PROJECTILE POINTS AND LATE PREHISTORIC OBSIDIAN PROCUREMENT IN THE CENTRAL SIERRA NEVADA, CALIFORNIA: A VIEW FROM THE RIM FIRE COLLECTION

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ABSTRACT

A large assemblage of projectile points recovered from the 2013 Rim Fire are studied to evaluate obsidian procurement patterns for the Late Prehistoric to Historic Period Me-Wuk and Washoe of the Sierra Nevada, particularly those who once inhabited what is now the Stanislaus National Forest (SNF). More specifically, this thesis assesses if the Me-Wuk and Washoe chose alternative obsidian procurement patterns after the arrival of outsiders (Europeans and Euroamericans). Two test expectations were developed to assess this issue. The cultural affiliation test expectation considers if the obsidian for Me-Wuk and Washoe projectile points came from different sources due to variations in territory, language, inter-community relationships, and other factors. The time test expectation considers whether the proportion of Me-Wuk and Washoe obsidian projectile points varied through time (Late Prehistoric to Historic) and why.

Addressing the two test expectations necessitated determining the style, raw material type, and cultural affiliation (Me-Wuk and/or Washoe) of the projectile points. I achieved this using the Monitor Valley (Thomas 1981) and Justice (2002) projectile point typologies and Energy Dispersive X-ray Fluorescence (EDXRF) to geochemically source 83 of the obsidian projectile points. The cultural affiliation test expectation was rejected, but the time test expectation revealed that the Me-Wuk and Washoe used significantly less Bodie Hills and Lookout Mountain obsidian during the Protohistoric and Historic periods. Why this occurred is unclear, but some explanations are provided.

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CHAPTER 1

INTRODUCTION

This thesis evaluates the obsidian procurement patterns of the Late Prehistoric to Historic period Me-Wuk and Washoe from the Stanislaus National Forest (SNF). Specifically, I assess if they chose to alter their strategies for obtaining obsidian from a variety of geologic sources to make projectile points when outsiders, such as Europeans and Euroamericans, arrived in the area. To do this, I assess whether the Me-Wuk and Washoe relied on the same or distinctly different obsidian sources to make projectile points through time and across the SNF. The Me-Wuk and Washoe lived in different parts of the SNF and had varied access to lithic raw material sources. The information obtained from this research will enable me to document if Me-Wuk and Washoe obsidian use patterns varied and whether any differences were caused by climate change, changing relationships with neighbors, and differential access to lithic sources because of controlled access, mobility, and/or trade patterns.

The data to assess these issues come from the 378 projectile points recovered while surveying the burn area of the 2013 Rim Fire. This fire started near the Rim of the World Lookout in the Me-Wuk District and spread to the Groveland District due to the actions of an irresponsible individual, as revealed by Forest Service investigations into the origin of the fire (Figure 1.1). The Rim Fire was one of the largest fires in California history. It resulted in conservation efforts conducted by botanists, hydrologists, timber crews, and archeologists to mitigate the effects of the fire, such as erosion danger and tree death. I was a member of an archaeology crew during the Rim Fire recovery effort and aided in collecting some of the projectile points analyzed in this thesis.

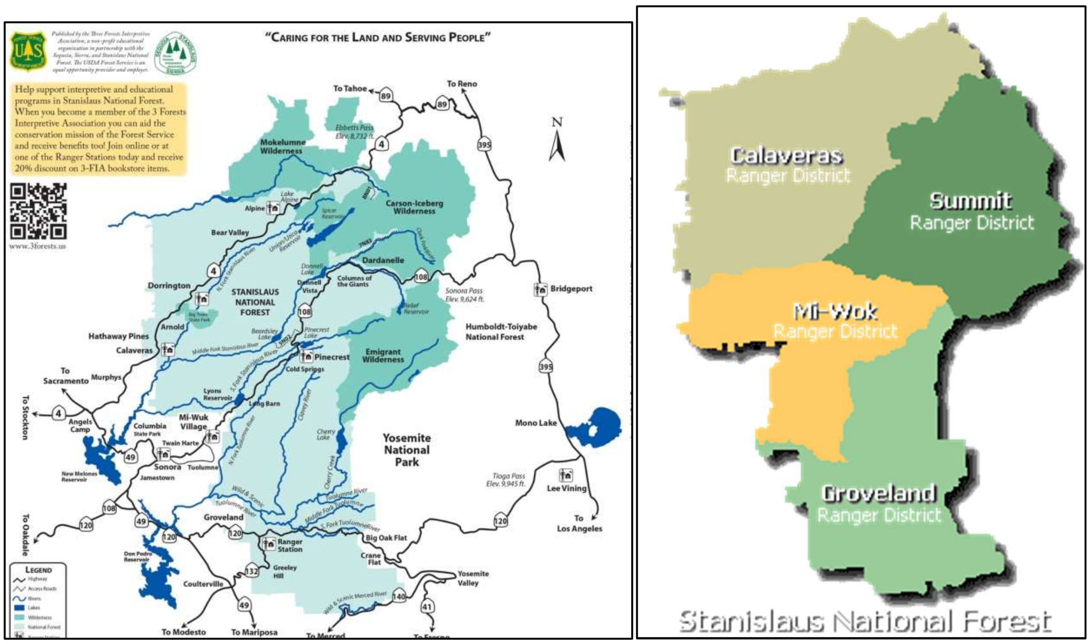

Figure 1.1. Location of Stanislaus National Forest showing rivers and highways (left), and the Stanislaus National Forest ranger district map (right). From www.fs.usda.gov

The Stanislaus National Forest (SNF) was founded on February 22, 1897, making it one of the oldest national forests currently in operation. It was originally part of the Stanislaus Forest Reserve, which was subsequently broken into five national forests. Along with the SNF, the other four include the Eldorado, Sierra, Tahoe, and Toiyabe National Forests (Figure 1.2). The SNF was named after the Stanislaus River. It covers more than one million acres and is today used for recreational purposes, conservation efforts, timber sales, and cattle grazing (Madley 2016; Miksicek et al. 1996).

Figure 1.2. Map depicting the five forests that comprise the Stanislaus Forest Reserve. Image from the USFS Region 5 website (https://www.fs.usda.gov/detail/r5/news events/mediatools?cid=STELPRDB5392280)

This thesis has six chapters. Chapter 2 provides background information about the Sierra Nevada environment, climate, regional prehistory, and the Me-Wuk and Washoe before and after contact. Chapter 3 describes the approach to my analysis, including the test expectations and methods. Chapter 4 contains the analytical results. Chapter 5 explores these results and considers the implications in light of the test expectations. Chapter 6 summarizes the conclusions and broader impacts of this thesis. Through the information presented in these six chapters, I hope to document variation in Me-Wuk and Washoe obsidian procurements patterns and the redistribution of obsidian used to produce their projectile points.

CHAPTER 2

SIERRA NEVADA ENVIRONMENTAL AND CULTURAL SETTING

The Me-Wuk and Washoe resided on lands that are now part of the SNF and inhabited the Sierra Nevada long before the discovery of gold in California. To better understand how and why the obsidian used by the Me-Wuk and Washoe to make projectile points potentially varied, it is first necessary to describe the natural and cultural environment of the Sierra Nevada. I begin by discussing the Sierra Nevada geography and paleoclimate, followed with the region's cultural setting, and conclude with a presentation of the pre- and post-contact Me-Wuk and Washoe cultures.

It is important to remember that the terminology used to describe the communities, territories, languages, and so forth of California's Native peoples originates from many sources and is varied. I have attempted to use the preferred of the Native peoples (e.g., bands vs tribes, Me-Wuk vs Miwok), though much of the terminology remains unchanged and does not necessarily reflect their perspectives of past events or terminology.

The Sierra Nevada

The Sierra Nevada mountain range is 130 km wide and extends 650 km north-to-south along the modern eastern border of California (Moratto 2004:12). It was subjected to substantial geologic activity that resulted in significant uplifting, particularly on the considerably steeper eastern than western flank. The difference in elevation and topography result in environmental, climatological, hydrological, and geologic variability. According to Meyer and Rosenthal (2008:5-6), areas with higher bedrock are separated from lower bedrock by faults that trend northwest-southeast in what is called the foothill fault zone. These faults consist of metamorphosed sedimentary and volcanic rock that become younger and less metamorphosed when traveling east to west. The materials found in the fault zone include marble, quartzite, metachert, schist, slate, and unfoliated hornfels. The crest of the Sierra Nevada is comprised of granitic batholiths, while the rest of the upper northern Sierra Nevada is Paleozoic volcanic, Mesozoic volcanic, and meta-sedimentary bedrock. Other commonly found stones include obsidian, basalt, marble, quartzite, and granite (Hull 2007).

The topography and vegetation influenced where Native people settled and gathered resources. River drainages were important topographic features that cut through the mountains in several areas along the length of the Sierra Nevada. These drainages permitted travel by Native people to higher elevation resources and were a highway through the Sierra Nevada to the Great Basin (Moratto 2004). River drainages also permitted access to a wide range of flora that varied by elevation, temperature, and precipitation. Different growing seasons and precipitation patterns resulted in the different environmental zones. For example, the environmental zones in the western Sierra Nevada are, from top to bottom, the alpine zone, subalpine zone, lodgepole-red fir forest, yellow pine forest, foothill woodland, and chaparral (Hull 2007:178; also see Figure 2.1). The availability of food resources and the forms they took in different locales influenced the subsistence strategies and material culture of Native people.

