

THESIS

LONG-TERM WILDFIRE IMPACTS ON ARCHAEOLOGICAL SITES AND SURVEY,  
APACHE-SITGREAVES NATIONAL FOREST, ARIZONA

Submitted by

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In partial fulfillment of the requirements

For the Degree of Master of Arts

Colorado State University

Fort Collins, Colorado

Fall 2020

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## ABSTRACT

### LONG-TERM WILDFIRE IMPACTS ON ARCHAEOLOGICAL SITES AND SURVEY, APACHE-SITGREAVES NATIONAL FOREST, ARIZONA

This thesis evaluates the long-term effects of wildfire on the integrity and visibility of prehistoric surface sites. Covering roughly 38 million acres of the Western hemisphere, ponderosa pine (*Pinus ponderosa*) forests rely on fire as a critical and defining element of these ecosystems, but climate change and poor land management have altered forest conditions and allowed severe crown fires to destroy forests that were previously characterized by milder ground fires (Rockman 2015; Westerling et al. 2014; Yue et al. 2013). Today's high severity wildfires result in major ecological changes and are unprecedented in their suppression costs, property losses, and loss of life. Wildfire is a powerful but often overlooked archaeological site formation process, and knowing its effects is critical to understand the character of survey inventories and surface sites in burned areas (Schiffer 1983).

Two primary research questions guide this study: in what ways and to what degree do post-fire ecological changes impact prehistoric site integrity, and what are the implications for archaeological data collection and interpretation. Archaeological site data collected at different times in relation to a high-severity 2002 wildfire are evaluated to identify measurable impacts, including PR1 (previously recorded, pre-fire) and PR2 (relocated, post-fire) records of the same fifty (50) sites, and data from newly identified (n=40) and non-relocated sites (n=22). Results show that long-term wildfire effects altered the surface expressions of all prehistoric sites identified in the 1,500-acre study area in 2018 (n=90). Comparative analyses of site data reveal significant changes in both assemblage content (artifacts and features) and site area (m<sup>2</sup>) in relocated sites. Implications for cultural resource management in fire-prone and burned areas are discussed.

## ACKNOWLEDGMENTS

This thesis has been a source of intrigue and evolution for years and there are so many to thank for their support. Dr. LaBelle is so dedicated to his students and the impacting in the work he does in the field and classroom; I'm grateful for his support as a mentor for going on five years now. Dr. Pante and Dr. Little provided important perspective and edits in the final steps of this project. Thank you to my fellow Rams – Trevor Keevil, Emily "lil' Em" Orlikoff, Leddy and Elliott, Julia Kenyon, Kate Yeske, Nick Simpson, Alex Freidl, April Tolley, Caitlin Holland, Edwin Harris, Reecie Dern, Michelle Dinkel, Kelton Meyer, Terry Manawche, Matt Muttart, and Katie Horton – for the laughs and love during and after our tenure at CSU.

Thank you to the whole crew who worked hard every day on the R-C Phase II survey, rain or shine, Ellsworth or Bagnol. Holly Hall, Seth Allison, Jason Seaman, Nathan Lefthand, Peter Byler, John Curry, Adam Sezate, Alison Talbot, and Caleb Ferbrache. I miss the heck out of you all and will treasure the memories of that project forever. Kent Mead's enthusiasm early in the project inspired me to tackle my questions and he and HEG provided an enormous amount of data that informed this thesis. Also, thank you Abby Docktor and Laura Brennan for all your background research and contributions to the 2019 survey report. USFS Archaeologist Sarah Stauffer provided data for the survey and this thesis.

Mom and dad, where do I start? I wouldn't be pursuing a career a field I love if not for you. You encouraged us to do what makes us happy, which led me here, to jobs and projects all over the country...that usually don't feel like work at all. I am forever indebted to you, for your unconditional love and for all the sacrifices you've made (emotional and financial) for three decades in what seems effortless. You guys rule and I'm fortunate to know that I was born on third.

Colleen, Matt, and Emz, thank you for motivating me when I need a push, making me laugh when I'm in a funk, and for listening and being there. Claire, welcome to the family - I'm so dang excited you're here! Finally, thanks to my pup Chinle for the constant smiles and companionship, through thick and thin.

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## CHAPTER 1: BACKGROUND

As a point of convergence between prehistoric groups and “mutable social boundary of Arizona,” the Mogollon Rim is an archaeologically-rich area with large village sites, impressive Puebloan architecture, dense assemblages, and abundant decorated ceramics (Haury 1985; Mills et al. 1999). The 2002 fire removed stabilizing vegetation, sterilized soils, and altered hydrologic processes in the area, transforming most of the forested area to a self-perpetuating shrubland. Cultural deposits that were once protected under dense layers of pine needles (or duff) are exposed in the unstable and erosive burned environment. Long-term effects of the 2002 Rodeo-Chediski wildfire were present on all ninety prehistoric sites identified in the study area in 2018, and enduring effects of the crown-consuming fire continue to transform burned areas nearly twenty years later. In high severity burn areas, the once-densely wooded ponderosa forest has shifted to a more barren landscape characterized by severe erosion and sedimentation. Despite the destruction we see today, pre-contact ponderosa forests once self-regulated with frequent, low-intensity fires that promoted nutrient cycling and maintained stand density (Neely 2012; Strom 2005), preventing the dense tinderbox-like conditions that characterize these forests today.

Catastrophic wildfires are key drivers of unnatural ecosystem changes that increasingly impact affected environments and societies. In the early 2000s, Arizona and New Mexico experienced several forest fires that surpassed any documented in at least the last 100 years (Westerling et al. 2014). Since the 1970s, the number of fires larger than 1,000 acres has more than quadrupled in Arizona (Huffman et al. 2015). The severity and rate of spread on these fires is far beyond any in recorded history, and in western forests, these crown-consuming (or stand-replacing) fires are becoming more of the norm than the exception (Bowman et al. 2011; Franklin and Agee 2003; Saunders et al. 2007). Now that we are losing over 100,000 acres at a time, it may only take a few decades for much of our Western forests to disappear (Schoennagel et al. 2017; Yue et al. 2013).

Ponderosa pine is a fire-dependent system which constitutes the most widely distributed forest type in the western United States (Bowman et al. 2004; Noss et al. 2006; Strom 2005), and often occurs in areas with increasing human development (Pollet and Omi 2002). These areas become part of the wildland-urban interface (WUI), a continually expanding area of overlap between wildlands and development, and increasingly a focal point for human-environment conflicts in the West (Bowman et al. 2011). Situated a few miles from the city of Show Low, the study area occupies the WUI which further complicates wildfire damage mitigation and site preservation efforts.

Prehistoric ponderosa pine forests of the Mogollon Rim once relied on low-intensity surface burns to maintain forest health. The modern forest fire does not resemble those healthy ignitions and instead more often results in abrupt, widespread, and irreversible changes to burned ecosystems. Climate conditions, logging, and aggressive suppression starting in the early 19<sup>th</sup> century effectively extinguished all natural fires, resulting in a fire deficit. Without low-intensity surface fires to cycle nutrients, limit fuel loads, and maintain density of tree stands, ponderosa forests accumulated an abundance of biomass (Ffolliott et al. 2011; Gottfried et al. 2003). An extended drought in the region in the early 2000s desiccated the Rim's landscape and vegetation; exceptionally high levels of flammable fuels and record low levels of moisture in the biomass produced ideal conditions for a catastrophic wildfire (Hanson 2001; Neely 2012; Schroder 2010). Severe crown-consuming wildfires result in fundamental shifts to newly exposed landscapes that are vulnerable to erosion without protective vegetation (Figure 1.1). This chapter reviews interdisciplinary research related to Rodeo-Chediski impacts to glean useful information that can shed light on archaeological site formation processes in burned areas.



Figure 1.1. The newly-exposed rocky landscape at the edge of the Mogollon Rim on July 21, 2002. Dave Sanders, Arizona Star.

Historic management practices that influence modern forest structure and wildland fire behavior are discussed to inform how post-contact use and abuse of these forests culminated in ideal conditions for devastating 21<sup>st</sup>-century wildfires. Long-term effects of resulting ecological changes have major implications for archaeological data collection and site preservation across huge expanses of land in the West that have burned, are burning, or are expected to burn in high-severity wildfires.

### *The Fire*

Poor historic forest management caused a massive buildup of trees and woody debris that were desiccated by extended drought conditions of the early 2000s (Noss et al. 2006; Westerling et al. 2014). In the summer of 2002, conditions on the Rim were excessively hot and dry following the drought cycle that lasted several years (Zieroth 2004). Human-caused changes to the old ponderosa pine forests of the Mogollon Rim resulted in ideal conditions for a catastrophic wildfire to devastate the region.

An arsonist started the Rodeo Fire on June 18, 2002 in the Fort Apache Indian Reservation near Cibecue, Arizona. A second ignition point occurred when a hiker's signal fire got out of control due to windy and dry conditions on Chediski Ridge. The two fires merged to become Rodeo-Chediski, a fifty-mile-wide wall of flames that was the largest wildfire in state history until 2011. Between June 18 and July 7, Rodeo-Chediski consumed over 467,000 acres and burned nearly five hundred structures to the ground, and over 30,000 people from nearby mountain communities were evacuated (BAER 2002). The unpredictable plume-dominated fire was characterized by a rapid rate of spread of around 5,600 acres per hour – around 100 acres per minute or nine square miles per hour – far faster than any in state history (USFS 2002). “It was burning erratically; it was burning hot. The rate of growth, rate of spread, was off the charts. It was frightening,” recalls Darin Whiting, Captain of the Timber Mesa Fire and Medical District. Rodeo-Chediski was so large it created its own weather system, and its scale of disaster went unprecedented until 2011. Fire whirls or “firenadoes” shot up 30,000 feet in the air and cast embers down onto the dry trees below, whipped up into inferno by high winds (Neely 2012;).

By the time it was contained on July 8, over 168,000 acres of Apache-Sitgreaves National Forest (ASNF) land was burned at moderate and high severity levels, killing many of the trees and other vegetation in several large watersheds and smaller tributary drainages (Ffolliott et al. 2011). Most of the forest canopy and soil organic layers were removed, resulting in increased run-off and erosion rates (Zieroth 2004). Rodeo-Chediski burned in a mosaic pattern typical to Western forests, characterized by mixed severity depending on the local fuel load, weather, and qualities of the terrain (Ffolliott et al. 2011; Westerling et al. 2014). On the ground, mixed severity burns result in highly variable but clearly observable impacts in the long and short terms and at the site and landscape levels.



Figure 1.2. Barren earth and scorched trees characterize high-severity areas of Rodeo-Chediski. Photo by USFS 2002.

Rodeo-Chediski resulted in immediate damage and destruction to ecosystems, disrupted hydrologic functioning, and alterations to the forest structure (Ffolliott et al. 2011; Schroeder 2010). Rehabilitation efforts in ASNF began shortly after the fire and involved a costly interagency effort to prevent further damage to forest resources. Detention dams and other water diversions were constructed to control the directions of overland water flows from post-fire summer monsoons (Ffolliott et al. 2011).

Attempts at reestablishing vegetation like aerial seeding were not successful because torrential rain washed away seedlings during the monsoon season in the following months (Neely 2012). The Burned Area Emergency Response (BAER) team worked to rehabilitate vegetation in over 6,500 acres of severely burned areas. Rehabilitation treatments used helicopters and other ground-disturbing machinery like bulldozers, quads, and trucks to create drops for straw bales picked up by blowing machines towed by tractors that dispersed the straw on areas susceptible to increased erosion (BAER 2002). Trees with any merchantable value that were not expected to survive were harvested immediately, and most other trees died within two years (Ffolliott et al. 2011; USFS 2002).

The USFS and Bureau of Indian Affairs (BIA) implemented emergency stabilization treatments including seeding (228,500 acres), mulching (34,500 acres), hazard tree removal (302 miles alongside roads), erosion control barriers (1,000 acres), reforestation (1,000 acres), emergency road treatments (130 miles), and other stabilization work (BAER 2002). Studies from the BAER team (2002), BIA, and the Arizona Department of Health Services (2003) estimate suppression costs between \$43 and \$50 million. The impacted area included twenty-two scattered communities that form a 110-mile chain on the Mogollon Rim between the towns of Payson on the west and Show Low and Pinetop-Lakeside on the east, and Snowflake-Taylor to the northeast. Sixty percent of the fire burned on the Fort Apache Reservation, which relies heavily on its ponderosa pine forests for logging, hunting, and tourism (AZ Dept. of Health 2002). Dependent on tourism, timber, and ranching, the economic base of these communities took a hit in the years after Rodeo-Chediski. Job losses on the reservation were acute in the wake of the fire; two timber mills did not resume pre-fire productivity which led to a decline in merchantable timber that would impact the tribe for decades (Dale 2009).



Figure 1.3. A burned truck and satellite dish are all that remains of one home in a subdivision where Rodeo-Chediski burned 94 homes to the ground. David McNew, Getty Images.





Figure 1.4. An aerial image from 6/26/02 shows part of the east flank of the fire near Show Low where a road and thinned conditions (from a prescribed burn, left) helped fire crews stop its spread. (Photo by George Frey 2002).

Long-term wildfire recovery costs are more difficult to calculate, and such cost estimates are often incomplete (Westerling et al. 2014). In 2009 the Western Forestry Leadership Coalition (WFLC) analyzed direct and indirect costs of Rodeo-Chediski and five other well-documented fires from 2000 to 2003 (Dale 2009). The report found that \$50 million in suppression costs estimated in previous studies accounted for only around 15% of the actual total. Additional costs not included in the BAER and state estimates include the loss of homes and property totaling \$122.5 million, current and projected rehabilitation costs totaling over \$139 million over just three years, and indirect costs including loss of sales tax revenue and job losses in the tribal community exceeded \$8 million (Dale 2009). Many items, including, for example, damage to infrastructure and ecosystem services, and loss of critical habitat for the Mexican spotted owl, were recorded during the fire but no cost values were attached to those losses (Dale 2009). In total, all direct, rehabilitation, indirect, and additional costs for the Rodeo-Chediski fire are estimated to exceed \$308

million (Dale 2009; Ffolliott et al. 2011), a staggering figure that reflects the severe and widespread impacts of today's catastrophic fires.

#### *Post-Fire Salvage Survey*

Effects of fire affects archaeologists' capacity to find and record cultural material, influencing the recognition and documentation of the archaeological record (Thompson 2012). Pre-fire survey conditions in ASNF were characterized by little to no surface visibility due to duff produced from the overly-dense ponderosa overstory. Rodeo-Chediski obliterated most mature trees in high severity burn areas, resulting in the exposure of artifacts and features (Figure 1.4). In 2002, ASNF contracted SWCA for a cultural resources survey of 19,017 acres that burned in Rodeo-Chediski. Results published by North and others (2003) report that the fire directly affected 575 known archaeological sites in some capacity. Though historic sites did not fare as well in the immediate aftermath of Rodeo-Chediski, SWCA found that direct or immediate fire effects were "generally benign" on the 294 prehistoric sites evaluated. Direct effects from Rodeo-Chediski observed on prehistoric sites in 2002 consisted primarily of charred artifacts and burned masonry construction materials, and some cultural deposits were being horizontally displaced by sheet wash erosion (North et al. 2003). The project area for the salvage survey did not intersect with Bagnal and sites evaluated in this study area were not assessed until 2018.



Figure 1.5. Rodeo-Chediski exposed artifacts and architectural features on Puebloan site 07-2485. (North et al. 2003).

In the months after the fire erosional downcutting was minimal at most sites, though North and others correctly warn that prolonged exposure will “almost certainly” have an adverse effect on cultural deposits and features. The authors identified erosional threats posed by drainages or washes adjacent to sites, and some records indicated sheet and slope wash were already operating on assemblages and “obscuring our understanding of any concentrations and thus, intact subsurface deposits that could make sites NRHP-eligible under criteria A or D,” (Schofer 2008). Results from this salvage survey show that impacts to prehistoric materials immediately following the fire were relatively negligible, but those working in the burned area anticipated long-term effects from exposure.

#### *Rodeo-Chediski Interdisciplinary Studies*

The study of impacts requires an interdisciplinary approach that incorporates studies by different specialists into final interpretations of the archaeological record (Wildesen 1982). Interdisciplinary studies of wildfire impacts shed light on the dynamic ecological processes that operate in burned landscapes.

Studies of Rodeo-Chediski impacts on geomorphology, vegetation, and hydrologic functions are discussed to inform a holistic understanding of long-term effects on archaeological sites and survey abilities.

The USFS and BAER team began planning and implementing emergency recovery work to address watershed and public safety risks immediately after the fire (BAER 2002; USFS 2002). The work focused on stabilizing soils, preventing erosion in high severity burn areas, and preparing for increased stream flows due to a lack of vegetation and water-repellant soils (Zieroth 2004). A group of 35 specialists composed the team that conducted intensive surveys of ASNF following Rodeo-Chediski; results quickly revealed that the fire was well outside the range of natural fire behavior and had the potential to affect soils beyond accepted limits of natural and historical variability (BAER 2002). Areas of immediate concern listed in the report include reduced soil stability and permeability, increased runoff and erosion rates, reduced organic matter and nutrient content, increased peak stream flows and flooding, and increased sedimentation and scouring of important ecosystems like wet meadows and riparian areas (BAER 2002). The cultural resources (CR) specialist noted in the report that increased accessibility and visibility of archaeological sites renders them more accessible to vandalism and unauthorized collection. Because wildfire affects every aspect of the environment in which sites are situated, studies related to the ecological alterations brought on by Rodeo-Chediski are critical in the evaluation of survey conditions and site and landform stability.

Functioning watersheds in forested landscapes are vital for flood and erosion control, and to maintain a sustainable water supply that is essential for stable societal operation (Cram et al. 2006). High-severity wildfires like Rodeo-Chediski impact the basic hydrologic patterns and soil structures that form stable watersheds (Noss et al. 2006). Oxidized soils become water repellent or hydrophobic, responding to water more like a parking lot than a sponge (Schoennagel et al. 2017). Ffolliott and others (2011) found that hydrophobic soils that formed after Rodeo-Chediski decreased surface infiltration rates and repelled water that should have been absorbed, resulting in skyrocketing overland streamflow rates. Altered

hydrologic patterns are especially concerning in light of more extreme weather events. In August 2002, one month after Rodeo-Chediski was extinguished, a severe monsoon dumped almost two inches of rain on the burned area in just a few hours, producing so much rainfall that meteorologists called it a 10-year event (USFS 2011). Subsequent runoff from the storm below the Rim resulted in peak discharge rates at stream monitoring stations, with some exceeding a 100-year streamflow (Ffolliott et al. 2011). Floods from post-fire rainfall events are likely to be far outside the natural range of variability and produce serious post-fire effects (Gottfried et al. 2003). Sites situated in high-severity burn areas sustain compound impacts from exposure and subsequent degradation from weather events.

Post-fire vegetation monitoring studies in the Rodeo-Chediski burn area show that production on high-severity plots was substantially greater than low plots due to decreased canopy cover and a more complete removal of litter and duff layers that inhibit regrowth (Ffolliott et al. 2011; Neely 2012). Results from these studies have implications for archaeological reconnaissance because site detectability is conditioned by surface visibility which is tempered by groundcover. Duff coverage is among the most obscuring types of biomass for pedestrian surface inspection. The amount of duff present depends on the size and density of the canopy above – a canopy differentially impacted according to burn severity (Gottfried et al. 2003; Strom 2005). Results from Neely’s 2012 study on vegetation regeneration in ASNF after Rodeo-Chediski highlight the variance in groundcover according to burn severity. Nine years after the fire, the layer of duff and leaf litter on moderate-intensity burn sites were on average thirteen times deeper than high-intensity burn sites (Neely 2012). Burn severity is the single most important factor to consider in planning for long-term effects.

Research from other disciplines provides critical context for this study because archaeological sites are affected by the geological, physical, and biological processes that shape the landscape. Newly exposed cultural deposits are vulnerable to redeposition and destruction, and effective mitigation requires familiarity with geomorphological processes. BAER reports provide important data from the

immediate aftermath of the fire, which can be used to inform appropriate long-term management strategies. Studies related to vegetation in fire-impacted environments shed light on expected survey conditions, as surface visibility is conditioned by tree mortality, since duff produced by living trees can completely obscure the ground surface. Vegetation studies also inform preservation and stabilization strategies that reference pre-fire conditions to improve forest health. Soil studies in the wake of Rodeo-Chediski and other major wildfires provide important data on changes expected to sedimentological contexts, which are directly applicable to cultural deposits (Waters and Kuehn 1996). Hydrologic research shows that burned hydrophobic soils cannot absorb precipitation resulting in increased stream flow levels that can influence the post-depositional behavior of cultural deposits. A comprehensive understanding of the long-term effects of catastrophic wildfire on cultural resources requires an interdisciplinary orientation that addresses all processes and mechanisms characterizing the post-fire environment.

#### *Euroamerican Forest (Mis) Management*

Beginning with the control and use of fire, intensifying with the development of agriculture, and accelerating dramatically with the Industrial Revolution, we have always been active agents of environmental change – changes that, in turn, elicit responses in humans (Van West 2011). Before white settlement of the area in the late 19<sup>th</sup> century, forests in Arizona had a few dozen old “veteran” trees per acre, characterized by relatively open canopies that supported a diverse understory of herbaceous plants (Fulé et al 1997). The history of fire and land use in an area matters in understanding site formation processes, ecosystems, and in formulating management plans and policy (Hayashida 2005). Though the ponderosa forest of the Mogollon Rim region is a naturally fire-dependent system, major ecological changes from historic forest mismanagement resulted in the increasing severity and frequency of crown-consuming fires (Segee and Taylor 2002). Short- and long-term effects of these disasters modify natural forest systems, biotic communities, natural fire patterns, and hydrologic functioning in affected forests across the western U.S. (Ffolliott et al. 2011; Noss et al. 2006; Strom 2005; Westerling et al. 2014). In the

Bagnal study area, fire-induced changes at the site and landscape levels from the devastating 2002 burn continue to manipulate the content and character of its prehistoric sites.

Land use legacies, or the lasting effects of past human actions (Hayashida 2005), influence ecosystem structure, soils, water, topography, and nutrient cycling. This section explores how the historic occupation of the Mogollon Rim transformed healthy pre-contact forest systems. The extreme behavior of Rodeo-Chediski is attributed to changes in forest structure derived from historic forest management practices that prioritized suppression, selective logging of large burn-resistant trees, and overgrazing (Hanson 2001; USFS 2002). Fires in ponderosa pine forests historically burned at a low-intensity at regular intervals, removing fine fuels like grasses and litter from the forest floor and helping to maintain sparse, open stands of large, fire-resistant (“veteran”) trees, some hundreds of years old (Franklin and Agee 2003; Neely 2012; Noss et al. 2006). Prehistoric inhabitants of the Mogollon Rim would have enjoyed a more park-like environment with diverse microhabitats (Kaldahl and Dean 1999; Mills et al. 1999; Noss et al. 2006). After a century of fire exclusion, grazing, and logging, the once-parklike landscape became choked with trees – in some areas stand density is 10 to 100 times than natural conditions (Huffman et al. 2015). Human-caused conditions have led fire severity in western forests to increase, while fire tolerance continues to decrease (Franklin et al. 2003; Saunders et al. 2007). Low intensity, high-frequency fire regimes are estimated to have had a return interval of two to eight years before Europeans arrived in the West (Strom 2005). As a response to lethal fires of 1910, a policy of total fire suppression was mandated for management of American forests (Pyne 2008). Aggressive suppression pushed the modern fire return interval to fifty years; considering developments in mechanized suppression techniques, some researchers estimate it is now closer to 120 years (Fulé et al. 1997; Schoennagel et al. 2017; Strom 2005). This fire deficit permanently alters fire regimes and forest systems throughout the western part of the continent.

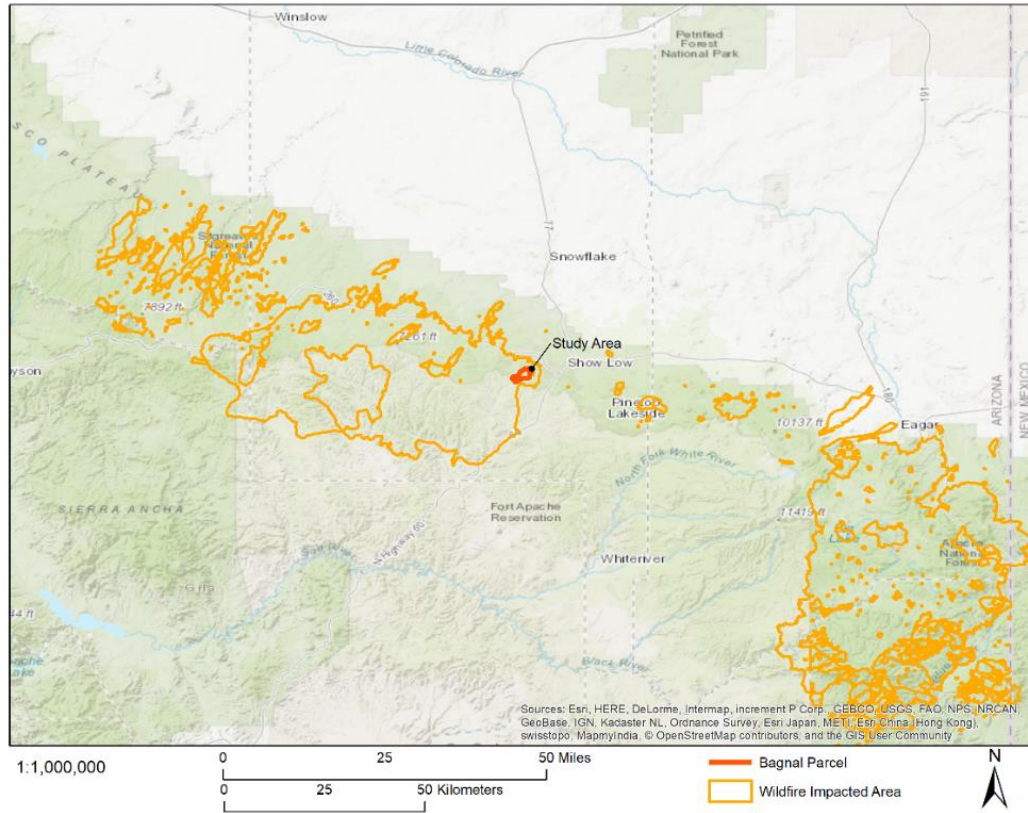


Figure 1.6. 1:1,000,000 map of USFS land impacted by modern wildfires in the Mogollon Rim region.

Historic settlements began to appear in force with the arrival of European trappers, miners, and homesteaders on the Rim in the early half of the 19<sup>th</sup> century. The Atlantic and Pacific Railroad reached Holbrook in 1880 resulting in an economic boom felt throughout communities in the region, including Snowflake, Show Low, Payson, and Heber-Overgaard (Lightfoot 1978). The arrival of the railroad brought sheep and cattle to the area and grazing quickly became widespread throughout the temperate plateau (North et al. 2003). Livestock influenced the natural fire return interval as grazing consumed the fine fuels needed to carry fire through the landscape (Neely 2012).

Timber production activities altered forest systems when commercial logging ventures began in the late 19<sup>th</sup> century (Lightfoot 1978). Logging camps and railroads established in land that is now under ASNF jurisdiction are recognized in the resource inventory as historic-era work camps, linear berms, push piles, and other landscape modifications related to improving accessibility and productivity for timber



sales (Schroeder 2010). Commercial logging on the Rim thrived until the Great Depression of the 1930s, after which trucks replaced railroads as the primary means of transporting timber (Lightfoot 1978). Logging railroads were dismantled entirely by 1944 and replaced with an extensive road network, parts of which are still used for ASNF timber production and management activities (Schroeder 2010; Segee and Taylor 2002). Nearly every PR1 site record in this study noted disturbance related to FS roads or logging.

Once a source of trees for processing into wood products, these forests are now vital for providing watershed protection in a water-deficient region, food for domestic livestock and indigenous herbivores, animal habitats, and sites for outdoor activities (Ffolliott et al. 2011). ASNF management emphasizes this combination of multiple uses, which includes grazing, farming, habitation, dispersed recreation, logging and sustained yields of timber and firewood production, hunting, and wildlife habitat (North et al. 2003; Schroeder 2010; USFS 2002). The nature of multiple use federal lands requires cultural and natural resource managers to be flexible, willing to compromise, creative, and interdisciplinary in orientation.

### *Statement of the Problem*

Increasingly frequent and severe wildfires in the last few decades have claimed lives, property, and cost states in the West billions of dollars in prevention, emergency, and recovery efforts. Unlike the frequent low-intensity fires that historically maintained ponderosa forest health, today's massive high-severity stand-replacing wildfires – the result of climatic conditions and poor forest management – irreversibly transform landscapes and the natural and cultural resources within them. Today's wildland fires impact archaeological resources to the extent that the interpretive value of the archaeological record has been significantly altered (Buenger 2003; Traylor et al. 1990). Almost two decades after the devastating Rodeo-Chediski fire, the once-densely wooded study area remains a denuded shrubland characterized by erosion, downcutting, and landform deflation. Intensified geomorphic processes following high-severity wildfires threaten site integrity and visibly affect the surface expressions of

impacted prehistoric sites - but, in what ways, and to what degree? How do long-term effects of a stand-replacing forest fire impact archaeological sites and data collection?

Wildfire is a powerful site formation process that can transform a landscape in minutes as organic materials and protective groundcover are obliterated and mineral soils exposed. Erosion has been shown to increase by more than three orders of magnitude in some areas following Rodeo-Chediski, and these trends can persist for over a decade after the event (Ffolliott et al. 2011). Land stabilization is often a primary concern in the days, months, and years following a major wildfire event (Westerling et al. 2014). Burned landscapes are constantly changing, shaped by altered vegetation communities, geomorphic processes, and shifts in hydrologic functioning. Agencies and managers by law must protect archaeological resources during any fire management activities, and the most informed strategies are usually the most effective. The study of impacts on archaeological resources provides important scientific, theoretical, and methodological underpinnings to help guide the future of our profession (Wildesen 1982:83). Because the first step in archaeological preservation is understanding the processes involved with destruction (Schiffer 1983), successful mitigation requires a comprehensive understanding of the mechanisms and processes that impact surface and near-surface sites in high and moderate severity burn areas. Despite the increasing prevalence and devastation of forest fires, research related to the long-term effects on archaeological sites remains scarce.

Situated on the edge of the Mogollon Rim, the prehistoric inventory of the study area echoes the bustling Puebloan occupation of the escarpment that forms a transitional zone between eco-regions and a known point of convergence for prehistoric peoples (Haury 1985; Schroeder 2010). With 40% of its ninety prehistoric sites eligible for the NRHP, the 1,500-acre study area offers an appropriate case study for the rich cultural resource base of the Mogollon Rim region. Inventories produced during surveys are increasingly the primary source of new archaeological data (Schachner 2015), and there is existing data from the study area with which to compare post-fire survey results. Analysis of impacts on a single site

does not adequately address the suite of impacts sustained by sites across a landscape, and therefore cannot inform reconnaissance or management strategies beyond that of the site (Van West 2011). The potential to identify patterns increases with data synthesized in aggregate at the landscape level.

This study is guided by two primary research questions: 1) in what ways and to what degree do post-fire ecological changes impact prehistoric site integrity; and 2) what are the implications of long-term wildfire effects for archaeological data collection and interpretation? The integrity and visibility of archaeological sites are important elements of pedestrian survey work, and both are differentially influenced by long-term post-fire formation processes. With survey data (including site data and archaeological and environmental spatial data) collected in the study area at various points in time in relation to the 2002 Rodeo-Chediski fire, this study evaluates long-term effects of wildfire on data collection and on the data itself.

Archaeological studies conducted in the aftermath of a wildland fire are abundant and include research on the effects of fire on different cultural material types (e.g. Buenger 2003; Burgh 1960; Purdy 1974; Rick 1978; McDowell-Loudan 1983; Perkins 1985; Rapp et al. 1999; Ryan et al. 2012), on various types of features (e.g. Higgins 1992; McCarthy 1990), on subsurface deposits (e.g. Bloemker and Oakley 1999; Conner and Cannon 1991; Guyette et al. 2002), and on dating techniques (e.g. Steffen 2005; Deal 1997; Linderman 1992; Green 1997). Studies of the use and effects of fire by indigenous groups are abundant (e.g. Bowman et al. 2011; Yazzie 2007), as are assessments of short term effects like scorching, vegetation removal, or general damage and inventory assessments that immediately follow wildfire on federal lands (e.g. North et al. 2003; USFS 2002 ). Post-fire reports provide a detailed view of the impacts from wildfire immediately following the burn, but they do not address continuing impacts from wildfire, such as increased erosion, which are not assessed uniformly by any federal agency (Morton et al. 2003).

Despite the abundance of literature related to wildfire and its intersection with cultural resources, evaluations of long-term impacts of wildfire on a collection of sites are rare and represent a need in

archaeological knowledge. This study, which evaluates long-term effects of wildfire on archaeological reconnaissance and site integrity sixteen years after the wildfire event, follows a relatively unexplored field of research. Wildfires across the West are starting earlier, lasting longer, and burning more intensely each year, and these trends are expected to accelerate in the coming years (Hayashida 2005; Noss 2006; Westerling et al. 2014; Yue et al. 2013). To preserve the resources we're tasked to protect, archaeologists must understand the suite of impacts from these disasters to mitigate data loss and site destruction.

### *Limitations*

It is necessary to identify biases and limitations at the outset to address gaps in available data, methods, and results. The reliability of archaeological landscape data is an enduring issue due to the numerous sources for potential error. Variations in data collection and reconnaissance methods between 1975, 1990, and 2018 make direct data comparison tenuous. Older site location data is generally more subject to error than more recent locations (especially since the era of GPS data) and the resolution of spatial data can vary greatly (Mehalic 2012). Inherent human biases and variations in recorder abilities are known to factor into survey results and information recorded (Goodyear et al. 1978; Plog et al. 1978). Surveys are conducted under the auspices of different individuals, institutions, and agencies, with wide variability in the amount and types of data collected, methods, spatial technologies, agency guidelines, project funding and motivations, and recording standards – all of which influence the nature of pedestrian survey data. Because only a few historic-era scatters dating to the 20<sup>th</sup> century were identified in the study area, this thesis focuses on Bagnal's impressive prehistoric occupation. Future studies on historic and multicomponent site survivability would benefit land managers tasked with preserving all resources.

Rodeo-Chediski transformed the landscape of the study area; the environments described in 1975 and 1990 site forms do not resemble those encountered in 2018. Many records lacked spatial data that would have encouraged or confirmed site relocation, and brief environmental descriptions in many previously recorded site records were not adequate to allow small survey crews site relocation in

expansive areas. High-resolution spatial data of groundcover and reconnaissance conditions before and after the fire is not available; evaluations of survey conditions derive from previously recorded site forms and visual estimates made in the field. Future research would benefit with precise reference conditions of pre- and post-fire environmental data to establish a baseline.

Without geoarchaeological data monitoring artifact movement, it is difficult determine whether increases in artifact counts and site area and decrease in artifact density result from artifact dispersal from intensified post-fire geomorphic processes, or improved surface visibility. Geoarchaeological and geomorphological studies tracking sediment movement and landform changes would shed light on the expectations and sources of impacts to surface expressions. The artifact sampling method employed in 2018 data recovery lacks consistency that would have made assemblage counts more reliable; sampling procedures followed USFS protocols for large-scale surveys that are not designed to produce precise inventories. Assemblages of sites that appeared to contain fewer than a couple hundred artifacts were typed and counted in their entirety. Those with more than a few hundred artifacts were sampled. One hundred ceramic and one hundred lithic artifacts were “randomly” selected, counted, typed, and described. These samples are meant to be representative of the entire assemblage; however, humans are drawn to shiny things and inherent biases undoubtedly factor into these selections. On the sampled sites, the estimated total artifact count ranges were based on visual observations – they were subjective. A defined sampling strategy (e.g. counts in truly random sample plots are applied to the total site area) may have produced more reliable estimates.

It is virtually impossible to avoid introducing biases into our data and to avoid making a variety of observational and recording errors in the field (Plog et al. 1978). An important source of bias is the variability between different crews or individuals; that is, how good are archaeologists as recording instruments? (Plog et al. 1978:413). Surveyors make subjective decisions about what to record, what is

significant, and where to look. Human error and biases cannot be avoided so it is necessary to recognize them; ultimately, human error is just difficult to fully account (Mehalic 2012).

The myth of 100% survey cannot be ignored, and the 2018 survey is no exception. Artifacts and sites are overlooked on pedestrian survey, and surface sites are especially prone to alteration from external factors. This study does not pretend that the dataset is a “complete” inventory of the study area – merely that it is as complete as possible given these biases, project budget and timeline, quality and quantity of existing data, recorder capabilities, and survey conditions. Definitions and recording methods vary between places, agencies, and companies. Definable limits of site boundaries are particularly problematic for the purposes of this study because a few outlying artifacts can make a site appear much larger than the area occupied for the prehistoric habitation or activity. Datum selection was subjective and involved finding a living tree somewhere in the middle of the site. Universal definitions, methods, and protocols would facilitate data collection, the production of syntheses, and more accurate analyses, but the discipline is not there yet.

### *Organization of Thesis*

The remainder of this thesis is divided into five chapters. Chapter 2 describes the environment of the study area, reviews past archaeological research and reconnaissance projects in the area and details the prehistoric chronology and cultural materials of the Mogollon Rim. The region’s prehistoric chronology is reviewed from the Archaic to historic eras, including descriptions of features, artifacts, and site types that characterize each period, including masonry building methods and materials, lithic materials and forms, ceramics, groundstone, and the culturally-introduced *Agave parryi*. Prehistoric subsistence practices are discussed from nomadic groups to later horticultural communities in order to contextualize the nature and function of sites evaluated in this study.

Chapter 3 begins with a review of cultural resource management (CRM) practices, legal mandates, and data collection methods. The nature of the prehistoric archaeological record and variables that factor

into site discovery are presented with an emphasis on the inherent and external qualities of surface expressions that help or hinder site discovery or detection. These first sections are considered outside the context of fire to establish baseline factors related to survey and site conditions that influence data collection on prehistoric surface sites. The remainder of the chapter deals explicitly with fire and its intersection with archaeology. Elements of the fire regime are discussed, including the nature of fuels and fire behavior, and factors of the environment that influence wildfires. Direct and indirect effects are discussed with an emphasis on qualities and conditions pertinent to this study.

Chapter 4 reviews the methods employed in 2018 fieldwork and in the present study. Pedestrian survey and data collection methods employed in 2018 are detailed, including USFS standards and project requirements, geographic information systems (GIS) techniques and instruments, personnel, and fieldwork SOPs of the 2018 R-C Phase II Prescribed Burn Survey (results reported in Mead et al. 2019). Data collection protocols are detailed, including technical elements of recordation, expectations and protocols of the agency and project, information required in field forms, and methods used in artifact analysis and inventory counts. Wildland fire risk assessments required in 2018 site records furnished this study with important data and are reviewed along with impacts identified on sites that are not fire related.

Chapter 5 reports results from analyses of data collected in the Bagnal parcel in 2018. Data for comparative analyses in the present study is based in two datasets from the same fifty (50) sites: original records (PR1) and 2018 records (PR2). PR1 and PR2 data are analyzed quantifiably and qualitatively to identify disparities in survey conditions, site integrity, and assemblage content following Rodeo-Chediski. Measurable changes in PR1 and PR2 prehistoric site data are presented by category and include site types, site location descriptions, site area, assemblage content, and number of features. The chapter concludes with a discussion of effects; direct effects include those which are immediately attributable to fire and suppression efforts, and indirect effects which include ecological and geomorphological changes to individual sites and the entire burned landscape. Reconnaissance results are then discussed in the context

of the two foundational research concerns related to long-term effects of wildfire on archaeological data collection and interpretation, and on prehistoric site integrity. Dynamic and compounding in the days, months, years, and even decades following the fire event, indirect effects have serious implications for site preservation and for doing archaeology.

Chapter 6 discusses results from the comparative analysis of PR1 and PR2 datasets. The first section puts results in the context of pedestrian survey conditions, or, the ecological conditions that influence site detectability and data interpretation. Visibility is a central focus as site and artifact detection on pedestrian survey is directly conditioned by the ability to observe items on the ground surface (Wildesen 1982). Results that influence site integrity are discussed, illustrating the long-term effects of wildfire on the spatial integrity of surface sites in the study area. Management implications are presented with a focus on proactive efforts that hold hope for mitigating the worst effects of major wildfires on important prehistoric resources. The thesis concludes with a discussion of implications the future of land and resource management in burned and fire prone western forests.



## CHAPTER 2. THE MOGOLLON RIM

The Mogollon Rim forms the geologic and geographic “spine” of Arizona (Mehalic 2012). From its position as a point of convergence between cultures, its impressive Pueblo village sites and remarkable assemblages, the Rim has long been a fascination of Southwestern archaeologists (Herr 2001). The massive south-facing escarpment forms a transitional zone between the Colorado Plateau and Basin-and-Range zones, rising 500 to 800 meters above the desert floor below (Plog 1981). The Rim was a prominent cultural and social boundary where various groups met, and traditions blended throughout the early part of the first millennia CE (Mills et al. 1999). The term “Mogollon” is a Spanish surname borrowed from a mountain range in New Mexico, which evolved into an appropriate label for the prehistoric people who made this mountain habitat their home (Haury 1931). Data from excavations like Tla’ Kii Ruin by Emil Haury in 1985 and the Great Kiva at Hooper Ranch Pueblo (Martin et al. 1962) have animated aspects of prehistoric life and produced solid cultural chronologies of prehistoric cultural traditions of the region (Herr 2013; Schroeder 2010). With the most varied topography in the state, the Rim is characterized by accompanying ecological diversity.



