THE USE OF REPEAT PHOTOGRAPHY FOR HISTORICAL ECOLOGY RESEARCH IN THE LANDSCAPE OF BANDELIER NATIONAL MONUMENT AND THE JEMEZ MOUNTAINS, NEW MEXICO

FINAL REPORT TO SOUTHWEST PARKS AND MONUMENTS ASSOCIATION

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INTRODUCTION

The detection and analysis of change at multiple temporal and spatial scales is fundamental to historical ecology research (Swetnam et al. 1999). Knowledge of past conditions is essential to our understanding of the dynamics that shaped, and continue to shape, current landscape patterns and processes. In the Southwest, the relative contributions of climate fluctuation and human disturbance to the observed changes in the composition, structure, function, and distribution of regional landscapes has been persistently debated (Hastings and Turner 1965, Bahre 1991, Allen et al. 1998). In Northern New Mexico, past environmental conditions and landscape patterns have been reconstructed from multiple lines of evidence, each with inherent strengths and weaknesses. Recently, repeat photography has been enlisted as a research tool to augment dendrochronology, palynology, land use history, and a suite of inventory and monitoring programs, in the study of the changing landscape in which Bandelier National Monument is embedded. Repeat photography can be a valuable tool in documenting and interpreting the causes of landscape changes. Outstanding Southwestern examples are the seminal *The Changing Mile* (Hastings and Turner 1965), *A Legacy of Change* (*Bahre* 1991), *The Colorado Front Range, a Century of Ecological Change* (Veblen and Lorenz 1991), and *Grand Canyon, a Century of Change* (Webb 1996). An initial description of the use of repeat photography for historical ecology research in the Bandelier landscape is presented here.

Although change is inherent in natural systems, sweeping human-caused ecological changes have occurred at rapid rates over vast areas in northern New Mexico during the last 100-150 years (deBuys 1985, Allen 1989). Some of the most obvious changes are in the appearance (and function) of vegetation communities. Figure 1 is a map of Northern New Mexico from the Wheeler expeditions of 1873-1876 (from Foxx and Tierney 1985), a pivotal period in regional history. This time period corresponds roughly with both the introduction of large-scale Anglo commerce and the advent of photography. While widespread local use of the new image-making technology lagged slightly behind this key time period, sufficient early historic images of this landscape exist to permit productive use of repeat photography approaches. Although the greater portion of Northern New Mexico could rightly be called the region of interest, this project focuses on the Jemez Mountains and the Pajarito Plateau, with particular attention given to the landscape of Bandelier National Monument. Evidence of human presence in this landscape dates back 10,000 years (Reneau and Dethier 1995). Agriculturally-based Anasazi settlements were abundant in the twelfth to sixteenth centuries (Stuart 1989), followed by Spanish colonists, Mexican land grant recipients, Euro-American entrepreneurs and homesteaders, and eventually the Manhattan Project. Today, people from all these ethnic and cultural traditions, and more, are present in unprecedented numbers in this landscape. Natural disturbance processes – fire, climate fluctuation, floods, insect outbreaks –continue their ancient and ever changing interactions with human endeavors – farming, logging, grazing, fire suppression, industry, and technology. Cascades of ecological consequences flow from these interactions.

For example, in the latter portion of the nineteenth century, a thriving commercial sheep industry developed in the region, overwhelming subsistence herders and the land that supported them. A few people, like Española merchant Frank Bond, got rich; many others were disenfranchised and impoverished. (Rothman 1992). Overgrazing removed the fine grassy fuels that carried frequent, low-intensity surface fires through the open, park-like woodlands and forests of the Pajarito Plateau and Jemez Mountains. These natural fires virtually stopped region wide by the 1890s (Allen 1989, Touchan et al. 1996).

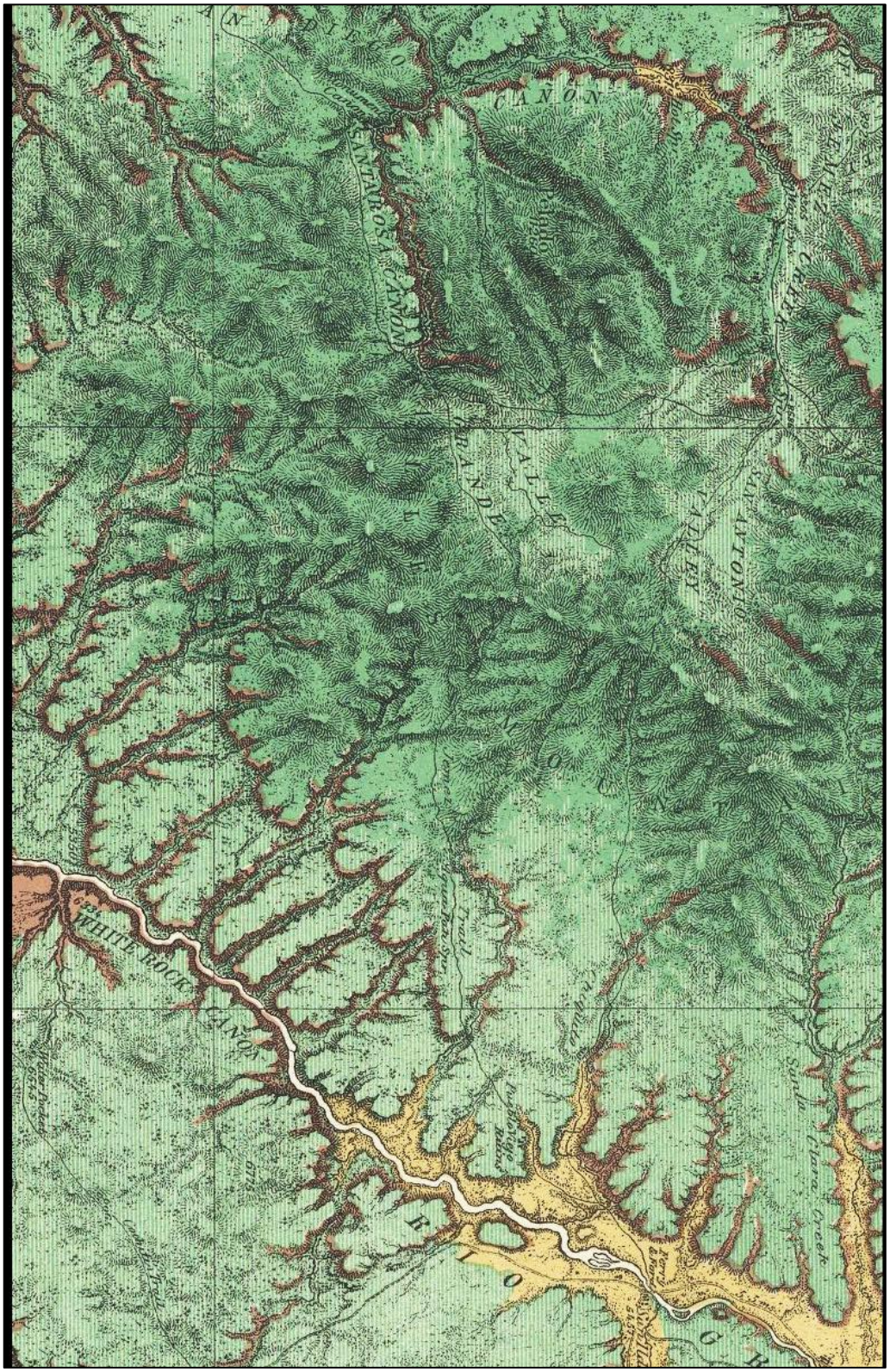


Figure 1 Historic map from the expeditions of 1st Lt. George M. Wheeler, Corps of Engineers, US Army, 1873-1876. *Available online: http://www.davidrumsey.com/maps5880.html.*

Woody vegetation increased markedly in the absence of frequent surface fires, affecting woodlands, forests, and high elevation grasslands (Allen 1989, Bogan et al. 1998). Ponderosa pine and mixed conifer forests became denser and heavy fuel loads built up, ultimately favoring fires of unprecedented magnitude and intensity like the 1977 La Mesa and 1996 Dome Fires (Allen 1996). Woody plants also increased in piñon-juniper woodlands at lower elevations, and erosion-prone bare soils became widespread (Allen 1989, Gottfried et al. 1995, Davenport et al. 1998).

In the wake America's nineteenth century economic fervor for the New West, a wave of infatuation with antiquity swept over the country. Archaeologists scoured the mesas and canyons, seeking knowledge of the vanished inhabitants, and definition of their infant science – some brought photographers with them.

Early landscape photography in the Southwest was concerned with archaeological excavations, geological exploration, railroad surveys, and advertising - not ecological interpretation of landscape change. This discrepancy in purpose can be inadvertently advantageous by reducing photographer bias: "Whatever the intent of an early photograph, however, it generally has the virtue of showing the landscape impartially and accurately, without the bias of giving attention to selected features that are expected to change" (Rogers et al. 1984). (See discussion of repeat photography strengths and limitations in Allen et al. 1998 and Swetnam et al. 1999)

Here we report on our efforts to utilize repeat photography to document and interpret changes in the landscape of Bandelier National Monument and the Jemez Mountains, New Mexico.

METHODS

Following earlier preliminary inquiries, a search for old photographs of Bandelier National Monument and the surrounding regional landscape began in earnest in 1994, with the goal of developing a repeat photography research collection. The results of this effort have evolved into the collection of the Jemez Mountains Field Station (JMFS) of the Biological Resources Division of the U.S. Geological Survey (U.S.G.S. - BRD), co-located at Bandelier National Monument. Libraries, archives, books, scientific literature, local residents, and amateurs and experts with local knowledge in various disciplines were queried. Thousands of photographs of archaeological sites, geographic features, railroads, towns, and people were reviewed in the photography collections of the U.S. Department of Agriculture Library in Beltsville, Maryland; the Smithsonian Institution and the National Photographic Archives near Washington, D.C.; the U.S. Geological Survey Photo Library in Denver, Colorado; the Southwest Museum in Los Angeles, California; the University of New Mexico Center for Southwest Research in Albuquerque, New Mexico; the Museum of New Mexico, the Laboratory of Anthropology, and the New Mexico State Archives in Santa Fe, New Mexico; and the archives of Bandelier National Monument and the Los Alamos Historical Society in Los Alamos, New Mexico. Photocopies were made of approximately 1,000 historic photographs, which we reviewed for repeat photograph potential. Originally 5"x7" black and white prints were obtained of selected photos. More recently, in 1998, a change was made to 8"x10" prints.

Repeat photography for this project began in 1995. Relocation of original camera locations and was based largely on the local knowledge of the participants. Ultimately, conversations over stacks of photos with Park Service and Forest Service personnel, and with local residents familiar

with the landscape and its history, were of the greatest value in relocating original photo points. Landmarks like roads, trails, ruins, rock outcrops, ridgelines, and mountains, along with old and current maps, and a bit of voodoo were employed. Fine tuning a camera location can be quite time consuming, and involves the use of parallax - lining up foreground and background features in horizontal and vertical planes (Rogers et al. 1984). In some cases an exact match is precluded by the object of study - by landscape change itself (e.g. tree growth or invasion obscures the view, or due to cliff retreat a canyon wall photo point has fallen into a canyon bottom). Access to photo point locations for this project was generously provided by the Pueblo of San Ildefonso, the Baca Land and Cattle Co., Los Alamos National Laboratory, Jemez State Monument, and the Los Alamos Ski Club, as well as Bandelier National Monument.

In 1995, photo points were located and repeat photographs taken by John Hogan, Steve Bracker, and Miki Promislow, with a tripod-mounted 35 millimeter Nikon FM2 with a Nikor 28-85mm zoom lens. Beginning in 1997, retakes were taken by professional photographer Steve Tharnstrom, guided and assisted by John Hogan, with a tripod-mounted 4”x5” camera and extremely fine grain film. The larger format significantly improved the clarity of the views. With the increased enlargement capacity of larger format negatives, lens selection was less critical. Views could be made covering more landscape than the original and cropped in the darkroom. Field support and assisstance during the 1999 field season were provided by Michelle Cummer and David Reiley of the Jemez Mountains Field Station.

In the field, a global positioning system (GPS) receiver was used to precisely determine the location of camera positions, or “photo points”. The date, time, camera direction (azimuth), a description and photograph of the point itself, and where appropriate, a description of the route taken, were recorded. Location information was entered into a geographic information system (GIS) using ArcInfo and ArcView software. All the geographic data processing and mapping were done by Kay Beeley of the National Park Service at Bandelier National Monument.

During the winter of 1997-98, we developed a catalog system to organize the growing collection. Photographs are assigned a number, then organized by geographical location. Any information associated with the original photos, such as the title, date, and photographer, is included. Similar information is entered for the repeat photographs, along with a photo point description and map coordinates.

Matched sets of photographs were scrutinized for evidence of ecological change in this landscape. Fourteen sets of photographs were selected for discussion here. A variety of other historic documents (including maps, survey notes, and field journals) were reviewed for information on landscape change.

RESULTS

Figure 2 is a map of the overall study region, showing land management jurisdictions and the locations of the camera points used for the all the repeat photographs considered below. Thus far, searches of collections with historic photographs depicting Bandelier National Monument and the surrounding regional landscape indicate that the favored subject matter of most local early photographers was archaeology, and that the timing of early photographs in this area was just a bit too late to capture the ideal “before” photos. Pre-1880 photos seem to be quite rare. Either they do not exist, they have been lost, or, hopefully, we have not yet found them.