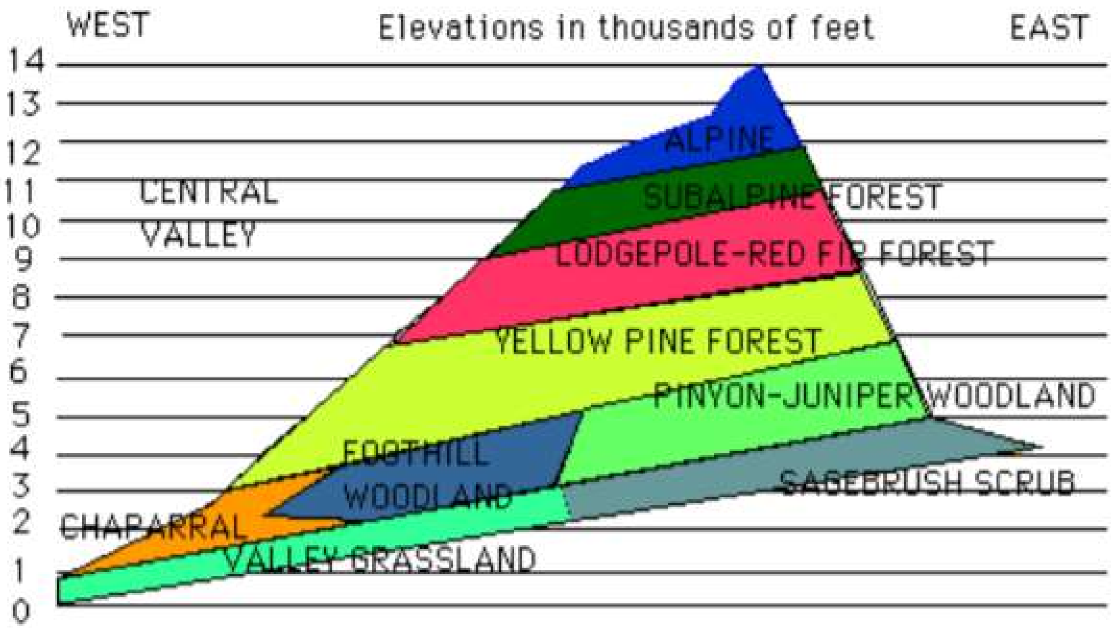

Figure 2.1. Life zones of the Western Sierra Nevada. Image from CampInternet.com.

Sierra Nevada Paleoclimate

The last glacial period or Wisconsin Glacial episode occurred during the terminal Pleistocene and is recognizable in the Sierra Nevada. Though the Wisconsin Glacial episode was mostly cold, warm or interglacial periods occurred in the High Sierras from 2600-2000 ^{14}C yrs BP (897-164 cal. BC), 1100-900 ^{14}C yrs BP (cal. AD 793-1225), and 600-100 ^{14}C yrs BP (cal. AD 1420-1778; calibrated dates calculated to two standard deviations using Calib 7.10). The interglacial periods resulted in cool and humid environments with minimal glaciation (Moratto 2004:30-37; Moratto et al. 1978:148). Pine forests stood where oaks grow today, deserts were lush, and hundreds of pluvial lakes spread across the Great Basin and Mojave Desert. The Mediterranean climate that characterizes modern California began to develop, though the terminal Pleistocene was still considerably cooler and moister than today. The archaeobotanical record shows many terminal Pleistocene plant species, especially trees, were pushed further south and closer to the coast than today (Johnson 1977; Moratto 2004:30-37). In the Sierra Nevada, this resulted in high altitude plant and animal communities shifting to lower altitudes (Birman 1964; Moratto 2004:30-37). More specifically, sagebrush was replaced by a forest environment in the Stanislaus River drainage by 10,000 years ago (Minnich 2007:43-70).

The Holocene (the current epoch) climate fluctuated. The Early Holocene lasted from approximately 10,000-7000 BP (9768-5990 cal. BC) (Miksicek et al. 1996:25; Moratto et al. 1978) and was a time when the Wisconsinian glaciers in the Sierra Nevada entirely or nearly entirely melted and caused high lake levels (Anderson 1990; Meyer and Rosenthal 2008:48; Minnich 2007:43-70). This is particularly true in the Southern Sierra Nevada where warmer and possibly drier conditions persisted than in the north Central Sierra Nevada. The Western Sierra Nevada was also generally warmer than today, with plant pollen from the more arid Eastern Sierra Nevada and Great Basin discovered in high concentrations in Western Sierra Nevada sediments. The westward spread of Great Basin plants occurred, for example, at Tulare Lake where more open forests with additional shrubs occurred than are seen today (Davis and Moratto 1988:133; Davis et al. 1985; Meyer and Rosenthal 2008:49; Miksicek et al. 1996:25; Moratto et al. 1978). Overall, the Early Holocene reflected a slight warming trend that was drier than today.

The Middle Holocene in California was a warm and dry period that lasted from 7000-3000 BP (5990-1398 cal. BC), and caused changes to the Sierra Nevada plant communities (Meyer and Rosenthal 2008:56; Miksicek et al. 1996:25; Moratto et al. 1978). The Middle Holocene in the Sierra Nevada region was highly variable, leading to a lack of agreement among scholars regarding the exact climactic trends (Meyer and

Rosenthal 2008:56). A portion of the paleoenvironmental record (including pollen) indicates that the Middle Holocene Sierra Nevada experienced more rainfall and slightly larger alpine glaciers, which resulted in smaller lakes during this period, than the Early Holocene due to increased precipitation. Other climate data indicate that the Middle Holocene was arid and dry. Mixed-conifer and subalpine forests spread through the Sierra Nevada during this period, replacing the more open shrub dominated vegetation of the Early Holocene. Pollen samples suggest that the tree lines established during the Early Holocene remained until around 3500 BP (1965 cal. BC), but went lower during the Middle Holocene as the temperature decreased and moisture increased. This trend in temperature variation was not reflected in other areas of modern California but is reflected in the Sierra Nevada (Meyer and Rosenthal 2008:56; Minnich 2007:43-70). The modern climate and plant communities developed towards the end of the Middle Holocene, particularly in the foothills (Meyer and Rosenthal 2008:57; Hull 2007:178).

The Late Holocene (3000 BP to present or 1398 cal. BC to present) is when the modern weather pattern settled in the Sierra Nevada with moderately wet winters and hot summers. The Medieval Climatic Anomaly (MCA) and Little Ice Age (LIA) affected the climate, environment, and people of California in the Late Holocene. The MCA was a hot and dry spell with periods of substantial drought that lasted from approximately cal. AD 800-1400 and affected regions around the globe (Jones and Schwitalla 2008; Kennett and Kennett 2000; Millar et al. 2006; Raab and Larson 1997; Schwitalla et al. 2014). The trend is supported in the Sierra Nevada through data gathered from tree rings, ice cores, sediments, and other sources of proxy data (Millar et al. 2006). Stress from this period is evident in the bioarchaeological, paleoenvironmental, and archaeological records.

Alterations in supply networks or changes in political boundaries were among the archaeological effects, as well as diminished dietary intake and increased disease. Warmer ocean temperatures devastated kelp forests off the California Coast, and reduced the availability of other marine resources (Jones and Schwitalla 2008; Kennett and Kennett 2000; Raab and Larson 1997; Schwitalla et al. 2014). The Little Ice Age (LIA) was a cooling event that occurred from approximately cal. AD 1400 to 1850 that led to changes in the environment worldwide. The climate grew significantly colder, ice caps formed, and winters grew more brutal. In California it caused cold loving plants to thrive. Native people altered their lifeways to cope with this restructuring, but the changes were not necessarily drastic (Campbell and McAndrews 1993; Koerper et al. 1985).

Sierra Nevada Cultural History

Paleoindian period (ca. 11,500-8,000 cal. BC: Miliken et al. 2007:124) and Archaic period (6000 BC – AD 500) sites are spread across California; however, there are no known Paleoindian or Archaic sites within the SNF. The Paleoindian fluted points that have been found are associated with later period diagnostic artifacts, which could suggest that more recent Native peoples collected these projectile points or occupied the same locations as Paleoindians. Beyond the few instances of fluted points there are no verified Paleoindian or Archaic sites in the Sierra Nevada (Rondeau et al. 2007; K. Strain, personal communication). Key sites with Paleoindian or Archaic components in the region surrounding the SNF include the Clark's Flat site (Peaks and Crew 1990; Miksicek et al. 1996) and the Skyrocket site near Copperopolis (Bieling et al. 1996; Miksicek et al. 1996; see Figure 2.2).

Yosemite Valley, to the south of the SNF, is important to understanding the region's prehistoric context. It was widely and extensively used by prehistoric and historic period Native communities given the variety of recovered projectile points (Barrett and Gifford 1933; Bennyhoff 1956; Elsasser 1978; Moratto 2004). Early sites in Yosemite Valley were created by peoples with unknown Native community affiliations who, based on their material culture, were influenced by their neighbors in the Great Basin and other parts of the Sierra Nevada (Elsasser 1978; Moratto 2004).

The early point styles resemble Martis and Great Basin projectile point types typically made of basalt, such as Elko and Martis points (Elsasser 1978; Moratto 2004). Smaller stemmed and corner-notched points (e.g., Desert Side Notched, Gunther Barbed, Stockton Expanded Stem) were common after AD 500 when the bow and arrow were introduced (Hull 2007:182; Justice 2002). Linguistic evidence supports the archaeological evidence for the spread of Native people from Yosemite Valley to the surrounding areas (Elsasser 1978; Levy 1978), and presumably explains many of the shared characteristics (e.g., culture, food resources) between the various Sierra Nevada Native communities.

To establish the Late Prehistoric through Historic period chronology, two Central Sierra Nevada cultural historic sequences were consulted (Table 2.1). None of these phases has been linked to Washoe, though the Washoe are associated with Great Basin phases discussed later in the chapter.

