art and for archival storage. A decision was also made to use Fujichrome copies for any future projection purposes.

Kodak T-Max 100 and T-Max 400 black-and-white films were used for 35mm format photographs (Eastman Kodak 1988a, 1988b). T-Max 400 film was used for all 6cm x 7cm format black-and-white photographs. T-Max films are the result of a refinement in the size and shape of the silver grains in the film emulsion. T-Max 100, which may be considered a medium speed film, has the extremely fine grain and high resolution previously found only in slow films. T-Max 400, which formerly would have been considered a high speed film (films have recently been released with recommended film speeds of 1,000 to 3,200) has the fine grain and high resolution of a typical medium speed film. Kodak Tri-X film packs were used to obtain 4in x 5in black-and-white negatives. Tri-X is the only film available from Kodak in film packs. Film packs were chosen rather than sheet film holders because of their greater convenience for use in the field. A film pack holds 16 exposures in a container about the same size as a single sheet film holder. The use of film packs also eliminates the need to load film holders, thus reducing the problems of abrasion and of dust or contaminants reaching the film. The advantages of ease of use, less bulk, and protection from contamination were felt to outweigh any improvement in grain and resolution resulting from the use of

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T-Max 400 sheet film. T-Max 100 film was not chosen for large-format use because of the anticipated use of a deep red filter, which would have required excessively long exposures and/or wide apertures. Long exposure times can lead to problems with camera movement, and wide apertures cause a reduction in the depth-of-field.

Infra-red sensitive black-and-white film in 35mm and 4in x 5in formats was also employed. Infra-red sensitive films have been found useful in revealing details invisible to the eye, such as writing on charred documents. It was felt that there might be portions of rock art panels, particularly pictograph panels, which might be more clearly revealed by infra-red radiation.

Polaroid Type 52 instant print black-and-white film was used to check exposure and composition in 4in x 5in format. The prints were also useful for showing the artist what to expect from the final prints made in the lab. This allowed the artist to concentrate on panel elements that probably would not reproduce well photographically and needed to be recorded in the field.

Kodachrome 64 transparency film was used for all 35mm color photographs because of its fine grain, high resolution, and archival properties. Transparency film was chosen instead of negative film because of its higher contrast, superior archival properties, higher resolution, and suitability for projection when used for visual presentations.

Kodak Vericolor HC film was used to obtain color negatives in the 6cm x 7cm format. The anticipated use of these negatives

was to make color prints for analysis and report illustrations; therefore, archival storage was not a concern. Color prints are easier and less costly to make from color negatives than from color transparencies. Transparencies in the 6cm x 7cm format were deemed to have little utility because there are no projectors currently on the market which are capable of handling the image size. No color films were used in the 4in x 5in format.

Filters

Another means of improving image quality in photographs is through the use of filters (Adams 1981a, Eastman Kodak 1988c). Some of the advantages and limitations of filter use are discussed in this section to help clarify why certain filters were or were not used for recording rock art in Dinosaur National Monument.

Unfortunately, filter options for increasing contrast in color photography without falsifying colors are extremely limited. Polarizing filters offer the only practical, effective way to increase contrast, but their application is limited to specific lighting conditions. A polarizing filter eliminates specular reflections, resulting in reduced glare and reflection and increased color saturation. There are two types of polarizing filters, linear and circular. Only the circular type will work with auto-focus cameras.

Polarizing filters were used on unshaded pictograph panels and petroglyph panels which consisted of figures cut through patinated host rock to reveal the lighter, underlying rock. When portions of the scene to be photographed included areas of both sun-

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light and shade, a polarizing filter was used to decrease the overall contrast. The polarizing filter darkened the sunlit areas, but had a negligible effect on the shaded areas.

A polarizing filter is not effective, however, when photographing petroglyph panels where the figures and the host rock are uniform in tone or color. Such a situation may arise when there is no patination, or when the figures themselves have become repatinated. In either case, the contrast between the glare off the host rock and the shaded relief of the figures is the only means of revealing the elements of the panel, and any reduction in glare resulting from the use of a polarizing filter would be undesirable.

The effect of a polarizing filter varies as the angle of the light source varies and as the angle of the subject to the light source varies. This can cause problems when using wide-angle lenses, since the degree of polarization will not be uniform across the entire field of the lens. Also the degree of polarization will vary throughout the day as the angle of the sun changes, regardless of the lens being used.

Filter options for black-and-white photography are considerably more extensive than for color. A polarizing filter may be used with black-and-white film as well as color; however, the same applications and problems mentioned above apply. In addition to polarizing filters, selective and corrective filters can be used with black-and-white film.

Selective filters cut sharply, as only certain definite wavelengths of light can pass through

them... Corrective filters are used when there is an unwanted preponderance of some color in the light,... or when the photographic emulsion is unduly sensitive to some particular color. They are not sharp-cutting as they let through light of all colors, but in varying amount, admitting more of their own and neighboring colors and restraining their opposites... (Wall and Jordan 1975:72-73).

The practical application deriving from these attributes is that a filter will lighten subjects of its own color and darken subjects of complementary colors in the final print (Eastman Kodak 1986). For example, a blue-green filter will lighten blue-green subjects and darken red subjects. At site 42UN178 a Tiffen #13 green filter was used for most black-and-white shots in an attempt to darken the red to reddish-brown pictographs in relation to the light yellow-tan host rock.

When using most filters the film will require increased exposure to obtain good negatives. If a hand-held meter is used, the published filter factors may be used to calculate the correct exposure. (Kodak's Publication No. R-32, Eastman Kodak 1988a, lists filter factors for T-Max films and should be consulted, since factors for most filters differ from those recommended for conventional black-and-white films.) Through-the-lens meters will compensate for the reduced light passing through selective and corrective filters, but they do not take into account the spectral sensitivity of the film. The film will

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often need more exposure than the meter indicates. The recommended exposure can be found by using the meter before installing the filter and then applying the appropriate filter factor. Any additional exposure needed when metering through the filter can be easily calculated by determining the difference between the exposure recommended by the meter with the filter in place and the exposure recommended using the filter factor, as above. This additional exposure can then be added to each shot without having to remove and replace the filter each time.

Both color and black-and-white films are sensitive to ultra-violet radiation. In addition, the shorter wavelengths of light at the blue end of the spectrum are scattered more easily by collisions with particles in the atmosphere than are longer wavelengths. These factors will cause a blue cast on color films, particularly on cloudy days and in shaded areas, as well as an increase in atmospheric haze. The same factors will cause black-and-white films to have less contrast, show increased atmospheric haze, and possibly have some overexposure. Most modern films have ultra-violet filtering layers built into the emulsion, but additional filtration is required. There are several types of filters which are designed to reduce or eliminate ultra-violet radiation. UV (ultra-violet) filters are available in different strengths depending on the percentage of ultra-violet radiation that they absorb. UV filters are also available under the designation of "Haze" filters. "Skylight" filters add a slight "warming" quality, in addition to ultra-violet filtration, in order to further counteract the blue cast. UV, Haze, and Skylight filters do not require any exposure

compensation. Many photographers keep one of these filters on their lenses at all times to protect the lens surface.

The types of filters used with each camera during 1988 are listed in Table 2.

1988 Field Procedures

This section outlines the methods used to document rock art sites in the field during the 1988 season. Although special situations at some sites required variations from the standard recording, in general the same tasks were accomplished at each site. Standard procedures included photographic documentation of all rock art panels with color and black-and-white film from permanently marked "photo stations". In addition, detailed close-up photographs were taken from unmarked stations. Additional details are discussed below.

Film sufficient for one day's shooting only was taken into the field. Care was taken to keep the photographic equipment and materials in the shade whenever possible to avoid heat damage to the film during the day. The balance of the unexposed film and all of the exposed film were kept in an air-conditioned room for the duration of the project.

One Nikon EF camera was always kept loaded with color film, while the second Nikon EF was always loaded with black-and-white film. The Pentax K1000 35mm camera was used exclusively for shooting infra-red black-and-white film. The Pentax 6 x 7 camera was used for all medium format 6cm x 7cm photographs. Black-and-white and color films

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were alternated as needed. Lenses for these cameras were also alternated as needed for the best coverage at each site.

The Crown Graphic 4 x 5 camera was used for all 4in x 5in photographs. The Graflex Film Pack Adapter No. 1234 was used with Tri-X Film Packs. The Polaroid 545 film back was used with Polaroid Type 52 Instant Print Film. Standard 4in x 5in sheet film holders were used with black-and-white infrared film.

All initial shots from established photographing stations were taken using a tripod and cable release. This allowed the use of small apertures, giving maximum depth of field, and slow shutter speeds when necessary. The Nikon EF 35mm camera has a provision for locking the viewfinder mirror in the raised position in order to reduce vibration, and this feature was used with tripod shots. The use of a tripod was also necessary in order to maintain a fixed position over the established photographing stations. For additional detail and overall site shots a tripod was used only when needed.

Exposures were determined using the internal through-the-lens meters in the 35mm and the 6cm x 7cm cameras. When using the Crown Graphic 4in x 5in camera, exposures were first estimated using the internal meter in one of the cameras which was so equipped. A trial exposure was then made using Polaroid Type 52 Instant Print Film. Once a satisfactory result was obtained with the Polaroid film, a +1/2 stop exposure factor was added to compensate for the difference in film speed between Type 52 film and Tri-X. (Type 52

film is rated at ASA 400, while Tri-X 4in x 5in film is rated at ASA 320.)

All critical exposures in each format were bracketed by shooting photographs at the recommended exposure, at 1/2 the recommended exposure, and at twice the recommended exposure. In most cases exposure adjustments were made by changing the shutter speed, rather than the lens aperture. This allowed the use of the small apertures for maximum depth of field and reduced the effects of lens aberrations.

The procedure of bracketing was employed to overcome the inherent problems arising from the use of light meters. Light meters are designed to give proper exposures of scenes with an average tonal range under average lighting conditions. An "average" scene is considered to be one in which 18 percent of the light falling on it will be reflected back to the camera. In photographic terms, this situation is often referred to as 18 percent gray and light meters are said to read the light falling on their photo-electric sensors as 18 percent gray. For most applications, exposures based on an 18 percent reflectance reading will give quite acceptable results. Where the system breaks down is when there are very large areas of light and/or dark.

Large areas of light and/or dark are commonly encountered when photographing rock art. They may be a result of the tone of the rock itself, or of the light falling on it. All in-camera light meters are reflected light meters, as opposed to incident light meters. Incident light meters read the light falling on

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a subject, rather than the light reflected by it. In the case of a brightly lit, or light-toned subject, a reflected light meter will recommend too little exposure in order to darken it to 18 percent gray. In the case of a dark-toned, or poorly lit subject, a reflected light meter will recommend too much exposure in order to brighten the subject to 18 percent gray. Bracketing is the easiest and simplest way to deal with these problems since its implementation does not require any sophisticated testing or knowledge of photography.

One of the goals of the Dinosaur Rock Art Project was to collect the baseline information for a monitoring program, to be conducted by the monument staff. The purpose of the monitoring program was to determine what environmental conditions were impacting the rock art and the rate at which they were affecting it. Pursuant to this goal, a series of photographing stations was established at each site, from which photographs could be taken over a period of years for comparative purposes. After an initial survey of the site to be recorded, a series of possible photographing stations was located which would allow for complete coverage of the site. Exact locations were determined and marked at the time the actual photographs were taken. Photographing stations were marked with an aluminum tag attached to a spike which, where possible, was driven into the ground. The project name, year, and station designation were recorded on the tag. Photographing locations where a spike could not be driven into the ground were marked with a tag covered by a stone cairn. All locations were plotted on the individual site maps.

A log was kept of all photographic exposures. The log entries included: date; exposure number; site number; site name, if any; exposure data; compass direction; filter; lens; height of the camera above ground surface; and station designation. The film type being used, film speed, roll number, and photographer's name were also recorded. The height above ground surface was measured at the point where the lens axis intersected the plane of the lens mount. The angle of the film plane to the vertical, or to the plane of the subject was not determined.

The Folding Evidence Scale and the ABFO NO.2 Photomacrographic Reference Scale were affixed to the rock art panels where possible. Artist's putty was used in order to minimize impact to the panels. In addition to supplying a size reference for the panels, the scales also made rectification of the image possible. Any deviation from parallel of the subject from the film plane will appear as a foreshortening of one or both of the legs, as well as a distortion of the circles on the ABFO NO.2 Scale. The image may be rectified optically, or by computer, by correcting for the distortion.

Priority was given to complete coverage in 35mm format. 35mm is the quickest, easiest, and least expensive to use of the three formats. In addition, it was the only format in which the making of a complete color record was planned. The 6cm x 7cm and 4in x 5in formats were employed, when time and circumstances permitted, to determine if the improvement in image quality deriving from a larger negative would justify the increased difficulty and expense attached to their use.

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In order to avoid damage to the panels, no substance was applied at any time to the surfaces to enhance the visibility of the figures.

Lighting

The most important and obvious necessity for successful photography of rock art is optimal lighting. Although optimal lighting conditions sometimes do exist in the field, they are usually of short duration. In addition, petroglyph panels generally require different lighting conditions than pictograph panels. Petroglyph panels with little or no contrast between the figures and the host rock require extremely acute lighting angles. Pictograph panels, on the other hand, require uniform, flat lighting in order to reduce shadows and texture which may make visual analysis difficult.

When possible, shooting schedules were arranged so as to take advantage of the best possible lighting conditions for a given panel. However, time, weather, and transportation considerations did not always allow flexibility in scheduling. No artificial lighting methods were employed. The lack of suitable equipment for use in the remote areas where most of the sites were located made the use of artificial lighting impractical if not impossible.

Some sites presented special lighting difficulties. For example, Panel 3 at site 42UN178 contained both pictographs and petroglyphs. Two recording sessions were required at this site in order to take advantage of the best lighting conditions for the respective types of rock art. The pictographs were

shot under indirect, shaded lighting conditions to eliminate confusing surface texture (Figure 2). The petroglyphs, on the other hand, were shot at midday, when the sun was at an acute angle to the panel (Figure 3). The petroglyphs were at their peak of visibility for only 15-20 minutes each day, and they were almost invisible under flat lighting conditions, whether from a direct or indirect source. Unfortunately, the host rock was so badly eroded that the best lighting conditions for the petroglyphs also emphasized confusing textural elements on the rock surface.

At site 42UN192 acute lighting was critical. The petroglyphs were of shallow relief, with little contrast between the figures and the host rock in most areas. Because the lighting was optimal for less than 20 minutes over the entire site, it was necessary to visit the site on two separate occasions to take advantage of the best lighting for each panel. Even under the best lighting conditions, elements of Panel 1 at the site were very difficult to discern.

At some sites such as 42UN217, where most of the figures were low relief petroglyphs on a light colored host rock, optimal lighting conditions were unobtainable. In this case, the overhanging edges of the shelter blocked the sunlight at the times when it would best reveal the figures, and other methods had to be used to enhance the images (see section on filters).

Similar problems occurred at 42UN45 where the contrast between the petroglyphs and the host rock at two of the panels was insufficient to delineate the elements without the aid of proper lighting conditions. How-



Figure 2. Panel 3 at site 42UN178 shot under flat lighting conditions to eliminate surface texture and enhance the pictographs.



Figure 3. Panel 3 at site 42UN178 shot under acute-angled lighting conditions to enhance the petroglyphs.

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ever, both panels were overhung by rock formations which partially, or wholly, blocked the sun at the most optimal times. Early in the day the light shone directly on the panels at an insufficient angle to show any relief. Later in the day the panels were entirely shaded and showed no relief. It is possible that the sun may be at a low enough angle at, or near, winter solstice to fully illuminate the panels. Artificial lighting is another possible solution, but would be difficult and expensive to implement.

1988 Lab Procedures

A number of techniques are available to improve the photographic image, once the film has been returned to the photography lab for processing. These include variations in exposure and development, developer formulation, chemical intensification, copying, various types of enlarger light sources, and different paper contrast grades. Some of the factors affecting methods chosen for use in this project are discussed below.

Film speeds and development times published by the manufacturer are designed to handle average lighting conditions and average contrast. However, using the recommended film speed and development times will not give optimum results under conditions of very high contrast, or very low contrast. Unfortunately, altering film speed and development parameters of color film is not generally recommended because color balance will be altered as well as exposure. In contrast, the film speed and development of black-and-white film may be adjusted to suit the particular lighting conditions existing at the time that the exposure was made. Be-

cause of the nature of the development process, reduced development time will reduce contrast, and increased development time will increase contrast (Henry 1986; Eastman Kodak 1988b). Similar effects will result from respectively decreasing or increasing the developer concentration, but the most commonly used method is to adjust development time. To be most effective, decreased development should be combined with a corresponding increase in exposure to support the shadows, and increased development should be combined with a corresponding decrease in exposure to prevent "blocking up" the highlights (Adams 1981a). There are, of course, limits on how much variation in exposure and development a particular film can withstand and still deliver acceptable results. The range of variability in exposure and development that a film will tolerate and still give acceptable results is referred to as the latitude of the film (Vestal 1975; Wall and Jordan 1975). As a rule, faster films will have more latitude than slower films.

There are drawbacks to using extended development to increase contrast, even within the range of latitude of the film. Highlights may become overdeveloped and difficult to print, hence the need for reduced exposure. However, reduced exposure can lead to a loss of shadow detail. Grain is also increased as a result of extended development, and the entire roll has to be shot under the same lighting conditions. Tests should be run for each film/developer combination to determine the best combination of exposure and development of a given lighting condition.

The formulation of the developer used can have a significant effect on acutance and

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resolution. Most so-called fine grain developers contain a silver solvent which will actually reduce acutance. Fine grain developers may also reduce the effective film speed. High acutance developers, on the other hand, will enhance the apparent sharpness of the image, although graininess may also be increased.

The effect is to surround all highlights on the print with a narrow dark line known as a 'Mackie Line.' In practical terms, this is equivalent to a raising of contrast at a boundary, which is precisely what we want in a high acutance image (Wall and Jordan 1975:124).

A third process that may be used to improve image quality is chemical intensification. This process may be applied to prints, but is more commonly used with negatives. There are a number of different formulas for intensifying negatives. The particular formulation will determine the rate and degree of effect on the different densities of exposed silver in the negative (Wall and Jordan 1975). The effect may be sub-proportional, proportional, or super-proportional. Sub-proportional intensifiers build up the low densities more than the high densities, thus reducing contrast. Proportional intensifiers act on all densities at the same rate, giving much the same effect as increased development, namely increased contrast and grain. Super-proportional intensifiers are most active in the areas of highest density, resulting in much higher contrast and increased grain. Selenium toning has also been found to be modestly effective for intensifying negatives, as well as im-

parting improved archival qualities (Adams 1981a, 1981b).

A fourth means of controlling contrast is by copying the original negatives to a higher contrast level. This can be done either by copying onto a high contrast film, or by copying onto normal film and increasing the contrast by adjusting the exposure and development.

A fifth means of controlling contrast is by the use of different enlarger light sources (Adams 1981b; Henry 1986). There are three main types of light source: point-source, condenser, and diffusion. (A "cold-light" source is a variation of the diffusion type of light source.) A point-source type will yield the most contrasty prints. A condenser source will yield somewhat less contrasty prints, and a diffusion source will yield the least contrasty prints. Most standard black-and-white enlargers come equipped with a condenser light source, whereas most color enlargers come with a diffusion light source.

Contrast-graded papers provide a sixth means of adjusting image quality when printing in black-and-white (Adams 1981b; Henry 1986). The most common contrast grades are 1 through 4. However, most manufacturers produce a number of different papers for different applications. Some papers may only be available in grades 1 through 3, while others may be available in grades as high as 5 or 6. The higher the grade number is, the higher the contrast of the print will be. The actual contrast of a given paper grade will vary, depending on the manufacturer. The variation will usually not be more than one

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half a grade. For example, one manufacturer's grade 2 paper may have a contrast level somewhere between another manufacturer's grades 2 and 3 papers.

The use of variable contrast papers eliminates the need to stock paper in rarely used contrast grades. Contrast is controlled by the use of various filters. Most enlargers have a provision for placing filters between the light source and the negative, thereby eliminating any image degradation due to the filter. If filters are used between the lens and the print, care should be taken to use only clean, high-quality filters.

At the time that the 1988 materials were processed, Kodak's filter sets came in half-grade intervals from 1 to 4. The main disadvantage, particularly for rock art applications, was that the higher contrast filters were quite dark. This could lead to tediously long exposures and make selective exposure of specific areas of the print, known as dodging and burning, extremely difficult. Heat from the light during long exposures could also cause the negative to buckle, throwing the image out of focus.

Photographic papers come in a variety of surfaces as well as contrast grades. A glossy surface will yield higher contrast and sharper detail than other surfaces such as luster, mat, silk, etc.

An Imagemaker II film processor was used for processing all 35mm black-and-white and 6cm x 7cm black-and-white film at the Midwest Archeological Center. All 4in x 5in black-and-white film was tray processed by hand. All 6cm x 7cm color negative film was

taken to a local commercial processor, and all 35mm Kodachrome color film was sent to a Kodak processing laboratory.

The Imagemaker II film processor uses a continuous agitation process which can result in overdevelopment if the manufacturer's recommended times for intermittent agitation processing are used (Henry 1986). Standard procedure at the Midwest Archeological Center photo lab is to reduce the recommended development time by 20 percent in order to produce normal contrast negatives.

Kodak T-Max Developer was used with all T-Max films. As a test, 35mm black-and-white rolls number BW-1 and BW-6 were processed for 20 percent less than the manufacturer's recommended times. After studying the results of this procedure, a determination was made that the remaining film would benefit from an increase in contrast which would result from increased development. Therefore, all remaining 35mm and 6cm x 7cm black-and-white rolls were developed at the manufacturer's recommended development times for small tank processing with intermittent agitation, thus effectively giving the film 20 percent extra development.

Each 4in x 5in Tri-X film pack contains sixteen exposures. The individual film sheets in film packs are thinner and slightly longer than standard sheet film and cannot be processed in most tanks or machine processors. In order to test the development of this film, exposures number 1-3 were tray developed in Kodak D-76 with continuous agitation for the manufacturer's recommended time. As in the case of the smaller format films, the normal processing times gave unacceptably

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low contrast negatives. Development times for the remaining exposures were increased by 50 percent.

Only eleven 4in x 5in infra-red exposures were made during the field project. Exposure IR-L1, which had been taken at the manufacturer's recommended ASA, was tray developed in Kodak D-76 with constant agitation for the manufacturer's recommended time to test development. Based on the resulting IR-L1 negative, subsequent negatives were developed according to their anticipated degree of overexposure or underexposure.

A Beseler 45 MX II Enlarger with a condenser head was used for all black-and-white contact sheets and prints. A Rodenstock Rodagon 50mm lens was used for 35mm and 6cm x 7cm contact sheets and prints from 35mm negatives. Prints from 6cm x 7cm negatives were made using a Rodenstock Rodagon 80mm lens.

Contact sheets were made from all black-and-white negatives. The paper used was single-weight Kodak Polyfiber "F" surface. Contact sheets were exposed without a polycontrast filter, which is the equivalent of exposing at a grade 2 level. Grade 2 is considered to be normal contrast when a condenser enlarger is used. Black-and-white 8in x 10in prints were made from selected negatives in order to demonstrate the effects of the various photographic techniques employed during the project. Single weight, "F" surface Kodabrome in grades 4 and 5 and single-weight, "F" surface Kodak Polyfiber were the printing papers used.

Prints were developed in Kodak Dektol diluted 1:2 from the stock solution. Development time was 2 min at 70-72 degrees F. Kodak Indicator Stop Bath was used to stop development. Prints were then put through two fixing baths for 30 seconds in each bath. The fixing bath consisted of Kodak Rapid Fix without hardener, diluted to film strength from the concentrate. Prints were treated for 2 min in Kodak Hypo Clear and washed for a minimum of 10 min in a Zone VI archival print washer. Prints were dried on a drum type Pako print dryer. The Midwest Archeological Center does not have a policy of archivingly storing prints. The above process will not yield archival quality prints without some modifications (see Keefe and Inch 1984).

1988 Results

A variety of field and lab methods were incorporated during the 1988 season in order to determine the best methods of rock art documentation for this area. The following section outlines the methods and equipment that produced the best results.

It was found that the figures on rock art panels were considerably easier to distinguish in prints made from 6cm x 7cm and 4in x 5in negatives than in prints made from 35mm negatives. This was particularly evident in cases where there were small figures and/or large numbers of figures, and also where the panels were severely eroded.

Definition of rock art figures can be very difficult or impossible when working with prints made from small negatives. Small figures are difficult to see unless they are

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adequately enlarged. However, as enlargement increases, grain size increases and resolution decreases.

Black, red, and yellow pigments were encountered at several of the sites, either as pictographs, or as elements in combined petroglyph-pictograph figures. The use of black-and-white infra-red film in the 4in x 5in format resulted in a slight enhancement of black pigmented figures. Some petroglyphs were also slightly enhanced, although the exact cause of this is undetermined. However, the enhancement of the figures as a whole was at the expense of a serious loss of fine detail due to the graininess of the film, and the methods of application of the rock art were totally obscured. The excessive graininess of 35mm black-and-white infra-red film obscured all but the boldest figures.

Kodachrome 64 gave excellent results under all of the conditions that were encountered. Since a tripod had to be used to maintain precise positions over photographing stations, slow shutter speeds rarely caused any added difficulty. Excessive contrast was a problem in scenes containing both sunlit and shaded areas, but that is a characteristic of all transparency films.

No color film can be relied upon to reproduce colors accurately. Each film has its own particular color bias and even the same brand of film will vary slightly from one batch to the next. In addition, the color temperature of daylight illumination changes throughout the day, and this will affect the color reproduction as well. The artist on the project recorded colors using a Munsell Color Chart,

and one should refer to this for a more accurate reading of the actual colors.

The Nikon L37C ultra-violet and Tiffen 1A filters were helpful in reducing the bluish cast caused by shaded areas or overcast conditions. Many photographers leave an ultra-violet or a 1A Skylight filter on their lenses at all times to protect the lens, and that practice was followed during this project.

The polarizing filter was effective for increasing the contrast between patinated host rock and the lighter figures on petroglyph panels (Figures 4 and 5). The filter also improved the image quality when photographing pictograph panels in sunlight by reducing glare and increasing color saturation. The filter also reduced distracting texture by reducing the contrast between highlights and shadows which delineate the textural elements. The filter was effective for both color and black-and-white film. The degree of polarization varies as the angle of the light source varies relative to the film plane. This variation is particularly noticeable over large areas of uniform density. While this effect is probably present in the 1988 photographs, it is difficult to determine because of the lack of large areas of uniform density.

The Tiffen #13 green filter was found to be only minimally effective for increasing the contrast between red pictographs and lighter reddish or yellowish to buff host rock.

The Tiffen #23A red filter was also found to be only minimally effective for increasing the contrast between patinated host rock and petroglyph figures, and the 2 2/3

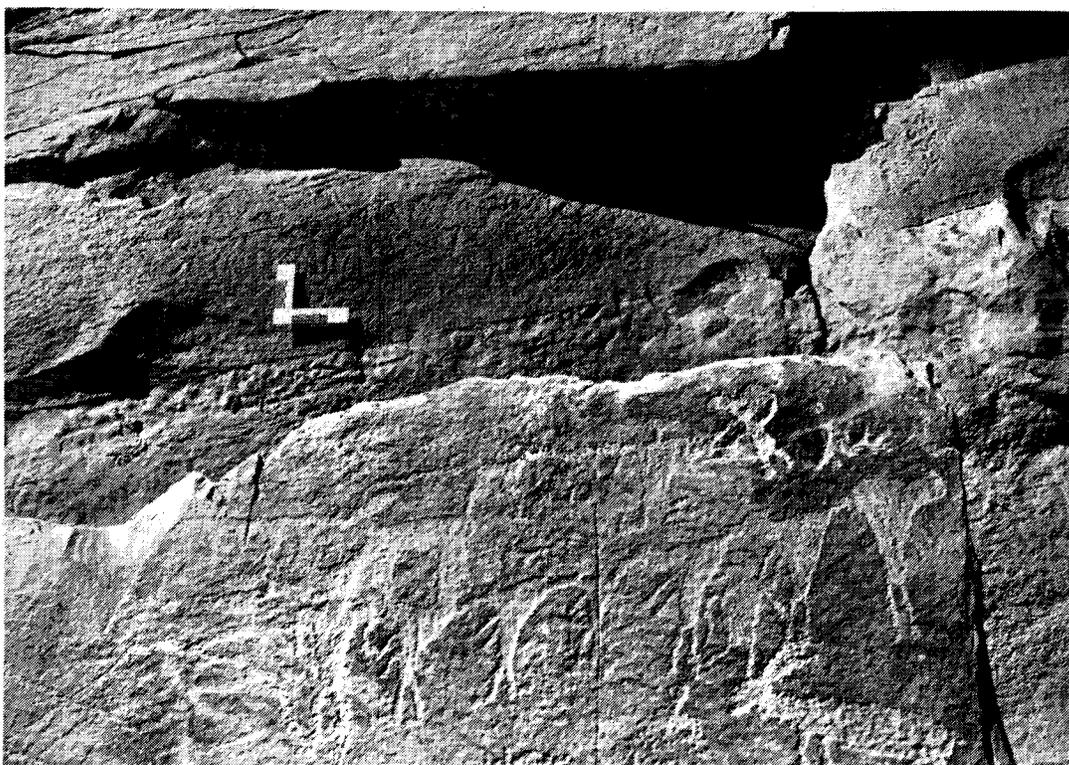


Figure 4. Panel 2 at site 42UN192 shot without a polarizing filter.