Among the early photographers represented in the Jemez Mountains Field Station collection, many are prominent figures in Southwest history. George C. Bennett, of the Bennett

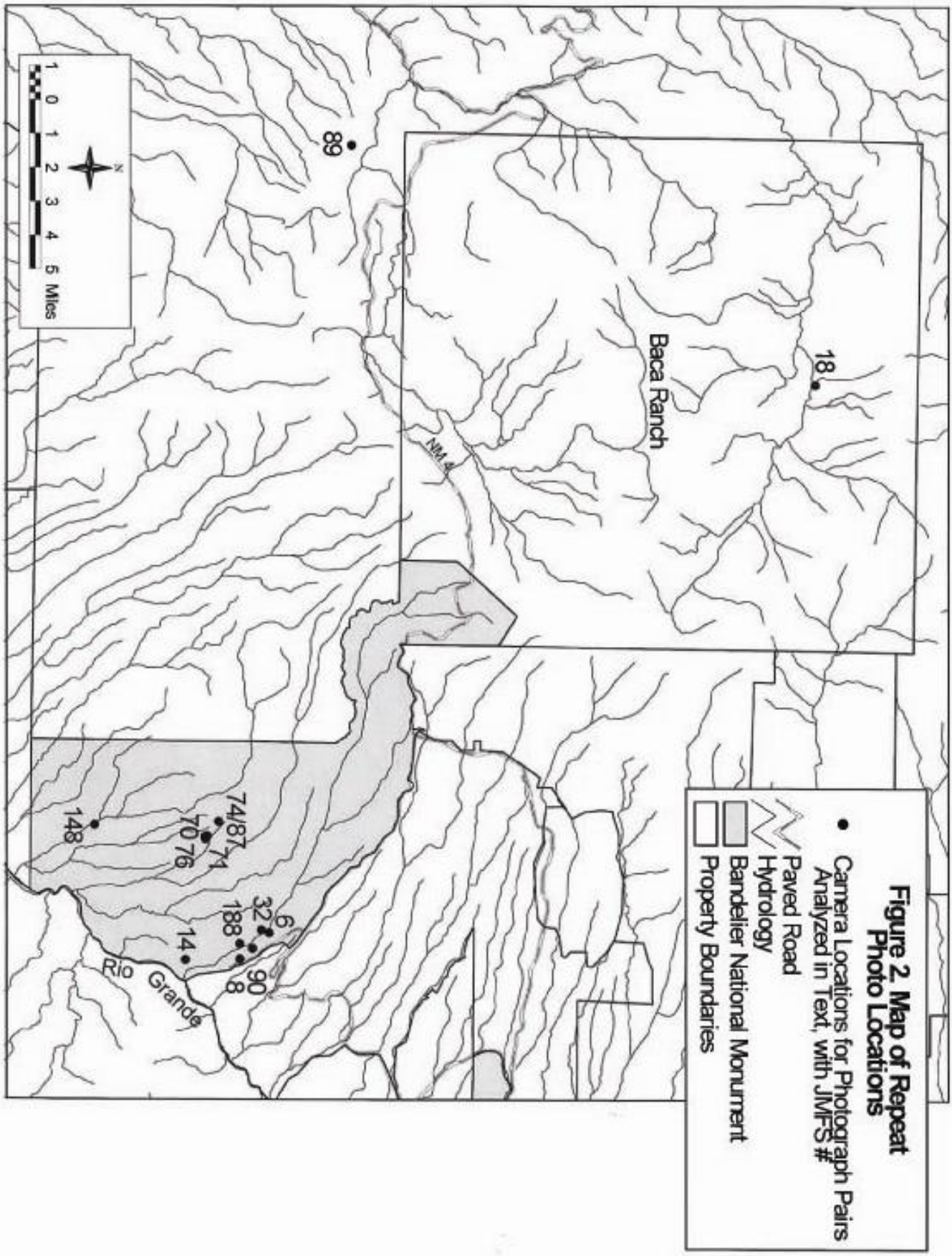


Figure 2. Map of Repeat Photo Locations
Camera Locations for Photograph Pairs Analyzed in Text, with JMFS #
Paved Road
Hydrology
Bandelier National Monument
Property Boundaries
18
89
Baca Ranch
NM 4
74/87
71
70
76
148
6
32
188
90
8
14
Rio Grande
N
1 0 1 2 3 4 5 Miles

and Brown Photographers of Santa Fe, accompanied Adolph Bandelier on his second trip into Frijoles Canyon in December 1880 (Lange and Riley 1966) and took the earliest photographs of the present Monument that we have yet located. Charles F. Lummis accompanied Bandelier on an expedition into the present Monument a decade later in 1890 (Lange, Riley, and Lange 1984). He was a prolific author, credited with coining the term Southwest, and Lummis Canyon in Bandelier National Monument is named for him. Lummis served for a time as editor of the Los Angeles Times and was the founder of the Southwest Museum in Highland Park, near Los Angeles. Jesse Nusbaum, who apprenticed under Edgar Hewett, was a cofounder with him of the Museum of New Mexico, and later served as Superintendent of Mesa Verde National Park. Nusbaum is in part responsible for the Pueblo Revival architecture that is now known as "Santa Fe style". Nusbaum photographed Hewett's School of American Archaeology excavations throughout the Pajarito Plateau, including the initial excavation of Tyuonyi Pueblo in Frijoles Canyon in 1908.

The Museum of New Mexico Photo Archive at the Palace of the Governors in Santa Fe was searched extensively in the summer of 1995. Museum of New Mexico materials form a key portion of the Jemez Mountains Field Station research collection, including some of the early Nusbaum photos of Frijoles Canyon considered below. The U.S. Department of Agriculture Library in Beltsville, Maryland houses the collections of the U.S. Forest Service and was another rich source of local photographs. The Laboratory of Anthropology in Santa Fe houses the glass-lantern slides Edgar Hewett used for lectures. The United States Geological Survey Photo Library in Denver was searched in 1998 with excellent results. The Southwest Museum in Los Angeles was also searched in 1998. The SWM collection includes over 7,000 glass negatives by C.F. Lummis, mostly of New Mexico. Nearly fifty prints by Lummis and his contemporaries were ordered. Photographs from the earliest known systematic biological inventory and physiographic survey of the State (1889-1908), conducted by Vernon Bailey of the US Department of Agriculture, Bureau of Biological Survey, were found in the National Photographic Archives near Washington, D.C. These include several early photos of the Baca Location No. 1, which adjoins Bandelier National Monument on the northwest.

To date, more than 300 historic photographs have been acquired**.** Nearly 100 of these have been repeated **.** The most common subjects are views of Frijoles Canyon and Tyuonyi, but the JMFS collection contains views of many of the major archaeological sites in the region, the Rio Grande, the Baca Location No. 1, and all the major vegetation and forest types in the region.

Examples of the landscape changes documented through repeat photography are presented in descriptions of fourteen matched sets of photographs from Bandelier National Monument and the Jemez Mountains. Descriptions are organized geographically. The matched sets of photographs, along with some reference details are presented as a separate Photo Appendix for ease of comparison with the text. Where an exact match was impossible due to human or natural alteration of the original photo point, or some other obstacle, an alternate point that would still "tell the story" was chosen. In some cases both the initial 35mm repeat taken 1995 and the later large format 4x5 repeats of the same view each portrays an important visual aspect of a scene better than the other retake (e.g. due to time of day or cloud cover). In these cases both the initial 1995 repeat and a later repeat are presented. Photographs are identified by their catalog numbers from the collection of the Jemez Mountains Field Station (**JMFS #**), of the U.S. Geological Survey - Biological Resources Division (USGS-BRD). At the risk of being redundant, identical text is sometimes repeated for appropriate sets of photographs to eliminate excessive cross-referencing.

DESCRIPTIONS OF MATCHED SETS OF PHOTOGRAPHS

Bandelier National Monument

Frijoles Canyon and Tyuonyi

Due to the presence of perennial water, Frijoles Canyon has been a focus of human activity since before the descendants of the Four Corners Anasazi settled here in the late A.D. 1100s and 1200s (Stuart 1989; Dunmire and Tierney 1995). The ruins of Tyuonyi, a three story circular pueblo of more than four hundred rooms with three kivas, date to the Rio Grande Classic period, from 1325 to1600. (Stuart 1989, Cordell 1984). Although direct evidence is scant, it is believed that resource depletion probably contributed to the exodus of the Anasazi from the mesas of the Pajarito Plateau, including from the lands of Bandelier National Monument. Standing trees may have been scarce due to structural and fuel uses of wood, and soils exhausted by agriculture. For example, old-growth piñon-juniper woodland is conspicuously absent throughout the study region (Allen – in review).

Following Anasazi occupation, and prior to the earliest photos presented here, portions of the Pajarito Plateau were included in various Spanish or Mexican land grants (Hoard 1983). The earliest known mention in Spanish documents of the area now known as the Rito de los Frijoles (literally, Bean Creek, but until recently synonomous with Frijoles Canyon) is in the will of Captain Andrés Montoya, dated at Santa Fe, New Mexico June 17, 1740 (Morley in Hewett 1938). Captain Montoya willed the Rito de los Frijoles Land Grant to his heirs. Due to a lack of supporting documentation – the original grant papers had been lost by Montoya – this grant was ultimately declared invalid by the U.S. Court of Public Land Claims in 1893 (Morley in Hewett 1938). The relatively abundant water and initially good quality, but limited, forage attracted seasonal Hispanic herders and early homesteaders. By the 1880s, Frijoles Canyon is said to have been showing signs of overgrazing (Rothman 1992).

Adolph Bandelier (1840-1914) conducted his explorations of the Southwest, including, Frijoles Canyon, between 1880 and 1892. He entered Frijoles Canyon for the first time, arriving on horseback from Cochiti Pueblo to the south, late in the afternoon of October 23, 1880. He called it “The grandest thing I ever saw” (Lange et al. 1984). His popular and scholarly works helped to generate an enduring national interest in Native American archaeology and ethnology. Figure 3 is a sketch from Bandelier’s Southwest Journals, 1880 - 1882, showing his names for the complex canyon and mesa topography of much of the region that is now Bandelier National Monument (from Lange and Riley 1966).

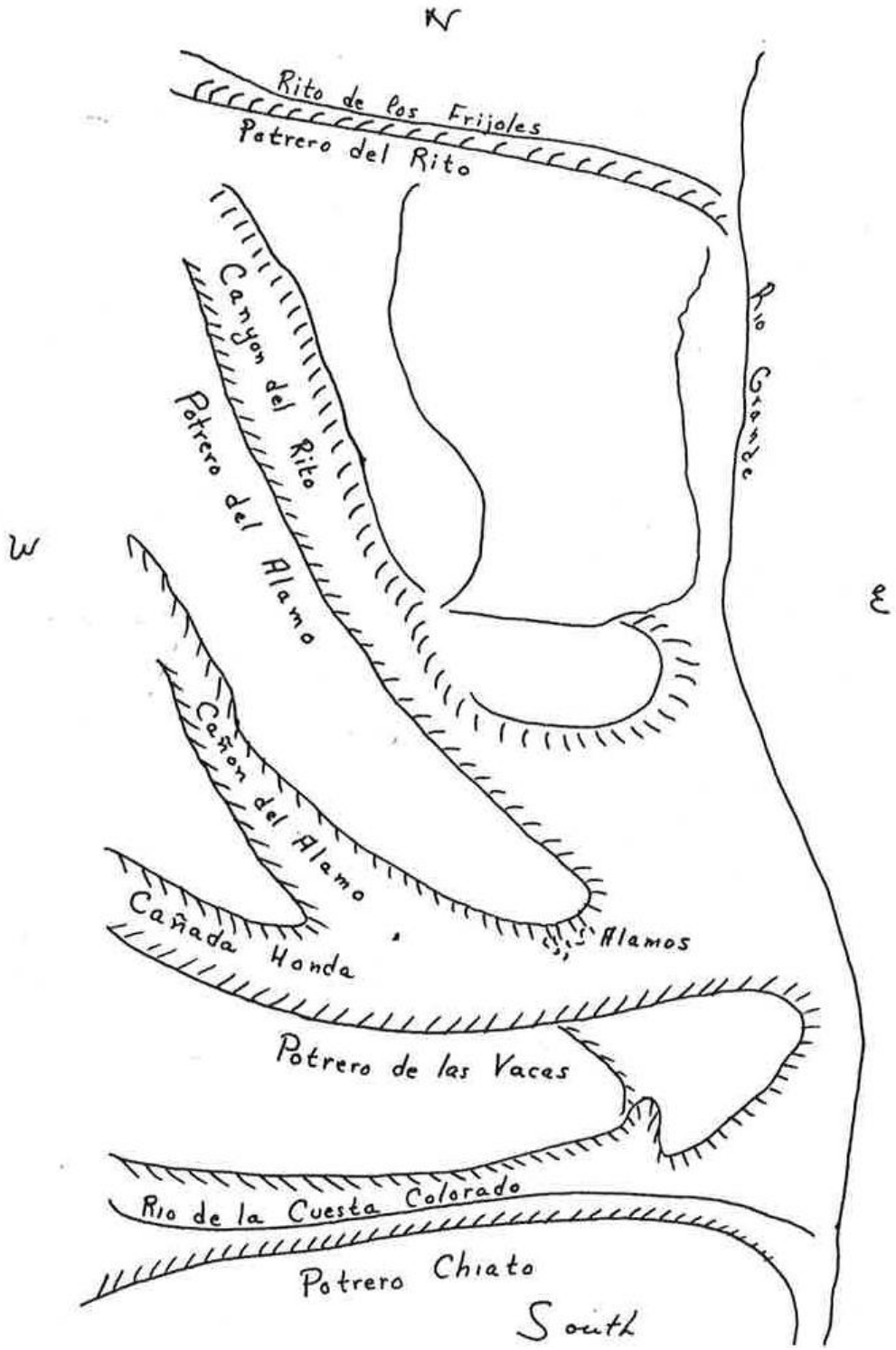


Figure 3 Sketch map by Adolph Bandelier of the canyon and mesa topography of today's Bandelier National Monument, showing the names he used in the 1880s.

At the turn of the century Edgar Hewett and others championed efforts to preserve the antiquities of the Pajarito Plateau in a large park. Amid these efforts, in 1905, Frijoles Canyon and the rest of the Pajarito Plateau were included in the Jemez Forest Reserve under the jurisdiction of the newly created U.S. Forest Service. Bandelier National Monument was eventually created in 1916, a less ambitious preservation effort due to complex political realities (Rothman 1992).

Judge Abijah J. Abbott, a sixty-four year old retired judge from Santa Fe, leased Frijoles Canyon from the U.S. Forest Service in 1907. He and his wife, Ada, established the "Ranch of theTen Elders" and lived there until about 1917 (Rothman 1992). (Bolgiano, 1997, states that the Abbotts called it "Ten Alders"). They grew much of their own food and grazed livestock along the creek. The canyon became a popular destination for the limited number of hardy travelers willing to hike in and out (Harrison et al. 1988).

Other homesteaders, including John Boyd, followed by the Davenports and the Reeds, took the operation over after the Abbotts, until George and Evelyn Frey arrived in 1925 (Rothman 1992). They further expanded the farming and livestock operations, added more fruit orchards, and built the guest cabins of Frijoles Canyon Lodge. These accommodations were originally across the creek from Tyuonyi. The Monument passed into the jurisdiction of the National Park Service in 1932. The construction of the current buildings by the Civilian Conservation Corps (CCC) took place between 1933 and 1941, with the entrance road being completed in 1934 (Harrison et al. 1988). The old log buildings across the creek were torn down and the lodge operation moved into the new CCC structures, where Evelyn Frey bade farewell to her last guests in November, 1976 (C. Judson, National Park Service 1998 – personal communication).

Frijoles Canyon and Tyuonyi Pueblo were the subjects of a flurry of archaeological and associated photographic interest during the latter eighteenth and early twentieth centuries. More than twenty of those photos have been repeated for the JMFS collection. Striking land use changes dominate this series of photos, with the greatest changes occurring in the original series, capturing the vestiges of Anasazi occupation of Frijoles Canyon through a period of intensive agricultural utilization during the early twentieth century. The repeat photos reflect a shift in the canyon's usage away from agriculture to its current usage as a center of intensive tourism administered by the National Park Service. Since its excavation the old pueblo has found itself amidst sea of landscape change.