Figure 2.1. View from the edge of the Mogollon Rim. (Photo by Roger Naylor 2016)

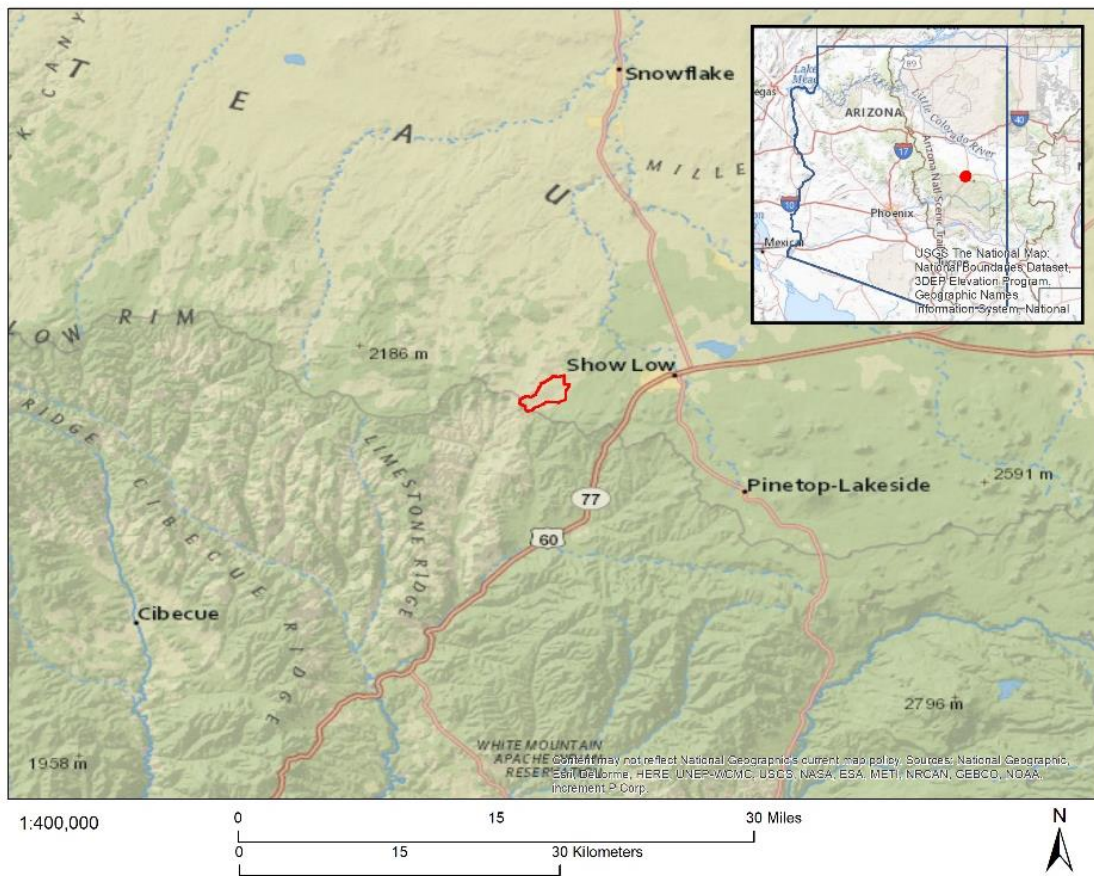


Figure 2.2. The study area (outlined in red) within the Greater Mogollon Rim Region, 1:400,000 terrain map.

The study area is situated in the 2.1 million-acre Apache-Sitgreaves National Forest (ASNF), which has a rich and diverse prehistory echoed in the cultural materials of its over 7,000 known archaeological sites. Based on the distribution of sites in the 2010 inventory, it is estimated that there are over 100,000 sites in ASNF (Schroeder 2010), with around 70% of prehistoric sites dating to Puebloan times (USFS 2012). The study area mirrors this intensive occupation in the size and number of its prehistoric sites, nearly half of which are deemed significant enough to include on the National Register of Historic Places (NRHP).

### *The Study Area*

Located in the Lakeside Ranger District of ASNF, the Bagnal parcel study area occupies 1,527 rolling acres bisected by Bagnal Draw, a large tributary of Show Low Creek. The southern edge of the study area is defined by the edge of the Mogollon Rim, where the escarpment drops off precipitously into Walnut Canyon to the southwest (Figure 1.1). Elevations in the study area range from 6,920 ft (2,109 m) in the south along the Rim, to 6,280 ft (2,109 m) along Bagnal Draw to the north. The parcel is irregularly shaped (Figure 2.2; outlined in green). Forest Service (FS) roads outline the study area to the west and north, and the edge of the Mogollon Rim, Rim Road (FS 300) and the Fort Apache Indian Reservation boundary, define its southern edge. The ancestral territories of several other tribes overlap the area, including Navajo, Zuni, Hopi, and other Apache groups (Mehalic 2012).

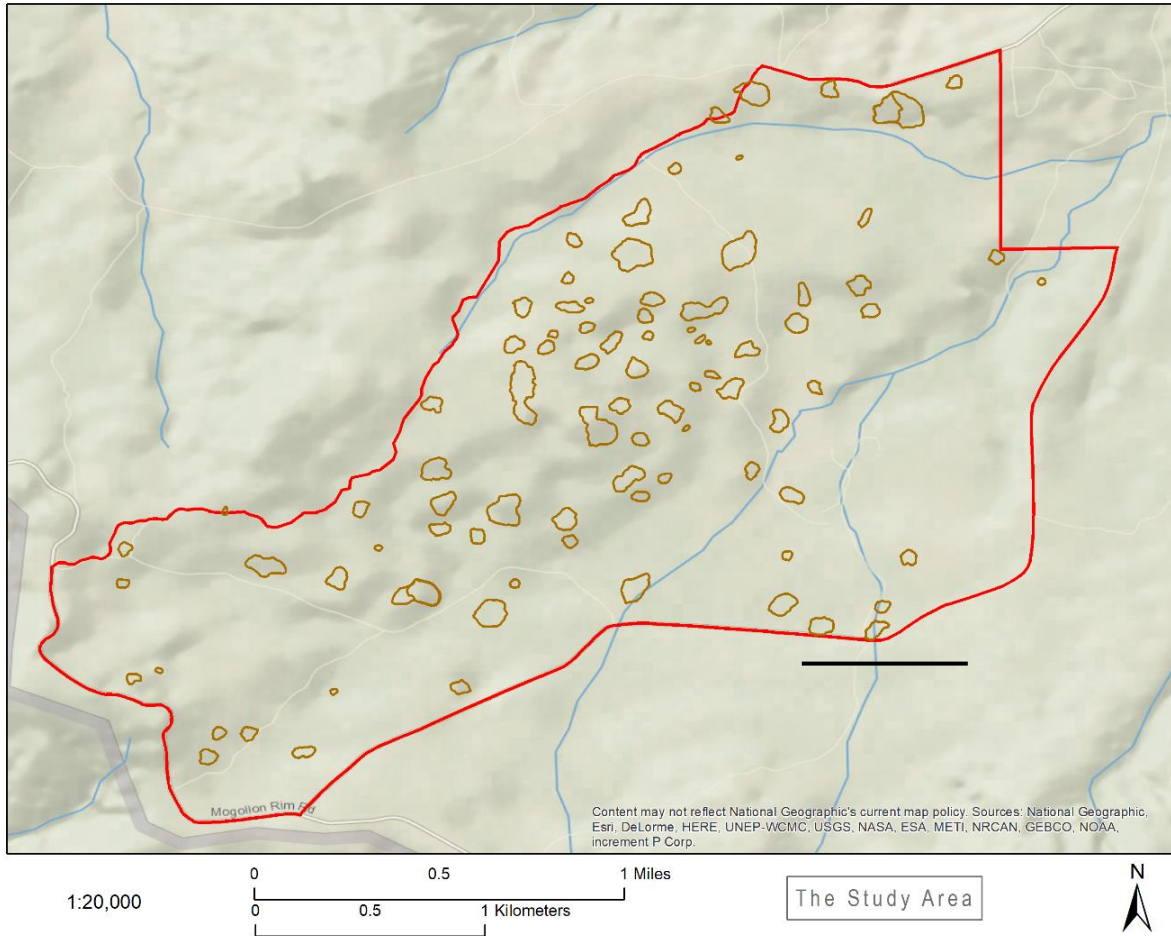


Figure 2.3. 1:20,000 map of sites recorded in the study area in 2018 (n=90; Bagnal outlined in red and PR2 sites in brown).

The 1,500-acre study area contains a substantial inventory of prehistoric sites recorded prior to 2018 fieldwork and importantly for this study, before the 2002 Rodeo-Chediski fire (n=72). Records from previously recorded sites provide pre-fire data to compare to site data collected during the 2018 phase II survey of the parcel by Harris Environmental Group (HEG). The study area has been sampled and surveyed at various times, including over 40 years ago in the mid-1970s (Donaldson 1975; Green 1975; Lerner 1975), before the fire in 1990 (survey by Dosh and others, reported in Neily 1991), immediately after the fire in 2002 (North et al. 2003), and by HEG in 2018 (Mead et al. 2019). Severe and widespread effects of Rodeo-Chediski observed on sites and landscapes during 2018 fieldwork prompted my questions about the integrity and reliability of archaeological data from burned areas.

## *Environmental Background*

Ecological information is reviewed here to understand prehistoric sites evaluated in this study within the context of their environment and formation processes. Geology in and around the study area is dominated by Cretaceous-age Dakota sandstone sedimentary formations, gray Pliocene and Miocene age sedimentary shale deposited in beach, river delta, and shallow sea settings, and Permian deposits of Kaibab Limestone and Coconino Sandstone (Plog 1981; Schofer 2008). Along the southern edge of the parcel are Quaternary and Tertiary gravel deposits known as “Rim gravels” (Plog 1981). Younger bedrock includes light colored conglomerate and sandstone deposited before mid-Tertiary volcanism and faulting (Schroeder 2010). Most sediment along the Rim was deposited by early Cenozoic streams that flowed northeast onto the Colorado Plateau from areas that are now lower in elevation (Mead et al. 2019). Sediments in alluvial channels and canyon bottoms are characterized by fine, shallow to deep sandy to cobbly loams, while sediments of the remaining topography are characterized by very gravelly sandy loams to very cobbly sandy loams (Plog 1981).

Hydrologic patterns in the area are driven by Silver Creek, a tributary of the Little Colorado River to the north, resulting in north-south trending landforms and drainages in the area (Donaldson 1975; Schroeder 2010). The Rim constitutes a watershed between drainages that feed north to the Little Colorado River and south to the Salt River, ultimately reaching the Gila River near Phoenix, then to the Colorado River and Gulf of California (Haury 1985; White 2008). The northeast-southwest orientation of Bagnal Draw in the study area has resulted in corresponding orientation of its gently sloping landforms, including hills, ridges, cliffs, floodplains, and alluvial channels or drainages (Mead et al. 2019). Drainages in Bagnal range from shallow swales or saddles to deeply entrenched washes that have increased in depth and breadth since Rodeo-Chediski which denuded the landscape surrounding its namesake drainage.

Soils in the area are described as sandy clay loams (Minnis and Plog 1976; Neily 1991; North et al. 2003; Sullivan 1982), though previous records of sites in the Bagnal parcel describe soils as “Mogollon

Sands” (Donaldson 1975; Haury 1985). Three surface soil types are present along the Rim: Overgaard gravelly loam, Show Low gravelly loam, and Winona extremely gravelly loam (North et al. 2003). The distribution of Overgaard gravelly loam soils loosely corresponds to Cretaceous age sedimentary formations, the Show Low gravelly loam soils are associated with Pliocene and Miocene age sedimentary deposits, and Winona extremely gravelly loam soils are associated with Permian age sedimentary formations (Mead et al. 2019; North et al. 2003; Schroeder 2010).

Vegetation in the study area before the Rodeo-Chediski fire was dominated by homogeneous stands of ponderosa pine, punctuated in some areas by Gambel oak, and alligator juniper (Neely 2012; Schofer 2008). These ponderosa forests grow from the dry mountains of central Mexico north to the Rocky Mountains of Canada, east to Nebraska, and west to the Pacific Ocean, and the largest are found in both northern New Mexico and along the Mogollon Rim (Bowman et al. 2011; USFS 2002). Trees of this biotic community that formed a dense mature canopy prior to the wildfire are included in the Rocky Mountain Subalpine Conifer Forest, or more commonly, Montane Conifer Forest (MCF) communities (Noss et al. 2006; Schroeder 2010). Since Rodeo-Chediski burned most of the mature canopy in the study area, MCF no longer characterizes vegetation on the parcel due to the fire-induced overhaul of the forest system. Characteristic of western ponderosa forest fires, Rodeo-Chediski burned in a patchy mosaic pattern of moderate- to high-intensity (Neely 2012; Hanson 2001). Regrowth today is dominated by an understory of occasional oak thickets, young juniper and oak, occasional surviving ponderosas, ponderosa saplings, manzanita, and various shrubs, forbs, and grasses. Sites in the present study are situated under an open canopy since Rodeo-Chediski destroyed most mature trees.

During 2018 fieldwork crews encountered black bears, wolves, bobcats, coyotes, mountain lions, mule deer, grey fox, raccoons, black-tailed and antelope jackrabbits, mountain and desert cottontails, pronghorn, woodrats, chipmunks, prairie dogs, deer mice, red and rock squirrels, striped and western spotted skunks, and shrews (see also Brown 1994). Non-native animals frequently encountered in the

field include cattle and wild horses, beloved to (most) Rim country residents today. Birds that live in or migrate through the Rim region include ravens, acorn and downy woodpeckers, bald eagles, golden eagles, red-tailed hawks, kestrels, merlins, Cooper's hawks, goshawks, owls, Turkey vultures, American robins, mountain bluebirds, cedar waxwings, dark-eyed juncos, chirping and white-crowned sparrows, bushtits, cowbirds, brown creepers, black-headed grosbeaks, mountain chickadees, pine siskins, vesper and violet-green swallows, vireos, tanagers, and a variety of flycatchers, wrens, thrushes, finches, nuthatches, warblers, and hummingbirds (author field notes; Cornell Lab of Ornithology 2012). Reptiles native to or identified in ASNF include snakes, lizards, and amphibians. Non-venomous snake species include the common kingsnake, gopher snake, milk snake, whipsnake, and garter snake, and venomous species include the Chihuahuan night snake and prairie rattlesnake (Brown 1994). Lizard species common to the area include the common sagebrush lizard, desert spiny lizard, eastern collared lizard, greater short-horned lizard, skinks, New Mexico & plateau striped whiptails, and southwestern fence lizard. Amphibian families found in the Rim region include salamanders, treefrogs, spadefoots, toads, and leopard frogs (Ffolliott et al. 2011). Wildlife in ASNF today is abundant and diverse, reflective of the game pursued by prehistoric inhabitants of the Mogollon Rim.

### *Weather and Climate*

With the most local relief in the state, the Mogollon Rim is characterized by corresponding variations in temperature and weather patterns across the escarpment (Huffman et al. 2015). Elevations on the edge of the Colorado Plateau are higher than the land on either side of the Rim, resulting in cooler, cloudier, and wetter conditions during all seasons than most other parts of the state (Durenberger 1976). As a transition zone between the Colorado Plateau and Basin-and-Range provinces of southern Arizona, resulting orographic effects make it one of the highest precipitation areas in the Southwest (Mills et al. 1999; USFS 2002). The average rainfall for the Rim is 16.2 inches per year (range of 10.3 to 22.3) with annual precipitation accumulation split almost equally between the late summer and late fall/winter

months (Ffolliott et al. 2011). Snow and low-intensity, long-duration rainfall occurring from October through April produces around 55% of annual precipitation; remaining precipitation comes during the monsoon season in the form of high-intensity, short-duration summer storms that are common to the Rim from late July to September (Ffolliott et al. 2011; Neely 2012). The highest peak stormflows originating on watersheds of the Rim are generated from these high-intensity, short-duration rainfall events (Ffolliott and Baker 1977). These weather events are salient to this research as monsoons further decrease soil stability in wildfire-impacted landscapes.

The climate of the Rim region is warm and semiarid. Temperatures across the region vary with elevation, as higher elevations experience lower annual temperatures than lower areas (Brown 1994; Mead et al. 2019). The wet seasons are December through March when winter storms are most common; frequent snowstorms on the Rim begin in late November (Grubbs 2008). October, November, and February through April are typically cooler and drier, and the summer heat sets in by May and June when temperatures regularly exceed 100 degrees Fahrenheit (°F) (Herr 2013). By early July, moisture moves in from the southeast and marks the onset of the North American monsoon (Grubbs 2008). Historic climatological records documented from 1912 to 1968 show the range for summer temperatures averaged between 60- and 70 °F (15°C -21°C) and a winter average between 30 and 40°F (-1°C-4°C; Neely 1991). Annual high temperatures typically occurred between July and August and averaged around 85.5 °F (30°C); annual lows occurred between January and February and averaged 15°F (-9°C; Mead et al. 2019).

Climate and weather data provide insight into the environmental context of site impacts evaluated in this study. Decreased precipitation rates and increased global temperatures have resulted in dry forests that are ripe for disaster. The deluge of water brought down by late summer monsoons has implications for newly exposed fire-impacted assemblages. Snow adds a complicating factor to consider as freeze-thaw cycles are known to impact sedimentological integrity (Ryan et al. 2012; Wildesen 2002).



Meteorological and climate data must augment wildfire assessments because of the integral nature of weather events, climate patterns, and fire behavior.

### *History of Research*

The prehistory of the Mogollon Rim has drawn archaeologists to the region since the early 20<sup>th</sup> century, some of whom began and continued to focus their archaeological careers around sites and landscapes of east-central Arizona (Herr 2001). From Emil Haury's late 1930s-era studies in the Forestdale Valley (Haury 1985) to the University of Arizona's Grasshopper Pueblo (1962-1992; Reid and Whittesley 2005) and Silver Creek Archaeological Research Projects (1993-2004; Mills et al. 1999), the region has been the focus of intense archaeological research for the better part of a century (Schofer 2008). Research ventures in the region were first supported by museums such as the Smithsonian Institution, then evolved into university-sponsored work, and after the mid-1970s became dominated by Section 106-mandated undertakings. Taken on for various reasons, by different entities, and at different points of time, stated goals of research and survey projects in ASNF reflect the changing theoretical paradigms under which the discipline operated at the time. Museum-sponsored projects led to academic studies in ASNF, which after the 1980s morphed into agency-driven and legally-mandated archaeological undertakings in the forests.

The first professional archaeologist to work in ASNF was Jesse-Walter Fewkes, whose Smithsonian-funded excavation work began in 1904. Fewkes' excavations at Pinedale Ruin and Fourmile Ruin attempted to trace Hopi clan migrations through pottery designs (North et al. 2003). With funding from the National Geographic Society's Third Beam Expedition, Emil Haury came to the White Mountains of Arizona in 1931 with the goal of identifying the eastern limits of Hohokam culture. What he instead found was the concept of the Mogollon culture, the chronology of which he defined with data from several village site excavations (Haury 1985). This first chronology of the area was defined with temporal horizons using pottery types from the Forestdale Valley, published by Haury and Sayles in 1947.

Research related to environmental factors of prehistoric life in the Rim region began with Lightfoot's 1978 surveys in the area. Lightfoot compiled survey data and identified several environmental correlations of site locations, including elevation, vegetation, topography, and soil. Results show that most prehistoric sites occupy locations below 6,800 ft in elevation within pinon-juniper woodlands and tended to concentrate on hills and ridges and in areas where loam soils are present (Lightfoot 1978). Donaldson (1975) reports on findings from a study of "man-land relationships" in the White Mountain Planning Unit of ASNF. The study uses existing survey data and previous research from the area to identify correlations between prehistoric sites and soils, vegetation and water and soil control strategies, and demography and social organization in the Rim region.

Dr. Paul S. Martin of the Chicago Field Museum of Natural History undertook around fifteen years of archaeological excavation and reconnaissance in an area north of Bagnal between the towns of Snowflake and Springerville. Martin and colleagues synthesized results in reports that have largely formed the basis of the current cultural chronology in ASNF (Martin et al. 1962). Another major research effort directed toward understanding the prehistory of ASNF was the Chevelon Archaeological Research Project (CARP) directed by Fred Plog from 1971 to 1977 which inventoried a one percent sample of the 2.2-million-acre national forest. Plog had worked in ASNF since 1971 and throughout his tenure on the Rim experimented with sampling strategies to document the rich cultural heritage of the area. Funded by the National Science Foundation (NSF) with support from academic institutions including University of California at Los Angeles, SUNY, the University of Michigan, and Arizona State University, CARP provided an important inventory for ASNF and a model for other agencies managing expansive lands with rich archaeological resources. Plog published results and helped set the stage for 1980s management of Southwestern federal land in *Managing Archeology: A Background Document for CRM in Apache-Sitgreaves National Forests, Arizona* (1981). Thomas King reviewed the report in 1982, lauding the interdisciplinary and forward-thinking qualities of Plog's management strategies which includes cultural

information as well as information about predictive modeling and mitigating site impacts. Fire-related threats and impacts identified by Plog only reference theft from fire crews during suppression; high-severity fire had not yet reached the Rim in 1981

Archaeological research in ASNF in the 1980s and 1990s was characterized by larger scale inventories and field schools that produced adequate data to inform syntheses related to different time periods and aspects of prehistoric life on the Mogollon Rim. Results from excavations at eighteen sites involved in a land exchange west of Show Low by Dosh (1988) suggest that from around 1000-1150 CE, people living on the Mogollon Rim consumed a broad-spectrum diet that relied to some degree on cultigens. The University of Arizona conducted ongoing field schools as part of the Silver Creek Archaeological Research Project (SCARP) from 1993 to 1999 which resulted in excavations at several large sites in the Silver Creek drainage (Herr 2001; Mills et al.1999). The project focused on the high density of 11<sup>th</sup>- and 12<sup>th</sup>-century great kiva sites in the Show Low area, and factors that conditioned population aggregation in the area during the Pueblo IV period. The synthesis of this work includes a revised chronology for the region, a detailed paleoenvironmental model for the Show Low area (Kaldahl and Dean 1999), along with analyses related to material culture, subsistence remains, and paleodemography.

As a foundation for understanding settlement patterns in the area, Newcomb's (1999) demographic study demonstrated that increases in population were not possible from natural community growth but were the result of migration, suggesting that favorable climatic conditions on the Rim at the time encouraged migration of other groups onto the escarpment. Herr's 2001 and 2013 analyses of the Ancestral Puebloan community organization and great kiva sites along the Rim built on Newcomb's migration theories. Herr contextualizes Puebloan architecture within the larger lifeways of prehistoric peoples to put smaller village sites or satellite communities into a larger Puebloan world. Larger regional studies produced with datasets like the Rodeo-Chediski salvage survey (reported in North et al. 2003) provide invaluable information about the nature and distribution of prehistoric sites in the Rim region.

Today, the Rim forms boundaries between towns, reservation land, federally managed lands, and private lands. Prehistorically, the Rim formed a fluctuating cultural and social boundary upon which groups traveled, met, exchanged materials and ideas, and settled. In her study that traced prehistoric population movement through corrugated ceramic forms, Neuzil (2005) found that many of the inhabitants of the well-known Bailey Ruin near Show Low were migrants. Based on the material culture these inhabitants brought with them, Mills and others (1999) and Neuzil (2005) argue that Pueblo IV period migrant populations were an important factor in social dynamics at Bailey during the time. A study from Ciolek-Torrello (1981) demonstrates continuity between the nature of sites and ceramic assemblages of sites on the Rim and immediately south of it, suggesting that similarities in site size, architecture, and ceramics reveal relationships and cultural interactions between native groups residing on and below the Rim. These and other studies demonstrate the significance of the Mogollon Rim region as a meeting point for prehistoric groups.

In addition to academic studies, over 2,720 cultural resource surveys have been conducted for land management activities in ASNF. Undertakings in ASNF that require Section 106 reconnaissance include timber and fuel wood sales, hazards fuels reduction projects, and several large data recovery projects for land exchanges, highways, infrastructure, and energy corridors (Schroeder 2010). Interdisciplinary research by forestry scientists and hydrologists inform the present study. An abundance of research following the Rodeo-Chediski fire lends ecological data important for evaluating long-term effects of wildfire on archaeological reconnaissance. ASNF assessment projects referenced in this study include the 2002 R-C cultural resource salvage inventory (North et al. 2003), a 2007 ASNF restocking burned area livestock study (White 2008), R-C reforestation projects (Schofer 2008), a long-term study of R-C impacts to hydrologic systems in ASNF (Ffolliott et al. 2011), a dissertation on small architectural sites of the Rim region (Mehalic 2012), and unpublished M.S. theses on post-fire vegetation regeneration (Hanson 2010 and Neely 2012). USFS-produced reports referenced in this study include a 2011 Prescribed

Burn Environmental Impact Analysis (EIA), a 2015 ASNF Cultural Resources Specialist report, and a 2015 Rodeo-Chediski Monitoring and Evaluation report. These research and reconnaissance projects have produced a wealth of data related to survey conditions and prehistoric lifeways in the bountiful ecotone.

### *Prehistory of the Mogollon Rim*

A regional perspective is essential to understand the dynamics of prehistoric Mogollon Rim communities (Herr 1999). Archaeological data from ASNF reflects a lasting and intensive habitation of the region after the Late Paleoindian period. Smaller nomadic tribes of the Archaic were replaced by more sedentary groups with the introduction of agriculture in the Basketmaker and Pueblo periods. Villages and towns largely replaced campsites and the of rockshelters, basketry gave way to pottery, and groups achieved greater levels of social, ritualistic, and economic complexity (Herr 2001; North et al. 2003). These groups would come to be known broadly as Ancestral Puebloan peoples, an area defined by the traditional groups Anasazi, Mogollon, and Hohokam (Herr 2001; Schroeder 2010). Compared to other areas in the Southwest during the same period, the density of great kivas in the Rim region is high, suggesting greater cultural and community interaction between Puebloan groups (Herr 1999). The Western Apache occupation of east-central Arizona from the 1500s to 1650s marks the period of greatest land use and manipulation (Herr 2013). By the mid-19<sup>th</sup> century, the lives and material remains of remaining native peoples – and the landscape in which they lived – irreversibly changed with the arrival of Euroamerican settlers on the Rim.

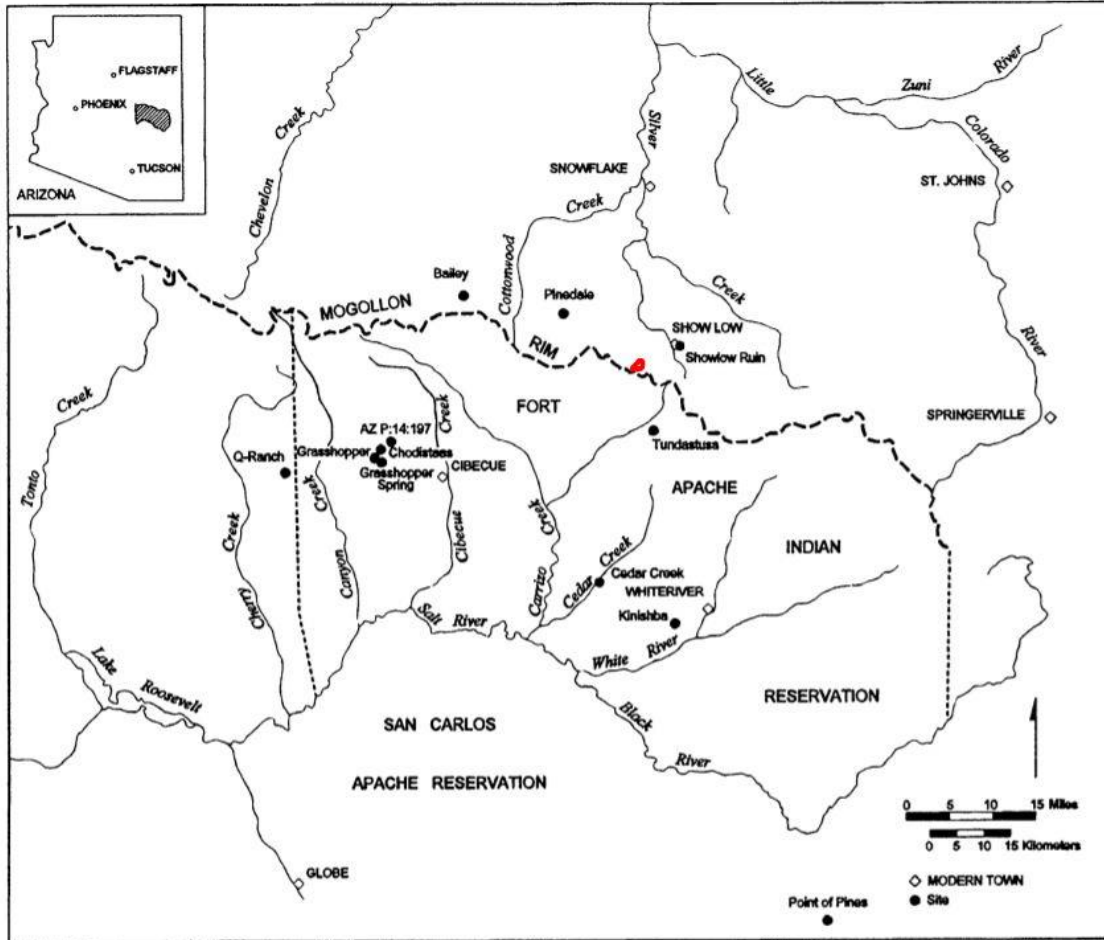


Figure 2.4. Important prehistoric sites of the Rim Region (from Herr 2001). The study area is indicated in red.

Abundant natural resources first drew nomadic groups who occupied the Rim seasonally to collect plant, animal, and mineral resources (Herr 2013). Later sedentary groups found wet conditions on the Rim to favor horticulture, resulting in the explosion of habitation sites and villages that is evidenced today by Puebloan ruins and spectacular assemblages. This section reviews (and assumes the integrity and accuracy of) existing prehistoric cultures and chronologies of the Mogollon Rim.

Table 2.1. Cultural chronology of the Mogollon Rim Region (adapted from North et al. 2003 and Schroeder 2010).

TEMPORAL PERIODS AND CULTURAL PHASES			CALENDAR YEARS
	Anasazi (Pecos)	Highland Mogollon (Haury)	
	Paleoindian		9500 – 6500 BCE
	Archaic		6500 – 400 BCE
<b>Early Agriculture</b>	Basketmaker II-III	Hilltop Cottonwood Forestdale	400 BCE – 800 CE

TEMPORAL PERIODS AND CULTURAL PHASES			CALENDAR YEARS
<b>Formative</b>	Pueblo I	Corduroy Dry Valley	800 – 1000 CE
	Pueblo II	Carrizo Linden	1000 – 1150 CE
	Pueblo III	Pinedale Canyon Creek	1150 – 1300 CE
<b>Proto-historic</b>	Pueblo IV		1300 – 1540 CE
<b>Historic</b>	Pueblo V		1540 CE – Present
	Euro-American		1600 CE – Present

The earliest known sites in ASNF date to the Archaic period (6500 – 400 BCE), though these are rare in the forest perhaps due to their more ephemeral nature (Mead et al. 2019; USFS 2002). Sites dating to the period in the region are represented by dispersed artifact scatters, bedrock mortars, rock-filled roasting pits, rockshelters, and a variety of dart point types (Neily 1991; Schroeder 2010). The report from SWCA’s salvage survey identified one site dating to the Archaic period. Two Pinto-style projectile points (dating to the Middle Archaic, 5000-1500 BCE) were documented on the site which is located on a bench overlooking a wash around two miles north of the Mogollon Rim (North et al. 2003). Dispersed over 4,000m<sup>2</sup>, the assemblage consists of 200-300 lithics that may represent a limited activity area or small campsite where stone tools were produced, retouched, and discarded, and is interpreted to relate to resource procurement and not to habitation (North et al. 2003).

Basketmaker II (B2) through III (B3) period sites dating to 400 BCE – CE 800 are less common than those of later periods but have been documented in ASNF (Mead et al. 2019; Schroeder 2010). Diagnostic forms associated with this early agricultural period include Hilltop, Cottonwood, and Forestdale (Haury 1985). People of the period appear to have preferred habitations in settings near arable land such as floodplains as horticulture became more prevalent (North et al. 2003), though it is not clear whether this is due to the preservation issues. B2 occupations appear more nomadic than later periods, and it is likely that their movements across the landscape followed seasonal availability of certain resources (Herr 2013;

Mead et al. 2019). B2 excavations contain circular houses with slab-lined entryways, existing research shows these sites are usually close to and upslope from arable land (Neily 1991; North et al. 2003; Schroeder 2010). B3 sites in the region seem to preference pithouses and lowland settings (Schroeder 2010). Village size and configuration suggest a high level of social organization as individual residential units were integrated into larger villages (Gunnerman and Dean 1989).

A greater emphasis on farming in B3 led to increased sedentism apparent in the artifacts: plain brownware evolved into grayware vessels then painted wares by 600 CE (Martin et al. 1962; North et al. 2003). Stone axes, corner- and side-notched dart points are common to the period and abundant marine shell at some B3 sites indicates participation in long-distance trade networks (Herr 2013). North and others (2003) identified seven artifact scatters confidently assigned to the B2 and B3 periods in their Rodeo-Chediski salvage survey. The scatters are relatively small, all measuring less than 2,500 m<sup>2</sup> and containing fewer than 400 artifacts, situated on ridges, hill slopes, and floodplains, and all in proximity to or overlooking a wash (North et al. 2003). People appear to have started moving out of the uplands to areas of richer soil that could support farming in the floodplains during these periods (Schroeder 2010). This locational preference for flood-prone lowlands may contribute to the apparent deficiency of these sites in the ASNF inventory.

The Formative era (800 – 1300 CE) includes the Pueblo I (P1) through Pueblo III (P3) periods. The most visible material signatures from this era in the Rim region is the widespread appearance of black-on-white pottery and the use of both pithouses and masonry surface structures (Dosh 1988; North et al. 2003). The P1 period (800 – 1000 CE) is characterized by the emergence of pithouse villages, above-ground habitation structures, and artifact scatters containing diagnostics reflecting the Corduroy and Dry Valley traditions (Haury 1985; Martin et al. 1962; Mead et al. 2019).

Previous studies document a dramatic increase in the intensity of Rim occupations during P2 and P3, roughly 1000-1300 CE (Dosh 1988; Neily 1991; Stafford and Rice 1980). Masonry pueblos occur with



small settlements containing jacal and jacal/masonry structures, three-walled dry-lay masonry structures, and pithouses (Neily 1991). Both year-round occupation and seasonal or limited-use sites are well-represented in the ASNF inventory (Schroeder 2010) and in the study area. A notable feature of the P2 period is the emergence of great kiva sites, which some theorize relate to the development of an integrated political system with these features functioning as a centralized location where people gathered to trade commodities (e.g. Herr 2001, 2013 and Lightfoot 1978) between surrounding satellite communities (Neily 1991). Great kiva sites are defined by the presence of a large (15-25 meters) circular depression; sometimes these occur in pueblo sites but also in total isolation on the forests (Plog 1981; Schofer 2008). The ASNF site inventory reflects the demographic shift of the P2 and P3 period with around 70% of identified culturally-affiliated sites dating to these periods (Herr 2013; Schroeder 2010).

Diagnostic artifacts from the P2 period (1000 – 1150 CE) on the Rim reflect the Carrizo and Linden traditions (Haury 1985). Larger habitations dating to P2 consist of multiple roomblocks of up to forty rooms, and several in ASNF include great kivas (Herr 2010; Mead et al. 2019). The most common sites that date to this period are one- and two-room masonry structures, small roomblocks of between four to six rooms, water control features, and artifact scatters without surface features (Plog 1981; Schroeder 2010). P3 (1150 – 1300 CE) diagnostics reflect Pinedale and Canyon Creek traditions (Haury 1985). Habitation of the Rim changes during the latter part of the P3 period, reflected in the ASNF inventory by a steep decline in the number of sites but increase in the number of rooms per site (Schroeder 2010). Sites like the 250-room Bailey Ruin appears to have been occupied until around 1325 CE, and the well-known Fourmile Ruin until the mid-1300s (Schofer 2008). By the mid-1400s it appears the forests on the Rim were no longer used for permanent habitation but instead on a temporary basis by small protohistoric groups that had descended from the Mogollon and Ancestral Puebloan people (Herr 1999; Martin et al. 1962; Schroeder 2010). .

Historic-era sites in the region are divided between indigenous and immigrant groups. Pueblo V (P5) sites emerge after 1540 CE, when the Rim region was occupied by various Apache tribes (Herr 2013; North et al. 2003). Relatively high residential mobility among the various Apache groups resulted in ephemeral sites that left little to no archaeological signature; materials include plainware pottery, basketry, and ollas (Martin et al. 1962; Mead et al. 2019). P5 groups lived in dome-shaped wickiups made of branches and bear grass thatched roofs (Herr 2001; Mead et al. 2019) and relied appear to have primarily on hunting and gathering though the Western Apache did engage in farming to some extent (Herr 2013; North et al. 2003).

Increased white settlement in Apache territory led to tensions between the two groups (Herr 2013). Following hostilities in the 1860s, Lieutenant Colonel George Crook was appointed as commander of the Army's Department of Arizona and tasked with the "pacification" of native groups (Schroeder 2010; North et al. 2003). In 1871 President Ulysses S. Grant established a policy designed to relocate Apaches to designated areas, and Crook embarked on a military campaign that eventually led to the creation of several reservations (Herr 2013; Neily 1991). To expedite communication and supply transport between the Mogollon Rim, Camp Verde, and Camp Apache (later Fort Apache), Crook's troops constructed a supply route that was used into the early 1900s (Schroeder 2010). The route became known as the General Crook Trail, an extensive NRHP-listed linear site that extends from below the Rim to Clay Springs, bisecting the study area near Rim Road.

Historic sites begin to appear in force on the Mogollon Plateau with the arrival of European settlers in the mid-1800s. European trappers were followed by settlers who came to east-central Arizona with the hopes of finding gold (Mead et al. 2019). In 1864, gold was discovered to the west in Prescott and the region saw an influx of Euroamerican settlement in this part of the frontier (Neily 1991). In 1880 the Atlantic and Pacific Railroad reached Holbrook, forty miles north of the study area, and the region experienced an economic boom (Lightfoot 1978). The arrival of the railroad brought sheep and cattle to

the area and grazing quickly became widespread throughout the temperate Mogollon Plateau (North et al. 2003). Homesteading sites dating from 1878 to 1969 are common in ASNF and typically reflect a multi-unit compound constructed on or adjacent to a floodplain with arable land (Schroeder 2010). Roads, trails, and telegraph lines found on the forests reflect the pattern of traffic among the major settlements of past periods (Plog 1981:24). Historic sites documented in the study area include roads and trash scatters dating to the 20<sup>th</sup> century.

### *Prehistoric Materials*

The Mogollon Rim has been a point of interaction between cultures for thousands of years, reflected in the abundant and diverse cultural materials left behind by large Puebloan occupations. These and the preceding and subsequent groups who occupied the region left behind extraordinary material signatures of their occupations in rich and diverse assemblages of artifacts that reflect creative production techniques, variation in raw materials, and awe-inspiring design qualities.

The most common prehistoric artifact type documented in the study area is lithics, or flaked stone artifacts. These items appear as formal and informal tools, and debitage or shatter – the refuse of toolmaking activities (Andrefsky 2005). Defined by technological and functional criteria, lithic artifact types documented in the study area include scrapers, projectile and dart points, bifaces, unifaces, knives, preforms, drills, hammerstones, cores, and flakes (utilized, primary, secondary, tertiary, pressure, bifacial thinning, bipolar, and overshot) (ASNF site forms). In order of frequency, raw material types documented in ASNF include chert, quartzite, basalt (or “fine-grained volcanic” though there is no distinction on site forms), petrified wood, silicified sediment, chalcedony, siltstone, jasper, and obsidian. All but obsidian occur naturally in ASNF, which suggests that prehistoric inhabitants of sites with obsidian in the assemblage were involved in long-distance trade.

Ceramic diversity is high in the Rim region, and most large prehistoric assemblages in the study area contain a variety of forms and decorative styles. Emil Haury noted that beyond the usual black-on-

white and sometimes polychrome pottery, he was “struck by the extensive surface scatters of broken pottery, predominately brown and red in color, much of it smudged,” (Haury 1985:7). Herr (2001) defined four functional classes of vessels based on surface treatment and vessel form: decorated bowls, undecorated bowls, decorated jars, and undecorated jars. Each ceramic type represents a cluster of attributes, such as paint types, paste and temper materials, and design patterns (Hayes-Gilpin and van Hartesveltd 1998). Ceramics types of the Mogollon Rim have been studied extensively (e.g. Haury 1985; Herr 2001; Mills et al. 1999; Newcomb 1999), resulting in a solid chronological association used to date sites in the field today. These types include a variety of gray, white, and red wares with a variety of decorations that can be used to trace distinct trajectories of development since pottery techniques represent specific learned group behaviors (Snow 2017). Different methods of ceramic production are evident in various indented and corrugated forms of brownware and plainware observed on prehistoric sites on the Rim (figures 2.5 and 2.6).



Figure 2.5. Diagnostic ceramic sample from site 07-0108. Diagnostic qualities vary by time period but are generally typed in the field using design patterns, type of paint (mineral or organic), and characteristics attributed to temper, firing methods, and ceramic composition. The most common ceramic type in the study area is plain undifferentiated brownware, but most sites in 2018 were found to contain more than one style. Photo by HEG 2018.