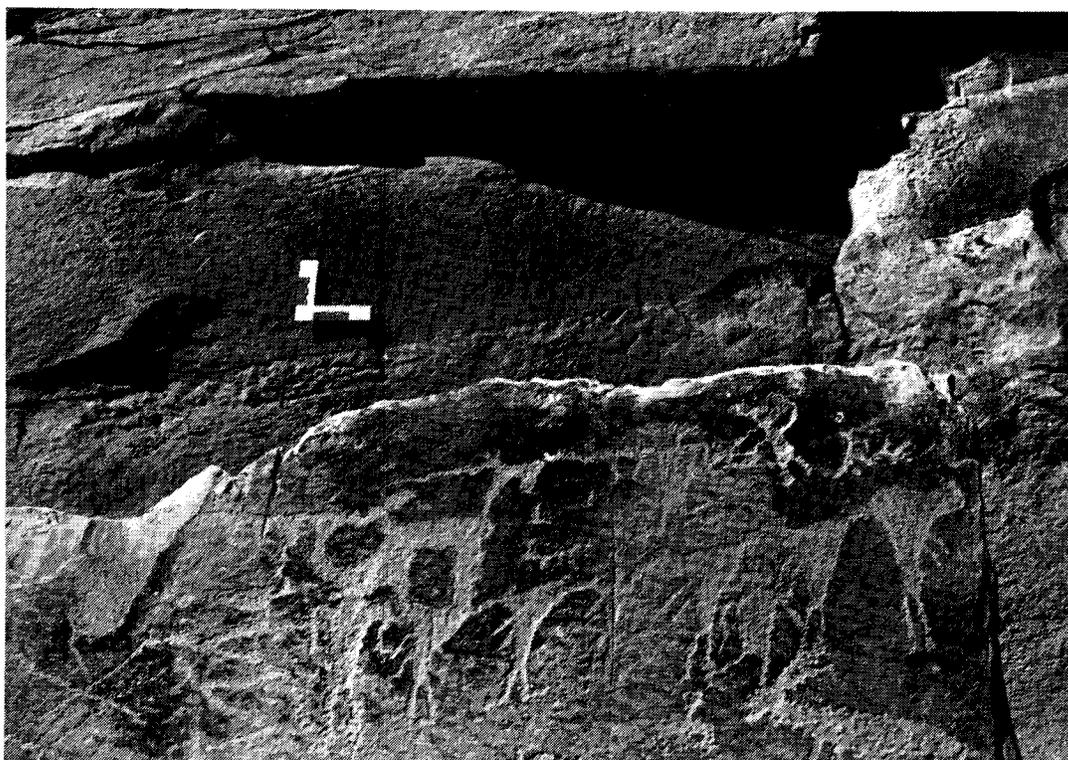


Figure 5. Panel 2 at site 42UN192 shot with a polarizing filter.

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stop exposure increase required to compensate for light loss through the filter may present problems when slow shutter speeds are used under certain conditions (e.g., high winds). At site 5MF157 the wind was too strong to allow for slow shutter speeds, even with the use of a tripod.

Petroglyphs photographed under uniform lighting conditions, such as shade or direct sun, were very difficult to discern unless the figures were particularly bold, or the contrast between the figures and the host rock was naturally high. However, when photographed under acutely angled lighting conditions, even figures with shallow relief were remarkably well defined. Pictographs yielded quite the opposite results. Uniform lighting, either from direct sunlight or total shade, was optimal. Acutely angled light caused distracting texture and contour to appear.

In terms of exposure, slightly underexposed transparencies gave the best results. Highlight detail was preserved and color saturation was strong.

The use of high contrast papers was the most effective lab procedure for improving the visibility of the rock art figures in black-and-white prints. Individually graded papers come in a wider range of contrasts than variable contrast papers and were easier to use at the higher contrast levels. The high contrast filters used with variable contrast papers were quite dark, requiring long exposures and making dodging and burning difficult. Also, heat from the enlarger lamp during long exposures occasionally caused the negatives to buckle and throw the image out of focus.

1989 Equipment and Materials

After evaluating the results of the 1988 field season, two camera and film formats were chosen for use in 1989: 35mm and 6cm x 7cm (2 1/4in x 2 3/4in). It would have been preferable to use medium format exclusively, but it was not possible because of equipment limitations. The equipment used during the 1989 project is listed in Table 3.

The same scales used during 1988 were used in 1989. These were the Folding Evidence Scale and an ABFO NO.2 Photomacrographic Reference Scale.

Kodak T-Max 100 and T-Max 400 black-and-white films were used for 6cm x 7cm format photographs. Kodachrome 64 transparency film was used for all 35mm color photographs. A limited number of transparencies were also made in the 6cm x 7cm format using Kodachrome 64 film. Kodak Vericolor HC film was used for obtaining color negatives in the 6cm x 7cm format, as prints are easier and cheaper to make from negatives than from transparencies. The anticipated uses of color prints from these negatives were for analysis and report illustrations. A Macbeth ColorChecker was used to aid in determining the correct color balance in color photographs.

1989 Field Procedures

Enough film for only one day of shooting at a time was taken into the field as was done during the 1988 season. The balance of the unexposed film and all of the exposed film were kept in the residence trailer for the duration of the project. Care was taken to

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Table 3. Equipment used for photographic documentation during the 1989 field season.

Camera (quantity)	Lens (quantity)	Filter
35mm Nikon EF (2)	50mm F1.8 Nikkor (2) 28mm F2.8 Soligor (1) 80-200mm F4.5 Soligor zoom (1)	Nikon L37c ultra-violet Tiffen Polarizer
Pentax 6 x 7 (1)	105mm F2.4 Takumar (1) 55mm F4.0 Takumar (1)	Tiffen #15 yellow-orange Tiffen Polarizer

Note: Additional equipment used with all cameras included one Bogen 3033 Tripod with a 3055 ball type head, one cable release, and one Macbeth Color Checker.

keep the photographic equipment and materials in the shade whenever possible to avoid heat damage to the film.

One Nikon EF was always kept loaded with color transparency film. The second Nikon EF was brought as a spare. The Pentax 6 x 7 camera was used for all black-and-white and some additional color photographs. Lenses were alternated as needed for the best coverage at each site.

All initial shots from established photographing stations were taken using a tripod and cable release, as with the 1988 season. This allowed the use of small apertures, giving maximum depth of field, and slow shutter speeds when necessary. The viewfinder mirror on the Nikon EF camera was locked in the raised position to reduce vibration. The tripod was used to maintain a fixed position over

the established photographing stations, but was used only as needed for additional site and detail shots.

Exposures were determined using the internal through-the-lens meters in all cameras. All critical exposures in each format were bracketed by shooting photographs at the recommended exposure, at 1/2 the recommended exposure, and at twice the recommended exposure. In most cases exposure adjustments were made by changing the shutter speed, rather than the lens aperture. This allowed the use of the small apertures for maximum depth of field and reduced the effects of lens aberrations.

Photographing stations were placed in locations which would allow complete coverage of the site and were marked with an aluminum tag which, where possible, was

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attached to a spike which was then driven into the ground. The project name, year, and station designation were recorded on the tag. Photographing locations where a spike could not be driven into the ground were marked with a tag covered by a stone cairn. All locations were plotted on the individual site maps.

A log was kept of all photographic exposures. The log entries included the same items recorded during the 1988 season, with the exception of the height above ground surface. An assistant was generally available to fill out the photographic log, which allowed the photographer to concentrate on obtaining the most complete coverage possible under the prevailing conditions. As a result, each site received more complete and detailed photographic coverage than was possible in 1988.

The Folding Evidence Scale and the ABFO NO.2 Photomacrographic Reference Scale were affixed to the rock art panels using the same methods established in 1988.

The Macbeth ColorChecker(R) chart was used in two ways. The first method followed the manufacturer's instructions. The chart was placed in the same light and at the same angle as the subject. A photograph was then taken with the chart filling the entire frame. This method allows for reflection density readings to be made in the lab from each square on the chart. The second method involved placing the chart somewhere within the picture frame. In this case the chart is useful as a visual color reference, but is reproduced too small for useful instrument readings to be made from it.

When possible, shooting schedules were arranged to take advantage of the best possible lighting conditions for a given panel. However, time, weather, and transportation considerations did not always allow for flexibility in scheduling. No artificial lighting methods were employed.

1989 Lab Procedures

The Imagemaker II film processor at the Midwest Archeological Center was used for processing all of the 6cm x 7cm black-and-white film. All Kodachrome 64 color film was sent to a Kodak processing laboratory. All 6cm x 7cm color negative film was taken to a local commercial processor. All 6cm x 7cm black-and-white rolls were developed in Kodak T-Max developer at the manufacturer's recommended development times.

A Beseler 45 MX II Enlarger with a condenser head was used for all black-and-white contact sheets. A Rodenstock Rodagon 80mm lens was used for 6cm x 7cm contact sheets. Contact sheets were made from all black-and-white negatives. Kodak Polycontrast III RC paper developed in Kodak Dektol was used for all contact sheets and prints. Prints were developed in Kodak Dektol diluted 1:2 from the stock solution. Development time was 1 min at 70 - 72 degrees F. Kodak Indicator Stop Bath was used to stop development. Prints were then put through two fixing baths for 30 seconds in each bath. The fixing bath consisted of Kodak Rapid Fix without hardener, diluted to film strength from the concentrate. Prints were washed for a minimum of 10 min in a Zone VI archival print washer. The Midwest Archeological Center does not have a policy of archivally

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storing prints. Resin coated paper is not considered to be archival.

Photographic Documentation for Future Projects

The following recommendations are made for future rock art photographic documentation, based on the results of the 1988-1989 field work:

1) Proper lighting is the single most important factor for obtaining the best possible images. Pictographs require flat, even lighting to eliminate relief. Petroglyphs, on the other hand, generally require lighting at an acute angle to the panel for maximum relief. The exception is when there is a marked natural contrast between the figures and the host rock due to patination. If possible, photography at each site should be planned for the time of day when the figures will show up the best. Sufficient time and transportation to sites is essential in accomplishing this task.

2) The use of a medium format camera is recommended for initial documentation. A medium format camera using 120, or 220, roll film represents a good compromise between the convenience of a 35mm camera and the superior image quality of a large format camera. Various medium format cameras retain much of the convenience and versatility of the smaller 35mm cameras, and a print from a medium format negative will yield a much sharper, more detailed image than a print enlarged to the same size from a 35mm negative. Combined with the use of a fine grain film, a medium format camera will yield excellent results without the inconvenience and

added expense of large format photography. Projectors are also available which will handle up to 6cm x 6cm transparencies. If 35mm slides are needed, copies can be made from the originals. In all cases, copies should be used for projection, not originals.

There are four popular sizes of medium format images; 6cm x 4.5cm, 6cm x 6cm, 6cm x 7cm, and 6cm x 9cm. The 6cm x 4.5cm and 6cm x 7cm sizes are referred to as "ideal format," because they can be enlarged almost exactly to the standard paper sizes without cropping. The reason for the improved image quality of medium format over 35mm is clear if one considers that, in terms of surface area, an 8in x 10in print from a 6cm x 7cm negative requires only a 13x enlargement, compared to a 60x enlargement required to make an 8in x 10in print from a 35mm negative. Even the smallest medium format, the 6cm x 4.5cm, only requires a 19x enlargement for an 8in x 10in print.

The use of a camera with interchangeable backs is strongly recommended. Film backs may be changed mid-roll on some models, allowing the concurrent use of several different films with only one camera body. One of the major drawbacks of the Pentax 6 x 7 used during the 1988-1989 field seasons was that, without a second camera body, only one type of film could be used at a time.

3) The use of a fine-grain film whenever possible is strongly recommended. The better resolution, higher acutance, and higher contrast yield sharper, more detailed negatives and transparencies than faster films do. Exposure should not be a problem, under most conditions, if a tripod is used.

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4) Kodachrome films should be used for the initial color documentation because of their superior archival properties under dark storage conditions. Medium format transparencies are preferable for the original documentation. 35mm duplicates can be made using an E-6 type film as needed for slide viewing or projection, since E-6 films are more stable when exposed to light.

5) Mounting the camera on a tripod allows the use of small apertures and/or slow shutter speeds when required, reduces camera vibration, and maintains the camera over a fixed position. When slow shutter speeds are required, a cable release should be used. Also, if the camera is equipped with a mirror lock-up feature, the mirror should be secured in the up position during the exposure.

6) Lenses should include a normal, a wide-angle, and a telephoto lens. Only top quality lenses should be used because inferior lenses will not be fully corrected for distortion and will have aberrations which degrade the image. Zoom lenses are very convenient to use and modern zoom lenses are quite well corrected; however, a fixed focal length lens should be used for very critical work.

Rock art panels are commonly found in locations that require close camera positions. A wide-angle lens is a necessity for dealing with these situations and wide-angle lenses are also useful for overall site shots. Telephoto lenses are the most convenient way of dealing with panels in locations that are inaccessible. Normal lenses are often the most suitable for use in dimly lit areas because they usually have wider maximum apertures than either telephoto or wide-angle lenses.

7) A polarizing filter can be very effective for enhancing images of rock art under appropriate conditions. Photographs of pictograph panels in sunlight, sunlit petroglyph panels with patinated host rock, if the figures have not been significantly repatinated, and panels which are partially sunlit and partially shaded may all benefit from the use of a polarizing filter.

8) The use of "selective" type filters for black-and-white photographs generally resulted in little or no improvement in image quality, with the added disadvantage of lowering the effective film speeds, and their use is not recommended. However, it may be worthwhile to try a stronger green filter, or a blue-green filter when photographing red pigmented pictographs.

9) Bracketing exposures should be a standard practice. The typical light meter found in most cameras averages the light across the entire image area, usually placing somewhat more emphasis on the center portions of the image than on the edges. As a result, they cannot be depended on to correctly read exposure under all circumstances. Making exposures at the recommended reading, at 1-stop over the recommended reading, and at 1-stop under the recommended reading will assure that a good negative is obtained under most circumstances. For particularly critical shots under extreme conditions, bracketing by 2-stops may be advisable, making five shots all together.

Film and processing costs represent a relatively small portion of most project budgets. Bracketing exposures provides the best guarantee for obtaining good images. Scrimp-

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ing on exposures is a false economy, since returning to the field to re-shoot would be considerably more expensive. After processing, the unsuccessful exposures may be discarded to reduce storage space and record keeping.

10) The use of a spot meter would be preferable to using the through-the-lens camera meters. Spot meters typically have a 1-degree angle of view. This narrow angle of view allows the photographer to get a precise exposure reading from all of the critical areas of the subject. The photographer can then adjust exposure and development to obtain the best image.

11) Various methods of artificial lighting should be experimented with, particularly on panels that are difficult to photograph under natural lighting conditions. These methods may include the use of a nonstandard light source such as ultra-violet, particularly on pictographs. Use of these light sources would require photographing at night.

12) Infra-red black-and-white film is not recommended except in the 4in x 5in format, and then only under extreme conditions where conventional films are inadequate for revealing faint figures done in black pigment. Loendorf et al. (1988) have noted that color infra-red film can be useful in photographing black and green pigments; however, no green pigments were encountered at any of the sites studied in the Monument.

There was little additional information revealed by the infra-red radiation on the panels tested. Even in situations where the infra-red radiation might reveal additional

information, the details would most likely be obscured by the extremely coarse grain, at least in the 35mm format.

Infra-red film also requires particular care in handling and storage. The film must be kept cool and can only be loaded and unloaded in total darkness, as it is extremely sensitive to both heat and light. The exigencies of field work make it very difficult to adequately protect the film before, during, and after exposure.

Exposure is a problem as well, since conventional light meters do not read infra-red radiation. Without considerable experience shooting infra-red film, a photographer will have to bracket widely in order to insure a proper exposure. This becomes particularly burdensome when using 4in x 5in sheet film, due to the space required for large numbers of sheet film holders and the increased time required to photograph with a 4in x 5in camera. (Konica is currently manufacturing a medium format infra-red film; however, no medium format infra-red film was known to be available at the time of the project.)

13) Kodak T-Max Developer is recommended for use with T-Max films. Although the films are compatible with most general purpose black-and-white film developers, T-Max Developer seems to give noticeably better results.

14) Extending development beyond the recommended time is an effective means of improving black-and-white image quality. The increased contrast serves to better delineate figures. Under certain circumstances, overdevelopment should be combined with a

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corresponding underexposure in order to prevent the highlights from "blocking up." However, there is a risk of not recording valuable information when negatives are underexposed. Negatives will tolerate overexposure much better than underexposure. (Transparency films, on the other hand, will tolerate underexposure much better than overexposure.) In any event, the procedure of bracketing exposures should yield a correctly exposed negative without any further adjustment.

Kodak has published tables of recommended development adjustment factors for increasing or decreasing the contrast of T-Max films using various developers (Eastman Kodak 1988a). (For other films see: Adams 1981a; Vestal 1975.) The limits on the degree of acceptable exposure and development adjustment depend on the film/developer combination being used. In extreme cases, most films will yield printable negatives at up to a 2-stop overexposure or underexposure with a corresponding adjustment in development.

Underexposure and overdevelopment do have their drawbacks. An underexposed negative will have reduced detail in the low values (e.g., shadows and dark tones) compared to a normally exposed negative. If the silver grains in the film emulsion are not exposed, then the image is not recorded and no amount of development will save it. As a result, there is a risk of not recording valuable information. Overdevelopment increases grain, which results in decreased sharpness and resolution. These drawbacks may be mitigated somewhat by careful exposure and the use of a fine grain or large format film.

Excessive overexposure and underdevelopment will yield negatives with too low a contrast level and insufficient tonal separation. The resulting prints would appear flat and grey and have inadequate image definition.

A further problem with tailoring exposure and development to specific lighting conditions is that the conditions must be similar for all exposures on the same roll of film. This condition does not present a problem when dealing with sheet film and is usually not a problem with short roll films having ten or twelve exposures. However, it is unlikely that lighting conditions will remain the same throughout the use of a 36-exposure roll of 35mm film.

15) Increasing paper contrast was the single most effective lab procedure used to improve the visibility of rock art figures in photographs (Figures 6 and 7). High contrast printing papers in the grade 4 and 5 range yielded the best prints. At the time that the 1988 materials were processed, individually graded papers were generally more convenient to use than variable contrast papers at the higher contrast levels. The high contrast filters used with variable contrast papers were quite dark, requiring long exposures and making dodging and burning difficult. In addition, individually graded papers came in a wider range of contrasts. Kodak's new generation of variable contrast papers has overcome most of these disadvantages. They have increased contrast range of 0-5, in half-grade increments, and the filters are considerably lighter than those used with the older materials. However, at the time of the study,



Figure 6. Panel 2 at site 42UN1728 printed on low contrast paper.



Figure 7. Panel 2 at site 42UN1728 printed on high contrast paper. Note the improved visibility of the rock art figures in this print over that in Figure 6.

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they were only available on resin-coated paper, which does not meet current archival standards.

16) An assistant to record entries in the photographic log while the photographer is shooting is recommended. This dramatically improves the efficiency of the photographic record keeping process. A photographer working alone must spend from 1/2 to 2/3 of his or her time writing entries in the log book. Optimal lighting conditions at many rock art panels are of extremely short duration, making complete photographic documentation difficult to obtain within the time available. Indeed, several sites were visited more than once during the 1988 field season and still could not be adequately photographed. When another member of the crew was available to record entries in the log book, photographic output more than doubled.

17) Digitization and rectification of photographic images holds great possibilities and should be attempted. This process was planned for the Dinosaur Rock Art Project, but has not been conducted to date.

18) Chemical intensification during film processing should be tested as a means of enhancing the visibility of rock art figures in photographs.

19) Copying negatives to a higher contrast level also should be tested as means of enhancing the visibility of rock art figures.

20) Rock art figures often seem to be more visible in the negatives than in the prints. Making a negative print, rather than a

positive, or projecting the negative, should be similarly helpful for improving the visibility of figures.

21) Three dimensional photographs of some panels were made by the photogrammetrist. Three-dimensional photography may prove helpful, particularly for analysis of complex sites, and should be utilized. Camera mounts for taking stereo photographs with conventional cameras are available, or can be easily manufactured, and the additional information supplied by a third dimension can be truly remarkable.

22) A method of superimposing old photographs over current sites has been outlined by Prince (1988). The procedure was recommended primarily for historic sites, but could prove very useful for rock art sites as well. Its use would make possible the location, identification, and measurement of damaged or destroyed figures and help in determining rates and types of impact on rock art panels.

23) The Macbeth ColorChecker(R) chart seems to be of little utility for anything other than a rough visual check of the color balance. Prints made from rock art negatives by a local custom photographic lab using readings from the corresponding negatives of the chart exhibited grossly inaccurate color balances. Prints of the rock art negatives made by the same lab using their color analyzer in the normal manner were far more accurate. However, it is entirely possible that the chart slides were not being used properly, or that the lab's equipment was not set up to use the chart correctly.

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The ColorChecker images may be useful in determining color changes in the film over time, but even that is problematical. Slides or negatives taken at some later date will not be directly comparable to the original images in any accurately quantifiable sense. The color balance of films and papers changes slightly from one batch to the next. Furthermore, by the time that any noticeable color changes appear in the original images, it is highly likely that continuing research being done by the manufacturers will lead to changes in the product formulations which will, in turn, affect the color balance.

The most effective way to determine both the accuracy of the color balance in the original photographs and the color change over time would be to compare the colors in the photographs with the Munsell readings from the ColorChecker and the rock art itself. Since the Munsell readings taken from the rock art can be compared directly to the photographs themselves, it is difficult to see the utility of the additional use of the ColorChecker.

FIELD SKETCHES AND SCALE DRAWINGS

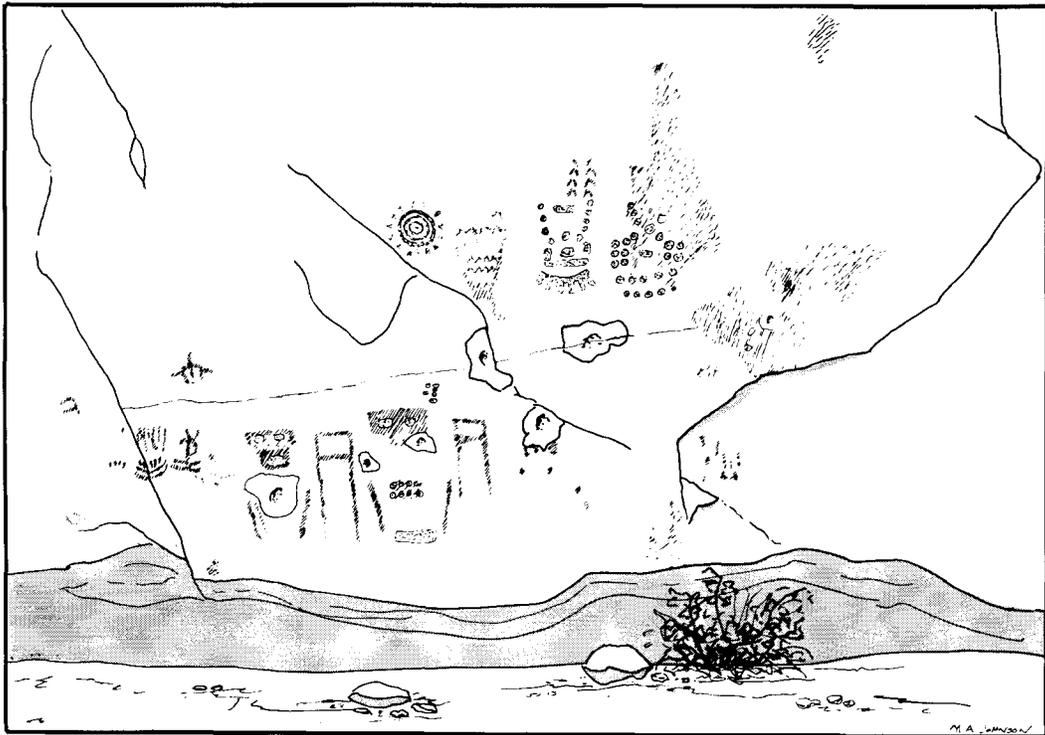
An artist/scientific illustrator accompanied the field crew to each of the sites documented during the 1988 and 1989 seasons. The artist created sketches and scale drawings of the rock art panels and elements as an essential part of *complete* rock art documentation. The sketches complement photographic documentation by providing a format that enhances the outline and other elements of images that are sometimes difficult to see

in photographs (Figure 8). While the main goal of the illustrator was to provide sketches and drawings of the rock art panels themselves, she also assisted with the production of site sketch maps, scale maps of the panels, and photo log recording. Only the methods used in panel illustration will be discussed here.

The illustrator used a variety of methods for documenting the rock art panels in the field. Each site was approached differently, as all methods were not applicable under the varying conditions resulting from time constraints, visibility, lighting, and occasional accessibility. The following represent some of the field methods applied.

(1) Rough sketches were made to illustrate, in an overview fashion, the placement of figures on the rock art panel and the relationship of figures to natural rock features as well as other elements on the panel (Figure 9). This type of sketch was completed for most of the sites.

(2) Rough sketches were made of individual elements on each panel. When it was felt that scaled photographs would not provide accurate measures of elements, measurements of corresponding areas were recorded directly on the sketch (Figure 10). However, given the time involved in obtaining measurements, the majority of the final illustrations were drawn to scale, based on scaled photographs. Scaled photographs taken by the artist complemented the overview and element sketches. Close-up, detail photos were taken of each element, with a scale placed near the element. The artist then stepped back and photographed the entire



42UN178 PANEL 3 STA. E
DELUGE SHELTER



Red Paint



Pecked Areas



Bullet Damage

Figure 8. Panel 3 at site 42UN178. Note how the panel sketch at the bottom allows for clear distinction of the elements not easily visible in the photograph at the top.

METHODOLOGY

panel with the scale in the same location near the specific element. This assisted the artist in recreating the arrangement of elements on the panel and at the same time obtaining the detail needed to create detailed element drawings. Color film was used to enhance the color in pictographs. Prints were often used instead of slides to allow for easier handling and organization; however, some slides were taken. The major advantage of slides is the ability to project the image to a larger scale, which sometimes enhances the visibility of elements or details.

(3) Light tracings of individual elements were made when the elements were faint or otherwise difficult to see. Tracings were made using two different methods. The most common method involved placing tracing paper over the rock art and using charcoal or pencil to trace the elements. Great care was taken not to adversely affect the elements during this process. Minimizing effects to the panel is important not only to preserve the art itself, but also to preserve desert varnish around the elements which can be used for radiocarbon or cation ratio analysis. A second method involved placing three-millimeter, single-sided, frosted acetate over the rock art and using black or colored permanent markers to trace the elements. The clarity and rigidity of the acetate made this method easier and more accurate than using tracing paper and the weight of the acetate made it easier to handle in windy conditions. Acetate is also tear resistant which gives it an advantage over tracing paper that may tear and allow marks to be made on the rock art during tracing. Acetate was not employed extensively in recording because it is heavier and bulkier,

making it more difficult to carry long distances, and it is more expensive. Acetate can, however, be replaced with visqueen which is similar in character except that it is more transparent, lighter, more flexible and available in larger sheet sizes. Oriental papers can also be used for rubbing or tracing. Heavier papers are good for producing rubbings of rock art and some oriental papers become transparent when wet (Loendorf et al. 1988). Neither visqueen nor oriental papers were used to record rock art during this project.

(4) Color drawings using pastels were made of pictographs and occasionally of petroglyphs. Color drawings of pictographs provided more realism and easier differentiation of design while the use of color with petroglyphs often helped to differentiate pecked areas and patinated surfaces.

(5) Descriptive data was recorded in addition to the use of the methods listed above. Written descriptions of outstanding features were made to aid in completion of finished drawings back in the lab. Munsell readings were also taken of painted, pecked and non-pecked/patinated areas.

Almost all of the sites recorded by the artist were approached in the same manner as most of the elements were easily accessible. However, special situations existed at a few sites that deserve mention here:

1) At site 42UN1244 Panel C was almost completely obscured by bird droppings making sketching and tracing difficult. Photographs of the panels were relied on to make the final drawing for this panel.

ROCK ART

2) At site 5MF88 the figures are located about 20 to 30 meters above the ground surface precluding the use of scales or tracings. Sketches were made by looking through binoculars and these were matched with the photographs back in the lab although scale could still not be added.

3) At site 5MF157, the figures of Panel 3 are located about 40 meters above the ground surface and windy conditions the day of recording made viewing through binoculars difficult. Consequently, no sketches were made of this panel.

4) At site 42UN1733 several of the panels could not be reached to place scales or make tracings so the panels were photographed with a zoom lens. Drawings were then made from these photographs.

5) The artist did not visit sites 42UN198 and 42UN1735. Final drawings for these sites were made from scaled photographs taken by other members of the crew.

Upon return to the Midwest Archeological Center, final camera-ready drawings were created from sketches, tracings, maps, and notes taken in the field. A variety of methods were used to produce the final drawings. The methods selected depended upon the type of product available from the field work at each site. The methods used included:

(1) Enlarged photographs with scales were traced to produce scale drawings of rock art panels.

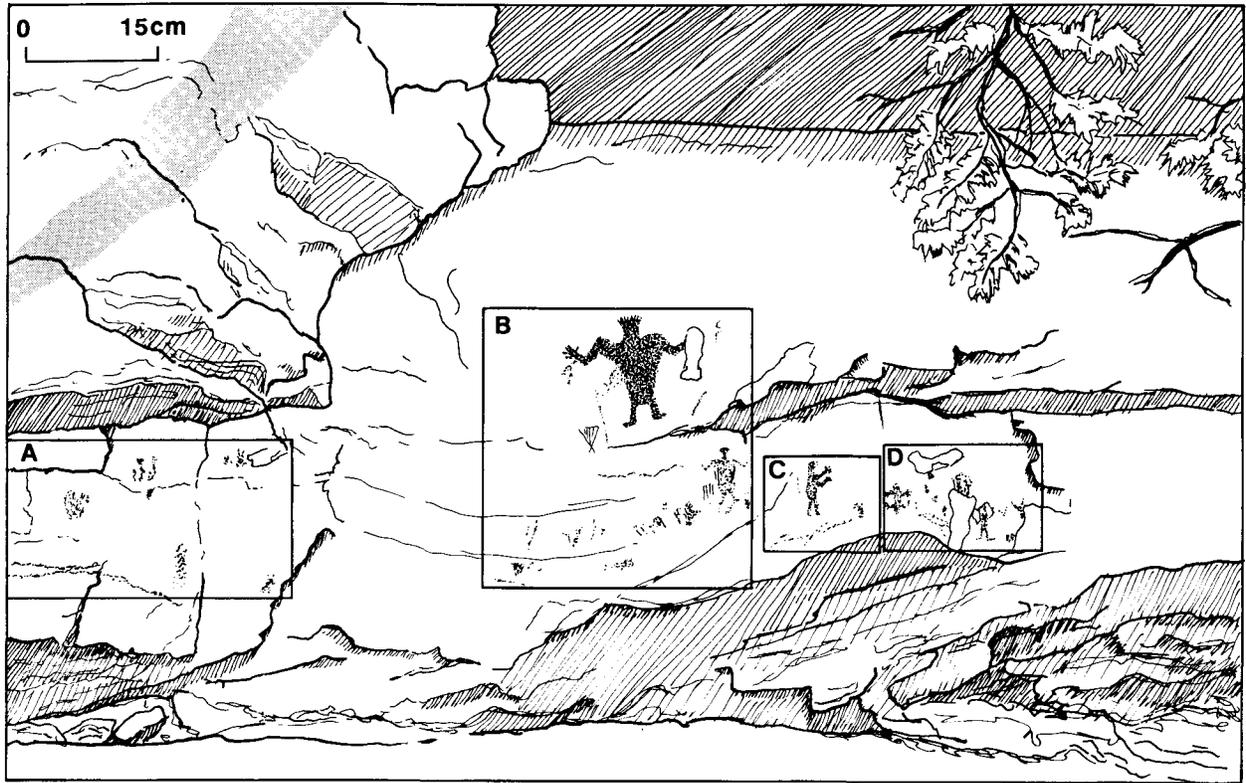
(2) Rough sketch maps of rock art panels made in the field were enlarged (using a photocopier) and traced onto mylar.