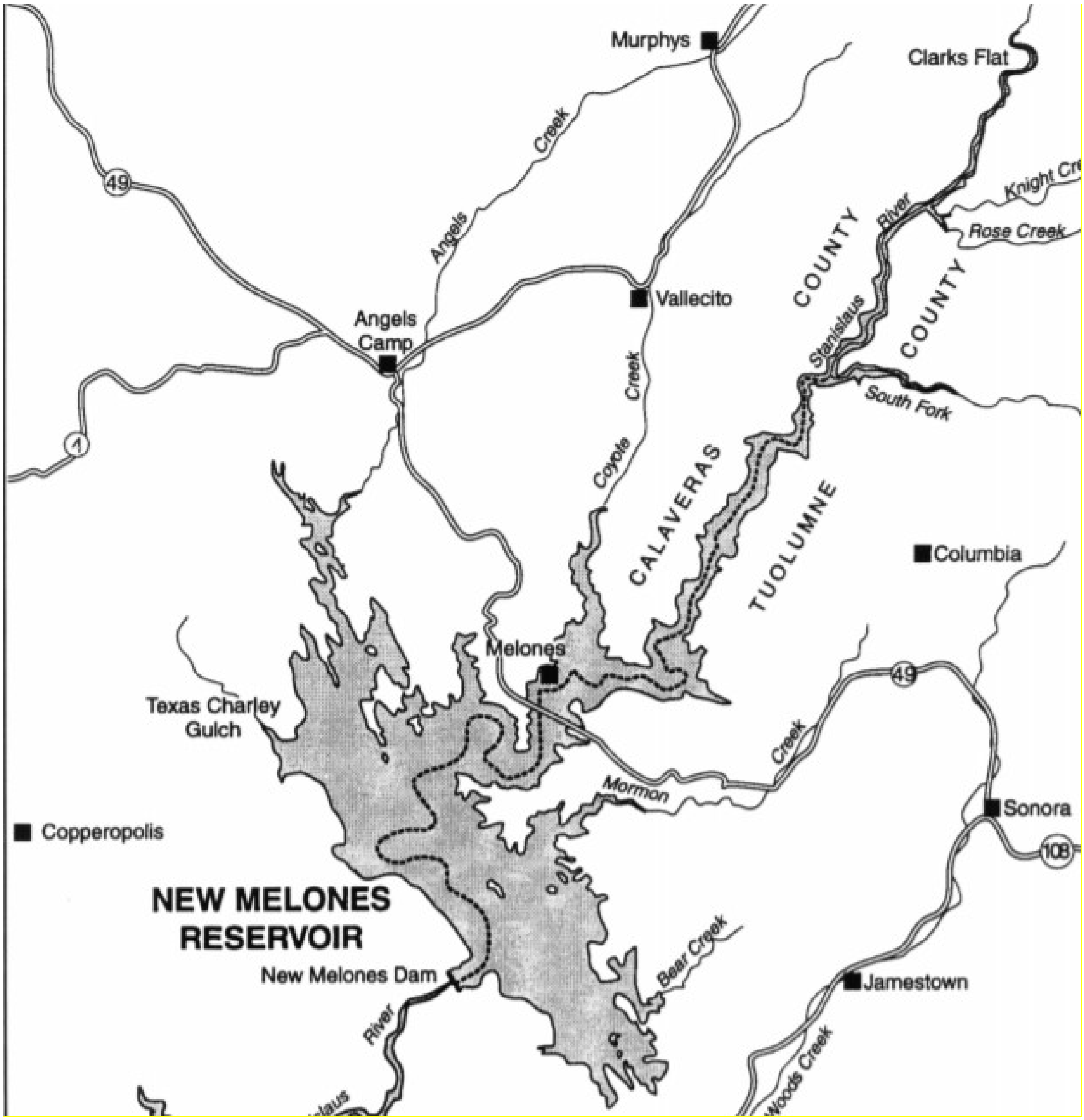

Figure 2.2. Towns in the vicinity of New Melones reservoir to give approximate locations of the Clark's Flat and the Skyrocket sites. Taken from Moratto (2002).

Table 2.1. Sierra Nevada Temporal Phases Following Moratto (2004:299)

Yosemite Sequence	Date	Stanislaus Sequence	Date
Mariposa	AD 1800	Horseshoe Bend	AD 1250-1700
Tamarack	AD 1500-500	Redbud	AD 500-1250
Crane Flat	750 BC- AD 500	Sierra	1000 BC- AD 500

The Yosemite sequence includes the Mariposa, Tamarack, and Crane Flat cultural phases. The Mariposa phase (AD 1800) is most recent and specifically relates to the Sierra Me-Wuk based on the association of Mariposa phase projectile point styles at Me-Wuk archaeological sites. The material culture of the Sierra Me-Wuk, according to Mariposa phase evidence, includes baskets, groundstone, bedrock mortars, clam shell disc beads, and bows with arrows made from soaproot-based glue, grooved steatite straighteners, steatite vessels, lightweight projectile points, bone scrapers, obsidian scrapers, wooden implements such as spoons, and pictographs (Levy 1978; Moratto 2004:309). Projectile point types associated with this period include Desert Side Notch and Cottonwood Triangular points (Hanson 1993:73). Tamarack is slightly older (AD 500-1500), and is characterized by projectile points weighing 1-3 grams, bedrock mortars, cobble pestles, bows and arrows (Hanson 1993:73; Moratto 2004:309). Tamarack sites contain less obsidian debitage than previous complexes (Hanson 1993:73) and characterized by a lower number of permanent or semi-permanent villages. Crane Flat, the oldest phase (750 BC- AD 500), is characterized by heavy projectile points, milling stones, atlatls, and darts (Moratto 2004:309).

The Stanislaus sequence includes the Horseshoe Bend, Redbud, and Sierra cultural complexes. The Horseshoe Bend phase is most recent (AD 1250-1700) and is similar to the Mariposa complex since it also represents the Sierra Me-Wuk just prior to contact. The material culture includes shell beads, pictographs, bedrock milling stations, more long-term habitation sites, steatite, and projectile points such as Desert Side Notch and Cottonwood Triangular points (Hanson 1993:73-74; Rondeau 1997). The Redbud phase is slightly older (AD 500-1250) and is characterized by the increased use of metates compared to previous phases, a decrease in permanent and semi-permanent villages compared to previous phases, less lithic debitage, and increased use of metates (Hanson 1993: 73; Rondeau 1997). The Sierra complex (1000 BC- AD 500) is oldest and marks the beginning of a reduction in the amount of lithic debitage found at Stanislaus Sequence phase sites that follow (Rondeau 1997). This complex also has flaked stone tools, ground stone tools, atlatls, darts, bedrock mortars, and cobble pestles (Stevens 2002:25).

California's unique ethnolinguistic history indicates that Native people were displaced by later immigrants into California, some of whom ended up in different areas by the Historic period (Codding and Jones 2013; Moratto 2002). California is home to several language groups, including Penutian, Hokan, Uto-Aztecan, and others as a result of this unique ethnolinguistic history. These different language groups originated from different parts of North America. The languages used by the Me-Wuk, Washoe, Maidu, Yokut, and others reflect their different origins and different associated material cultures (Arnold and Walsh 2010; Arnold et al. 2004; Codding and Jones 2013; Johnson and Lorenz 2006; Moratto 2002).

Ethnographic Setting: Me-Wuk and Washoe

Me-Wuk

The endonyms of Native communities in northern California today include Me-wuk, Mi-Wok, Miwuk, and Miwok (U.S. Bureau of Indian Affairs 2018), and variant spellings are found in historic documents, as well (Levy 1978;). In this thesis, I will use Me-wuk, generally speaking, following guidance by SNF tribal liasons. The Me-Wuk are divided regionally and linguistically into six groups: Coast Me-Wuk, Plains Me-Wuk, Lake Me-Wuk, Northern Sierra Me-Wuk, Central Sierra Me-Wuk, and Southern Sierra Me-Wuk (Hall 1978; Levy 1979; Miksicek et al. 1996:30). The Miwok languages constitute a branch of the Utian language family and likely originated 2,500 years ago before the Me-Wuk spread from the central coast to the Central Valley and then into the Sierra Nevada. Since the Coast, Plains, and Lake Me-Wuk did not reside in the Sierra Nevada, they are not considered further so that I can focus more closely on the Sierra Nevada Me-Wuk.

Me-Wuk occupation of the Sierra Nevada is recent compared to those Me-Wuk who lived in the Sacramento Delta region, though current understanding of the Sierra Me-Wuk is limited (Levy 1978). The best time depth estimate for the Sierra Me-Wuk is approximately 800 years, lasting from approximately AD 1300 to present. Within the Sierra Nevada, the Northern Sierra Me-Wuk occupied the foothills of the Sierra Nevada, specifically the area around the Mokelumne and Calaveras River drainages (Hall 1978; Levy 1979; Miksicek et al. 1996:30) (see Figure 2.3). The Southern Sierra Me-Wuk lived in the upper regions of the Merced and Chowchilla River drainage areas (Hall 1978; Levy 1979; Miksicek et al. 1996:30), and the Central Sierra Me-Wuk in the foothills and mountains of the Stanislaus and Tuolumne River drainages (Hall 1978; Miksicek et al. 1996:30). The southern boundary of the Central Sierra Me-Wuk extended approximately 5 km south of the town of Groveland, and their northern boundary from a fork in the Calaveras River to the furthest north fork of the Stanislaus River. Some Me-Wuk lived in the foothills of the San Juaquin Valley before being pushed further into the Sierra Nevada when the Spanish arrived (Gifford 1926; Levy 1978; Miksicek et al. 1996). Some variation exists between publications as to the exact boundaries and peripheries of the Me-Wuk, but the core areas are always the same (Barrett and Gifford 1933; Gifford 1926; Levy 1978; Miksicek et al. 1996).