Figure 2.6. Coiled and corrugated sherd sample from site 07-0699. Coils are believed to have been developed as a way to better insulate and reinforce ceramic vessels. Corrugation styles are culturally distinct and typed in the field using ceramic references. Corrugated items in the region were made using both whiteware and brownware. Photo by HEG 2018.

The abundance of ceramic artifacts in the area is in part attributed to the plentiful sources of clay on the Rim. Petrographic assessments of a potter's assemblage from *Tla Kii* Pueblo shows that mineral aplastics in the samples included a spherical, arkosic sandstone that is typical of the formations along the Mogollon Rim (Herr and Stinson 2005). Refiring and petrographic analyses have demonstrated that the clays in sands in Mogollon brownware from sites excavated in the nearby Silver Creek area match those that are locally available (Mills et al. 1999). Petrographic analysis of the *Tla Kii* assemblage found that plainware sherds were made with Kaolinitic clays consistent with local exposures of the Cretaceous-age deposits (Herr and Stinson 2005).

Groundstone tools in ASNF assemblages are rare in comparison to lithics and ceramics; it is not uncommon to document over a thousand sherds and flakes on a surface site without any groundstone fragments. Vesicular basalt appears to have been preferred by inhabitants of the site area, followed by sandstone and granite.



Figure 2.7. A vesicular basalt metate fragment from site 07-2217. Photo by HEG 2018.

The rich and diverse prehistoric materials of the Mogollon Rim have dazzled Southwestern archaeologists and collectors for more than a century. Decorated fragments of ceramic bowls and vessels reflect increased sedentism and exploration of artistic forms. Corrugated variations reflect ingenuity in design and the widespread transmission of new ideas. Abundant lithic debris, formal, and informal stone tools attest to the intensive occupation and use of local materials. Though less common than lithics or ceramics, groundstone items point to horticulture and the processing of native plants. With the largest and most intriguing assemblages on sites with visible features, the following section reviews the prehistoric building methods and materials that characterize early occupants of the Rim.

### *Prehistoric Architecture and Features*

Prehistoric inhabitants of the Rim region left behind abundant structural remains that have formed the basis of many research ventures (e.g. Haury 1931, 1985; Martin et al. 1962). Pueblo architecture – defined by evidence of above-ground masonry structures – is markedly diverse in the Rim

region (Plog 1981). Variations in size, materials, and elements of prehistoric habitation sites reflect the size, needs, and behaviors of occupying groups. Notable prehistoric feature types in ASNF include pithouses, pueblo roomblocks, great kivas, and field houses.

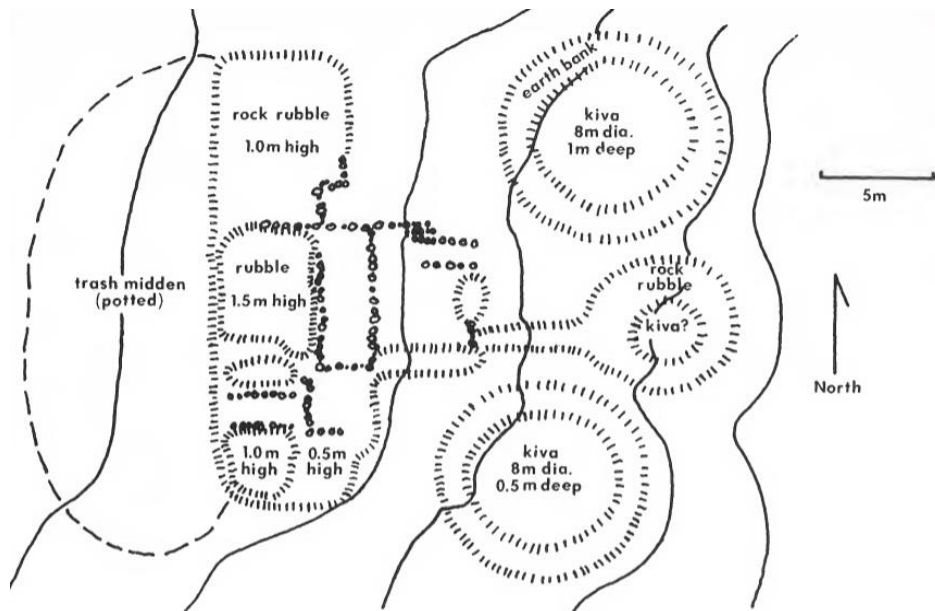


Figure 2.8. Example of a typical pueblo village layout from site 06-0013. Consider the importance of the spatial integrity of features for interpretation of these sites. Sketch from Plog 1981, originally recorded by Wood 1978.

Pithouse sites describe a variety of partially sub-surface structures that are thought to have been built by standing timber supports in a pit and laying branches or reeds against and on top of these to form walls and roofs; these were then covered with dirt, adobe, or daub (Plog 1981). Field house sites are usually found on or adjacent to arable land or floodplains and are the smallest architectural sites, typically containing a single room structure and sometimes an external storage feature. Great kiva sites represent what has been interpreted as centers of ceremonial activity and important loci of exchange and trade. These sites are defined by the presence of large (roughly 15-25 meters) circular depressions and can occur as features on pueblo sites or in isolation (Plog 1981).

The primary source of prehistoric building materials are angular blocks of varying dimensions that broke off local outcrops of Coconino and Dakota sandstone; builders would have had the choice of a wide range of stone sizes without resulting to quarrying (Haury 1985). Structures were built with a combination

of materials and methods, most commonly reflecting stone and jacal (Herr 2010; Mills et al. 1999). Features are often identifiable in the field by the presence of a mound or roughly linear alignment of sandstone slabs and always occur in conjunction with artifacts.



Figure 2.9. An excavated wall from a roomblock feature at *Tla-Kii* Ruin. Photo by Haury 1985.

Daub describes hardened burned clay fragments found in archaeological contexts (Kruger 2015), and its existence is indicative of a once-present superstructure constructed above a masonry foundation that may have had plastered roofs or walls for added weather protection (Dosh 1990; Herr 1999; Plog 1981). Because daub is interpreted to have been linked to prehistoric structures and therefore habitation, daub concentrations in the study area are considered features. Daub concentrations in the 2018 project area were almost always found in association with dense artifact scatters.



Figure 2.10. A daub fragment with finger imprints from site 07-0139. Photo by HEG 2018.



*Agave* (*Agave parryi*) does not grow naturally near the project area and research has shown that its existence is strongly indicative of prehistoric cultivation (Minnis and Plog 1976). In the Bagnal study area and ASNF more broadly, the sight of *Agave parryi* alerts crews to archaeological materials and its presence is highlighted on site records as it is considered inextricably linked to prehistoric habitation. In the Chevelon Archaeological Research Project (CARP) undertaken in the western part of ASNF, Minnis and Plog (1976) found that the distribution of agave is not only associated with but restricted to archaeological sites; 100% of *Agave parryi* occurrences identified in or immediately adjacent to a prehistoric site. The authors deny observer error because of its conspicuous nature (e.g. Figure 2.11); *Agave parryi* can be observed from a distance and is hard to miss on survey.



Figure 2.11. *Agave parryi* on site 07-0264. Photo by author.

The genus *Agave* is characterized by plants with large succulent leaves arranged in a rosette with a large inflorescent stalk that flowers rarely (Minnis and Plog 1976:303). *Agave parryi* is easily transported as clones from an established succulent can be removed and replanted. This species is hardy, being both fire resistant and able to withstand temperatures as low as -20°F (Schroeder 2010). The economic

utilization of agave is diverse and extensive. Cassetter and others (1938) summarized the ethnographic uses of agave, including its cultivation for fiber, food, alcoholic and non-alcoholic beverages, syrup, cordage, nets, bags, basketry, blankets, clothing, sandals, pottery rests, paint and hair brushes, war lances, needle and thread, armor, fire hearths, musical instruments, paint, a gum-like caulking material, soap, for smoking medicine, and ceremonial objects. North and others (2003) found that in ASNF, *Agave parryi* is more common to pithouse sites than any other type, pointing to the more sedentary agrarian activities associated with pithouses in the Rim region. In addition to agave, Plog (1981) noted saltbush as a plant that often grows in disturbed soil situations on archaeological sites in the Lakeside District.

Like the artifacts, prehistoric architecture of the Rim reflects an intensive occupation of the region during the Pueblo II and early Pueblo III periods. Approximately 70% of all documented sites on the forests date to this period and are associated with the archaeological cultures identified as Mogollon and Anasazi (Schroeder 2010). Impressive Puebloan sites with great kivas and roomblocks between thirty and forty rooms are not uncommon in ASNF and across the Rim. These important features are vulnerable to erosive forces in the unstable post-fire environment.

### *Subsistence and Settlement*

The forests on the Rim were used by native groups for foraging and farming; trade routes between Puebloan and Apachean groups would have passed over what is now ASNF (Plog 1981; Schroeder 2010). Elements of the natural environment are considered by some to be the determining factors of success in adaptive prehistoric subsistence strategies (Butzer 1982), and plentiful resources of the Rim encouraged prehistoric resource procurement and settlement. The region's hills and canyons create a mosaic of microenvironments with an accompanying diversity of plant and animal life (Herr 2013). Abundant natural resources first drew nomadic groups to the Rim who hunted deer, rabbits, squirrels, woodrats, and other small game. It is generally accepted that hunting and gathering were major aspects of Mogollon subsistence, although opinions vary about the extent to which these factored into the prehistoric diet

versus cultivated plants after the Formative era (Sullivan 1982). Throughout the first millennium CE the Rim was a frontier area that was the focus of in-migration from populations in the Cibola region to the east, after which groups engaged in horticulture (Schofer 2008).

Considerable topographic relief in the region provided a diversity in plant foods; evidence exists for the collection of black walnuts, manzanita berries, and acorns (Haury 1985). Faunal remains recovered from excavations at pueblo village sites in the area include mule deer, jack rabbit, cottontail, pocket gopher, fox, bear, sharp-shinned hawk, harlequin quail, turkey, band-tailed pigeon, mourning dove, and black-billed magpie (Haury 1985). According to the bone inventory from excavations at nearby Tla Kii ruin, deer, antelope, and rabbits were the chief suppliers of meat, while magpie and sharp-shinned hawk may have been prized for their feathers (Haury 1985). The material culture of the region also reflects adaptive strategies utilizing seasonal rounds of settlement shaped by game availability and harvest cycles of wild and domestic plants (Martin et al. 1962).

The variety and abundance of natural resources throughout the Rim region were sought after by different groups with myriad needs and preferences. Diverse qualities and features of the landscape have resulted in a considerable amount of archaeological diversity in ASNF. With the variable local relief of the study area come variations in physical features and topography, vegetation, and soils that would have factored into settlement choice. A 1990 survey of around 4,000 acres near the study area documented 59 new sites ranging from small limited activity loci to substantial habitation areas with up to 30 structures (Neily 1991). Of the total inventory, 34% represent habitation sites; 20% are interpreted to be field houses, 15% designated temporary encampments, and an additional 15% recorded as either encampments or possible habitation sites. The highest site density occurred on ridges at an elevation of around 6,600 ft AMSL (2,011 m) where terrain is characterized by broad, gently sloping ridges extending below steeper sandstone bedrock or cobble-covered ridges (Neily 1991). PR2 data from the present study supports this finding with 22% of sites located on benches, 22% on ridges, and an average elevation of 6,560 ft AMSL.

With data from previous research (e.g. Lightfoot 1978; Neily 1991), North and colleagues identify six environmental correlates of distribution for 279 prehistoric sites in the Rodeo-Chediski burn area. Correlates include elevation, topography, vegetation, soil, geologic setting, and distance to water, with the strongest correlations between elevation, terrain, vegetation, and proximity to water (North et al. 2003). Plog (1981) argues in his ASNF management plan that across the region, elevation is highly correlated with two variables that would have been crucial to prehistoric people: vegetation and rainfall (Plog 1981:38). Several studies (Sullivan 1982; Minnis and Plog 1976; Herr 2001; Neily 1991) analyzing site locations in ASNF repeatedly show a strong tendency for sites within 500 feet of a drainage.

Artifact scatters are most evenly distributed of all sites in ASNF (North et al. 2003; Schroeder 2010); their diverse locations may relate to the widespread distribution of plant and animal resources that were procured at these limited activity sites (Schofer 2008). In their summative study on Rim region archaeology, Martin and others (1962) found that regardless of period, prehistoric people preferred to occupy knolls and low ridges on the floor of the valley. The relatively confined distribution of pithouses and roomblocks to ridge and hilltop settings may relate to the need for level surfaces to construct features, a desire to overlook nearby fields, avoidance of cold air drainage pathways in the valley bottoms, or possibly defensive concerns (Jewett 1978; Herr 2013; North et al. 2003; Sullivan 1982). Smaller sites or scatters and their spatial configuration inform our understanding of mobility and the settlement and re-use of landscapes over time by Pueblo peoples (Schofer 2008).

A relatively high percentage of field house sites below 6,400 ft AMSL and the “overwhelming tendency” for roomblock sites to be located between 6,400 and 6,600 feet in elevation is attributed to preferences associated with horticulture (North et al. 2003). According to Ciolek-Torello (1981), the lower elevations preferred by these site inhabitants “almost certainly” correlates to the proximity of these sites to favorable farming areas that are less likely to experience late spring and early fall frosts. Though little is known about specific agricultural techniques employed by those who occupied the mountainous timber

country of the Mogollon Rim (Sullivan 1982), an abundance of evidence of prehistoric farming has been documented in ASNF. More than 70% of sites in the ASNF inventory date to periods characterized by the emergence of agriculture, the Pueblo I through Pueblo IV periods (Schroeder 2010).

The moisture-inducing properties of the Mogollon Rim-White Mountain orographic belt may be the sole reason indigenous groups could cultivate land on the Rim (Mills et al. 1999). Relatively abundant rainfall on the Rim allowed prehistoric farming at elevations over 6,000 feet AMSL, despite the area's shorter growing season, marginal soil productivity, and forested and dissected terrain (Sullivan 1982). The climate of the general Mogollon Rim region from the late B3 to P2 periods (300 – 1150 CE) provided ideal farming conditions for small groups whose subsistence included horticulture in addition to hunting and gathering (Martin et al. 1962). Groundwater reserves were probably greater at that time, and the many dry drainages that bisect the forest had year-round water flow (Sullivan 1982). Some have proposed that that prehistoric cultigen productivity on the Rim derived from the natural fire regime that once maintained healthy forests and open areas (Sullivan 1982; Herr 1999). Frequent low intensity fires were beneficial for prehistoric horticulturalists since combustion of organic debris on the forest floor accelerates the rate of organic decomposition, increasing soil fertility (Sullivan 1992). In this way, a marginal agricultural environment is transformed into a productive one by “exploiting the predictable successional pattern that develops in response to understory disturbance,” (Sullivan 1992:7). So, inhabitants of sites situated in what appears to be poor soil may reflect agricultural subsistence strategies that synched with the environment to maximize productivity (Mills et al. 1999).

Social needs would have also factored into settlement choice. Prehistoric land use patterns and settlement distribution correspond to natural factors like resource availability and also to aspects of the social environment like the needs of small groups within a dispersed community system, maintenance of networks of interaction, and establishing “tenure or prior rights” of access to specific resource areas or horticultural land (Neily 1991). Migrants living in small settlements formed communities around large

structures of ritual architecture such as great kivas (Herr 2001). Considered together, clustering of pueblo settlements might be expected if certain sites were occupied continually or re-occupied over several generations (Schroeder 2010; USFS 2002).

Findings from previous research related to prehistoric subsistence and settlement in the region inform expectations about initial (cultural) deposition of artifacts and the functions and locations of different site types. Since these sites were first formed, historic activities in the area and associated with utilization of forest resources – such as the arrival of the railroad, recreation, and commercial logging – have influenced the physical and depositional landscape of the Rim region.

### *Conclusion*

Archaeological data from the many excavations and surveys on the Mogollon Rim since the early 20<sup>th</sup> century reveal an intensive and enduring prehistoric habitation of the region. Smaller nomadic tribes of the Archaic period were replaced by more sedentary groups with the introduction of agriculture in the Basketmaker and Pueblo periods. Villages replaced camps, basketry gave way to pottery, and groups adopted more complex social, ritualistic, and economic systems (Herr 2010; North et al. 2003). Sites ASNF reflect this intensive Puebloan occupation with numerous village and habitation sites containing masonry architecture, and rich associated assemblage of lithics and decorated ceramics. Situated on a prominent place on the landscape on the edge of the Rim, sites in the Bagnal study area contain important evidence of the Puebloan and earlier occupations of and interactions within the region. In the severely burned and fire-prone region beyond the study area, thousands of important prehistoric sites are increasingly threatened and impacted by the transformative effects of high severity forest fire.

## CHAPTER 3: WILDFIRE AND ARCHAEOLOGY

This chapter reviews legislation and concepts related to the practice of cultural resource management (CRM) and data collection. Fire behavior in Southwestern ponderosa forests and elements contributing to its severity are discussed, followed by a review of research related to indirect and direct effects of wildfire on archaeological sites and reconnaissance abilities. Most of the archaeological data produced during projects requiring Section 106 clearance in the West rely on the existence of and ability to identify cultural materials on the ground. These resources become the known archaeological record, which may or may not accurately reflect the nature of the original deposit or occupation. In order to interpret site data or prescribe appropriate and effective preservation treatments, archaeologists must understand the mechanisms and processes that impact cultural deposits and the way they present on the surface (Schiffer 1983; Wandersnider and Camilli 1992; Waters and Kuehn 1996). The impacts of wildfire on surface sites vary widely depending on a variety of factors inherent to the deposit, qualities of the local environment, and fire behavior.

### *CRM Archaeology and Data Collection*

To contextualize data used in this study, aspects of data collection in CRM are reviewed with a focus on pedestrian survey. Cultural resource management (CRM) generally describes the activities aimed at documenting and understanding cultural resources and preserving sites and artifacts (King 2013; Ryan et al. 2012). CRM work accounts for most of the archaeology conducted in the United States today and is most often driven by legally mandated environmental reviews on federal lands. Federal land management agencies have legal requirements to protect significant cultural resources during fuels treatments, restoration activities, wildfire suppression, and post-fire rehabilitation (Ryan et al. 2012). This study hopes to inform long-term planning for mitigation of wildfire effects on surface prehistoric sites. Data produced from surveys has garnered increasing interest from researchers and academics since the mid-20<sup>th</sup> century;

some even argue that the relative importance of survey and excavation data is nearly equal (Alcock and Cherry 2004; Plog et al. 1978). While excavation provides data from a single site, survey data provides information about spatial distribution of occupations across a landscape. As compared to excavation data, survey data is logistically and economically easier, capable of providing regional perspectives, and archaeological deposits are not destroyed as a result of data collection (Lipe 1974; Wandersnider and Camilli 1992).

In 1966 Congress passed the National Historic Preservation Act (NHPA) which for the first time defined specifically the types and forms of cultural resources and outlined the criteria by which their significance is measured (King 2013; NPS 1998). The NHPA today, as amended, and its implementing regulations, require that federal agencies consider the effects of undertakings on cultural resources, especially those listed on or eligible for inclusion on the National Register of Historic Places (NRHP). Authorized in Section 101 of the NHPA, the NRHP identifies a variety of cultural resources deemed significant under certain criteria and provides for long-term protection of those resources (NPS 1983; Ryan et al. 2012). Section 106 of the NHPA, responsible for most of the archaeological work done in the U.S. today, requires that before activities or undertakings take place on federal lands a thorough review of potentially impacted archaeological sites is conducted (King 2000). Findings are submitted in a report that provides archaeological information for planning purposes, primarily aimed at avoidance (Schiffer 1983).

The management of cultural resources on federal lands usually begins with an inventory of historic and prehistoric sites and isolates, generated by pedestrian survey (Hanson 2001). Archaeological survey refers to an examination of all or part of an area in sufficient enough detail to generalize about the types and distributions of historic and prehistoric properties that are and may be present (NPS 1983). Inventories produced during these surveys are increasingly the primary source of new archaeological data and the main venue of archaeological fieldwork (King 2000; Schachner 2015). Archaeological surveys identify and record the distribution of material traces of past human presence across a landscape,



producing inventories that provide the empirical foundation for interpreting prehistoric landscapes and settlement patterns (Feinman 2015; Schiffer et al. 1978). Site data contained in these inventories are used to inform determinations of significance, management and treatment plans, monitoring schedules, and preservation strategies. Relative to pedestrian survey, excavation on federal lands in the southwest is rare, and often the visible surface expression becomes the knowable extent of archaeological data in an area (Rockman 2015).

As a discipline, archaeology routinely deals with enormous amounts of data related to activity loci, sites, regions, environments, and the relationships between them (Wheatley and Gillings 2002). The expected submission of information to state archaeological record files has [theoretically] ensured a minimal level of standardized recording practices (Schachner 2015). There are important differences in terminology, cultural designations, and methods employed in reconnaissance projects conducted in 1975, 1992, and 2018, for example. Standard, directly comparable methods of survey are lacking in American archaeology (Sundstrom 1993). Data collection techniques and survey strategies vary by state, county, and even by project. Survey intensity depends on funding, instructions from project directors, agency needs, survey area size, terrain, vegetation, and a variety of other factors. Decisions made in survey planning and in the field – transect spacing and sampling strategies, for example – can result in different survey results (Plog et al. 1978). Controlling for these variables is a notorious challenge in producing syntheses.

CRM addresses a variety of archaeological site types in the widest possible array of settings because of legal mandates and agency requirements for inventory, assessment, data recovery, or preservation of significant resources (Ryan et al. 2012). Archaeologists surveying in the western U.S. need to routinely evaluate methods for acquiring information about the nature, distribution, and interpretive potential of a vast range cultural materials and phenomena (Sullivan et al. 2007). Surveyors must be versed in a variety of cultures, material types, environments, site types, and artifact forms spanning from

fifty to over 10,000 years old. This is no easy task, and we are not capable of getting it right all the time. Many interpretations are based on what we are currently observing on a site – conditions that may or may not be drastically different from the prehistoric context of a site. In addition to identifying and recording cultural resources, CRM archaeologists also must anticipate threats and document impacts on sites, plan and navigate with topographic maps, GIS, GPS, and compasses, devise management and treatment recommendations, accurately record and map artifacts and sites, test and excavate those sites, accession and catalogue collections, process and interpret data, and prepare reports in support of the State Historic Preservation Office (SHPO) and NRHP. Other peripheral and cooperative projects involving CRM include regional syntheses, research projects based on archaeological material types, cultural periods, or other themes of interest, planning and mitigation of resource damage, and stewardship of archaeological sites in the context of land management (Ryan et al. 2012; ). Effective CRM archaeologists have a holistic understanding of the geological, biological, and environmental contexts that shape the material record to identify threats and disturbances to sites, produce complete inventories, and recommend appropriate treatments. Field archaeologists in the Southwest will increasingly find themselves working in burned areas and ideally will be able to recognize the short and long-term impacts of wildfire that have operated on a site or group of sites.

#### *Archaeological Site Condition Assessments*

The description and study of artifacts per se are not the sole purposes of CRM archaeology today. In the context of modern archaeological resource conservation and management, the integrity of the site, its potential for answering significant research questions, and its susceptibility to damage as the direct or indirect result of human activity are central data collection points that are crucial for decision-making (Wildesen 1982). Site integrity, the degree to which cultural remains retain authenticity of physical characteristics that existed during prehistory, is a critical data point in cultural resource management (Ryan et al. 2012). An important aspect of CRM on federal lands are site condition assessments, or SCAs.

Also called site monitoring (e.g. NPS 1983), in the West these assessments typically entail a thorough review of previous records and a visit to the site to identify changes visible in the surface expression. SCAs are vital because they are designed to identify, track, and mitigate impacts to sites in the short and long terms. Typical impacts documented on sites in ASNF include grazing, road construction and maintenance, bioturbation, visitation and recreation, and wildfire and suppression efforts. A well-planned SCA schedule is critical for effective and cohesive management of archaeological resources on federal lands. Monitoring frequency is assigned according to site significance, visitation, accessibility, existing or anticipated threats, and the nature of the resource. For some agencies like the Intermountain Region of the National Park Service, these site monitoring schedules are a gage for department managers and region heads to evaluate the amount of work field technicians and managers undertake each year.

It is important to identify the practical distinction between an “impact” and “effect” because the terms are important for Section 106-related projects. The 2011 Environmental Impact Assessment (EIA) for the Rodeo-Chediski Prescribed Burn Project defines impacts generally as, “anything that results in the removal of, displacement of, or damage to artifacts, features, and/or stratigraphic deposits of cultural material,” (ASNF 2011:175). An effect, on the other hand, is a professional judgment about a measurable change in a characteristic of an archaeological site that relates to significance (Schroeder 2010; Wildesen 1982). Impacts and effects can be direct and indirect. Direct impacts or effects are those which result from the practice or event, such as bulldozer lines, fire-scorched materials, or mechanized tree felling. According to the Arizona Cultural Resources Handbook (2016) indirect and long-term impacts or effects are more difficult to foresee and include impacts to “settings, feelings, and associations” of cultural resources, off-site impacts from peripheral or temporary project activities like vehicle traffic or staging areas, and future actions or processes that are imminently threatening or currently operating on cultural resources (Ryan et al. 2012). Impacts on sites are determined by physical observation, measurement, and

description, while effects on values are determined by reference to a philosophical, methodological, or regulatory standard (Wildesen 1982).

In the context of the present study site condition assessments provide a road map to track and evaluate long-term impacts to sites in burned areas. Designed to identify adverse impacts or threats to surface sites, SCAs or site monitoring forms provide information that is vital for the production of appropriate and effective long-term preservation strategies. Prehistoric sites that have been burned in high severity wildfires will especially benefit from SCAs because of the erosive energy of exposed landscapes. SCAs speak to the impacts and effects of various mechanisms and processes on archaeological sites; lacking protective vegetation and exposed to intensified geomorphological processes, a geological orientation is necessary to best understand the mechanisms and processes at work in burned landscapes.

### *Geoarchaeology*

To best understand the archaeological record, it is necessary to understand both the human activities and natural processes that contribute to it (Rapp and Hill 2006). Because the processes that affect archaeological materials and sediments are the same, and the archaeological record in any area is in large part controlled by geological processes, geomorphological principles regarding sediments in various depositional systems may be used to model potential site formation processes (Lyman 1994; Waters and Kuehn 1996). Section 106 undertakings require archaeologists to determine treatment plans for adverse impacts to cultural resources, including alteration, destruction, removal, or relocation of any artifacts, features, or structures, and to address active and foreseeable changes in drainage, sedimentation, and erosion patterns (Schroeder 2010; USFS 2002). An inherently interdisciplinary endeavor, geoarchaeology includes areas of research that bridge the interface between archaeology and earth sciences like sedimentology, stratigraphy, geomorphology, pedology, geochemistry, geophysics, and geochronology (Nicholson et al. 2007).

Most archaeological data produced during undertakings requiring Section 106 clearance in the West rely on the ability to identify cultural materials on the ground surface (McManamon 1984). Cultural deposits are subject to a variety of post-depositional disturbances that alter the content and character of the surface expression and by extension, cultural interpretations based on it (Schiffer 1983). A key factor that has been historically underappreciated in the discipline is the changing landscape – that is, that landscapes are not static and rather dynamic and constantly changing (Waters and Kuehn 1996). How do geological processes affect site preservation and bias our perception about prehistoric occupations? In a study of prehistoric sites in the North Dakota Badlands, Waters and Kuehn (1996) show that the histories of erosion and deposition temporally and spatially segregated the archaeological record, leading to false conclusions about human utilization of the landscape. Soils are not static but dynamic, open systems, that move other soils and objects, including artifacts; it therefore must be included as one of the major natural features we must contend with to interpret the archaeological record (Wood and Johnson 1978).

The degree to which geological processes affect an archaeological sample vary from site to site. Changing landscape geomorphology has alter the temporal and spatial qualities of prehistoric cultural deposits (Schiffer 1983; Waters and Kuehn 1996). The geomorphological qualities of an area determine whether, for example, a site will be visible on the surface or buried, *in situ*, or redeposited, damaged, or destroyed. Depositional and erosional processes that shape landforms and larger areas also operate on surface and subsurface archaeological materials. Erosion and deposition have major impacts on our understanding of the regional record in most areas; for example, small and ephemeral loci or sites in depositionally active areas are more likely to be obscured than larger and more permanent loci (Plog 1981). If we fail to record the context, or if we misread or misinterpret that context, proper archaeological interpretation is impossible (Wood and Johnson 1978).

### *Factors in Site Discovery*

*It is not what you find, but what you find out.*

David Hurst Thomas (2018)

Field data from survey projects relies on site discovery, which is tempered by the detectability of cultural materials, so research that uses survey data must address factors affecting site discovery (McManamon 1984). The archaeological record is a product of both behavioral and natural environmental processes, that results in the deposition of artifacts in a complex and interactive setting characterized by the physical, biological, and cultural qualities of that location (Nicholson et al. 2007; Schiffer et al. 1978). While human activity is the essential contributor of cultural materials to the record, noncultural site formation processes operating after deposition alter the arrangement and inventory of artifacts observable on the surface (Baker 1978). Context in archaeology implies a four-dimensional spatial-temporal matrix composed of the cultural and natural environment around a site or constellation of sites (Butzer 1982). Because an artifact's spatial context is often as important as the artifact itself, it is important to understand the ways site formation processes influence the context of archaeological materials observed in the field (Plog et al. 1978; Schiffer 1983; Wildesen 1982).

The focus of the present study is on surficial deposits – i.e. the last 3,000 years in many cases – and not those deeply buried. For the purposes of this study, “surface” refers to exposed mineral soil, the uppermost stratum at which evidence of human activity can be detected (Ryan et al. 2012). The detectability of artifacts and features on the surface is conditioned by a variety of factors inherent to the deposit and attributable to external conditions of the environment (Wildesen 1982). Field archaeologists conducting surveys in the Southwest know well that the identification of cultural materials varies as a function of survey time and effort, ground visibility, terrain and weather, artifact size and clustering, and a variety of other factors (Banning et al. 2006; Plog et al. 1978; Schiffer 1983). Factors influencing surficial site discovery include inherent qualities of artifacts and deposits, external environmental variables like

groundcover that affect visibility, and post-depositional processes that impact site morphology, integrity, and identification.

Qualities inherent to cultural materials, such as their size, color, and shape, also influence detectability. Wandersnider and Camilli (1992) found that some artifact classes are more susceptible to discovery by virtue of their size and contrast of coloration to surrounding sediments. Banning and others (2006) note that an important aspect of detectability is the contrast between materials and background substrate. The relative size of an artifact factors into discoverability, since larger artifacts are typically more prone to discovery (Baker 1978). The spatial distribution, patterns, and relationships of surface materials within a site also affect whether and how a surface assemblage is recorded. Artifact clustering has been used to refer to the abundance of materials observable in a confined area (McManamon 1984; Schiffer 1983). Because of its associations and clustering, a lithic concentration is more detectable than a lone flake. Artifact obtrusiveness refers to the discoverability of cultural materials in each environment (Schiffer et al. 1978). Assemblages in the study area for example are large and relatively obtrusive in comparison to less intensively occupied desert areas. Another example is in the increasing obtrusiveness of archaeological remains as developments in food production led to sedentism, which resulted in an increase in archaeological features across the Southwest (Herr 2001; Upham 1988).

Beyond the nature of the deposit itself, external variables influence the detectability of cultural materials. Visibility, a characteristic of the modern environment in which the site is located, refers to the extent to which a site has been buried or covered by soil aggradation and vegetation since its occupation (McManamon 1984). Surface visibility determines whether artifacts can be identified by visual inspection (Wandersnider and Camilli 1992). A focus of previous research related to detectability is on the obscuring effects of vegetation cover (Banning et al. 2006). A surface site in a dense conifer forest, for example, is less visible or detectible than a surface site in the Chihuahuan Desert. Landform type and burial processes (e.g. slopes, mesa tops; alluvial, aeolian) play major roles in the visibility of remains of previous

occupations (Waters and Kuehn 1996). Dynamic geomorphic processes that operate on surface assemblages are highly variable and hyper-local, shaped by weather events, slope and aspect of the landform, sediment exposure, soil types, and bedrock formations. These variables differentially affect the spatial orientation, visibility, and integrity of prehistoric surface materials.

Additional factors that influence site discovery relate to the strategies used and degree of effort put into pedestrian survey. The ability to identify artifacts on the surface is conditioned by a given survey technique (Schiffer et al. 1978) and degree of effort, or intensity (Banning et al. 2006). Survey intensity relates to the degree of surface inspection and most often refers to transect spacing. For example, a small lithic scatter is more obtrusive or detectable when transects are 15 meters apart versus 30. Search time also factors into identification rates; slower field walking is expected to result in more complete inventories than a faster-paced survey (Banning et al. 2006; Plog et al. 1978). Time and weather conditions also influence site discovery on pedestrian surveys. The time of year a survey is conducted influences the extent and nature of surface-obscuring vegetation; for example, wet conditions following snow melt can hide artifacts or prevent coverage of muddy areas. Time of day factors into detectability since variable lighting conditions and shadows can deter or encourage identification of surface materials. Likewise, weather-related elements like cloud cover and rainfall can produce conditions that favor or thwart site discovery. Disasters like mudslides, floods, and wildfire clearly impact a site's susceptibility to discovery or destruction. The hyper-local nature of weather makes it difficult to account for these nuances.

Variables influencing site discovery must be addressed when using survey data. Factors contributing to the discovery of archaeological materials include qualities inherent to the deposit (e.g. size, density, color, or obtrusiveness), characteristics of the surrounding environment (e.g. vegetation cover, slope, or sedimentation rates), and aspects of the reconnaissance project (e.g. crew experience, time of year, transect spacing, or survey intensity). Experience level and preferences of the individual surveyor or crew can encourage or preclude site identification; some shovel bums avoid 25% slopes while



others charge up a 60% talus slope to access a knoll. Time of day and temperature can influence mood, willingness, and abilities to cover ground effectively. These and many other variables must be considered when evaluating the reliability of archaeological data, but cannot be controlled. Ideally, crews would survey in arms' length transects and encounter perfectly *in situ* assemblages that reflect clear prehistoric behaviors, but this is far from reality.

### *Provenience*

Most archaeological data are spatial in nature or have an important spatial component (Wheatley and Gillings 2002). Artifacts, features, and sites, whether large habitation complexes, ephemeral campsites, isolated occurrences, or excavated materials, reflect a series of spatial relationships relative to other prehistoric materials, sites, and elements of the natural environment. Interpretive ability of archaeologists relies to varying degrees on the spatial patterns and relationships of *in situ* cultural deposits; integrity and data potential are inextricably connected to spatial reliability – that is, that a site or deposit has remained more or less in place since initial deposition (Wildesen 1982). The concepts of provenience and context are central to the discipline regardless of the paradigm, approach, or explanatory theory (Lyman 2012). These concepts are imperative for a comprehensive understanding of prehistoric activities evidenced at certain locations in relation to elements of the natural world. Cultural inferences are often made based on spatial qualities of archaeological materials, such as the inference that a field house was situated next to an arable floodplain, a defensive site was situated strategically on a hilltop, or a rockshelter was occupied seasonally according to available plants or game.

The resolution of provenience can vary from coarse to fine depending on, for example, research objectives, available data, and project area. Coarse resolution could refer to a region, such as the American Southwest, or a physiographic area such as the Mogollon Rim or Edwards Plateau. Mid-level resolution may refer to an artifact's location from a site, such as its source from Lindenmeier or Bonfire Shelter. At the fine end of the resolution spectrum provenience refers to an artifact's precise location within, for

example, a roomblock feature or a stratum from an excavation (Lyman 2012). The scale of provenience resolution varies beyond the examples provided, and different perspectives of provenience provide information pertinent to different research questions.

Context describes the artifact, feature, or site in relation to something else, and in some cases provides the primary evidence for the use and meaning of an artifact, (Meighan 1966; Plog et al. 1978). The spatial context and relationships characterizing sites and artifacts are necessary for interpreting human history through material remains. A narrative of a site's environmental context should include, for example, descriptions of its nearest water source, vegetation community, prominent features of the landscape, proximity to other sites or known resource extraction locales, and its elevation and aspect. Context can also refer to the position of an artifact or feature within a site, relative to other physical elements of the site and landscape. Each of these data points augment our understanding of prehistoric occupations and land use and can produce important data about site function, subsistence, and human behavior. Impacts that disturb the context and provenience within and between prehistoric sites threaten to diminish the quality and quantity of data that surface sites produce.

### *Fuels and Fire Behavior*

Wildland fire behavior is highly variable, dependent on factors like vegetation type and moisture content, slope, aspect, humidity, and wind speed (Moore et al. 2004; Rockman 2015; Ryan et al. 2012). The behavior of these regimes is important for this study because there are major differences in the effects of, for example, a creeping surface burn and crown-consuming fire. Though frequent low-intensity fires are critical for the maintenance of healthy Western ponderosa forests, human-induced changes to the climate and forest structure primed conditions for today's high-severity wildfires, which continue to surpass in size and severity all in recorded history (Guyette et al. 2002; Westerling et al. 2014). The following reviews elements of fire and fuels that contribute to fire behavior, severity, and resulting effects.

Fuels are defined by their size, whether they are living or dead, their availability for burning, and chemical properties (Ffolliott et al. 2011; Fulé et al. 1997). Ground fuel includes organic matter just below loose surface litter that includes pine duff, dead and decomposing trunks and stumps, and root systems (Ryan et al. 2012). A lack of aeration causes ground fires to burn these densely compacted organic soil horizons by smoldering burns that last from hours to weeks (Neely 2012). Overstory or canopy refers to trees that are mature, and understory refers to communities of non-tree plants like shrubs, bushes, thicket, grasses, annuals, and forbs (Strom 2005). In this study, new growth refers to young trees or saplings present in the study area, typically young stands of Gambel oak, Ponderosa pine, and Alligator juniper. The elements that form the fuel ladder in forested environments differentially contribute to the behavior of wild and prescribed fires in these environments. Figure 3.1 illustrates the basic fuel elements that influence forest fire behavior.

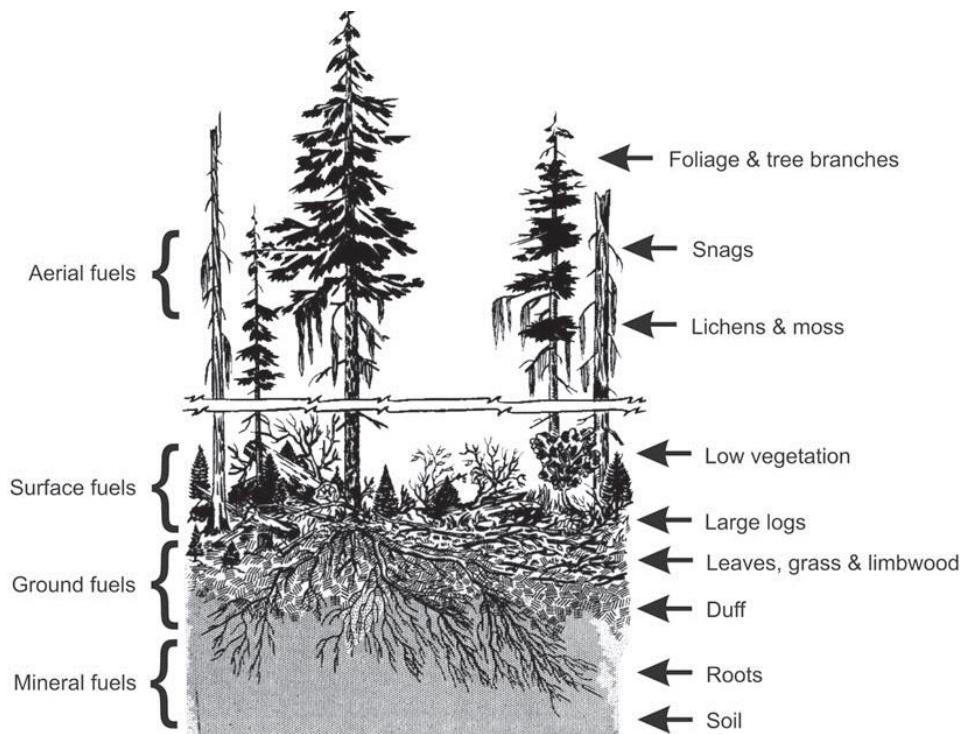


Figure 3.1. Fuel elements by stratum. From Sandburg et al. 2001.

Broader weather patterns are also important in considering fuels, both in the short-term (hours to days) and long-term (years to decades), as moisture content in these fuel load can dictate combustibility

thus fire behavior (Floyd et al. 2002). The weather – specifically temperature, relative humidity, wind, and drought – defines the fraction of the total fuel that is available to be consumed by a given fire (Guyette et al. 2002; Ryan et al. 2012). The intensity of a surface fire depends on the mass and type of total fuel and prevailing moisture, wind, and slope conditions on site (i.e. the fire environment; Noss et al. 2006). The depth at which a fire burns depends on the ground and surface loads of fuels, or fuel complex. For example, a site situated beneath a thick layer of pine duff may be heated to the point of destruction during a high-intensity fire (Strom 2005). Poor historic forest management of ASNF and the greater Mogollon region resulted in the buildup of fuels to support near-surface burning of fallen trees, leaf litter, and pine duff; these smaller combustibles fueled the progression of Rodeo-Chediski into a relentless crown-consuming force. The Bagnol parcel was burned over entirely by moderate and high intensity fire, the effects of which vary widely and have implications for site identification and preservation.