(3) Tracings of individual elements made in the field were reduced (using a photocopier) to an appropriate scale and then were traced onto mylar.

(4) Field sketches of individual elements and written descriptions were used as reference for detail when using photo and panel sketches to produce finished drawings.

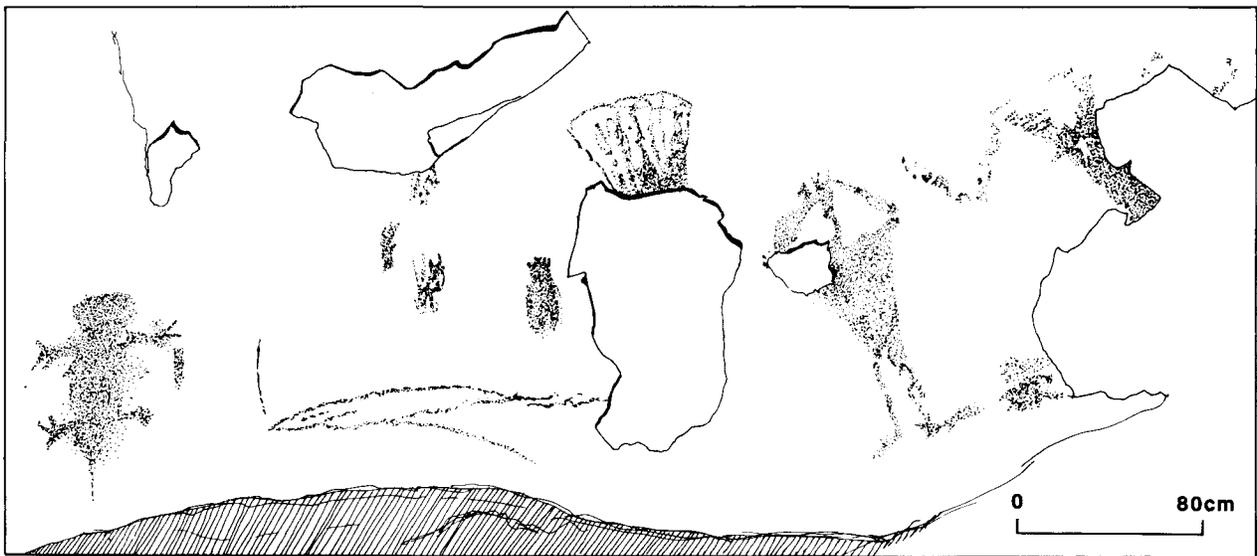
In general, the process used was to draw an overview to scale using site overview sketches and scaled overview photographs. Detailed elements were then drawn by tracing the scaled photographs or reduced tracings from the field. These detailed element drawings were then reduced to fit the scale of the overview and placed in their appropriate location on the overview. If the overview drawing did not show each element sufficiently (e.g., if an element was too small or on the underside of a rock), the location of the element was indicated with a lettered inset and a separate drawing of the element was included (Figure 11).

For final delivery of the panel illustrations to the monument for monitoring purposes, the artist also made copies of the drawings by xeroxing them onto clear acetate. These acetate copies can then be used as an overlay on which any vandalism or weathering observed during monitoring can be recorded.



42UN179 Panel 1 Big Man Alcove

Mineral Stain Deposit



42UN179 Big Man Alcove Panel 1 Detail D

Pictograph Munsell - 2.5YR 4/6 (Red)

Figure 11. Example of a final drawing produced for site 42UN179 showing the panel overview with lettered insets and an example of an inset detail illustration.

ROCK ART

The goal of the artist in recording the panels was to represent as realistically as possible the current status of the rock art. This goal contradicts with that recommended by some rock art recording manuals which suggest that rock art should be drawn to show the elements as they originally appeared. For example, Sanger and Meighan (1990) appear to be suggesting that artists attempt to interpret and draw elements that may be faded or missing segments due to weathering or vandalism. They state:

Recorders sometime have problems determining how best to represent rock art that has deteriorated due to natural or human causes. If they are so scientific and literal-minded that they draw only the paint remaining on the wall, they will have to omit every place where part of a line or surface has spalled off or weathered away. This can be done very exactly, but if a site is extremely weathered, the recording of scattered splotches of paint may not give any idea at all of what the rock art originally looked like (Sanger and Meighan 1990:124-124).

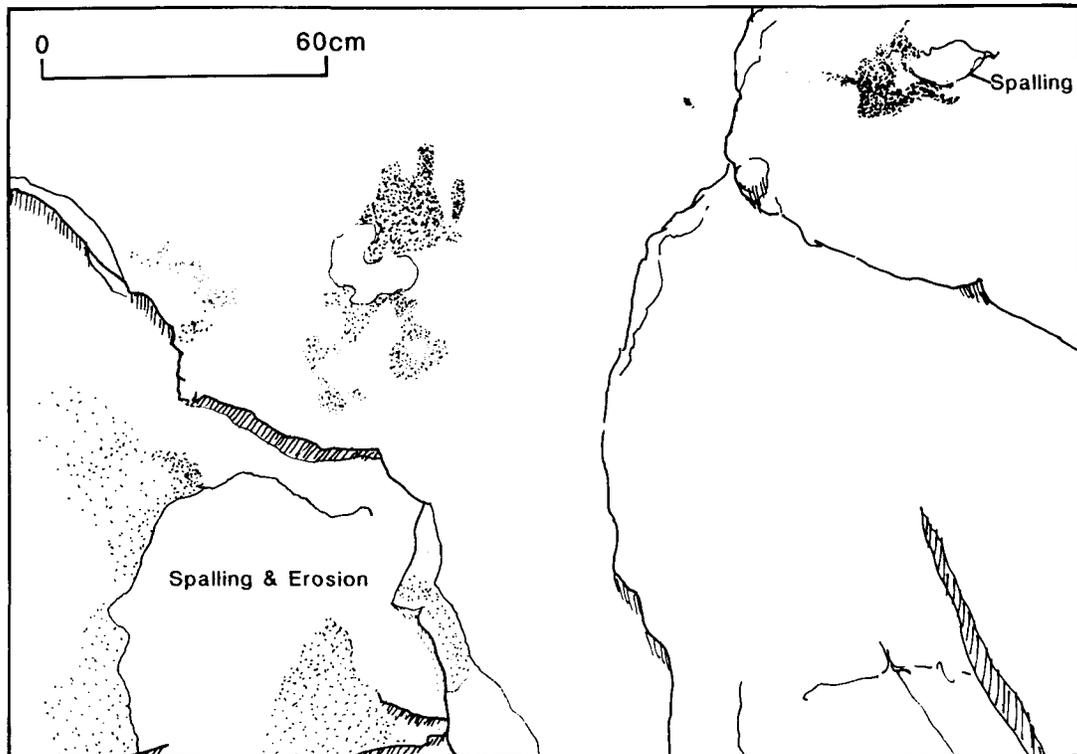
As was the case with many of the sites in the Jones Hole area, what currently appears on the surface is indeed scattered splotches of paint. To attempt to interpret what these remnants may have originally represented would involve conjecture, guessing, or even the construction of images that never did

exist. For this project, the artist drew only what was visible at the time, although areas that had obviously spalled away were indicated on the sketches as such (Figure 12). Indicating spalled areas or areas that had been vandalized (e.g., bullet holes) helped to document impact to the panels (Figure 13). Realistic representation of the current state of the rock art will also help with future monitoring of any recent impacts to the art.

TERRESTRIAL PHOTOGRAMMETRY

Used for almost three decades, close range photogrammetry is a technique for detailed recording of rock art (e.g., Clouten 1974, 1976, 1977; Turpin et al. 1979; Turpin 1982; Beaton 1983; Valiga 1987). This recording procedure was conducted at six sites in Dinosaur National Monument (42UN45, 178, 192, 217, and 5MF88 and 157) by Mr. David DeVries of Hammon, Jensen, Wallen and Associates of Oakland, California. Although this technique is not new the camera equipment used for this field recording provides improved accuracy and greater flexibility than equipment used in earlier work. The photogrammetric recording in the monument was done with a Rolleiflex 6006 metric camera with a built-in grid plate (reseau) using a 6cm x 6cm (2 1/4in x 2 1/4in) format system.

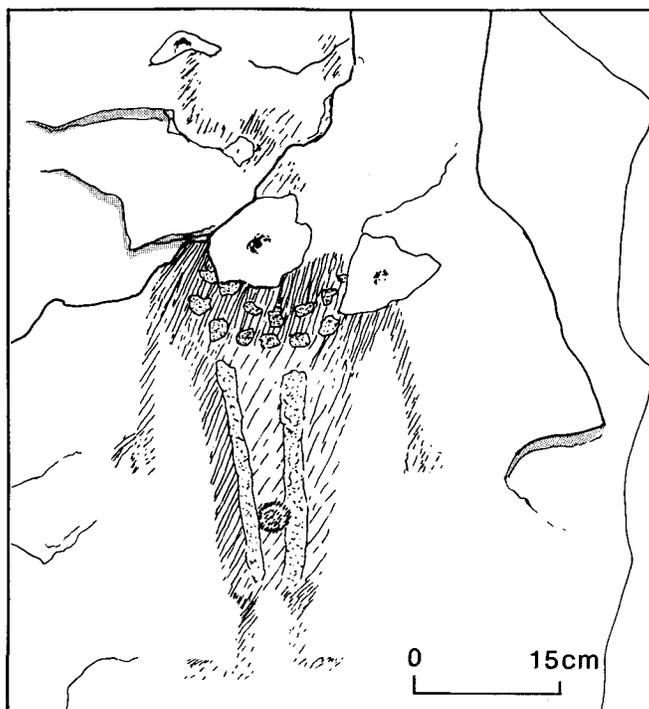
The photo-mapping process requires stereo model survey control, stereo photography showing the control points, and compilation of the relevant data into a map. Control points on the rock art panels were targeted with temporarily affixed multicolored tape. The subject surface was photographed with a



42UN198 J.P. Penthouse Area 14
Panel 1 East End

Pictograph Munsell - 10R 4/6 (Red)

Figure 12. Rock art panels were drawn to show only elements that were visible at the time of field work with spalled and eroded areas indicated as such. This is a part of Panel 1 from site 42UN198 (Area 14).



42UN178
DELUGE SHELTER
PANEL 4 STA. D

-  Red Paint 2.5YR 3/6
-  Pecked Areas
-  Bullet Damage

Figure 13. Final drawing of an element on Panel 4 at site 42UN178 clearly showing damage from bullets fired by vandals at the panel.

ROCK ART

calibrated camera of known focal length having reseau marks at the film plane that are exposed with the subject. The control at the subject, the control at the film plane, the stereo image, and the principal distances of the lens establish the geometry of similar triangles necessary to translate image point distances to subject point distances, and ultimately to produce a contour map. An infinite number of point data are available and contour maps of a portion of the site can be made at contour intervals ranging from 10 cm to 5 mm.

Photogrammetric recording offers several advantages in rock art documentation. First, like any kind of photographic procedure, there need not be physical contact with the rock art or any other cultural remains at the site, eliminating concern for adverse impact. Secondly, the entire topographic setting of the site can be recorded for map production at levels of accuracy and speed that surpass that of theodolite and tape procedures. Most importantly, this procedure allows for highly detailed maps to be made at any time after the field photographic work is completed. With proper curation the film allows for mapping to be done decades after the initial field visit.

Mapping of site 42UN192 was conducted at Hammon, Jensen, Wallen and Associates with stereoscopic plotting instruments and digital data acquisition systems by personnel not having familiarity with the site or prehistoric rock art (see Figure 33). Results of this effort demonstrate the need of an archeologist or others familiar with a site to work with those using the computer graphic equipment and analytic software to produce a

map useful to future managers and researchers.

VIDEO PHOTOGRAPHY

The application of video photography to archeological work is being recognized as a highly efficient means of recording cultural remains as well as the process of their investigation (e.g., Hanson and Rahtz 1988). The rock art, other cultural features, and the topographic setting surrounding each site in the monument were recorded using a tripod mounted Sony video camera recorder (CCD-V9). Video recording of these sites was made for two reasons: (1) as film documentation, complementary to still photography, and (2) as a source for potential development of interpretive films. Site documentation to establish baseline information for future monitoring of site changes remained the immediate goal.

The film used for field recording consisted of 8-mm video format cassettes in various time lengths of from 30 to 120 minutes. The camera's recorded "count" and direction of view were recorded in a photographic log book for each segment of tape made. The date and time, embedded on tape by the camera, were also recorded for each tape segment along with brief descriptive information about the site. Upon returning from the field, the footage on the original 8-mm tapes was transferred to 1/2 inch VHS master tape of professional quality for ease of viewing and editing. The original 8-mm tapes and VHS master tape from which copies can be made are curated at the Midwest Archeological Center.

SITE DESCRIPTIONS

Twenty-three rock art sites were documented during the 1988 and 1989 field sessions (Table 4). The following are brief descriptions of these sites. Additional detailed information about these sites is available from the Intermountain Antiquities Computer System (IMACS) forms filed with the State of Utah, or the Colorado Historical Society forms filed with the State of Colorado. Copies of these forms are also filed at the Midwest Archeological Center and at Dinosaur National Monument. Extensive photographic and illustrative information about these sites is also available at the Monument and the Midwest Archeological Center.

5MF87

This site consists of a petroglyph panel in association with a rockshelter near the base of a south-facing cliff on the north side of Pool Creek Canyon near Echo Park. The shelter is a narrow, deep, crevice-like formation with no cultural material visible on the surface. The extensive panel of petroglyphs, almost entirely outside the shelter, includes anthropomorphic, zoomorphic, and abstract geometric design elements (Figure 14). Due to time constraints, the site was only partially documented in the fall of 1988.

5MF88

This petroglyph panel is situated on an east-facing cliff face on the west side of Pool

Creek about 3/4 mile from the mouth of Pool Creek Canyon. The petroglyphs (15+) all appear to be anthropomorphic in design, with elaborate headdresses and necklaces (Figure 15). The headdresses and body elements are composed of parallel lines of pecked circular indentations, while the necklaces are abraded rectangular elements. The panel measures about 30 x 10 meters and is located approximately 25 meters above the stream bed that runs at the base of the cliff (Figure 16). No cultural material was observed in proximity to the rock art.

5MF157

This site consists of three petroglyph panels situated along a cliff face that faces northeast near the Green River at the mouth of Pool Creek Canyon. The southwestern most panel appears near the ground surface and may be partially buried. One, and possibly two, anthropomorphic figures are displayed here. About 120 meters to the northwest along the same cliff face is another panel near the ground surface that contains an abstract geometric design on a patinated segment of sandstone (Figure 17). The most extensive panel (Panel 3) is about 30 meters above the ground and contains a large bighorn sheep with an associated anthropomorph with bow and arrow, two smaller bighorns, two geometric design elements, and two rows of footprints (Figure 18). Access to this last panel is difficult (if not impossible) because of its height on the cliff face.

ROCK ART

Table 4. Rock art sites recorded in Dinosaur National Monument during 1988 and 1989.

State Trinomial Number	Site Name	MWAC Temporary Number	Other Number (Breternitz 1965)	Other Number	Year Recorded by MWAC
5MF87					1988
5MF88					1988
5MF157					1988
42UN45	McKee Springs Petroglyphs		42un89		1988
42UN178	Deluge Shelter		42un1	Stirland Site #1	1988
42UN179	Big Man Alcove		42un2	Stirland Site #2	1989
42UN185	Dos Ciervos Alcove	MWAC88-1	42un8	Stirland Site #8	1988 & 1989
42UN187		MWAC 6	42un10	Stirland Site #10	1989
42UN190	Blueberry House Shelter	MWAC 12	42un13	Stirland Site #13	1989
42UN192			42un15	Stirland Site #15	1988
42UN198	J.P. Penthouse	MWAC 13 & 14	42un21	MacLeod Site #17	1989
42UN201	Poison Shelter	MWAC 4	42un24	MacLeod Site #20	1989
42UN217	Swelter Shelter		42un40		1988
42UN1244					1988
42UN1715	Centipede Shelter	MWAC 5			1989

SITE DESCRIPTION

Table 4. Concluded.

State Trinomial Number	Site Name	MWAC Temporary Number	Other Number (Breternitz 1965)	Other Number	Year Recorded by MWAC
42UN1728	Fingerpaint Shelter	MWAC 1			1989
42UN1729		MWAC 2			1989
42UN1730		MWAC 3			1989
42UN1731	Talus Petroglyphs	MWAC 9			1989
42UN1732	Canyon View Petroglyphs	MWAC 10			1989
42UN1733	Scary Ledge Petroglyphs	MWAC 11			1989
42UN1734	The Target Site	MWAC 15			1989
42UN1735	Rich-Hartle Inscription	MWAC 16			1989

42UN45 - MCKEE SPRINGS PETROGLYPHS

This site consists of an extensive series of mostly petroglyphs and a few pictographs along a south-facing cliff that spans about 200 meters east-west. This Frontier Formation rises about 12 meters above Stone Bridge Draw that runs east toward the Green River (Figure 19). Fifteen separate rock art panels were delineated at the site (Figure 20). Petroglyphs range in size from a few centimeters up to 3 meters high. Several anthropomorphic figures are associated with "shields."

Other representative figures include zoomorphs, geometric designs, and a few kokopellis (Figure 21). At least one anthropomorph has been painted.

42UN178 - DELUGE SHELTER

This east-facing shelter is located on a terrace west of Jones Creek about one-quarter mile north of the confluence of Ely and Jones Creeks. The shelter is a low, shallow alcove that was partially excavated in 1965 and 1966 (Leach 1967, 1970a) (Figures 22 and

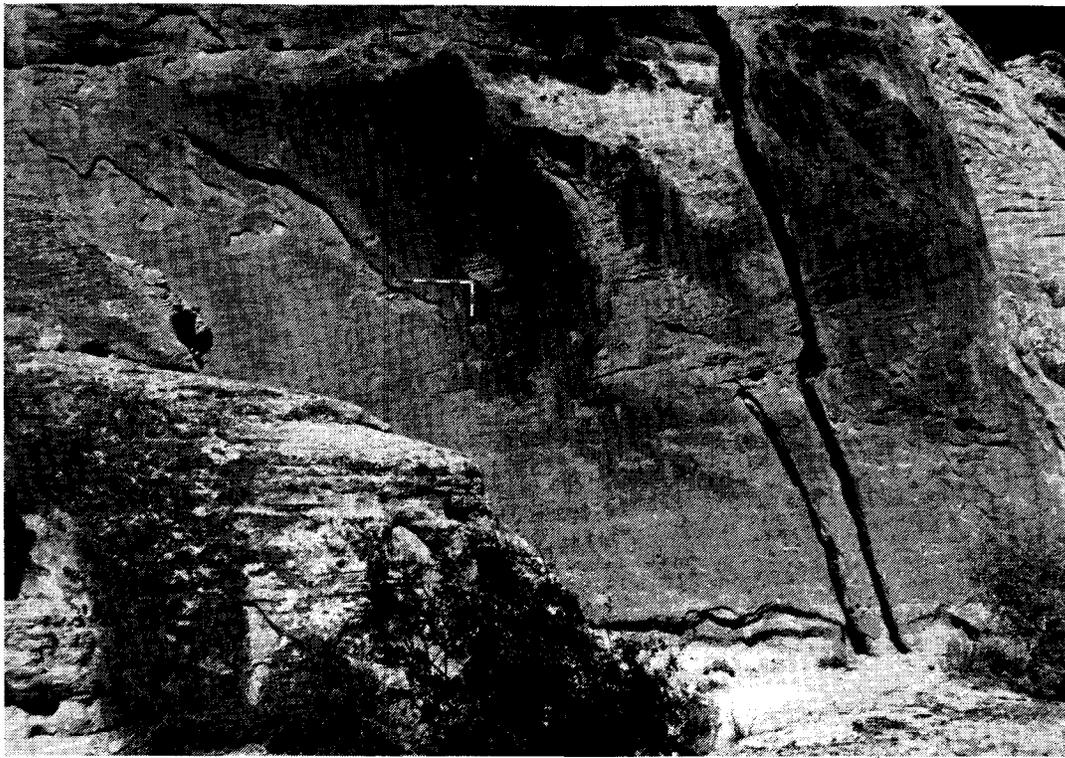


Figure 14. Overview of rock art panel at site 5MF87, looking north.



Figure 15. Anthropomorphic petroglyphs on the central portion of the panel at site 5MF88.

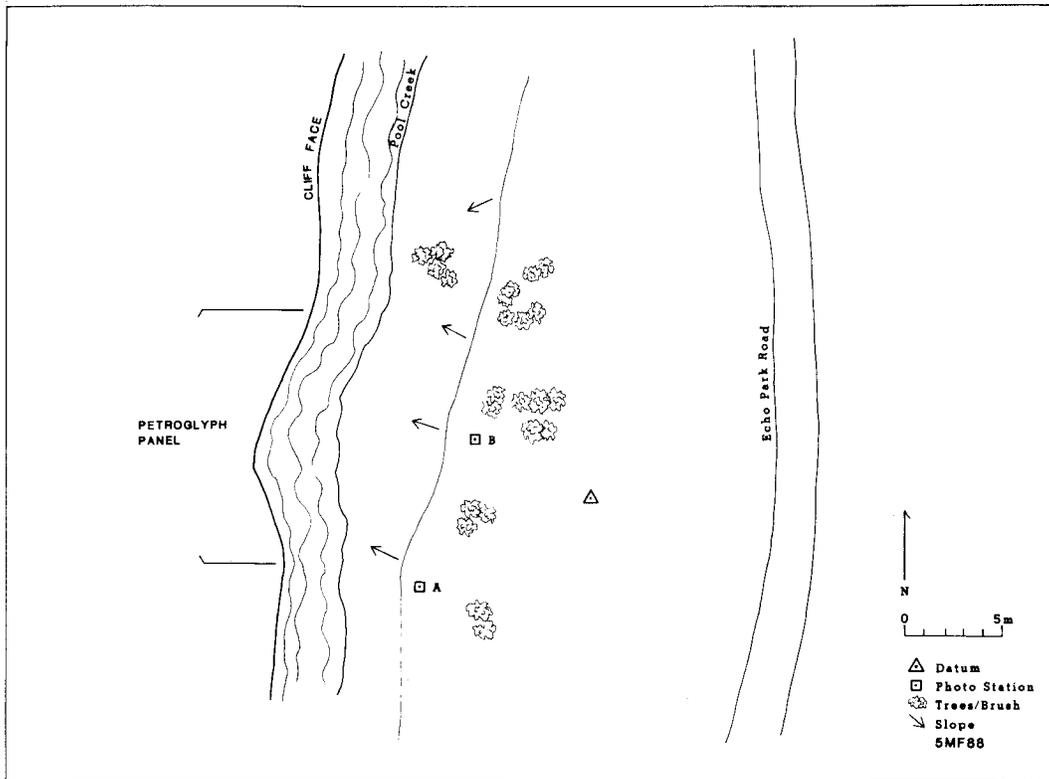
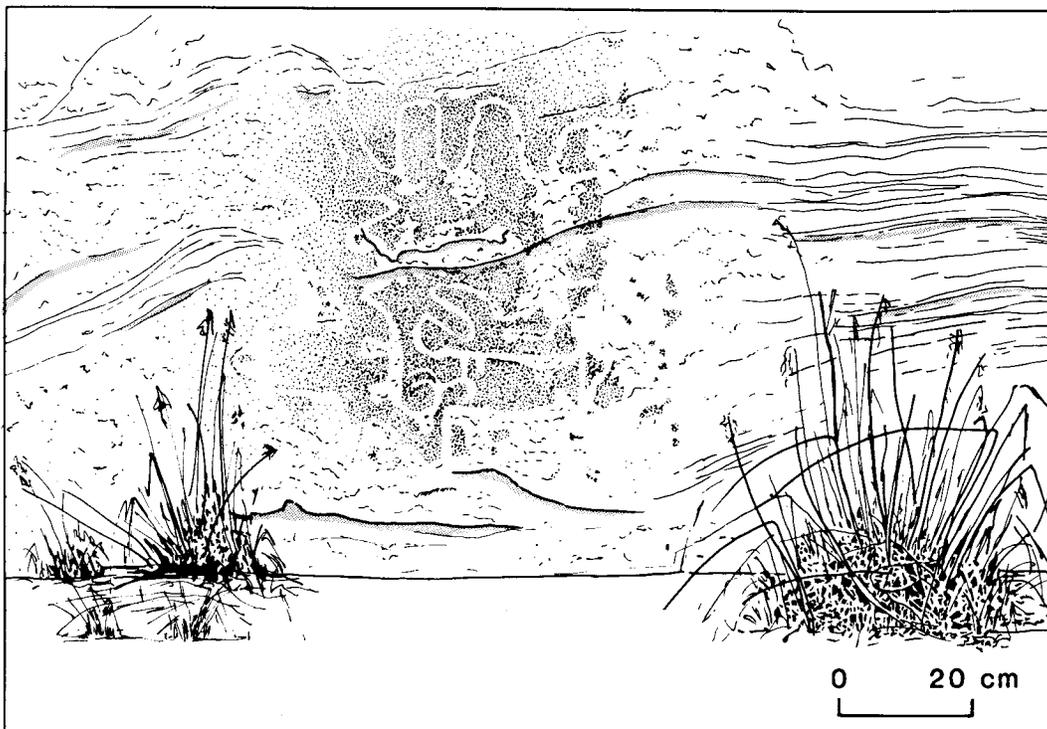


Figure 16. Sketch map of site 5MF88.



5MF157 Panel 1

Figure 17. Artists drawing of Panel 2 at site 5MF157 showing the abstract design.

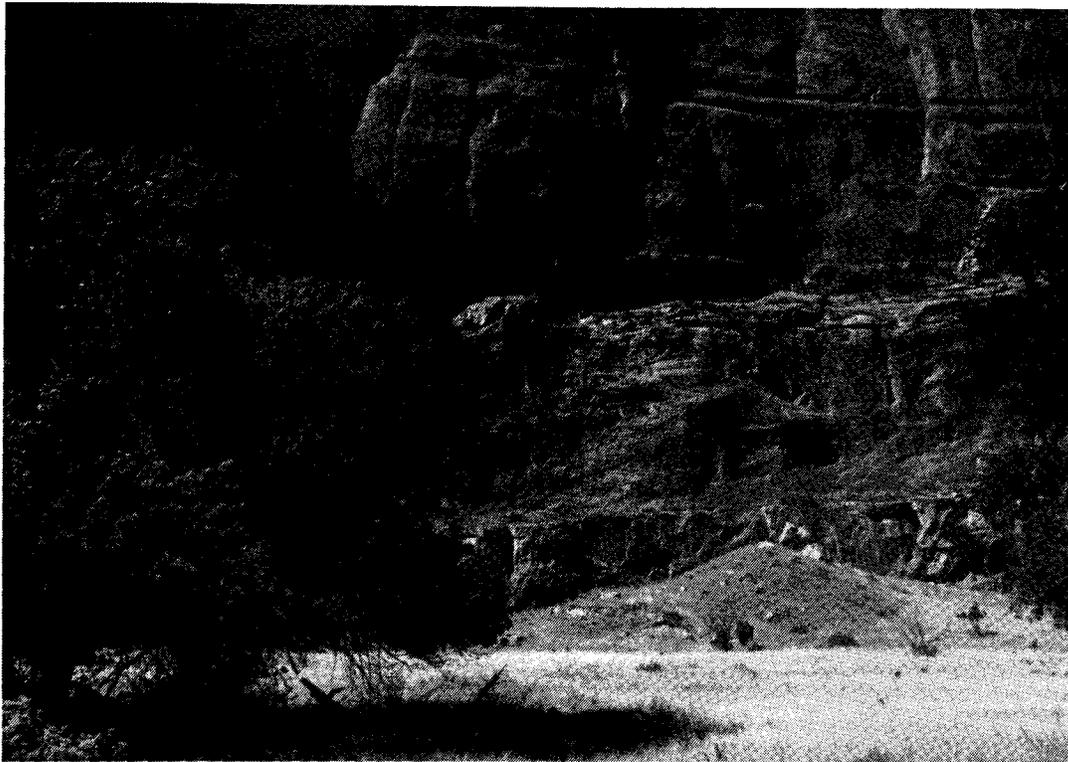


Figure 18. Panel 3 at site 5MF157. Zoomorphic and anthropomorphic petroglyphs are located at the top center of the photograph. Panel 2 is located at ground level behind the tree in the left of the photograph.



Figure 19. Morrison formation outcrop containing the petroglyphs at site 42UN45.