The Me-Wuk referred to from now on, unless otherwise stated, are the Central Sierra Me-Wuk as they inhabited the SNF. The Central Sierra Me-Wuk shared their easternmost border with the Washoe and Mono Lake Paiute (Figure 2.3). The Central Sierra Me-Wuk's westernmost boundary is the San Juaquin Valley and foothills of the Sierra Nevada where they are bordered by the Valley Yokuts, Nisenan, Washoe, Southern Sierra Me-Wuk, Foothill Yokuts, Lake Me-Wuk, and Patwin (Hall 1978; Levy 1978).

Before incursions by Europeans and Euroamericans, the Me-Wuk maintained permanent and seasonal settlements within the territory of a given band, and the locations of settlements varied by activity (e.g., fishing or hunting; Gifford 1926; Miksicek et al. 1996:30). The Me-Wuk altered their lifeways and settlement patterns after contact (Cook 1976 [1943]; Madley 2016; Levy 1978; Miksicek et al. 1996). The colonizers changed the landscape with their activities and settled the land without permission from the local Native communities. Consequently, the Me-Wuk often lived in resource poor locations and some difficult to access areas after Europeans and Euroamericans came to the area. Me-Wuk villages were sometimes relocated, but other villages resided on choice pieces of land (Levy 1978; Miksicek et al. 1996).

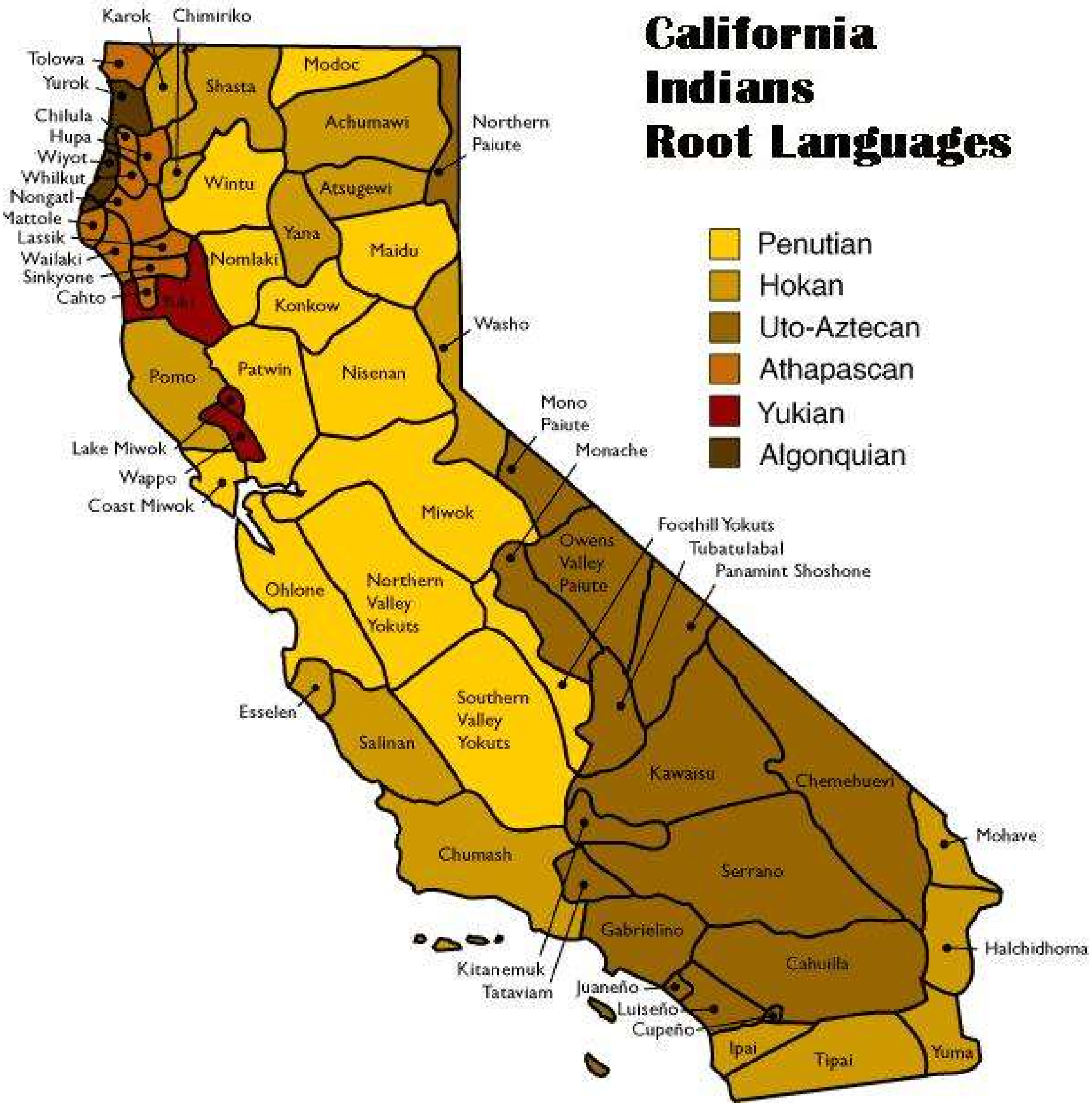

Figure 2.3. Map of California's Native communities and dialectic boundaries. From https://www.parks.ca.gov/?page_id=23545

Social organization. The political unit of the Me-Wuk, as with many other California Native communities, has been characterized by anthropologists as a tribelet (Kroeber 1976) or band, and many contemporary Native communities self-identify as "bands". Bands or tribelets are socio-politically independent groups (Kroeber 1976; Levy 1978) that typically consisted of 100-300 people and share a common territory. The name of the primary settlement of a band sometimes served as the name of the band in historic documents (e.g., if the primary settlement was called Black Oak, then the band's name was also Black Oak). The leader of the band lived in the primary settlement (Levy 1978; Miksicek et al. 1996). Me-Wuk women could be leaders or sub-leaders, or serve in other professions (Dick-Bissonnette 1998). The primary settlement of the band had an assembly house or round house that was treated as the personal property of the leader and was the location of important social events and religious ceremonies. Each band maintained a territory within the broader area affiliated with the Me-Wuk (Levy 1978; Miksicek et al. 1996).

Me-Wuk lineages, which were patrilineal in nature and formed important political units with specific names and locations (Gifford 1926; Miksicek et al. 1996), were important to their socio-political organization. The Me-Wuk employ a binary social scheme of moieties that included land and water. The Me-Wuk moieties are hereditary, exogamous, patrilineal, and associated with totems (Gifford 1926; Miksicek et al. 1996). The name of a Me-Wuk individual is bestowed during infancy, which reflects their moiety and totemic relationship. Me-Wuk moieties each have common names like bear-related names for the land moiety and deer for the water moiety. Totem animals are not considered ancestors, nor are they indicative of a potential spirit animal that may appear to an individual later in life. The land and water moieties competed through games, but assisted each other with funerals, mourning, and other social and "quasi-ceremonial functions" (Miksicek et al. 1996:33). The moieties do not appear to carry ritualistic importance, though Me-Wuk marriage practices were preferential because relatives of the opposite moiety were those typically chosen for marriage by the elder female relatives of marriageable individuals (Dick-Bissonnette 1998; Miksicek et al. 1996).

Relationships with neighbors. The Sierra Nevada Me-Wuk were generally peaceful (Barrett 1908:348; James and Grazianni 1991:68-69). They traded with the Yokuts of the Central Valley, other Me-Wuk, and other Native communities north of their territory in the Sierra Nevada (e.g., Nisenan and Maidu). Most of their trade arrangements were east-to-west and west-to-east, but to a lesser degree they also traded north-to-south and south-to-north (Elston 1986; Hutchins and Simons 2000; Levy 1978). Shells were traded from the coast, with baskets and bows traded amongst neighboring groups (Levy 1978).

The Me-Wuk also traded with the Mono and Washoe in Yosemite Valley. Despite peaceful interactions, especially with the Washoe, conflicts arose with the Mono Lake Paiute (Barrett 1908:348; James and Grazianni 1991:68-69; Figure 2.3). Other known conflicts occurred in Hetch Hetchy Valley, a key acorn gathering spot, where the Eastern Mono gained control of the Valley before it was discovered by Euroamericans and Europeans. The Me-Wuk had very friendly relations with Valley Yokuts and regularly traded with them (Barrett 1908:348; James and Grazianni 1991:68-69).

Valley Yokuts is a blanket title that refers to both the Northern Valley Yokuts and Foothill Yokuts who bordered the Me-Wuk to the west (Figure 2.5). The Northern Valley

Yokuts, who resided in the northern portion of the San Juaquin Valley, are little known because they were quickly wiped out by missionization, disease, and displacement once Europeans and Euroamericans arrived. They traded with the Sierra Me-Wuk for baskets, arrows, and bows. The Northern Valley Yokuts were generally peaceful, but fought along the banks of the San Juaquin River and around Tulare Lake (Wallace 1978:462-468). The Foothill Yokuts, who were dispersed into several bands, resided in the foothills of the San Joaquin Valley from the Fresno River drainage south to the Kern River. No documentation exists regarding their trade relations with other Native communities (Spier 1978:471-481). The Yokuts speak a Penutian language (Silverstien 1978:446-447) as do the Nisenan (Southern Maidu) who occupied lands just north of the Sierra Me-Wuk between the Yuba River and Feather River (Wilson and Towne 1978:387-398).