The five sets of repeat photos of Frijoles Canyon presented here span the period from Adolph Bandelier's 1890 visit with Charles Lummis to 1920, four years after the designation of Bandelier National Monument and five years prior to the arrival of George and Evelyn Frey. These photos dramatically depict the human and ecological history of Frijoles Canyon, and emphasize the connections between the two. Due to the prominence of this canyon in the history of the Southwest and its importance to the modern Monument, these sets of photos are given substantial emphasis in this report.

JMFS 188 – (Original photo by Charles F. Lummis, October 13, 1890, courtesy of the Maxwell Museum of Anthropology, University of New Mexico, Catalog No. 88.18.15; 1.592)

The earliest views of Frijoles Canyon we have found were taken by George C. Bennett of Santa Fe, who accompanied Adolph Bandelier on his second visit to "the Rito" in December of 1880 (Lange and Riley 1966). The surviving plates, as far as we know, depict close-up views of the cavates from the canyon floor. Charles F. Lummis took the earliest landscape-scale views that we have yet found a decade later, in 1890. Lummis also accompanied Bandelier into the Rito

in October of that year, partly for the purpose of retaking lost or damaged Bennett views for inclusion in Bandelier's Final Report to the American Institute of Archaeology, of which Lummis was an official (Lange et al. 1984).

One of Lummis's views, taken from the south rim of Frijoles Canyon, which we obtained from the collection of the Southwest Museum is dated October 22, 1891. A copy of this same view, found in the Bandelier archives, is labeled in Lummis's hand as, "The mouth of the Rito de los Frijoles, looking east…The first view ever taken of the Rito."

During the winter of 1999, we discovered a nearly identical print, in the collection of the Maxwell Museum of Anthropology at the University of New Mexico, which is of particular interest to the Park. An old, extremely dark print mounted on card stock was closely examined on a light table, revealing a shadowy figure seated on the canyon rim. Charles Lummis's original handwriting shone through from the back of the print, underneath the card stock. We laboriously deciphered the following caption: "In the Rito looking east through the 'Boca'. Bandelier seated in foreground. Photo by Chas. F. Lummis 1890." The seated figure is Adolph Bandelier! No one that we have consulted thus far has seen this photo before, possibly due to its poor quality. A copy negative was made from this print, then manipulated in the darkroom to enhance the image of Bandelier. These prints were cataloged as JMFS 188.

Close inspection of the details of both Lummis photos – shadows, foreground tree branches, cliff features, the horizon line - indicates that the two views were taken from exactly the same camera position, i.e. they were taken on the same day. Bandelier's journals from October of 1890 and October of 1891 were consulted, confirming 1890 as the true year. On October 13, 1890, he wrote, "Day very pretty. We (he and Lummis) photographed the Rito all day…Night brilliant, starry, but cold. Ice in the Rito" (Lange et al. 1984). We believe that JMFS 188 was taken on that day.

The photo point for this set is near the top of an old Indian trail ascending the south canyon wall, beginning on the current Falls Trail, opposite the Monument's stables. Some segments of this trail show signs of historic improvement, especially widening and leveling, perhaps by Hispanic shepherds to facilitate the movement of stock between mesa top range and the water in the canyon bottom. Considered concurrently, the written and photographic evidence suggest that this trail was the route used to access this portion of the canyon, from Cochiti to the south, from the days of the Anasazi through the days of the early explorations of Bandelier and his contemporaries. This trail is nearly invisible from across the canyon, even when you know it's there. It has been suggested that this trail once connected with the trail remnant portrayed in JMFS 8 below, which is just above the road in a small drainage on the other side of the canyon.

On October 12, 1890, Bandelier wrote, "We left (their camp at Painted Cave) at 9A.M. and returned to the Rito de los Frijoles at 4 P.M. The Rito is beautiful. We stayed at the ranch-house of Pacífico Baca. There are three or four cows in the Rito". Baca was a Spaniard whom Bandelier had met in earlier years when he (Baca) lived at Cochiti Pueblo. Pacífico had since moved to a rancho in the Rito de los Frijoles, where Bandelier had visited him in August of 1885(Lange et al 1984). Information of this sort helps us to piece together the rather fragmentary record of occupation of the canyon, and helps to verify other lines of evidence regarding regional land use history.

In addition to its obvious human interest, JMFS 188 contains important landscape change information. An extensive south-facing slope of piñon-juniper woodland covers the entire left side of the photo, from the mesa top to the rim of Frijoles Canyon (at the edge of the shadows). This is the most common vegetation type on the Pajarito Plateau, dominated by piñon pine and

one-seed juniper. The broad terrace above the canyon rim was the location of prehistoric fields. The stone relics of ancient agricultural use still abound in the midst of the woodland, which is well-established in 1890. John Hogan's1999 repeat view, with photographer Steve Tharnstrom sitting in for Adolph Bandelier, shows that the previously open interspaces between the trees have closed in somewhat during the intervening century. The interplay of climate, grazing, and fire suppression has led to similar changes across the plateau and throughout the Southwest (Allen 1989, Gottfried et al. 1995, Swetnam et al. 1999)

The light horizontal stripe at the upper edge of the terrace at left marks the location of a break in the slope delineated by a band of twenty to thirty foot cliffs of Bandelier tuff, the welded volcanic ash that flowed from the Valles Caldera in two massive events about one million years ago, forming the Pajarito Plateau. The 1999 view shows that the road into Frijoles Canyon, completed in 1934 by the Civilian Conservation Corps (CCC) (Harrison et al. 1988) follows the base of the cliffs as it descends from the mesatop at right toward Monument headquarters, out of view to the left. This road replaced the Old North Trail as the main visitor access to the canyon, ending its relative isolation.

The largest hill on the horizon is Cerro Montoso at center, in the Caja del Rio unit of the Santa Fe National Forest, across the Rio Grande from the Monument. The far wall of White Rock Canyon is just visible beyond the mouth of Frijoles Canyon near the center of the view (See JMFS 14 below).

JMFS 188 by Charles F. Lummis 1890

JMFS 188(99) by Steve Tharnstrom 11/12/1999 **UTM** – 385326E 3959345N AZ – 126

JMFS 8 – (Original photo by Jesse Nusbaum, 1908, courtesy of the Museum of New Mexico, Neg. No. 48896)

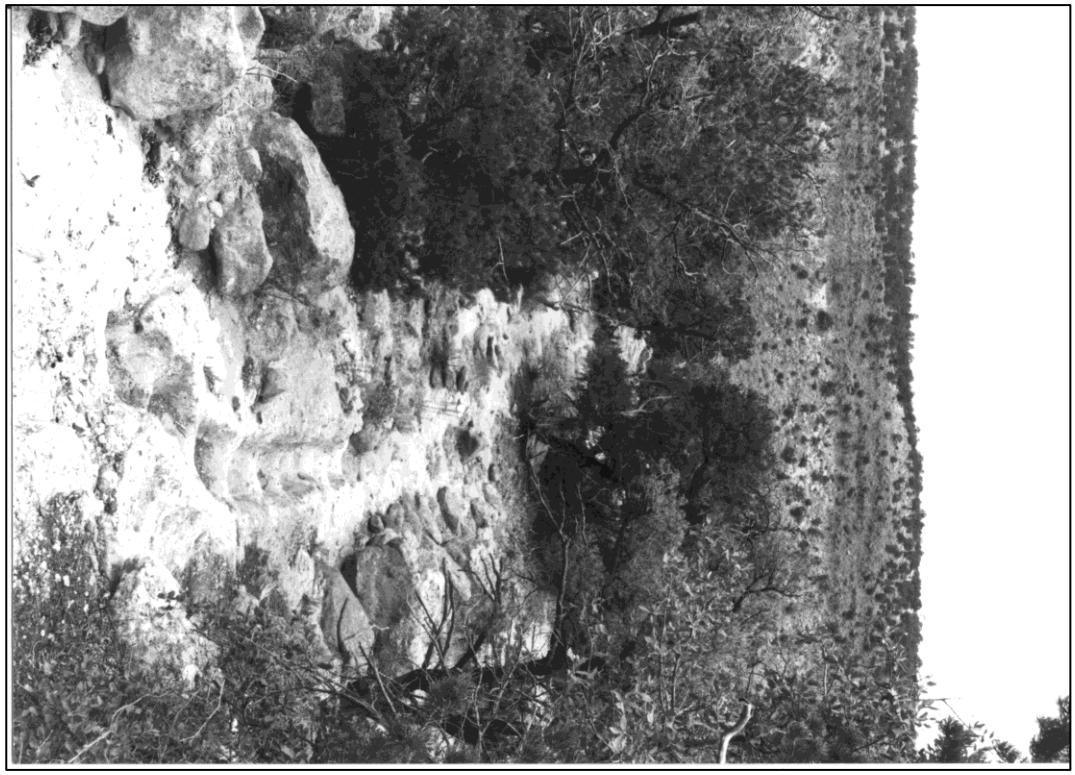
This 1908 view by Jesse Nusbaum, looking to the southwest, shows his friend Santiago Naranjo, ascending an old trail out of Frijoles Canyon. Santiago, who was also Edgar Hewett's guide and a friend of Charles F. Lummis, was five times the governor of Santa Clara Pueblo. In later years Nusbaum related, "I wanted my great friend to see Mesa Verde, because he said he would like to. He always said, 'Well, I can't go. I have to look after my people'" (Nusbaum 1980).

This trail provided visitor access prior to the building of the Old North Trail (now known as the Frey Trail) and completion of the entrance road by the Civilian Conservation Corps in 1934. There is some indication that, prior to the construction of the road into Frijoles Canyon, this trail may have connected with the trail discussed in JMFS 188 above, providing both canyon access and a cross-canyon route.

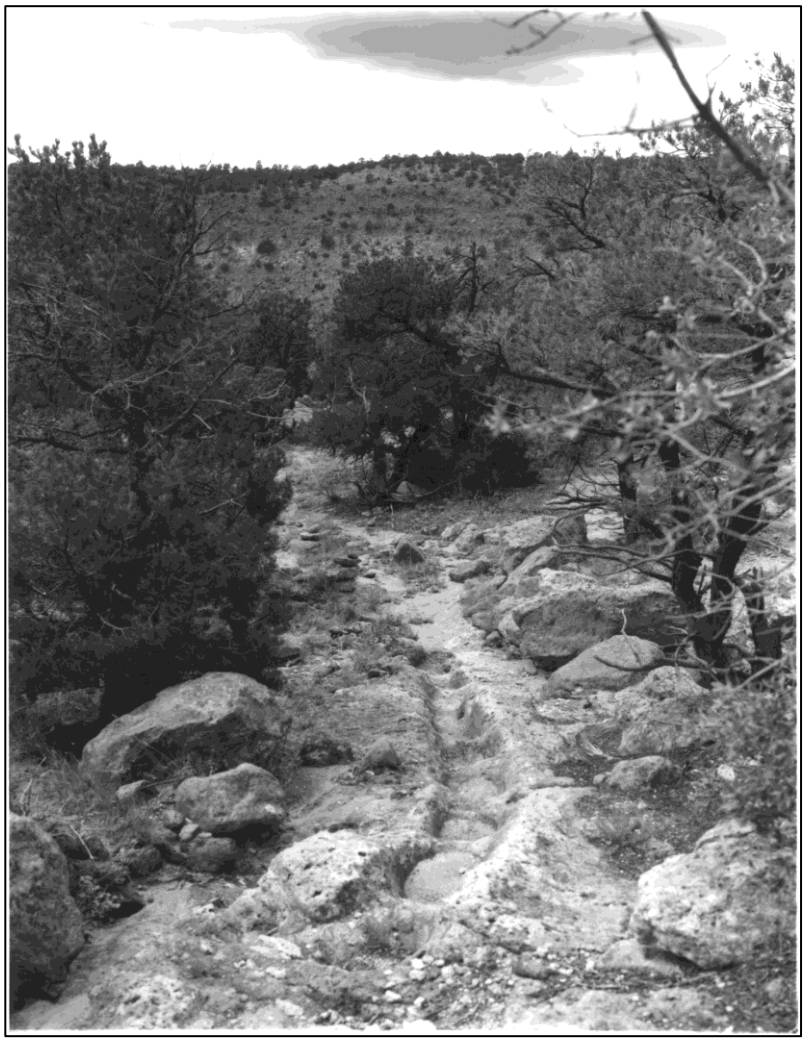
The importance of information contained in the periphery or margins of a view is well illustrated here. Ponderosa pines are silhouetted along the top of the mesa, which is across Frijoles Canyon (the Rio Grande is down-canyon to the left). These trees are conspicuously absent in the repeat view. The remains of these pines, stressed by extreme drought in the 1950's and killed by bark beetles, now litter the mesa top. This pair of photos captures the rapid, climate-driven shift in the ecotone between ponderosa pine forest and piñon-juniper woodland that occurred region wide (Allen and Breshears, 1998). In less than five years the lower margins of the ponderosa pine forest retreated approximately two kilometers upslope, leaving piñon and juniper, species better adapted to arid conditions, to fill in the void (Allen and Breshears 1998). These photos are near the lower elevational extent of the pre-drought ecotone. This recent climatic disturbance came in the wake of an extended period of overgrazing in the late eighteenth and early nineteenth centuries, which altered vegetation communities and fire regimes (Allen 1989). Concerns about accelerated soil erosion in these altered landscapes, with associated damage to cultural and natural resources, has prompted quantitative research into these processes (Wilcox et al. 1996, Davenport et al. 1998) in a small watershed study area on the mesa top to the south of Tyuonyi.

The repeat view, taken by Steve Bracker in 1995 with John Hogan in Santiago's place on the trail, also illustrates the persistence of wavyleaf oak (Q*uercus undulata*) as a component of canyon wall vegetation; the same individual can be seen along the right margin of this pair. Several piñon and juniper individuals have also survived. Some of the foreground tuff boulders appear the same, while others, like the large boulder in the left foreground, have split apart, demonstrating the high propensity of Bandelier tuff for spalling, especially in the frequent freeze-thaw cycles characteristic of south-facing slopes.

JMFS 8 by Jesse Nusbaum 1908



JMFS 8(95) by Steve Bracker 8/2/1995



JMFS 8(97) by Steve Tharnstrom 8/17/1997 **UTM** – 385923E 3959352N AZ – 247 deg.