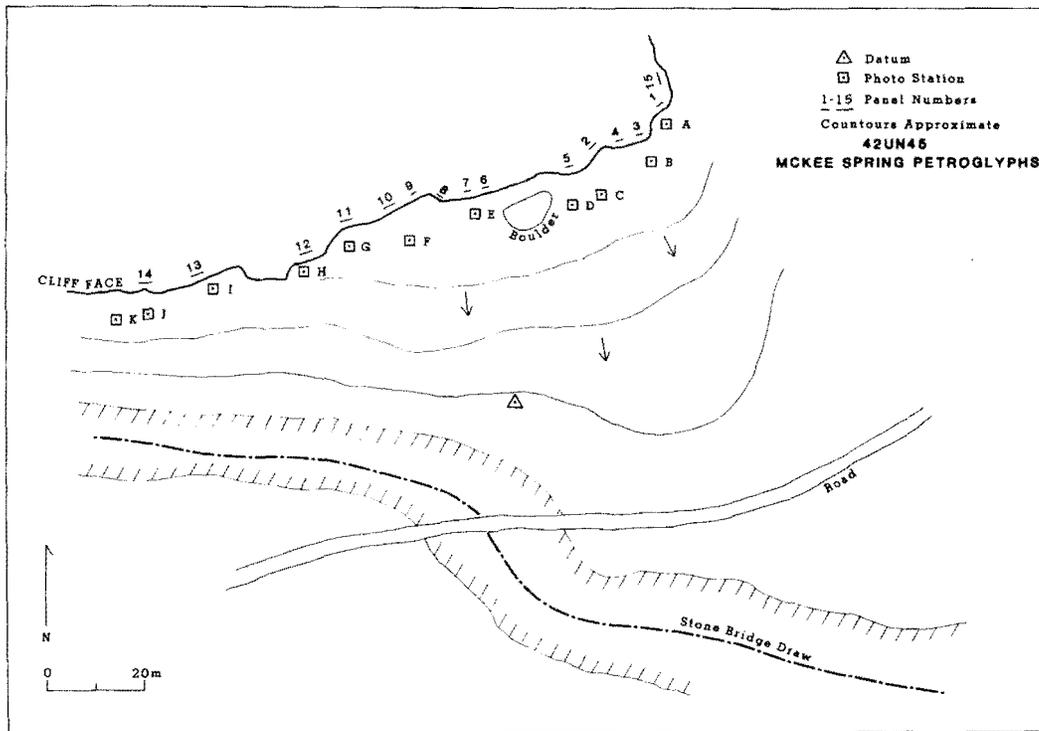


Figure 20. Sketch map of site 42UN45.

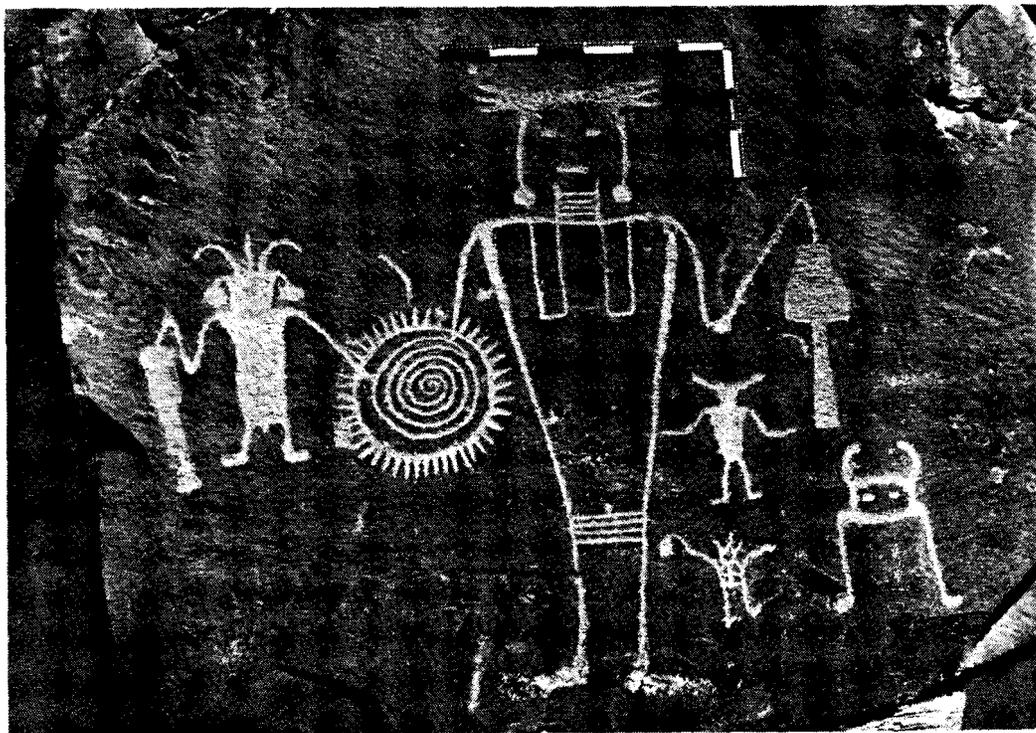


Figure 21. Example of anthropomorphic figures at site 42UN45.

ROCK ART

23). Although this work is well documented, few artifacts remain. Much of the artifact collection was lost during a flash flood in 1966, which occurred while field work was in progress. Leach documented fifteen occupation levels, interpreting intermittent use of the shelter from about 5000 B.C. to the nineteenth century.

Pictographs and petroglyphs are found along the base of a 120-meter cliff face, against which the shelter is formed. Five panels of rock art were delineated that consist of anthropomorphic and zoomorphic figures, handprints, and rectilinear, concentric, and abstract geometric figures (Figure 24). Pictographs were painted with a red pigment, with the exception of one yellow and red figure.

Abrasion by vegetation near the cliff face has enhanced erosion of some of the figures. It is unclear, however, to what extent shading of the pictographs has limited their deterioration due to ultra-violet light.

42UN179 - BIG MAN ALCOVE

The site is situated in an alcove above Jones Hole and Ely Creeks. The shelter measures over 20 meters wide, 4 meters high, and a maximum of 4 meters deep (Figure 25). Seven distinguishable anthropomorphic pictographs, all of a red pigment, characterize the interior of the rockshelter (Figure 26). Two small inverted triangles and several "smudges" and lines of the red pigment are also found within the shelter. Just outside and to the north of the shelter is a small circular pictograph (red) with lines radiating out on the top and sides. Other red pictographs in

this area of the site include a possible eroded anthropomorphic pictograph and two vertical lines. No cultural materials were observed on the surface of the site; however, Stirland (1947) noted lithic materials at 42UN180, a rockshelter located approximately 30 meters north of 42UN179.

42UN185 - DOS CIERVOS ALCOVE

This site consists of a small (2 meters x 6 meters) shallow alcove about 4 meters above and on the north side of Ely Creek streambed (Figure 27). Two zoomorphic figures are situated on the back wall of the shelter (Figure 28). These pictographs are painted with a red pigment and spaced about 50 cm apart. What appears to be charcoal graffiti or possibly historic inscriptions is scattered along the wall south of the zoomorphs. A 2- to 3-meter-high cutbank at the drip line of the alcove is being eroded by the stream. A dark lense of soil or ash is visible in the cutbank about 10 cm below the surface. Cultural material observed was limited to one cryptocrystalline flake on the surface. Another small shelter is located about 15 meters to the east; however, no cultural materials were observed on the surface in the vicinity. Another rock shelter containing ash and charcoal (42UN186) is directly north of this site along the same formation.

42UN187

The site is situated in a low rockshelter (about 2 meters high) above Ely Creek. The shelter is approximately 16 meters long and 4.5 meters deep (Figure 29). Five pictographs



Figure 22. Deluge Shelter (42UN178) during 1965/1966 excavations.

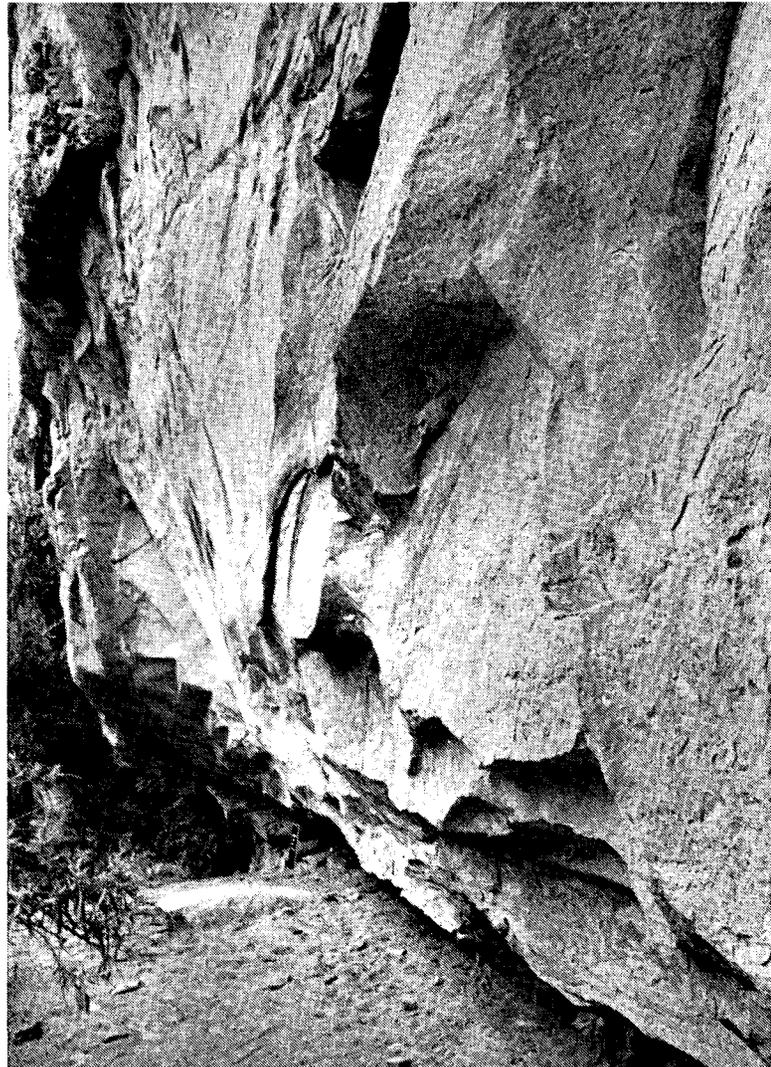


Figure 23. Deluge Shelter (42UN178) in 1988.

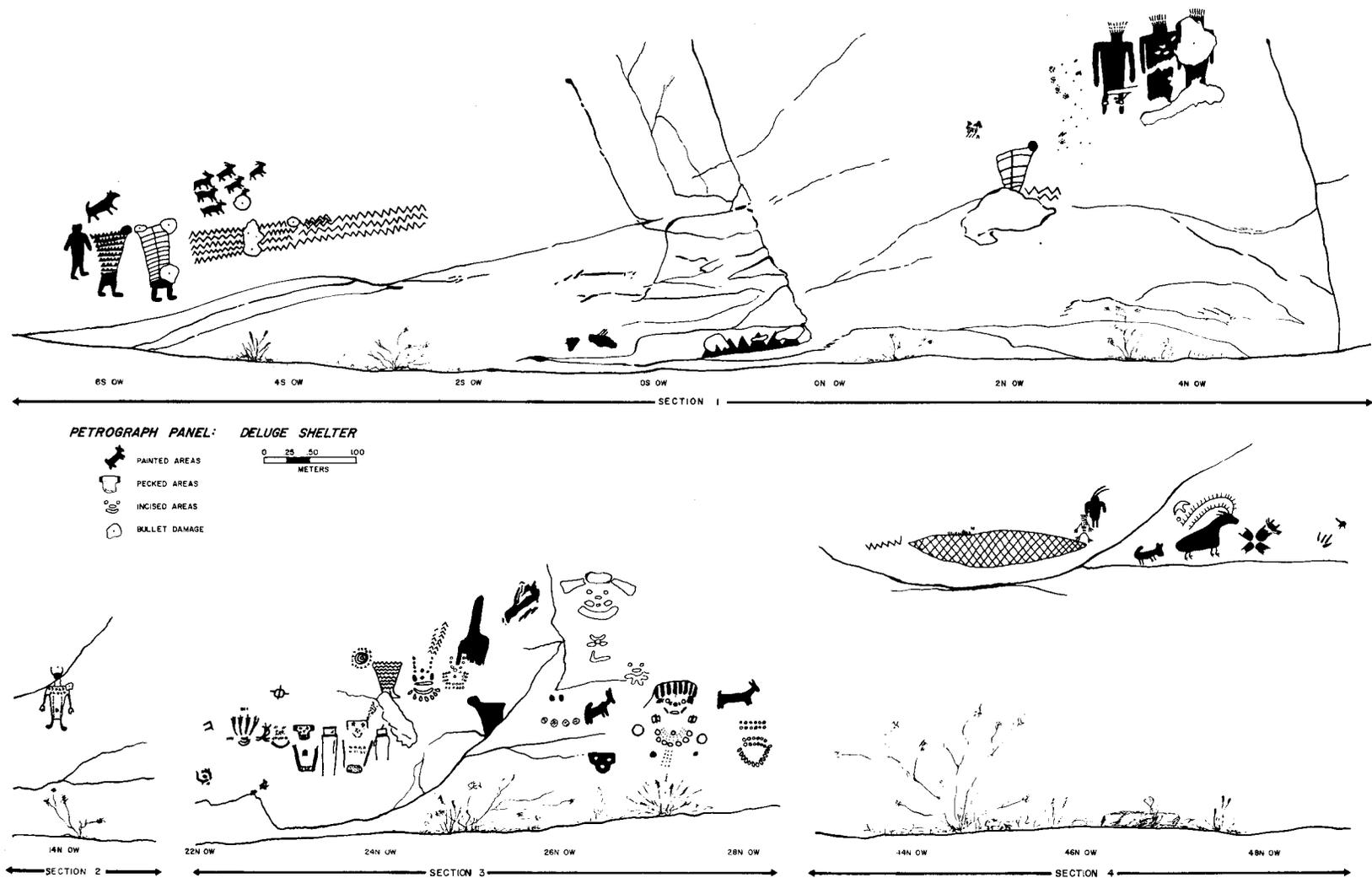
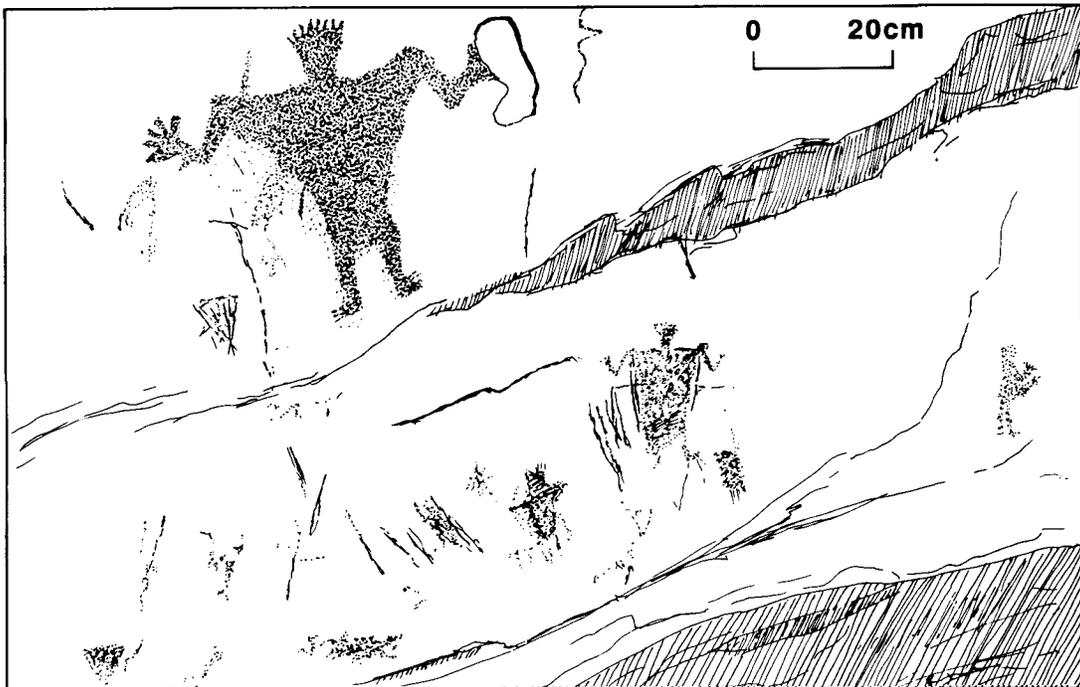


Figure 24. Some of the major rock art elements at site 42UN178 (sketch from Leach 1970a).



Figure 25. Overview of the shelter containing pictographs at site 42UN179.



42UN179 Big Man Alcove Panel 1 Detail B
Pictograph Munsell - 2.5YR 4/6 (Red)

Figure 26. Example of anthropomorphic pictographs at site 42UN179. Pictographs are red (Munsell 2.5YR 4/6).

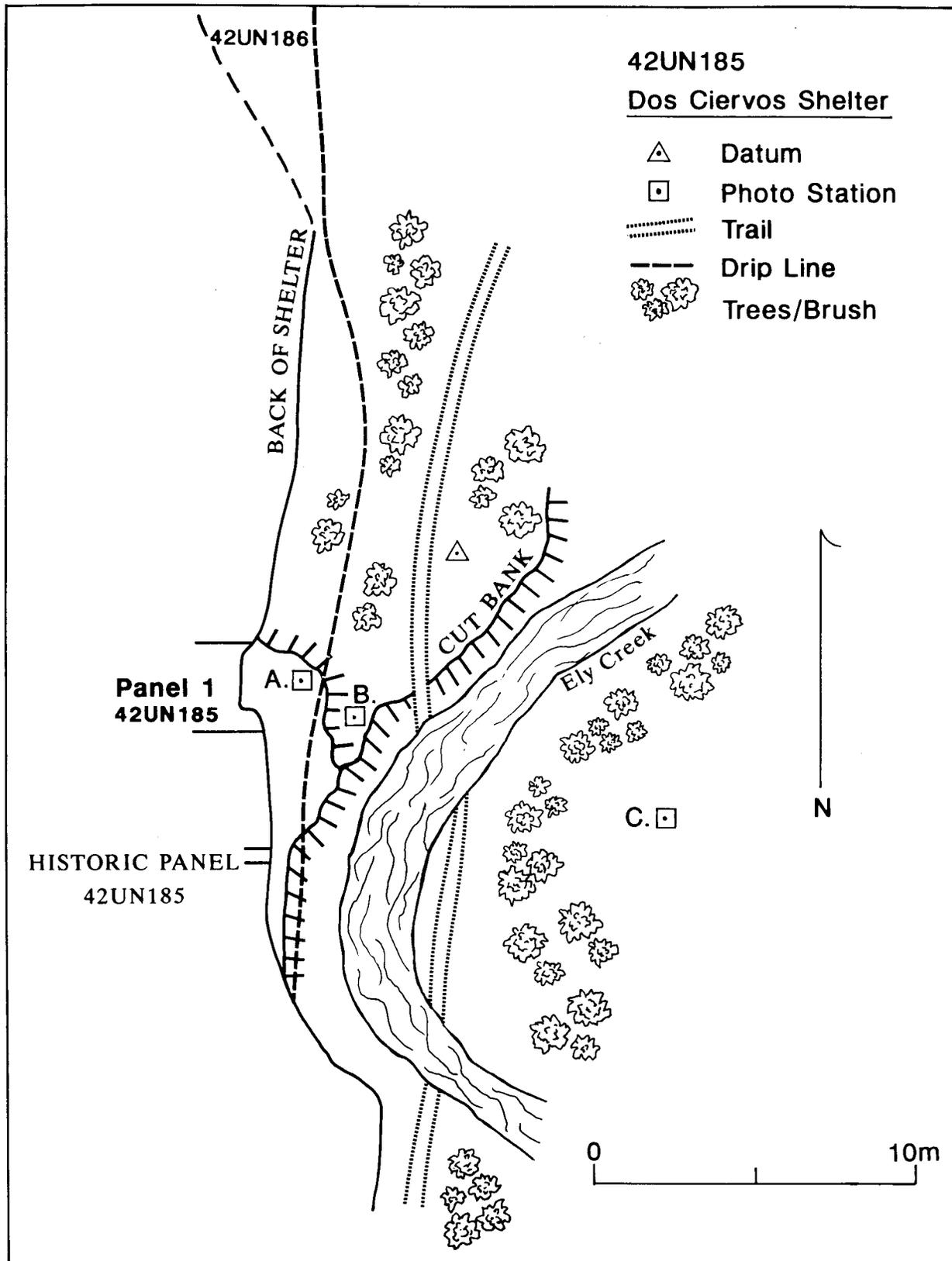
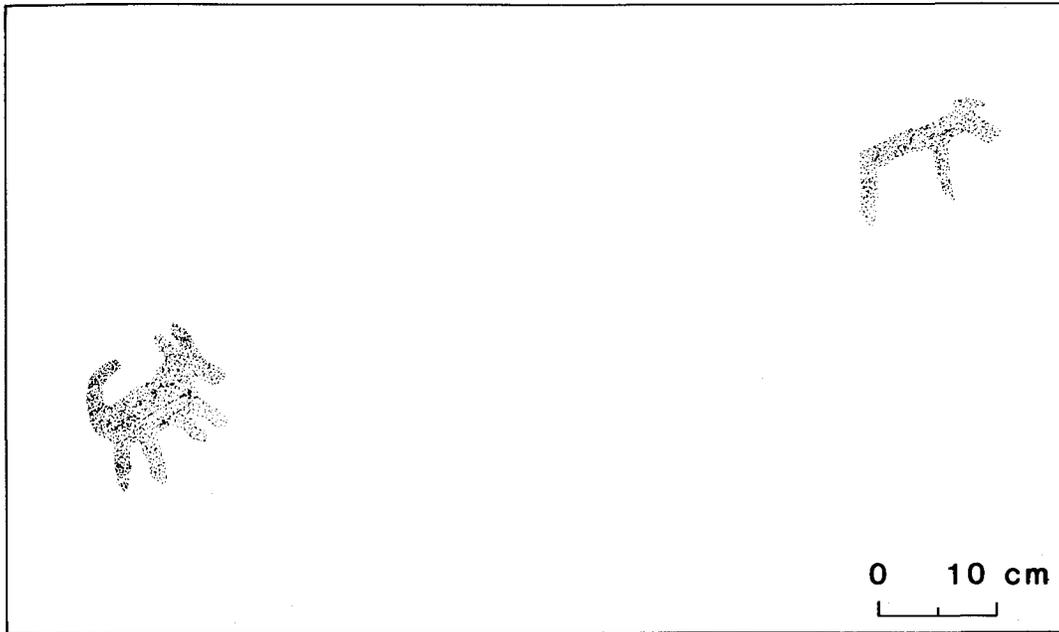


Figure 27. Sketch map of site 42UN185.



**42UN185 PANEL 1
DOS CIERVO ALCOVE**



Pecked Areas

Figure 28. Zoomorphic pictographs on the back wall of the shelter at site 42UN185.



Figure 29. Overview of site 42UN187 looking west-northwest.

ROCK ART

of a red pigment are located within the eastern end of the shelter. One is a partial handprint and the others lack apparent representation. The soil in the western end of the shelter is very dark and filled with charcoal, burned rock and bone, and dead brush. Substantial disturbance is apparently the result of "pot-hunting." Historic graffiti written with charcoal is found above this disturbance.

42UN190 - BLUEBERRY HOUSE SHELTER

This site constitutes a very large rockshelter in which the ceiling measures over 11 meters high (Figure 30). The southern portion of this site was tested in 1965 (Burton 1970). A side-notched projectile point, a drill, worked bone, and a small cache of four complete bifacial tools were recovered. A black anthropomorphic pictograph and a red figure (possibly a remnant of a zoomorphic representation) are the predominant rock art elements at the site (Figure 31). Other very small black and red pigment marks extend southeast from the distinguishable pictographs to the end of the shelter. Extensive faded graffiti and turn-of-the-century cans and wooden crate remains were observed at the site. Dense cow dung and a recent camp fire with associated trash were also observed in the shelter.

42UN192

This site consists entirely of petroglyphs, pictographs, and painted petroglyphs near the base of an east-facing

cliff overlooking Jones Creek. The site is situated north of 42UN178 along the same cliff face. One panel consists of an upright rock slab leaning against the cliff face. Figure 32 shows the artist's drawing of this panel and Figure 33 shows a photogrammetric display of this slab. Rock art consists of anthropomorphic and zoomorphic figures, and concentric, rectilinear, and curvilinear figures.

Additional figures are found on the cliff face behind and to the north of the slab. No cultural material was observed on the ground surface near the site.

42UN198 - J.P. PENTHOUSE

This complex of small rockshelters is situated high on a cliff face above the mouth of an unnamed side canyon that drains into Jones Hole Creek (Figure 34). One shelter contains two boulders sitting at right angles with a single zoomorphic pictograph (red) element positioned on each rock. A small depression between these rocks appears to have been a cache (Figure 35). Flakes of various sizes, one ceramic sherd, and three branch segments of equal length litter the interior of the shelter. These remains were likely exposed as the result of vandalism of the small cache positioned between the boulders with the pictographs. Immediately east of this shelter is another small shelter with the remains of a red pictograph placed on the top and exterior of the shelter. Another larger segment of the site includes a shelter further to the east containing numerous pictographs of a red pigment, both on the exterior surface of the shelter and on the interior walls. Many

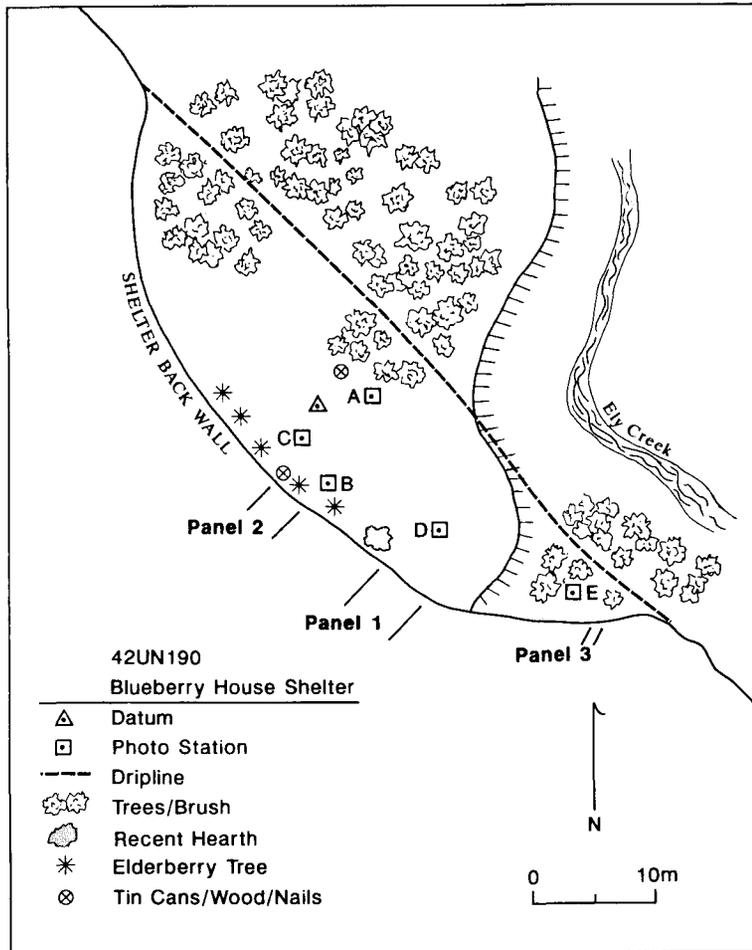
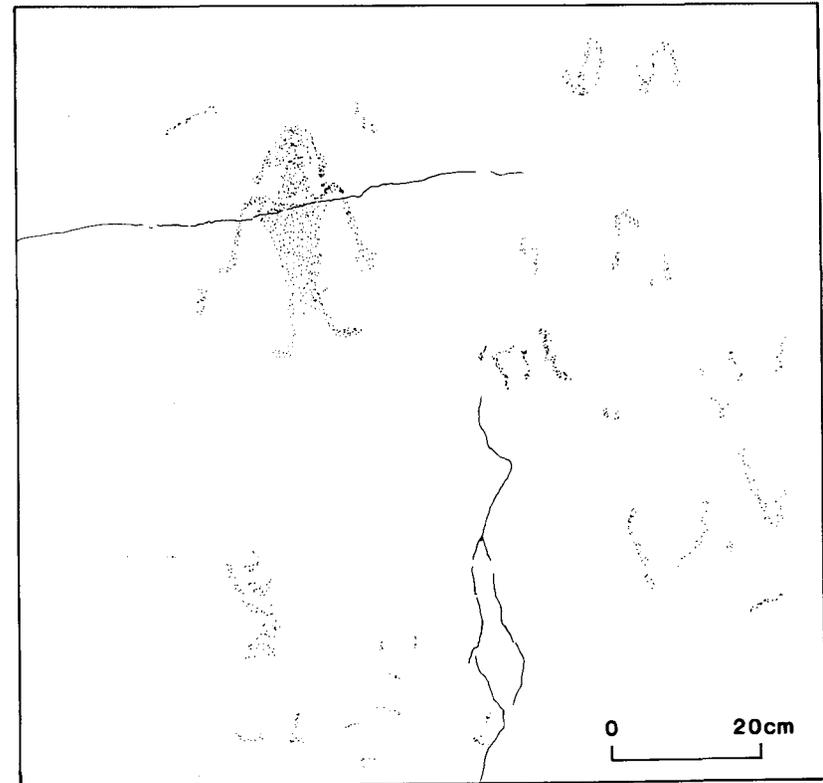


Figure 30. Sketch map of site 42UN190.



42UN190 Blueberry House Shelter Panel 2 Detail B
Pictograph Munsell - 2.5YR 4/0 (Dark Grey)

Figure 31. Pictographs on Panel 2 at site 42UN190.