Ponderosa pine is a fire-adapted species with bark up to four inches thick to protect living tissue beneath and long needles to help protect growing branch tips from the heat of flames (Moore et al. 2004). As ponderosas grow, they self-prune smaller branches near its base to increase its resilience to surface fires by removing fuels that could transfer the fire to the crown of the tree. Root systems are buried deep underground to offer protection during recurring fires. Evolved to flourish with these frequent low-intensity fires, even stands of the oldest and largest trees are vulnerable to destruction by the high-severity stand-replacing fires that characterize our unhealthy ponderosa forests today. The following section examines the consequential differences in effects of low- versus high- severity fires in ponderosa pine forests.

### *Burn Severity*

As a physical-chemical process, fire is a continuum resulting primarily from the interactions of weather, slope, topography, soils, and vegetation (Gottfried et al. 2003). Burn severity refers to the nature and extent of impacts resulting from the combination of fire intensity and duration (Noss et al. 2006;

Strom 2005). Manifested differently according to highly localized conditions, fire severity is classified as low, moderate, or high according to the amount of organic material consumed within an area. These classifications have important implications for future management of fire-impacted lands as burn severity directly influences ecological consequences, mitigation strategies, and ability or duration of recovery. The qualities of severity classes differ per agency and location; the following reviews those generally applied in Southwestern ponderosa forest settings. Understanding how fire severity influences the short- and long-term effects of wildfire and knowing expected recovery stages will help resource managers decide how to best use their time and funding in mitigation and restoration efforts.

Low severity fire in Southwestern ponderosa forests results in light charring of the ground surface and scorched or consumed litter, and dry, low-lying vegetation (Gottfried et al. 2003). Pine duff is left largely intact and there are no changes to the mineral soil. Low severity effects were not identified anywhere in the area burned by Rodeo-Chediski due to the massive buildup of dry flammable fuels and weather conditions that encouraged the extreme behavior of the 2002 fire. Low severity fire is critical to the maintenance of healthy ponderosa pine forest systems.

Moderate severity fire effects in ponderosa forests include deep charring of pine duff, consumption of woody debris and grasses, and the presence of a light-colored ash (Gottfried et al. 2003). The understory may be consumed but there are no visible changes to underlying mineral soil (NPS 1998). Sites in the study area that contain evidence of moderate burns are often characterized by poor surface visibility from remaining duff produced by few surviving mature ponderosas (Figure 3.2).



Figure 3.2. Evidence of moderate severity burning in surviving ponderosas and pine duff at site 07-0178 (datum flagged).

High severity (or crown-consuming, stand-replacing) fire in western ponderosa forests results in the loss of most vegetation and woody debris, deep soil charring and oxidization, and the consumption of pine duff, leaving fine white ash (Gottfried et al. 2003; Neely 2012; Noss et al. 2006). The magnitude of these increasingly common disasters derives from historic suppression, logging, and grazing that piled on fuel loads as tree density increased exponentially – some estimates say stand density in these forests has increased by over 400% since the start of the 20<sup>th</sup> century (Fulé et al. 1997; Moore et al. 2004). Burn scars from high-intensity fires are barren and clearly distinguishable from lower severity burn areas. The Rodeo-Chediski BAER report distinguishes high severity effects as areas without any remaining needles from moderate severity effects which leave behind some brown needles (USFS 2002). Trees are unlikely to survive high severity burns so affected areas often sustain permanent fire-induced changes in ecosystem composition (Ffolliott et al. 2011). Without a canopy of layer or duff blocking the sun, grasses, oak saplings, and shrubs like manzanita flourish. Mineral soil, along with artifacts, are exposed throughout much of these areas, improving ground visibility from pre-fire environments (Figure 3.3; Guyette et al. 2002).



Figure 3.3. Evidence of high severity burn impacts on site 07-0173 by the completely open canopy and lack of duff.

Burn severity is driven by array of variables, including: fuel load, slope steepness, climatic conditions, weather conditions before and during the fire, plant “vigor” before the fire, pre-fire treatments, soil type and cover, time of year, and burn duration (Bowman et al. 2011; Gottfried et al. 2003; Moore 2004; Neely 2012; White 2008). The magnitude and extent of impacts sustained by a burned site, then, vary in the long term according to local conditions like weather, aspect, moisture content, soil type and depth, and plant community. The severity of the burn also dictates the degree of direct effects to cultural materials – those caused by suppression efforts and from the fire itself.

#### *Direct Effects*

Wildfires are by definition unplanned events. Suppression of today’s high-severity forest fires requires rapid and effective response to slow spread, contain spot fires, and remove fuels from the path of the fire. Direct effects to cultural resources are those that occur while the fire is “hot,” and include

those caused by the physical-chemical processes associated with combustion, as well as operational effects from suppression activities.

Catastrophic wildfire suppression is complicated and dangerous and carries with it a high potential for ground disturbance. Mineral soil must be exposed to prevent the fire from spreading across organic fuels. Fuel break construction, equipment staging areas, skid trails, and dozer push piles are common in the study area and in ASNF more broadly. Crews in 2018 identified suppression impacts on every site in the Bagnal study area, most often documenting mechanized tree felling and dozer push piles. Fuels reduction is critical in wildfire response but clearing organic materials from the soil surface can expose and displace cultural materials, exacerbating issues with site preservation. Sites in the WUI are especially threatened as the protection of life and property supersedes that of cultural and natural resources, and suppression efforts may become more destructive (e.g. Figure 3.4).



Figure 3.4. Contractors from LPS Excavating drive a bulldozer along a fire line to prevent Rodeo-Chediski from spreading into an adjacent residential subdivision. Photo by A. E. Araiza, Arizona Daily Star.

Operational effects associated with suppression activities can rapidly and substantially damage prehistoric surface and near-surface sites. Suppression activities include conducting prescribed burns or



firefighting, establishing staging areas, digging fire lines, constructing fuel breaks, excavating handlines, widening trails or roads to act as fire roads, chaining and pushing, and dousing flames with fire retardant or water (Ryan et al. 2012; Schultz 2010). Ground disturbance caused from heavy machinery is often unavoidable and widespread. In a study on the impacts of firebreak construction on sites burned in a Montana wildfire, Wettstaed (1993) documented extensive damage to the surface and subsurface components of all twelve sites evaluated. Trails bladed with skid steers and bulldozers were thirty meters wide and up to a meter deep, resulting in the transfer of features and artifacts in affected sites.

In a study on the impacts of brush removal by mechanized crushing in nearby Prescott, Arizona, Wood (1978) found artifact dislocation to be far more destructive than artifact damage. By tracing to movement of planted artifacts after brush removal, Wood shows that abundant cultural materials can quickly and easily be pushed subsurface, highlighting the serious implications such land manipulation has for the recognition, description, and evaluation of sites based on surface expressions. Fire suppression and containment often entails removing all organic material (or fuel) to get to the mineral soil – an inherently ground disturbing activity. Most operational effects observed in the Bagnal study area relate to bulldozer use evident in push piles and smaller bladed trails.

Chaining impacts are ubiquitous in ASNF; it is done by dragging a long section of anchor chain between two tractors to uproot burned trees and encourage new vegetation (Mead et al. 2019). Massive depressions, skid trails, and soil movement caused by chaining can alter and destroy sites on and just below the ground surface. In 1975, DeBloois and others evaluated the results of pinyon-juniper chaining at a site in eastern Utah by placing brightly painted artifacts in test squares around the project area for re-identification. When chaining was complete only 53% of the artifacts were relocated, and two-thirds of the items had been disturbed in some way. Results reveal that density and distribution of trees are important factors in determining the extent of impact to an assemblage.

Operational effects can be mitigated with proper planning and communication. Sites can be flagged for avoidance and cultural resource (CR) specialists should work on the ground with crews to lessen ground disturbance in culturally sensitive areas. In the first major post-fire investigation of effects on cultural resources, Traylor and others (1990) examined 99 sites in an area impacted by the 1977 La Mesa Fire in Bandelier National Monument. Results show that damage caused by fire suppression and rehabilitation occurred at nearly 50% of sites and of these, bulldozer impacts were the most severe. Because of poor communication and suppression conducted without consultation, bulldozers leveled eight sites and caused significant architectural damage to seven (Traylor et al. 1990).

The direct effects on cultural materials of combustion by the fire itself varies by burn severity, duration, and material type. For example, a lithic quarry will fare better than a historic cabin in a major wildfire, and a low-severity fire is expected to have less severe direct effects on sites from any period than a high severity wildfire. The following reviews research associated with direct effects of fire on different prehistoric material types in order to inform expectations about the ways fire can damage, obscure, and destroy contents of prehistoric surface sites. Artifact types and materials discussed here include those documented in the Bagnal parcel. Figure 3.5 summarizes the temperature ranges and associated effects of fire on different cultural material types.

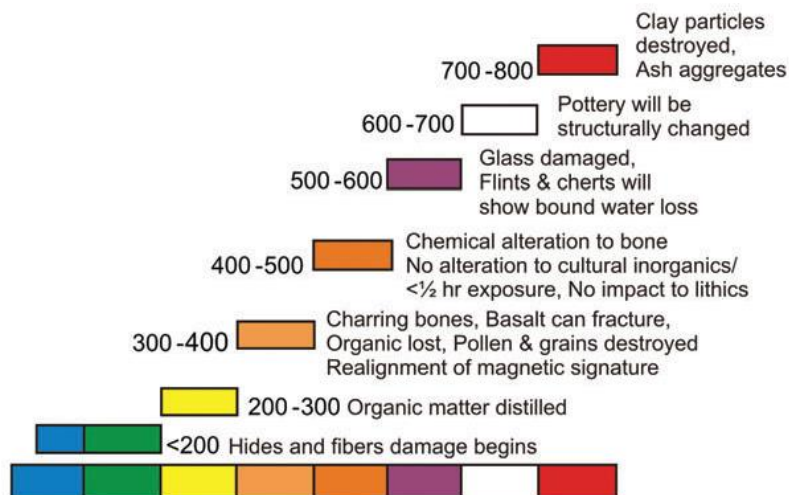


Figure 3.5. Temperature ranges (°F) of expected fire effects on cultural materials. From Ryan et al. 2012.

Lithic artifacts are abundant in the study area due to widespread prehistoric availability of quarry sources and the durable nature of stone (Martin et al. 1962). Despite this resilience, fire can impact the physical and chemical qualities of lithic artifacts, producing effects like crazing (fine, non-linear cracks), exfoliation, cracking, and color changes (Ryan et al. 2012:210). Fire can also impede or prevent obsidian dating with XRF and hydration methods (Anderson and Origer 1997). Chert, the dominant lithic raw material type in the study area, and other cryptocrystalline silicates were often heated deliberately by prehistoric people to improve flaking ability and consistency (Andrefsky 2005). Though this initial controlled treatment improved the stone for toolmaking, studies have shown that a second round of heating can shatter or break lithic artifacts (Seabloom et al. 1991).

Prehistoric ceramic fragments make up the lion share of diagnostic artifacts in ASNF (Schroeder 2010). Damage to prehistoric ceramics from wildfire include physical degradations such as spalling and crumbling, and changes to surface wear, slip, or design (Ryan et al. 2012) which can inhibit accurate pottery typing. Factors influencing the integrity of a ceramic artifact include its method of production (i.e. coiled, corrugated, etc.), fire severity, duration, and the depositional environment of the artifact (Ryan et al. 2012).

Groundstone artifacts include manos, mortars, pestles, handstones, shaft straighteners, and milling slicks (Adams 2003). The overall effects to this artifact class depends on fire intensity and may include blackening (or sooting), oxidation, or loss of structural integrity (Schultz 2010). Visible impacts to groundstone artifacts include spalling, exfoliation, cracking, and smoke-blackening, which could result in artifact misidentification (i.e. mano mistaken for fire-cracked rock) or preclude identification altogether.

The existence of daub in the study area implies prehistoric habitation since it indicates the presence of a superstructure that once stood above a masonry foundation (Schroeder 2010). Daub concentrations documented by crews in 2018 were often found in association with dense artifact scatters or middens, suggesting that the site was used as a habitation site or at least repeatedly occupied for a

particular purpose. Since daub contains organic materials it is susceptible to burning, cracking, sooting, and destruction (Ryan et al. 2012). Bone artifacts in archaeological deposits include animal or food remains, tools, and human remains. Burned bone artifacts may sustain blackening and charring when exposed to wildfires, though studies (e.g. Seabloom et al. 1991) have shown that the degree of alteration is less than what is found in culturally modified bone. So, bone burned in a hearth is expected to show more alteration than one burned over in a wildfire. Fire and heat can induce changes to the bone called diagenesis which can alter the physical appearance and chemical structure of bone and such changes can speed up decomposition rates (Lyman 1994).

Direct effects essentially describe those which occur while the fire is burning and are extremely difficult to mitigate. It is important to document the nature and extent of these effects immediately after a fire because the scars on the landscape can remain and expand over time. From 2017 to 2019 crews identified dozens of tracks, skid trails, and dozer push piles on sites. Understanding the processes associated with the direct effects of fire and suppression on archaeological materials can inform expectations and appropriate treatment strategies geared towards mitigating the most concerning long-term, indirect effects of wildfire on cultural resources.

### *Indirect Effects*

Indirect effects constitute the most complex suite of threats faced by resource managers in burned areas. The most concerning is the intensification of geomorphic processes that occurs in burned environments that lack stabilizing and protective vegetation (Ffolliott et al. 2011). High severity wildfires destroy all protective groundcover, rendering landscapes susceptible to increased erosion, downcutting, sedimentation, and slope wash (Fulé et al. 1997; North et al. 2003; Schroeder 2010). These fires also oxidize soils, rendering large areas barren for years following a fire (Noss et al. 2006; Strom 2005).

Indirect wildfire effects, like those observed to Bagnal sites in 2018, can change the context in which a cultural resource is found and expose archaeological materials to altered site formation

processes. Intensified soil erosion can displace and destroy features and surface assemblages. According to 2018 site forms, erosion is the most ubiquitous and pervasive impact to cultural resources in the Rodeo-Chediski burn scar (Mead et al. 2019). Oxidized soils devoid of microbial activity in high intensity burn areas often are not capable of producing vegetation in the short-term (Neely 2012). Intense and extended smoldering in the Bagnal parcel resulted in severe erosion, sheet, and slope wash that transformed the landscape. Post-fire erosion can increase by three orders of magnitude, capable of transporting nearly fifty tons of material per acre (Ffolliott et al. 2011). While the most severe effects are soon after the fire, studies show that increased erosion can persist for over a decade (Robichaud and Ashmun 2012).

Under ideal hydrologic conditions, the ground surface on the Mogollon Rim would be covered with more than 75% vegetation and duff, 2% of rainfall becomes surface runoff, and erosion rates would be low (Ffolliott et al. 2011). Severe wildfire impacts like those from the Rodeo-Chediski fire can result in poor hydrological conditions, and with less surface vegetation to stabilize soil, erosion rates can increase by up to 300% from pre-fire conditions (Robichaud and Ashmun 2012; Ryan et al. 2012). The different sedimentary systems that we relate to site formation show that the final condition of surface archaeological sites reflects a continuum between the primary context and post-occupational transformational processes (Rapp and Hill 2006). An erosive environment like Bagnal's can easily compromise site integrity, even more so if the site is on a slope and exposed to the elements. Sheet wash caused by erosion, water, and wind can relocate artifacts and bury ephemeral sites (Schultz 2010).

In addition to the environmental effects of exposure, burned prehistoric sites are exposed to collectors. Numerous studies have found that increases in post-fire surface visibility correspond with increases in looting and inadvertent collection (North et al. 2003; Rockman 2015; Ryan et al. 2012; Schroeder 2010). Numerous instances of collecting were documented in the 2002 salvage survey (North et al. 2003) and during surveys in 2017-2019 (Figure 3.6; Mead et al. 2019). Instances of collecting on Bagnal sites are detailed in Chapter 5.



Figure 3.6. Collectors' piles at Pueblo village site 02-4698. Photo by Mead et al. 2019.

These long-term indirect impacts of Rodeo-Chediski exemplify the ways post-fire processes can influence the interpretability of data from sites that have been impacted by high severity wildfire. To most effectively manage sites in burned or threatened areas, archaeologists should be able to identify and distinguish between natural and cultural formation processes. Indirect effects discussed here present the most concerning long-term impacts to sites evaluated in this thesis.

### *Conclusion*

CRM archaeology in burned areas requires broad understanding of impacts, including those associated with site formation processes under normal conditions and those related to wildfire response. Direct impacts result from combustion, biochemical interactions, and operational effects from suppression activities (Ryan et al. 2012; Schultz 2010). Indirect, long-term effects are more destructive and can result in the transformation of ecosystems and landscapes of burned areas. The nature and severity of fire impacts varies widely and is dependent on, for example, qualities of the local environment, soil types and slope, biomass type and moisture content, duration and intensity of the fire, terrain, and local weather and climate patterns (Franklin and Agee 2003; Gottfried et al. 2003; Noss et al. 2006).

Historic fire regimes in ponderosa forests of the Southwest were characterized by frequent, low intensity burns that thinned forests to encourage regeneration and nutrient cycling which prevented conditions that exacerbate today's devastating wildfires. Since Euroamerican settlement of the region, logging has wiped out massive swaths of forests and destroyed trees that would have been instrumental in carrying a low-intensity natural fire (Strom 2005). Patchy over-logged forests transitioned as timber activities decreased, and forests grew far too dense as modern fire management focused on suppression at all costs (Ffolliott et al. 2011). Manufactured forest conditions are a key factor in the compounding intensity and frequency of massive fires in forests of the West (Bowman et al. 2011). Aggressive suppression neglected to consider the need for natural fire intervals to support healthy ponderosa forest systems; without natural fires, fuel loads piled up and trees become increasingly and unnaturally dense (Neely 2012). Resulting from these practices are more frequent and destructive high severity wildfires in public lands of the West. Long-term modifications from high severity wildfire at the landscape level from geomorphic effects bear directly on archaeological site integrity, visibility, and preservation potential. This study attempts to identify the manifestations of these effects. Methods are discussed next.

## CHAPTER 4: MATERIALS AND METHODS

This chapter reviews terms, definitions, and methods used in this study and the data collection techniques employed in during the Phase II R-C Prescribed Burn Survey (reported in Mead et al. 2019). Procedures and standards correspond to those outlined by the Arizona SHPO, the USFS, and the Lakeside Ranger District of ASNF. Data and methods specific to this project are discussed, including pedestrian survey methods, data collection standards, fire severity and impact assessments, and artifact analysis.

### *Definitions*

Terms and definitions employed in this study derive from ASNF files and SOPs, the Arizona Cultural Resources Handbook (2006), the U.S. Forest Service Heritage Program (n.d.) , and the Department of the Interior. Table 4.1 defines diagnostic site types that have been documented in the Bagnol parcel. Most prehistoric sites in the study area are Puebloan in origin; the most common site types with architecture in the study area are field houses and roomblocks that are categorized as Puebloan in ASNF.

Table 4.1. Prehistoric site types that have been identified in the study area (adapted from Plog 1981 and, Schroeder 2010).

Site Type	Description
<b>Prehistoric mixed artifact scatter</b>	Artifact scatters containing both ceramic and lithic artifacts. All groundstone artifacts in the study area are individually mapped and described.
<b>Lithic scatters</b>	Artifact scatters containing only flaked stone artifacts, including debitage and tools.
<b>Ceramic scatters</b>	Artifact scatters containing only ceramic sherds; suggests activities that require the use of ceramic vessels such as carrying water, storage, or manufacture.
<b>Pithouse sites</b>	Habitation sites that predominately date prior to 1000 C.E. and may consist of a single pithouse structure or multiple organized as a village. Pithouses range in size, depth, and construction, but all are structures dug into the ground with a superstructure of wood branches and/or beams and dirt or adobe walls.
<b>Pueblo sites</b>	Habitation sites constructed of aboveground masonry that dominate the settlement system after 1000 C.E. Three different site types are categorized under the label “pueblo sites”: field houses usually evidenced by a boulder pile over a small area, U-shaped structures with one or two rooms, and pueblos (roomblocks) with four walls consisting of three or more rooms.
<b>Great kivas</b>	Large circular ceremonial structures commonly evidenced as a large depression; may contain this feature singly or can be associated with a larger pueblo site.

This table includes only descriptions of sites identified within the study area; a complete list of site types found in Apache-Sitgreaves National Forest can be found in the ASNF Cultural Specialist Report



(2010). Site numbers employed in this study follow the standard Smithsonian trinomial format (AR-03-01-07-0106). For brevity's sake, this thesis references only the last six digits of the trinomial (e.g. 07-0106).

Site data used for this thesis were obtained from ASNF Lakeside Ranger District and HEG project manager Kent Mead. According to the Arizona Handbook of Cultural Resources (2006), prehistoric archaeological sites in the state must meet at least one of the following criteria:

- 30 or more artifacts of a single class within an area no more than 15 meters in diameter,
- 20 or more artifacts if two or more classes of artifacts are present within the same area,
- One or more archaeological features in temporal association with any number of artifacts, and/or
- Two or more temporally associated cultural features without artifacts.

The following describes site qualities based on artifact count ranges devised for the present study:

1. High-density sites: 300 or more artifacts
2. Moderate-density sites: 100-299 artifacts
3. Low-density sites: < 100 artifacts

Density here only refers to the total counted or estimated number of artifacts on site (as opposed to number of items per square meter). Artifact density per square meter calculations are more tenuous due to the nature of available data and were excluded from this thesis. Habitation sites contain at least one feature with an associated artifact scatter and are interpreted to represent at least an overnight occupation at a site. Prehistoric scatters for the purpose of this study contain only artifacts and no features in the surface expression. The surface expression of these artifact scatters represents limited activity or resource extraction locales lacking features to suggest habitation.

For inclusion on the NRHP, sites are “graded” on their significance, a quality based on perceived potential to produce data needed to inform important research questions. Under Criterion D of the NRHP, resources with integrity of location, design, setting, materials, workmanship, feeling, and association may be eligible for listing on the register if they have yielded or may likely yield important information about prehistory (NPS 1983; Rockman 2015). A significant site should retain integrity, which refers to a site’s authenticity, evidenced by the survival of physical characteristics that existed during the site’s original occupation (NPS 1983). Integrity factors into NRHP nominations because it reflects the quality and

potential of archaeological data on a site, ultimately considered in decisions to preserve or stabilize, monitor, inventory, or demote to a non-site.

Isolated occurrences (IOs) refer to features without associated artifacts or artifact scatters that do not meet the above criteria. An isolated occurrence is defined as a locus of past human activity that may not have been purposeful (North et al. 2003), such as a single artifact or small (>10) scatter of artifacts of the same class. If the activity is interpretable, it is apparently a single event or an episode of short duration occurring within a tightly circumscribed area (Mead et al. 2019). IO data in 2018 were documented per parcel in an ASNF IO Record available in Appendix C of the R-C prescribed burn report.

#### *2018 Pedestrian Survey Methods*

Field archaeologists from Harris Environmental Group (HEG), including the author, were contracted by ASNF to survey 15,237 acres for the Phase II Rodeo-Chediski Prescribed Burn Survey. The undertaking was completed under Sections 106 and 110 of the National Historic Preservation Act (NHPA) of 1966, as amended. The prescribed burn project under review involves mechanized tree thinning to improve forest stand densities and forest health, promote large tree development, and reduce the risk of stand-replacing crown fires (Mead et al. 2019:1). When each parcel was surveyed, crews returned to relocate and assess the condition of all existing sites, and completely record new sites and those that had not been updated within five years. ASNF archaeologists provided site records and shapefiles which were used to relocate sites and referenced for updated recordings. Most of the site shapefiles were identically-sized circles around a datum point because few sites had associated spatial data besides a datum. Because of the NAD27 to NAD 83 datum shift and changes in geographic information systems (GIS) technologies in the past four decades, some plotted locations were incorrect, and locations of both projections were inspected.

HEG crews surveyed the 1,527-acre Bagnal parcel from September 5 to October 29, 2018 as one of seven parcels inventoried for the project. Crew members involved in the Bagnal area survey had

professional experience ranging from a recent college graduate without field experience to a 30-year-veteran of CRM work. Kent Mead, M.A., RPA, directed the Rodeo-Chediski Prescribed Burn (Phase II) project and coordinated from HEG headquarters in Tucson, Arizona with USFS archaeologists and HEG field crews. Field personnel on the project include: Holly Hall, Peter Byler, John Curry, Nathan Lefthand, Seth Allison, Katherine Sinsky, Jason Seaman, Alison Talbot, Caleb Febrache, and Adam Sezate. Sessions consisted of eight 10-hour days with fieldwork typically starting at 6:30am and ending at 4:30pm. Rain, snow, and sleet prevented work on a handful of days, and monsoons often delayed or prevented fieldwork in the late summer and early fall. If the ground was overly saturated, fieldwork was postponed avoiding disturbances to exposed sites with foot traffic.

Each crew member recorded tracks and referenced UTM positions on a handheld Garmin Oregon 550 GPS unit. One crew member from each of the two crews recorded precise locations and site maps on a Trimble Geo7x. Transects were spaced fifteen (15) meters apart and trended north/south or east/west depending on the survey strategy deemed appropriate for the terrain, parcel shape and size, and time available. Steep landforms were contoured if necessary, though the Bagnal study area is relatively flat and able to be transected entirely. Two crews of four or five people worked in different parcels simultaneously. Crews first surveyed each parcel, and when three or more artifacts were observed in a small area, the group gathered to examine the location. If the locale did not meet the criteria for a site, crews documented the location and description of the isolated occurrence (IO). If the area contained adequate materials to qualify as a site, crews recorded UTM coordinates on a Trimble, assigned a TBR (“to be recorded”) number, and entered this and a description of the resource on a TBR list. When a parcel was completely surveyed, TBR coordinates and existing spatial data was used to relocate sites for a complete recordation.

### *2018 Data Collection Methods*

Pedestrian survey of the Bagnal study area was completed in late August 2018. From September 5 to November 1, 2018, a crew of four relocated and recorded existing and newly identified sites in the Bagnal. HEG used blank field forms and referenced existing site records and spatial data provided by ASNF. Site recordation was completed in accordance with the recording standards and FS protocols outlined in the *2360 Heritage Program Management Manual* (USFS 2008). Sites in the study area had not been updated in at least ten years and all sites were re-recorded entirely.

Spatial data for most previously recorded prehistoric sites in Bagnal (n=72) contained only an encircled datum, and many of which were situated in locations that did not resemble the description indicated on original site records. No physical tags existed for PR1 sites and only a UTM location was provided for relocation. If cultural materials were not observed in the vicinity of previously recorded sites during pedestrian survey, crews examined the areas surrounding provided datum points (in NAD 27 and NAD 83 UTM coordinate systems) for an average of two hours. If the previously recorded site was not relocated, crews completed a *Site Protection and Monitoring Form* including locational information and descriptions, disturbances to the area, and management recommendations.

Data from sites identified in the study area in 2018 were recorded directly onto an iPad in a fillable PDF titled *ASNF Cultural Resource Record*. For prehistoric site recordings, each crew member assumed responsibility for different aspects of site recording, including Trimble mapping, the main site record, site and artifact photography, feature counts and descriptions, and individual forms containing data specific to lithics, ceramics, and groundstone artifacts. The main site record includes information about the project, date, and recorders, a site narrative, site location and dimensions, ground surface visibility, condition of site, threats or disturbances present, management recommendations, and determination and justification of NRHP eligibility. Temporal ranges of site occupations were recorded if adequate diagnostic ceramic materials permitted relative dating.

Environmental data from each site references current conditions encountered at the time of recordation in 2018. The dominant vegetation community on site was recorded, including ponderosa, ponderosa-oak/juniper, mixed conifer, transition zone, pinyon-juniper, juniper savannah, oak woodland, meadow, grassland, and riparian. On-site vegetation narratives describe specific plant and tree species constituting the understory and overstory (canopy) and the observed fire impacts to living and scorched vegetation on site. Features identifying the nature of the landform/s upon which sites are situated were selected from a list and include (in alphabetical order): alluvial fan, arroyo/wash, base of cliff, base of talus/hill slope, basin, bench, canyon rim, cave, cliff, canyon, cutbank, drainage, dune, floodplain, hill slope, hill top, knoll, lava flow/malpais, ledge, mesa, mountain, outcrop, pass, plain, plateau, ridge, rockshelter, saddle, slope, spring, terrace, valley, meadow, extinct lake/playa, and river. Narratives describing the landform and features recorded include data related to the slope and aspect of the site area, geology and geologic formation, geomorphology, soils, and variations of these identified within the site boundary.

Because the stated purpose of the 2018 R-C phase II survey project was to mitigate adverse impacts to cultural resources during prescribed burn activities, fire-related assessments were documented for each site. Wildland fire hazard assessment identified each site as either high risk (e.g. rock art, sensitive historic resources), moderate risk (e.g. prehistoric structures or features), or low risk (e.g. prehistoric artifact scatter, historic can scatter). The fuel load on and around sites – high (e.g. heavy dead and down, thickets, dense stands), medium (e.g. duff, some woody debris, brush), and low (e.g. leaf litter, grasses, and sparse brush cover) – was recorded to inform mitigation strategies for sites in the study area. Wildland fire treatment recommendations identified include references to on-site living vegetation and fuel load. All prehistoric site forms included the following standard/provided recommendations: “Site should be avoided during mechanized thinning and fire suppression. Do not burn through site. Do not inundate. Recommend foam application for fire suppression effort. Recommend removal of ground fuels

by hand crew. Site should be monitored by fire archaeologist or resource advisor during controlled burn.” Threats and disturbances observed at all prehistoric sites in the study area include fire, bioturbation, erosion, and grazing. Additional disturbances commonly observed in Bagnal sites include fire suppression, vehicular traffic, sheet and slope wash, road construction and maintenance, chaining, recreation, vandalism, aeolian processes, heavy machinery, logging, facility, trash, fuel wood, inundation, unauthorized collection, and colluviation.

For smaller scatters (under 200 artifacts), crews used pin flags to mark the locations of all artifacts identified on the surface. For larger sites with more than a couple hundred artifacts, pin flags were used to mark artifact concentrations (e.g. Figure 4.1), diagnostics, and groundstone artifacts. Pin flags also marked the last or furthest artifacts identified in the site vicinity, representing the extent of cultural material observed that would become the site boundary. White flagging tape was tied around trees encircling sites in order to mark locations for avoidance during prescribed burn activities.



Figure 4.1. Crew member Nathan Lefthand flags an artifact concentration at site 07-2217.

Information recorded about features includes feature number, type, dimensions and area, and a written description. Types common to the study area are dry-lay sandstone masonry structures that represent a single- or multi-unit structure. Many features identified during survey include rubble mounds with at least one wall alignment but an indeterminate number of rooms or units. Though not included in the feature form, concentrations of *Agave parryi* are considered features for the purpose of this study because their presence is restricted to archaeological sites (see chapter 2) and many previous records indicated its presence within or adjacent to sites in the parcel.

Crews used a Trimble Geo7x to record spatial site and environmental data. Polygonal site boundaries drawn by the person on Trimble duty represent the flagged extent of cultural material identified plus a one-meter buffer. Additional spatial data recorded at each site include a datum point, diagnostic artifacts, groundstone items, artifact concentrations and middens, features, prominent landforms such as drainages or cliff faces, and features of the landscape like springs and bedrock outcrops. Major disturbances to sites were mapped and recorded and typically include FS and user-created roads, dozer push piles, skid trails, campsites, collectors' piles, and major arroyos and drainages. A digital Olympus Tough camera was used to photograph various elements of each site, including the datum (double-flagged with white flagging tape), a view in each cardinal direction from within the site, features, a sample of ceramic artifacts, diagnostic artifacts, major disturbances, and if illustrative, artifact concentrations. Photo numbers, directions, and detailed information were recorded on separate photo logs for each site. Larger habitation sites took around three hours for a crew of five to record completely. Smaller activity areas or artifact scatters took one to two hours. Up to five sites were recorded in one day if sites were near roads and smaller in size, though two to three sites per day was typical due to large assemblages and access issues.

### *Artifact Analysis*

Artifact analysis was limited to cursory field evaluations during 2018 fieldwork. Temporal designations were assigned if crews identified diagnostic ceramic artifacts or projectile points on a site. The total number and estimated range of artifacts on a site was determined in accordance with ASNF standards and project requirements. Artifact counts of smaller sites appearing to contain fewer than 100 artifacts were complete. Project guidelines required that no more than 100 lithic and 100 ceramic artifacts were typed and counted on each site; these 200 artifacts would represent a sample of raw materials, artifact forms, and ceramic types present in the surface assemblage. Crews photographed distinctive and re-shaped ceramic items as well as a representative sample of sherds (e.g. Figure 4.2). Representative sherd samples contain at least one of each diagnostic and non-diagnostic type identified on site.



Figure 4.2. A representative ceramic sample photographed from assemblage at site 07-0191.

Ceramic artifact data were recorded in the *ASNF Ceramic Checklist*. Diagnostic ceramics were counted per series within Cibola white ware, Cibola gray wares, Tusayan gray ware, White Mountain red ware, Little Colorado white ware, Roosevelt red ware, and Mogollon brown wares. Crew members with



more experience typing ceramics in the region were usually tasked with recording this artifact class. Series counts were divided into sherd counts indicating its source from a jar or bowl if determinable.

The 2018 survey used the chronology defined by North et al. (2003) which recognizes that the project area is defined by both Mogollon and Ancestral Puebloan chronologies (Mead et al. 2019). Distinctive ceramic artifacts are abundant in the study area and include plain brown and white wares, corrugated, and decorated sherds. The well-defined ceramic chronology of the region is a subject of numerous studies related to prehistoric subsistence, production techniques, group interactions, and raw material use on the Mogollon Rim (Herr 2013; Martin et al. 1962; Neily 1991; Snow 2017; Sullivan 1982). Crews typing ceramics in the field referenced Hayes-Gilpin and van Hartesveldt (1998) and Goetze and Mills (1993).

Lithics in this study refers to all flaked stone items, including formal and informal tools and debitage. Lithic artifact data were recorded in the *ASNF Lithics Checklist* which provided space for counts of each type of debitage (primary flake, secondary flake, tertiary flake, pressure flake, bifacial thinning flake, shatter, bipolar flake, overshot flake, and indeterminate), lithic tool (scraper, knife, biface, projectile point, preform, drill, hammerstone, utilized flake), and each type of core (amorphous, bipolar, unidirectional, single facet, core tool, and other). Counts were recorded in the checklist per material type: chert, quartzite, chalcedony, fine-grained volcanic, jasper, petrified wood, obsidian, siltstone, silicified sandstone, and other. Lithic forms require additional specific data for projectile points, including dimensions, description, and (Trimble-mapped) location.

Groundstone artifacts include stone items manufactured through mechanisms of abrasion, polish, or impaction, or itself is used to grind, abrade, or polish (Adams 2002). Because these artifacts are less common than lithics and ceramics in ASNF, each is assigned an artifact number and individually mapped, described, and measured. Object types of complete and fragmented groundstone items encountered in the study area include one- and two-handed manos, and slab and basin metates. Material types of

groundstone in the study area include vesicular basalt, sandstone, quartzite, and granite. Groundstone artifact “completeness” indicates the estimated portion of the whole represented by each groundstone artifact: 1-24%, 25-49%, 50-74%, 75-99%, and 100%. Dimensions recorded include length, width, and thickness. Diagnostic artifacts were mapped, described, and photographed in the field; this data is available in the 2018 report by Mead and others. Because the focus of the present study is on long-term wildfire impacts to site integrity and our ability to *do* archaeology (as opposed to the archaeology itself), categorical counts of specific ceramic and lithic artifact types are not evaluated in this study. Site type descriptions, artifact counts, NRHP eligibility, area occupied, and environmental qualities of the area are more pertinent data points for the purposes of this study and are evaluated in Chapter 5.

### *Site Types*

Prehistoric sites fall into six site types designed to be simplified for comparative purposes. The six type designations reflect the visible contents of the surface expression and its interpreted use. Habitation sites contain at least one feature and are thus interpreted to reflect short-, long-term, or repeated occupation. Prehistoric habitation evidence in the study area include sandstone rubble mounds and structures, rock alignments, pit depressions (larger kivas and smaller pithouses), bedrock milling features, daub concentrations, middens, and agave concentrations. For the purposes of this study, any site with evidence of habitation (pueblos, pithouses, kivas, daub concentrations, and rubble mounds) is classified simply as a “prehistoric habitation site,” or “PHS.” The following codes applied to sites in this study reflect the amount of cultural material visible in surface expressions.

1. **LDPS** refers to a low-density prehistoric scatter of < 99 artifacts. No evidence of habitation.
2. **MDPS** is a moderate-density scatter that contains 100-300 artifacts and no evidence of habitation.
3. **HDPS** is a high-density scatter of 300+ artifacts and no visible evidence of habitation.
4. **PHSLDS** is a prehistoric habitation site (that has features) and an associated low-density scatter (fewer than 99 artifacts).
5. **PHSMDS** is a habitation site with an associated moderate-density scatter of 100-300 artifacts.
6. **PHSHDS** is a habitation site with an associated high-density scatter of over 300 artifacts.

An important drawback of this categorization is that it is oversimplified for purposes of this study and may misrepresent some sites. For example, a site with one exposed feature is classified as a habitation site, while a scatter of 500 artifacts is just a scatter. Intensive Puebloan occupation of the Mogollon Rim left numerous sites with architectural features ranging from a field house and storage cist to a village site with over one hundred rooms and an impressive Great Kiva. These occupations were abundant and declaring a site non-significant because it lacks a defined linear wall is neglecting to acknowledge the success of these groups. A scatter of thousands of diverse lithic materials and ceramic forms was probably a habitation; features may have been buried, dispersed, or become part of a skid trail. Tabular sandstone blocks are abundant in the study area, so crews had to be careful to avoid conflating natural exposures with cultural features. That said, there were several occasions where an amorphous cluster of sandstone blocks on a dense mixed scatter was not recorded as a feature because it did not have the required linear qualities. These were noted but not included in feature counts and therefore may misrepresent the ratio of “ephemeral” to habitation sites.

According to Mehalic (2012), documentation of archaeological sites in the region has been influenced by two primary factors: the nature of archaeological survey projects (e.g. sample surveys for larger timber sales, systematic surface surveys, reconnaissance surveys, etc.) and the site typologies used by these researchers. Differences in the definitions and interpretations of site types based on surface expressions is an enduring issue for regional studies and CRM more generally. The site types defined for this study aim to avoid these issues by standardizing site qualities based on the observed surface expression to facilitate comparison of PR1 and PR2 datasets.

#### *Wildland Fire Assessments*

ASNF site records for this project include a wildland fire assessment to evaluate fuel load on site and management recommendations related to the upcoming prescribed burn. Fire effects observed

include cracking or spalling and smoke or soot on boulders and bedrock, depressions from uprooted trees, scorched standing trees, and burned woody debris. Suppression impacts include dozer lines, tree felling, vegetation removal, and vehicle ruts. Burn severity on sites range from low to severe and are defined by ASNF (BAER 2002) as the following:

**Low:** duff partially consumed, none to little ladder fuels burned, and no canopy burned.

**Moderate:** duff consumed, ladder fuel burned, isolated crown burns or torching.

**Severe:** duff, ladder, and crown completely consumed.

The type of vegetation that can grow in a given place is governed by moisture availability, which is a function of both precipitation and temperature (Stephenson 1988). As a result, the spatial distribution of vegetation types and their associated fire regimes is strongly correlated with long-term average precipitation and temperature (Westerling et al. 2014). Because fuel load essentially describes vegetation and organic debris, precipitation and temperature data are both important to consider both survey conditions and for conducting wildfire risk assessments.



Figure 4.3. Effects of mixed severity burn at site 07-0168 are evidenced by a few surviving mature ponderosas (background) and incineration of all vegetation in other parts of the site (foreground).

Burn severity estimates employed in this study derive from classifications of post-fire vegetation studies (e.g. Ffolliott et al. 2011; Neely 2012) and are based on visual observations of fuel load in the field. Sites in Bagnal reflected impacts from either high-severity burn (stand-replacing, crown-consuming fire defined by USFS as “heavy dead and down, thickets, dense stands”), or moderate-severity burns (evidenced by few remaining ponderosas, thinned but existent duff, burned woody debris). No evidence of low-intensity burn was identified in the study area. Burn severity estimates were provided for the purposes of informing prescribed burn strategies; area with a heavy fuel load in 2018 had not burned in 2002, and sparser areas lacking a mature canopy evidence high severity burn. ASNF requires wildland fire information for proactive management purposes but these sections of site records also provide data to inform questions in this study about long-term fire effects on archaeological sites and survey.

#### *Non-Fire Site Impacts*

This section reviews impacts observed at sites in 2018 that are not attributed to wildfire. The forest system of the Mogollon Rim has undergone dramatic changes since the arrival of Euroamerican settlers (Cooper 1960), and past land use practices – including Forest Service management activities, public resource procurement, recreation use, and natural processes – have impacted the cultural resource base (Schroeder 2010). These threats and disturbances were documented on many sites in the study area and are discussed here to avoid conflation with long-term wildfire effects.

Timber-related activities are central to the USFS mission. Though today’s sales are more carefully monitored to avoid adversely impacting resources, historic logging impacts to cultural sites is common in ASNF and most often appears as old logging roads bisecting sites. According to Fred Plog (1981), the greatest impact arising from timber harvest in ASNF is the construction of haul roads and landings, which involves skidding trees and moving heavy equipment across the ground surface. Vehicular use related to timber activities on ASNF ranges from 2x4 administrative vehicles to 18-wheel haulers.