<u>JMFS 32 and 34</u> – (Original photo by Jesse Nusbaum, 1908, courtesy of the Museum of New Mexico, Neg. No.130377 and 138382)

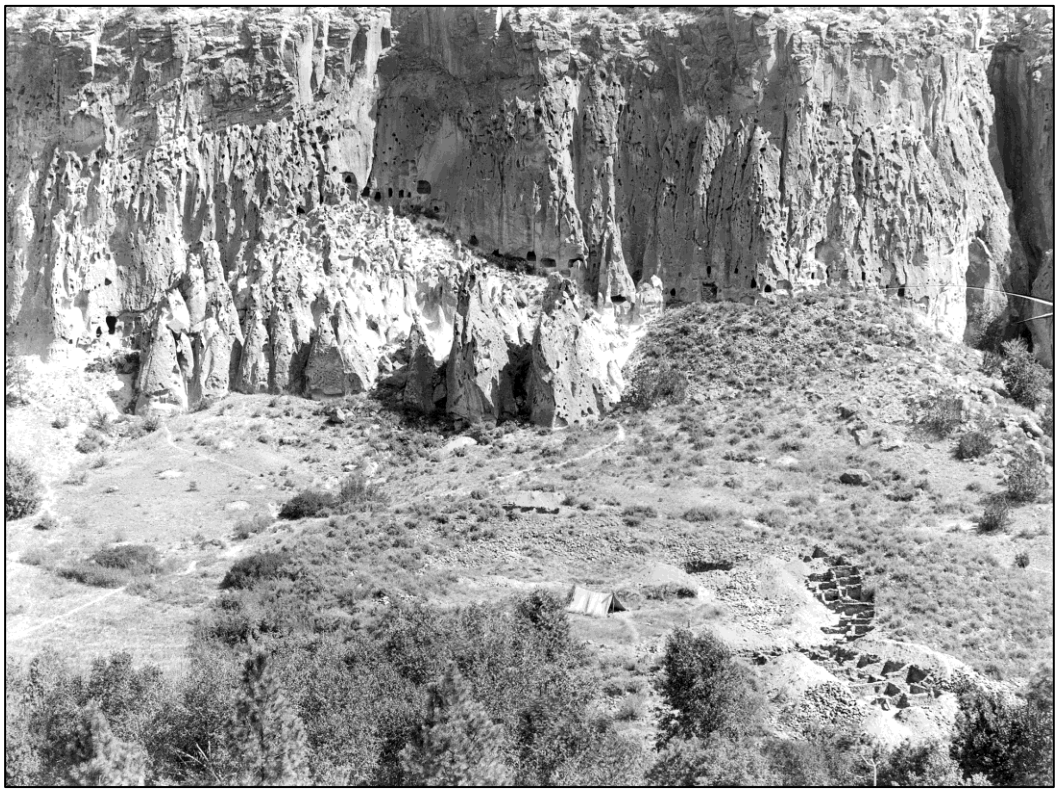
These Jesse Nusbaum photos from 1908 are included together because they are the same view; the analysis refers to JMFS 32. JMFS 34 is an enlargement of JMFS 32 (note shadows) and is included to facilitate examination of some details. These photos, taken from the south wall of Frijoles Canyon during the Abbott years, document the early stages of the first excavation of Tyuonyi, carried out by Edgar Hewett and his School of American Archaeology between 1908 and 1912 (Mathien et al. 1993). Hewett's tent is visible in the plaza. The archaeologists camped in the canyon during the summers, sharing a logistically as well as socially symbiotic relationship with the Abbotts (Rothman 1992). Note the piles of tuff building blocks near the mounds of excavated soil; Abbott's home was constructed of these. Fourwing saltbush (*Atriplex canescens*) is the abundant shrub on the unexcavated portions of the mound. Pale wolfberry (*Lycium pallidum*) is interspersed among the saltbush in the canyon bottom, and is the dominant shrub the on talus slopes below the cavates on the far canyon wall. These two disturbed-soil specialists are among the species identified as "indicators" of prehistoric ruins, along with several members of the genus *Solanum* (Yarnell 1958). The band of primarily deciduous trees at the bottom of the view is

rooted in the riparian zone of Frijoles Creek and includes narrowleaf cottonwood (*Populus angustifolia*), box elder (*Acer negundo*), thinleaf alder (*Alnus tenuifolia*), and water birch (*Betula occidentalis*). These are also indicator species in the arid Southwest, announcing the presence of water at or near the surface (Dunmire and Tierney 1995). Ponderosa pine (*Pinus ponderosa*) is present as scattered individuals on the mesatop opposite the camera, on the talus at left center, below the cone-shaped tent rocks at right center, and interspersed in the riparian zone at the bottom of the view.

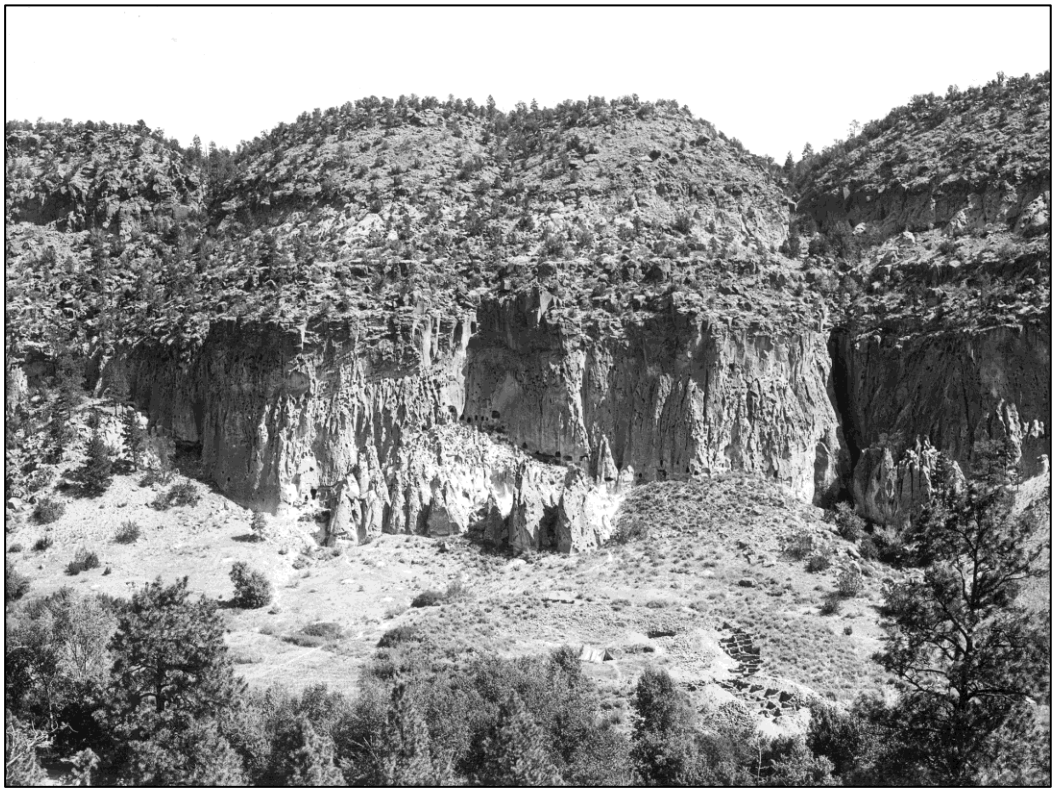
JMFS 32(95), taken by John Hogan in 1995, was intentionally shot from further up the canyon wall to include more of the canyon floor. JMFS 32(98), taken by Steve Tharnstrom in 1998, more closely duplicates Nusbaum's 1908 camera location. The increase in height, density and abundance of riparian species is immediately apparent in these views, as it is in all the sets depicting Tyuonyi. This change may be attributed in part to the cessation of harvesting trees for fuel and building materials, and to the elimination of livestock grazing and trampling in the riparian zone. The persistence of the tent rocks aided in locating the camera location.

The ponderosa pines, stressed by years of extreme drought in the 1950's and killed by bark beetles (Allen and Breshears 1998), have been almost entirely eliminated from the canyon wall and mesa top. This pair of photos captures the rapid, climate-driven shift in the ecotone between ponderosa pine forest and piñon-juniper woodland that occurred region wide. They are thriving in the riparian zone, which provided refuge from climatic extremes. The remains of these ponderosa pine trees litter the mesa top; some are visible on the talus slope at left center.

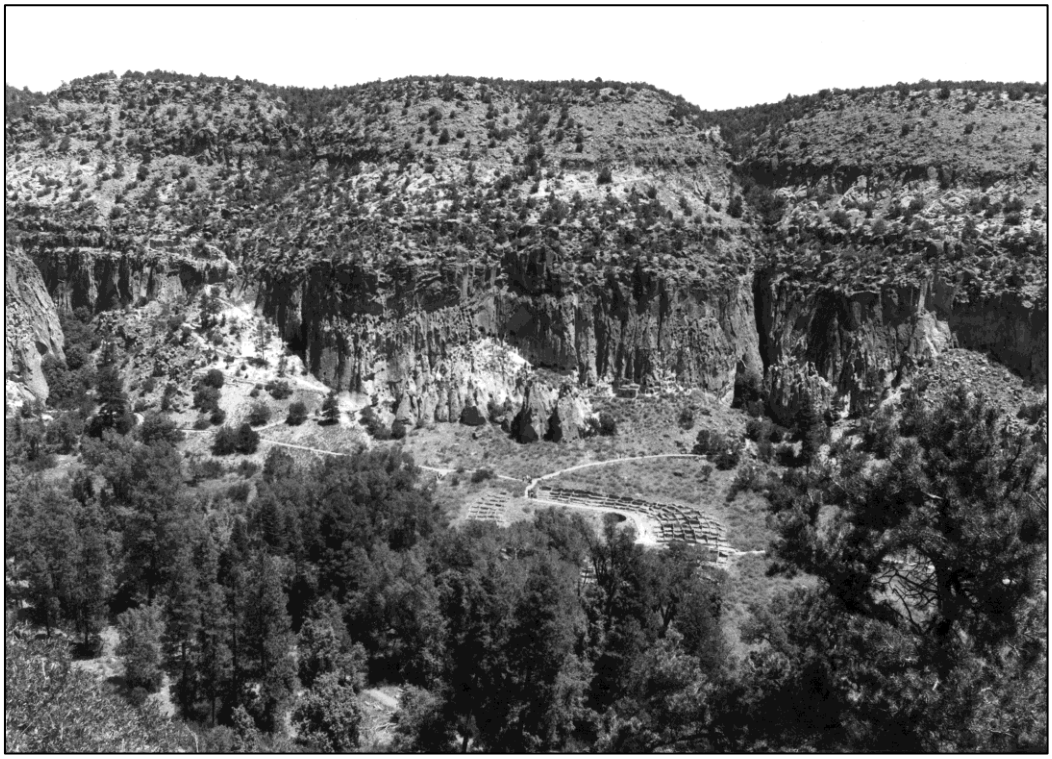
In the years since Nusbaum's early views almost the entire remainder of Tyuonyi was excavated, a portion of Talus House was reconstructed (to the right of the tent rocks in the center of the view addition), and a formal trail system was added. The Main Loop Trail is visible in the canyon bottom and along the line of cavates at the cliff base. The Frey Trail climbs out of the canyon through the talus at left center, along the ledge at the top of the vertical cliff face, and through the notch in the mesa at upper right. Though current usage honors George and Evelyn Frey, the Old North Trail, built by the Forest Service during the Abbott's tenure in the canyon, followed the same general route (Hoard 1983).



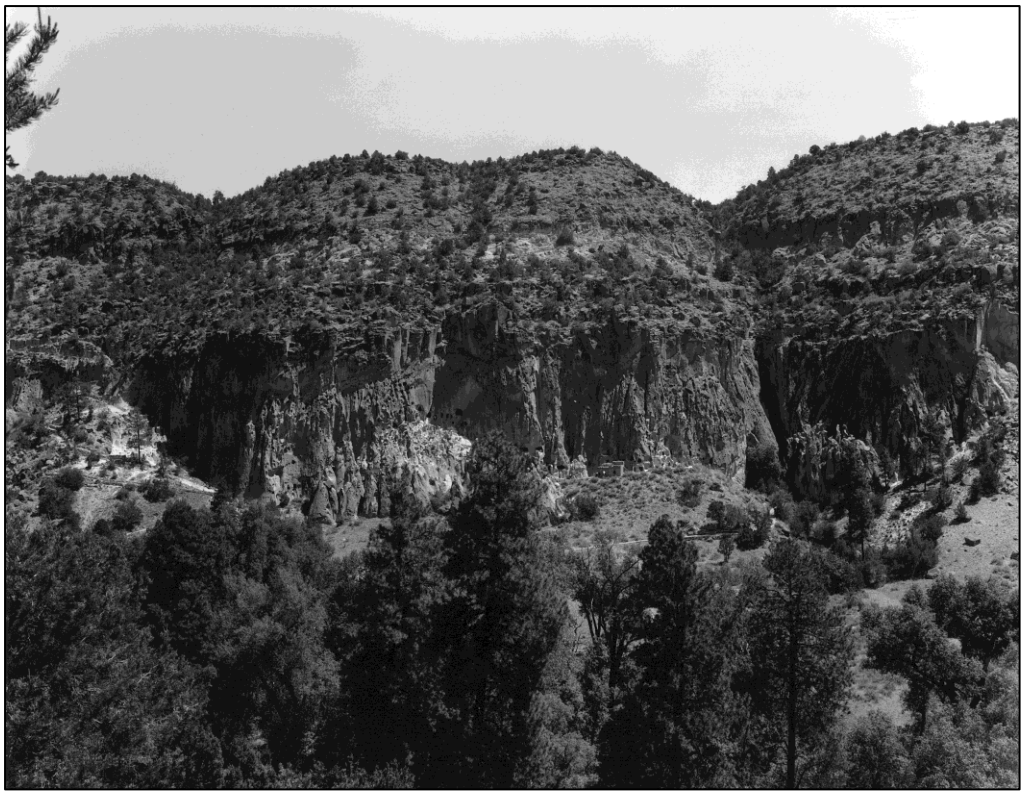
JMFS 34 by Jesse Nusbaum 1908



JMFS 32 by Jesse Nusbaum 1908



JMFS 32(95) by John Hogan 6/29/1995



JMFS 32(98) by Steve Tharnstrom 6/19/1998.
UTM – 1995: coordinates unknown AZ – 34 deg 1998: 284793E 3960184N AZ – 32 deg.

JMFS 6 – (Original photo by W.C. Barnes, ca. 1917, courtesy USDA, Forest Service, Neg. No. 36829-A)

This circa 1917 Forest Service photo, taken near the end of Judge Abbott's tenure in the Canyon, looks to the southwest from the cliff above Tyuonyi. The photographer , Will C. Barnes, was chief of grazing for the Forest Service and a friend of Edgar Hewett (Rothman 1992). Some of the same rocks appear in the foreground of both views and served as points of alignment to select the camera position in 1995 and 1997. The visible ruins, fully excavated in this view, are believed to have been built during the late thirteenth to mid fifteenth century. The unexcavated mound to the upper left of the main pueblo complex, covered with fourwing saltbush (*Atriplex canescens*), is known as the Tyuonyi Annex.