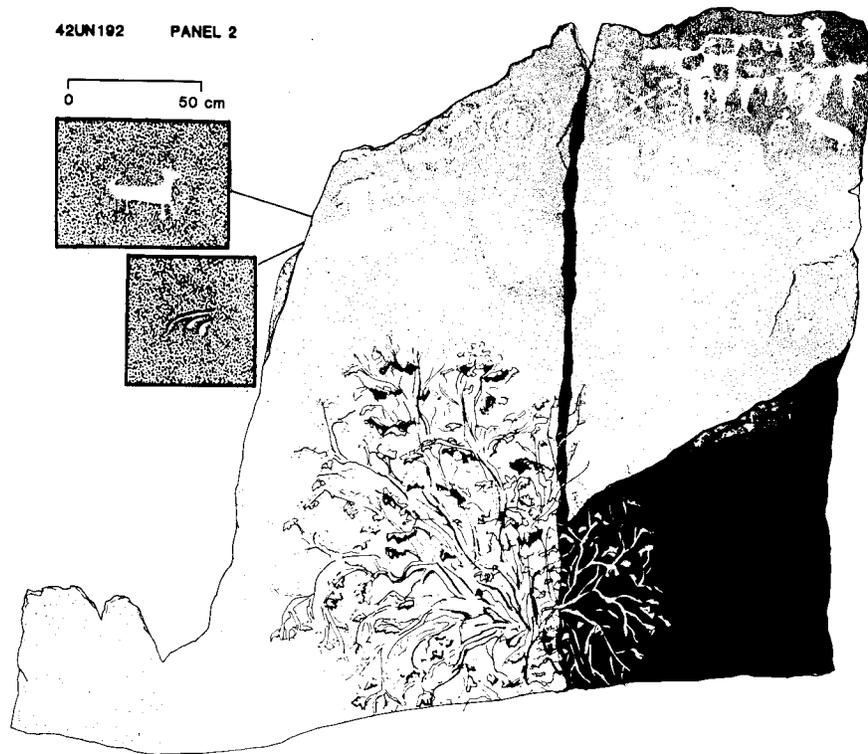


Figure 32. Artist's drawing of petroglyphs on Panel 2 at site 42UN192.



Figure 33. Photogrammetric map of Panel 2 at site 42UN192 (compare with Figure 32).

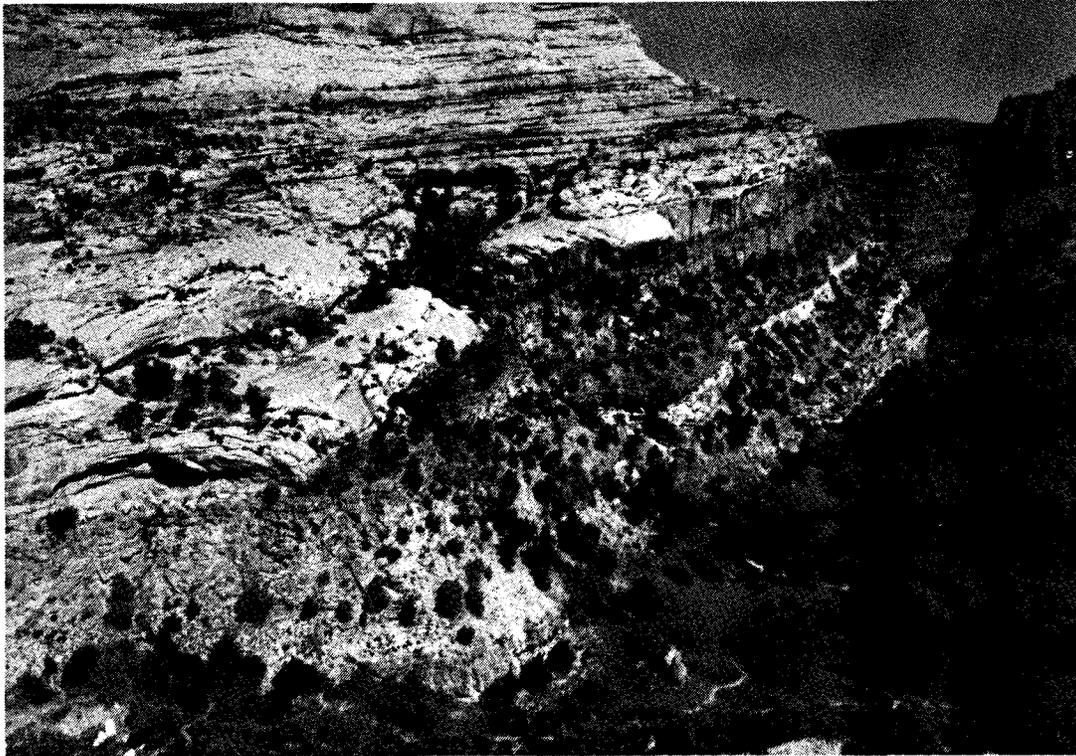


Figure 34. Overview of topography surrounding site 42UN198. Site is marked by white parentheses near center of photo.



Figure 35. Zoomorphic pictographs on boulders surrounding possible cache location at site 42UN198.

ROCK ART

of these pictographs are highly eroded, making determinations of representations difficult. Others are small circles evenly spaced around a large circle. Lithic debris is scattered throughout the shelter, and a possible retaining wall lies in front of the shelter.

42UN201 - POISON SHELTER

The site consists of a low, shallow rockshelter about 49 meters above Ely Creek. The shelter is 18 meters long and about 3 meters deep (Figure 36). One rectangular anthropomorphic pictograph is on the ceiling of the rockshelter (Figure 37). Red and black pictograph remains that are now indistinguishable are scattered throughout the shelter. The interior of the shelter is heavily spalled, creating the impression that many of the existing pictograph remains were far more elaborate in origin. Drainage in front of the shelter has formed several potholes in the slickrock that hold water for several days following rain.

42UN217 - SWELTER SHELTER

This site is a rockshelter located at the base of a Frontier Formation sandstone outcropping (Figure 38). About 1/2 mile to the south lies the Green River. This site was partially excavated in 1964 and 1965 by Leach (1970b). Extensive petroglyphs and pictographs are situated on the south- and south-east-facing walls at the rear of the shelter. The rock art includes over 40 anthropomorphic figures, five zoomorphic figures, and some apparently abstract geometric figures

(Figure 39). Several of the anthropomorphic figures have been painted with red pigment within the trapezoidal body. Although natural stratigraphy was absent, Leach (1970b) interprets the site as having been occupied intermittently from about 4000 B.C. to Fremont times (circa A.D. 1000-1100) based upon diagnostic artifacts recovered and the rock art.

42UN1244

The rock art at this site is situated along an east-facing cliff that lies about 30 meters above Split Mountain campground. The petroglyphs consist of three panels that extend in total about 70 meters along the base of the cliff. Predominant figures include several pecked and incised horses, all badly vandalized. Prehistoric figures include anthropomorphs, zoomorphs, and geometric figures. Fill at the base of the cliff is a combination of deposited river cobbles, cliff spall, and aeolian deposited sand. A restroom facility is currently located about 20 meters east of the cliff face.

Panel C is, for the most part, covered with bird droppings from nests situated in an overhang directly above these petroglyphs. The excrement has likely inhibited modern graffiti and defacement beyond that which was documented in the mid-1960s (Figure 40). However, chemical analysis of the excrement, nests, and sandstone was conducted by the National Soil Science Laboratory of the Soil Conservation Service. Results of this work suggest that over time the acidic nature of the excrement will affect the bonding of

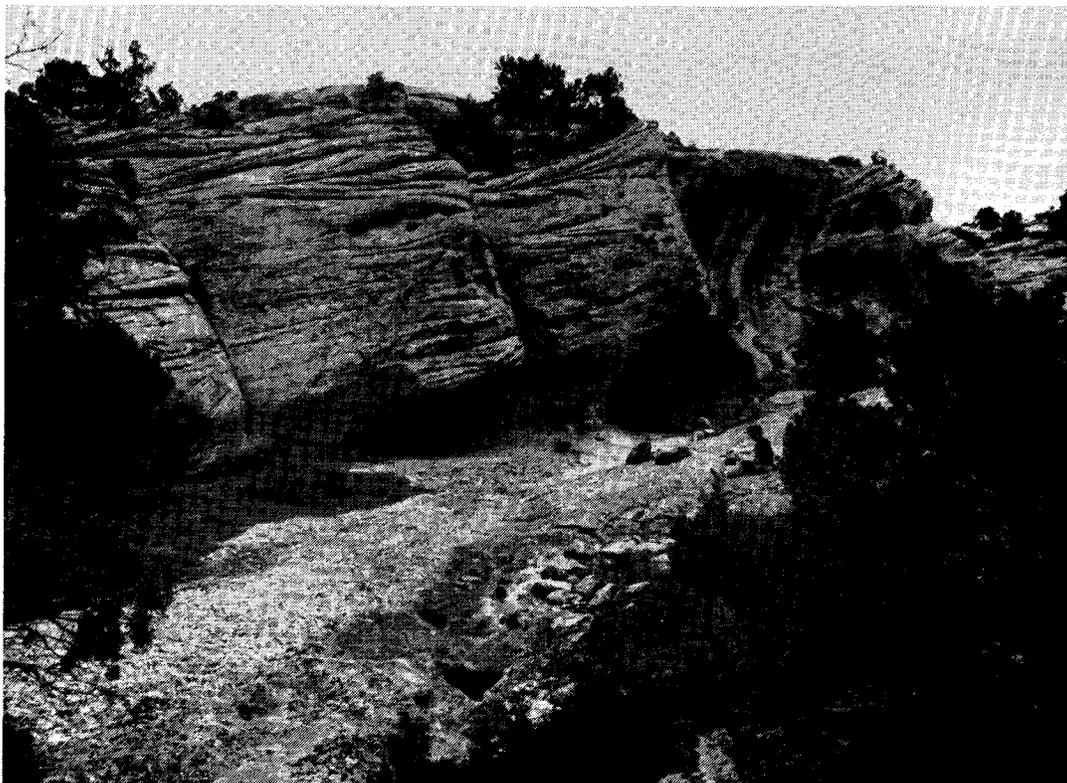


Figure 36. Overview of site 42UN201 looking north.



42UN201 Panel 1 Poison Shelter
Detail D Pictograph Munsell -
2.5YR 3/4 (Dark Reddish Brown)
0 10cm

Figure 37. Artist's drawing of anthropomorphic pictograph on the ceiling of the shelter at site 42UN201.

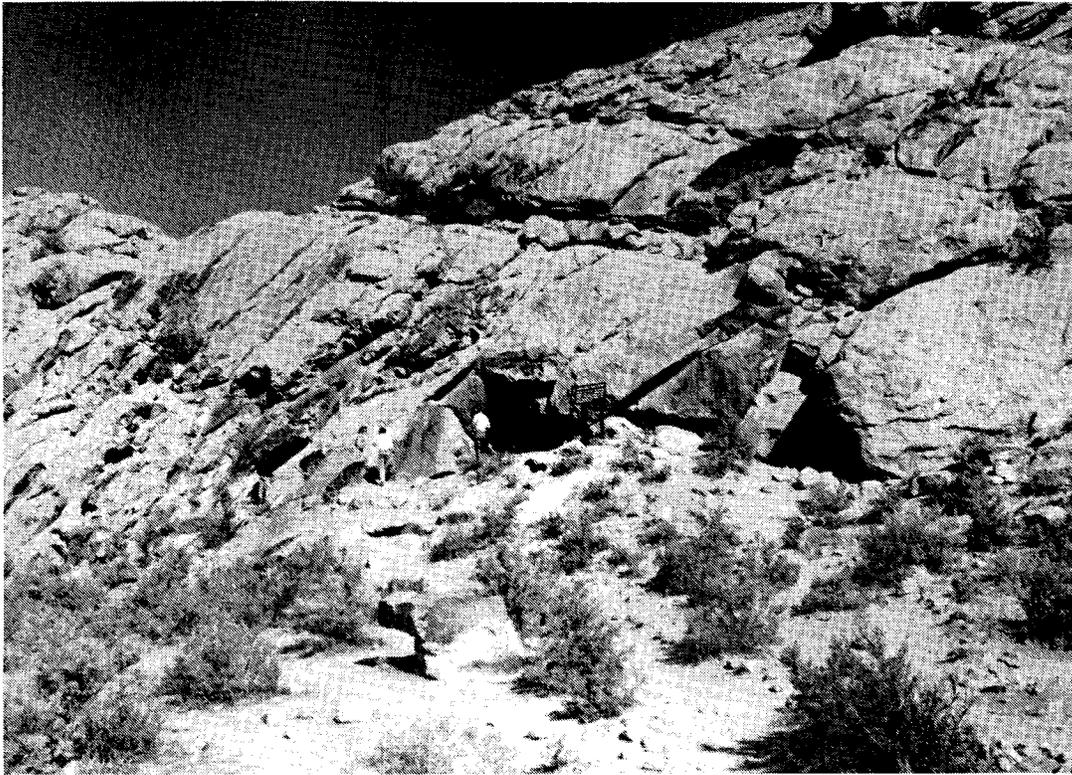


Figure 38. Overview of site 42UN217, Swelter Shelter, looking northwest.

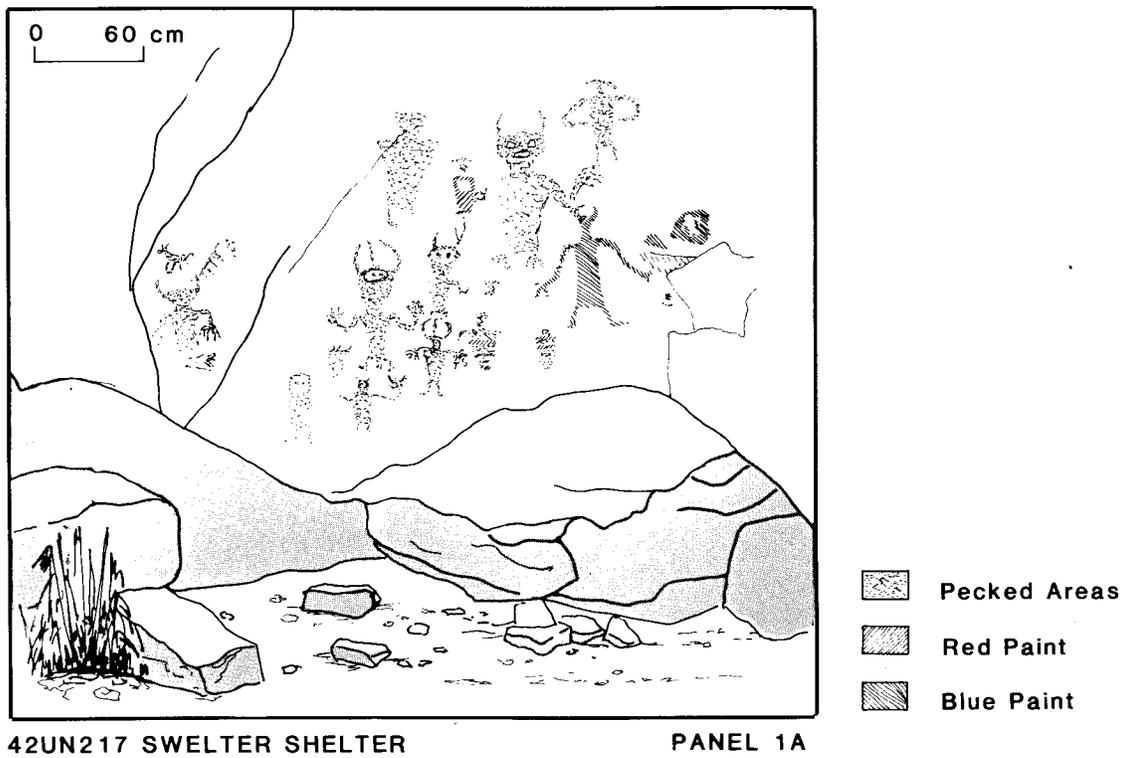


Figure 39. Artist's drawing of petroglyphs and pictographs on the west half of the shelter wall at site 42UN217 (Swelter Shelter).



Figure 40. Panel C at site 42UN1244 during the mid-1960s (top) and its condition in 1988 with bird droppings (bottom).

ROCK ART

silica in the sandstone. Freezing and thawing cycles, as well as the exposed position of the cliff face, will enhance this deterioration process.

42UN1715 - CENTIPEDE SHELTER

The site consists of a small rockshelter situated above Ely Creek and a lithic scatter on a sage-covered slope to the east and south-east of the shelter (Figure 41). Red and black pictographs are present on the interior of the shelter and on a rock face near the shelter. This shelter measures about 10 meters long and 2 meters deep. The ceiling of the shelter is very fragile. One black anthropomorph has been damaged and will likely continue to deteriorate as the result of spalling actions (Figure 42). Lithic debris of various colored cherts and quartzite is scattered on the slope down to Ely Creek. Fire-cracked rock was also observed about 10 meters below the shelter. Pictographs consist of an arrow-like element, a zoomorphic figure with many legs, and at least two remains of anthropomorphic figures.

42UN1728 - FINGERPAINT SHELTER

The site is situated in a shallow south-east-facing rockshelter and associated alcove on a ledge above Ely Creek (Figure 43). Pictographs in the shelter and alcove area consist of several "smudges" or highly eroded figures of red pigment, and approximately twenty positive handprints (Figure 44). In addition, three chert flakes and a projectile point tip were observed in the shelter. The

sheltered area measures about 17 meters in length and 3.5 meters at its maximum depth.

42UN1729

This rockshelter measures over 16 meters long and 3.6 meters deep with a low overhang at the north end. The shelter faces east above Jones Hole Creek. Pictographs located at the center of the shelter consist of two red vertical lines. No other cultural materials were observed at the site.

42UN1730

The site consists of a rockshelter over 13 meters long and 4.2 meters deep above Ely Creek. The shelter is open to the southeast (Figure 45). Five clusters of pictographs were observed, most of which are located on the ceiling of the shelter. Two of these are of charcoal markings that may be of historic or recent origin. All others are of a red pigment. Six pieces of lithic debris (chert and quartzite) were observed outside the shelter and extending onto the slickrock. The pictographs of red pigment include one arrow figure and the remains of a possible anthropomorphic figure (Figure 46). The arrow figure points 85 degrees east toward Ely Caves (42UN181 and 182) excavated by Sheets (1968). The remaining elements are not distinguishable.

42UN1731 - TALUS PETROGLYPHS

The site consists of several petroglyphs at the base of a 90-meter cliff southwest of Ely

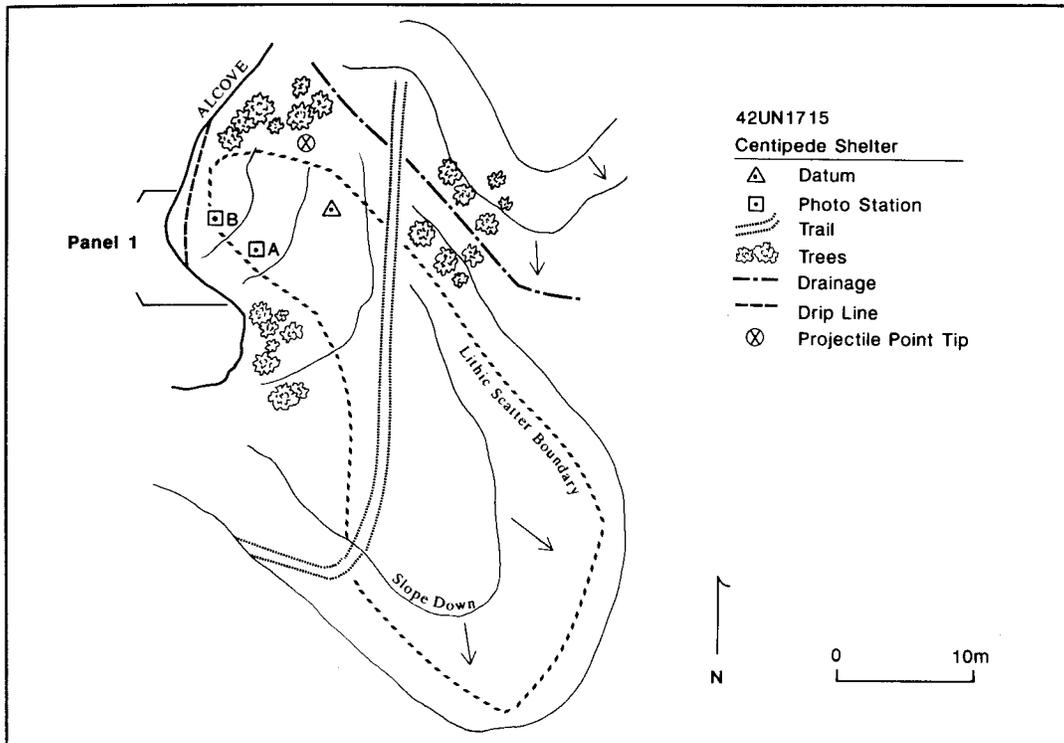


Figure 41. Sketch map of site 42UN1715.

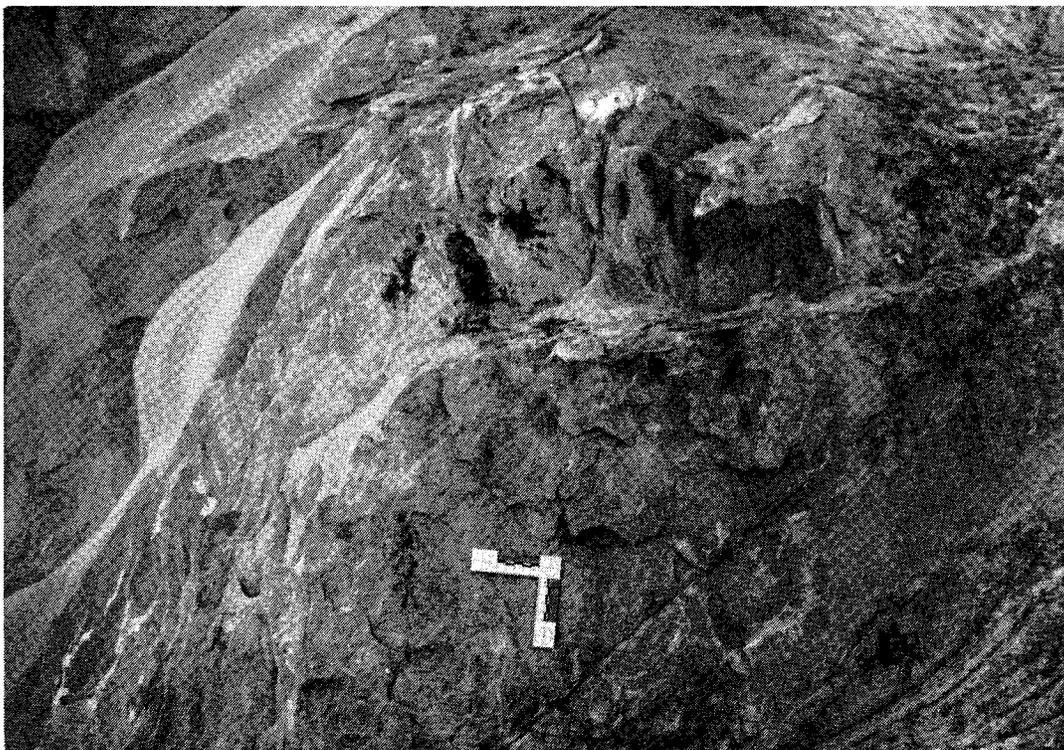


Figure 42. Black anthropomorphic pictograph on the ceiling at site 42UN1715.

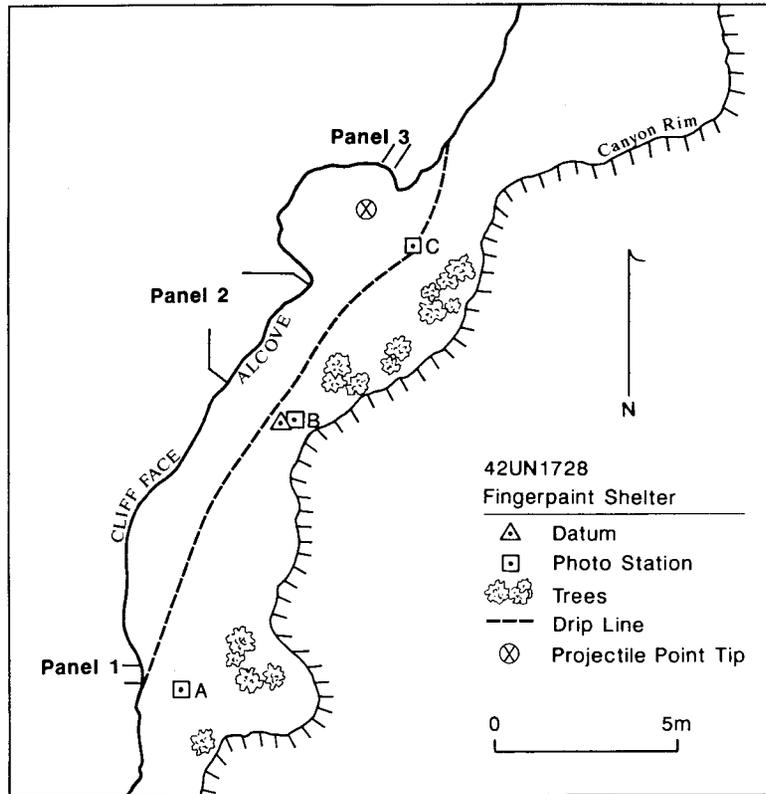
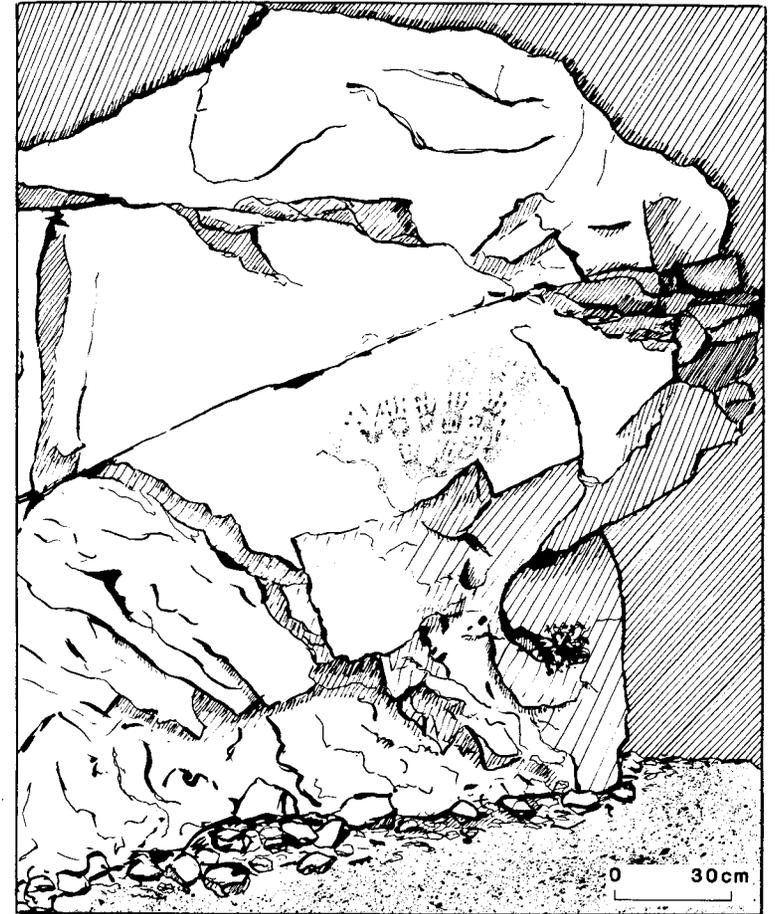


Figure 43. Sketch map of site 42UN1728.



42UN1728 Panel 2 (Northeast End)

Fingerprint Shelter

Figure 44. Artist's drawing of handprints on Panel 2 at site 42UN1728.

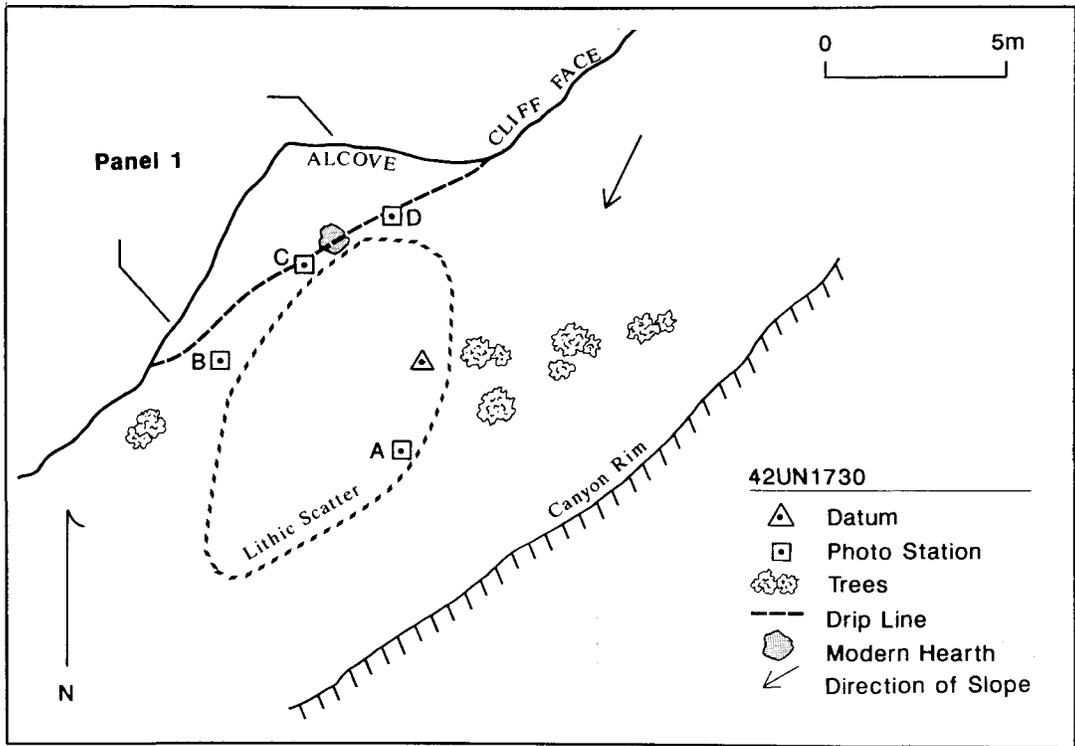
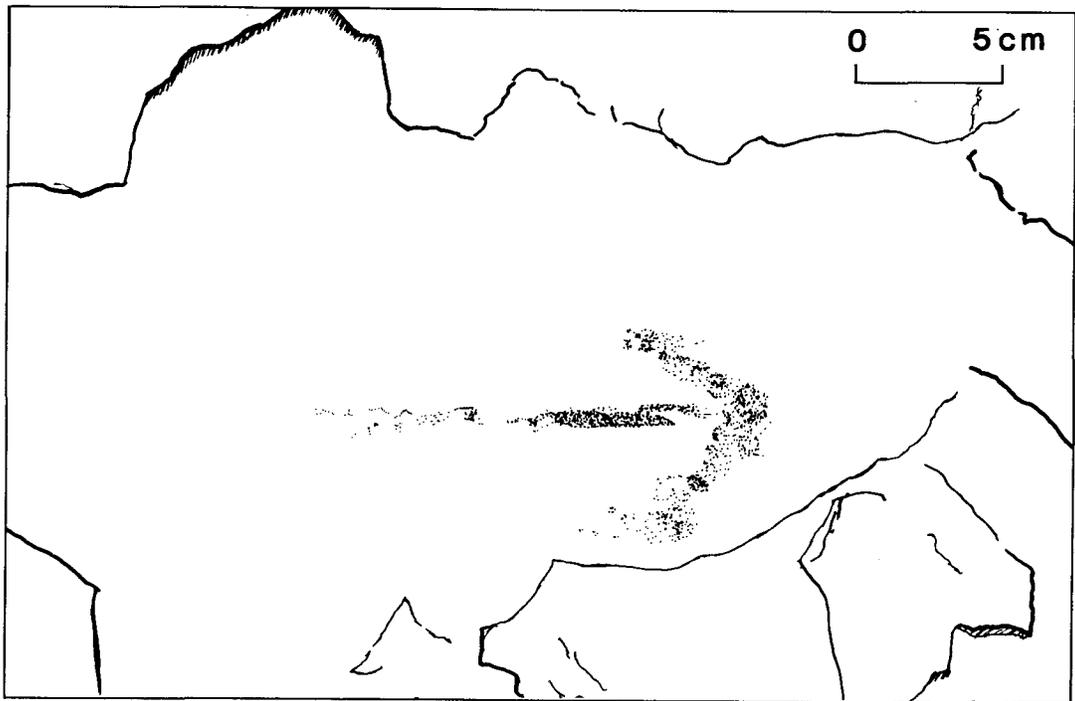


Figure 45. Sketch map of site 42UN1730.