The Me-Wuk generally fought with others for the purposes of retaliation. They used long range bows when fighting, which reportedly resulted in no deaths or a few casualties, but sometimes caused significantly more casualties when they ambushed settlements. The Me-Wuk also provoked conflict by abduction or capture of women, who were usually Paiute. Me-Wuk became involved in conflict for reasons such as the entry and use of acorn gathering areas without permission, witchcraft, and murder (Hall 1921:58; Heizer and Whipple 1971: 480-483; James and Grazianni 1991:70).

Material culture. Me-Wuk material culture was quite varied, and in ways unique from that of the Washoe. The Me-Wuk preferred bows made of incense cedar, but also used maple or hazel wood (Elsasser 1978; Levy 1978; Miksicek et al. 1996; Moratto 2004:310). Their bows often had sinew that was adhered to the bow using several layers of soap-root based glue. The Me-Wuk made concave-base projectile points (sometimes with notches or ears) that fit within the Western Triangular Cluster and Desert Side Notch Cluster of projectile point styles (Hutchins and Simons 2000; Levy 1978; Miksicek et al. 1996; Figure 2.4). They used other point styles based on their discovery at known Me-Wuk habitations, though no ethnographic information exists to validate these associations.

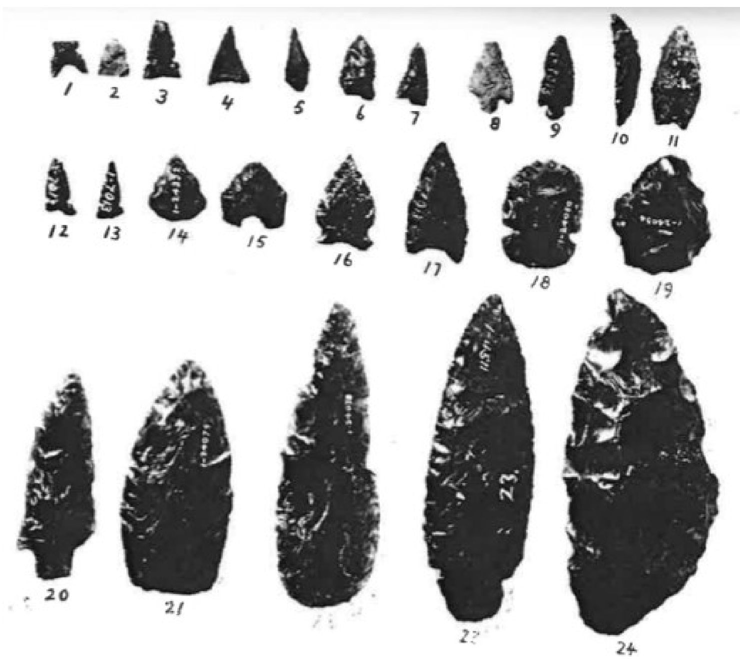

Figure 2.4. Plate of projectile points and bifaces associated with the Me-Wuk. Taken from Barrett and Gifford (1933:298).

The point and foreshaft of Me-Wuk arrows were designed to remain inside the target, regardless of whether the main shaft broke when hunting large game or during war. Arrows lacking a foreshaft were selected when hunting smaller game like rabbits, and simple wooden arrows to hunt fish and birds. The arrows were often fletched with the feathers of a red-tailed hawk in radial positions. Grooved steatite shaft straighteners and scrapers (obsidian or deer leg bone) were used to make the bows and arrows. The Me-

Wuk used deer skin bags as arrow quivers within villages, but sometimes fox or otter quivers when hunting (Barrett 1933; Elsasser 1978; Levy 1978; Miksicek et al. 1996; Moratto 2004:310).

Central Sierran Native communities, like the Me-Wuk, individually or communally hunted deer, rabbits, squirrels, and other animals using bows and arrows, spears, and nets (Hall 1978; Lightfoot and Parrish 2009). Communal hunts ended with the meat divided among the participants, whereas individually killed animals were shared with the hunter's family. Deer and rabbit were the most commonly hunted animals (Levy 1978). Foraging and hunting returns were enhanced by anthropogenic burning that completed some plant lifecycles and improved the food sources for animals (Levy 1978).

Post-Contact Me-Wuk. The Spanish colonization strategy for California was to establish missions, presidios, and rancherias. The Me-Wuk, unlike other Native communities, were not directly affected by these missionization efforts (Hall 1978; Madley 2016; Miksicek et al. 1996) since the missions originated on the coast and only later spread inland. The Me-Wuk interacted with Missionaries and the Spanish when they traveled the rivers of the Sierra Nevada to explore and bring neophytes to the missions (Hall 1978; Madley 2016; Miksicek et al. 1996). Their interactions with the Spanish occurred primarily along the Stanislaus and Tuolumne Rivers, and were mainly attempts to repel them through military action. These battles later resulted in the loss of life as subsequent Spanish forays into the Sierra Nevada were undertaken to recapture neophytes and punish the local Native people. Despite resistance, some Me-Wuk eventually were listed on the registers at Mission San Juan Bautista. The mission period marked the beginning of huge changes in the lives of many California Natives, including the Me-Wuk (Cook 1976 [1943]:351-361; Hall 1978; Madley 2016; Miksicek et al. 1996).

The Sierra Nevada remained unsettled by outsiders until the mid-1800s. The first settlement in Central Sierra Me-Wuk territory occurred two years after the United States took control of California in 1848 (Hall 1978:12). The Me-Wuk, and other Native communities, were indirectly affected by the Spanish presence in California through their trade connections with the Yokuts of the San Joaquin Valley (Miksicek et al. 1996). These trade relationships, due to the intense trade between the Spanish and Yokuts, likely increased the transmission of Old World diseases throughout California (Arkush 1993). Over the course of three years more than half of the Central Valley Yokut population was wiped out by disease, specifically by malaria. The Me-Wuk were decimated by a smallpox epidemic (Hall 1978; Miksicek et al. 1996).

Mission Indians that escaped, or otherwise gained their freedom, sought to avoid or find refuge from the Spanish by living among other Native communities. Some found refuge with the Me-Wuk in the Sierra Nevada foothills, which resulted in extensive population displacement and increased mobility as Me-Wuk groups struggled to find adequate food as a result of their displacement and altered access to and depletion of food resources. Many Native people left their traditional lands or, when they left the Missions, returned to them. The Southern and Central Me-Wuk, Mono, and Yokuts resided in Yosemite Valley until the arrival of Euroamericans and Europeans.

Settlement parties that came west over the mountains, after crossing the Eastern Sierra Nevada, represented the next wave of outsiders to enter California. The subsequent cohabitation and movement of substantial populations of Native peoples due to these new arrivals resulted in the creation of new communities and political units. The Yokuts, for example, moved from their homes in the southern Sierra Nevada into Me-Wuk territory, and integrated into Me-Wuk villages to avoid attacks by newcomers, former neophytes, and disease (Chartkoff 2001; Hall 1978; Miksicek et al. 1996). The flow of immigrants substantially altered the lifeways of the Me-Wuk.

The immigration of large numbers of Euroamericans, Europeans, and other groups to California during the mid-1800s was initiated by the Gold Rush. The already dwindling number of Me-Wuk was further decreased by disease, hostile relations with miners, and settlers. Mass killings carried out by miners against the Me-Wuk took the lives of up to 200 individuals over time (Hall 1978; Miksicek et al. 1996). The total number of Me-Wuk, or any Native peoples, killed is ultimately unknown due to inconsistencies in the historic records. Many of the killings of Native people in the Sierra Nevada were carried out by miners from Oregon, some of whom made a living by hunting Native people (Madley 2016). These conflicts did not stop the new comers from employing Native people, however.

Some Me-Wuk and Yokuts worked as laborers for gold mining operations in the Sierra Nevada, such as in the Big Oak Flat area. As the number of large mining operations decreased and the number of miners increased, Native people were employed less often (Miksicek et al. 1996). The Me-Wuk, and other Native communities, persisted well into the 1850s in Yosemite Valley (Arnold et al. 2004; Hull 2009), one of their only refuges that did not require them to work for mining companies (Spence 1996). Native communities could live there somewhat autonomously, separate from Americans and Europeans. Some Native people chose to continue to work for the mining operations

(Spence 1996), and others mined for themselves, although many were cheated out of their profits or assaulted by others for mining (Hall 1978). The efforts by Euroamerican settlers to expel the Me-Wuk, such as by burning their villages, were less pointed than attempts to drive away the Europeans (Hall 1978; Miksicek et al. 1996).

The Me-Wuk moved further into the mountains during 1849 because of the threat posed by newcomers and the ground disturbing activities of the mining operations that significantly altered the landscape and resource availability. Access to resources was severely limited, especially as the number of refugees fleeing the Euroamericans and Europeans increased, further reducing food resource availability. This posed particularly major problems during the winter. Changes to the landscape altered access to traditional foods and forced the Me-Wuk to adapt their lifeways. They eventually began to utilize domesticated livestock rather than traditional prey animals, such as deer, and increased the number of guerrilla warfare raids against Americans and Europeans. This caused further, but smaller scale displacement of their populations. This fighting and the search for resources in less familiar areas, as they either chose to become or were pushed into isolation, increased the need for mobility and food (Hall 1978; Miksicek et al. 1996).

A treaty between the Me-Wuk and United States federal government was implemented in 1850, but only really benefitted the United States. The Me-Wuk were forced to abandon their homelands and gave up their land rights in return for protection by the government. The treaty was never ratified by the U.S. government (Miksicek et al. 1996). Yosemite Valley was one of few places the Me-Wuk and other Native peoples resided without the imminent threat of removal. They stayed into the early 1900s on the scattered rancherias provided to their Native community (Spence 1996), though some moved from their ancestral lands to Fresno (Miksicek et al. 1996).