As of 2010, over 1.5 million acres of ASNF's 2.1 million acres are open to motorized use, including 2,832 miles of FS roads, 156 miles of motorized trails, 3,591 miles of management roads closed for public use, and an unknown number of user-created roads (Schroeder 2010). The use and maintenance of these roads threatens and has damaged cultural resources in ASNF by excavating and grading away soils, changing erosion patterns, increasing or altering water flows across the ground surface, compacting soils, and downslope rutting from runoff and vehicle use during wet conditions (Schroeder 2010:23). Roads in the vicinity of sites have also indirectly impacted sites by increasing access for unauthorized collection.

Impacts from grazing livestock intensify without the roots of mature trees to stabilize landforms. Pine duff from mature ponderosa canopies that once protected surface assemblages is mostly absent, exposing artifacts and features to trampling evidenced by broken sherds in well-entrenched game trails. Grazing further contributes to an unstable post-fire environment as young new growth vegetation is preferred by cattle, wild horses, elk, and deer, perpetuating issues related to site exposure (Neely 2012). Grazing animals are attracted to and frequently concentrate on a recently burned area because new growth vegetation is usually more palatable, accessible, and nutritious (Moore et al. 2004), and the appeal of these resources leads to the greater utilization and trampling of burned areas by grazing animals (Pase and Granfelt 1971). Continued post-fire grazing compounds long-term fire effects by removing vegetation that would have stabilized soils. Crews documented grazing impacts on all Bagnal sites in 2018.

Impacts unrelated to wildfire must be considered because these can intensify the long-term impacts imposed by the burn. Vehicle traffic and grazing in newly exposed areas can increase erosive processes over entire landforms. The "multiple use" quality of the USFS mission makes mitigation in these areas difficult; grazing, recreation, and timber sales are central to ASNF. Threats and disturbances from logging, recreation, and grazing should be monitored in culturally sensitive areas and considered in preservation plans. Mitigating these impacts after a wildfire should be a priority due to the compounding threats they pose.

## *Conclusion*

Methods employed during 2018 survey follow those outlined by the SHPO, ASNF, and the USFS. Prehistoric site data recorded in 2018 includes detailed maps, artifact inventories and samples, site photographs and sketch maps, ceramic typing, lithic analyses, locational, environmental, and cultural information, NRHP eligibility determination and justification, and a wildland fire assessment. Sites are divided into one of six types that reflect the content and interpretation of the visible surface expression. For the purpose of study, some data are simplified to facilitate comparative analyses between datasets to determine if the fundamental character of sites have changed since previous (PR1) recordings.

## CHAPTER 5: RESULTS

This chapter presents the results of the 2018 survey and the analyses of prehistoric site data collected in the study area before Rodeo-Chediski (PR1) and from the same fifty (50) sites in 2018 (PR2). In 2018 crews relocated around 70% (n=50) of previously recorded sites (n=72) in the study area. Forty (40) new prehistoric sites of varying sizes were identified and added to the inventory in 2018. Archaeological data evaluated here derives from 162 site records (PR1: 50, PR2: 50, non-relocated: 22, newly-recorded: 40), representing 112 sites (50 relocated, 22 not relocated, and 40 new; Table 5.1).

Table 5.1. Datasets of prehistoric site records from the Bagnal parcel evaluated in this study.

DATASET	NUMBER OF SITE RECORDS	DESCRIPTION
PR1	50	Original site records and updates (1975-2002) of prehistoric sites in the Bagnal study area; only includes 50 of 72 total previously recorded sites (22 not relocated in 2018)
PR2	50 (same sites as PR1)	Site records from 2018 representing the fifty (50) relocated prehistoric sites in the study area.
Newly recorded	40	Previously unrecorded prehistoric sites added to the Bagnal inventory in 2018.
Non-relocated	22	Previously recorded prehistoric sites that were not relocated in Bagnal in 2018.
Total	90	Total prehistoric sites identified in the Bagnal study area during 2018 survey.

Records from fifty existing sites (PR1) that were relocated in 2018 (PR2) provide data for direct comparative analyses on a site-by-site basis to identify relative changes at the site level. Differences in PR1 and PR2 data include location descriptions, feature counts, and NRHP eligibility. Statistically significant increases in artifact counts and site area suggest that long term effects of Rodeo-Chediski exposed and dispersed prehistoric surface sites in the study area. The following results show trends in Bagnal site data that augment our understanding of long-term effects of wildfire on archaeological sites in Western forests.



## 2018 Survey Results

The 2018 Phase II pedestrian survey inventory of prehistoric sites in Bagnal consists of ninety (90) prehistoric sites, a 25% increase from the pre-fire inventory (n=72). Improved visibility from exposure promoted artifact identification, resulting in larger assemblages. Several individual small sites exposed in Rodeo-Chediski in 2018 were found to overlap, representing a larger and more significant occupations. Twenty-two sites were not relocated in 2018. PR1 records (n=50) and PR2 records (n=50) provide data from the same fifty sites recorded before and after the fire to identify changes in site content and condition over time.

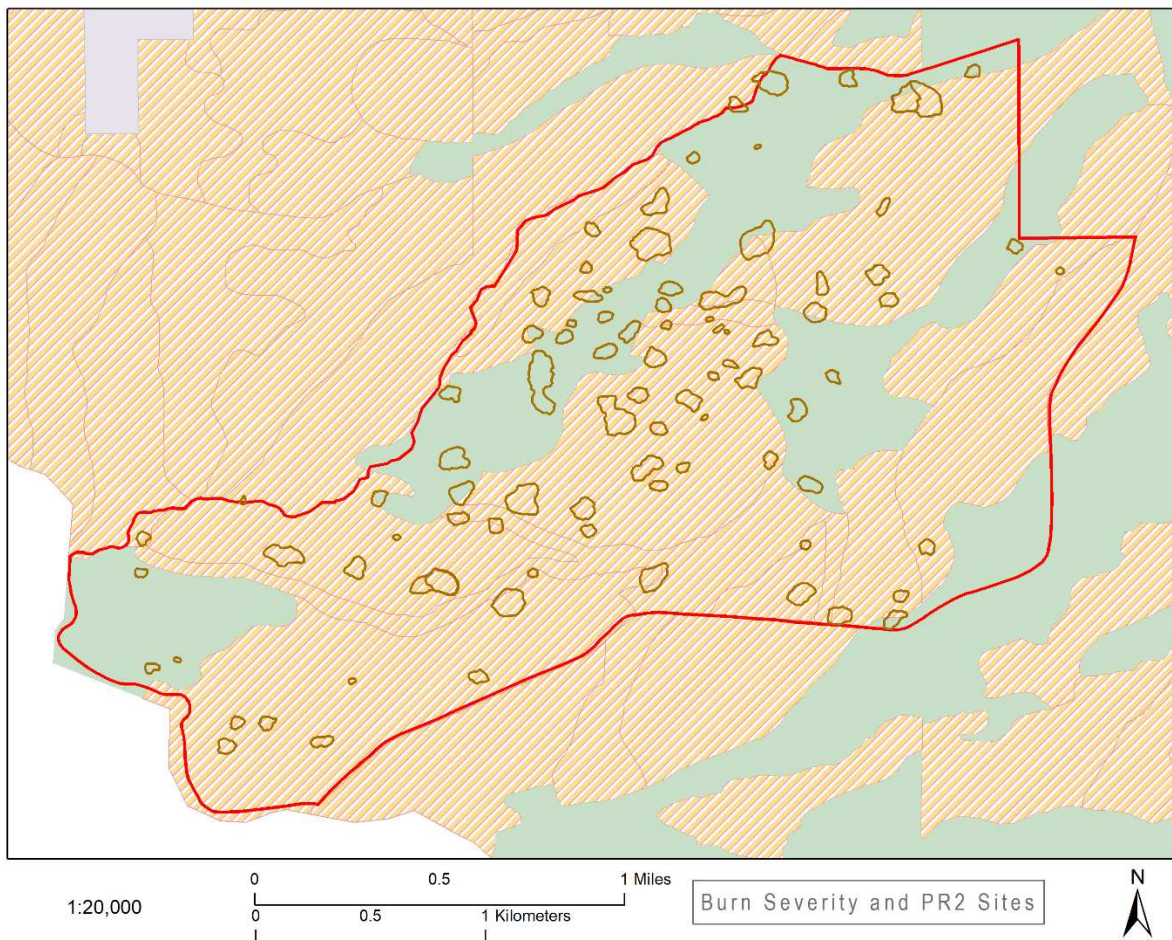


Figure 5.1. 1:20,000 map of moderate (green) and high (orange) intensity burns in Bagnal (outlined in red).PR2 site boundaries outlined in brown. The Mogollon Rim forms the edge of the white area to the southwest.

Fire data in figure 5.1 is a gross representation of areas impacted by high-severity fire (orange) and moderate-severity fire (green), characterized by few remaining ponderosas and thinned pine duff. Precise fire qualities and behaviors are notoriously difficult to determine at the site level due to the variability of hyper-local conditions that dictate fire behavior, including fuel load, wind speed, moisture content in soils and vegetation, terrain, previous treatments, and stand density (Ffolliott et al. 2011; Neely 2012; Ryan et al. 2012). The above fire severity map derives from visual observation of the burn scar by aerial photography and reflects the highest resolution available for Rodeo-Chediski (USFS 2002). Approximations of burn severity identified in wildfire risk assessments (included in 2018 ASNF site records) provide more precise burn information at the site level and are used in this analysis.

Enduring effects of Rodeo-Chediski on Bagnal sites in 2018 were ubiquitous and devastating. Forested environments described in previous (PR1) site records did not resemble the scrubland encountered in 2018. Exposure-related impacts were impacting sites and entire landforms, lacking stabilizing vegetation since 2002. Exposure resulted in the identification of additional sites and artifacts, including several NRHP-eligible sites that were not previously identified despite numerous pre-fire surveys in the parcel. Situated near one of the largest clusters of great kivas in the Southwest (Herr 1999), sites the study area contain valuable data that is vulnerable to manipulation in the exposed landscape.

#### *Relocated Sites*

Crews in 2018 relocated fifty (50) of the 72 (69.4%) previously recorded prehistoric sites in Bagnal. Pre-fire records (PR1) and 2018 records (PR2) of the same sites provide comparative information related to changes in site integrity and visibility after Rodeo-Chediski. Data points that inform the understanding of the extent and character of these changes include recorded site area, assemblage size, presence of features, surface visibility, landform type, vegetation, and burn severity. Comparison of site contents reported in PR1 and PR2 records show that many sites continue to be transformed by the lasting impacts of Rodeo-Chediski, and every site is vulnerable to a degree. Appendix A includes individual site narratives.

Table 5.2. Summary of data analyzed from PR1 and PR2 site records.

	PR1	PR2	Change	Description of Change
<b>Total Site Area</b>	71,768	250,869	(+) 179,101	Total area of PR2 is 3.5x PR1
<b>Total Artifact Count</b>	4,472	17,135	(+) 12,663	PR2 has 3.8x more artifacts than PR1
<b>Total Feature Count</b>	42	32	(-) 10	PR2 has fewer features than PR1
<b>Site Type Frequencies</b>				
PHSHDS	6	11	(+) 5	PR2 has more high density habitations
PHSMDS	8	3	(-) 5	PR2 has fewer mod density habitations
PHSLDS	12	4	(-) 8	PR2 has fewer low density habitations
HDPS	0	5	(+) 5	PR2 has more high density scatters
MDPS	3	5	(+) 2	PR2 has more moderate density scatters
LDPS	21	22	(+) 1	Similar number of low density scatters

Exposure from the 2002 wildfire encouraged a more complete identification of cultural materials.

Table 5.2 shows how the post-fire inventory reflects what could be interpreted as a more intensive prehistoric occupation of the study area as PR2 records identified additional high density scatters.

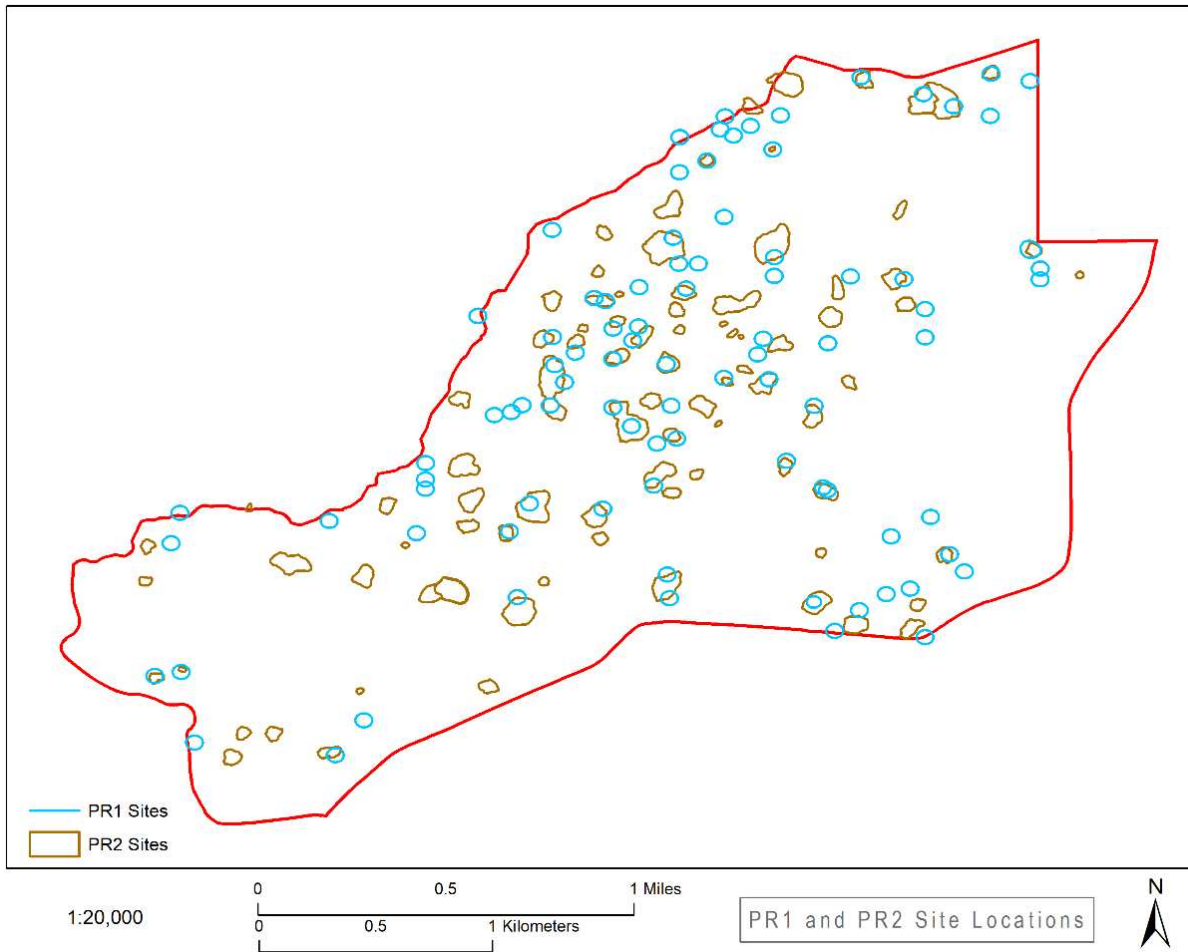


Figure 5.2. 1:20,000 map with PR1 (blue) and PR2 (brown) site boundaries; the study area is outlined in red.

The dominant vegetation community in PR1 records before the fire was ponderosa pine, which occurred in dense, mostly homogeneous stands with occasional Gambel oak and juniper. The canopy of these trees produced abundant pine duff and litter that covered most of the ground surface; at times this biomass layer could be over half a meter deep (Neely 2012). Ponderosa pine was not dominant in any PR2 record, and if present, occurred in small, highly dispersed stands of one to four scorched but surviving trees. The elimination coniferous overstory improved visibility for PR2 recorders, however, exposed sites are highly vulnerable in the erosive and unstable landscape. The exposed assemblage on site 07-0139, for example, continues to sustain active damage from slope wash (Figure 5.3); artifact positions and patterns apparent in the soil show channelization and erosion impacting the assemblage.



Figure 5.3. Sparse vegetation and active slope wash impact site 07-0139. Pin flags mark artifact locations.

In the field, it is clear that Bagnal sites have been transformed since pre-fire records, and I had to know what changed and to what degree. Results show that PR2 records more than triple PR1 artifact counts and area for the same sites, revealing what appears to be a larger and more intensive prehistoric occupation of Bagnal. With improved visibility in 2018, several distinct existing sites were found to overlap

and represent a single larger occupation (e.g. Figure 5.2). More high-density scatters in PR2 records reflects effects of exposure, which may also have contributed to the identification of fewer features in 2018. Five high density habitation sites were added to the inventory in place of smaller scatters documented in PR1 records. Site location descriptions are markedly dissimilar, suggesting landscape-level changes have altered the environmental contexts of relocated sites. The following sections examine in detail the disparities in site type designations, location descriptions, area occupied, artifact density, and assemblage contents to identify fire-induced changes to Bagnal’s prehistoric inventory.

### Newly Recorded Sites

Crews identified forty new prehistoric sites in Bagnal in 2018, ranging from large habitation sites with thousands of artifacts to small scatters with fewer than a dozen items. The nature and contents of these sites may shed light on why sites went previously undetected, which can contribute to our understanding of how wildfire impacts site detectability over the long term. Table 5.1 summarizes data points evaluated in this study. Appendix C includes detailed individual site narratives.

*Table 5.3. Summary of newly recorded site data (n=40).*

Habitation sites contain at least one figure and are defined as: PSHDS (high density, >300 artifacts), PHSMDS (moderate density, 100-299 artifacts), and PHSLDS (low density, <100 artifacts). Sites without visible surface features include: HDPS (high density prehistoric scatter), MDPS (moderate-density prehistoric scatter), and LDPS (low-density prehistoric scatter).

Site No.	Site Type	Area (m <sup>2</sup> )	Artifact Count	Feature Count	Location Description	% Surface Visible	Artifact Density (perm <sup>2</sup> )	Burn Severity	Impacts Observed
07-2203	HDPS	4762	500	0	Ridge / slope	70	0.105	High	Suppression, erosion, slope wash
07-2204	LDPS	3278	292	0	Hillslope	65	0.089	High	Suppression, erosion, slope wash, burn-out stumps
07-2205	LDPS	1127	60	0	Ridge / slope	60	0.053	High	Suppression, erosion, grazing
07-2206	LDPS	667	18	0	Hill top / slope	70	0.027	High	Suppression, slope wash, grazing, erosion
07-2207	MDPS	3227	128	0	Hillslope	55	0.040	Moderate	Suppression, erosion, chaining
07-2209	HDPS	957	300	0	Bench / slope	45	0.313	High	Erosion, water transport, slope wash
07-2210	MDPS	1974	100	0	Bench	50	0.051	High	Suppression, slope wash, erosion
07-2211	LDPS	1368	89	0	Bench	40	0.065	High	Erosion, burned-out stumps, suppression
07-2212	LDPS	1171	35	0	Hill top / slope	70	0.030	High	Erosion, suppression, sheet wash, chaining
07-2213	LDPS	985	65	0	Bench	60	0.066	High	Suppression, erosion, slope wash
07-2215	HDPS	3502	900	0	Hillslope	50	0.257	Moderate	Suppression, sheet wash, grazing
07-2216	LDPS	464	5	0	Hillslope	45	0.011	High	Suppression, dozer push piles, burned-out stumps

Site No.	Site Type	Area (m <sup>2</sup> )	Artifact Count	Feature Count	Location Description	% Surface Visible	Artifact Density (perm <sup>2</sup> )	Burn Severity	Impacts Observed
07-2217	PHSHDS	8743	1600	2	Hill top / slope	80	0.183	High	Suppression, burned-out stumps, erosion, slope wash
07-2218	PHSLDS	978	8	1	Bench	70	0.008	High	Suppression, grazing, road use, collecting, erosion
07-2220	LDPS	1899	19	0	Hillslope	20	0.010	Moderate	Suppression, slope wash
07-2221	PHSLDS	2044	77	1	Hillslope	70	0.038	High	Erosion, suppression, slope wash
07-2222	PHSHDS	9484	2000	4	Bench / slope	80	0.211	High	Suppression, erosion, grazing, slope wash
07-2223	LDPS	6517	55	0	Bench / slope	60	0.008	Moderate	Suppression, slope wash
07-2224	LDPS	3170	34	0	Ridge / slope	75	0.011	High	Erosion, suppression, chaining
07-2225	LDPS	1923	40	0	Hill top / slope	55	0.021	High	Erosion, suppression, grazing
07-2226	LDPS	2478	51	0	Ridge	70	0.021	High	Erosion, grazing, suppression
07-2227	PHSHDS	8557	1200	1	Ridge / slope	60	0.140	Moderate	Erosion, suppression, burned-out roots, grazing
07-2228	MDPS	1361	133	0	Ridge / slope	65	0.098	Moderate	Dozer push piles, erosion, suppression, slope wash
07-2229	HDPS	3816	500	1	Ridge / slope	60	0.131	High	Erosion, suppression, dozer push piles, grazing
07-2230	PHSLDS	2280	58	1	Hill top / slope	75	0.025	High	Suppression, erosion, burned-out stumps
07-2231	LDPS	1419	18	0	Ridge / slope	80	0.013	High	Erosion, sheet and slope wash, suppression, dispersal
07-2232	LDPS	1107	51	0	Hillslope	70	0.046	High	Erosion, road, fire break, slope wash, suppression
07-2233	LDPS	400	106	0	Hillslope	60	0.265	High	Erosion, slope wash, suppression, burned-out stumps
07-2234	PHSHDS	2469	1400	2	Hill top / slope	50	0.567	Moderate	Erosion, slope wash, dispersal, suppression
07-2235	LDPS	1065	24	0	Bench / slope	90	0.023	Moderate	Suppression, erosion, grazing
07-2236	LDPS	1174	38	0	Hillslope	50	0.032	High	Erosion, dispersal, slope wash, suppression
07-2237	LDPS	471	19	0	Bench	35	0.040	High	Grazing, suppression, erosion
07-2238	PHSHDS	4880	325	1	Hill top / slope	40	0.067	Moderate	Erosion, slope wash, dispersal, suppression
07-2239	LDPS	3003	59	0	Hillslope	60	0.020	High	Erosion, suppression, slope wash
07-2240	PHSMDS	8900	132	1	Bench / slope	30	0.015	Moderate	Erosion, dispersal, slope wash, puddling
07-2241	LDPS	374	15	0	Hill top / slope	80	0.040	High	Suppression, erosion, grazing
07-2242	MDPS	1925	118	0	Hill top / slope	85	0.061	High	Erosion, dispersal, sheet and slope wash, suppression
07-2243	LDPS	2146	87	0	Bench / slope	75	0.041	High	Erosion, dispersal, puddling, slope wash, chaining
07-2244	LDPS	607	77	0	Bench	40	0.127	High	Suppression, grazing, erosion, sheet wash
07-2265	PHSHDS	2955	1175	1	Ridge / slope	30	0.398	Moderate	Erosion, sheet and slope wash, puddling, dispersal

Survey conditions favoring site detectability in 2018 resulted in the identification of forty new prehistoric sites in the study area. A sizeable chunk (20%) of the Bagnal inventory was previously undetected despite numerous past surveys in the study area. These are no minor additions; newly recorded sites occupy over 100,000m<sup>2</sup> and contain nearly 12,000 artifacts and sixteen features.



Figure 5.4. Located in a moderate intensity burn area, visibility on newly recorded site 07-2240 was conducive to feature identification, but remaining pine duff may have obscured associated artifacts.

The apparent expansion of Bagnal's prehistoric occupation in 2018 suggests that pre-fire inventories were understandably incomplete. Before the fire, most of the ground surface would have been covered in duff over a half meter deep in some areas. Dense groundcover would have rendered discovery of these sites impossible – unless, as was the case of many PR1 records, the organic layer had been disturbed by logging or FS activities, exposing mineral soil and artifacts beneath. Newly identified sites highlight the fallacy of complete or 100% survey coverage. Though Bagnal was considered to have been completely surveyed on multiple occasions prior to 2018, forty sites containing a substantial amount of cultural materials were not identified until after the fire. Fourteen of the forty (35%) newly identified sites identified in 2018 containing significant deposits and architecture are recommended NRHP-eligible. Exposure from long-term wildfire effects in the study area contributed to an expanded site inventory and addition of significant sites that require special management considerations. Results from the 2018 survey

suggest that fire-induced impacts from exposure of materials can persist for at least sixteen years after a major forest fire.

*Non-Relocated Sites*

Twenty-two (22) of 72 total prehistoric sites were not relocated in 2018. Analysis of pre-fire data from these sites sheds light on the impacts of Rodeo-Chediski on site survival and detectability. Table 5.2 summarizes site data and Appendix C includes narratives of each site and descriptions of search efforts.

Table 5.4. Site data from previously recorded sites that were not relocated in 2018 (N=22).

Site No.	Site Type	Site Area (m <sup>2</sup> )	Artifact Count	Feat. Count	Density	Site Loc	Elevation (ft)	Slope	Vegetation	% Disturb.
07-0105	HDPS	3750	200	0	0.053	Ridge	6640	8	Ponderosa/oak canopy	40
07-0127	LDPS	15	20	0	1.333	Hillslope	6540	2	Ponderosa/oak canopy	unk
07-0133	MDPS	1000	100	0	0.100	Hill top	6510	2	Ponderosa/oak canopy	50
07-0134	LDPS	167	20	0	0.120	Logging	6480	5	Ponderosa/juniper canopy	80
07-0136	MDPS	514	70	0	0.136	Logging	6480	5	Ponderosa canopy	80
07-0138	MDPS	225	120	0	0.533	Logging	6420	2	Ponderosa canopy	80
07-0140	MDPS	50	20	0	0.400	Logging	6495	2	Ponderosa/oak canopy	90
07-0142	PHSMDS	1200	150	1	0.125	Ridge	6595	2	Ponderosa/juniper canopy	60
07-0150	LDPS	250	20	0	0.080	Ridge	6490	2	Ponderosa canopy	70
07-0151	PHSMDS	375	120	1	0.320	Ridge	6560	2	Ponderosa canopy	70
07-0154	MDPS	500	100	0	0.200	Hillslope	6400	2	Ponderosa canopy; agave	80
07-0161	PHSMDS	525	80	1	0.152	Bench	6640	2	Ponderosa/oak canopy; agave	40
07-0162	PHSMDS	240	70	2	0.292	Bench	6640	5	Ponderosa canopy	unk
07-0171	PHSLDS	170	100	1	0.588	Bench	6580	5	Ponderosa/juniper canopy; agave	40
07-0176	PHSMDS	6600	170	1	0.026	Ridge	6440	2	Ponderosa canopy; agave	unk
07-0187	LDPS	96	30	0	0.313	Hillslope	6640	2	Ponderosa canopy	30
07-0193	LDPS	15	10	0	0.667	Bench	6560	5	Ponderosa/oak canopy	70
07-0201	PHSLDS	104	40	1	0.385	Hill top	6520	2	Ponderosa/juniper/oak canopy	40
07-0204	PHSMDS	150	50	1	0.333	FS Road	6480	2	Ponderosa canopy	60
07-0613	PHSLDS	2886	30	1	0.010	Logging	6440	3	Ponderosa/oak canopy	100
07-0623	LDPS	1530	50	1	0.033	Ridge	6640	18	Ponderosa/oak/juniper canopy	100
07-0707	LDPS	1088	15	0	0.014	Logging	6570	5	Ponderosa canopy	70

There are several possible explanations almost one third (30.5%, n=22) of sites were not relocated in 2018. PR1 records were recorded in 1975 and 1990, and many records indicated that sites were 60, 70, and 90% disturbed. These surface expressions may have since been displaced or destroyed. Issues with



existing spatial data prevented straightforward relocation. Crews of three or four spent hours scouring the surfaces around each reported datum location, either a reported UTM location, point on a GPS unit or hand-drawn map. Landscapes described in 1975 and 1991 do not resemble Bagnal in 2018, leaving crews without environmental references, further complicating relocation. Another possible explanation relates to the detectability inherent in the deposit because of its size, obtrusiveness, and other qualities. The average area of non-relocated sites is 975m<sup>2</sup>, quite small in relation to the PR2 average of 5,000m<sup>2</sup> or the 2,700m<sup>2</sup> average of newly identified sites. The average number of artifacts on non-relocated sites is 72, less than 25% of the PR2 average of 343 artifacts. Almost one-third (32%) of records from non-relocated sites indicate locations in disturbed contexts related to logging or FS roads, which suggests some sites were exposed by timber activities and road traffic and may have since been dispersed or destroyed.

Non-relocated sites provide insight into the range of factors influencing site discoverability in the pre- and post-fire environments. Survey results suggest that in the decades after Rodeo-Chediski surface visibility remains conducive to feature identification, but duff in moderate density burn areas continues to obscure artifacts (Figure 5.9). These sites also highlight the practical issues caused by spatial data incongruities and differences in recording techniques over the past forty years. Relocating a small scatter based on a UTM coordinate and one-line description is difficult, and even more difficult when the current environment does not remotely resemble its description in the site form. Sites may have been relocated with more recent records; in 2018 most sites in Bagnal in 2018 had not been updated in over thirty years. The abundance of rich prehistoric sites in ASNF makes it difficult to manage cultural resources under normal conditions; effective site management (including stabilization, data recovery, recordation, and monitoring) under post-fire conditions is even more problematic. size and abundant cultural resources of ASNF make it difficult to manage under normal conditions.

### *NRHP-Eligible Case Studies*

Of the ninety prehistoric sites recorded in the study area in 2018, 40% (n=36) are recommended eligible for inclusion on the National Register of Historic Places (NRHP), suggesting these resources contain important data that is worth preserving. This section details changes on four of the more significant NRHP-eligible prehistoric sites in the study area to show the variety and degree of impacts sustained by even the largest sites. PR1 and PR2 records from NRHP-eligible sites 07-0130, 07-0165, 07-0603, and 07-0612 differ in important ways with implications for data collection and interpretation.

#### *Summary of Site AR-03-01-07-0130*

Site 07-0130 was originally recorded in 1975 as a limited activity scatter of 100 ceramics and 20-50 lithics dispersed over 787m<sup>2</sup> on a sandstone outcrop. A concentration of *Agave parryi* was adjacent to the scatter. In 2018 crews found the site to be a far more intensive habitation consisting of an estimated 400-450 ceramics and 200-250 lithics dispersed over 5,276m<sup>2</sup>. Crews in 2018 also documented two previously unrecorded multi-room features with dense associated scatters, but the agave concentration was not relocated. An open canopy and lack of pine duff indicate high severity burn impacts over the whole site, leaving good visibility with only around 25% of the surface obscured by burned debris, leaf litter, and thin grasses. Operational effects on the site related to suppression include mechanized tree felling and bulldozer impacts to a feature and scatter. Suppression efforts were evidenced by bulldozer push piles, including one that disturbed a feature and scatter (Figure 5.4).



Figure 5.5. A newly-recorded feature at site 07-0130 may have been previously obscured by duff. Shown are portions of walls from two roomblock features. Note scorching on building materials.

The surface expression of site 07-0130 changed from a moderate density scatter to a multi-feature habitation site in the years after Rodeo-Chediski. Once a relatively insignificant locale, 07-0130 is now an NRHP-eligible Pueblo habitation site with far more data potential than indicated on the PR1 record. On the other hand, the site had been protected by vegetation and duff – its extent unknown to FS archaeologists – but also to collectors. Crews documented egregious looting efforts on this site, evidenced by a hand-excavated trench, collector’s pile, and shovel in the center of a feature. Collecting in ASNF is well-documented and known to occur after wildfires (Martin et al. 1962; USFS 2002); numerous instances of looting were observed during the 2017 to 2019 R-C Phase II survey. Looting was most often identified on sites with newly exposed architecture, perhaps due to the obtrusiveness of these larger habitations.

#### *Summary of Site AR-03-01-07-0165*

Site 07-0165 was recorded in 1975 as a one-room pueblo and associated scatter of 50-100 ceramics and 20-50 lithics dispersed over 200m<sup>2</sup>. Site 07-0166 was recorded in 1975 as a scatter of 10-20

ceramics and 20-30 lithics situated on an outcrop. 07-0714 was recorded in 1990 as a two-room masonry structure and associated scatter of 20 sherds and four flakes dispersed over 3,584m<sup>2</sup> on a bench overlooking an unnamed wash. Conditions in 2018 permitted a more complete examination of the ground surface, which resulted in the identification of a continuous scatter between these three sites and all were combined under the earliest site number.

The PR2 update describes a severely impacted multi-unit rubble mound structure and associated scatter of 900-1000 lithics and 750-800 ceramics dispersed over 13,782m<sup>2</sup>. The site was impacted by high severity burns across the entire surface, evidenced by a completely open canopy and absence of duff. Visibility in 2018 was good with around 15% of the surface obscured by sparse manzanita, thin grasses, and woody debris. A rectangular structure containing two to four rooms is deflating from burned-out stumps and erosion. Channelization and erosion are pronounced along a lower slope where artifacts are concentrated along dry rivulets (Figure 5.9). Modern trash and fresh boot tracks around two collector's piles point to unauthorized collection and recreation impacts.



Figure 5.6. Artifacts are dispersed downslope across the exposed surface of site 07-0165.



Figure 5.7. Part of a roomblock feature was impacted by tree throw and erosion at site 07-0165.

The PR2 record for site 07-0165 exemplifies a more complete recording of a single large habitation site previously thought to be three distinct scatters. Effects of high severity fire resulted in the obliteration of that mature canopy and duff was completely absent from the site. Though visibility improved, the site sustained severe exposure-related impacts; erosion and channelization are actively dislocating artifacts and manipulating the visible surface expression. Boot tracks, trash, and collectors' piles documented on the site in 2018 suggest exposure has drawn collectors to the once-concealed assemblage.

#### *Summary of AR-03-01-07-0603*

Site 07-0603 was first recorded in 1990 as a possible jacal field house with a rock lined sandstone cist feature and small scatter of 20-50 sherds. 07-0604 was recorded in 1990 as a Puebloan habitation site containing a four-room block and a kiva depression occupying 3,360m<sup>2</sup>. Artifacts identified include a pot drop, two projectile points (collected), 100+ lithics, 100+ ceramics, and 20 basalt and sandstone groundstone items. The site condition in 1990 was described as "excellent" despite road construction. In

2018, artifacts from sites 07-0603 and 07-0604 were found to form a continuous scatter and the two were combined under the earlier site number.

The PR2 recording documented 900-100 ceramics and 300-350 lithics dispersed over 19,475m<sup>2</sup>. Visibility in 2018 was good with around 30% of the surface obscured by burned woody debris, thin pine duff, forbs, and grasses. All features besides the pit depression were relocated, and crews identified an additional midden. Evidenced by surviving mature trees, the site was impacted by moderate severity burn; suppression efforts are apparent in burned saw-cut logs and stumps. The two-track mentioned in the PR1 record was relocated and noted to increase erosion around the jacal feature. Slope wash was impacting areas of the site and artifacts were observed downslope in dry rivulets.



Figure 5.8. Exposure at 07-0603 resulted in good surface visibility but erosion dispersed features in sloped areas.

Changes to the 07-0603 site record illustrate the push and pull of positive and negative effects of wildfire on prehistoric surface deposits. Improved surface visibility facilitated a more complete recordation of the site which had previously existed as two smaller unrelated sites. The implications for data interpretation here are clear: PR1 narratives could be interpreted as two independent, shorter-term

occupations by different groups, while the PR2 narrative reveals a single cohesive settlement of one group. How many other large sites have been split because poor visibility prevented a complete recording? Though 07-0603 is now considered a more accurate reflection of the prehistoric occupation, the site sustained severe impacts related to exposure. Crews identified erosion across much of the site and slope wash actively redepositing features (Figure 5.8) and artifacts downslope from the site. Because of the hilly landscape, post-depositional artifact movement resulting from exposure likely contributes to increased site area.

#### *Summary of Site AR-03-01-07-0612*

Site 07-0612 was first recorded in 1974 as a prehistoric habitation site and associated scatter occupying 7,000m<sup>2</sup> of a prominent sandstone bluff. Features observed on site in 1974 include a seven-room pueblo, midden, masonry alignment features, and a large agave concentration on the southern edge of the site. A 1990 site update describes a large rubble mound feature, possible kiva depression, agave concentration, and scatter of 300+ ceramic and lithic artifacts occupying 4,158m<sup>2</sup>. The PR1 site record indicated that the site was in “very good” condition, but it had been bladed and burned slash piles were on site. PR1 recorders noted that the site has very high research potential.

In 2018, the estimated artifact count on site 07-0612 doubled and more than tripled in area to over 14,000m<sup>2</sup>. The multi-room structure and smaller detached feature were relocated but have sustained damage; PR1 records identified standing walls but in 2018 feature walls had collapsed and dispersed. The agave concentration and kiva depression were not relocated; it is possible that the kiva has infilled with sediment since 1990. The more widely dispersed associated scatter contains an estimated 400-450 ceramics and 200-250 lithics. The site and surrounding area reflect high severity burn impacts evidenced by the completely open canopy and lack of duff. Suppression impacts include a dozer push pile, a two-track that flanks the eastern portion of the site and saw-cut stumps and logs. Evidence of looting include a collector’s pile and pot hunting depression in one of the features. Erosion was displacing artifacts and

architectural stones downslope. Visibility was good with around 20% of the surface obscured by manzanita, new growth scrub oak, bunch grasses, forbs, and shrubs. Burned-out stumps in features imply that fire impacted subsurface deposits through smoldering root burn; the subterranean character of stump holes and root channels creates the opportunity for sustained extreme heating that can damage surface and subsurface artifacts and features (Ryan et al. 2012; Figure 5.9).



Figure 5.9. A burned juniper on multi-room structure at site 07-0612 suggests root burn may have affected subsurface deposits. The PR1 record indicated that these walls were standing but have collapsed since the fire.

Differences in PR1 and PR2 data at site 07-0612 exemplify impacts induced by long-term fire effects. Two features were not relocated, and dozer push piles had disturbed much of the site surface, exacerbating erosion issues on the already unstable landform. PR1 and PR2 records reflect a different type of occupation. Kivas represent community and interaction at Puebloan sites on the Mogollon Rim (Herr 2001). Now lacking a kiva, interpretations based on features documented in 2018 would miss information about the social context and function of the site.



These four case studies illustrate the suite of exposure-related impacts sustained by prehistoric sites in burned areas. Measurable changes in surface expressions reported in PR1 and PR2 records for the same sites show how the enduring effects of Rodeo-Chediski led to major changes in some fundamental qualities of these important NRHP-eligible sites. The nature and extent of impacts varies from site to site and are attributed to the local terrain, fire behavior, site contents, and suppression activities. Though the larger surface expressions of these sites fare better than smaller scatters in the post-fire environment overall, differences in PR1 and PR2 records from these sites suggest that even these more substantial NRHP-eligible sites are vulnerable disturbance from wildfire. Exposure encouraged more complete recordings of these four sites, but its long-term effects resulted in displacement from erosion, damage from suppression efforts, and increased the visibility of cultural materials for unauthorized collection.

#### *Artifact Counts*

The 2018 survey resulted in an estimated 180,000 additional artifacts in the Bagnal parcel. PR2 records contain an average of 343 artifacts per site, while PR1 records average only 89 artifacts per site (Figure 5.4). The increase in PR2 artifact counts relates to improved ground visibility from Rodeo-Chediski, which resulted in the discovery of additional artifacts due to decreased pine duff. The average number of artifacts for the same sites in 2018 (PR2) is nearly three standard deviations more than the PR1 average, showing a highly significant change in assemblage content reported at the same sites. This significant ( $P > 0.05$ ) increase in assemblage content has implications for future site preservation in the unstable landscape, as well as cultural references based on artifact counts.

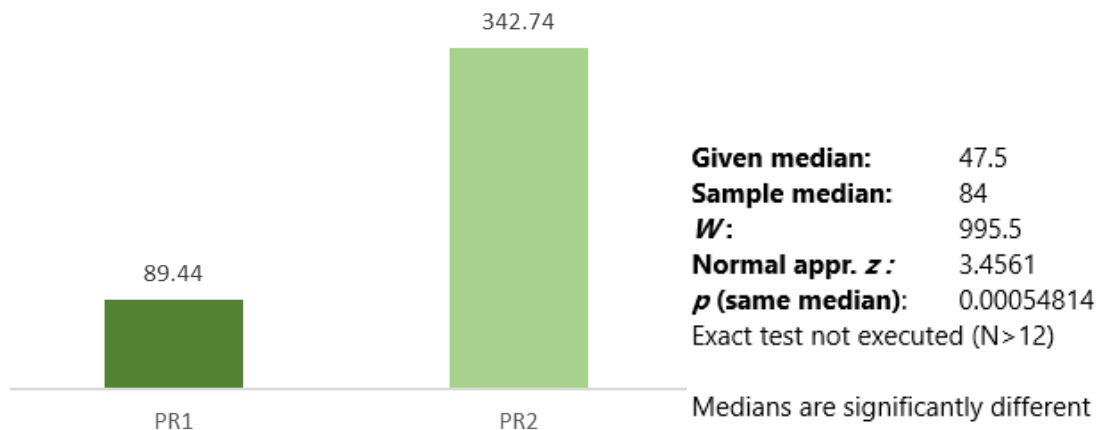


Figure 5.11. Average number of artifacts reported in PR1 and PR2 sites; Wilcoxon rank test results.

A Wilcoxon signed rank test shows that the PR2 median number of artifacts per site (n=84) is significantly larger than the PR1 median (n=47.5). Though the surface expressions of sites in the study area are larger than previous records indicate, these assemblages are impacted and threatened by exposure, dislocation, and reburial by erosion in the unstable environment. Because of the abundance of diagnostic ceramic material in the study area and broader Mogollon Rim region, the increase in numbers of artifacts visible on the surface translates into more opportunities to date these occupations. Site data from the 2018 survey suggests that in the study area, improved visibility from exposure persisted for nearly twenty years after the fire event.