42UN1730 Panel 1 Detail F
Munsell Pictograph - 2.5YR 4/6 (Red)

Figure 46. Arrow pictograph on the ceiling at site 42UN1730 (Munsell 2.5YR 4/6, red).

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Creek. The rock art panel contains thirteen elements; one is of a large anthropomorph with an oval body, hands, a square head with horns, and hair or ear bobs. A small zoomorphic figure (mountain sheep) appears next to the anthropomorphic head. Additional petroglyphs include circular and triangular figures, and several anthropomorphic heads with horns (Figure 47).

42UN1732 - CANYON VIEW PETROGLYPHS

Four petroglyphs and one pictograph at the base of a 90-meter cliff constitute this site. The rock art panel overlooks Ely Creek, part of Big Draw Canyon, and the confluence of Jones Hole and Ely Creeks. The four petroglyphs are anthropomorphic, ranging in size from 27 to 54 cm in height. All have rectangular bodies, arms and legs. One has apparent hair or ear bobs and horns. The pictograph is of a nonrepresentative form painted with a red pigment (Figure 48).

42UN1733 - SCARY LEDGE PETROGLYPHS

The site consists of several large petroglyph panels at the base of a 90-meter cliff near the mouth of Big Draw Canyon (Figure 49). Five rock art panels were delineated along a 35-meter span of the cliff base. Petroglyph figures include variations of anthropomorphic figures with headaddresses, necklaces, and other decorations (Figure 50). One

triangular-bodied anthropomorph is filled with small triangular shapes in horizontal rows. Rows of dots, a starlike figure, and a set of four concentric circles were also observed along a low ledge at the site.

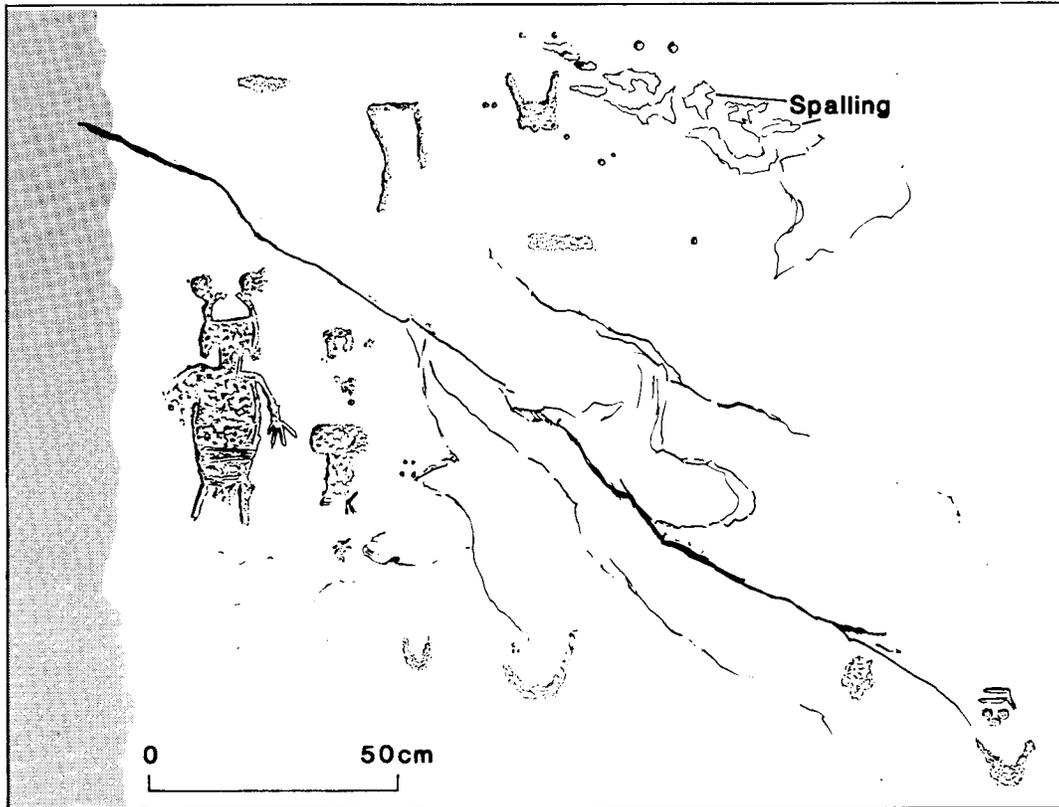
42UN1734 - THE TARGET SITE

The site consists of a historic inscription and concentric "bull's-eye" of black paint or tar near the base of a cliff in an unnamed side canyon west of Jones Hole Creek. Names and dates include: "James A Feeman;" "Joe Haslem;" "Tolydie (?);" and "5-24-06" (Figure 51).

42UN1735 - RICH-HARTLE INSCRIPTION

This historic inscription is scratched and/or grooved into a detached slab of sandstone near the top of the talus above Jones Hole Creek. Two historic anthropomorphic stick figures are placed above the detached rock on the cliff face.

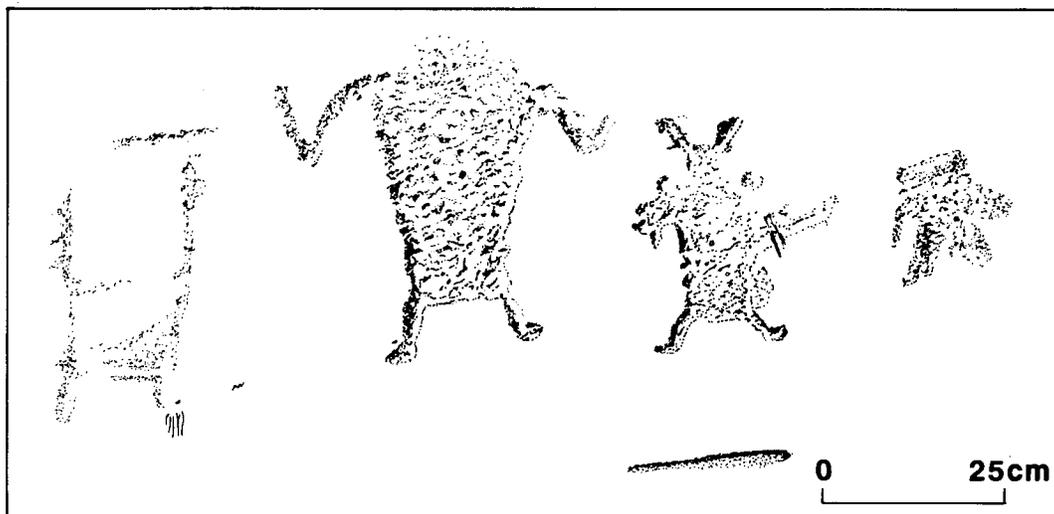
Names and dates include: "Orn" or "Orwn Rich;" "Vernal Utah Aug. 4 1916;" and "Ruben Hartle." A horse figure is placed near the center of the rock below the names and dates (Figure 52). Correspondence with Carma Hartle, a relative of Ruben Hartle, reveals that he was born March 12, 1900, lived on a farm in the area all of his life, and enjoyed fishing and hunting.



42UN1731 Talus Petroglyphs Panel 1

Mineral Stain Deposit

Figure 47. Artist's drawing of petroglyphs at site 42UN1731.



42UN1732 Canyon View Petroglyphs Panel 1

Pictograph Munsell - 2.5YR 4/6 (Red)

Figure 48. Artist's drawing of petroglyphs and pictograph (Munsell 2.5YR 4/6, red) at site 42UN1732.

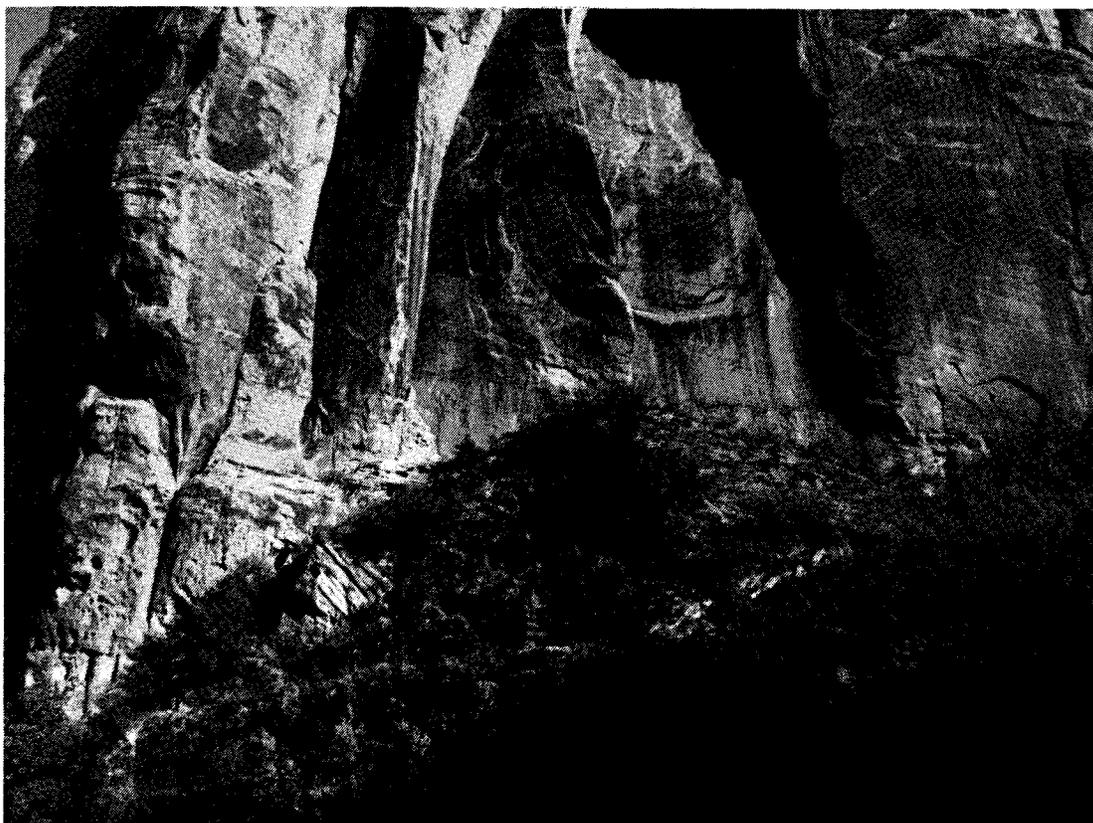
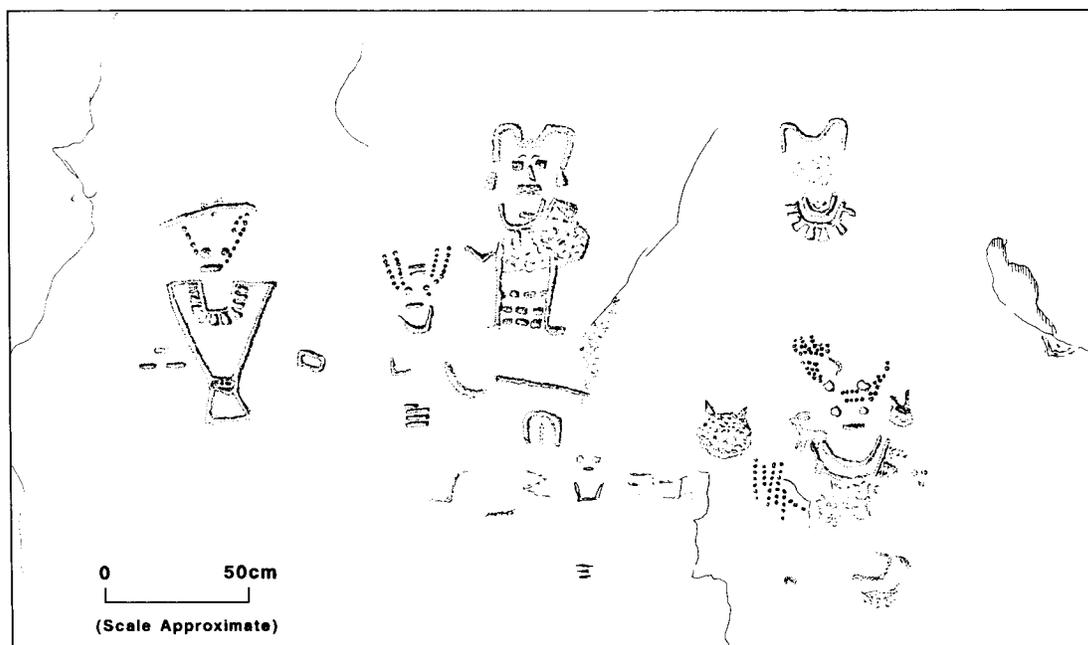


Figure 49. Overview of site 42UN1733 looking east. Ledge is at left of photo.

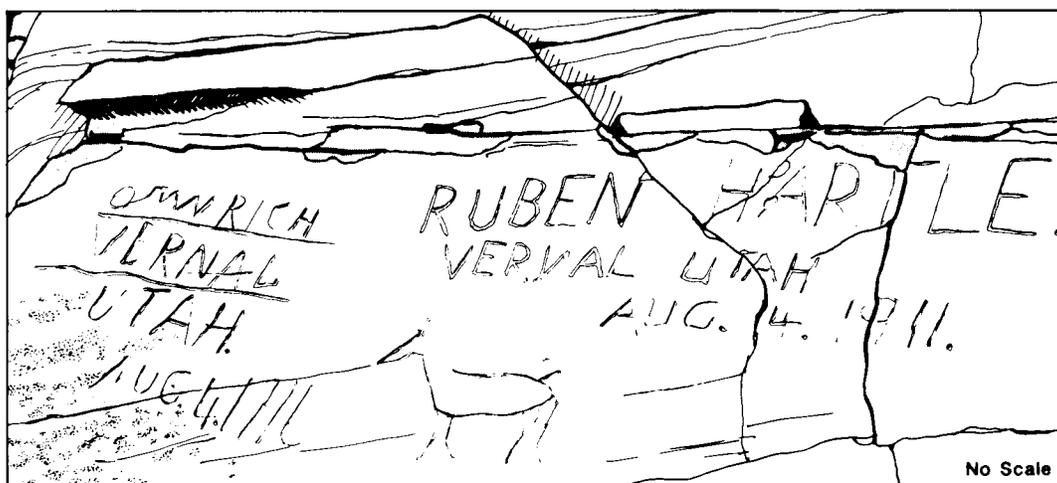


42UN1733 Scary Ledge Petroglyphs Panel 3 (North End)

Figure 50: Example of anthropomorphic petroglyphs on Panel 3 at site 42UN1733.



Figure 51. The target and names on Panel 1 at historic site 42UN1734.



42UN1735 Rich Hartle Inscription Historic Inscription

- Spalling
- ◊ Sandstone Flaking

Figure 52. Historic inscription at site 42UN1735. It is believed that both dates are 1916, although the date on the right is weathered and difficult to read.



A PERSPECTIVE ON THE ROCK ART IN DINOSAUR NATIONAL MONUMENT

INTRODUCTION

The aboriginal rock art in Dinosaur National Monument has attracted attention for decades. Historic graffiti and the imitation of prehistoric anthropomorphs dated by the artists themselves are vivid evidence of the impact prehistoric rock art had on these visitors. Investigators focusing on the rock art of the area have asked questions about this phenomenon that are common to observers of prehistoric rock art throughout the world—how old is it, who produced it, and why? This section reviews some of the means by which these general questions are being addressed, the applicability of these procedures to the rock art of Dinosaur, and in addition, some thoughts about the role rock art played in the prehistoric cultural systems of this area that should be addressed.

CHRONOLOGICAL AND CULTURAL PLACEMENT

Assigning petroglyphs and pictographs to a chronological framework is a goal that is frustrating and often has required investigators to immerse their research in assumptions that are in need of critical evaluation. Both relative and absolute dating techniques have been employed in the Intermountain West, but no absolute dating procedures have been attempted in the Monument or its vicinity. Neutron activation, x-ray fluorescence, cation-ratio, and reflectometer techniques have been employed to measure the age of desert varnish and petroglyph patination in the Great

Basin and southeast Colorado (Bard 1979; Whitley 1982; Dorn and Whitley 1983; Whitley and Dorn 1984; Whitley et al. 1984; Loendorf 1989; Dorn 1990a, 1990b; Loendorf and Kuehn 1991). Attempts at carbon-14 dating with accelerator mass spectrometry (AMS) of organic matter collected beneath desert varnish and of organic pigments in pictographs have had mixed results (Van der Merwe et al. 1987; Conard et al. 1988; Dorn et al. 1989; Russ et al. 1990). Recently, however, human blood protein as a constituent of red pigments in pictographs in northern Australia and Tasmania has been dated using AMS procedures (Loy et al. 1990). All of these techniques are continually being revised. The use of these procedures will undoubtedly produce means by which we can generate independent lines of evidence regarding the age of petroglyphs and pictographs. For example, sixty-one cation-ratio dates of rock art panels near the Purgatoire River in southeast Colorado have been completed to help establish the chronological sequence of prehistoric and protohistoric activities associated with rock art in that area (Loendorf 1989, 1991; Loendorf and Kuehn 1991). Although there is no generally accepted measure of the absolute age of rock art, continual attempts to experiment with these and other dating methods is the means by which science is operationalized and procedures are improved (cf. Dorn 1990b).

Dating rock art by associative methods is by far the most widely used method on the Colorado Plateau. In many instances, petroglyphs and pictographs are found in close proximity to artifactual or structural remains

ROCK ART

which may be datable by either absolute or relative means. Structural remains sometimes contain timbers conducive to dendrochronological methods of dating, and remains of features, such as hearths, may contain organic material which can be dated by absolute means. More often than not, however, nonorganic artifacts such as ceramic fragments, lithic tools, and/or structural remains are found. In this case, archeologists attempt to date these artifacts, based on their physical attributes. These artifacts are assumed to be, more or less, contemporaneous with other artifacts of similar type or character that may have been found in contexts where absolute dating was conducted. In either case, rock art is often assigned a chronological and cultural placement relative to its proximity to other datable remains at a site. The underlying assumption in this reasoning is that the rock art is contemporaneous with other artifacts or features present at a particular site. The potential problems inherent in this approach are obvious. We know that places where rock art, structures, and other prehistoric artifactual remains are observed likely experienced multiple visits during the course of several hundred or thousand years. We can not assume that the elements of an assemblage of rock art were all produced at the same time or even within a brief period of time.³ The superimposition of figures over others at some sites in Dinosaur constantly brings that possibility to our attention.

It must be recognized that the chronological assignment of rock art often relies heavily on inferences from other artifactual features in a given area. The literature about rock art in northwest Colorado and elsewhere

on the northern Colorado Plateau is littered with what at first appear to be conclusive statements about the temporal and cultural placement of specific images. What is actually being observed are the perceived similarities of certain morphological shapes and their distribution across the landscape. These "styles" of rock art are then associated in space with other "cultural traits" (particularly material aspects of culture) assigned to spatiotemporal placement related to a socio-cultural system (e.g., Turner 1963, 1971; Cole 1987, 1990). Underlying the interpretation that results from "style-mapping" is the assertion that a particular style is the product of a particular historical sociocultural entity (Schapiro 1953; Levine 1957). Distributional patterns of apparent morphological similarities cannot be denied, yet caution is warranted when explanations for these patterns are couched in cultural historical terms (cf. Haskovec and Sullivan 1989). Explanations of rock art element distribution based on assignment of patterns to archeologically constructed "cultures" are themselves defined on the basis of spatial variation in material remains of a technological nature.

Most qualitatively oriented studies of rock art in the Intermountain West have begun with the same objective, the assignment of temporal and cultural placement to the distribution of subjectively defined "styles," "motifs," "elements," or "types" (e.g., Steward 1929; Heizer and Baumhoff 1962; Schaafsma 1971; Heizer and Clewlow 1973; Wellmann 1979; Cole 1987, 1990; Faris 1987). Both Castleton (1979:5-7) and Wellmann (1979:99), two researchers that have compiled important syntheses of Colo-

rado Plateau and Great Basin rock art, strongly suggest that researchers be extremely cautious about assigning age and cultural affiliation to rock art based on style. Recent evaluations of assumptions about rock art styles in southeastern Utah (Manning 1990) and northern Wyoming (Loendorf et al. 1991; Francis et al. 1991) have revealed irregularities in "style" dating, exemplifying the need to not be content with dating and cultural assignment on the basis of morphological similarities alone.

Table 5 represents our attempt to associate rock art documented in 1988 and 1989 with other sites and "styles" in the region. Cited references are those considered well known to researchers of the study area. It is imperative that this table be used with caution, for permutations of style definitions are subject to the inclinations and intent of the investigator. Figure 53 represents the approximate time period associated with the various styles as assigned by the researchers listed. Examples of elements from sites in Dinosaur National Monument that compare with these styles are depicted in Figures 54 through 57, and Figure 58 depicts images that do not compare with any defined "styles" in the surrounding area. The two historic sites documented in 1989 were not included in this analysis.

THE INTERPRETATION OF ROCK ART

Interpretations of the motivation underlying prehistoric rock art production include a broad range of ideas such as associations with hunting magic, astronomical sig-

nificance, medical or magico-religious activity, fertility cults, or production as the result of drug-induced visions. Prehistoric rock art elicits these kinds of interpretations throughout the world, and the use of and perspectives about rock art images by aboriginal peoples in various parts of Australia lend credence to these interpretations (e.g., Blundell and Layton 1978; Blundell 1982; Mowaljarlai et al. 1988).

Interpretations of prehistoric rock art on the Colorado Plateau and elsewhere are often laden with an assignment of "meaning" to the images. "What does it mean?" is an oft-times cited question presented by archeologists and the public alike. Implicated in this question is the presumed responsibility of professional archeologists to reconstruct the mental life of prehistoric peoples. As argued elsewhere (Hartley 1992a), an aboriginal participant in a prehistoric cultural system might well tell us why he or others produced rock art, why it is located in a particular place, and what it "meant" to him. These responses would need to be recognized, however, as a function of sociocultural reasoning that would likely be of little value in answering questions about the long-term adaptive functioning of their socioeconomic system (cf. Parkington 1989:25; Gould 1990) which, purportedly, is a fundamental goal of contemporary anthropological archeology.

It is asserted here that "meaning" associated with prehistoric rock art cannot be reconstructed, for intent and significance of the phenomenon to prehistoric and contemporary peoples alike is vulnerable to variability and change among individuals through time. Knowledge of emic constructions in the

ROCK ART

Table 5. Rock art styles present at sites recorded during 1988 and 1989 in Dinosaur National Monument.

	CVS	SRF	FRE	UNK	BM	BCS	UCS	UTE	ALS	ABS
5MF87				X*						
5MF88	X									
5MF157	X	X								X
42UN45		X	X	X						
42UN178		X		X			X			
42UN179				X						
42UN185					X					
42UN187					X					
42UN190		X								
42UN192			X			X				X
42UN198					X					
42UN201						X	X			
42UN217			X	X						
42UN1244			X	X				X	X	
42UN1715						X		X	X	
42UN1728				X						
42UN1729					X					
42UN1730					X					
42UN1731		X	X							
42UN1732		X	X							
42UN1733		X		X		X				

NOTE: References consulted concerning style include Schaafsma (1980), Cole (1987) and Tipps and Hewitt (1989).

Elements at these sites in the monument are considered "comparable" to the styles listed as present at each site in this table.

- CVS = Classic Vernal Style
- SRF = San Rafael Fremont (Northern and Southern)
- FRE = Fremont
- UNK = Unknown
- BM = Basketmaker (San Juan Anthropomorphic Style)
- BCS = Barrier Canyon Style
- UCS = Uncompahgre Style
- UTE = Ute, Paiute (and/or other historic Indian)
- ALS = Abajo-LaSal Style
- ABS = Abstract (Great Basin Abstract and/or Abstract Tradition)

* Analysis of this site was not complete enough to allow classification

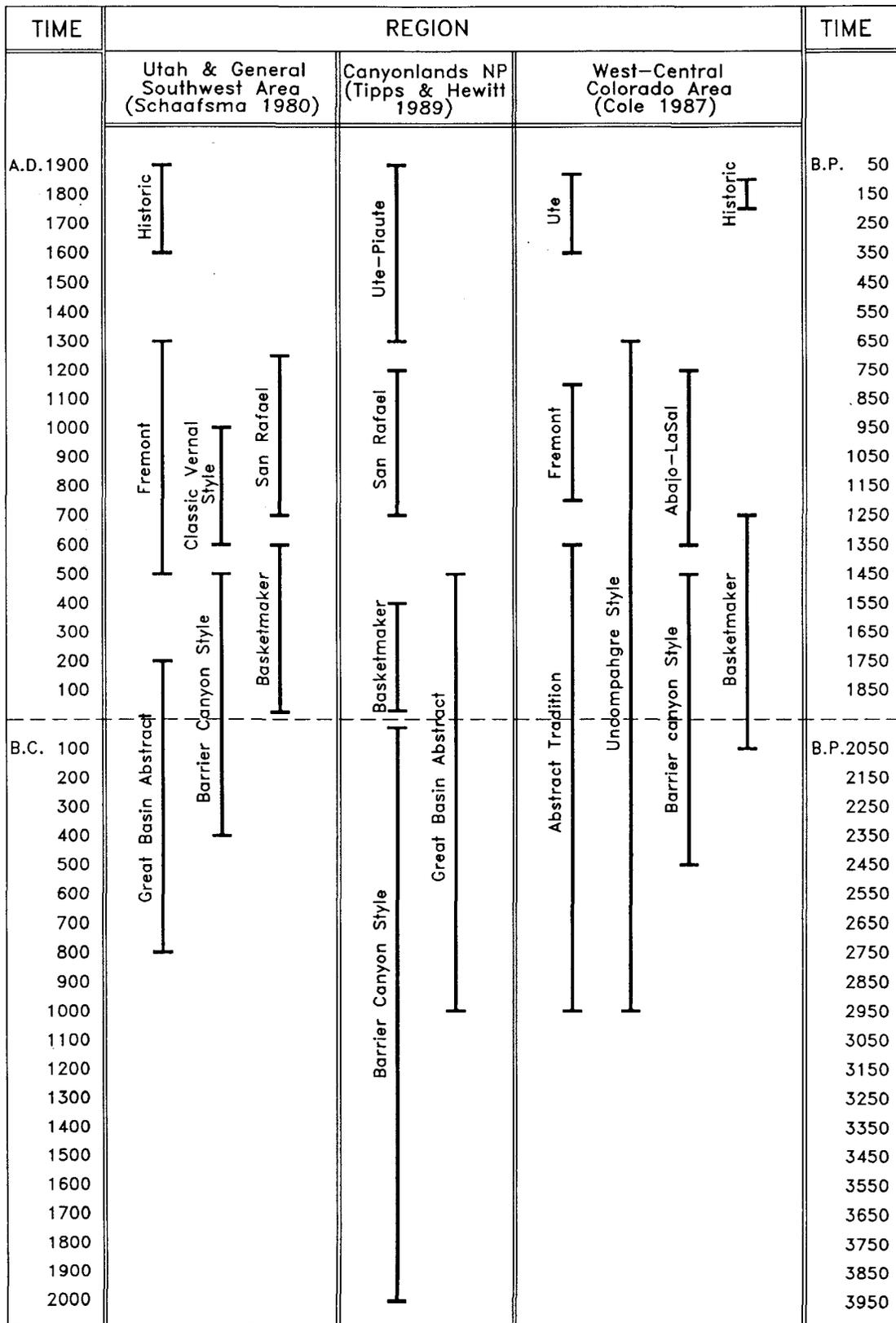


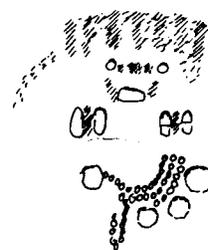
Figure 53. Approximate dates/time ranges associated with the various rock art styles as assigned by specific researchers.