The Hispanic period (late 1700s to early 1800s) in California saw a decrease in the population of the Me-Wuk, though the Gold Rush did far more damage. This damage continued for years, with the Me-Wuk population at the beginning of the 20th century approximately 10% of their pre-contact numbers. The pre-contact population may have been as high as 30,000 people (Chartkoff 2001; Miksicek et al. 1996).

Washoe

The Washoe (their preferred spelling over Washo; U.S. Bureau of Indian Affairs 2018) resided along the border of the Great Basin and the Sierra Nevada (see Figure 2.3), and have characteristics of both regions. They share less in common with Great Basin Native communities, however, as they had earlier contacts with California Native communities (de Azevedo 1986:466; Miksicek et al. 1996:31). The Washoe are more like California Native communities, for example, in their use of bedrock mortars, which are generally not used by other Great Basin Native communities (Price 1963). The sharing of characteristics between culture areas is not unusual as many California Native communities share portions of their material culture with Native peoples outside of California (Beardsley 1948).

Washoe territory extended westward from Honey Lake to the West Walker River in Nevada, past Reno and Carson City (Figure 2.3). Their westernmost border is the highest point of the Sierra Nevada—Mt. Whitney (Miksicek et al. 1996)—and includes some land at the head of the Mokelumne River (Hall 1978). The Washoe's core area includes "a chain of fertile valleys on the eastern slope of the Sierra Nevada from

Antelope Valley in the south to Honey Lake in the north" (de Azevedo 1963:1). Washoe lands in the Sierra Nevada were often at high altitudes where the compression of multiple life zones into a relatively small geographic area resulted in the Washoe living with ready access to a variety of animals and plants. The core area is the generally accepted habitation area of the Washoe, though some variation exists in historic records and publications as to the exact boundaries. Importantly, this territory includes major access routes between the Great Basin and California, making the Washoe centrally located for trade.

The Washoe are the only Great Basin Native community to not speak a Numic language (de Azevedo 1986; Miksicek et al. 1996). They instead speak a Hokan language, which indicates their occupation of California predates their Numic speaking neighbors (Hull 2007). Anthropologists believe that the Washoe language separated from other Hokan languages long before its departure from the Yana language (de Azevedo 1963:79; Price 1963).

Neighbors. The Washoe are surrounded by a number of Native communities. The Washoe are bordered on the Great Basin side by the Paiute and on the California side by the Me-Wuk and Nisenan/Maidu (de Azevedo 1986; James and Grazianni 1991). The Owen's Valley Paiute to the south speak a dialect of the Mono language, which is part of the Numic subset of the Uto-Aztekan language family. The Owen's Valley Paiute fought with the Washoe in isolated skirmishes in the protohistoric and historic periods. The Northern Paiute, like the Owen's Valley Paiute, speak a language similar to the Mono (i.e., a Numic subset of the Uto-Aztekan language family). The Northern Paiute lived much as the Washoe, with dispersed bands or familial groups that formed loose Native communities with little central organization. The prehistory of the Northern Paiute does not appear to extend before AD 1000 (Fowler and Liljeblad 1986:454-455). This lack of information indicates there was likely variation in the territory and presence of the Northern Paiute in the Great Basin.

The Washoe occasionally fought the Maidu from the Placerville and Colfax area (James and Grazianni 1991:68) to the north of the SNF. Washoe were competitive with their neighbors and sought to exclude the Maidu and Paiute from the area around Lake Tahoe, causing conflict between the Native communities. The Maidu stole game from Washoe hunters and sometimes killed them in the process (James and Grazianni 1991:68). The Maidu lived on the western border of Washoe in several mountain valleys and spoke a Penutian language. Maidu typically experienced more intra-Native community than inter-Native community conflict, but had conflicts with the Washoe, Yana, and Achumawi. The Maidu traded with their neighbors (e.g., the Wintu and the Achumawi) for a variety of goods (Riddell 1978:370-380).

The Me-Wuk respected the hunting and gathering rights of the Washoe, whose subsistence range was very large and extended from the upper Stanislaus River to Calaveras Big Trees. The Washoe generally ventured beyond their typical territory in the summer and fall to gather acorns, but otherwise generally remained within their own range (de Azevedo 1986; Miksicek et al. 1996). The Stanislaus River canyon is the primary area of overlap in the home territories of the Me-Wuk and Washoe.

Material culture. The Washoe extended across several temporal phases that are addressed here to provide a timeline and context for the development of their material culture (Table 2.2). The Martis phase (once known as the Martis complex) is earliest and occurs on both sides of the Sierra Nevada. Early Martis (3000-5000 BP; 1398 cal. BC to 3945 cal. BC) and Late Martis (1300-3000 BP; cal. AD 645 to 1398 cal. BC) are distinguished by different projectile point styles and artifacts such as bifaces and perforators (Absher 2013; Elston et al. 1994). Because the analyzed projectile points do not extend to the Martis phases they are not considered further.

Table 2.2. Temporal Phases of the Washoe Following on Moratto (2004:300)

Phase	Time markers	Uncalibrated Age	Climate
Washo-Late Kings Beach	Desert Side-notched and Cottonwood series points, chert cores, utilized flakes, and other small chert tools	Historic Contact- AD 1200	Neoglacial—wet and cool with little summer precipitation
Early Kings Beach	Eastgate and Rose Spring series points, chert cores, utilized flakes, and other small chert tool	AD 1200-500	Nonglacial—dry, trees growing in former bogs
Late Martis	Corner-notched and eared points of the Martis and Elko series; Large side-notched points; Large basalt bifaces and other basalt tools	500 BC?-AD 500	Neoglacial—wet but not necessarily cooler with increased summer precipitation
Early Martis	Contracting stem points of the Elko-Martis series; Large basalt bifaces and other tools. Light-colored basalt artifacts.	2000-1500 BC	Beginning of Neoglacial, wet but not necessarily cooler, increased summer precipitation, Lake Tahoe begins to overflow

The Kings Beach complex was changed to the Early (700-1300 BP; cal. AD 1396 to 645) and Late Kings Beach phases (150-700 BP; cal. AD 1664 to 1221) (Absher 2013; Elston 1994). These phases represent the best documented portions of Washoe prehistory and reflect a time when obsidian projectile points were commonly created (Absher 2013;

Elston 1994). Both phases occurred during a dry time that resulted in numerous small and widespread winter settlements as expected during periods of resource stress. Along with fish and smaller game, seeds were heavily exploited as indicated by the increased use of bedrock mortars. The Late Kings Beach phase represents Washoe culture into the historic period and represents a time when the bow and arrow replaced the atlatl (de Azevedo 1986). The Washoe switched from basalt to obsidian as their primary lithic material at the beginning of the Kings Beach complex (Absher 2013; de Azevedo 1986; Elston 1994; Hutchins and Simons 2000).

Washoe obsidian trade patterns were very complex. The Washoe lithic raw material trade network extended from the upper portion of Owens Valley (e.g., Fish Springs) California to eastern Nevada (e.g., Hidden Cave, Lovelock Cave) and to the Bodie Hills region of California (Hughes and Bennyhoff 1986). Beyond California, the trade network extended from the border of eastern Nevada to Nevada's northeastern corner where several sources (e.g., Bare Cave, Fox Mountain, Windmill Quarry) occur in a relatively small geographic area and enabled a complex web of trade that extended into Oregon (e.g., Quartz Mountain, Glass Buttes). This complicated exchange area is visible in the inset in Figure 2.5 (circled in red). The extent of this trade network indicates that the Washoe used or had access to a wide array of obsidian sources (Hughes and Bennyhoff 1986:240).

No Washoe villages are recorded within the SNF (Miksicek et al. 1996). The Washoe instead preferentially settled on the floor of large or small valleys, with year-round settlements typically in valleys situated around 5,500 feet (1,676 m) in elevation (de Azevedo 1986). Evidence suggests that the Washoe wintered at Me-Wuk villages near Big Trees in Calaveras County (Miksicek et al. 1996), which is not unexpected given that Washoe sometimes intermarried with the Me-Wuk (de Azevedo 1986). Washoe villages were loosely connected households that varied in composition and size by the environment or relationships within the communities (de Azevedo 1986; Miksicek et al. 1996).

Figure 2.5. Washoe obsidian trade. Taken from Hughes and Bennyhoff (1986:240).

The families or individuals at winter settlements also may have resided in the same villages during non-winter months. Villages had hereditary leaders from a matrilineal or patrilineal line. Villages were the largest collective unit of Washoe families who cooperated to perform activities such as rabbit drives (de Azevedo 1986; Miksicek et al. 1996). The Washoe considered themselves distinct from other peoples (de Azevedo 1986; Miksicek et al. 1996).

Washoe subsistence patterns required frequent moves because specific families had a right to collect or hunt within a specific area. This prompted families to rely on their hereditary resource locations (de Azevedo 1986; Miksicek et al. 1996). Fish were a key resource and were captured from covered platforms that spanned the width of streams (de Azevedo 1986; Miksicek et al. 1996). Some Washoe traveled to the coast to obtain resources like shells (Downs 1963).

Post-contact: Washoe. The Washoe first interacted with Europeans when they entered their territory in the early 1800s (Downs 1963; Miksicek et al. 1996). They actively avoided interactions by attempting to hide their settlements and left their homes when trappers or explorers were sighted (de Azevedo 1986). The Ute and other Native peoples from the American Southwest captured Great Basin peoples for sale as slaves to the Spanish, likely causing the Washoe to be wary of newcomers (de Azevedo 1963:120). Epidemics greatly reduced the Washoe population in the early 19th century, before the arrival of Europeans and Euroamericans. Together, these factors led to decentralization of the Washoe political and social system (de Azevedo 1963:2).