Abbott's diaries don't indicate that many animals were present in the canyon during this period (Belgian 1997), but the continuous line of fence at the far side of the fields would have allowed livestock access to forage and water along the creek, while keeping them out of the by – then extensively cultivated canyon bottom. The semi-circular earthen levee or dike curving around the lone ponderosa pine to the left of the ruin appears to be part of a ditch system rerouting water from the natural drainage that originates in a cleft in the cliff to the left of the photo point. The "V" pattern to the left of the pueblo and below the field indicates the location of a portion of Abbott's irrigation system. Based on its size and location, the field at left center probably later became the site of the baseball diamond built with a grader in 1934, by and for the CCC camp in the "formerly cultivated area between the Great Kiva and the river below the barns and sheds belonging to Mr. Frey…" (Harrison et al. 1988).

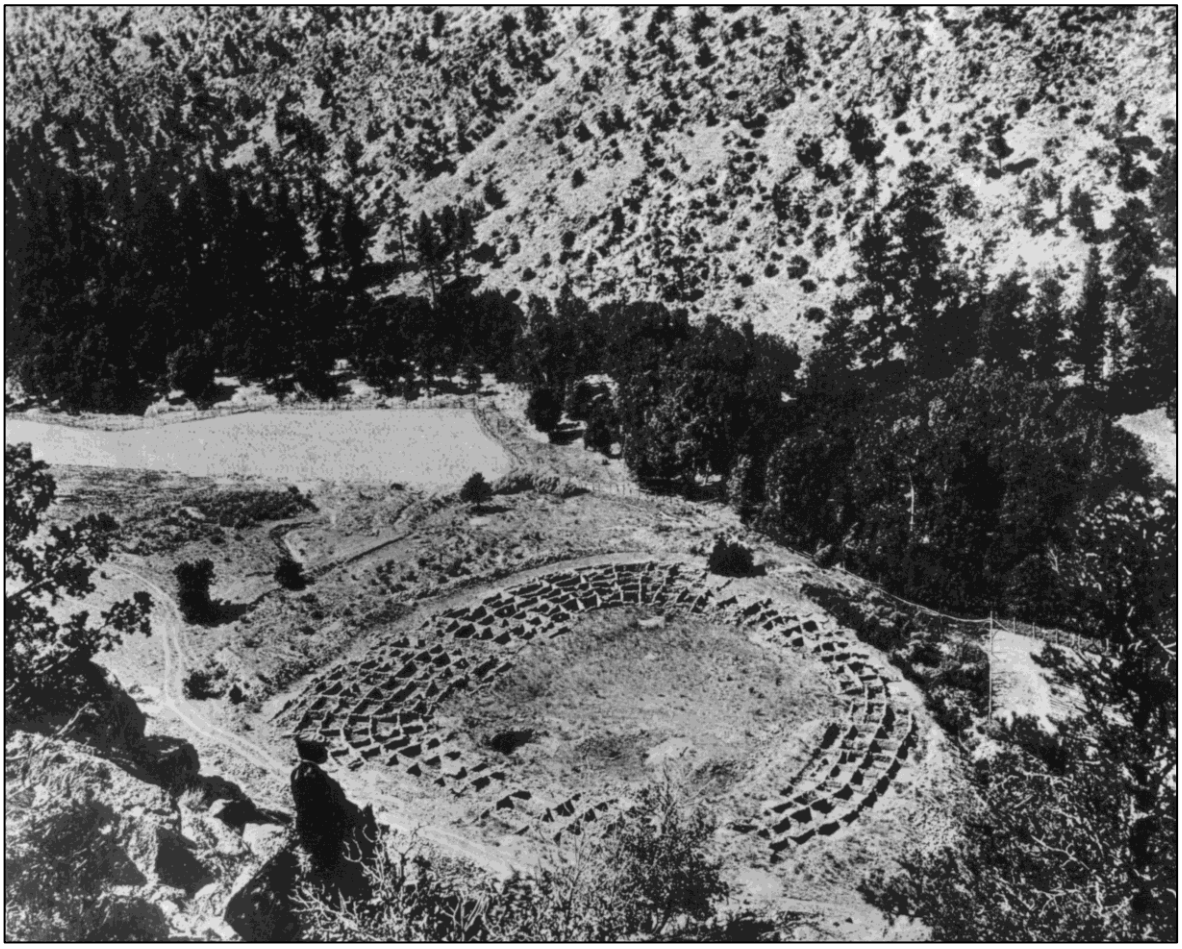
The narrow footpath skirting Tyuonyi in Nusbaum's 1908 views has, by 1917 become Judge Abbott's wagon road, likely to access his fields up canyon, just visible to the right of the pueblo. Some of the pueblo walls and the kiva in the plaza show signs of deterioration since 1908.

The band of primarily deciduous trees beyond Tyuonyi indicates the course of El Rito de los Frijoles (Frijoles Creek). The repeat views show a now towering gallery of riparian forest along the creek, which includes Fremont cottonwood (*Populus fremontii*), narrowleaf cottonwood, Rocky Mountain maple (*Acer glabrum*), and box elder (*Acer negundo*). This increase from the comparatively impoverished conditions of the original view, suggests that human utilization of riparian timber resources was probably extensive. This assumption, inferred from documentary sources, should be tested against fire and flood reconstructions, and livestock utilization history to ascertain the relative contribution of each to the 1917 conditions.

In JMFS 6(95), and less clearly in JMFS 6(97), the switchbacks of the modern Frijolito Trail are visible at upper left, ascending a canyon wall that is much more heavily vegetated than in 1917. Piñon pine and juniper are much increased in both size and abundance. The herbaceous component of the canyon wall vegetation appears to be much more extensive and vigorous. Stringers of ponderosa pine extend further out of the riparian zone, both up mesa and into the old field. The light stripe of partially bare soil extending away from the kink in the trail just to the left of the pueblo appears to be a scar left from rerouting the natural drainage visible in the original photo. Notice the "V" pattern of the drainage and diversion in the original. The new trail was routed around the box elder (A*cer negundo*)at the point of the "V". The establishment and persistence of this tree outside the riparian zone indicates the presence of ample water. Other individual trees have persisted as well. Between the ditch and the field at left in the original is a mound covered with fourwing saltbush (*Atriplex canescens*). This is the still largely unexcavated Tyuonyi Annex.

There is a large piñon in the lower right corner of the original - its skeleton is visible amongst the now larger and more numerous wavyleaf oak (*Quercus undulata*) and mountain mahogany (*Cercocarpus montanus*) in the foreground of the 1995 view. The clump of oaks at bottom center of the original, and the rock with the triangular shadow to the left of the unidentified man in the original are both present in the 1995 and 1997 views.

The 1997 view contains an inadvertent record of what many locals called the greatest abundance of thelypody (*Thelypodium wrightii*), a crucifer with delicate lavender flowers, that anyone had seen in twenty years. The tall, and unfortunately blurry, stem along the left edge of JMFS 6(97) is thelypody. Many of these stems, some over six feet tall, were still standing through the fall of 1998. The amount and timing of moisture during the exceptionally wet spring and often-dry early summer of 1997 are believed to have played a role in the germination of the long-dormant seeds. We saw no thelypody anywhere in the Monument during 1998, and only a few individuals during 1999, when the bulk of the moisture came late in the season from August to October.



JMFS 6 by W.C. Barnes 1917

JMFS 6(95) by John Hogan 7/7/1995

JMFS 6(97) by Steve Tharnstrom 8/17/1997
UTM – 1995: coordinates and AZ unknown 1997: 384902E 3960483N AZ unknown.

JMFS 90 – (Original photo by an unknown photographer, June 1920, courtesy of the Museum of New Mexico, Neg. No. 94072)

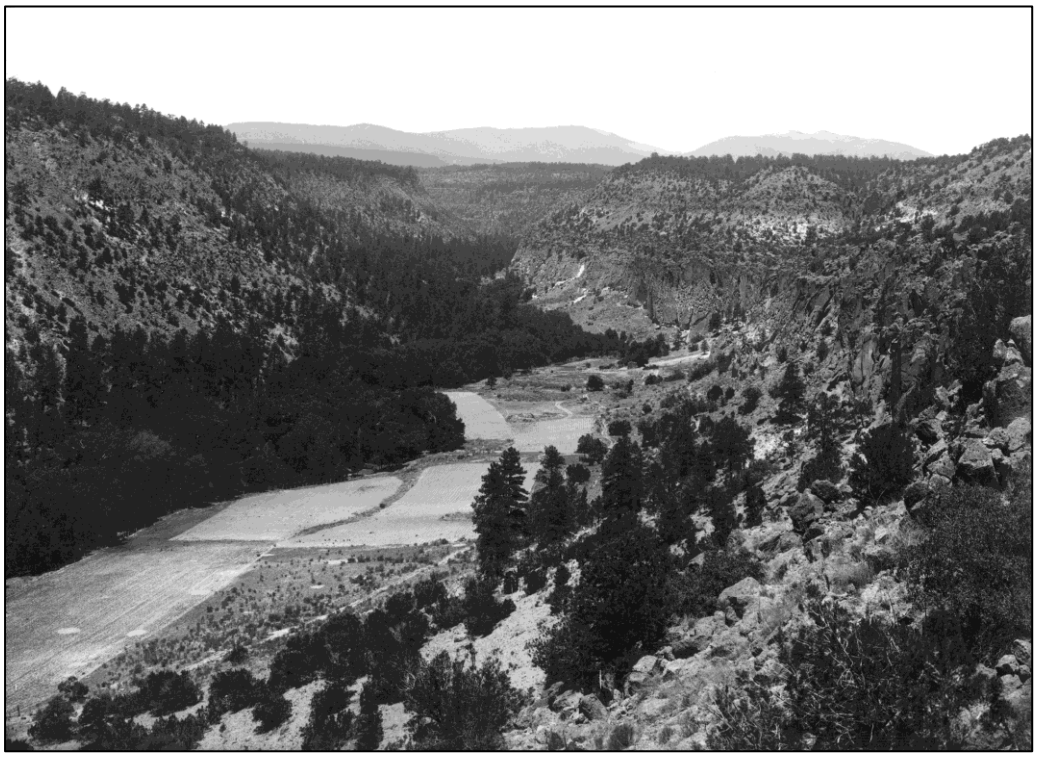
The final pair of photos depicting landscape change in Frijoles Canyon looks toward the northwest from half way up the canyon wall. The original photo point could not be used, because the portion of cliff where it was located had fractured off, falling victim to the inexorable freeze-thaw-induced process of cliff retreat that is so characteristic of south facing canyon walls. This dramatic overview includes most of the major vegetation zones in the Monument and documents many of the natural and human-caused disturbances previously discussed.

The original view taken in 1920 highlights the extent of historic human agricultural use of the canyon prior to the 1925 arrival of George and Evelyn Frey, who expanded it even further, adding an orchard, barns, and other outbuildings (Rothman 1992, Harrison 1988). Although Judge Abbott had departed three years previously in 1917, the canyon bottom in this photo primarily reflects his influence. By 1999 the fields, fences, and irrigation ditches are gone from view. In the foreground now stand the stone buildings of Bandelier National Monument's Headquarters and Visitor Center. Beyond that, old field succession has progressed with the riparian trees encroaching along the margins of the fields, while grasses, shrubs, and annual forbs have colonized the interior. Among these are blue grama grass (*Bouteloua gracilis*), pale wolfberry (*Lycium pallidum*), and several members of the family Compositae. Broom snakeweed (*Gutierrezia sarothrae*), a composite woody subshrub widely recognized in the West as an indicator of overgrazed rangeland, is present here and throughout the piñon-juniper woodlands of the Pajarito Plateau. The new visitors trail follows much the same route as the old wagon road. On the canyon floor in the middle distance Tyuonyi persists largely unchanged.

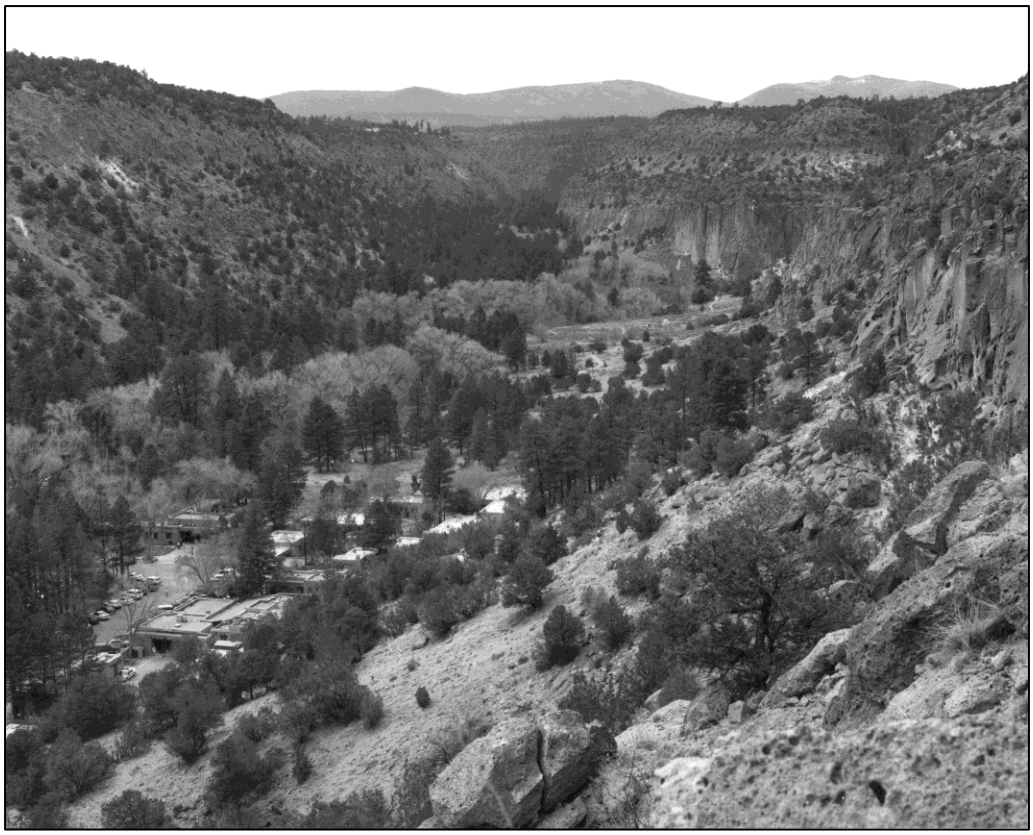
The band of primarily deciduous tress at the base of the canyon wall at left marks the course of the Rito de los Frijoles, or Frijoles Creek. These riparian zone trees, which include Fremont cottonwood, narrowleaf cottonwood, Rocky Mountain maple (*Acer glabrum*), and box elder (*Acer negundo*) are much taller and denser now than in the original view, as discussed above. (The gray appearance of many of the riparian zone trees in 1999 is due to the fact that this view was taken in mid April, before these trees had leafed out.)