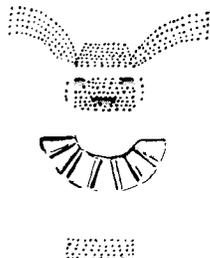
42UN45



42UN1733



42UN178



5MF88



42UN1733



42UN45



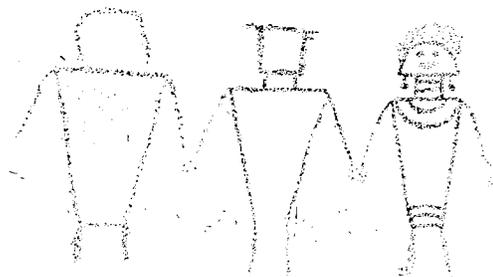
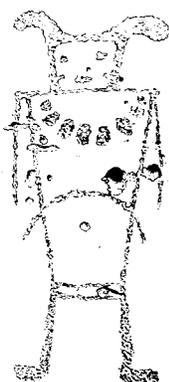
42UN1733



42UN178



42UN190



42UN45



Figure 54. Classic Vernal Style (compare with Schaafsma 1971:9-23 and Cole 1987:192-196).



42UN179



42UN1244



42UN178



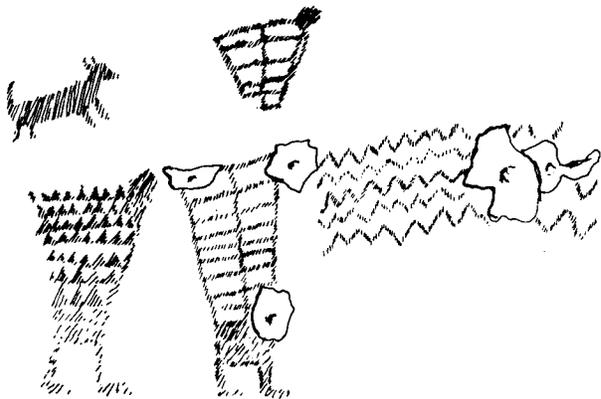
42UN1733



42UN179

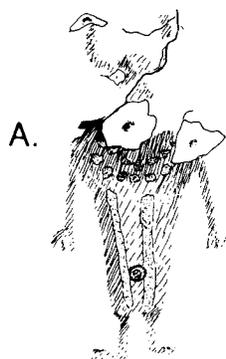


42UN1728



42UN178

Figure 55. Fremont rock art style (compare with Cole 1987:193 and Castleton 1979:43, 54, 79, 80).



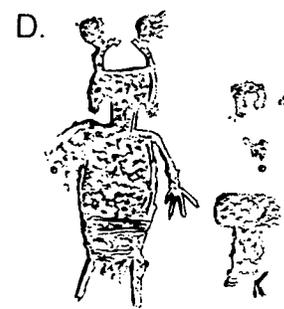
42UN178



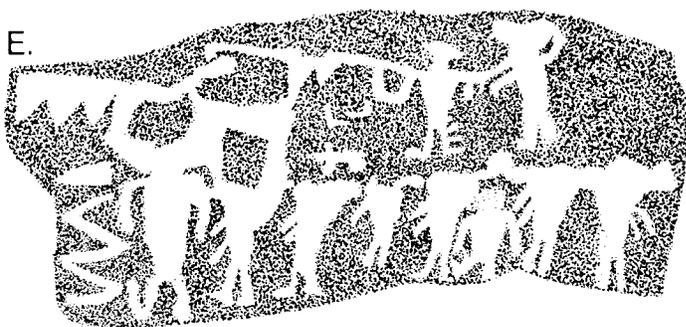
42UN217



42UN1732



42UN1731

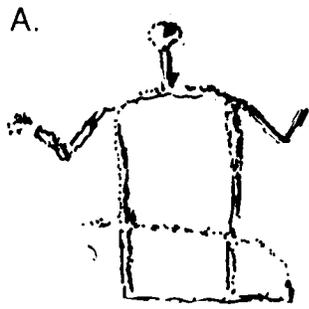


42UN192



42UN201

Figure 56. Rock art styles. a. and b. Fremont or San Rafael Fremont, (compare with Schaafsma 1971:31-33 and Castleton 1978:52-53); c. and d. San Rafael Fremont or Classic Vernal style (compare with Schaafsma 1971:18-19, 30-33); e. and f. Abajo-LaSal style or Basketmaker (compare with Cole 1987:170-182).



42UN1733



42UN1733



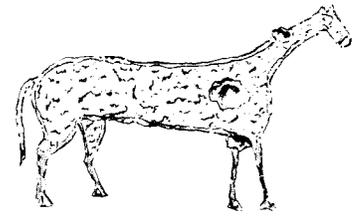
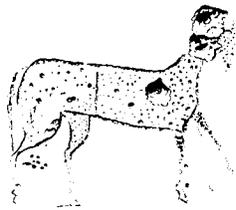
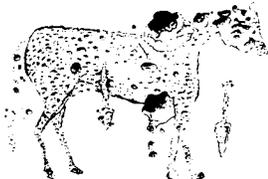
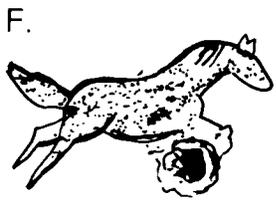
5MF 157



42UN1715



42UN178



42UN1244



42UN178

Figure 57. Various styles of rock art. a. and b. Basketmaker (compare with Schaafsma 1971:140); c. Abstract (compare with Abstract Tradition [Cole 1987:82] and Great Basin Abstract [Tipps and Hewitt 1989:22]; d and e. Uncompahgre style (compare with Cole 1987:90, 104); f. Ute (historic) (compare with Tipps and Hewitt 1989:24 and Cole 1987:229-233); g. Barrier Canyon style (compare with Schaafsma 1971:72-79).



42UN1730



42UN179



42UN1733



42UN198



42UN185



42UN1715

Figure 58. Unknown styles. These element styles do not compare with any "defined" style for the surrounding area.

life of prehistoric peoples as advocated by postprocessualist and antipositivist research cannot contribute to "predictive or retrodictive nomothetic theories about the evolution of sociocultural differences and similarities" (Harris 1990:53-54). In anthropological archeology, as Harris (1990:60) points out, etic descriptions of behavioral phenomena increase in importance with the time span over which one seeks explanations for these differences and similarities. Our interests in this study are simply to further an understanding of the role of petroglyphs and pictographs in the prehistoric cultural system without presupposing a need to describe the ideologies of those peoples.

The location or position of rock art in the physical environment is also a subject of interpretation that has caught the attention of archeologists in their attempt to integrate rock art more directly into the realm of socioeconomic investigations. For example, associations between game migration trails and the location of rock art, the proximity of petroglyphs to hunting blinds and drift fences, and the association of the location of zoomorphic petroglyphs and pictographs and hunter-gatherer mobility have all been suggested (e.g., Heizer and Baumhoff 1959; Thomas 1976; Mazel 1983). Ecological and biogeographical factors that condition the mobility of aboriginal groups in the Central and Western Desert of Australia have also been shown to underlie the content and placement of rock art sites (Lewis 1976; David and Cole 1990; Gould 1990). These investigators are, in essence, concerned with the ways in which aboriginal peoples enhanced places on the landscape with rock art to help insure efficiency in land-use practices.

Places are "read" and interpreted by people. Settings "communicate" information about expected behavior to those who plan to act in them. To insure that the functional meanings associated with a place are sustained, humans often design changes in the environment that foster specific behaviors. Modifications, like petroglyphs and pictographs, to places in the environment enhance their "assigned" functional meanings. Ethnographic and ethnohistoric documentation contain numerous examples of rock art being used to communicate the significance of a place and to enhance some assigned sociocultural meaning to a place (e.g., Crawford 1972; Young 1985; Gould 1990). Rock art, we believe, is most profitably examined in relation to its situational setting. For archeologists interested in rock art images the question is whether these images can be associated with the character and/or use of places, and if so, can we relate the production and use of rock art in different environments to the socioecological mechanisms employed to successfully live in these environments?

DINOSAUR ROCK ART: AN ASSESSMENT

The assemblage content of aboriginal rock art varies from place to place on the northern Colorado Plateau. Rock art, like other components of the physical environment, served aboriginal peoples as a source of information about the dynamics of the social and physical environment. The resource structure of this region suggests that aboriginal peoples needed to have knowledge of the availability of potential food and nonfood resources over a vast area. As the population

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density of the northern Colorado Plateau increased through time cooperation and competition between groups became more defined. With increasing population density came restrictions on the sharing of information about the resource base and possibly territorial behavior (Hartley 1992a).

One approach to gaining some understanding of the role of rock art in Colorado Plateau prehistoric cultural systems and to assess the value of this phenomenon in the study of aboriginal socioeconomics is to consider variability within and between assemblages of rock art. Relationships between the assemblage content of rock art and the situational context of the place at which the rock art occurs have been examined previously at 388 sites in Canyonlands, Arches, and Capitol Reef National Parks, Glen Canyon National Recreation Area, and Natural Bridges National Monument (Hartley 1992a). Results of that analysis show differences in the petroglyph and pictograph assemblages placed on boulders, rockshelters, and at the base of cliffs. Rock art on detached boulders and at the base of cliffs revealed the greatest amount of information to aboriginal observers. Displays of ownership and/or access restriction were more prevalent in rockshelters, especially those showing evidence of storage, caching, and/or habitation. It is also argued that the frequency and diversity of use of places exhibiting petroglyphs and/or pictographs is reflected in the information content of the rock art.

Twenty of the sites documented in Dinosaur were examined in a manner similar to that reported in Hartley (1992a, 1992b) to ascertain if the generalizations derived from

those studies are potentially applicable to the socioecological conditions of prehistoric cultural systems in the Yampa-Green River drainage. Two sites, 42UN1734 and 1735, were not used in this analysis because of their historic nature, and the historic petroglyphs of 42UN1244 were also not used. Prehistoric rock art at site 5MF87 was likewise not used in this analysis, because we considered the site recording incomplete.

Procedures

Rock art images were categorized into 28 units that follow the 14 classification schemes described in Table 6. All glyph elements were classified as either pictographs or petroglyphs under these units. In those few cases where petroglyphs were partially painted, the image was categorized as a petroglyph.

It is recognized that the classification (n) potentially masks variability in the elements that may be perceived by other observers. But this classificatory scheme reduces the potentially infinite variation of morphologically defined elements into 28 units that permit systematic investigation and search for patterning, irrespective of any illusive meanings assigned to these images by prehistoric peoples.

Information theory and its measures were used to evaluate the organizational structure of the rock art panels. This theory provides a system of accounting for quantities of information; it is a calculus which defines units of measurement (Krippendorf 1975). Information, as used here, is not to be confused with meaning. Meaning is the significa-

Table 6. Rock art element classification.

Code	Element Label	Element Description
(a)	anthropomorphic	where the human figure is represented in its entirety, torso, or as headless.
(b)	human hand	where the figure depicts the human hand, positive or negative image.
(c)	human feet	where the figure depicts the human foot, positive or negative image.
(d)	human head	where the figure depicts the head of a human.
(e)	mammalian figure	where the figure seemingly represents a mammal.
(f)	mammalian	where the foot (or feet) of a mammal is "tracks" represented.
(g)	bird figure	where the figure seemingly represents a bird.
(h)	bird "tracks"	where the foot (or feet) of a bird is represented.
(i)	reptilian figure	where the depiction suggests a reptile, e.g., snake, lizard.
(j)	rectilinear	non-representational figures characterized by straight lines; formed or bounded by straight lines.
(k)	curvilinear	non-representational figures consisting of or bounded by curved lines. Painted "dots" were included in this class; however, rows of "dots" were considered classificatory units rather than the total quantity of "dots".
(l)	concentric	figures having a common center or common axis, e.g., circles, spirals.
(m)	abstract	motifs or outlines that are characterized by geometric both straight and curved lines but that bear no resemblance to natural forms.
(n)	indiscriminate	these markings may have been representational markings but were either not completed by the artist(s), have eroded, or been vandalized to the extent that they cannot be categorized under other classificatory units.*

* In some cases the remains of pictographs may have eroded and/or been mixed with mineral stains to obliterate any recognizable images present. In any event, we have chosen to make these markings a separately grouped category on the assumption that they have contributed in the past to the information content of the rock art assemblage.

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tion of information to a system which processes it. In all forms of human communication, a piece of information is given meaning by us; the meaning is not a part of the message as such. Meaning cannot yet be precisely measured whereas information can (see Miller 1978; Zeller 1984).

Assigning a quantitative index of information content to an assemblage of petroglyphs and pictographs enables us to compare these panels with each other and to associate this index of the panel layout with other characteristics of the site. The Dinosaur sites were assigned a quantitative index using the Shannon formula (Shannon and Weaver 1949) to calculate the initial measure of information for each assemblage. This measure, H_n , lies on a scale that ranges from 0 to \log_n . Zero, the minimum value, occurs where only one kind of the glyph element is observed. Maximum dispersion of a set of proportions occurs when each of the 28 glyph element categories contain the same number of figures (Thomas 1981). This degree of dispersion can be standardized on a scale of 0 to 1 by further calculation. These standardized or relative measures of information (Rel. H_n) no longer express the magnitude of diversity or variety, but may be interpreted as an index of uniformity (Krippendorf 1986).

One of the most useful advantages of Rel. H_n over other indices of dispersion is that its value is invariant with the value of n , permitting comparison between rock art assemblages that differ widely in the number of glyph elements present. Redundancy, the complement of Rel. H_n , measures the amount of unutilized possibilities for carrying infor-

mation. In the realm of communication, the property of redundancy assigned to a source suggests that it becomes increasingly likely that mistakes in reception will be minimized. An assemblage of rock art that is highly redundant in terms of the kinds of images displayed therefore communicates a "message" that is relatively unambiguous.

These information values have been computed for each of the 20 sites used in this study. The components of the distribution used in the computation are the glyph categories described above.

It should be pointed out that this approach does not negate interpretations about ceremonial, magico-religious, and/or aesthetic functions that may have been served by rock art images in the area of the monument. Well over a half century ago Radin (1937) argued that economic conditions in a cultural system underlie the organizational character and constituency of religion in that system. Rock art, when directly associated with the ideological components of a cultural system, served prehistoric peoples in ways we likely are never to have knowledge of through the examination of rock art alone. Nevertheless, petroglyphs and pictographs, as a part of the archeological record, can be integrated into assessments of the kinds of functions these sites served in the socioeconomic system of these peoples in the absence of emic knowledge about sociocultural "meaning" assigned to these images. The remainder of this discussion is guided by this assertion and formulates some avenues of research that can be addressed by anthropological archeologists in the future.

Results

The prehistoric rock art sites examined in this study were categorized as to their situational context: i.e., (1) rockshelter/al-cove - defined here as any recessed opening in a sandstone cliff face caused by erosional forces (Ledges with overhangs that offered protection from the elements are included here as shelters.); and (2) cliff face/canyon wall - defined here as a steep face of sandstone caused by water and wind. Rock art at 13 sites was categorized as being in or associated with rockshelters (see Table 7), and seven were categorized as being on cliff faces (see Table 8). Information measures calculated for the rock art assemblage at each of these sites suggest differences in their situational context that are similar to the rock art

sites assessed along the Colorado River drainage in southeastern Utah.

The mean Rel. H_n (.2974) for the 13 rock art sites associated with rockshelters in Dinosaur is similar to the mean Rel. H_n (.363) of rock art at the 248 rockshelters examined along the Colorado River drainage. The mean Rel. H_n (.4040) for the seven rock art assemblages situated on the face of cliffs is greater than that of rock art at rockshelters, similar to the pattern exhibited at 388 sites of various topographical situations examined along the Colorado River.

The reuse of rockshelters by various peoples through time was argued to account, in part, for the variation within the range of information measures of rock art at

Table 7. Information measures for rock art at rockshelter sites.

	REL. H_n	REDUNDANCY
42UN178	.4648	.5352
42UN179	.4112	.5888
42UN185	.7500	.2500
42UN187	.0000	1.0000
42UN190	.3334	.6666
42UN198	.3492	.6508
42UN201	.1813	.8187
42UN217	.1898	.8102
42UN1715	.1587	.8413
42UN1728	.1958	.8042
42UN1729	.0000	1.0000
42UN1730	.3653	.6347
42UN1733	.4669	.5331
\bar{X}	.2974	.7026

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Table 8. Information measures for rock art sites on cliff faces.

	REL. H _n	REDUNDANCY
5MF88	.0599	.9401
5MF157	.4140	.5860
42UN45	.3670	.6330
42UN192	.3342	.6658
42UN1244	.5827	.4173
42UN1731	.7592	.2408
42UN1732	.3109	.6891
\bar{X}	.4040	.5960

rockshelters examined by Hartley (1992a; 1992b). A similar assertion can be made for the thirteen Dinosaur sites; however, since excavation has been conducted at only three sites, functional variation is difficult to ascertain. For example, the small cache of bifacially worked tools found at 42UN190 suggests a rock art assemblage that would be highly redundant at an initial episode of use; however, the limited subsurface testing and the few additional tools recovered suggest variation in the occupation and use of the shelter.

Leach (1970b) likewise reported a cache of 28 lithic tools at Swelter Shelter (42UN217), a site believed to contain the remains of several occupations, based on the associative dating of artifactual materials. The high redundancy in the information content of rock art (.8102) at this site suggests that the shelter may have been used for similar purposes through time (e.g., storage/caching)

and/or by peoples who assigned the place significance that was carried across generations.

Deluge Shelter (42UN178), excavated by Leach (1970a), is considered to have been used intermittently for several centuries. Rock art located in and near the shelter exhibits an information content that is high (.4648) compared to the other shelters examined, with the exception of 42UN185. This latter shallow alcove is situated on the bank of Ely Creek along a natural trail route that provides access to the upper reaches of the drainage. The two most prominent rock art features at this site are two zoomorphic pictographs; however, the remains of other figures and historic graffiti are present. The high information content (.7500) of the rock art assemblage suggests a place that may have been passed often when moving up Ely Creek away from its confluence with Jones Creek.

PERSPECTIVE

Those sites examined on cliff faces exhibit variation in the information content of the rock art that range from (.0599) at 5MF88 along Pool Creek (and an access route to Echo Park) to a petroglyph assemblage with a high information content (.7592) at 42UN1731 situated on a cliff face southwest of Ely Creek. The topographic setting and rock art at 42UN1731 confirm our expectations concerning places in which information about the sociophysical environment accumulated through time by peoples who used the place or passed by.

The high redundancy of anthropomorphic petroglyphs at 5MF88 may be the result of its physical setting. The petroglyphs are currently high on the cliff face and inaccessible, due to erosion of the surface by Pool Creek that runs at the base of the cliff. These anthropomorphic images of similar style were likely made in a relatively short period of time when this portion of the cliff face was readily accessible from the ground surface. The creek channel on the west side of this narrow canyon probably rapidly eroded the surface that allowed access to this petroglyph panel, limiting the ability of future aboriginal visitors to add figures (cf. Sundstrom 1990:217). In most cases the lower portion of cliffs and canyon walls in the area are accessible, allowing for the accumulation of rock art images through time.

CONCLUSIONS

If rock art assemblages reflect, in some way, the use of places, then our interest should be directed toward understanding the variable use of these sites and why petroglyphs

and pictographs were produced at some places of aboriginal activity and not at others. Intentional markings of features on the landscape are produced to communicate. Markings at a place are used intentionally to influence the behavior of future visitors to that locality. Those conditions that helped determine where these markings are placed in the environment and the content of the images should underlie the means by which questions about rock art are structured in anthropological archeology.

The sites discussed here are only a few of the likely hundreds of prehistoric sites with rock art in the Monument and immediate vicinity. The socioeconomic conditions under which the rock art was produced are unclear. Nevertheless, some speculation can be made, based on comparison with the results of analyses conducted along the Colorado River drainage in southeastern Utah. The rock art assemblages examined in Dinosaur are similar in terms of the scale of their measure of information and topographic setting to those of 388 rock art sites examined in southeastern Utah. Use of rockshelters in Dinosaur can be expected to vary through time; however, the high redundancy (low information content) of the rock art assemblages at rockshelters relative to those rock art panels on cliff faces, supports the assertion that the rock art at rockshelters may have functioned as a display of ownership and/or access restriction. The remains of storage, caching, and food processing equipment from long- and short-term occupations would be expected to underlie the fill in many of these shelters. The higher information content (lower redundancy) of rock art assemblages on the faces of cliffs suggests places where people visited often. The accretion of various

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rock art images is reflective of the accumulation of episodes of site use through time.

These assertions can be evaluated only with much more research of the content of rock art assemblages and their topographic setting at the hundreds of prehistoric sites in the Dinosaur area. The prehistory of this area is less well understood than that of southeastern Utah, but the initial findings of this study also allow the formulation of some research questions that address the systemics of demographic change, resource structure, and rock art. For example,

- (a) How did the population density in the Yampa-Green River drainage area of Dinosaur change through time, and under what conditions did the food and nonfood resources in this area affect that change?
- (b) Do specific rock art images reflect change in use of the

area by groups of different breeding populations?

- (c) Does the content of rock art assemblages at or in rockshelters help us predict the kinds of cultural materials and features that would be observed during excavation of these sites?

Petroglyphs and pictographs are a part of the archeological record that need not be relegated to the realm of phenomena that are assigned a solely ideological foundation. If we consider rock art something that can only be speculated about in terms of its sociocultural meaning, then its existence serves us little purpose in our attempts to understand the conditions that generated the ways in which these people lived. We will always find it easy to see similarities and differences in the morphological qualities of these images; however, until we develop means by which to fit these observations into research that accommodates the entire archeological record, prehistoric rock art will remain an enigma.

RECOMMENDATIONS

Field observations of rock art sites in Dinosaur National Monument has led to concerns about the preservation, interpretation, and management of the resources. Some of these concerns have been incorporated into the body of this report. The following recommendations are those resulting from fieldwork in 1988 and 1989, as well as from related, recent developments in the research of rock art.

(a) We recommend that the growth of various woody plants near surfaces with rock art be monitored closely. The lack of natural fires has apparently permitted this growth. The scraping of brush on sandstone was identified as a substantial impact at 42UN1733, where brush marks as deep as 1.2cm were measured. Future fires fueled by this growth will likely adversely impact petroglyphs and pictographs (see Noxon and Marcus 1983; Fredlund 1990).

(b) Analysis of the chemical composition of pictographs in Dinosaur has not been undertaken. Knowledge of the organic composition of these pigments may help assess their vulnerabilities to natural erosion, as well as their potential for C-14 dating. We recommend that selected pictographs be sampled for analysis of organic components.

(c) The potential for C-14 and cation-ratio dating in Dinosaur should be evaluated. Techniques and procedures developed in the last few years demonstrate that our lack of knowledge about the age of rock art produced in Dinosaur can be remedied.

(d) Accurate plotting of site locations in the Jones Hole area on available topographic maps or aerial photographs is difficult because of the steep canyon walls and close proximity of rockshelters in these canyons. Terrestrial photogrammetry should be considered as a technique to map those canyons where high site density is known to exist. Extremely accurate and reproducible maps could be constructed to allow for proper plotting and field monitoring of these sites.

(e) In 1972 a National Register of Historic Places nomination form for the Jones Hole area was prepared by park personnel. This nomination was not submitted for SHPO review or for review by National Register personnel. We recommend that park personnel consider completing this nomination as an archeological district under the current requirements of the National Register of Historic Places.

(f) Public education about prehistoric remains and the role archeology plays in the conservation and preservation of these remains is becoming increasingly important to public land agencies. Interpretive signs at Deluge Shelter, Swelter Shelter, and Mantle Cave provide excellent introductions to these places. Visual communication in the form of film is also a means of sharing knowledge and values that is highly effective. An educational film focusing on the rock art of the park, its vulnerability, and its potential significance to understanding what has gone on in the area of the park is recommended (e.g., see Caldwell 1983; Loendorf and Ganje 1990).

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(g) The natural erosion of rock art was observed at all of the sites examined in 1988 and 1989. Although erosional action on pictographs is more readily apparent, the natural erosion of both pictographs and petroglyphs will eventually eliminate them. Chemical additives that help solidify porous sandstone to assist in petroglyph preservation are being developed (Grisafe and Nickens 1991). Petroglyphs known to be eroding rapidly (e.g., 42UN1244, 1733, 192), or those deemed significant to public enjoyment of the park, should be evaluated for stabilization with these processes in mind.

(h) Several investigators have recorded rock art sites in the park, producing a variety of field sketches and photographs. Investiga-

tors who have noted the existence of such documentation in their reports include Scoggin (1940:4), who recorded sites in Castle Park in 1939; Stirland (1947), who recorded sites in Jones Hole; and Breternitz (1964, 1965), who recorded rock art sites throughout the park. Attempts should be made to locate the original negatives, photographs, or panel sketches made by these and possibly other investigators who recorded rock art in the park. Although the original negatives from the Breternitz work are now in the park, attempts should be made to locate a photo log which identifies the sites in those photographs. This documentation, especially that of the very early photographs, could be very important in assessing the impact to much of the park's rock art in the last half century.

NOTES

1. Several recent publications of rock art recording procedures are available (e.g. Clegg 1983; Loendorf et al. 1988; Sanger and Meighan 1990; Texas Parks and Wildlife Department 1991). These references and others reflect the preferred methods and varied experiences of the authors, not all of which do we find adequate or acceptable for rock art in Dinosaur. Standardization for the recording of rock art is a topic that has also received attention in the literature (Swartz 1981a, 1981b; Swartz and Zancanella 1991; Clegg 1991). Although not specifically referred to in this report, we consider proposed standards a commendable means of improving the general recording of rock art sites in the absence of specific research needs.

2. Because of confusion with sites previously recorded in the park by Gunnerson (1957), the trinomial numbers assigned during this survey and used in the Breternitz report were later reassigned by the state of Utah. Consequently, the site numbers referred to in this report do not correlate with the numbers in Breternitz (1965).

3. It is safe to assume that these places examined in Dinosaur were subjected to intermittent visitation and use by people-prehistoric, historic, or contemporary. The existence of petroglyphs or pictographs at a place very likely fosters additional production of rock art when observed by visitors or occupiers of the site. Historic and contemporary markings at sites known to have been used by prehistoric aboriginal peoples provide an excellent example of the very behavior we are trying to understand and build into the picture we have of prehistoric life. Those markings we call "graffiti" and often relegate to "vandalism"-negative connotations-betray our western European sense of protectionism and possibly ethnocentric leanings. When "graffiti" is assigned historic "significance," it becomes a phenomenon to be protected. Oftentimes historic graffiti gives us a means by which to identify those who visited a place and when, but it offers us no more specific insight into the behavior of a population under particular social and environmental conditions than the results of contemporary graffiti.



REFERENCES CITED

Adams, Ansel

1981a *The Negative*. New York Graphic Society, Little, Brown and Company, Boston.

1981b *The Print*. New York Graphic Society, Little, Brown and Company, Boston.

Ambler, John

1966 *Caldwell Village and Fremont Prehistory*. Ph.D. dissertation, Department of Anthropology, University of Colorado, Boulder.

Baldwin, Gordon C.

1947 An Archeological Reconnaissance of the Yampa and Green Rivers. *Kiva* 12(3):31-36.

Baldwin, Gordon C., Charles Scoggin, and Frank M. Setzler

1942 Yampa and Green Rivers Archeological Reconnaissance. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Bard, J. C.

1979 *The Development of a Patination Dating Technique for Great Basin Petroglyphs Utilizing Neutron Activation and X-Ray Fluorescence Analysis*. Ph.D. dissertation, Department of Anthropology, University of California, Berkeley.

Beaton, J.M.

1983 Terrestrial photogrammetry in Australian Archaeology. In *Australian Field Archaeology: A Guide to Techniques*, edited by G. Connah, pp. 64-66. Australian Institute of Aboriginal Studies, Canberra.

Berry, Claudia

1975 Report on Record Search for Archeological Sites along Routes of the Proposed Big Springs Culinary Water System, Roosevelt, Utah. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Blundell, V.J.

1982 Symbolic Systems and Cultural Continuity in Northwest Australia: A Consideration of Aboriginal Cave Art. *Culture* 2:3-20.

ROCKART

Blundell, V.J., and R. Layton

1978 Marriage, Myth and Models of Exchange in the West Kimberleys. *Mankind* 11:231-245.

Breternitz, David A.

1964 Archeological Survey in Dinosaur National Monument, Colorado-Utah, 1963. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

1965 Archeological Survey in Dinosaur National Monument, 1963-1964. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

1970 *Archeological Excavations in Dinosaur National Monument, 1964-1965*. University of Colorado Studies, Series in Anthropology No 17, Boulder.

1972 Archeological Reconnaissance of the road right-of-way at the Gates of the Lodore access road. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

1974 Archeological Reconnaissance of alternate road alignment "B", Gates of Lodore access road. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Brown, F. Martin

1937 The prehistoric ruins of Castle Park. *Southwestern Lore* 3(2):22-28.

Burgh, Robert F.

1950 A Fremont Basket Maker House in Dinosaur National Monument. *Tree Ring Bulletin* 16:19-20.

Burgh, Robert F., and Charles R. Scoggin

1948 *The Archeology of Castle Park: Dinosaur National Monument*. University of Colorado Studies, Series in Anthropology No. 2, Boulder.

Burton, Robert J.

1970 Jones Hole: Sites 42UN9 and 42UN13. In *Archaeological Excavations in Dinosaur National Monument, Colorado-Utah, 1964-1965*, assembled by D.A. Breternitz, pp. 152-157. University of Colorado Studies, Series in Anthropology No. 17, Boulder.

REFERENCES CITED

- 1971 *The Pictographs and Petroglyphs of Dinosaur National Monument*. Master's thesis, Department of Anthropology, University of Colorado, Boulder.
- Caldwell, Dave
1983 *Rock Art Treasures of Ancient America*. Dave Caldwell Productions, Hayward, California.
- Castleton, K.B.
1979 *Petroglyphs and Pictographs of Utah, Vol. Two: The South, Central, West and Northwest*. Utah Museum of Natural History, Salt Lake City.
- Chandler, Susan M., and Paul R. Nickens
1979 Archaeological Investigations of the Coal Development Areas and Coal Transport Corridors for the Moon Lake Project, Rio Blanco County, Colorado, and Uintah County, Utah. Manuscript on file, Bureau of Land Management, Vernal District, Utah.
- Clegg, John
1983 Recording Prehistoric Art. In *Australian Field Archaeology: A Guide to Techniques*, edited by G. Connah, pp. 64-66. Australian Institute of Aboriginal Studies, Canberra.