#### *Site Area*

Fire-induced exposure also resulted in a significant increase in the average site area (m<sup>2</sup>) between PR1 (pre-fire) and PR2 (2018) records. The average site area in the pre-fire PR1 dataset was 1,435m<sup>2</sup>. Sixteen years after Rodeo-Chediski, the same fifty sites were found to occupy over 5,000m<sup>2</sup> (Figure 5.3).

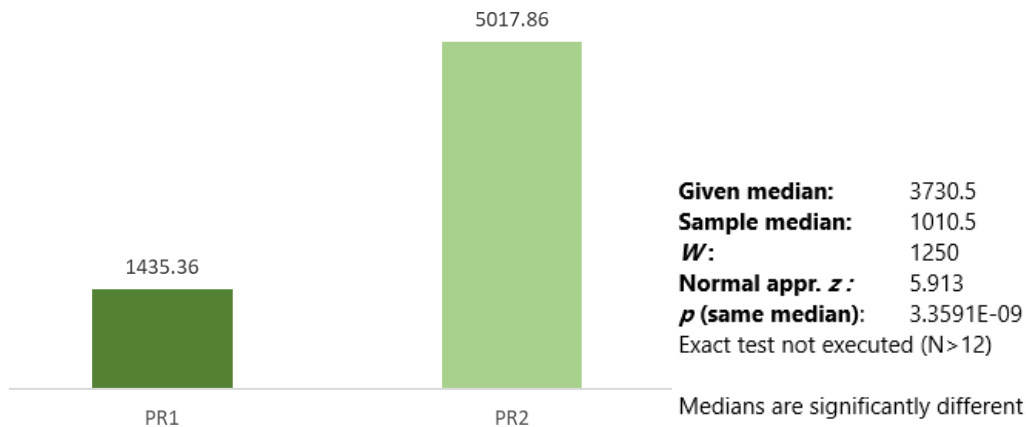


Figure 5.12. Average (mean) site area (m<sup>2</sup>) of PR1 and PR2 sites; Wilcoxon rank test results.

A Wilcoxon signed rank test shows that the PR2 median area (3,730.5 m<sup>2</sup>) is significantly larger than the PR1 median (1,010.5 m<sup>2</sup>). Site area is important for a variety of research questions and data points in cultural research management. Archaeologists – especially those conducting or using data from regional surveys – generally assume that there is a correlation between the areal extent of a habitation site and the number of people living at that site (Schreiber and Kintigh 1996). In Bagnal, prolonged exposure resulted in larger sites due to improved visibility and artifact dispersal (Figure 5.13).



Figure 5.13. A sherd and burned debris washed downslope from a concentration on site 07-0713.

The significant increase in the area occupied by the same fifty sites is due to increased exposure, which improves surface visibility, while unfortunately making sites vulnerable to transfer, burial, and removal. Materials situated on exposed surfaces with any slope are easily dispersed downslope with rain or snow events, often deposited throughout and at the base of rivulets and gullies that scour the study area. Crews in 2018 witnessed this in action as sherds washed downslope from a site in rain-filled rivulets. Clearly these post-depositional processes continue to rapidly degrade surface expressions and the implications for cultural inferences based on site size and artifact positioning are clear.

### Features

PR1 records reported more features (n=10) than what was identified in the study area in 2018 (PR2; Figure 5.16). In PR1 records 25 of 50 sites (50%) contained features, while in PR2 records features were identified on only 19 of the same 50 sites (38%). The 20% reduction in the total feature count in PR2 records and 12% decrease in sites containing features may be a result of feature dislocation and dispersal since original recordings in 1975 and 1990. More than half of PR1 sites containing features (60%) reported impacts to masonry structures from logging or road construction; it is feasible that these and other disturbances reduced some structures to amorphous scatters of sandstone slabs. Some clusters dismissed as natural may have been dispersed remains of a masonry foundation.

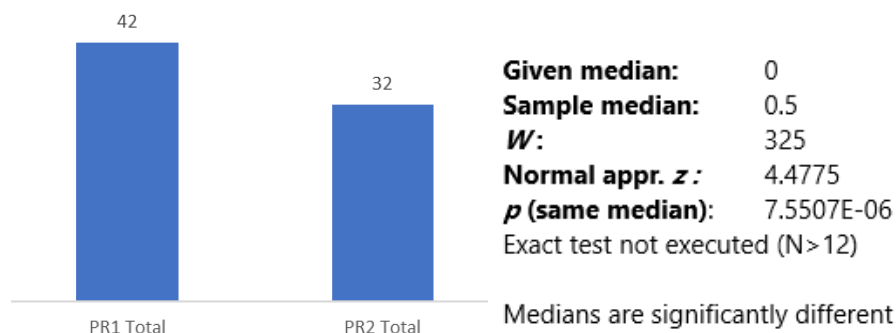


Figure 5.14. Total number of features identified in pre-fire (PR1) and 2018 (PR2) records from the same fifty sites.

Because sandstone blocks are ubiquitous in the study area, crews in 2018 recorded only features with clear linear qualities. A possible explanation for the decreased feature count in 2018 is the dispersal of once-intact masonry features from fire and suppression impacts, crew skills, or accelerated geomorphic processes spurred by a lack of vegetation in the post-fire environment. Mehalic's 2012 dissertation on small architectural sites on the Mogollon Rim highlights these issues with the region's cultural features and notes that many sites with features are recorded as artifact scatters because construction materials are often obscured by sediments or vegetation. In other cases, natural outcrops at sites have been mistaken for architecture, only becoming clear after dramatic alterations to the environment, "like wildfire or excavation," (Mehalic 2012:14).



Figure 5.15. Evidence of high-intensity scorching on downed trees and masonry building materials on a feature at site 07-0703.

*Agave parryi* concentrations are considered features for the purposes of this study because their existence is restricted to archaeological sites and their presence suggests a horticultural settlement (Minnis and Plog 1976). Although several communities of this culturally introduced species were burned and destroyed in high-moderate intensity fires, studies show that the species has begun to rebound

(Ffolliott et al. 2011; Neely 2012). Results from the 2002 survey following the Rodeo-Chediski fire (North et al. 2003) indicated the presence of agave at 40 of the 279 sites (13.6%). Of PR1 records, 24% (n=12) identified agave on sites, while only 8% (n=4) of PR2 records identified the plant within or around sites in 2018. It is possible that the highly erosive Bagnal landscape is no longer stable enough to sustain the slow-growing succulent (Hall *personal communication*).

During 2018 fieldwork it became clear that collecting was more common, or at least more visible, on sites with architecture. Known to locals, larger Puebloan village sites contain dense and diverse assemblages of items sought by collectors, including formal tools, projectile points, decorated ceramics, and complete vessels. Evidence of collecting was common on larger sites and typically appeared as collector's piles, hand-dug pits or trenches in features, and alterations to structures such as re-stacked courses of feature walls (Figure 5.18). On one large hilltop village site outside the study area crews observed dirt bike tracks in "donut" patterns over the main roomblock feature. In the already unstable environment, each new disturbance to these features further exacerbate threats to integrity.



Figure 5.16. Re-stacked courses of materials on structure suggests visitation at site 07-0686.

With the available data it is not possible to determine whether the 20% reduction in features identified on Bagnal in 2018 is a result of actual feature dislocation or identification and recording differences. Non-linear clusters of fine building materials on sites were not recorded as features to avoid conflation with natural sandstone exposures. PR1 records reported impacts to most of the masonry structures during original recordings in 1975 and 1990; it is conceivable that these have since been dispersed and/or no longer retain linear qualities.

### Site Types

PR1 and PR2 site contents are compared to identify relative changes in the surface expressions of these fifty sites. The nature and amount of cultural material visible on a site dictates interpretation about prehistoric life, including interpreted function, and length of occupation (Baker 1978). Figure 5.19 illustrates the type distribution of sites in PR1 and PR2 datasets.

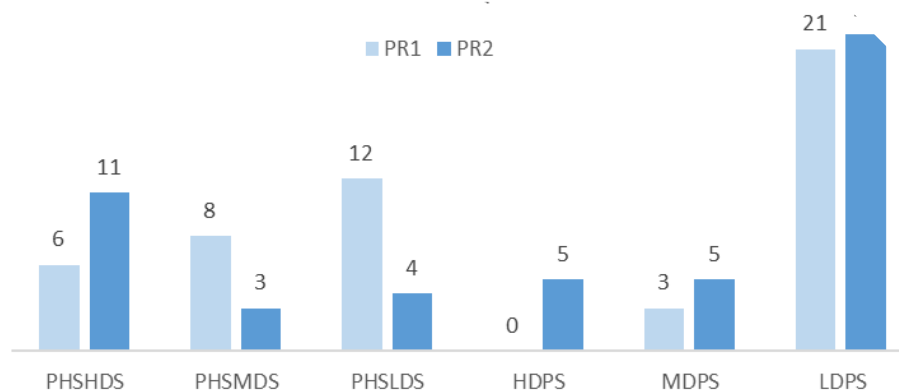


Figure 5.17. Frequency of site types in PR1 (n=50) and PR2 (n=50) records. Each of the fifty relocated prehistoric sites were assigned a type based on the number of artifacts and/or features identified in 2018: habitation sites contain at least one feature and include PSHSDS (high density, >300 artifacts), PSHMDS (moderate density, 100-299 artifacts), and PHSLDS (low density, <100 artifacts). Site types without visible features include: HDPS (high density prehistoric scatter), MDPS (moderate-density prehistoric scatter), and LDPS (low-density prehistoric scatter).

In his ASNf management plan (1981), Fred Plog discusses the existence of substantial pueblo masonry structures in the nearby Pinedale area whose only surface manifestations are small surface scatters. In areas of the forests where sites are buried, the “percentage of limited activity sites is probably overestimated” and site densities are probably “artificially low.” Plog’s 1981 concerns with typing sites based on surface expressions echoes those here: “...if masonry structures appear as artifact scatters, there

are probably artifact scatters that are not visible at all,” (1981:44). Differences between site contents reported in PR1 and PR2 records reflect changes in ground visibility and surface deposits that have occurred since previous (pre-fire) recordings. The PR2 dataset includes five newly recorded high density prehistoric habitation sites – NRHP-eligible under Criterion D due to the presence of architecture and therefore has practical implications for site management in perpetuity. PR1 records did not contain a single high-density prehistoric scatter (over 300 artifacts and no features); in 2018, five sites met these criteria. The apparently denser nature of the same group of sites relates in part to improved surface visibility and/or exposure of subsurface deposits from increased erosion.

The most common site type in both PR1 and PR2 datasets are low density artifact scatters (LDPS), which constitute over 40% of the sample. These locales may reflect limited activity areas that relate to the procurement and processing of local resources (Herr 2013), visited by nomadic groups who either relied entirely on hunting and gathering, or later agricultural groups who foraged to augment crops (Sullivan 1982). The prevalence of these smaller ephemeral scatters is anticipated. Most prehistoric sites in the ASNF inventory – and in the Southwest more broadly – are small surface scatters that lack associated features, interpreted to reflect limited activity or brief occupation of a locale (Plog et al. 1978). Some archaeologists have argued that artifact scatters represent primary sources of data for reconstructing land-use patterns, bridging gaps in regional prehistory, assigning meaning to variation in site size and site-type frequencies, and other frequently used measures of land use (Sullivan 1992). Standing alone, these small scatters do not offer substantial data potential; however, their significance increases when evaluated together as these common activity areas hold valuable data for landscape and regional archaeological research.

The most notable change in site type designations is the identification of ten new high density sites in 2018, reflecting a more populated and utilized area. It could be argued that the apparently more intensive occupation reflected in PR2 records is more representative of the actual prehistoric habitation



of the area. The increase in cultural material identified in the post-fire landscape has practical implications for land managers in fire-affected or fire-prone forests. Interpretations and site management strategies based on recorded surface deposits need to adapt as cultural materials are uncovered after a wildfire. Sites were classified into one of six types according to contents to compare the essential nature of sites reported in PR1 and PR2 records. Results suggest that prolonged fire-induced exposure can persist for at least sixteen years after a high severity fire, and this prolonged exposure can lead to a more complete inventory of surface artifacts and sites in burned areas.

### *Site Locations*

This section explores briefly the interaction of large geomorphic processes with archaeological materials and their documentation to identify the ways in which the archaeologists' perception of the current landscape imbues the description (and perhaps our interpretation) of prehistoric landscapes. For example, Dosh in 1990 and Greene in 1975 encountered a densely wooded and shaded forest with integrity of landforms but homogeneity in terms of vegetation communities (mostly ponderosa pine) and location descriptions. Site locations and their distribution reflect both natural and cultural environmental factors inhabitants preferred or needed, as well as elements and processes of the current environment that impede or aid site discovery. Variations in topography and horticultural potential, for example, affected settlement choice, land use patterns, and networks of interaction (North et al. 2003). Modern depictions of site locations are pertinent to this study because differences in environmental and location descriptions between records for the same sites reflect broader changes that could relate to long-term wildfire impacts operating on the landscape. Differences in PR1 and PR2 location descriptions suggest that long term effects have altered the actual and interpreted environmental context of relocated sites in the study area.

Over a-third (34%) of PR1 records show that site discovery is dependent on modern ground disturbance from roads and logging activities. The tendency of previous records to link site discovery to

ground disturbance from logging roads, staging areas, and FS roads suggests that duff and organic litter from mature pre-fire ponderosa, oak, and juniper canopies concealed the ground surface. PR1 records indicate that of the 50 sites, 26% (n=13) are located on a ridge, 22% (n=11) on a bench, 26% (n=13) were found in a logging-related disturbance (road or staging area), 14% (n=7) on a hill slope, 8% (n=4) in a FS road, 2% (n=1) in a floodplain, and 2% (n=1) on a sandstone bedrock outcrop. PR2 records for the same 50 sites indicate that 40% (n=20) are on a hill slope, 28% (n=14) are on a ridge, 16% (n=8) are on a knoll, 8% (n=4) are on a bench, 6% (n=3) are in a floodplain, and 2% (n=1) have eroded into a drainage.

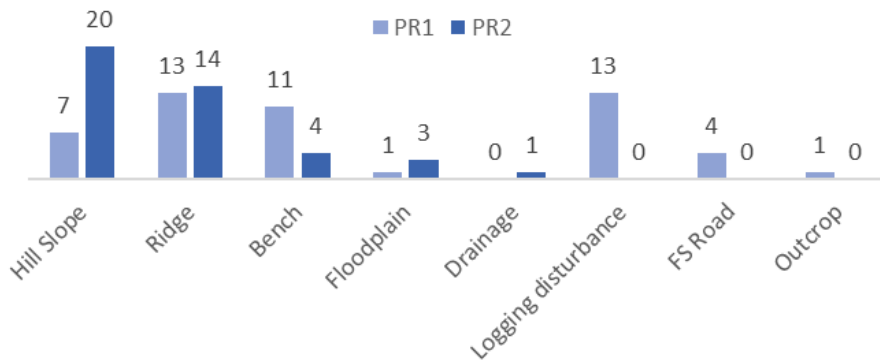


Figure 5.18. Location descriptions indicated (for the same fifty sites) in PR1 versus PR2 records.

With hill slope as the dominant descriptor in PR2 records, these differences may speak to the erosive nature of the landscape. The average slope on PR2 sites nearly doubled the average of PR1 sites, suggesting these sites are situated in more unstable locales than the relatively flat landforms described in PR1 records. Prehistoric artifacts from PR2 sites were often found eroding downslope from a flatter upslope surface, or what was once a flat surface like a bench or ridge top has since devolved into a hill and slope. The increase in average slope on the same fifty sites may relate to artifact dispersal downslope from water transport or slope wash, which increases the site area to include the slopes that are now eroding, and artifacts being transported. Slope calculations in PR1 and PR2 site records were made with the best estimates and are not adequate for quantitative analysis, though the doubling of average slope is of note. Changes in site location descriptions also relates to differences in terminology; USFS standards, forms, and definitions have changed in the past four decades, as has jargon used in the field. For example,

several records describe site locations in terms of the context in which artifacts were identified (e.g. at the junction of two logging roads), rather than describing the landform upon which the site is situated.

### *Direct Effects*

Direct effects are those which occur during and immediately following a fire event, while it's hot. In the study area, the most impacting of these relate to its suppression efforts, the effects of which were observed on all ninety (90) prehistoric sites in 2018. Suppression operations are often inherently ground-disturbing and appear in ASNF as dozer push piles, mechanized thinning disturbances (Figure 5.16), and skid trail construction and use. Seven habitation structures were directly impacted by dozer push piles (Figure 5.17) and skid trails which displaced building materials and sandstone blocks on some structures.



Figure 5.19. Evidence of fire suppression as scorched, saw-cut trunk in roomblock feature at site 07-2217.

Suppression impacts can be mitigated in certain situations. Consulting a cultural specialist prior to all ground disturbing activities is preferred but not always possible during a wildfire. Education of field crews and machinery operators could improve abilities to identify cultural features and avoid these sites.



Figure 5.20. Bulldozer push piles displaced cultural materials at site 07-0698.

Though not visible on the surface, it is likely that subsurface deposits were affected during Rodeo-Chediski. Trees often grow in close association with cultural resources (Rockman 2015; Ryan et al. 2012). Burned-out stumps in features (e.g. Figure 5.26) suggest subsurface damage to sites from smoldering fire that travels through root systems and organic materials in the soil, slow-moving burns that can scorch deposits over a meter below the ground surface (Ryan et al. 2012). Burned-out stumps are ubiquitous in the study area and in burned forests more broadly. Potential impacts to subsurface deposits should be considered prior to testing or excavation in fire-impacted areas.



Figure 5.21. Exposed elements of a feature wall on site 07-0612 erode downslope with associated artifacts.

Collecting evidence of burned artifacts was not a goal of the 2018 survey and Bagnal records only included a few photos of direct effects on cultural materials. Crews identified what looks like post-depositional scorching on some ceramic items (Figure 5.18) and faded black mineral paints derived from iron oxides, manganese ores, and other clay minerals (Figure 5.19; Ryan et al. 2012).



Figure 5.22. A large corrugated sherd from site 07-2227 appears to have post-depositional scorching.



Figure 5.23. Faded organic paint on sherds at site 07-2236.

Direct effects to prehistoric sites from combustion do not present significant threats in the long term; however, scars of suppression impacts remain and continue to exasperate damage on affected sites in the study area. The severity of direct effects bears directly on the nature and extent of long-term, indirect effects which can operate on an impacted landscape for months, years, and even decades after a major wildfire.

#### *Indirect Effects*

Indirect effects of Rodeo-Chediski were identified on all ninety (90) prehistoric sites in the study area in 2018, which, to varying degrees, bears on reconnaissance and interpretive abilities. The identification of such impacts on 100% of sites in 2018 suggests that this trend persists outside the boundaries of the study area. The most destructive effects of Rodeo-Chediski appear to be long-term, indirect ecological changes to the landscape brought on by the fire. Shifts in forest composition and intensified geomorphic processes brought on by a wildfire have serious implications for prehistoric site integrity, survey conditions, and data collection and interpretation. High-intensity fires impacts nutrient cycling in the soils, as large inputs of decay-resistant plant litter and a lack of microbial activity reduce

nutrient availability in mineral soils (Moore et al. 2004). The loss of protective vegetation, formation of water-repellent (or hydrophobic) soils, and increase in overland stream flows from lowered soil absorption rates results in accelerated geomorphic processes, increasing soil erosion and deposition on the hillslopes of a fire-impacted watershed (Ffolliott et al. 2011:82). Chemical changes altering the biotic communities supported by these soils results in substantial and permanent ecological changes to the affected landscape (Neely 2012). On the Mogollon Rim, ponderosa is the grandmother of the woods. Without mature trees, the entire ecosystem is at risk.

Rodeo-Chediski burned in a patchy pattern of alternating high and moderate intensity. Some parts of Bagnol sustained impacts associated with moderate-intensity burns, which present as scorched and thinned areas with a few remaining mature ponderosas. Root systems and duff produced in these canopies aid soil stability and protect cultural materials. In the more prevalent high intensity burn areas, canopies were consumed entirely, along with much of the duff and litter that had obscured but protected artifacts, features, and site integrity. Without stabilizing vegetation to retain soil structure, erosion and sedimentation processes occur at unnaturally rapid rates, capable of exceeding by three orders of magnitude the volume of sediment under normal conditions (Ffolliott et al. 2011).

The highest peak stormflows originating on ponderosa pine watersheds of the Rim are generated from high-intensity, short-duration monsoon events (Ffolliott and Baker 1977), a climatic quality of the plateau that adds to issues related to stability of fire-impacted sites and landforms. Greater opportunities for post-occupational site changes occur in higher energy settings (Waters and Kuehn 1996), and the combination of a highly unstable post-fire environment and monsoon activity suggests sites in the study area have sustained compounding impacts in the erosive environment. Enduring impacts threaten to continually degrade the integrity of sites that have been exposed by high-severity wildfire.



Figure 5.24. High-severity burn impacts are evidenced by an open canopy and absence of duff on newly recorded site 07-2232.

Collectors have known about and visited Puebloan sites in the Rim region for years (Martin et al. 1962). Enduring exposure from Rodeo-Chediski presents opportunities to collectors as rich assemblages are newly visible for looters and inadvertent collecting. Decorated black-on-white ceramics are common in the study area; these conspicuous sherds appear in stark contrast to surrounding sediments and are easily spotted by an untrained eye. According to locals from the nearby Clay Springs community where the crew camped for much of the project, surface collection of decorated black-on-white ceramics is common in ASNF. Serious and accidental collectors are known to have descended upon well-known pueblo and Great Kiva sites after Rodeo-Chediski (Mead *personal communication*). Evidence of looting in the form of collector's piles (Figure 5.22), potholes, and hand-dug pits in features was observed at four prehistoric sites recorded in the study area in 2018. It is unfortunate that the most impacting effects of looting – the theft of artifacts – remains undetectable. To mitigate data loss, agencies should prioritize immediate post-fire salvage surveys in culturally sensitive areas and prepare for unauthorized collection at known, conspicuous, and accessible sites.





Figure 5.25. A collector's pile at habitation site 07-0612.

Long-term, indirect effects of Rodeo-Chediski are concerning; the once dense forest is now characterized by a shrubland. When mature trees are incinerated, soil structures become untethered and, along with the cultural materials within them, highly vulnerable to increased erosional processes. Exposure also increases "lootability"; artifacts on sites that lack pine duff, artifacts stand out conspicuously against gravels and mineral soil. These effects have implications for the integrity and future management of prehistoric sites in burned areas and are discussed in Chapter 6.

### *Conclusion*

Long-term effects of Rodeo-Chediski transformed Bagnol from a dense ponderosa pine forest to a more barren and denuded landscape dissected by arroyos and rivulets. Comparative analyses of PR1 and PR2 data reveal significant differences in site area and assemblage content – data used to inform cultural inferences about the prehistoric occupation. Differences in landform descriptions and site type also reflect fundamental changes to the character of prehistoric sites in the study area. Vegetation encountered in 2018 does not resemble that described in previous records, all fifty of which described a

dense canopy of mature ponderosa with oak or juniper. Over a third (34%) of PR1 records attribute site discovery to ground disturbance from logging activities and FS roads, giving pre-fire surveyors slivers of visibility in the duff-covered forest. With most (51.9%) of the ground surface visible on sites in 2018, artifact counts, and area occupied increased. PR2 sites were found to occupy a nearly 400% greater area and contain 350% more artifacts than indicated on previous records. The addition of forty new prehistoric sites to the Bagnal inventory also reflects improved surface visibility. In a study on the short-term fire effects, Todd and Burnett (2009) compared the pre and post visible assemblages of six sites and found that the number of artifacts observed increased by an average of 1592%, and site area increased by an average of 652%. Results from this study suggest that conditions from fire-induced exposure persisted for nearly twenty years after the Rodeo-Chediski wildfire.

PR2 data reflects a 10% increase in high-density habitation sites (n=5) and 10% increase in high-density artifact scatters (n=5). The PR1 dataset included more (n=8, 16%) low-density prehistoric habitation sites than PR2 records, and PR1 records identified 20% more features than the PR2 dataset. Sites with features tended to be associated with high-density scatters in PR2 records and with low density scatters in PR1 records, suggesting that these long-term effects can influence studies that rely on artifact densities to determine population size, for example. High-intensity fire oxidized the soil in much of the study area, preventing regeneration of new growth vegetation and rendering impacted areas barren for weeks, months and years after Rodeo-Chediski. The most severe disturbance observed at all sites in 2018 was erosion. Without stabilization or regeneration of vegetation, these sites will continue to sustain compounding impacts from erosion. Long-term, indirect effects of wildfire identified in this study have serious implications for the integrity and management of prehistoric sites in burned landscapes.

## CHAPTER 6: DISCUSSION

The imprint of fire is everywhere in western forests. Fire in ponderosa systems is a phenomenon that is as natural as wind and critical as rain. Frequent low-intensity prehistoric fire regimes once maintained a parklike environment with around a dozen large “veteran” trees per acre, creating more resilience to fire with less fuel accumulation close to the ground (Ffolliott et al. 2011; Franklin and Agee 2003; Noss et al. 2006). Once a friend of the forest, fires in the last two decades have become massive crown-consuming disasters that cause irreversible changes to affected watersheds and ecosystems. In areas impacted by high severity fire, where vegetation has been killed, soil has been damaged, and hydrologic systems permanently altered, many experts question whether the natural forest systems will ever return (Franklin and Agee 2003; Noss et al. 2006; Rockman 2015; Westerling et al. 2014). Cultural deposits are no less vulnerable to destruction and alteration than the ecosystem itself, which changed from a ponderosa forest to self-perpetuating shrubland after the 2002 Rodeo-Chediski wildfire. If current climate projections are correct, the frequency and magnitude of catastrophic wildfires will continue to increase at alarming rates; one wonders whether these trends can be reversed in the future.

The effects of fire-induced exposure to surface sites are two-fold: improved visibility promotes site detectability, but also subjects cultural materials to a barrage of threats such as erosion, dispersal, feature collapse, and unauthorized collection. Surface assemblages exposed in burned environments are more visible – but also imminently threatened. In the study area, effects of prolonged exposure from Rodeo-Chediski resulted in an expanded cultural resource inventory, including the addition of over a dozen NRHP-eligible sites that went undetected in pre-fire surveys. Exposure is advantageous for site and artifact identification, but sites in high severity burn areas sustain continued and severe impacts from the lack of stabilizing vegetation, almost twenty years after the fire event. Significant increases in site area

and feature and artifact counts from the same fifty sites suggest that these expanded site boundaries and assemblages are outside the range of natural variability.

Results from comparative analysis of with PR1 and PR2 data from Bagnal sites, landscape-level alterations in the years after a major forest fire have major consequences for the identification, interpretation, and preservation of archaeological data. With improved surface visibility, artifact counts in 2018 more than tripled pre-fire counts for the same sites. In pre-Rodeo-Chediski site records (PR1) site area averaged 1,435 m<sup>2</sup>; in 2018 the average area for the same sites increased to 5,018 m<sup>2</sup>. The substantial increases in artifact and feature counts and site area reflect artifact dispersal and improved visibility. Differences in the surface expressions of the fifty relocated sites have implications for the future management of these resources. Interpretations of survey data from fire-impacted areas must be put in the context of the post-fire depositional environment, which, in the case of the present study, was drastically different than what was encountered in pre-fire surveys.

Sixteen years after Rodeo-Chediski, conditions in Bagnal remained conducive to artifact identification, but exposure also made sites vulnerable to erosion. Changes from long-term effects of wildfire can upend existing cultural resource inventories and by extension, the interpreted prehistory of an area. This chapter reviews results from this study and the cumulative effects of Rodeo-Chediski on archaeological survey conditions, site integrity, and future research and management of impacts to resources and landscapes.

### *Survey Conditions*

Fire-induced changes affect archaeological data and interpretations; what we choose to document and how it is interpreted depends on the identification of wildfire-induced patterns (Ryan et al. 2012; Schultz 2010). Immediate and persistent changes in vegetation density and composition affect visibility during survey, and increased erosion exposes and buries cultural materials (Buenger 2003). Soils lacking protective cover and stabilizing microbial qualities resulted in erosion that has denuded the

landscape and the sites within it. A better understanding of the conditions that influence survey outcomes inform reconnaissance strategies, allow quantitative analyses, and promote confidence in patterns identified (Banning et al. 2006). Survey conditions and surface visibility in 2018 were categorically different than those that characterized the pre-fire landscape.



Figure 6.1. High severity burns removed vegetation, causing profound horizontal sheet wash at site 07-0160. Surviving mature trees in the background reflect the patchy mosaic pattern that characterizes wildfires in southwestern ponderosa forests.

Rodeo-Chediski transformed the once-dense forest to an erosive shrubland with few surviving mature trees (Ffolliott et al. 2011). Pedestrian survey is effective only if part of a site is on the surface and that surface is cleared enough to recognize its contents (McManamon 1984), and the primary (and perhaps only) advantage of recording in burned landscapes is improved visibility. Complete site inventories benefit land managers since known resources can be better funded and managed (Hanson 2001). Surveys undertaken in the parcel in 1974 and 1990 were characterized by different conditions than in 2018; visibility data from PR2 suggests that Rodeo-Chediski cleared more than half (51.9%) of duff that once obscured Bagnal site surfaces. In 2018, forty additional prehistoric sites including fourteen NRHP-

eligible sites were added to the Bagnal inventory. Aerial images show the changes in surface visibility apparent from 50,000 feet (figures 6.2 and 6.3).

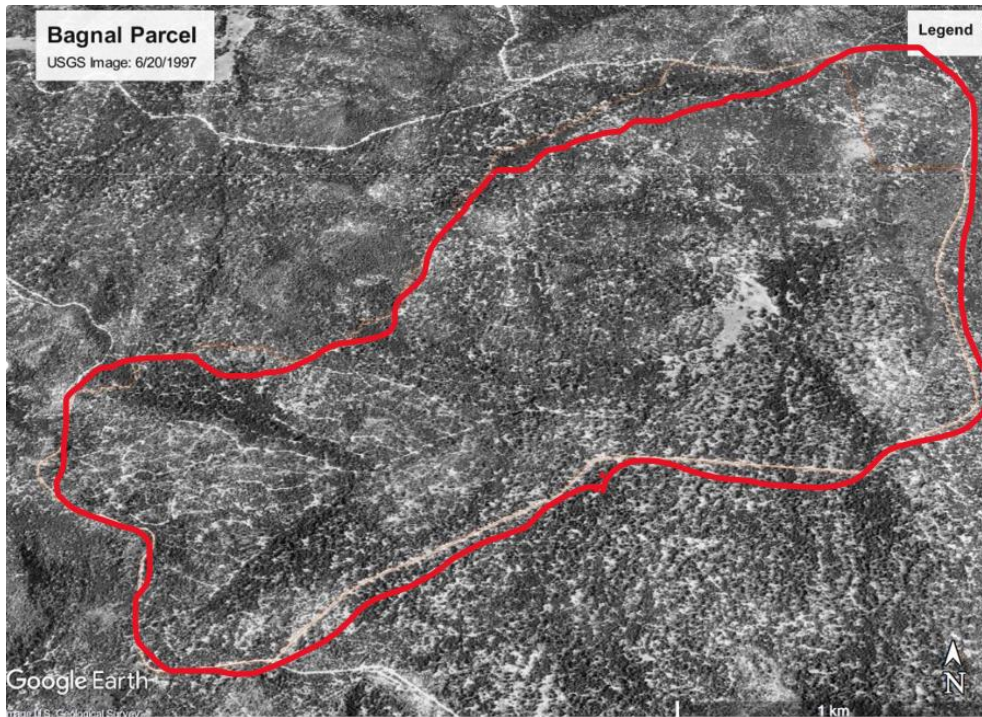


Figure 6.2. Aerial image of Bagnal before Rodeo-Chediski in 1997. Imagery from USGS, contrast enhanced.

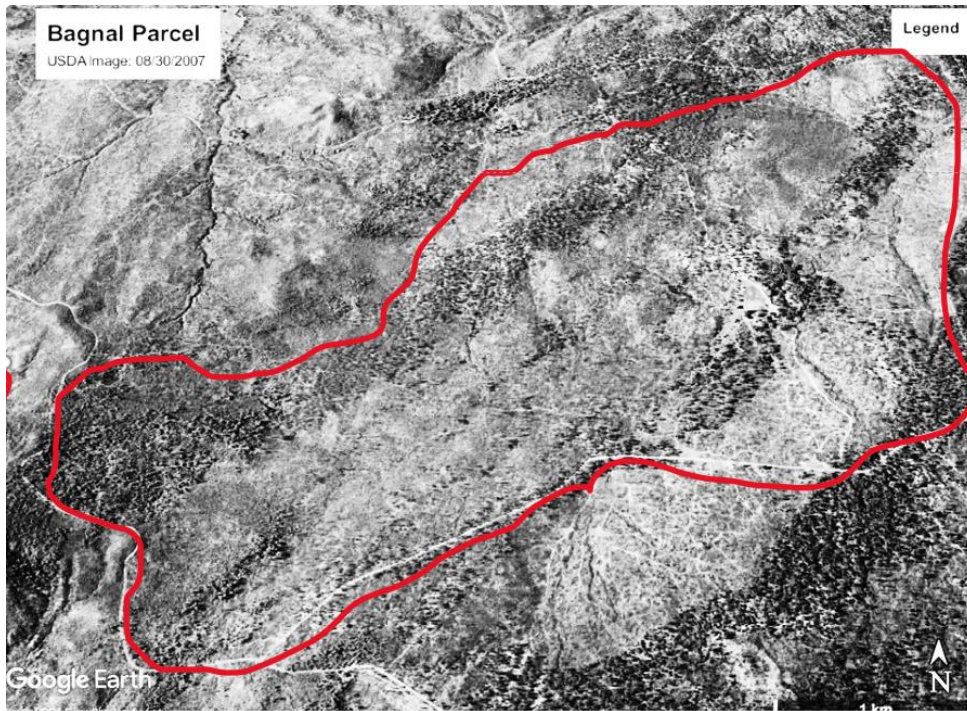


Figure 6.3. Aerial imagery of Bagnal in 2007. Imagery from USGS, color removed, and contrast enhanced.

Burn severity factors prominently in post-wildfire survey conditions. Neely (2012) evaluated long-term differences in vegetation regrowth of high- and moderate-intensity burn sites and found that nine years after Rodeo-Chediski, the depth of groundcover of high severity burn sites was one-thirteenth that of the moderate severity burn sites. Understory vegetation – including various types of brush, grasses, annuals, and forbs – thrives in the post-fire environment, able to absorb sunlight in the absence of a mature canopy and layer of duff. Herbaceous production directly influences surface visibility and site conditions. Due to competition between new-growth vegetation like manzanita (Figure 6.4) and regenerated ponderosa saplings, long-term effects of Rodeo-Chediski will likely result in the transformation of the pine forest into a desert scrub ecosystem (Neely 2012; Strom 2005). The permanent change of high-severity impacted areas from forests to scrublands has implications for archaeological data collection and site preservation that are not yet understood.



Figure 6.4. Manzanita thriving in a post-fire environment at site 07-2211.



Figure 6.5. Oak saplings and thin grasses leave much of the surface visible at site 07-0131.

Hyper local conditions and fire behavior dictate effects that cause differential groundcover, even within a small area. Figures 6.5 and 6.6 illustrate how visibility can vary within a single site.



Figure 6.6. Poor visibility around the datum tree, a surviving ponderosa at site 07-0141.





Figure 6.7. Good visibility at the same site (07-0141), in an area where high severity burns removed 100% of the canopy.

The importance of spatial relationships in archaeology cannot be understated; patterns in the relative positioning of artifacts and features within sites and between sites and features of the landscape inform research questions about prehistoric resource use and behavior, settlement choice, and the nature of occupations (Kvamme 1989; Schiffer 1983; Wildesen 1982). Post-depositional changes from long-term fire impacts like those sustained by Bagnol sites weaken interpretive potential of spatial data. Though beneficial for data recovery, the elimination of mature canopies following Rodeo-Chediski caused serious issues for landform stability and site preservation. Exposed surfaces are vulnerable to erosion and sedimentation processes which impact site integrity and content, altering interpretability of surface assemblages. The increase in PR2 artifact counts could be interpreted as more extensive prehistoric occupations than the content identified in the same sites before Rodeo-Chediski. A site that appeared in 1975 to be a scatter of twenty artifacts confined to a logging skid trail expands to a sprawling habitation site containing thousands of artifacts (e.g. site 07-0130 or 07-0165), exposed and dispersed in the post-fire environment. Archaeologists must consider the effects of these processes and the types of changes

associated with their operation (Wildesen 1982). Results from this study suggest that in Bagnol, the escalation of these processes after Rodeo-Chediski affected the character of its archaeological inventory.

### *Site Integrity*

*Archaeologists must be willing to study the effects of disturbance on resources or resign themselves to the cessation of archaeological fieldwork.*

Tamalge et al. (1977)

The study area was occupied intensively during the Puebloan period, in part due to its location on the edge of the Mogollon Rim. The prehistoric import of the 1,500-acre study area is reflected in its many known surface sites, 40% of which are significant enough to include on the National Register. The density of impressive prehistoric sites within and beyond the study area suggests that the region contains archaeological data that we must preserve for study by future generations. The first order of business in preservation is to identify the nature of the cultural and noncultural formation processes that create and alter archaeological deposits (Schiffer 1983). The identification of long-term wildfire impacts on 100% of prehistoric sites in Bagnol suggests these trends persist beyond the boundaries of the study area.

Evaluations of site integrity consider the spatial relationships of artifacts and features within a site and the degree to which cultural materials exist *in situ*. The transfer and removal of artifacts directly affects site integrity, data potential, and the validity of cultural inferences based on spatial relationships within and between sites (Wildesen 1982). With active post-depositional disturbances operating on all sites in the study area in 2018, site integrity is affected as cultural materials lose provenience. The environmental context and contents of each site vary and are differentially impacted; while long-term wildfire impacts modify parts of a larger site, the same processes can destroy smaller ephemeral sites. Low-density prehistoric scatters – the most ubiquitous site type in the American Southwest – become the most vulnerable to destruction in highly erosive environments like that of the study area. The implications for data interpretation apply at the regional and landscape levels; sites that have been destroyed or are otherwise unrecordable result in the fragmenting of the record of human settlement and activity (Waters

and Kuehn 1996). Regional and landscape studies referencing site distribution are affected and gaps in the inventory can alter interpretations of, for example, communication networks and settlement choice (Sullivan 1992). Though a low-density prehistoric scatter does not offer much data potential on its own, the importance of these common sites lies in their spatial relationships to one another and their distribution across the landscape. Given the increasing amount of data from archaeological surveys and environmental variability, more synthetic investigations of small sites are warranted (Mehalic 2012).

Four of the more significant sites selected for case studies reveal changes at the site level that are beneficial for data collection but discouraging for future site preservation. After Rodeo-Chediski site 07-0130 transformed from a small scatter to a NRHP-eligible multi-feature habitation site. Previously three small scatters, exposed (and looted) site 07-0165 was found in 2018 to represent a single cohesive occupation. Habitation site 07-0603 was also the resulting combination of two previously distinct small scatters, though prolonged exposure dispersed much of the assemblage and its features need stabilization. Site 07-0612 sustained the most severe damage of the four; two features including a great kiva were not relocated despite exhaustive efforts and good visibility, and remaining features sustained extensive impacts from erosion and dozer push piles. These case studies demonstrate the different ways long-term effects manifest on and influence the integrity of even the largest sites.

The depositional environment of the Bagnal parcel prior to Rodeo-Chediski was characterized by wooded ridges, hills, and slopes, stabilized by root systems and duff from mature overstory vegetation (Strom 2005). The fire obliterated most mature vegetation whose roots stabilized landforms and layers of duff protected cultural deposits. High severity burn areas are characterized by increased soil erodibility with the destruction of organic or microbial material in previously stable soil structures (Gottfried et al. 2003). Oxidized soils become hydrophobic, or water-repellant, causing disruption due to natural soil erosion and deposition rates (Laughlin et al. 2011). Artifacts on the surface of hydrophobic soils are susceptible to water transport, especially during monsoons common to the Rim in the late summer and

early fall. Sheet and slope wash can relocate artifacts and bury ephemeral sites; evidence of these processes was ubiquitous in the study area in 2018. Wettstaed (1993), for example, observed a “puddling effect” when localized heavy downpours concentrated lithic debitage into concentrations that could be easily be mistaken for activity areas. In Bagnal it was common to find artifacts in pooled together at the base of slopes (e.g. Figure 6.8). Concentrations of artifacts downslope from a denuded hilltop have about the same spatial data potential as a collector’s pile.



Figure 6.8. A high-density concentration at site 07-2215 is likely a result of “puddling” or downslope dispersal.

Knowing the effects of erosion, sedimentation, and vegetation on resource integrity and detectability are crucial to produce accurate interpretations of the archaeological record (Wildesen 1982). Hydrological studies show that patterns of soil deposition following R-C are unpredictable, and generally dependent on cumulative effects depending on the severity of the fire, the magnitudes of post-fire soil erosion, hillslope topography, and the timing and nature of precipitation events after the fire (Ffolliott et al. 2011). Though the effects of these processes are highly localized and influenced by an array of

elements, a broad understanding of the ways these site formation processes operate in burned landscapes will aid more effective treatment strategies and more accurate cultural inferences.



Figure 6.9. Active displacement of artifacts in high severity burn area at site 07-2203.