The foreground mesa tops clearly show the rapid, climate-driven shift in the ecotone between ponderosa pine forest and piñon-juniper woodland that occurred region wide. During the severe drought of the 1950s ponderosa pine trees died back over the lower portions their distribution, causing the forest/woodland boundary to retreat upslope as much as two kilometers (Allen and Breshears 1998).

The ridgeline below the mountain peaks, in the middle distance to the left, is Mesa del Rito. The 1977 LA Mesa Fire started here and burned across 15,000 acres of Santa Fe National Forest, Bandelier National Monument, and Los Alamos National Laboratory lands. On the horizon is a the southern portion of the Sierra de los Valles range of the Jemez Mountains - 10,441 foot Pajarito on the right, and to its left 10,199 foot Cerro Grande, the highest point in the Monument, with the lush valleys of the Baca Ranch just beyond.



JMFS 90 by unknown photographer June 1920



JMFS 90(99) by Steve Tharnstrom 4/12/1999
UTM – 385511E 3959846N AZ – 297 deg.

The Bandelier Wilderness

Bandelier was originally designated a national monument because of its interesting and abundant cultural resources, containing within its boundaries one of the highest densities of Anasazi archaeological sites in the entire Southwest. By the mid-twentieth century, as development consumed more of the surrounding landscape, the importance of protecting the rare beauty and broad ecological diversity of the Monument's natural resources became increasingly apparent. On October 20, 1976, the 23,267 acre Bandelier Wilderness gained federal protection under the Wilderness Act. The six pairs of photos that follow briefly describe the history and patterns of landscape change in three of the more remote, yet well known areas of Bandelier.

Yapashi Pueblo

According to Cochiti legend, sometime after 1350 A.D., three to four hundred people left the village of Tyuonyi in Frijoles Canyon and established the pueblo of Yapashi, in the first of a series of six southeasterly moves across the Pajarito Plateau, culminating at the current site of Cochiti Pueblo (Harrington 1916, Pettitt 1990). Edgar Hewett estimated the dates of occupation to between 1200 and 1475 (Hewett 1938). In several local Indian languages the name of the pueblo describes its association with the Stone Lions shrine, about a half mile to the northwest. In the Keresan language of Cochiti, it is "the old settlement where the panthers lie extended" (Harrington 1916). The name Yapashi, also a Keres word meaning sacred enclosure, seems to be a generic reference to shrines similar in style the Stone Lions. It also emphasizes the connection of the pueblo to the shrine. Adolph Bandelier first visited this site on October 24, 1880, guided by Juan José Montoya of Cochiti Pueblo, his "principal informant" (Lange and Riley 1966).

JMFS 71– (original photo by George C. Bennett, Dec. 7, 1880, courtesy Museum of New Mexico, Neg.No. 90)

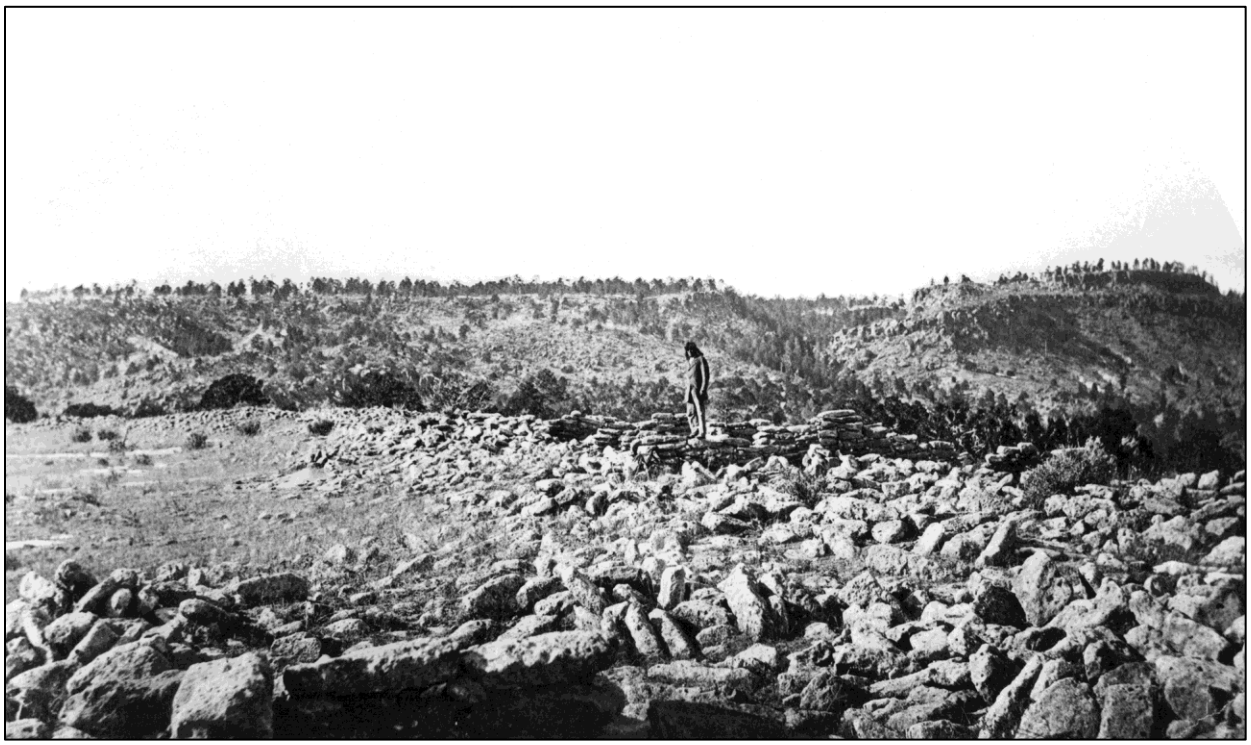
This view of Yapashi is by George C. Bennett, who accompanied Bandelier on his second visit to the pueblo in December of 1880. It is dated December 7th, but based on Bandelier's journals was probably taken on December 2nd or 3rd. It is among the earliest photos in the JMFS collection. The view looks from the southeast edge of the pueblo, across the central plaza toward the northwest. The man standing on the wall is José Hilario Montoya of Cochiti Pueblo, the brother of Juan José (mentioned above). He served ten one-year terms as governor of Cochiti and served as liaison with outsiders like Bandelier (Lange and Riley 1966).

The extent of still-standing walls in the original is striking, as is the nearly complete absence of foreground vegetation. Bandelier noted, on his first visit, that there was "no brush, not even sabinos"(junipers). Although the numbers of livestock present at this time are unknown, the mowed appearance of the plaza could be due to grazing. The Spanish name for this mesa, in common usage at the time of Bandelier's visits here, was Potrero de las Vacas, which could be translated as cow pasture, although potrero was generally translated as "land tongue" by Bandelier and his contemporaries.

In Steve Tharnstrom's 1999 repeat many of the walls have toppled, though some are now hidden by vegetation, which has increased dramatically. The rubble mounds marking the plaza perimeter have been colonized by cheatgrass, an invasive species imported from the Mediterranean. Cheatgrass is a prolific seed producer that germinates before the native species in early spring, outcompeting them for water and other resources in critical early growth stages. When this photo was taken in mid-May, the cheatgrass already had seedheads. Other species

present on the mounds include cane cholla and blue grama grass (*Bouteloua gracilis*). Broom snakeweed (*Gutierrezia sarothrae*), a woody subshrub widely recognized in the West as an indicator of overgrazed rangeland, is present here along with fourwing saltbush (*Atriplex canescens*), considered to be an indicator of prehistoric disturbance (Yarnell 1958). The same species have taken hold in the plaza, with the exception of the cheatgrass, which is less abundant here than on the looser soils of the rubble mounds. Piñon pine and juniper are much increased in both size and abundance surrounding the pueblo, but are uncommon on the interior.

The background cliffs are the escarpment above the far wall of Hondo Canyon. Piñon-juniper expansion is also evident on these slopes, as well as on the mesa tops above. The taller mesa-top trees are ponderosa pine. The effects of the 1950's drought and associated bark beetle infestation (Allen 1989) have combined with the 15,000 acre 1977 La Mesa fire and the 17,000 acre 1996 Dome Fire to reduce the extent and density of the ponderosa pine forest here.



JMFS 71 by George C. Bennett, Dec.7?, 1880 (See AFB)

JMFS 71(99) by Steve Tharnstrom 5/12/1999
UTM – 381230E 3958022N AZ – 294 deg.

JMFS 76 – (Original photo by an unknown photographer, 1908, from the collection of Bandelier National Monument, Catalog # 14184, Image #0157A)

Yapashi remains largely unexcavated today. A single trench was dug in 1908, under the direction of Edgar Hewett (Hoard 1983). The original photo, which dates from that year, depicts Indian laborers digging that trench; the identity of the overseer is unknown to us. This view looks to the southwest, but much of the background scene overlaps with JMFS 71 above. It was taken at the site of the 1908 excavation, near the northwest extent of the pueblo. The woody shrubs in the foreground appear to be broom snakeweed and a species of sage (*Artemesia* sp.).

The depression and spoils pile from the 1908 excavation were relocated in May of 1999. The repeat view by Steve Tharnstrom was taken from a slightly higher camera position than the original because the spoils were piled over the foreground rocks. A remnant of standing wall is visible at the right edge of both views. In addition to the cane cholla cactus (*Opuntia imbricata*), a colony of harvester ants appears in the foreground of this view (note dome shaped sand pile just beyond the cholla). The tall grass with seedheads is last year's crop of blue grama grass. The thick-leafed grass growing behind the wall blocks at lower left is cheatgrass, an invasive species imported from the Mediterranean.

A dense growth of piñon pine and juniper has encroached up to the pueblo perimeter, but has not crossed into the rubble mound. The background cliffs again show the scarp face behind the far wall of Hondo Canyon, with increased densities of piñon-juniper evident.

Beyond the wall of Hondo Canyon, on the horizon at left, is Boundary Peak. This distinctive, cone-shaped landmark, visible from much of the Pajarito Plateau, is in the San Miguel Mountains. The western boundary of the Monument bisects its summit. The 17,000-acre Dome Fire of 1996 burned over much of the rugged landscape of the San Miguels.

JMFS 76 by unknown photographer, 1908

JMFS 76(99) by Steve Tharnstrom 5/12/1999
UTM – 381106E 3950080N AZ – 296 deg.

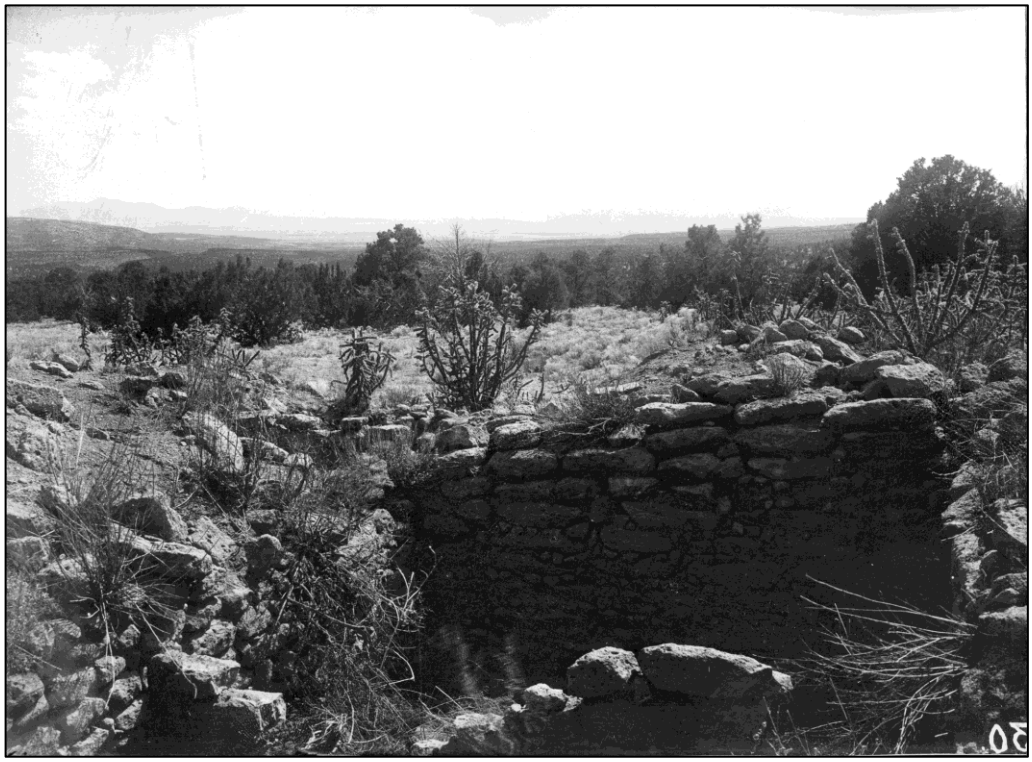
JMFS 70 – (Original photo by T. Harmon Parkhurst, ca 1920, courtesy of the Museum of New Mexico, Neg. No. 58392)

This view to the south is centered on a partially excavated room near the southwest extent of Yapashi Pueblo. The wall is built of shaped tuff-block masonry with stone chinking and mud mortar – all original. Cane cholla cactus is already present in the original view and piñon pine and juniper are encroaching upslope in the middle distance. The light-colored area beyond the walls appears to be bare soil, interspersed with broom snakeweed. This indicates that the Potrero de las Vacas, as this mesa was known in Bandelier's day, may have seen heavy livestock use. According to Bandelier's translation, the name means "land-tongue of the cows", a land-tongue being a mesa (Lange and Riley 1966).

The mouth of White Rock Canyon is near the base of the dark hills in the middle distance at left. Here the Rio Gande enters the valley, flowing south past Cochiti, which is located near the center of this view. The Ortiz Moutains are on the horizon at left. Barely visible on the horizon just right of center, is Sandia Crest. The city of Albuquerque sits at its base to the right.

The 1999 repeat by Steve Tharnstrom clearly shows how excavated but unstabilized archaeological resources are subject to damage. Note that the foreground wall has collapsed, as has the wall on the left, causing the entire corner at left center to fail. Substantial soil loss has also apparently occurred in this portion of the view. Some of the same cane cholla cacti are still present beyond the wall, though larger now. Others have taken hold in the intervening 80 years. Cheatgrass, an invasive European species that is now the dominant spring grass on the rubble mounds, is thick in the foreground. Mullein (*Verbascum thapsus*), the tall spikes in the left foreground, is another European invader of disturbed ground that has now colonized this site. Grass cover, including blue grama, appears more abundant in 1999 than in the original.

Another important change, just visible in the valley at left, is the addition of Cochiti Lake. Cochiti Dam appears as a small white rectangle, just right of the tallest junipers on the left edge of the photo. Some of the ecological impacts of this project on the Rio Grande and the Monument are discussed under JMFS 14 below.



JMFS 70 by T. Harmon Parkhurst ca. 1920

JMFS 70(99) by Steve Tharnstrom 5/12/1999 **UTM** – 381145E 3958004N AZ – 172 deg.