Washoe lives changed drastically with the Gold Rush, though outsiders entered Washoe lands to explore and search for furs prior to the Gold Rush. Washoe territory was traversed by a high number of miners, who often created camps on the shores of Lake Tahoe and wagon roads. Mormons soon followed the miners. These newcomers and the interloping Paiute caused stress for the Washoe. Trading posts formed by 1855 supported nearly 1,000 settlers, who then occupied some of the best land in Washoe territory, thereby altering their access to resources. There was little conflict between the settlers and Washoe. When coming near the trading posts the Washoe worked to earn money before leaving (de Azevedo 1963; Downs 1963; Miksicek et al. 1996).

The Washoe never fought the settlers and were never hunted by them (de Azevedo 1986; Downs 1963; Miksicek et al. 1996). This was despite the Washoe having experienced worsening conditions and being unable to practice their native lifeways. They eventually learned to participate in the Euroamerican economic system but maintained their distance. The Washoe are considered to be one of the few Native peoples to never be forced onto reservations or rancherias. They were viewed as squatters until they were eventually were allocated land to live and work on. Their work opportunities decreased as the region switched from cattle ranching to farming and their employers began to employ more Basque immigrants. The last mobile Washoe band settled in 1920 (Downs 1963; Miksicek et al. 1996).

Chapter Summary

The Sierra Nevada is a mountain range of variable environments and climates that afforded the Me-Wuk, Washoe, and other Native people access, depending on their territories, to unique combinations of plant, animal, and mineral resources. This variation influenced Me-Wuk and Washoe culture history, as did the impacts to their social organization caused by the influx of Euroamericans during the Gold Rush. The Me-Wuk and Washoe interacted with Native communities from California and the Great Basin that spoke different languages and had cultural repertoires that varied over time. These changes in social structure, time, and differences in culture and language possibly altered Me-Wuk and Washoe obsidian procurement patterns and the obsidian sources used to manufacture projectile points.

CHAPTER 3

PROJECTILE POINTS, METHODS, AND TEST EXPECTATIONS

This chapter introduces and describes the framework, methods, and test expectations used to address the following questions: Does significant variability occur in the obsidian sources selected by the Me-Wuk and Washoe to make projectile points? If so, does the proportion of obsidian from different sources significantly vary through time and space? And, which factors (e.g., language, culture area, resource structure) may explain any differences? To address these questions, I provide background on projectile points, followed by two test expectations that will be used to evaluate these questions. I conclude by describing the methodology used to evaluate the test expectations.

Projectile Points

Projectile points are specialized bifaces created through the reductive process of stone tool manufacture. Stone tools are often created from blanks removed from cores, with the blanks modified into a given tool form. In the case of projectile points, they are often made from flake blanks. The lithic materials typically selected for manufacture into projectile points are those with homogenous, elastic and brittle properties, and prone to conchoidal fracture (Whitaker 1994). Raw materials commonly used to manufacture projectile points are obsidian, basalt, chert, and other igneous, sedimentary and metamorphic rocks (Andrefsky 1994, 2005; Salem and Churchill 2016; Whitaker 1994).

Projectile points come in four types: thrust spears, javelins (thrown spears), darts (thrown with an atlatl), and arrows. The way to differentiate between darts, arrowheads, and the other weaponry tips is typically by their haft elements. Arrow shafts are smaller than dart shafts, which are smaller than spear and javelin shafts. Dart points are also typically larger and heavier than arrowheads, though this is not always true (Andrefsky 1994, 2005; Salem and Churchill 2016; Whitaker 1994).

Projectile point effectiveness depends on the ability to penetrate an animal's body and cause significant internal damage (e.g., Salem and Churchill 2016). For this reason, projectile points have specific design parameters (Hughes 1998) and are made from different raw materials. Wooden points penetrate deeper into targets than stone points, but stone points create a wider wound track and are thus usually more destructive to tissue (Salem and Churchill 2016:206).

Projectile points were designed to absorb impacts to protect the more difficult to create haft element, but as a tool class generally have a short use-life when used as projectiles (e.g., Cheshier and Kelly 2006). According to Cheshier and Kelly's (2006) experiment using 50 projectile points of varying length and thickness, projectile points survive an average of about 2 casts. They also frequently break during production, especially delicate portions like tangs or ears. Projectile point design criteria (i.e., considerations of lethality and survivability) and function influence their final form and typology (Andrefsky 2005; Binford 1979; Cheshier and Kelly 2006; Clarkson 2016; Couch et al. 1999; Fischer et al. 1984; Flenniken and Raymond 2007; Kelly 1988; Musil 1988; Nelson 1991; Salem and Churchill 2016; Shott 1986; Titmus and Wood 1986).

Projectile Point Style

Projectile point typologies are generally based on morphological characteristics of projectile points. Some morphological characteristics are designed to improve function and others are solely or primarily stylistic (Loendorf et al. 2017). Technological and cultural information are often communicated through projectile point characteristics (Justice 2002; Kelly 1988; Musil 1988; Salem and Churchill 2016; Thomas 1981).

Typology as an analytic tool began in earnest with the Binford and Bordes debate (Binford and Binford 1966; Binford 1973, 1983; Bordes 1961; Bordes and de Sonneville-Bordes 1970). The debate began with Bordes' (1961) differentiating between Mousterian assemblages based on their content, which showed little morphological difference between the Mousterian assemblages of Neanderthals and the Acheulean assemblages of *Homo erectus*. Binford and Binford (1966) replied to Bordes' (1961) using his own data to run statistical analyses. The Binfords' supported their function-based hypothesis that specific activities occur at certain locations (e.g., hide treatment, clothing manufacture), and result in similarities between assemblages. It was this focus on functional differences in tools rather than morphological differences that helped develop the typologies used today (Wargo 2009).

The Binford-Bordes debate also touched on the issue of cultural evolution and its effect on tool assemblages. The Binford-Bordes debate may not be linked to it, but the focus on cultural evolution was one of the early forays into the development of evolutionary archaeology. Evolutionary archaeology can generally be defined as the application of Darwinian Theory to archaeological assemblages to understand their development, and why this information is culturally transmitted through time (Bettinger and Eerkens 1999; Eerkens and Lipo 2005; Lyman and O'Brien 1998). A common way that researchers evaluate evolutionary change in projectile points is through cladistics. Cladistics is a classification method common to biological sciences, but is now sometimes used by archaeologists to establish evolutionary relationships between taxa of artifacts or artifact types. Cladistics consider which traits were inherited, where they came from, and which groups shared them (Lyman and O'Brien 1998). The tools or organisms that form a clade (a group of taxa or tool varieties, such as projectile points) have closer evolutionary relationships with each other than any taxa outside of their clade. Clades often resemble a family tree, going from a general relationship (e.g., vertebrate or invertebrate, biface versus flake tool) to more specific relationships (e.g., similarities between tigers, lions, and cheetahs; projectile points, bifaces, and knives) (Lyman and O'Brien 1998).

Evolutionary archaeology has been used to study various projectile point types. For example, Buchanan and Collard (2007; also O'Brien and Lyman 1998) used cladistics to study a Paleoindian projectile point styles from several assemblages for specific heritable morphological characteristics that were traceable to other Paleoindian point types. They found that Paleoindian projectile points in North America were created by mobile populations that broke into smaller groups as they spread across the New World (Buchanan and Collard 2007).

Unfortunately, cladistics cannot be applied to Late Prehistoric projectile points (like those considered for this thesis) since the evolutionary and phylogenetic relationships between these point types are unclear (Eerkens et al. 2006). The lack of clarity results from the point types being more dissimilar than similar and having a high degree of variability (Eerkerns et al. 2006; Lyman et al. 2009; Musil 1988). This variability possibly results from stylistic preferences rather than functional differences, much as Loendorf et al. (2017) found in the American Southwest.

Research Questions

Key differences between the Me-Wuk and Washoe described in Chapter 2 lead me to expect variability in their choices of obsidian to make projectile points. This variability leads me to ask three questions: Does significant variability occur in the obsidian sources selected by the Me-Wuk and Washoe to make projectile points? If so, does the proportion of obsidian from different sources significantly vary through time and space? Which factors (e.g., language, culture area, resource structure) may explain any differences? To answer these questions various cultural aspects (language, relationships with neighboring Native communities) of the Me-Wuk and Washoe are considered, as well as the regional obsidian landscape.

The Me-Wuk and Washoe speak different languages—the Me-Wuk speak a Utian language and the Washoe a Hokan language. Linguistic barriers possibly arose that impacted effective communication between these and other nearby Native communities, ultimately influencing trade and exchange patterns (Speth et al. 2013; Whitaker et al. 2008). Language may also determine if another Native community was an appropriate trading partner. People who speak the same language are more likely to trade with one another rather than with Native peoples who speak a different language (Buchanan et al. 2019; Whitaker et al. 2008). Speaking the same language makes it easier to communicate and does not require those involved to learn a different language, use an interpreter, or develop an alternative form of communication. This may be reflected in the archeological record by sites associated with peoples who speak a similar language or share a language group having more similar assemblages than other peoples nearby who speak a different language or are from a different language group.