Figure 6.10. Horizontal sheet flow at site 07-2242 redeposits lithic and ceramic artifacts downslope.

Studies have shown that post-fire erosion can increase by more than three orders of magnitude, transporting nearly fifty tons of material per acre; while some of the most severe effects are soon after the fire, increased erosion can persist for more than a decade (Ffolliott et al. 2011; Robichaud and Ashmun 2012). In post-Rodeo-Chediski watershed and hydrologic studies, increases in erosion rates were greatest after fires characterized by large percentages of high-severity fire and where high-intensity, short-duration rains fell on soil surfaces exposed by the fire (Ffolliott et al. 2011:24; Neely 2012). Localized climate patterns should be considered because these influence geomorphic processes and herbaceous production (Ryan et al. 2012; Bowman et al. 2011; Neely 2012). Monsoons produce more than one third (35%) of the region's precipitation, while the rest (65%) occurs in the form of snow and sleet during the winter months. These weather events continue to denude the landscape and impact the sites within it.

Cultural deposits are subject to alteration over time by various processes which at any moment define the nature of knowable history of human land use and cultural development (Wildesen 1982). Alterations to soil structure and landform stability in the post-fire depositional environment directly impact archaeological data collection and interpretation (Hanson 2001). The alteration of site morphology in burned landscapes results in the displacement of cultural deposits, altering spatial components of sites. Without a reliable spatial context, a scatter of sherds and flakes dispersed down a hill slope (e.g. Figure 6.11) lose spatial data potential of an intact deposit. Each subsequent degradational event diminishes the completeness of those portions of the geological and archaeological record that have survived into the present, and the greater number, duration, and intensity of erosional events, the greater the destruction (Waters and Kuehn 1996).



Figure 6.11. Active downslope dispersal of artifacts at site 07-0173. High-severity burning is evidenced by an open canopy and complete lack of duff on site.



Figure 6.12. Dislocated and dispersed masonry elements from roomblock feature at site 07-0612. Pre-fire records indicated that these features were intact and standing.

Architectural features are vulnerable to collapse and dispersal in an environment like this, and it is likely that some features have eroded into amorphous clusters of tabular sandstone and, lacking the linear qualities desired in a structure, not recorded as a feature. Figure 6.12 shows collapsed and dispersed elements of a feature that was reported to be intact and standing in the PR1 record. High-severity burning on this site (07-0612) is evidenced in this area by the lack of a mature canopy and absence of duff, which likely contributed to the dispersal of building materials. The conduct of archaeology implies by its very nature a spatial orientation; sites are distributed within regions and artifacts are distributed within sites (Kvamme 1989). The spatial component of sites and landscapes affects interpretations about prehistoric settlement and behavior, and when this component is no longer reliable, the site loses integrity. Lacking spatial integrity, sites lose data potential, or the ability to produce relevant, reliable, and interpretable information (Ryan et al. 2012), which directly influences future site treatment plans.

Fire-induced exposure led to a more complete inventory of the study area; however, exposure to varying degrees impacted the integrity of all sites in the study area, rendering inferences based on spatial positioning less reliable. Archaeologists and cultural resource managers working in and with data from burned and fire-prone western forests must recognize and adapt to variable conditions of these environments and the ways in which different impacts influence our ability to collect and interpret representative data from prehistoric surface sites. These results suggest that in a landscape as unstable as Bagnol's in 2018, geomorphic settings are not conducive to archaeological site preservation. Without immediate post-fire surveys and stabilization treatments, data potential of severely burned sites can erode indefinitely.

### *Management Implications*

Management of fire-prone forests is one of the most controversial natural resource issues in the West today (Noss et al. 2006). The majority of existing forests in the western U.S. are on federal lands managed by federal resource agencies (Westerling et al. 2014). As wildfires increase in frequency and



severity in the west, resource managers are faced with compounding threats from long-term impacts of these disasters. Results from this thesis suggest that long-term effects of exposure from wildfire can have measurable impacts on the character of an agency's archaeological resource base. What actions, before and after fire season, can we take to mitigate the negative impacts of high severity wildfire to archaeological sites in the future? If western forest fires continue to increase in frequency and intensity as indicated in climate projections (Laughlin et al. 2011; Noss et al. 2006), land and resource managers must devise effective planning initiatives aimed at mitigating data loss and resource damage. Generally, management of cultural resources is reactive. Looking ahead, we must take proactive measures to mitigate the most severe impacts of the fire events we know are coming.

Successful mitigation efforts require careful inventorying, monitoring, and interdisciplinary approaches to assessment and treatment. Detailed records of topography, geology, hydrology and biology during site recording improves interpretation, and may better prepare archaeologists to manage sites in the aftermath of the next fire. An awareness of how local materials and terrain responds to wildfire can inform interpretation of fire history, prehistoric occupation, artifact distribution and excavated features (Buenger 2003). An interdisciplinary approach that borrows data from other areas will promote more effective responses to wildfire and better equip archaeologists with the tools to differentiate between and interpret natural and cultural site formation processes (Rapp and Hill 2006). Post-wildfire vegetation monitoring studies can provide data critical for informing expectations about survey conditions. For example, results from a study monitoring ecological conditions after Rodeo-Chediski show that low-severity burn areas rebounded within around five years, but high severity burn areas were not expected to return to pre-fire conditions for decades (Ffolliott et al. 2011).

The development of appropriate and effective mitigation strategies requires that archaeologists can predict with some degree of reliability the nature of impacts expected in the field (Wildesen 1982). Higher resolution burn severity data would inform more accurate expectations of impacts at the site level.

More baseline cultural resource data is needed across the west. Without reference conditions, it is difficult to isolate and treat factors that damage and destroy sites. In his 1981 ASNF management plan, Fred Plog argued that “there is no question” that the greatest single source of potential impact on cultural resources is a “simple lack of awareness” of those resources. Funding should be provided to conduct cultural inventories of fire-threatened and burned federal lands. Post-fire inventories should be prioritized to document sites before they are affected by erosion and unauthorized collection. With more complete inventories and high-resolution data from different disciplines, ecological models can be applied to simulate long-term effects and inform management of archaeological sites in burned areas.

Predictive models using burn severity and environmental data would benefit agency archaeologists tasked with managing thousands of cultural resources over large areas. The Fire and Fuels Extension to the Forest Vegetation Simulator, or FFE-FVS, is a program that models stand development, fuel dynamics, fire behavior, and fire effects, allowing for fire behavior predictions, impact simulations, and the development of models that can compare immediate to long-term effects (Reinhardt 2005). The Fire Effects Information System, or FEIS, is an enormous online database of scientific literature related to fires, natural resources, and effects on federal lands in the U.S. (USFS 2002). Wildfire, biological, and forestry studies provide ecological and spatial data related to fire-induced changes to vegetation regimes, species production, and landscape integrity, for example. Interdisciplinary and informed approaches will result in the most effective mitigation and preservation plans. Federal databases like the FEIS and FFE-FVS provide valuable fire and ecological data to construct predictive models that can inform effective site management strategies.

The healthiest and most stable ponderosa pine systems are those that mirror the more parklike pre-contact forest conditions, with a few dozen mature trees per acre and diverse microhabitats (Kaldahl and Dean 1999; Mills et al. 1999; Neely 2012). The scientific consensus is that large and old fire-resistant veteran trees should be retained (Fulé et al. 1997; Noss et al. 2006; Westerling et al. 2014; Yue et al. 2013).

From an ecological perspective these are the last trees that should be removed because these are the most likely to survive a fire and therefore serve as focal points for recovery (Franklin and Agee 2003). The roots of these trees provide critical landform stabilization and are essentially irreplaceable because they can take decades and even centuries to reach veteran state. With oxidized soils offering little chance of vegetation regrowth, management treatments need to focus on land stabilization. Severe, long-term geomorphic manipulation of burned sites complicate management strategies and render preservation efforts difficult. Erosion can be mitigated by planting carefully selected vegetation whose root systems reinforce and strengthen soils. Revegetation, or the reintroduction of plants on or around an archaeological site, can be a less unobtrusive stabilization technique, as floral systems have the advantage of being elastic, and capable of dissipating wind and water energy that could destroy cultural deposits in unvegetated areas (Thorne 1999). Careful species selection produces a vegetative cover that blends well with the surrounding environment can enhance the habitat for the surrounding faunal community, adding the benefit of improving ecosystems on federal lands (Noss et al. 2006; Thorne 1999).

Results from this study and others highlight the importance of implementing proactive stabilization efforts on significant sites that have been burned at a high severity and are threatened by erosion. Hand mulching with straw has also been shown to stabilize sites in high severity burn areas and can be done with few materials (and a lot of hands). After Rodeo-Chediski, students from the University of Arizona led by Barbara Mills successfully stabilized a large pueblo village site in ASNF using straw (figures 6.14 and 6.15). Mulching by hand avoids potential disturbance by mechanized equipment and does not require much funding or training.



Figure 6.13. Hand mulching with straw was effectively used to protect a pueblo site burned over by Rodeo-Chediski. Photo by Barbara Mills, University of Arizona.



Figure 6.14. The mulching was successful in mitigating erosion at the pueblo site, the relatively stable landform seen here two years later in 2004. Photo courtesy of Barbara Mills, University of Arizona.

As the extended costs associated with wildfire are more widely recognized, investments in preventative treatments such as thinning and “pre-suppression” are increasingly favored over the current reactive system that gives funding priority to suppression (Lynch 2004). Federal land agencies across the nation are plagued by insufficient emphasis on proactive management *before* emergency mitigation is

needed. Funding is often allotted for suppression at the expense of preventative measures. Although the need to suppress fires will never disappear, increased emphasis on prevention would address the heavy fuel loads making western forests so prone to devastating fires. Fuel reduction treatments like prescribed burns and thinning reduce the severity of inevitable fire, improve recovery time, and contribute to ecosystem function before, during, and after the event (Neely 2012).



Figure 6.15. (Left) Remnants of a high-severity fire that burned through a ponderosa forest. (Right) Low-intensity fire in another ponderosa forest reduced vegetation but only minimally burned trees. Photo by NPS.

Forest fire mitigation efforts that consider the past role of natural fires in shaping western ecosystems inform effective management approaches to today's catastrophic fires (Gottfried et al. 2003). Most prehistoric sites in ponderosa forests have likely been burned by - and survived - numerous high-frequency, low-intensity fire regimes characteristic of pre-contact ponderosa forests (Hanson 2001). Prescribed burns replicate the fires that naturally maintained forests by encouraging nutrient cycling and self-regulating stand density while deterring catastrophic wildfires (Ffolliott et al. 2011). These are also advantageous because they allow time to survey before and immediately after the fire, providing improved surface visibility in a more controlled environment. Studies have shown that cool burning prescribed fires are likely to have a limited impact on the diagnostic characteristics of surface artifacts and features (e.g. Brunswig et al. 1995; Buenger 2003; Salyer et al. 1989). By reducing the volume of flammable fuels to prehistoric levels, prescribed burns and thinning treatments are less impacting to archaeological

sites, soils, and forest systems than wildfires. A combination of thinning and prescribed burn shows enormous promise for returning forests to natural pre-contact conditions (figures 6.16 and 6.17).



Figure 6.16. A typical untreated ponderosa pine plot before any thinning or prescribed burn in 2012. Tom Bean, USFS.



Figure 6.17. The same plot five years after thinning and two years after prescribed burn treatments. Tom Bean, USFS.

A caveat to prescribed burns is the effect of fuel load; some studies show that there is potential to significantly impact surface archaeological materials if they are in close association with ponderosa logs and litter (Buenger 2003). To avoid replicating wildfire conditions, thinning treatments can decrease severity of prescribed and wildfires and their associated effects by controlling stand density of immature trees, redistributing growth potential to fewer trees past the sapling stage, leaving stands with desired structure and composition (Graham et al. 1999; e.g. Figure 6.18). In an assessment of effects of thinning on forest structure, Strom (2005) found that only 5% of untreated mature ponderosa pines survived Rodeo-Chediski, while tree survival was around 50% in areas that had been treated with prescribed burn or thinned prior to the fire. With the roots of mature ponderosas to stabilize landforms and duff to protect surface and near-surface materials from exposure-related impacts, thinning can mitigate the worst effects to archaeological site integrity by removing the fuels that feed high-severity fire.



Figure 6.18. Low-intensity fire rolls through the understory of a thinned forest, preventing an overhaul of the forest system brought on by crown-consuming wildfires. Photo courtesy of NPS.

Mixed conifer forests covering ~1.7 million hectares of the American southwest have undergone dramatic changes since Euroamerican settlement of the region (Huffman et al. 2015; Moore et al. 2004; Bowman et al. 2011, Ryan et al. 2012; Westerling 2014). Aggressive suppression, grazing, and over-logging

have disrupted natural fire regimes, resulting in denser forests that are ripe for megafires, only expected to become more frequent in the coming decades (Floyd et al. 2000; Fulé et al. 2007). Shifts in the composition of western forest systems from catastrophic wildfire results in long-term damage to soil and altered and destroyed biotic communities, which can shift from forest to self-perpetuating scrubland (Laughlin et al. 2011; Neely 2012; Saunders et al. 2007). The ecological implications of modern catastrophic fires in Ponderosa forests are complex, and the transformation of these forest systems have social, economic, and environmental effects that are not yet understood (Strom 2005). Recent wildfire events and current conditions in these forests call for proactive management approaches focused on ecological restoration to healthy pre-contact conditions to increase resilience to forecasted extreme fire events (Huffman et al. 2015).

#### *Conclusion and Future Research*

*The time has come for archaeologists to take a more active role in designing and participating in research that addresses contemporary environmental concerns and contributes to public policy.*

Frances M. Hayashida (2005)

We are now in the era of megafires – those that exceed 100,000 acres and burn until the wind changes or they run out of fuel (Dale 2009; Pyne 2008). Projections show an increase in heat waves in the western U.S. and droughts in the Southwest, and the fire season and area burned are expected to increase substantially by mid-century across the country (Franklin and Agee 2003; Noss et al. 2006; Westerling et al. 2014). In recent years, the size and scale of wildfires have changed dramatically, and the records for largest wildfire in state history are being broken – again and again. In 1996 the 61,000-acre Lone Fire was the largest on record. In 2002, Arizona was introduced to a new breed of destruction with Rodeo-Chediski which burned over 465,000 acres or 700 square miles, an area larger than the cities of Phoenix, Scottsdale, and Tempe combined. Primed by conditions brewing in western forests for over 100 years, megafires are expected to become more frequent over the next fifty years (Yue et al. 2013). Now that we are losing over



100,000 acres at a time, it may only take a few decades for much of our Western forests to disappear (Schoennagel et al. 2017; Yue et al. 2013).

On July 26, 2019 dry lightning struck a single snag in Bagnal and started a wildfire that burned over 2,500 acres, including 1,300 acres of the study area. As global temperatures rise and drought conditions perpetuate in the Southwest, forested areas will become increasingly vulnerable to natural (lightning) and human-caused wildfires (Franklin and Agee 2003). Because of Bagnal's proximity to Show Low, the study area occupies the contested wildland-urban interface (WUI), an area where residential areas overlap with undeveloped wildlands (Radeloff et al. 2005). With development from housing growth and suburban expansion in recent decades, the rapidly expanding WUI is increasingly a focal point for human-environment conflict. Wildfire events in the WUI can be devastating - the 2018 Camp Fire in California claimed at least 85 lives and destroyed over 18,000 structures. Suppression in these areas aims first to preserve life and property, and fire crews may not have the means to avoid damaging cultural and natural resources. The proximity of sites in the WUI to populated areas presents other issues related to visitation. Plog (1981) found that on sites near population centers like Show Low, incidence of vandalism was 150% greater and land modification 25% greater than those of wildland areas. Easily accessible from nearby Show Low and recently re-exposed by the 2019 wildfire, prehistoric habitation sites in this study are more than likely to have been looted since 2018 surveys.

Archaeologists in the West need to consider the different ways wildfires affect terrain, archaeological sites, and cultural materials (Buenger 2003). Awareness of potential effects and appropriate mitigation measures will improve understanding of site formation processes, which inform more effective preservation and stabilization strategies. Vast expanses of public land in the West requires that management strategies are effective and efficient, capable of mitigating resource damage on a large scale. Careful, methodical planning – far in advance of any fire event – mitigates potential adverse effects of wildland fire and management of fire on cultural resources (Rockman 2015). Cultural resource

managers should collaborate with and incorporate the research of disciplines like geology, physical science, and silviculture to devise the most effective and holistic mitigation and treatment strategies. Fortunately, the discipline has the tools to contribute valuable information to wildfire research. Geoarchaeology, landscape archaeology, and experimental archaeology can provide precise data about landform stability, the displacement of materials, erosion and sedimentation rates, post-fire vegetation regrowth, and effects to subsurface deposits. Excavations of sites in high-severity burn areas and studies tracing the movement of materials in these landscapes can inform expectations about site morphology and integrity. Long-term geoarchaeological monitoring studies on exposed site and feature integrity can inform stabilization plans.

Landscape archaeology, which blends geoscience with archaeological interpretation to understand the evolution of landscapes (Nicholson et al. 2007), evaluates with precision the long-term effects of wildfire on landform stability. A landscape archaeological approach will improve our understanding of effects by applying geoarchaeological concepts to a wider area beyond the site, situating impact studies into landscape and regional contexts to inform models related to post-wildfire landscape evolution and associated site impacts. Experimental burn studies would improve our understanding of wildfire impacts over time by allowing for controlled fire conditions and close monitoring. Though such studies are common in botany and forestry research, they have yet to break through into this discipline (Ryan et al. 2012). We have the means and the data to contribute important knowledge to wildfire research; understanding the severity of wildfire impacts should motivate us to support research and mitigation efforts. Future studies in the area of long-term effects will not only benefit the discipline but will contribute to broader national and international efforts aimed at reducing the ecological devastation of today's wildfires.

The fire season and area burned in the western U.S. are expected to increase substantially in the coming years as climate change generates higher temperatures and more frequent and intense droughts

(Franklin and Agee 2003; Saunders et al. 2007; Westerling et al. 2014; Yue et al. 2013). Changes in forest locations, extent, and types are projected to continue to occur throughout the southwest as catastrophic stand-replacing fires become more frequent and severe (Fulé et al. 2007; Moore et al. 2004; Westerling et al. 2014), unless action is taken to restore current conditions to pre-contact forest structure and function (Huffman et al. 2015).

Archaeological survey data collection, interpretation, and preservation efforts will improve with increased awareness of the severe but understudied long-term impacts of wildfire. This thesis is an attempt to document the effects of wildfire on archaeological sites, like those which transformed the landscape and prehistoric inventory of Bagnal. There is little research documenting or comparing the pre and post long term effects of fire on specific site surveys. The massive 700-square-mile Rodeo-Chediski wildfire of 2002 provided an unfortunate, but natural experimental opportunity to study these questions. Because both natural and human intervention resulting from these fires profoundly affects our ability to accurately document sites, findings discussed here show the urgency and importance of careful post fire surveys, as there is a window of opportunity here to collect data after fires before human intervention and the natural effects of erosion destroy much of the site integrity.

With longer and more devastating fire seasons projected in the future, it is inevitable that more southwestern forests will burn to the ground. These threats are real and impacts severe. Archaeologists must contribute to the conversation with interdisciplinary research and proactive management efforts focused on understanding and mitigating the impacts of these devastating wildfires on the cultural and natural resources we strive to protect. Spurred and exacerbated by human activity, wildfires in western forests today continue to surpass all in recorded history in size and severity, and many high-severity burn areas are not expected to return to the forests they once were (Moore et al. 2004; Noss et al. 2006; Rockman 2015; Strom 2005). Today's wildfires result in loss of life, long-term damage to soil, altered and destroyed biotic communities, declining air quality, and billions of dollars in suppression and rehabilitation

costs (Noss 2006; Strom 2005). Results from this study suggest the effects on archaeological sites are proportionately damaging. Given the current situation there is an urgent need for controlled studies focused on the long-term effects of wildfire on cultural resources. As a discipline we have the data, tools, and incentive to make valuable contributions to climate-related research in an uncertain future. This thesis is a step in that direction.

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## APPENDIX A. RELOCATED SITE SUMMARIES

The following presents narratives of the fifty previously recorded (PR1 records) and relocated (PR2 records) sites that form the basis of comparative analyses. Tool, ceramic, and raw material types are listed in decreasing order of frequency. Each narrative first summarizes pertinent PR1 data, followed by PR2 information collected in 2018.

AR-03-01-07-0106 is a high-density prehistoric scatter situated on a foot slope of an unnamed ridge west of Bagnol Draw. 07-0106 was three separate sites in PR1 records (07-0106, 07-0163, and 07-0712), combined in 2018 because the three shared a continuous artifact scatter. 07-0106 was recorded in 1974 as an “undisturbed” scatter of 50-100 lithics occupying 50m<sup>2</sup> on and downslope from an east/west-trending ridge. 07-0163 was documented in 1975 as a thin but continuous scatter of 100+ lithics and one sherd occupying 600m<sup>2</sup> along the break of a ridge. 07-0712 was recorded in 1975 as a scatter of 10 flakes and 13 sherds confined to a 25m<sup>2</sup> area. The 1990 site update identified no changes from the 1975 record. The PR2 update found the (combined) site to contain 250-300 lithic and 450-500 ceramic artifacts dispersed over 17,360m<sup>2</sup>. The site sustained high severity burn impacts evidenced in the lack of mature overstory vegetation and scorched logs on the surface. Visibility was good with around 30% of the surface obscured by burned debris and pine duff. This site is recommended eligible for inclusion on the NRHP.

AR-03-01-07-0108 was recorded in 1974 as a prehistoric habitation site consisting of a two-room pueblo structure and associated scatter of 100 lithic and ceramic artifacts dispersed over 1200m<sup>2</sup>. The PR1 record identified severe impacts from logging and noted that pine duff likely obscured the extent of cultural materials. The PR2 record identified 68 sherds and 76 lithics dispersed over 5087m<sup>2</sup>. The feature was not relocated. The site sustained moderate severity burn impacts evidenced in several remaining ponderosas producing pine duff that obscures over 60% of the surface. Erosion was transporting artifacts downslope into a drainage channel to the south. This site is recommended eligible for inclusion on the NRHP.

AR-03-01-07-0131 was recorded in 1975 as a scatter of 10 ceramics and possible one-room pueblo occupying 1000m<sup>2</sup> of a shallow ridge about 70m north of FR 140. PR2 records identified 22 ceramics and eight lithics dispersed over 2,023m<sup>2</sup> on a nearly level floodplain of a small tributary along Bagnol Wash. The possible feature was not relocated. Mature ponderosas remain in the area but an open canopy on site suggests the locale was impacted by high-severity burn. Suppression impacts, regular inundation, and grazing were noted to have contributed to increased erosion that was dispersing artifacts downslope. Visibility is fair with around 30% of the surface obscured by woody debris, thin grasses, and forbs. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0132 was recorded in 1975 as a scatter of 10-20 sherds dispersed 100m<sup>2</sup> on a hilltop. PR2 records documented 20 ceramic and lithic artifacts widely dispersed over 2,827m<sup>2</sup> on a hillslope. High severity fire resulted in an open canopy and good visibility, around 25% obscured by thin grasses, sparse manzanita, and burned debris. Other impacts include saw-cut stumps, dozer push piles, and erosion which has distributed artifacts downslope. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0137 was recorded in 1975 as a scatter of 50 lithics and a single mano occupying 1,021m<sup>2</sup> on a hilltop. The PR2 update identified 72 lithics, 9 ceramics, and 2 groundstone items dispersed over 4421m<sup>2</sup> on an actively eroding pronounced hillslope. High severity burn is evidenced by the open canopy and lack of groundcover; visibility is good with around 30% obscured by burned debris, manzanita, grasses, and forbs. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0139 was recorded in 1975 as a scatter of 100 ceramic and 50-100 lithic artifacts dispersed over 2,016m<sup>2</sup>. “Road encroachment” was identified as the sole threat to the site. The PR2 update identified over 300 lithic



and ceramic artifacts dispersed over 3,020m<sup>2</sup>. A newly identified daub concentration points to the presence of a structure. The site sustained high severity fire impacts and lacks a mature canopy. Erosion was prevalent throughout the site and a dozer path or fire break bisects a dense part of the artifact scatter. Visibility was good with around 30% obscured by manzanita, burned debris, forbs, and thin grasses. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0141 was first recorded in 1975 as a discrete scatter of 50-100 lithics dispersed over 500m<sup>2</sup>. In 2018 the site contained 49 lithics widely dispersed over 5,256m<sup>2</sup>. Remaining overstory vegetation suggests the site was impacted by moderate intensity burn, which left behind duff and burned debris on the surface. Artifacts situated in two shallow downslope drainages suggest erosion is impacting the assemblage. Biomass from surviving vegetation includes duff and leaf litter, which along with manzanita and thin grasses obscure 80% of the surface. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0143 was recorded in 1975 as a scatter of 20-30 ceramics and 10-20 lithics confined to 25m<sup>2</sup> in a skidder trail. 2018 fieldwork resulted in the identification of a continuous scatter between 07-0143 and 07-0144 and the two were combined under this site number. 07-0144 was recorded in 1975 as a scatter of 10-20 ceramic and 5-10 lithic artifacts distributed over of 120m<sup>2</sup>; both scatters were collected. PR2 records identified a sparse scatter of five (5) artifacts widely dispersed over a 4576m<sup>2</sup> area. The area was moderately burned, and small stands of mature ponderosa, oak, and juniper remain; mass sediment movement associated with sheet and slope wash were identified. Visibility was fair with 60% of the surface obscured by pine duff, burned debris, grasses, and manzanita. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0145 was recorded in 1975 as a scatter of 100 ceramics and 50-100 lithics thinly and widely dispersed over 1,400m<sup>2</sup> on a flat ridge top. The PR1 record notes that the nature of the scatter points to a pithouse locus, but logging disturbance precluded definition of possible depressions. The PR2 record identified 18 ceramics and 16 lithics dispersed over 3658m<sup>2</sup> on a ridge top. Severe impacts from extensive erosion and sheet wash, intensified from a lack of vegetation in the post-fire environment, point to high severity fire effects. Artifacts were scattered in and around bundles of woody debris and dispersed downslope by sheet and slope wash. Visibility in 2018 was good with around 30% of the surface obscured by manzanita, woody debris, and thin grasses. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0156 was recorded in 1975 as a scatter of 20 ceramic and lithic artifacts confined to 5m<sup>2</sup> in a FS road. The PR2 update identified 11 ceramic and 12 lithic artifacts dispersed over 1,524m<sup>2</sup> on a long and gently sloping ridge. Artifacts consisting primarily of debitage and small plain and brown ware sherds were observed within and adjacent to FR 9820W. Fire impacts to the site are relatively minimal and reflect moderate severity impacts; pine duff from remaining ponderosas obscure over 70% of the site surface. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0164 was recorded in 1975 as a one-room pueblo with four walls of undressed sandstone, three to five courses in height, and associated scatter of 30 ceramic and lithic artifacts dispersed across 1246m<sup>2</sup> in a (logging) skidder trail. PR2 records identified 34 ceramics and 16 lithics dispersed over 2,563m<sup>2</sup>. The structure was not relocated. The site's poor condition is attributed to high severity fire impacts evidenced by an open canopy and severe erosion operating on the assemblage. Visibility was good with around 25% of the surface obscured by burned debris, sparse manzanita, and thin grasses and forbs. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0167 was recorded in 1975 as two discrete artifact scatters, each estimated to contain 20-50 ceramics and 10-20 lithic artifacts, occupying 156m<sup>2</sup> on a northeast-facing slope of a ridge west of Bagnal Draw. The PR2 update identified six lithics, nine sherds, and one mano fragment dispersed over 3,835m<sup>2</sup>. The site sustained moderate severity burn impacts evidenced by sparse remaining overstory vegetation and pine duff. Sheet wash was impacting the surface of the landform and may have transported PR1 artifacts downslope. Visibility was poor with 80% of the site surface obscured by pine duff, woody debris, and dense grasses and annuals. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0168 was recorded in 1975 as a two- to four-room pueblo roomblock and associated scatter of 50 ceramic and lithic artifacts dispersed over 300m<sup>2</sup>. The site was situated in a disturbed area "under a thicket and

logging offal.” PR2 records identified seven sherds and 12 lithics dispersed over 3,612m<sup>2</sup> on a broad, flat knoll. No features or structural elements were relocated in the vicinity. Conditions on site point reflect moderate severity burn effects that resulted in the survival of canopy vegetation. These mature ponderosas continue to produce pine duff which, along with bunch grasses and forbs, obscured over 70% of the site surface in 2018.

AR-03-01-07-0169 was recorded in 1975 as a scatter of 40 ceramic and lithic artifacts confined to 150m<sup>2</sup> of a disturbed area at the junction of two logging roads. PR2 records expanded the assemblage to include 84 sherds and 46 lithics dispersed over 3,395m<sup>2</sup>. Fire and suppression impacts were identified across the site, and the lack of canopy and indirect impacts related to slope wash and sedimentation suggest the site was burned at a high intensity. Flourishing new growth vegetation and burned debris obscured 60% of the surface. Sediments were identified in small downslope rivulets and the pronounced 4 to 15-degree slope makes the site susceptible to increasing erosion. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0170 was recorded 1975 as a scatter of 20-50 ceramics and 10-20 lithics confined to 48m<sup>2</sup> in a logging road. PR2 records identified 18 flakes dispersed over 2,543m<sup>2</sup>. Impacts identified in 2018 include slope erosion, fire, and suppression impacts, and a disused two-track bisecting the site may be the logging road described in 1975. Vegetation and debris on site reflect both high- and moderate-intensity burn impacts; 50% of the surface was obscured by burned debris, manzanita, annuals, and thin grasses. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0173 was recorded in 1975 as a scatter of 50-100 ceramics and 20-50 lithics occupying a disturbed 150m<sup>2</sup> area at the junction of two logging roads. PR2 records identified a smaller scatter of nine flakes occupying 100m<sup>2</sup> of a hillslope with angles ranging from 8 to 14 degrees. High-intensity fire impacts evidenced by the lack of a canopy and sparse new-growth vegetation have resulted in channelization of areas with pronounced slope. Visibility was good with around 30% of the surface obscured by burned debris, manzanita, and sparse grasses. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0174 was documented in 1975 as a sparse scatter of 10-30 ceramic and 20-40 lithics occupying 400m<sup>2</sup> at the confluence of two small washes. In 2018 the site contained 22 ceramic and 11 lithic artifacts dispersed across 3,803m<sup>2</sup> on a hillslope at the confluences of two unnamed drainages. The site appeared to have been impacted by moderate intensity fire that left behind a few mature ponderosas and pine duff. Visibility was fair with 60% of the surface obscured by duff, woody debris, and grasses and annuals. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0175 was recorded in 1975 as a sparse prehistoric scatter of 10-20 ceramics and 10-20 lithics dispersed over 192m<sup>2</sup> in a logging skid trail. Site discovery was attributed to the ground disturbance. The PR2 update identified 14 sherds and one flake dispersed over 1,083m<sup>2</sup>. High severity burn impacts were evidenced by a completely open canopy lacking mature trees; erosion was actively displacing artifacts downslope. Visibility was fair with around 60% of the surface obscured by new growth vegetation including relatively dense forbs, grasses, and shrubs. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0178 was recorded in 1975 as a scatter of 20-30 lithics and ceramics occupying 257m<sup>2</sup>. A 2008 update identified 30 artifacts dispersed over 959m<sup>2</sup>. In 2018 the site contained 13 sherds and 11 lithics scattered over 3,959m<sup>2</sup>. The site sustained moderate severity burn impacts evidenced by surviving mature ponderosas and relatively abundant pine duff covering over 75% of the surface. Impacts identified in 2018 include saw-cut stumps and logs attributed to suppression efforts, and effects related construction and maintenance of adjacent FS roads FR 140 and FR 9822P. Active erosion was depositing sediments downslope in a shallow drainage channel. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0188 was recorded in 1975 as a low-density scatter of 20-50 ceramic and 10-20 lithics confined to an area of 32m<sup>2</sup> in a logging road. The 2018 update identified 13 ceramic and 18 lithic artifacts dispersed over 2892m<sup>2</sup>. The open canopy and abundant burned debris points to high severity fire impacts. Thriving new growth vegetation and woody debris obscured over 60% of the site surface. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0189 was recorded in 1975 as a scatter of 20-50 ceramic and 10-20 lithic artifacts confined to a disturbed 45m<sup>2</sup> area. In 2018 the assemblage contained two sherds and three flakes dispersed over 392m<sup>2</sup>. The site was burned at high-intensity and lacks a canopy, and erosion was identified as the primary impact. The surface consisted mostly of exposed Rim gravels and cobbles, apparently no longer able to retain fine sediments. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0191 was recorded in 1975 as a scatter of 100+ lithics and ceramics dispersed over 3,300m<sup>2</sup> on an east-facing slope of a low sandstone ridge. Three daub clusters and an agave concentration upslope from the scatter suggested the presence of features. PR2 records identified 250-300 lithics, 650-700 ceramics and a metate fragment distributed over 4,675m<sup>2</sup>. High severity burn is evidenced by the lack of canopy and duff. A dozer path or fire break bisects the western part of the site, and visibility was good with around 35% obscured by sparse forbs and burned debris. The agave concentration and daub were not relocated. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0602 was recorded in 1990 as a prehistoric structure and associated scatter of 20 ceramics, a biface, and two groundstone items dispersed over 1,000m<sup>2</sup>. The feature had been bulldozed for a two-track road. The 2018 site update identified 25 lithics and 128 ceramics dispersed over 3,184m<sup>2</sup>. Interpreted as a possible field house, the relocated structure is described as a poorly preserved rubble mound constructed of small, locally available sandstone blocks. The site is bisected by an FS road which may have acted as a fire break during R-C, as the area sustained moderate severity impacts evidenced by a remaining partial canopy. Erosion was displacing artifacts downslope from the feature and into dry rivulets that have formed in areas with more pronounced slope. Visibility was fair with 55% of the surface obscured by pine duff, thin grasses, forbs, and manzanita. This site is recommended eligible for inclusion on the NRHP.

AR-03-01-07-0620 was recorded in 1990 as a scatter of 10-50 ceramics and three metate fragments occupying 880m<sup>2</sup> on the side of a small hill. The 2018 update recorded a deflated scatter of two flakes and one sherd in a 25m<sup>2</sup> area. The site sustained moderate severity burn impacts and several mature ponderosas remain; relatively dense pine duff obscured more than 85% of the surface. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0622 was recorded in 1975 as a heavily disturbed scatter consisting of a wide range of ceramic types. The 1990 update recorded 10-30 lithics, 30-50 sherds, and a two-handed basalt mano concentrated in dozer mound. The site was assessed immediately after R-C in 2002 and found to contain 50-100 lithics, 25-50 ceramics, a large daub concentration, two rock alignments and a possible cross wall interpreted to be a field house, occupying 2,000m<sup>2</sup>. The 2018 update documented 42 sherds and 11 lithics dispersed over 2,265m<sup>2</sup>. The site reflects moderate severity burn impacts and some mature overstory remains. Typical of moderate-severity R-C burn areas, visibility is poor with around 80% obscured by pine duff and litter. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0624 was recorded in 1990 as a scatter of 10-30 ceramics and 10-30 lithics occupying 500m<sup>2</sup> on a broad, shallow slope. The 2002 post-fire assessment identified an additional feature with seven rooms and associated artifact scatter occupying 1,885m<sup>2</sup>. The PR2 record identified 77 ceramics and eight lithics dispersed over 3,109m<sup>2</sup>. The seven-room pueblo feature was not relocated. High-intensity burn resulted in an open canopy with only new-growth vegetation in the area including oak and juniper saplings. Tree fall, grazing, erosion, and sheet wash were impacting the site. Visibility was poor with around 75% of the surface obscured by burned debris, grasses and annuals, and manzanita. This site is not eligible for inclusion on the NRHP.



Thin grasses and woody debris at site 07—0624.

AR-03-01-07-0685 was recorded in 1990 as a diffuse scatter of 30 ceramics and lithics and amorphous remains of a structure occupying 450m<sup>2</sup> on a flat bench. The PR2 update identified two features and scatter of 56 ceramics and 14 lithics dispersed over 1610m<sup>2</sup>. One feature is an amorphous rubble mound of sandstone blocks with burned daub, and the other is described as a storage pit or cist constructed with local Rim gravel cobbles. Moderate severity burn impacts are evident in the few surviving ponderosas and remaining duff layer. Erosion and sedimentation were noted in addition to pre-R-C logging impacts. Visibility is good with around 30% of the surface obscured by manzanita, woody debris, and thin grasses and annuals. This site is recommended eligible for inclusion on the NRHP.

AR-03-01-07-0686 was recorded in 1990 as a three-room pueblo structure, detached wall, a cist feature, and associated scatter of 100+ sherds and 100+ lithics dispersed over 1,200m<sup>2</sup>. Impacts from roads and logging slash piles were noted in 1990. The 2018 update relocated the structure and identified 400-500 ceramics and 300-350 lithics dispersed over 10,442m<sup>2</sup>. The cist was not relocated but an additional bedrock milling feature was recorded. The lack of canopy and duff suggest high severity burn impacts; related impacts include saw-cut stumps and logs and a dozer push pile. Visibility is good with around 40% of the surface obscured by manzanita, woody debris, thin grasses, and young oak. The feature walls appeared to have been re-stacked, suggesting visitor impacts. This site is recommended eligible for inclusion on the NRHP.

AR-03-01-07-0687 was recorded in 1990 as a small prehistoric scatter of three flakes and 18 sherds occupying 267m<sup>2</sup> in a relatively level area. The PR1 record noted the site's poor condition. PR2 records identified only four artifacts dispersed over 2,673m<sup>2</sup> on a shallow slope of a ridge overlooking a tributary of Bagnol Draw. With an open canopy and only new-growth vegetation, high severity fire has severely impacted the stability of the site which was noted to have been eroded by sheet wash and channelization that has transported sediments downslope. Visibility is poor with around 65% of the surface obscured by manzanita, new growth oak and juniper, shrubs, annuals, forbs, and grasses. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0688 was recorded in 1990 as a scatter of 100 sherds and 10 flakes dispersed over 840m<sup>2</sup>. In 2018 site contents shared a continuous scatter with adjacent site 07-0704 and the two were combined under this site number. 07-0704 was recorded in 1990 as a one-room jacal foundation, daub scatter, and associated scatter of 30-50 lithics and 30-50 ceramics dispersed over 4,224m<sup>2</sup>. The combined PR2 record identified a daub concentration and scatter of 150-200 lithics and 250-300 ceramics dispersed over 5,724m<sup>2</sup>. The lack of pine duff and overstory vegetation suggests high severity burn impacts; new growth vegetation includes oak, ponderosa, and juniper saplings. Visibility was with around 35% of the surface obscured by thin grasses and woody debris. Artifacts were dispersed downslope. This site is recommended eligible for inclusion on the NRHP.



Burned daub with imprints on site 07-0688.

AR-03-01-07-0698 was recorded in 1990 as a habitation site consisting of a room foundation, small rock feature, and associated artifact scatter of 20-30 ceramics and 20-30 lithics dispersed over 1,200m<sup>2</sup>. The site had been heavily disturbed by blading. The 2018 site update identified four chert flakes dispersed over 2,558m<sup>2</sup>. No features were relocated. High severity fire impacts are evident in the lack of pine duff or a canopy. The area has been significantly modified from blading and bulldozing. Visibility in 2018 was good with around 45% of the surface obscured by manzanita and burned woody debris. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0699 was recorded in 1974 as a “very disturbed” two- to six-room pueblo and scatter dispersed over 200m<sup>2</sup>. The site was updated in 1990 and contained two large rooms, 21 small storage rooms, and two habitation rooms, in associated with a scatter of 100 lithic and 300 ceramic artifacts dispersed over 3,696m<sup>2</sup>. The 2018 update expanded the assemblage to an estimated 3,000+ lithic and ceramic artifacts dispersed over 6,355m<sup>2</sup>. The relocated structure was described as a large seven- to ten-room pueblo made with local sandstone blocks. High severity burn impacts are evidenced in the lack of pine duff, open canopy, and new growth vegetation that obscures around 50% of the surface. In addition to fire-related impacts, a packrat has made one of the features its home, and the feature is severely deflating from uprooted trees and erosion in areas of more pronounced slope. This site is recommended eligible for inclusion on the NRHP.

AR-03-01-07-0700 was recorded in 1990 as a multi-unit pueblo site with two structures and an associated scatter of 300-400 sherds and 5-10 lithics occupying 4,680m<sup>2</sup> on a ridge top. The 2018 update identified a rubble mound feature and associated scatter of 62 ceramics and 11 lithics dispersed over 2,971m<sup>2</sup>. The other feature was not relocated. The area appears to have sustained moderate intensity burn impacts and a few surviving ponderosas remain in the area. Visibility is poor with around 80% of the surface obscured by pine duff, forbs, and grasses. This site is recommended eligible for inclusion on the NRHP.

AR-03-01-07-0703 was recorded in 1990 as a two- to three- room structure with a sandstone wall alignment and associated scatter of 10-20 ceramics and 10-20 lithics dispersed over 875m<sup>2</sup>. Dosh reported that the site was heavily impacted by logging. The PR2 update recorded a masonry rubble mound, midden, and scatter of 64 sherds and 93 lithics dispersed over 1,967m<sup>2</sup>. Though mature ponderosas remain in the area, the site itself has impacts from high intensity burning including a lack of pine duff and open canopy. Visibility is fair with around 60% of the surface obscured by manzanita, woody debris, and thin grasses. Erosion has impacted sloped portions of the site. This site is recommended eligible for inclusion on the NRHP.



Burned woody debris on parts of feature at site 07-0703.