Stone Lions Shrine

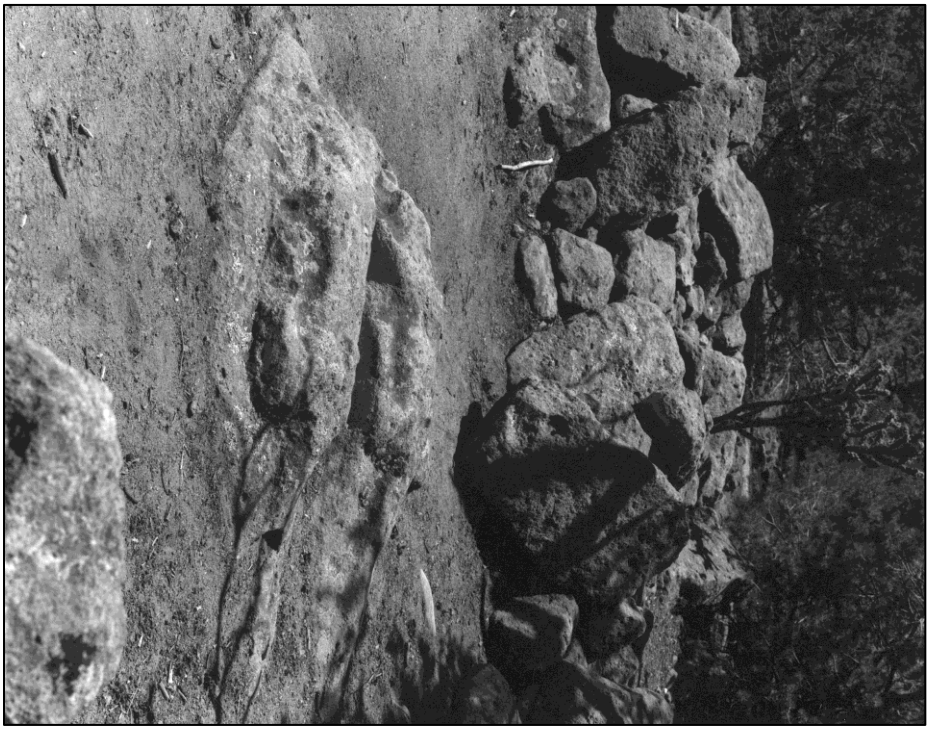
Located about a half mile northwest of Yapashi Pueblo, also on the ridgeline of the "Potreo de las Vacas", is a roughly circular rock-walled enclosure, about four feet high and more than twenty feet in diameter. Inside are the life-size effigies of two mountain lions carved from the native tuff bedrock, lying side by side, tails extended, facing toward the southeast. This shrine is well known to local tribes, who still actively use it. To the Cochiti it is known as "the ancient shrine where the mountain lions lie" (Harrington 1916). According to Hewett, deer hunters anoint the eyes and claws with red ochre to help assure a successful hunt (Hewett 1938). It is said that young men from Zuni Pueblo must make a pilgrimage here on foot, as part of their right of passage into manhood (Harrington 1916, Stuart 1989). The round trip is close to four hundred miles. Figure 4 is a sketch of the shrine by Adolph Bandelier.

Figure 4 Sketch of Stone Lions Shrine by Adolph Bandelier from his Final Report, 1892.

JMFS 74 – (Original photo by George C. Bennett, ca 1881, courtesy Museum of New Mexico, Neg. No. 41512)

The date on the original is suspect. Based on Bandelier's journals, and other Bennett photos, it was probably taken on December 2 or December 3, 1880, on the same day as JMFS 71 of Yapashi. This original is especially interesting due to the manner in which it is labeled and mounted, being the right side of a "stereopticon pair", to be viewed in the predecessor of the more modern stereoscope. Bandelier noted that the lions, especially their heads, had already been disfigured when he first saw them about six weeks earlier on October 25 (Lange and Riley 1966). Although this photo pair is not a landscape scale view, it is included here because it highlights the level of human impact that even remote sites can be subjected to. Note the litter and vegetation ground cover present around the lions in the original, while they are surrounded by bare soil in the repeat. The branches beyond the lions in the original are piñon pine. This tree, marked on Bandelier's sketch, is still living. Most of the lower branches have been lost, some showing signs of having been cut.

JMFS 74 by George C. Bennett ca. 1881 (probably first week in December 1880, in the company of Adolph Bandelier)



JMFS 74(99) by Steve Tharnstrom 5/13/1999
UTM – 380555E 3958528N AZ – 195 deg. (Photo point is six feet northwest of that used for JMFS 87(99)below; GPS was unable to differentiate between the two.)

JMFS 87 – (original photo by Charles F. Lummis, 1890, courtesy of the Center for Southwest Research, University of New Mexico, Neg. No. 990-009-0183)

Charles F. Lummis accompanied Adolph Bandelier into the present Monument from October 9-15 of 1890, partly for the purpose of retaking lost or damaged Bennett views for inclusion in Bandelier's Final Report to the American Institute of Archaeology, of which Lummis was an official (Lange et al. 1984). José Hilario Montoya of Cochiti Pueblo served as guide on this trip, as he had on the December 1880 trip with Bennett.

On the afternoon of October 11, they arrived at Stone Lions. Bandelier wrote, "They are even more mutilated than they were ten years ago" (Lange et al 1984). In Lummis's original view, the piñon pine growing in the enclosure wall can be seen clearly, but the lower branches, visible in JMFS 74 above, have been shed or broken off by 1890. There is still vegetation surrounding the lions. The stone-lined entrance corridor is visible across the enclosure to the left of the lions, pointing S-SW toward the abandoned pueblo of San Miguel. Bandelier's informants told him that the entrance of a shrine always extends toward the pueblo where the worshippers live (Lange et al. 1984).

In the 1999 repeat by Steve Tharnstrom, the piñon in the wall has grown and the vegetation within the enclosure is gone, likely due to human traffic. There is only a narrow band of litter at the base of the wall. Some of the rocks appear to have toppled or been rearranged. A noteworthy change has occurred in the location of the entrance to the shrine, which is at the left edge of the 1999 view, facing more toward the southeast. It does not have a long entry corridor like the original. The old entrance has been filled with smaller rocks, visible just to the right of the shadowed rocks at left.

Piñon and one-seed juniper are already well established in the original, beyond the wall to the south, though not very tall. The mesa forming the far side of the mouth of White Rock Canyon is visible on the horizon at left. In 1999, the piñon-juniper woodland has closed in around the shrine and grown considerably in height, blocking the distant mesa.

JMFS 87 by Charles F. Lummis October, 1890

JMFS 87(99) by Steve Tharnstrom 5/13/1999
UTM – 380555E 3958528N AZ – 195 deg.

Painted Cave

In lower reaches of what is now known as Capulín Canyon, not far from the Monument's southern boundary, there is an arched depression in the southwest-facing canyon wall, about fifty feet across and thirty feet above canyon floor. The gentle curve of the back wall is covered with a parade of pictographs, mostly red, with some black and white, visible from quite a distance. This is La Cueva Pintada, the Painted Cave. On first seeing it, on October 26, 1880, Bandelier called it, "…a grand portal, of volcanic tuff; below are the signs of cave houses…At a height of ten meters are the paintings, red in a semi-circle. Hands and many with the cross. Juan José tells me that these were made by shepherds, who dwelt frequently in this cave" (Harrington and Riley 1966). Here, as elsewhere in his journals, Bandelier acknowledges livestock use of this landscape.

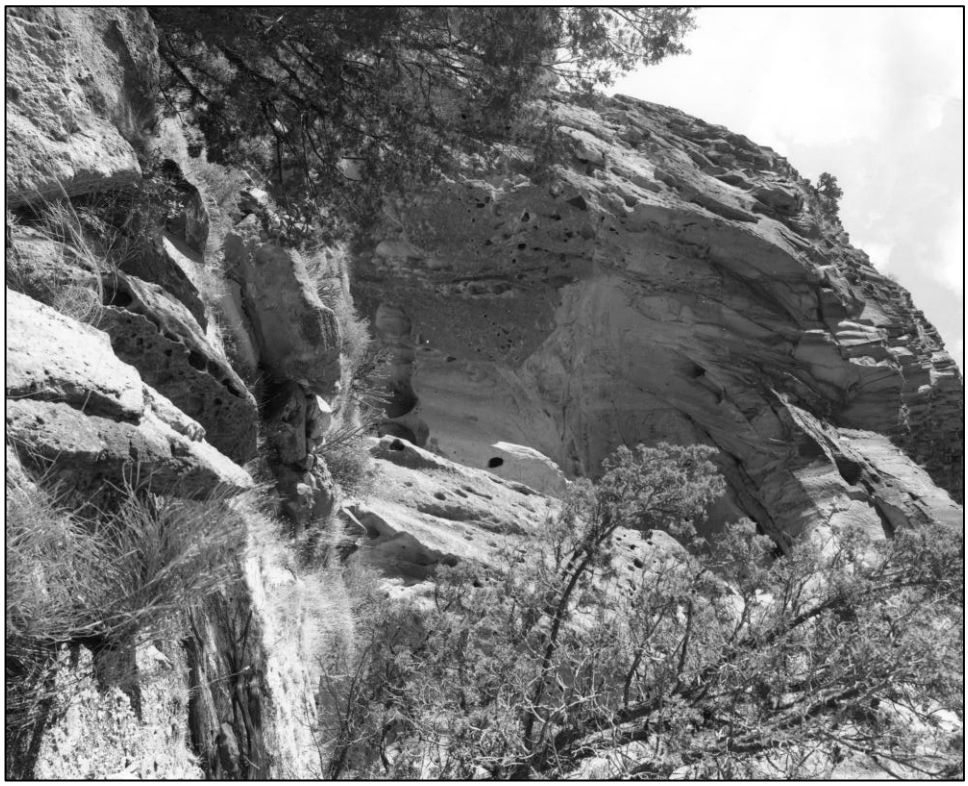
JMFS 148 – (original photo by Charles F. Lummis, 1890, courtesy of the Southwest Museum, Item # N.759, P.24018 or P. 35238)

On October 10 and October 14, 1890, Charles Lummis and Adolph Bandelier camped in the Cañon de la Cuesta Colorada (Red-slope or Red-cliff Canyon), below the Cueva Pintada, as Bandelier had done on previous trips between Cochiti and the Rito de los Frijoles (referring to Frijoles Canyon) (Lange et al 1984). Both Spanish and Native American names for Capulín Canyon in use at the time made reference to the red cliffs visible just upstream, opposite the cave. These red, iron-rich soils were likely utilized to make the paint.

On October 10, 1890 Bandelier wrote, "We (i.e. he and Lummis) followed the road (north from the Cañada de Cochiti) on foot with José Hilario, two horses, two burros, and a soldier named Abbott. Lummis's original photo is a view to the southwest from the talus slope just southeast of the cave. Note the stone and wood corral with two horses at the base of the cliff; the ground here shows heavy use. A man, probably José Hilario is climbing the cliff, using the hand and footholds in the tuff. To his right are the remnants of a tuff block wall, and what appears to be soot from a fire above it (other views confirm this). The pictographs are just visible in the cave above. The foreground vegetation, just in front of the camera is quite sparse.

Steve Tharnstrom's 1999 repeat was taken from a camera position slightly lower than the original, and a little to the left. This was necessary due the invasion of the site by one-seed juniper, visible along the margins of the view. Many of the same foreground rocks are present, though some appear to have moved. The foreground vegetation seems much improved. Grama grasses (*Bouteloua* spp.) are relatively abundant. Sages (*Artemesia* spp.), fourwing saltbush, and cane cholla cactus are also present. The shrub at the cliff base is skunkbush (*Rhus trilobata*). Cheatgrass has invaded this site, notably the disturbed area within the old corral. This invasive species is already dominant on other archaeological sites in the Monument. The corral wall is still evident, though not nearly as tall now. It appears that much of the rock was used in the construction of the spur trail connecting to the main route in the canyon bottom. The same junipers cling tenaciously to the cliff top above the cave.

JMFS 148 by Charles F. Lummis October 1890



JMFS 148(99) by Steve Tharnstrom 5/11/1999
UTM – 380673E 3953726N AZ – 360 deg.

The Rio Grande

The Rio Grande drains a watershed of a quarter million square miles, the sixth largest in North America (Hink and Ohmart 1984). The reach considered here is in White Rock Canyon, between Otowi Bridge and Cochiti Reservoir, at the confluence of the Rio Grande and the Rito de los Frijoles. The camera position and much of the landscape depicted lie within the Bandelier Wilderness. The following photo pair documents impacts on the Bandelier landscape from both upstream and downstream, highlighting the fact that administrative boundaries are not ecological boundaries.

JMFS 14 – (Original photo by an unknown photographer, ca. 1920, courtesy of the Museum of New Mexico, Neg. No.23242)

This ca. 1920 view was shot from the mesa top, just south of the mouth of Frijoles Canyon, looking north up the Rio Grande, with the Sangre de Cristo Mountains on the far horizon. Since the original photograph was taken water control projects such as dams, levees, and diversion channels have altered the course and flow regime of the river. The most dramatic changes in this view resulted from flooding of unnatural depth and duration in 1979-1980 and 1985-1988 in the floodpool of Cochiti Reservoir. Several feet of sediment was deposited from the slack waters of the reservoir atop the river terraces through this reach (Potter 1981). Flooding and sedimentation caused almost complete mortality in the riparian woodland on the Frijoles delta, along the near bank at bottom right. Springs at the mouth of Frijoles Creek were buried and populations of several uncommon to rare plant species eliminated (Allen 1989, Allen et al. 1993). The riparian vegetation on both banks was killed and replaced with weedy species, with cocklebur (*Xanthium strumarium*) dominating the understory on the terraces. The "bathtub ring" marking high water is still visible, due in large part to the color difference on the rocks caused by water staining and the failure of lichens to fully re-establish below the flood level. The floodwaters also facilitated the establishment or spread of exotic species, including saltcedar, (*Tamarix pentandra*), Russian olive (*Eleaegnus angustifolia*) and Siberian elm (*Ulmus pumila*), the most troublesome being saltcedar, (Potter 1981). A host of understory weeds are also on the increase throughout White Rock Canyon. In recent years willows (*Salix* spp.) have begun to recolonize the banks, bars, and backwaters (Promislow 1996, Weschler and Fettig 1999), and young Fremont cottonwoods are struggling to gain a foothold (Allen et al. 1993 and recent observations).

Above the river, many aspects of the canyon wall environment are remarkably stable and persistent - notice the scree slopes across the canyon. Some of the same juniper skeletons and a still-living Mormon tea individual (*Ephedra viridis*) persist in the foreground.

JMFS 14 by unknown photographer ca. 1920

JMFS 14(97) by Steve Tharnstrom 9/13/1997
UTM – 385954E 3957248N AZ – 78 deg.