1991 Cleggnotes on Recording Prehistoric Pictures. In *Rock Art and Posterity: Conserving, Managing, and Recording Rock Art*, edited by C. Pearson and B. K. Swartz, Jr., pp. 113-114. Occasional AURA Publication No. 4. Australian Rock Art Research Association, Melbourne.
- Clouten, N.H.
1974 The Application of Photogrammetry to Recording Rock Art. *Australian Institute of Aboriginal Studies Newsletter* 1:33-39.

1976 Photogrammetry and the Measurement of Rock Form and Aboriginal Art. *Australian Institute of Aboriginal Studies Newsletter* 6:33-45.

1977 Further Photogrammetric Recordings of Early Man Shelters, Cape York. *Australian Institute of Aboriginal Studies Newsletter* 7:54-59.
- Cole, Sally J.
1987 *An Analysis of the Prehistoric and Historic Rock Art of West-Central Colorado*. Cultural Resource Series No. 21. Bureau of Land Management, Colorado.

ROCKART

1990 *Legacy on Stone: Rock Art of the Colorado Plateau and Four Corners Region*. Johnson Books, Boulder, Colorado..

Connor, Carl E., and Danni L. Langdon

1989 *The Excavation of Hummingbird Rockshelter*. Cultural Resources Series No. 27. Bureau of Land Management, Denver, Colorado.

Conard, Nicholas J., Peter Breunig, H. Gonska, and Guido Marinetti

1988 The Feasibility of Dating Rock Paintings from Brandberg, Namibia, with C¹⁴. *Journal of Archeological Science* 15:463-466.

Crawford, I.M.

1972 Function and Change in Aboriginal Rock Art, Western Australia. *World Archaeology* 3:301-312.

Creasman, Steven D.

1981 *Archaeological Investigation in the Canyon Pintado Historic District, Rio Blanco County, Colorado*. Reports of the Laboratory of Public Archaeology No. 34. Colorado State University, Fort Collins, Colorado.

Creasman, Steven D., and Calvin H. Jennings

1977 *Archaeological Reconnaissance of the East Douglas Creek Gathering System, Rio Blanco County, Colorado*. Cultural Resource Management Report No. 17. Colorado State University, Fort Collins, Colorado.

David, Bruno, and Noelene Cole

1990 Rock Art and Inter-regional Interaction in Northeastern Australian Prehistory. *Antiquity* 64:788-806.

Day, K.C.

1964 Thorne Cave, Northeastern Utah: Archeology. *American Antiquity* 30(1):50-59.

Dick, Herbert W.

1949a Field Notes: 1949 Excavations of Marigold's Cave and Sand Dune area (5MF11), Hell's Midden. On file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

1949b Report on archeological research in the Yampa and Green River Canyons, Dinosaur National Monument, Dinosaur, Colorado, 1949. Manuscript on file, Dinosaur National Monument, Dinosaur, Colorado.

REFERENCES CITED

- 1950 Report on archeological research in the Yampa and Green River Canyons, Dinosaur National Monument and adjacent areas, 1950. Manuscript on file, Dinosaur National Monument, Dinosaur, Colorado.
- Dorn, R.I.
1990a Age Determination of Petroglyphs in Southeast Colorado. *Southwestern Lore* 56:21-36.
- 1990b Rock Varnish Dating of Rock Art: State of the Art Perspective. *La Pintura* 17(2):1-2, 9-11.
- Dorn, R.I., and D.S. Whitley
1983 Cation-ratio Dating of Petroglyphs from the Western Great Basin, North America. *Nature* 302:816-818.
- Dorn, R.I., A.J.T. Dull, D.J. Donahue, T.W. Linick, and L.J. Toolin
1989 Accelerator Mass Spectrometry Radiocarbon Dating of Rock Varnish. *Geological Society of America Bulletin* 101:1363-1372.
- Eastman Kodak Company
1986 *Kodak Professional Photoguide*. Kodak Publication No. R-28, Rochester, New York.
- 1988a *Kodak T-Max Professional Films*. Kodak Publication No. F-32, Rochester, New York.
- 1988b *Kodak Black-and White Darkroom Dataguide*. Kodak Publication No. R-20, Rochester, New York.
- 1988c *Using Filters*. Kodak Publication No. KW-13, Rochester, New York.
- Eddy, Frank W.
1980 *The Archaeological Mitigation Program and Excavations at Site 5MF605, Brown's Park National Wildlife Refuge, Moffat County, Colorado*. Submitted to U.S. Fish and Wildlife. Copies available from Science Applications, Inc., Boulder.
- Faris, Peter K.
1987 Post-Classic Vernal Abstraction: The Evolution of a Unique Style in Late Fremont Rock Art in Dinosaur National Monument, Utah. *Southwestern Lore* 53(1):28-41.

ROCKART

Fike, Richard E., and H. Blane Phillips II

1984 *A Nineteenth Century Ute Burial from Northeastern Utah*. Cultural Resources Series No. 16. Bureau of Land Management, Salt Lake City, Utah.

Francis, Julie, Lawrence Loendorf, and Ronald I. Dorn

1991 Results of AMS and Cation-Ratio Dating of Rock Art in the Bighorn Basin of Wyoming and Montana: New Advances for Rock Art Studies. Paper presented at the 49th Plains Anthropological Conference, Lawrence, Kansas.

Fredlund, Lynn

1990 *Investigations at Two Rock Art Sites on the South Fork of Canyon Creek, Yellowstone County, Montana*. GCM Services, Inc., Butte, Montana.

Frison, George C.

1978 *Prehistoric Hunters of the High Plains*. Academic Press, New York.

Gardner, A. Dudley

1981 *A Survey of a Tradeware Site and a Quarry Site in Northwestern Colorado*. Laboratory of Public Archaeology, Colorado State University, Fort Collins.

Gordon, E. Kinzie, Kris J. Kranzush, Donna J. Knox, Victoria E. Keen, and Craig A. Engleman

1981 *A Class III Cultural Inventory of the Texas-Missouri Evacuation Creeks Study Area, Rio Blanco County, Colorado*. Submitted to Bureau of Land Management. Copies available from Gordon & Kranzush, Boulder, Colorado.

Gould, Richard A.

1990 *Recovering the Past*. University of New Mexico Press, Albuquerque.

Grady, James

1984 *Northwest Colorado Prehistoric Context*. Office of Archeology and Historic Preservation, Denver, Colorado.

Grisafe, David A., and Paul R. Nickens

1991 Chemical Stabilization of Porous Sandstone Bearing Petroglyphs. Paper presented at the 56th Annual Meeting of the Society of American Archaeology, New Orleans, Louisiana.

Gunnerson, James H.

1957 *An Archeological Survey of the Fremont area*. Anthropological Paper No. 28. University of Utah, Salt Lake City.

REFERENCES CITED

- 1969 *The Fremont Culture: A Study in Culture Dynamics on the Northern Anasazi Frontier*. Papers of the Peabody Museum of Archeology and Ethnology 59 (2). Harvard University, Cambridge, Massachusetts.
- Hall, Daniel
1982 *Draft Report, Mobil Parachute Project*. Unpublished and unreleased report. Western Cultural Resource Management, Inc., Boulder, Colorado.
- Hansen, Sheryl
1978 *Report of Excavation for Cultural Resources for Energy Fuels Corporation Bid on Three Short-term Strip Mines C-22676*. Bureau of Land Management, Little Snake Resource Area, Craig, Colorado.
- Hanson, W.S., and P.A. Rahtz
1988 Video Recording on Excavations. *Antiquity* 62:106-111.
- Harrell, Lynn L., and Scott McKern
1986 *The Maxon Ranch Site*. Cultural Resource Management Report No. 18. Western Wyoming College, Rock Springs.
- Harris, Marvin
1990 Emics and Etics Revisited. In *Emics and Etics - the Insider/Outsider Debate*, edited by Thomas N. Headland, Kenneth L. Pike, and Marvin Harris, pp. 48-61. Sage Publications, Newbury Park.
- Hartley, Ralph J.
1992a *Rock Art on the Northern Colorado Plateau*. World Wide Archaeology Series, Avebury. Aldershot.

1992b Rockshelters and Rock Art: An Assessment of Site Use. *Proceedings of the Anasazi Symposium 1991* (in press).
- Haskovec, Ivan P., and Hilary Sullivan
1989 Reflections and Rejections of an Aboriginal Artist. In *Animals into Art*, edited by Howard Morphy, pp. 57-74. Unwin Hyman, London.
- Hauck, R.F.
1975 An Archeological Reconnaissance of the Roosevelt Culinary Water Supply Project, Roosevelt, Utah. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

ROCKART

Hauck, R.F., D.G. Weber, and S. Kennette

1979 Final Report on The Natural Buttes Cultural Mitigation Study. Unpublished manuscript submitted to the Bureau of Land Management, Vernal District, Utah.

Heizer, R.G., and M.A. Baumhoff

1959 Great Basin Petroglyphs and Prehistoric Game Trails. *Science* 129:904-905.

1962 *Prehistoric Rock Art of Nevada and Eastern California*. University of California Press, Berkeley.

Heizer, R.G., and W.C. Clewlow

1973 *Prehistoric Rock Art of California*. Ballena Press, Ramona, California.

Henry, Richard J.

1986 *Controls in Black-and-White Photography*. Focal Press, Boston.

Jennings, Clavin H., and William D. Wade

1970 The Lowel Springs Site, 5MF224. In *Archaeological Excavations in Dinosaur National Monument, Colorado-Utah, 1964-1965*, assembled by D. A. Breternitz, pp. 83-92. University of Colorado Studies, Series in Anthropology No. 17. Boulder.

Jennings, Jesse D.

1974 *Prehistory of North America*. McGraw-Hill Book Company, New York.

Keefe, L., Jr., and Dennis Inch

1984 *The Life of a Photograph*. Focal Press, Boston.

Krippendorff, K.

1975 Information Theory. In *Communication and Behavior*, edited by G.J. Hanneman and W.J. McEwen, pp. 351-389. Addison-Wesley, Reading, Massachusetts.

1986 *Information Theory - Structural Models for Qualitative Data*. Sage University Paper Series on Quantitative Applications in the Social Sciences, 07,062. Sage Publications, Beverly Hills, California.

La Point, Halcyon

1987 *An Overview of Prehistoric Cultural Resources: Little Snake Resource Area Northwestern Colorado*. Cultural Resource Series No. 20. Bureau of Land Management, Denver, Colorado.

REFERENCES CITED

Larralde, Signa L., and Susan M. Chandler

1981 *Archaeological Inventory in the Seep Ridge Cultural Study Tract, Uintah County, Northeastern Utah with A Regional Predictive Model for Site Location*. Cultural Resource Series No. 11. Bureau of Land Management, Salt Lake City, Utah.

Larralde, S.L., and P.R. Nickens

1980 Archeological Inventory in the Red Wash Cultural Study Tract, Uintah County, Utah. In *Sample Inventories of Oil and Gas Fields in Eastern Utah, 1978-1979*, assembled by P. R. Nickens. Cultural Resources Series, No. 5. Bureau of Land Management, Utah.

Leach, Larry L.

1966 *The Archeology of Boundary Village*. Anthropological Paper No. 83. University of Utah, Salt Lake City.

1967 Archeological Investigations of Deluge Shelter, Dinosaur National Monument. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

1970a *Archeological Excavations at Deluge Shelter in Dinosaur National Monument*. Ph.D. dissertation, Department of Anthropology, University of Colorado, Boulder.

1970b Swelter Shelter, 42UN40. In *Archeological Excavations in Dinosaur National Monument, Colorado-Utah, 1964-1965*, edited by David A. Breternitz, pp. 127-135. University of Colorado Studies, Series in Anthropology No. 17, Boulder.

Levine, Morton H.

1957 Prehistoric Art and Ideology. *American Anthropologist* 59:949-964.

Lewis, D.

1976 Observation on Route Finding and Spatial Orientation Among the Aboriginal Peoples of the Western Desert of Central Australia. *Oceania* 46:249-282.

Liestman, Terri L.

1985 *Site 42UN1103: A Rockshelter in Dinosaur National Monument*. Occasional Studies in Anthropology No. 13. Midwest Archeological Center, Lincoln, Nebraska.

ROCKART

Lindsay, La Mar W.

1982 An Archeological Survey of Clay Basin, Dagget County, Utah. In *Archeological Investigations in Utah*, assembled by D. B. Madsen and R. E. Fike, pp.1-46. Cultural Resource Series No. 12. Bureau of Land Management, Salt Lake City, Utah.

1986 Fremont Fragmentation. In *Anthropology of the Desert West: Essays in Honor of Jesse D. Jennings*, edited by C.S. Condie and D.D. Fowler, pp. 229-252. Anthropological Paper No. 110. University of Utah, Salt Lake City.

Lister, Robert H.

1951 *Excavations at Hell's Midden, Dinosaur National Monument*. Series in Anthropology No. 3. University of Colorado, Boulder.

Loendorf, Lawrence L.

1989 *Nine Rock Art Sites in the Pinon Canyon Maneuver Site, Southeastern Colorado*. Contribution No. 248. Department of Anthropology, University of North Dakota, Grand Forks.

1991 Cation-ratio Varnish Dating and Petroglyph Chronology in Southeastern Colorado. *Antiquity* 65:246-255.

Loendorf, Lawrence, Linda Olson, and Stuart Conner

1988 A Recording Manual for Rock Art. Draft manuscript, National Park Service, Rocky Mountain Regional Office, Denver, Colorado.

Loendorf, Lawrence, and Lucy Ganje

1990 *Rock Art at Pinon Canyon Maneuver Site, Southeastern Colorado*. Film written and directed by L. Loendorf and L. Ganje. University of North Dakota, Grand Forks, North Dakota.

Loendorf, Lawrence L., and David D. Kuehn

1991 *1989 Rock Art Research Pinon Canyon Maneuver Site, Southeastern Colorado*. Contribution No. 258. Department of Anthropology, University of North Dakota, Grand Forks.

Loendorf, Lawrence L., Julie E. Francis, and Ronald I. Dorn

1991 A Rock Art Chronology for the Bighorn Basin, Wyoming and Montana: Varnish and C-14 Dating as an aid to Rock Art Studies. Paper presented at the 56th Annual Meeting of the Society of American Archaeology, New Orleans, Louisiana.

REFERENCES CITED

- Loy, T.H., Rhys Jones, D.E. Nelson, Betty Meehan, John Vogel, John Southon, and Richard Cosgrove
1990 Accelerator Radiocarbon Dating of Human Blood Proteins in Pigments from a Late Pleistocene Art Site in Australia. *Antiquity* 64:110-116.
- MacLeod, R. Bruce
1959 Supplemental report to Robert D. Stirland's reconnaissance in the Jones Hole area. Manuscript on file, Dinosaur National Monument, Dinosaur, Colorado.
- Manning, Steven J.
1990 Barrier Canyon Style Pictographs of the Colorado Plateau. Part One: Hypothesis and Evidence for the Existence of Post Circa A.D. 1300 Panels. *Utah Archaeology* 1990 3(1):43-84.
- Marwitt, John P.
1970 *Median Village and Fremont Culture Regional Variation*. Anthropological Paper No. 95. University of Utah, Salt Lake City.

1986 Fremont Cultures. In *Great Basin*, edited by W.L. d'Azevedo, pp. 161-172. Handbook of North American Indians, Vol. 2, W.C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.
- Mazel, A.D.
1983 Eland, Rhebuck and Cranes: Identifying Seasonality in the Paintings of the Drakensberg, Natal, South Africa. In *New Approaches to Southern African Rock Art*, edited by J. D. Lewis-Williams, pp. 34-37. The South African Archaeological Society, Godwin Series Vol. 4., Cape Town, South Africa.
- Miller, J.G.
1978 *Living Systems*. McGraw-Hill Book Co., New York.
- Mowaljarlai, David, Patricia Vinnicombe, Graeme K. Ward, and Christopher Chippindale
1988 Repainting of Images on Rock in Australia and the Maintenance of Aboriginal Culture. *Antiquity* 62:690-696.
- Mueller, James W.
1982 Trip Report Dinosaur National Monument PR/IP-H90. Memorandum to the Chief, Midwest Archeological Center, May 4, 1982. On file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

ROCKART

Noxon, John S., and Deborah A. Marcus

1983 Wildfire-induced Cliff Face Exfoliation and Potential Effects on Cultural Resources in the Needles District of Canyonlands National Park, Utah. *Southwestern Lore* 49:1-8.

Parkington, John

1989 Interpreting Paintings Without a Commentary: Meaning and Motive, Content and Composition in the Rock Art of the Western Cape, South Africa. *Antiquity* 63:13-26.

Prince, Eugene R.

1988 Photography for Discovery and Scale by Superimposing Old Photographs on the Present-day Scene. *Antiquity* 62:112-116.

Radin, Paul

1937 *Primitive Religion: Its Nature and Origin*. Viking Press, New York.

Reed, Alan D.

1988 A Stabilization Assessment of Mantle's Cave, Site 5MF1, Dinosaur National Monument, Colorado. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

Russ, Jon, Marian Hyman, Harry J. Shafer, and Marvin W. Rowe

1990 Radiocarbon Dating of Prehistoric Rock Paintings by Selective Oxidation of Organic Carbon. *Nature* 348:710-711.

Sanger, Kay K., and Clement W. Meighan

1990 *Discovering Prehistoric Rock Art - A Recording Manual*. Wormwood Press, Calabasas, California.

Schaafsma, P.

1971 *The Rock Art of Utah*. Papers of the Peabody Museum of Archaeology and Ethnology Vol. 65. Harvard University, Cambridge, Massachusetts.

1980 *Indian Rock Art of the Southwest*. University of New Mexico Press, Albuquerque.

Schapiro, Meyer

1953 Style. In *Anthropology Today*, edited by A.L. Kroeber, pp. 287-312. University of Chicago Press, Chicago.

REFERENCES CITED

Schroedl, Alan R.

1976 *The Archaic of the Northern Colorado Plateau*. Ph.D. dissertation, Department of Anthropology, University of Utah, Salt Lake City.

Scoggin, Charles R.

1940 Preliminary Report of the Archeological Field Work of the University of Colorado Museum in Yampa Canyon, 1939-1940. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

1941 Report of Reconnaissance in Dinosaur National Monument, season 1941. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Shannon, C.E., and W. Weaver

1949 *The Mathematical Theory of Communication*. University of Illinois Press, Urbana.

Sharp, Nancy D.

1989 Redefining Fremont Subsistence. *Utah Archaeology* 1989 2(1):19-31.

1990 Fremont and Anasazi Resource Selection: An Examination of Faunal Assemblage Variation in the Northern Southwest. *Kiva* 56:45-65.

Sharrock, Floyd W.

1966 *Prehistoric Occupation Patterns in Southwestern Wyoming and Cultural Relationships with the Great Basin and Plains Cultural areas*. Anthropological Paper No. 77. University of Utah, Salt Lake City.

Sheets, Payson D.

1968 The archeology of the Ely Caves, Dinosaur National Monument. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Simms, Steven R.

1986 New Evidence for Fremont Adaptive Diversity. *Journal of California and Great Basin Anthropology* 8:204-216.

1990 Fremont Transitions. *Utah Archaeology* 1990 3(1):1-18.

ROCKART

Smith, Catherine J.

1983 Archeological Compliance Survey within Dinosaur National Monument, Colorado-Utah, 1983. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

1986 Echo Park Archeological Clearance. Rocky Mountain Region Archeological Project Report, dated September 3, 1986. Transmitted under memo from Associate Regional Director, Planning and Resource Preservation, Rocky Mountain Region, dated October 20, 1986. On file, Midwest Archeological Center, National Park Service, Lincoln, Nebraska.

Steward, J.

1929 *Petroglyphs of California and Adjoining States*. Publications in American Archaeology and Ethnology 24. University of California, Berkeley.

Stirland, Robert D.

1947 Report on reconnaissance in Dinosaur National Monument, Jones Hole area. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Strait, Richard A.

1987 Section 106 Compliance, Mantle Mine, Dinosaur National Monument. Memorandum to Superintendent, Dinosaur National Monument, dated June 1, 1987. On file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Sundstrom, Linea

1990 *Rock Art of the Southern Black Hills: A Contextual Approach*. Garland Publishing Company, New York.

Swartz, B.K., Jr.

1981a Standards for the Recording of Petroglyphs and Pictographs. *Current Anthropology* 22:94-95.

1981b Recording Standards for Petroglyphs and Pictographs. *Journal of Field Archaeology* 8:118-119.

Swartz, B.K., Jr., and John K. Zancanella

1991 The Management of Recording Procedures in the Preservation of Petroglyph Resources. In *Rock Art and Posterity-Conserving, Managing, and Recording Rock Art*, edited by C. Pearson and J.K. Swartz, Jr., pp. 114-115. Occasional AURA Publication No. 4. Australian Rock Art Research Association, Melbourne.

REFERENCES CITED

Texas Parks and Wildlife Department

1991 *Rock Art Recording Manual*. Texas Parks and Wildlife Department, Austin.

Thomas, T.

1976 Petroglyph Distribution and Hunting Hypothesis in the Central Great Basin. *Tebiwa: Journal of the Idaho State University Museum* 18(2):65-74.

Thomas, R.W.

1981 Information Statistics in Geography. *Concepts and Techniques in Geography* No. 31.

Tipps, Betsy L., and Nancy J. Hewitt

1989 *Cultural Resource Inventory and Testing in the Salt Creek Pocket and Devils Lane Areas, Needles District, Canyonlands National Park, Utah*. Selections from the Division of Cultural Resources, National Park Service, Rocky Mountain Region, Denver.

Truesdale, James A.

1988 106 Compliance on the Construction of a Fenceline Around the Josie B. Morris Cabin (HS-200) 42UN1661. Rocky Mountain Region Archeological Project Report, dated April 19, 1988. On file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

1989 Archaeological Investigations Along the Echo Park Road, Dinosaur National Monument, Moffat County, Colorado. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

1990 A Case Study: Sand Canyon Shelter (5MF2639) and the Determination of Archaeological Value. *Southwestern Lore* 56(1):25-30.

Turner, C.G.

1963 *Petroglyphs of the Glen Canyon Region*. Bulletin 38. Museum of Northern Arizona, Flagstaff.

1971 Revised Dating for Early Rock Art of the Glen Canyon Region. *American Antiquity* 36:469-471.

Turpin, S.A.

1982 *Seminole Canyon: The Art and The Archeology*. Texas Archeological Survey Research Report No. 83. University of Texas, Austin.

ROCKART

Turpin, S.A., R.P. Watson, S. Dennett, and H. Muessy

1979 Stereophotogrammetric Documentation of Exposed Archeological Features. *Journal of Field Archaeology* 6:329-337.

Valiga, James P.

1987 Visual and Computer Assisted Analysis of Amerindian Rock Paintings. *Remote Sensing Newsletter in Anthropology and Archaeology* 1(4):7-10.

Van der Merwe, N.J., J. Sealy, and R. Yates

1987 First Accelerator Carbon-14 date for Pigment from a Rock Painting. *South African Journal of Science* 83:56-57.

Vestal, David

1975 *The Craft of Photography*. Harper and Rowe, New York.

Wall, E.J., and F.I. Jordan,

1975 *Photographic Facts and Formulas*. Amphoto, Garden City, New York.

Wellmann, K.F.

1979 *A Survey of North American Indian Rock Art*. Akademische Druck u. Verlagsanstalt, Graz, Austria.

Wenger, G.R.

1956 *An Archeological Survey of Southern Blue Mountain and Douglas Creek in Northwestern Colorado*. Master's thesis, Department of Anthropology, University of Denver.

Wieszczyk, Joe

1987 Section 106 Compliance, Project # 87001, Fee Entrance Station and Utility Lines Construction at Dinosaur Nat'l. Monument. Memorandum to Chief Ranger, DINO, dated April 15, 1987. On file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Whitley, D.S.

1982 *The Study of North American Rock Art: A Case Study from South-Central California*. Ph.D. dissertation, Department of Anthropology, University of California, Los Angeles.

Whitley, D.S., J. Baird, J. Bennett, and R. G. Tuck, Jr.

1984 The Use of Relative Repatination in the Chronological Ordering of Petroglyph Assemblages. *Journal of New World Archaeology* 6:19-25.

REFERENCES CITED

Whitley, D.S., and R.I. Dorn

1984 Chemical and Micromorphological Analysis of Rock Art Pigments from the Western Great Basin. *Journal of New World Archaeology* 6:48-51.

Wilhelm, Henry

1991 *The Permanence and Care of Color Photographs: Prints, Negatives, Slides, and Motion Pictures*. Preservation Publishing Co., Grinnell, Iowa.

Young, M.J.

1985 Images of Power and Power of Images - The Significance of Rock Art for Contemporary Zuni. *Journal of American Folklore* 98:7-48.

Zalucha, L. Anthony

1976 Archeological Survey, Dinosaur Quarry Locale, Dinosaur National Monument, 1976. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Zeller, C.

1984 Knowledge, Information, and Unpredictability. *Journal of Social and Biological Structures* 7:145-153.



APPENDIX A

DINOSAUR NATIONAL MONUMENT ROCK ART DOCUMENTATION AND MONITORING PROGRAM FIELD MONITORING PACKET AND FORMS

Each rock art site has a specific section in the site documentation and monitoring booklets. This section is referred to as the Field Monitoring Packet and Forms. The Field Monitoring Packet and Forms section includes:

- 1) A completed Dinosaur National Monument Rock Art Monitoring Form.
- 2) USGS map showing location of site.
- 3) Scale drawing and/or sketch map of rock art panel(s).
- 4) Photo of rock art panel(s).

The scale drawings and/or sketch map of each panel is placed in a folder with a transparent sheet. This transparency is placed over the sketch map so that impacts to the rock art may be penciled in and recorded with a grease pencil. The transparency with the new penciled-in impacts is copied and placed under the transparency. The transparency is then wiped clean so it may be used again.

New information is continually added to the Rock Art Monitoring Form. The rock art monitoring data for all of the rock art sites in the Monument are located in a main data base file. This file is updated as monitoring continues for each site. When an update is completed a new form is printed out and the old form discarded.

DINOSAUR NATIONAL MONUMENT ROCK ART MONITORING FORM

SITE NUMBER: 42UN1727 DATE: 10 / 11 / 89 TIME: 12:00

PANEL NUMBER: 1

PHOTOGRAPHY:

(Take photos from photographic station)

Photos: yes X no Photo Station number: Datum

Photo station: Located yes X no ; Missing ; Disturbed ;
Turned in to Park Staff , date / / .

ROCKART

Color: Roll # ___ Exposure # ___

Comments: (view, angle, aperture, speed, type of lens)

Black and White: Roll # ___ Exposure #

Comments: (view, angle, aperture, speed, type of lens)

Additional Photographic Comments (Weather conditions, hot-cold, sunny-overcast, wind): Sunny and partly cloudy

VISIBLE EFFECTS ON ROCK ART

___/Note presence or absence of all effects and possible threats to Rock Art panel in following list.

___/Fully describe and as accurately as possible the effects in comment section.

___/Note in the comment section if a photo was taken of the visible impact or possible impact.

___/Identify, label and map, characteristics, quantity, and location of effects on sketch map provided.

NATURAL

Bird Droppings: yes X no ___; describe Ledge above panel is used as a perch for birds.

Bird Nests: yes ___ no X; describe _____

Animal Activities (ie. pack rat midden, domestic cattle [sheep, cows, horses], rubbing on panel, dung below panel on the ground surface): yes X no ___; describe Wood rat midden and nest located in crevice above panel.

Insect Activity (ie. termites, ants, wasps, bees, boxelder bugs): yes ___ no X; describe

Weathering and Erosion:

1.Exfoliation (ie. peeling, spalling, cracks, holes): yes X no ___; describe Portion of the eastern side of the panel is exfoliating below and above the furthest easterly figure. In addition, cracks run through several figures (Figure 3 and 4).

2.Wind/Sand abrasion: yes X no ___; describe there may be some abrasion from the wind however, this is not easy to quantify.

APPENDIX

3. Water/Ice/Snow: yes no ; describe It appears that water is causing several of the pictographs to fade. The impact is from snow and ice is unknown and the site needs to be monitored in the winter.

4. Patination (desert varnish): yes no ; describe _____

5. Vegetation (lichen, brush, trees): yes no ; describe
Mineral Encrustation (leaching, precipitation): yes no ;
describe _____

Fading (ie. sun action, percentage of sun exposure during the day): yes no ; describe Several of the pictographs may be fading to sun.

Burial (ie. mud flow, talus slope): yes no ; describe _____

CULTURAL

Air Pollution (Power Plants, Mining Operations, Vehicular Traffic): yes no ; describe The level of impact due to air pollution is unknown at this time.

Acid Precipitation: yes no unknown ; describe _____

Vandalism (intentional and inadvertent):

1. Graffiti (ie. spray paint, charcoal, scratching, inscriptions, obscenities): yes no ;
describe _____

2. Urination: yes no ; describe _____

3. Obliteration: yes no ; describe _____

4. Touching (ie. smudge marks, finger prints): yes no ;
describe _____

5. Shooting (ie. Bullet holes on panel, spent cartridge shells on ground): yes
no ; describe _____

6. Specimen Removal: yes no ; describe _____

7. Walking, Sitting on art panels: yes no ; describe _____

8. Taking of Latex Molds: yes no ; describe _____

ROCKART

9.Chalking: yes no ; describe _____

Development (proposed construction i.e. roads): yes no ; describe _____

Access and Visibility (ie. accessibility, site visibility, visitation): yes ; no ; describe The site is visible from the Island Park road but its location is not well known.

Sonic Boom: yes ; no : describe _____

ADDITIONAL COMMENTS

RECORDER: James A. Truesdale AFFILIATION Dinosaur National Monument

REPORT CERTIFICATION

I certify that "Documenting Rock Art in Dinosaur National Monument"
by Ralph J. Hartley et al.

has been reviewed against the criteria contained in 43 CFR Part 7(a)(1) and upon
recommendation of the Regional Archeologist has been classified as
available.


Regional Director

12/14/92

Date

Classification Key Words:

"Available"--Making the report available to the public meets the criteria of 43 CFR 7.18(a)(1).

"Available (deletions)"--Making the report available with selected information on site locations and/or site characteristics deleted meets the criteria of 43 CFR 7.18(a)(1). A list of pages, maps, paragraphs, etc. that must be deleted for each report in this category is attached.

"Not Available"--Making the report available does not meet the criteria of 43 CFR (a)(1).