AR-03-01-07-0708 was recorded in 1990 as a large rubble mound feature with 15-20 rooms and associate scatter 300+ lithic and ceramic artifacts dispersed over 2,320m<sup>2</sup>. The 2018 update identified a two- to four-room structure

and associated scatter of over 500 lithic, ceramic, and groundstone items dispersed over 13,857m<sup>2</sup>. A newly identified exposure of burned bones and pottery may represent a human burial. The site lacks a canopy and duff, reflecting high severity burn effects. Erosion was noted in many areas of the site and an FS road bisects the site. Visibility is good with around 40% obscured by woody debris, manzanita, and sparse grasses. A collector's pile was identified near the feature. This site is recommended eligible for inclusion on the NRHP.

AR-03-01-07-0709 was recorded in 1974 as a scatter of 100+ lithics and ceramics occupying 3,600m<sup>2</sup> on the eastern slope of a ridge. A 1990 site update identified a smaller scatter of one flake and 20-30 ceramics dispersed over 1,600m<sup>2</sup>. The site was assessed after R-C in 2002 and an additional single room feature was identified; the site occupied 920m<sup>2</sup>. The 2018 update identified 24 lithics and 127 ceramics dispersed over 2,070m<sup>2</sup>. The site sustained high severity burn impacts and lacks canopy vegetation and duff; erosion was dispersing artifacts downslope in dry rivulets near the eastern edge of the site. Despite the burn intensity, visibility was poor in during this recording in September 2018 and over 75% of the surface was obscured by grasses, annuals, forbs, shrubs, and burned debris. This site was not evaluated for inclusion on the NRHP.



Grasses limit some visibility at site 07-0709.

AR-03-01-07-0710 was recorded in 1990 as a two- or three-room masonry structure and associated scatter of 20-50 artifacts dispersed over 2,304m<sup>2</sup>. In 2018 site content was found to share a continuous scatter with nearby site 07-0706 and the two were combined. 07-0706 was recorded in 1990 as small structure and scatter of 20-30 ceramics and 10-20 lithics dispersed over 1,200m<sup>2</sup>. Both sites noted adverse impacts from logging. In 2018 only one structure was relocated in addition to a small scatter of 12 ceramics and five lithics dispersed over 3,859m<sup>2</sup>. Mature ponderosas on the site point to moderate severity burn impacts. Visibility is poor with pine duff and grasses obscuring over 70% of the site surface. Evidence of sheet flow, general slope erosion, and deflation within the site follows terrain which dips downslope towards a canyon to the north. This site is recommended eligible for inclusion on the NRHP.

AR-03-01-07-0711 was recorded in 1975 as a heavily disturbed possible pithouse and scatter of 200-300 ceramics, 50-100 lithics, and one metate fragment dispersed over 600m<sup>2</sup>. A 1990 site update identified two jacal structures and scatter of four groundstone items, 20-30 lithics, and 10-20 ceramics dispersed over 1,764m<sup>2</sup>. The 2018 site update found only a scatter of 103 sherds and 76 lithics dispersed over 1,856m<sup>2</sup>. Fire impacts on site reflect moderate to high severity effects as it lacks mature ponderosas but a few large single-seed junipers remain. Visibility is fair with burned debris and grasses obscuring 50% of the surface. Erosion and sedimentation associated with adjacent ephemeral drainage channels actively impacts the assemblage. This site is recommended eligible for inclusion on the NRHP.

AR-03-01-07-0713 was recorded in 1990 as a four-room jacal structure, a sandstone mortar, and associated scatter of 30 lithics and 20 sherds dispersed over 2,852m<sup>2</sup>. Site impacts in 1990 related to an old logging road that bisected the site and a slash pile in the boundary. The 2002 post-fire assessment recorded a field house with two features and associated scatter dispersed over 3,040m<sup>2</sup>. It is possible that the single, larger feature identified in 2018 as a multi-room structure was recorded as two separate features in 2002. The PR2 update identified a multi-unit roomblock and associated scatter of 250-300 lithics and 300-350 ceramics dispersed over 4,718m<sup>2</sup> on a level, prominent high point with expansive views. Effects of high severity burning on site include a completely open canopy, lack of pine duff, and several burned-out stumps. A dead tree partially obscured the feature which may have resulted in its identification as a single feature (versus two separate features recorded in 2002). Ground visibility in 2018 was good with around 35% of the surface obscured by manzanita, woody debris, Gambel oak, and sparse grasses and forbs. This site is recommended eligible for inclusion on the NRHP.



Partially obscured walls of feature on site 7-0713.

AR-03-01-07-0715 was recorded in 1990 as a single two-room jacal structure foundation, a rock concentration, and scatter of 30-40 ceramics and 20-30 lithics occupying 1,806m<sup>2</sup> on a ridge. The PR2 update relocated the feature and identified a new daub concentration in association with a scatter of 81 sherds and 29 lithics dispersed over 7,643m<sup>2</sup> on a prominent high point of an unnamed ridge. Moderate severity fire is evident in the remaining ponderosa canopy and pine duff that obscures 60% of the surface. Impacts include uprooted stumps and saw-cut logs, a path bladed around the feature, a two-track bisecting the site, and active erosion observed to displace artifacts downslope in dry rivulets. This site is recommended eligible for inclusion on the NRHP.



Nice wall alignment on feature at site 07-0715.

AR-03-01-07-0716 was recorded in 1990 as a two- to four-room masonry structure with associated scatter of 60 lithics and 50 sherds dispersed over 2,000m<sup>2</sup> on a southwest-facing bench above a drainage of Bagnal Draw. PR2 records identified a two- to five-room masonry structure and dense associated scatter of 1000+ lithics and 1000+ ceramics dispersed over 11,991m<sup>2</sup>. occupying a slope, sustained high severity burn impacts and lacks a canopy; many barren areas suggest oxidization influenced soil productivity. Visibility was good with 20% of the surface obscured by woody debris and annuals. Cultural materials displaced downslope reflect erosion and slope wash. This site is recommended eligible for inclusion on the NRHP.



Slope erosion impacting integrity of site 07-0716.



AR-03-01-07-0717 was recorded in 1975 as a scatter of 10-30 lithics and ceramics occupying 160m<sup>2</sup> along a logging road. The PR2 update expanded the assemblage to 84 sherds and 250-300 lithic artifacts dispersed over 5,770m<sup>2</sup> on the top and slopes of a hill. High severity burn effects is apparent in the open canopy, and erosion was visible in bare, sloped portions of the site. Other impacts observed relate to a disused two-track and modern trash dump in the site boundary. Visibility was good with 25% of the surface obscured by woody debris, thin grasses, and sparse manzanita. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-0718 was recorded in 1990 as a scatter of 40-60 ceramics and lithics occupying 1,748m<sup>2</sup>. In 2018 site contents were found to overlap with nearby site 07-0172 and the two were combined. 07-0172 was recorded in 1975 as a thin, intermittent scatter of 10 sherds and one mano fragment on a low gravel ridge at the confluence of two washes. Logging disturbance was noted on both site forms. The 2018 update of the combined sites identified an additional structural feature, daub concentration, and associated scatter of 450-500 lithics and 450-500 ceramics dispersed over 8,342m<sup>2</sup>. Impacts included blading, a road bisecting the feature, and extensive erosion that has dispersed artifacts downslope and eroded out the feature. The site was impacted by high severity burning and lacks pine duff and a mature canopy; visibility is good with around 15% of the surface obscured by thin grasses, annuals, and sparse manzanita. This site is recommended eligible for inclusion on the NRHP.

AR-03-01-07-0720 was recorded in 1990 as a two-room structure and associated scatter of 10 ceramics and two flakes dispersed over 2,576m<sup>2</sup> on a bench. The PR2 update did not relocate the structure but documented a larger surface assemblage consisting of 300-350 lithics and 400-450 ceramics dispersed over 6,837m<sup>2</sup>. A scattered group of sandstone blocks did not have any linear qualities but may reflect remains from structure identified in the PR1 record. The site was in poor condition and high severity burning was apparent in the lack of mature vegetation. Severe impacts from extensive blading related to suppression efforts were present throughout the site. Visibility was good with 20% of the surface obscured by woody debris, manzanita, brush, and thin grasses and annuals. This site is not eligible for inclusion on the NRHP.

AR-03-01-07-1093 was recorded in 2002 as a single room feature and associated scatter of 15-30 ceramics and 10-15 lithics occupying 500m<sup>2</sup> on a hilltop. The 2018 site update recorded 26 lithics and 50 ceramics dispersed over 2,173m<sup>2</sup>. The sandstone feature was relocated and described as a one- or two-room structure (Figure xx). The site was impacted by moderate severity burning and several mature trees remain. Impacts include suppression evidence and active erosion observed displacing artifacts downslope. Visibility is good with around 30% of the surface obscured by a thin layer of pine duff, manzanita, and sparse grasses and annuals. This site is recommended eligible for inclusion on the NRHP under Criterion D.



Pueblo room feature and double-flagged datum on site 07-1093.

AR-03-01-07-1417 was recorded in 2002 as a single room masonry structure and associated scatter of 50-60 ceramics and 50-75 lithics occupying 375m<sup>2</sup> on a broad floodplain. 2018 investigations found site content to form a continuous scatter with nearby site 07-0135 and the two were combined. 07-0135 was recorded in 1975 as a scatter of 100 ceramic and lithic artifacts dispersed over 1,622m<sup>2</sup>. The 2018 PR2 update relocated the feature and an associated assemblage of 43 lithics and 69 ceramics dispersed over 4,279m<sup>2</sup>. The feature had been impacted by blading and was almost completely covered in burned debris. Moderate severity burn is apparent in surviving mature ponderosas and visibility is poor with over 75% of the surface obscured by pine duff, burned debris, manzanita, grasses, and annuals. This site is recommended eligible for inclusion on the NRHP.

## APPENDIX B. NEWLY RECORDED SITE SUMMARIES

This section summarizes data from forty (40) sites in the study area that were newly identified during the 2018 R-C Prescribed Burn Survey. Artifact counts presented here reflect the lowest number in the estimated range of total artifacts.

AR-03-01-07-2203 is a high-density prehistoric artifact scatter containing more than 500 lithic and ceramic items dispersed over an area of 4,762m<sup>2</sup>. Located on the top of and downslope from a ridge, high-intensity fire appears to have burned over the site and surrounding area; mostly barren soils have resulted in active erosion that is severely impacting the assemblage. Evidence of mitigation efforts include saw-cut stumps and felled trees. Surface visibility is good, around 30% obscured by manzanita and young juniper and oak.

AR-03-01-07-2204 is a prehistoric scatter of 42 lithics and 250-300 ceramics dispersed over an area of 3,278m<sup>2</sup>. The site appears to have been burned in a high-intensity stand replacing fire; only new-growth vegetation remains on the site. Impacts from fire and suppression efforts are evident in the numerous burned logs scattered across the site surface. Visibility is good with around 35% obscured by woody debris, thin grasses, and small annuals.



Scorched and fallen trees strewn across site 07-2204.

AR-03-01-07-2205 is a newly recorded low-density artifact scatter consisting of 48 sherds and 12 lithics dispersed over an area of 1127m<sup>2</sup>. The site, which occupies a west-facing ridge, was burned at a high severity and all mature trees are burned and downed. Surface visibility is 40% obscured by immature Gambel oak and manzanita, and erosion is active around the margins of the site.

AR-03-01-07-2206 is a newly recorded low-density prehistoric scatter containing at least 16 ceramics and 2 lithic artifacts on and downslope from a hilltop, occupying an area of 667m<sup>2</sup>. The site and vicinity were burned at a high intensity; remaining understory vegetation includes manzanita, native grasses, and young Gambel oak which obscure around 30% of the ground surface.

AR-03-01-07-2207 is a newly recorded moderate-density prehistoric artifact scatter containing at least 79 ceramic and 49 lithic items dispersed over an area of 3,227m<sup>2</sup>. A single white chert Awatovi Side-Notch projectile point was photographed and mapped. The site appears to have been at least partially burned and lacks a canopy; vegetation consists of new-growth Gambel oak and juniper. Ground visibility is fair with 45% obscured by bunch grasses and manzanita. Erosion is dispersing artifacts downslope towards an adjacent drainage.

AR-03-01-07-2209 is a newly recorded high-density prehistoric scatter consisting of an estimated 300-400 ceramic and lithic items dispersed over a 957m<sup>2</sup> area. The area has sustained wildfire impact; there is no longer a mature overstory and the area looks more like a grassy prairie than a forest. Ground visibility is good with sparse vegetation, including bunch grasses, Gambel oak, and narrow leaf yucca. Erosion is actively impacting the assemblage by displacing some artifacts downslope. Ground visibility is fair with bunch grasses, annuals, manzanita, and woody debris obscuring around 55% of the site surface.

AR-03-01-07-2210 is a newly recorded moderate-density prehistoric scatter consisting of 108 ceramic and lithic items dispersed over 1,974m<sup>2</sup> of a low flank on a shallow ridge. There is evidence that the site was extensively burned due to the lack of overstory vegetation. Ground visibility is fair with an estimated 50% of the surface obscured by bunch grasses and young oaks.

AR-03-01-07-2211 is a newly recorded low-density prehistoric scatter consisting of 70 ceramic and 19 lithic items occupying a 1,368m<sup>2</sup>-area. The site appears to have been burned over at a high severity and lacks mature overstory vegetation; remaining on site is dense manzanita that obscures over 60% of the site surface.

AR-03-01-07-2212 is a newly recorded low-density prehistoric scatter consisting of 23 ceramic and 12 lithic artifacts dispersed over an area of 1,171m<sup>2</sup>. The site occupies a burn scar and lacks all overstory vegetation. Manzanita, young Gambel oak and juniper, and bunch grasses obscure an estimated 30% of the ground surface. The assemblage is impacted by surface erosion in areas of pronounced slope, and sheet wash is evident in the wide dispersal of artifacts.

AR-03-01-07-2213 is a newly recorded low-density scatter consisting of 30 lithics and 35 ceramics occupying 985m<sup>2</sup> along the eastern margins of Linden Draw. The site was at least partially burned and lacks an overstory; surface visibility is fair with immature juniper, manzanita, and various bunch grasses obscuring approximately 40% of the ground surface.

AR-03-01-07-2215 is a newly recorded high-density prehistoric scatter composed of 900 to 1000 lithic and nine ceramic artifacts within a 3,502m<sup>2</sup> area occupying a shallow west-facing slope of a saddle. The site was only partially burned over; a handful of mature ponderosas still comprise the overstory. Ground visibility is fair, with around 50% of the site surface obscured by new-growth vegetation such as scrub oak and sparse bunch grass.

AR-03-01-07-2216 is a newly recorded sparse artifact scatter consisting of one ceramic and four lithic artifacts occupying 464m<sup>2</sup> of a shallow east-facing slope along Bagnal Wash. Ground visibility is fair, with an estimated 55% of the site surface obscured by new-growth vegetation including Gambel oak, manzanita, young juniper, and sparse rabbit brush and bunch grasses. The site is in poor condition from fire- and mitigation-related impacts evident in downed trees, saw-cut trunks, slash piles, and a dozer cut through the north part of the site.

AR-03-01-07-2217 is a newly recorded prehistoric habitation site consisting of a multi-unit rubble mound feature, a midden, and dense mixed artifact scatter consisting of an estimated 900-1000 sherds and 700-800 lithic artifacts dispersed over an area of 8,743m<sup>2</sup>. The structure is constructed of locally available, partially shaped sandstone blocks and appears to contain two to five rooms (Figure xx). The site appears to have been burned over entirely and lacks mature overstory vegetation. Large scorched trunks and stumps are scattered across the site, and sparse new-growth vegetation makes for improved ground visibility, with only about 20% of the surface obscured by manzanita, deer grass, and small annuals.



Burned-out stumps and exposed structure at site 07-2217. Pin flags in background mark artifact locations.

AR-03-01-07-2218 is a newly recorded prehistoric habitation site consisting of a single-unit rubble mound structure and sparse mixed artifact scatter of seven sherds and one flake dispersed over an area of 978m<sup>2</sup>. The site appears to have sustained high severity burn impacts and lacks overstory vegetation. Surface visibility is good with an estimated 30% of the surface obscured by numerous fallen trees and woody debris, and some new-growth juniper and oak. The feature is immediately adjacent to a cattle tank in an area heavily used by livestock. The proximity of a user-created road and the paucity of artifacts suggests that the site may have been surface collected.

AR-03-01-07-2220 is a newly recorded lithic scatter consisting of 19 flaked stone artifacts distributed over an area of 1,899m<sup>2</sup> occupying a shallow slope above an unnamed drainage. The area appears to have been burned at a moderate severity as mature ponderosas and oak remain in the site. Ground visibility is poor, with over 80% of the site surface obscured by pine duff.

AR-03-01-07-2221 is a newly recorded prehistoric site consisting of a one-room rubble mound feature and small but dense mixed artifact scatter occupying 2,044m<sup>2</sup> on a southeast-facing hill slope within the Bagnal Draw drainage. A total of 40 sherds and 37 flakes were identified in proximity to the feature which may represent a field house. Ground visibility is good, with less than 30% of the surface obscured mostly by woody debris and bunch grasses. The entire area appears to have been burned over at a high intensity as there is no mature overstory vegetation in the vicinity of the site.

AR-03-01-07-2222 is a newly recorded prehistoric habitation site consisting of a multiunit rubble mound structure, three bedrock mortars, and a large, dense mixed artifact scatter. The site occupies an area of 9,484m<sup>2</sup> on a bench and adjacent slope situated on a prominent scarp in the Bagnal Draw drainage basin. The surface assemblage consists of over 1000 lithic and 1000 ceramic artifacts; three groundstone items were also recorded. The site appears to be burned at a high intensity, as it lacks a mature overstory and the surface is littered with scorched woody debris and logs. Ground visibility is good, with only around 20% of the surface obscured by sparse manzanita, young juniper, and small annuals.



A rubble mound at site 07-222 is indicative of a structure but too disturbed to define.

AR-03-01-07-2223 is a newly recorded prehistoric scatter consisting of 40 sherds and 15 flakes widely dispersed across an area of 6,517m<sup>2</sup>. The site appears to have been burned at a moderate intensity; the surface is littered with burned debris, but a few mature ponderosas still stand in the vicinity. Ground visibility is fair with around 40% obscured by understory vegetation including manzanita and grasses.

AR-03-01-07-2224 is a newly recorded sparse prehistoric scatter consisting of 28 ceramic and six lithic artifacts distributed over a 3,170m<sup>2</sup> area occupying a low spur ridge and east-facing slope of the Mogollon Rim. The site appears to have been burned over at a high intensity as it lacks mature overstory vegetation. Immature juniper, manzanita, and woody debris obscure an estimated 25% of the site surface.

AR-03-01-07-2225 is a newly recorded sparse prehistoric scatter consisting of at least one groundstone, 20 ceramic and 19 lithic artifacts distributed over a 1,923m<sup>2</sup> area which encompasses several items that have eroded into rivulets downslope. The site appears to have been burned over at a high intensity and is most threatened by active erosion. The emerging understory vegetation obscures an estimated 45% of the site surface.

AR-03-01-07-2226 is a newly recorded low-density prehistoric scatter consisting of 43 ceramics and eight lithics dispersed over 2,478m<sup>2</sup> occupying a ridge adjacent to the Mogollon Rim. The site was at least partially burned over; mature overstory ponderosas and juniper stand near but outside the site boundary. Ground visibility is fair, with around 30% of the surface obscured by bunch grasses and manzanita.

AR-03-01-07-2227 is a newly recorded high-density prehistoric artifact scatter and possible field house occupying 8,557m<sup>2</sup> on a slope of an unnamed ridge bordering a side drainage of Bagnal Draw. The feature is a concentration of daub located near the center of the site, indicating that a superstructure was once present on site. The assemblage consists of an estimated 450-500 lithic and 750-800 ceramic artifacts, and five groundstone artifacts were mapped. The area appears to have been moderately burned and the datum a healthy mature ponderosa. Impacts include burned tree stumps and downed and saw-cut branches are visible across the site. Ground visibility is good with an estimated 40% of the surface obscured by small annuals, manzanita, and woody debris.

AR-03-01-07-2228 is a newly recorded prehistoric scatter consisting of 108 ceramic and 25 lithic artifacts distributed over 1,361m<sup>2</sup> of a low spur ridge and slope of the Mogollon Rim. The feature is a daub concentration that appears to be at least partially buried. The site appears to have been burned at a moderate intensity and a few mature

ponderosas and juniper still stand on site. Ground visibility on the site is fair, with an estimated 35% obscured by bunch grasses, small clusters of annuals, and manzanita. The site has sustained impacts like dozer pushes from fire mitigation and erosion is the clearest visible threat to the assemblage, as several items were displaced downslope.

AR-03-01-07-2229 is a newly recorded high-density prehistoric habitation area and scatter consisting of least 202 ceramic and lithic artifacts and a single mano fragment distributed over 3.816m<sup>2</sup> of a north-facing foot slope of an unnamed ridge which overlooks the Bagnal Draw floodplain. The site has been burned at a high intensity and lacks a mature canopy; scorched and saw-cut trees and branches are strewn across the surface. A dozer push pile possibly associated with fire suppression efforts cuts into the assemblage, and several artifacts are moving downslope. An estimated 40% of the site surface is obscured by woody debris, manzanita, and thin grasses.

AR-03-01-07-2230 is a newly recorded prehistoric habitation area and scatter of 58 ceramic and lithic artifacts dispersed over an area of 2,280m<sup>2</sup>. The daub concentration contains roughly 40 fragments, though no other structural elements could be discerned. The site was burned at a high intensity, evidenced by the lack of mature overstory vegetation and the numerous downed and scorched trees and trunks on site. Ground visibility is good, with around 25% of the site surface obscured by small annuals, woody debris, and manzanita.

AR-03-01-07-2231 is a newly recorded low-density prehistoric artifact scatter consisting of 16 ceramic and two lithic artifacts distributed over a relatively flat area of 1,419m<sup>2</sup> overlooking Bagnal Draw. The site appears to have been burned over at a high intensity as it lacks mature trees and is littered with burned wood debris, the latter of which, along with thin grasses and manzanita, obscure an estimated 20% of the site surface. The lack of vegetation may contribute to visible erosion on site; artifacts were observed washing downslope from the site and sediments on the ridge have been washed down to the next layer of rim gravels.

AR-03-01-07-2232 is a newly recorded low-density prehistoric artifact scatter consisting of at least 26 ceramic and 25 lithic items dispersed over a 1,107m<sup>2</sup> area on a gentle hill adjacent to Bagnal Draw. The site appears to have been burned at a high intensity and no mature trees stand in the vicinity (Figure xx). Adverse impacts include erosion and a disused road grade or fire break passes through part of the site. Ground visibility is fair with an estimated 30% of the site surface obscured by manzanita, young shrub oak, and thin low-lying annuals.

AR-03-01-07-2333 is a newly recorded low-density scatter with 73 ceramic and 33 lithic artifacts occupying 400m<sup>2</sup> on a hill and slope. The site was clearly once heavily wooded and appears to have been burned over entirely at a high intensity. The site's location at the confluence of two small drainages has resulted in significant erosion impacts and artifacts are washing downslope in all directions from the site. Burned debris, manzanita, and thin grasses obscure around 40% of the site surface.



AR-03-01-07-2234 is a newly recorded prehistoric habitation site consisting of two masonry rubble mound features and a high-density scatter of 750-800 sherds and 650-700 lithics dispersed over an area of 2,469m<sup>2</sup>. The site appears to have been at moderately burned and few mature trees still stand in the vicinity. Surface visibility is fair, with pine duff, burned debris, and manzanita, obscuring around 50% of the site surface. Erosive forces are visible on site as structural elements of one feature are scattered downslope.

AR-03-01-07-2235 is a newly recorded low-density scatter consisting of 13 sherds, ten lithics, and a portable slab mortar dispersed over 1,065m<sup>2</sup> on a low bench and slope. The site appears to have been moderately burned; impacts include scorched and downed trees and increased erosion. Surface visibility is good – bunch grasses, light woody debris, and new growth obscure just 10% of the site surface.

AR-03-01-07-2236 is a newly recorded low-density lithic scatter with 23 ceramics and 15 lithics dispersed over 1,174m<sup>2</sup>. The site appears to have been burned over at a high intensity and lacks overstory vegetation; general slope and sheet wash erosion are evident throughout the site as cultural materials are pushed down the pronounced slope. Mineral paint on sherds found at the site were thermally altered to the point where the paint is barely visible. Surface visibility is fair with around 50% of the site surface obscured by woody debris, thin grasses, and new growth vegetation.

AR-03-01-07-2237 is a newly recorded low-density prehistoric scatter consisting of a total of 18 sherds and a single sandstone mano fragment on a bench dispersed over 471m<sup>2</sup>. The site appears to have been at burned at a high intensity no mature trees stand in the vicinity. Ground visibility is fair with around 65% of the surface obscured by dense new-growth vegetation, manzanita, and grasses.

AR-03-01-07-2238 is a newly recorded prehistoric habitation site and high-density scatter consisting of a large multi-unit rubble mound structure and scatter with at least 250-300 sherds and 75-100 lithics dispersed over an area of 4880m<sup>2</sup>. The hill and slope on which the site is situated sustained moderate intensity burns and several mature ponderosas still stand in the boundary. Visibility is fair with around 60% of the surface obscured by pine duff and woody debris. Fire impacts include a slash pile around the feature, a dozer path that clipped the feature and bisects the site, and increased slope erosion. Artifacts extend in decreasing density downslope, suggesting water transport.

AR-03-01-07-2239 is a newly recorded low-density prehistoric scatter consisting of 26 lithic and 28 ceramic artifacts scattered over an area of 3,003m<sup>2</sup>. The site appears to have been burned at a high intensity and lacks a mature canopy; new growth overstory vegetation consists of Gambel oak and juniper. Visibility is fair with around 40% of the surface obscured by manzanita, grasses, and woody debris. Erosion is apparent in sediment movement occurring in areas of pronounced slope.

AR-03-01-07-2240 is a newly recorded prehistoric habitation site and moderate-density scatter consisting of a dry-lay sandstone structure and over 100 ceramic and 32 lithics artifacts dispersed over an 8,900m<sup>2</sup> on a bench and slope. The site was moderately burned, and few mature ponderosas remain in the vicinity. Surface visibility is poor with pine duff from the remaining ponderosas, woody debris, and new-growth vegetation obscuring around 70% of the site surface. Erosion is impacting the site and many artifacts were concentrated in arroyos extending downslope from the feature.

AR-03-01-07-2241 is a newly recorded low-density prehistoric artifact scatter consisting of one mano, 12 lithic and 2 ceramic artifacts dispersed over an area of 374m<sup>2</sup>. The site appears to have been burned over at a high intensity and lacks a mature canopy. The most damaging impact observed is erosion. Ground visibility is good with around 20% of the surface obscured by woody debris and thin grasses.

AR-03-01-07-2242 is a newly recorded moderate-density prehistoric scatter consisting of 55 lithics, 62 ceramic, and one mano dispersed over an area of 1,925m<sup>2</sup>. The site appears to be heavily impacted by fire and even new-growth vegetation is sparse, leading to active erosion observable in the boundary. Visibility is good with around 15% of the surface obscured by woody debris and thin grasses.

AR-03-01-07-2243 is a newly recorded moderate-density prehistoric scatter consisting of 61 sherds and 25 lithic artifacts dispersed over a bench occupying 2,146m<sup>2</sup>. The site was burned over at a high intensity, and no mature vegetation exists in the vicinity. Visibility is good with around 25% of the site surface obscured primarily by woody



debris; the lack of vegetation on site appears to contribute to active erosion that has moved some materials downslope from the flat area where artifacts are concentrated.

AR-03-01-07-2244 is a newly recorded low-density prehistoric artifact scatter consisting of 41 sherds, 34 lithics, and two groundstone artifacts confined to an area of 607m<sup>2</sup> on a low terrace of Bagnal Wash. The site was burned over at a high intensity, and new-growth vegetation consists of sparse immature Gambel oak and dense grasses. Visibility on site is poor with more than 60% of the surface obscured by dense grasses and annuals.



Dense grasses and woody debris obscure most of the surface at site 07-2244.

AR-03-01-07-2265 is a newly recorded high-density scatter and prehistoric habitation site consisting of one large multi-unit rubble mound, over 1,000 ceramics, 175-200 lithics, and four groundstone artifacts distributed over an area of 295m<sup>2</sup> on a ridge and adjacent slope. The site appears to have been moderately burned and several mature scorched ponderosas, juniper, and Gambel oak still stand in the boundary. Erosion is the greatest impact to the site and artifact sorting from sheet wash has displaced smaller artifacts downslope and left larger artifacts upslope on more level areas. Visibility is poor with more than 70% of the site surface obscured by pine duff and woody debris.

## APPENDIX C: NON-RELOCATED SITE SUMMARIES

The following presents brief narratives of the twenty-two (22) sites that were previously recorded in the Bagnol parcel but not relocated by HEG crews in 2018.

AR-03-01-07-0105 was recorded in 1974 as a high-density prehistoric scatter consisting of an estimated 100-300 ceramic and 100-400 lithic artifacts dispersed over an area of 3,750m<sup>2</sup>. The site was described as occupying a low ridge approximately 200 meters from Joe Tank Road (FR 140) with a dense canopy of mature trees. The site was noted to be in good condition with minor impacts from nearby logging roads. HEG crews revisited the location as indicated in ArcGIS shapefiles provided by ASNF and did not observe any cultural materials in or beyond the site boundary. One possible explanation may be the result of the NAD27 to NAD83 datum shift, or the surface expression may have been (Mead et al. 2019).

AR-03-01-07-0127 was recorded by Lerner in 1975 as a low-density prehistoric scatter consisting of an estimated 10-20 lithic and ceramic artifacts deposited over 15m<sup>2</sup>. A three-person crew scoured the plotted site location and surrounding area in September 2018 and did not identify any artifacts. The provided location is thought to be correct because the landscape description in the original site form correspond with the NAD27 UTM coordinates revisited in 2018. The general area is severely impacted by burning, tree fall, road construction and maintenance, recreation, grazing, and erosion. The current corridor of FR 9822P passes directly through the plotted site area, and there is substantial evidence of inundation and sheet flow. Because of the lack of cultural material, HEG recommended the site be removed from ASNF files.

AR-03-01-07-0133 was recorded by Green in 1975 as a moderate-density prehistoric scatter with over 100 ceramic and lithic artifacts dispersed over 1,000m<sup>2</sup>. On October 2, 2018 HEG crews revisited the location of the site, which corresponds with the coordinates and description on the original site form. The site was not relocated after a three-person crew combed the area for two hours. The previously recorded site may have been misplotted, displaced, or otherwise impacted such that no surface assemblage remains. Impacts observed to the area include high intensity burning, abundant woody debris, grazing, and sheet wash.

AR-03-01-07-0134 was originally recorded by Donaldson in 1975 as a low-density scatter consisting of 10-20 ceramic and lithic artifacts distributed over an area of 167m<sup>2</sup>. Donaldson reported that the site was in good condition, situated on a terrace under a ponderosa-oak canopy. A three-person crew scoured the plotted site location in October 2018 and did not relocate any cultural material in the provided site boundary or beyond it. This may be due to the NAD27 to NAD83 datum shift, or the site may have been previously collected.

AR-03-01-07-0136 was recorded by Green in 1975 as a moderate-density prehistoric scatter of 50-100 ceramic and 20 lithic artifacts over a 514m<sup>2</sup> area. The original site form reported that the site was 80% disturbed by logging activity. HEG crews revisited the site location in October 2018 and did not identify any cultural materials in the area; Because the site was 80% disturbed in 1975 it is possible that it has been destroyed in the 43 years elapsed since its last recording.

AR-03-01-07-0138 was recorded by Green in 1975 as a moderate-density scatter of over 100 ceramic and 20-50 lithic artifacts distributed over 225m<sup>2</sup>. The site was under a ponderosa canopy and was heavily (80%) disturbed by logging activity. HEG crews returned to the plotted site location in October 2018 and did not find cultural materials. Because the site was 80% disturbed in 1975, it is possible the surface expression is gone.

AR-03-01-07-0140 was recorded by Donaldson in 1975 as a low-density scatter of 10-20 ceramic and lithic artifacts confined to a 50m<sup>2</sup> area in a logging skidder trail, under a ponderosa-oak canopy. The assemblage was 90% disturbed in 1975 and only visible because of mechanized ground disturbance. A three-person crew returned to the plotted site location in October 2018 and did not find any cultural material in the vicinity. Datum UTM locations were examined under NAD27 and NAD83 and neither falls near the site location indicated on a 1975 topographic map.

This site was not relocated, either because it is misplotted, or since the 1975 form reports 90% disturbance, it may have been destroyed.

AR-03-01-07-0142 is a prehistoric habitation site and moderate-density scatter recorded by Donaldson in 1975. Distributed over 1,200m<sup>2</sup> on the edge of a steep ridge overlooking a wash, the “site is apparently located for vantage point provided by topography,” and this quality was “unique” in the area (Bagnal Hollow; Donaldson 1975). The structure is described as a one- to five-room dry-lay sandstone pueblo surrounded by over 100 ceramic and 50-100 lithic artifacts. The 1975 form notes that intense logging activity obscured what may have been an associated string of jacals. HEG revisited the location of the site and scoured the area for over two hours without relocating anything resembling features or any cultural material.

AR-03-01-07-0150 was recorded by Donaldson in 1975 as a low-density scatter of 10-20 lithics confined to an area of 0.25m<sup>2</sup>. The scatter was described as consisting of “exotic, worked pieces of apparently different functions (denticulate, scrapers and knives of different edge angles),” which “lends impression of lost ‘tool kit,’” Donaldson 1975. The site occupied a flat “undisturbed” wooded area under a ponderosa-oak canopy. HEG crews did not observe any cultural material in or around the plotted site location. Though the 1975 site form did not indicate that the site was collected, it is possible that a small “toolkit” like this was collected in 1975.

AR-03-01-07-0151 was recorded in 1975 by Lerner as a prehistoric pueblo and moderate-density artifact scatter occupying 375m<sup>2</sup> of a flat ridge with steeply sloping sides. Lerner described the rooms as disturbed from “logging and potting” and estimated the assemblage to contain over 100 ceramics and 20-50 lithics. The site’s plotted location was revisited in October 2018 and a three-person crew did not relocate cultural material. The terrain and general landscape of the location described in the 1975 site form does not resemble that encountered by HEG crews.

AR-03-01-07-0154 was recorded by Green in 1975 as a moderate-density scatter consisting of over 100 lithic and ceramic artifacts distributed over 500m<sup>2</sup>. Green noted that the site reflects “heavy disturbance and range of ceramic types.” Crews scoured the area of the site’s plotted location and did not identify any artifacts. The inability to relocate the site may be due to the NAD27 to NAD83 datum shift.

AR-03-01-07-0161 was recorded by Donaldson in 1975 as a two- to four-room pueblo structure and associated moderate-density scatter of 50-100 ceramics and 30-50 lithics. Occupying 525m<sup>2</sup> of a bench flanking the southeast face of an unnamed ridge, the site was situated under a dense ponderosa-juniper-oak canopy. Donaldson documented a concentration of *Agave parryi* immediately east of the roomblock. A three-person crew scoured the plotted site location and surrounding area and did not identify any cultural material or agave. It is possible that the datum projection was incorrect, or the site has since been destroyed.

AR-03-01-07-0162 was recorded by Donaldson in 1975 as a prehistoric pueblo and associated moderate-density scatter consisting of 50-100 ceramics and 20-50 lithics confined to an area of 240m<sup>2</sup> on a bench below a ridge top. The site consisted of one to two rooms and one circular storage structure. HEG crews returned to the site location as indicated on the ArcGIS shapefiles provided by ASNF and no structure remnants or artifacts were observed. It is possible that this may be the result of the NAD27 to NAD83 datum shift, or the site may have been destroyed by erosion, activity related to logging, or fire suppression efforts.

AR-03-01-07-0171 was recorded in 1975 by Donaldson as a pueblo and associated low-density artifact scatter occupying 170m<sup>2</sup> on a bench below a ridge top. The scatter contained around 100 ceramic and lithic artifacts which surrounded the two- to three-room pueblo. Donaldson also identified an agave concentration among outcrops downslope from the feature. Crews returned to the site location in October 2018 and did not relocate structural remains or artifacts. The plotted site location is about 20 meters from the updated boundary of site 07-0612, a large multi-room pueblo site and dense scatter recorded in 1974. Since descriptions of these sites share several qualities (pueblo features, mixed artifact scatter, and an agave concentration) it is possible that Donaldson inadvertently re-recorded part of 07-0612 year after a different team of archaeologists first recorded it.

AR-03-01-07-0176 was recorded by Donaldson in 1975 as a four-room pueblo and moderate-density scatter of over 100 ceramic and 20-50 lithic artifacts distributed over 6,600m<sup>2</sup>. Donaldson identified an agave concentration downslope from the structure, which consisted of at least three detached rooms situated atop a broad ridge. HEG revisited the site in October 2018 and did not relocate any structural or other cultural material. It is possible that the

site was not relocated because of the datum projection shift, or the site may have been destroyed or obscured by natural forces like erosion and sedimentation, or human activities related to logging and fire suppression.

AR-03-01-07-0187 was recorded by Donaldson in 1975 as a small, low-density scatter of 20-50 ceramic and 10-40 lithic artifacts confined to an area of 96m<sup>2</sup>. Crews did not identify any cultural material at the plotted site location in 2018. This may be due to the shift in datum projection from NAD27 to NAD83, or artifacts may have been collected in 1975.

AR-03-01-07-0193 was also recorded by Donaldson in 1975 as a small, low-density scatter containing 0-20 ceramics and lithics confined to an area of 15m<sup>2</sup>. Crews revisited the location as indicated in ASNf-provided shapefiles and did not identify any cultural materials. The plotted site location corresponds to the NAD27 UTM and landscape description in the original site form. The area occupies a burn scar along the southern margin of FR 9818Y in an area that has been severely impacted by wildfire and suppression efforts, bioturbation, grazing, recreation, and erosion. HEG recommended 07-0193 for removal from the ASNf site inventory.

AR-03-01-07-0201 was recorded by Donaldson in 1975 as a possible one-room pueblo and low-density artifact scatter occupying 104m<sup>2</sup> of a knoll overlooking Joe Tank. The scatter contained 20-50 ceramics and 1-20 lithics in an area disturbed by logging. On October 14, 2018 crews scoured the area in and around the plotted site location and did not find structural features or artifacts. Spatial data indicates that the site sits between FR 9820W on the east and an unnumbered, possibly user-created road. It is possible the site was destroyed by road-related disturbance.

AR-03-01-07-0204 was recorded by Donaldson in 1975 as a prehistoric one-room pueblo and associated moderate-density scatter of 50-100 ceramic and lithic artifacts dispersed over 150m<sup>2</sup>. The site was described as a "rubble mound adjacent to road," and disturbances evident included those related to the road and logging. HEG crews revisited the site in 2018 and did not identify any artifacts within or around the plotted site location. The site may have been destroyed by the maintenance and use of the adjacent road, or it may be misplotted during the NAD27 to NAD83 datum shift.

AR-03-01-07-0613 was recorded by Dosh in 1990 as a prehistoric habitation site consisting of structural remains (sandstone blocks and daub) and a scatter of 10-50 ceramic, lithic, and groundstone artifacts distributed over 2,886m<sup>2</sup>. Dosh noted in 1990 that "logging road construction and bulldozing have destroyed the site." SWCA crews revisited 07-0613 for the R-C salvage survey and found it to contain a pithouse feature and scatter dispersed over 1,326m<sup>2</sup>. Crews revisited the location indicated in the ArcGIS shapefiles provided by ASNf and did not relocate any structural remnants or artifacts in the plotted site boundary or vicinity. The area has been moderately burned and remaining vegetation obscures most of the ground surface. It is possible the feature remains underneath this organic layer.

AR-03-01-07-0623 was originally recorded by Donaldson in 1975 as a five-room pueblo and associated artifact scatter. Dosh revisited the site in 1990 and recorded a low-density prehistoric scatter of 10-20 ceramic, lithic, and groundstone artifacts occupying 1,530m<sup>2</sup> of a sloped ridgetop. 07-0623 was recorded again in 2002 as part of the fire impact assessment. The site was reported to have been completely (100%) burned, and severe damage from erosion and fire-felled trees had impacted site integrity. With surface visibility afforded from the recent fire, the 2002 recording documented 25-50 ceramics, 25-50 lithics, and a daub concentration dispersed over 2,208m<sup>2</sup>.

HEG crews returned to the reported site location(s) in 2018 did not relocate any cultural materials. The surface expression of the site described in 1990 does not match that described in 1975; daub was identified but the site lacked the masonry features reported in 1975. Furthermore, the two sets of coordinates on each form are different. The 1990 description corresponds with that of 2002, though even with surface visibility no masonry features were identified. 2002 management recommendations included removal of dense burned debris and trees from the site. It is possible that the presence of woody debris and post-fire vegetation obscured site visibility in 2018.

AR-03-01-07-0707 was originally recorded by Donaldson in 1975 as a low-density scatter of 20-50 ceramic and 0-20 lithic artifacts and a possible one-room pueblo confined to 35m<sup>2</sup>. Impacts from logging were observed in the possible roomblock. The site was recorded again by Dosh in 1990 when the boundary was expanded to encompass 1,088m<sup>2</sup> of a bench, situated in an area 25% disturbed by logging activities. Dosh did not relocate the possible feature or ceramics; the 1990 assemblage consisted only of about 15 lithic artifacts. HEG crews revisited the site in October 2018 and did not identify any cultural materials after scouring the plotted site location and surrounding area.