Interior of the Jemez Mountains

Monument Canyon

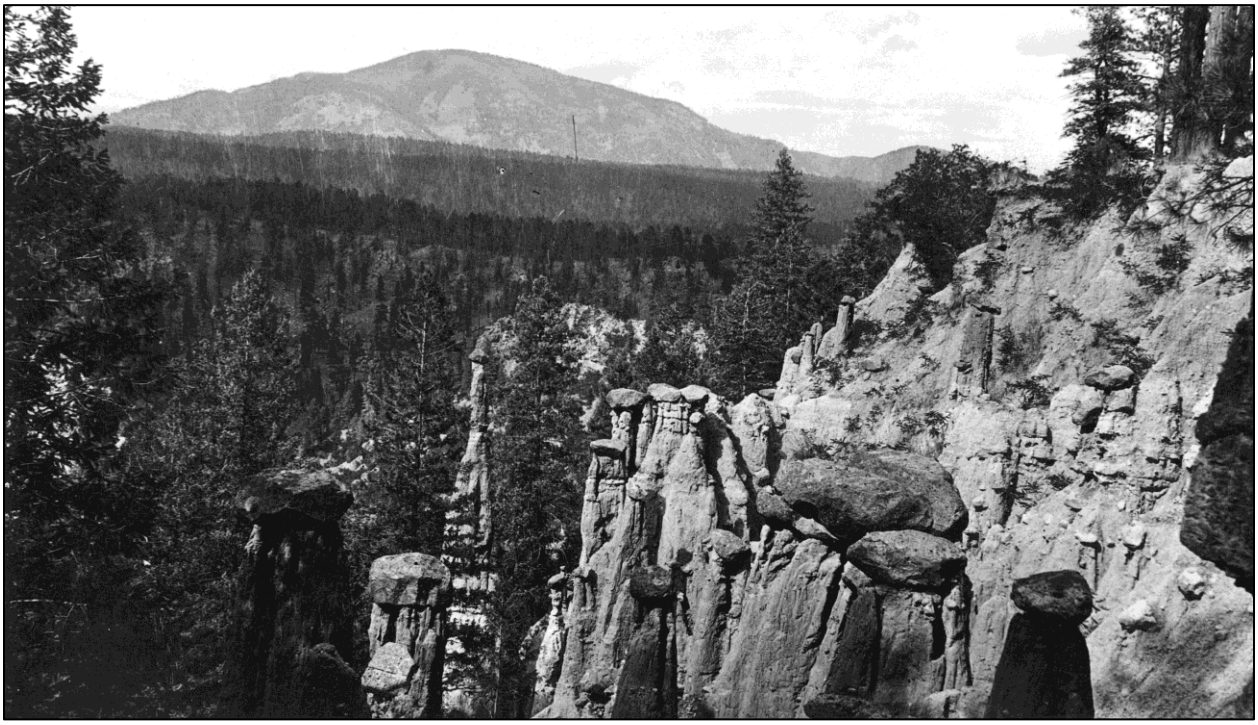
Monument Canyon was apparently named for the tent rock "monuments" present in these photographs. A 640-acre "Monument Canyon Research Natural Area" was created on U.S. Forest Service lands here in 1934 to study the "natural" conditions of a ponderosa pine stand. However, the 20th Century history of fire suppression has led to unnatural conditions in the RNA, evident along the hike to the photo point which passes through extremely dense "dog-hair" thickets of small diameter ponderosa pine, devoid of any understory vegetation. The photo point is along a portion of the old Padre Alonzo Trail from Jemez Springs to Santa Fe (see Fig. 1 - Wheeler map), which followed this portion of the canyon rim (T. Swetnam 1998 - personal communication). This area on the northern edge of the Research Natural Area also falls within the 11 mile-long Wild and Scenic River corridor of the East Fork of the Jemez River, designated by Congress in 1990. In addition, the camera point and the majority of the landscape included in the photographic field of view are within the boundaries of the 57,650 acre, Jemez National Recreation Area (JNRA), established by the United States Congress in 1993 to help protect this interesting landscape (U.S. Department of Agriculture, Forest Service 1998).

JMFS 89 – (Original photo by an unknown photographer, ca. 1890, courtesy of the Museum of New Mexico, Neg. No. 147691)

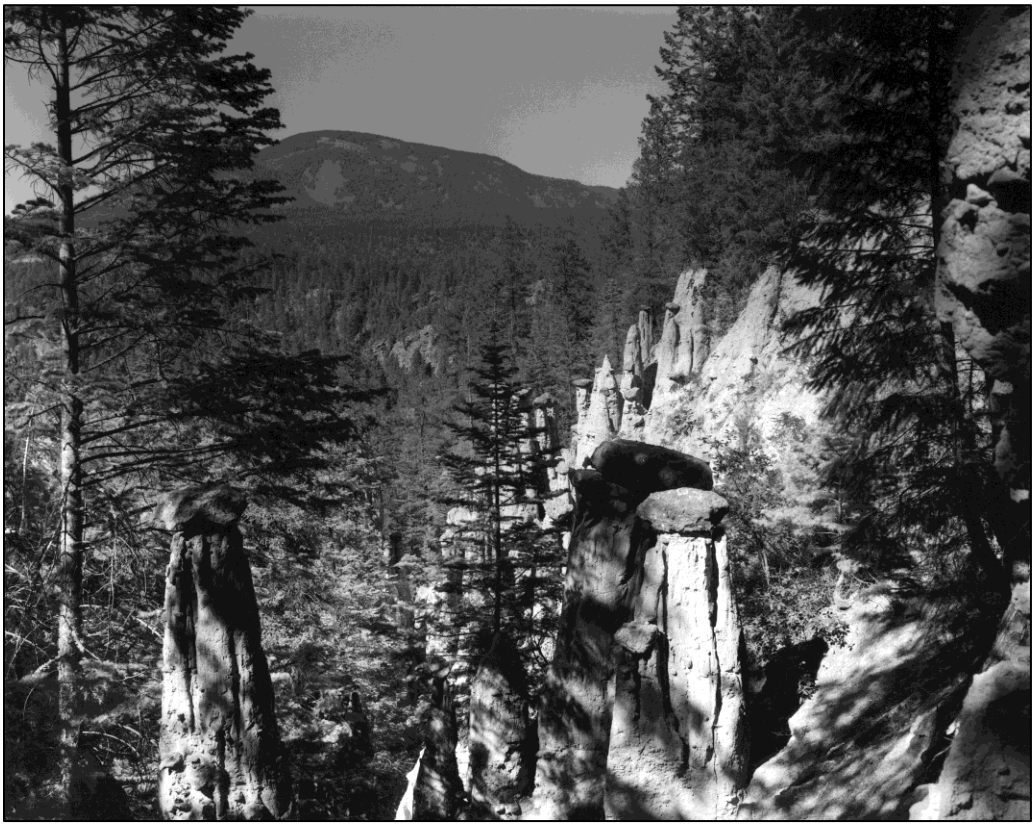
The original view of these stone monuments, for which this part of the canyon is named, was taken in about 1890, probably from the old Padre Alonzo Trail. Below these spires the canyon wall drops steeply to the East Fork of the Jemez River, which runs approximately right to left below this camera position. Because the original view is blocked by the evident increase in the size and density of Douglas fir (*Psuedotsuga menziesii*) and white fir (*Abies concolor*) in the foreground, the repeat view was taken about 30 feet downslope from the rim. The persistence of the erosion-resistant "caps" atop many of the softer tent rocks for over a century is impressive, although some have lost their caps and eroded away. Indeed, new tent rocks have emerged due to erosion on the slope behind the large, persistent caprock at center-right..

There is a noticeable increase in the density of mixed conifer forest on the ridges across the canyon in the mid-distance. Douglas fir is dominant in these stands, which also contain white fir and Englemann spruce (*Picea englemanni*), with ponderosa pine intermingled on south aspects and less rocky sites where natural fire frequencies were higher.

Redondo Peak, an 11,254 foot resurgent dome in the interior of the Valles Caldera on the Baca Ranch, dominates the horizon. (This peak is also visible in JMFS 18 below.) Several "bare spots" are nearly the same size and shape in 1998 as they were in 1890. Most of the openings evident in the 1890 scene are felsenmeers - fields of volcanic boulders without soil - that apparently persist without vegetation cover for thousands of years (Tierney and Potter 1985). For example, the big, irregular-shaped patch on the steep, lower-central portion of Redondo is a large felsenmeer, with some interspersed trees growing in favorable pockets that have remained little-changed since 1890. Above that felsenmeer in the 1998 view are relict swathes of ancient montane grasslands which have generally been subject to much tree invasion over the past century in the Jemez Mountains (Allen 1989); extensive grasslands were present on Redondo Peak in 1890, but they are hard to see in this photograph.



JMFS 89 by unknown photographer ca. 1890



JMFS 89(98) by Steve Tharnstrom 6/19/1998
UTM – 354085E 3972006N AZ

Baca Location No.1

In 1860, the U.S. government granted five parcels of land to the heirs of Don Luis Maria Cabeza de Vaca in settlement of a Mexican land grant dispute dating back to 1825. The 100,000 acre Baca Location No. 1 in the heart of the Jemez Mountains was the first parcel chosen. The ranch changed hands several times after the turn of the century. It was acquired in 1962 by James P. "Pat" Dunigan of Abilene, Texas, whose heirs still operate it as the Baca Land and Cattle Company. (USDA, Forest Service 1993.) The Baca Ranch sold the headwaters portion of the Frijoles watershed to Bandelier in 1977; the park and the ranch adjoin in this area, a still-wild landscape of high peaks and lush mountain meadows near the southern end of the Sierra de los Valles, including the 10,199 foot summit of Cerro Grande, the highest point in the Monument.

JMFS 18 – (Original photo by Vernon Bailey, August 1906, courtesy of the National Archives, Neg. No. 9007)

From 1889-1908 biologist Vernon Bailey traveled extensively in New Mexico, gathering information on geography, plants, and animals for inclusion in physiography reports for the U.S. Bureau of Biological Survey. He kept detailed notes and took some photographs. In August of 1906 he passed through Valle San Antonio, near the northern extent of the Baca Location No.1 (Bailey 1906).

In September 1997, with the help of Archie McKellar of the Baca Land and Cattle Co., we relocated three of Bailey's photographs on the Baca Ranch. Bailey took this view at about 8,400 feet in Valle San Antonio, looking southeast across the Rio San Antonio, about five miles from it's headwaters.

Between 1906 and 1997 extensive structural changes occurred in the vegetation of Valle San Antonio. Notable changes visible by 1997 include an increase in conifer distribution and density and much improved range conditions.

The lighter colored Aspen (*Populus tremuloides*) stands are less abundant and smaller, while stands of Englemann and blue spruce (*Picea pungens*) are denser and have moved down slope. The relatively open, grassy patch on the slope, near the center of Bailey's view, likely resulted from fire. This area is covered with dense tree growth by 1997. A century of fire suppression has probably contributed a great deal to these conditions.

The bottomlands in Bailey's view are seriously deteriorated. Note the rocks and soil exposed in the original, likely due to overgrazing and livestock trampling, although recent deposition of sediment from the small ephemeral drainage which passes through this field of view might have contributed to the raw look of this site. In contrast, the 1997 view depicts the lush growth of grass possible with the more sustainable range management practices employed by the current owners, including the exclusion of sheep, lower stocking rates, and herd rotation. The 1906 view shows barren stream banks and margins along the Rio San Antonio, while the stream is obscured by vegetation in the modern view. An unpaved road and small diameter culvert are just behind the 1997 camera position.

JMFS 18 by Vernon Bailey, 1906

JMFS 18(97) by Steve Tharnstrom 9/25/1997
UTM – 363479E 3981743N AZ – 122 deg.

DISCUSSION

Knowledge gained from multiple additional lines of evidence informs the interpretation of repeat photographs. The photos themselves are of most value when combined with information on the history of human and natural disturbance. Land use history, climate records, fire history, maps delineating the nature and extent of vegetation types, or the previous extent of perennial and intermittent water courses are all of great utility in the interpretation of repeat photographs. Especially valuable are journals or detailed captions describing the original photographs.

The most obvious, and therefore most frequently identified changes in the photographs repeated for this project were in the composition and structure of vegetation associations and communities. The changes in vegetation are, in most of the cases described, intertwined with human land use (e.g. the presence of ruins, agriculture, grazing, logging, and fire suppression). Increases in density occurred in all forest types in the absence of fire. Piñon-juniper woodlands and forests of ponderosa pine, mixed conifer species, and spruce-fir all now carry increased fuel loads capable of supporting high-intensity, stand-replacing fires (Touchan et al. 1996).

Concurrently, other landscape components have been reduced. Open grasslands have diminished in all forest types, and at high elevations aspen groves are on the decline. These changes are altering the mosaic character or patchiness of vegetation patterns in this landscape, with mostly unknown effects on local ecosystem processes and wildlife populations.

Repeat photography is an effective means of documenting landscape changes, but its utility is confined to a constrained range of temporal and spatial scales (Swetnam et al. 1999) due to its relatively recent advent and inherent limitations in the ability of photographs to record particular details. Within these bounds, however, repeat photography can enhance our perception of landscapes, add to a continuous landscape record, and help to identify and quantify the nature, direction, and rate of landscape change (Rogers et al. 1984). It has proven its worth in documenting change at many levels of ecological organization, from individual plants or trees, to forests and mountains.

Beyond the patterns evident on the repeat photographs themselves, the process of relocating the photo points and retaking the photographs is also an important source of information. Observations made in this process (e.g. landmarks, species present) should be meticulously recorded to assist in the interpretation. The visual and written products of repeat photography provide powerful research and communication tools that help to focus future research efforts and guide resource managers.

Part of the utility of repeat photography is its suitability as a framework for the organization of information (Rogers et al. 1984). Future work in the Bandelier landscape would benefit from expanding on the preliminary connections made here between the photographs and other place-based information. Information on climate variability, fire, flood, land use, and other natural and human disturbances could be developed for sets of photos at specific sites prior to and during the repeat photography interval. An abbreviated version of this information could be distilled down to a timeline by site, locale, or forest type for use with individual pairs or groups of photos. This is an iterative and interactive process; the photographs aid in the development of place-based chronologies of landscape change, and in turn the chronologies aid in the interpretation of the photographs.

Repeat photography usually generates a lot of interest among scientists as well as the public, as it provides a direct, easily understood means of demonstrating how the world has changed. People often wonder, “Why does the landscape look like it does today? Why are these

species found in these patterns?" These are, after all, some of the fundamental distribution and abundance questions that define ecology. Where old photographs exist, they offer rich opportunities to enhance research and interpretation activities on the topics of landscape change. Repeat photography provides a visual frame of reference to tell true stories that integrate cultural and natural histories. This is important because the histories of the land and the people are inextricably intertwined, and so are their futures.

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