Because the Washoe are from the Great Basin and the Me-Wuk from California, they likely had different relationships with their neighbors. Both groups were generally peaceful, but the Me-Wuk primarily fought with other groups for retaliation (see Chapter 2). The Washoe, however, primarily fought with others to protect their lands around Lake Tahoe (see Chapter 2). Moreover, the Me-Wuk and Washoe had different access to obsidian sources given their respective locations. Other Native communities' peaceable or antagonistic relationships with the Me-Wuk and Washoe possibly allowed trade or enabled/prevented direct procurement of the different obsidian sources available in each area (i.e., Great Basin and California). This would affect their use of different obsidian sources because, for example, you would not want to trade with or have someone on your land who killed friends or family members, so you would keep them away. Conversely, you would want to trade with someone who allowed you on their land to gather acorns or to hunt. These relationships may also vary over time. In the archaeological record these kinds of relations may be reflected by more intensive use of obsidian from the lands of known allies rather than obsidian sources in or bordering the lands with a community with whom a group regularly conflicts with. For these reasons, if these differences in relationships between communities and limitations in obsidian source access hold true over time, they should result in the Me-Wuk and Washoe using different obsidian sources, or at least having different percentages of these obsidians in their assemblages (Whitaker et al. 2008).

The Me-Wuk and Washoe each inhabited a territory with variable topography that presumably affected the ease of access to and proximity to obsidian sources. This differential access should be evident in the obsidian sources the Me-Wuk and Washoe preferentially used to make projectile points (Absher 2013; Elston et al. 1994; Bloomer and Jaffke 2009; de Azevedo 1986; Levy 1978). This would result in variation simply as a result of location and what lithic raw material sources were the easiest to access, either as a result of distance or the effort required to reach a given source.

Based on the research questions, I created two test expectations that will be evaluated through the rest of this thesis. I discuss the cultural affiliation test expectation first, followed by the time test expectation.

Cultural Affiliation Test Expectation

The cultural affiliation test expectation predicts that differences occur in the obsidians selected by the Me-Wuk and Washoe to make projectile points. I expect preferential use of obsidian from areas where they shared commonalities (language, kinship, and/or culture) with other local Native communities. The Me-Wuk should significantly select California obsidians over those from the Great Basin. California sources include those on the eastern or western slopes of the Sierra Nevada and any sources to the west within California. Thus, the Me-Wuk should preferentially have selected obsidian sources accessible from their higher altitude territory significantly more than other sources, such as Mono Craters, Obsidian Dome, Casa Diablo, and Mono Glass Mountain (Figure 3.1). Conversely, I expect that the Washoe preferentially obtained obsidian from California and Great Basin sources, resulting in no significant difference between the frequency of obsidian from the two regions. Obsidian sources favored by the

Washoe would include Bodie Hills, Mt. Hicks, Silverpeak, and Queen (Figure 3.2). Based on these expectations, a higher number (richness) of Great Basin sources should be represented in Washoe rather than Me-Wuk assemblages.

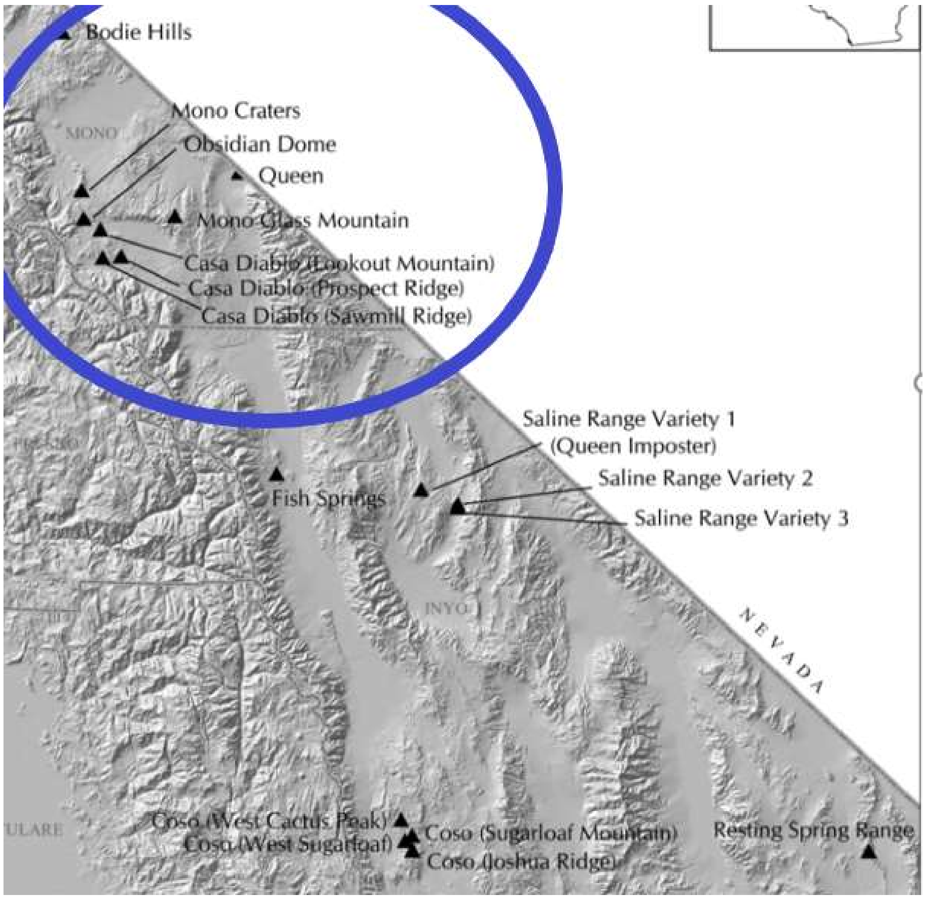

Figure 3.1. California obsidian sources likely used by Me-Wuk and Washoe (circled in blue). Taken from http://www.sourcecatalog.com/image_maps/image_maps.html.

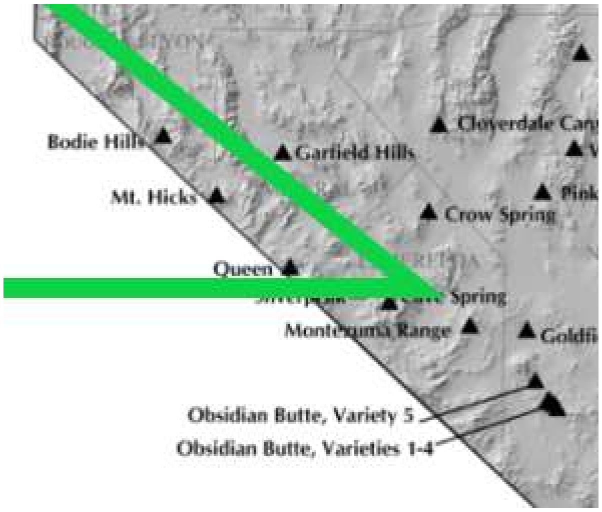

Figure 3.2. Nevada obsidian sources likely used by Washoe (bordered in green). Taken from http://www.sourcecatalog.com/image_maps/image_maps.html.

Time Test Expectation

The time test expectation anticipates that Me-Wuk and Washoe projectile points were made from different lithic sources through time due to changes in climate, territory, neighbors, and/or trading partners. Climate oscillations during the MCA and/or LIA potentially altered mobility patterns and access to lithic material sources (Absher 2013; Basgall 1989; Eerkens et al. 2008; Schieber and Finley 2011; Skinner et al. 2004; Smith 1990; Talieferro et al. 2010; Whitaker et al. 2008). The arrival of new Native peoples and Euroamericans into Me-Wuk and Washoe territory potentially increased competition for lands with obsidian sources, thereby altering prior raw material procurement practices (e.g., Barrett 1933; Bettinger 1982; Justice 2002:24). Given the increasingly complex social and political factors, I expect that the Me-Wuk and Washoe used a wider variety of obsidian sources earlier than later in time since there was less competition and/or fewer issues with access to obsidian sources (Johnson and Lorenz 2006; Justice 2002).

Furthermore, because the Washoe experienced less variation in language compared to the Me-Wuk and were more closely affiliated with other Great Basin Native groups, I expect they maintained improved access to the regional obsidian sources later in time than the Me-Wuk. The Washoe should thus have significantly more obsidian sources represented than the Me-Wuk (see Morgan 2009).

Methods

The collection of projectile points analyzed for this research comes from the 2013 Rim Fire recovery efforts in the SNF, which netted 378 projectile points of different styles and lithic raw material types. I analyzed the Rim Fire Collection, on loan from the SNF, in the Lithic Laboratory at CSU Fullerton under the guidance of my thesis advisor, Dr. Edward Knell, in the Spring and Summer of 2016.

A primary goal was to assign each artifact to a known point type. This was done to characterize the Rim Fire collection, but more importantly to determine the points that were identifiable as Me-Wuk, Washoe, or other. These determinations were made using established projectile point typologies and ethnographic sources. Another primary goal was to geochemically source a sample of the obsidian points to establish their original source area.

Projectile Point Typology

Several California-based projectile point typologies have been developed, including Heizer's Berkeley Typology (Heizer and Hester 1978), Thomas' (1981) Monitor Valley Typology, and Justice's (2002) California and Great Basin cluster approach. These typologies reflect the interests of their developers and focus primarily on prehistoric styles and their place in time, culture, and morphology. Temporal typologies evaluate how projectile points changed through time, and are established using obsidian hydration, association with temporal diagnostics, and/or radiocarbon dates. Cultural typologies establish changes manifest in a region's projectile points based on differences in ethnographic observation and/or geography (Bettinger and Eerkens 1999; Justice 2002; Thomas and Bettinger 1976; Thomas 1981). Morphological typologies are based on the physical characteristics of points, such as their size, shape, and notch location, and are usually considered in conjunction with temporal and/or cultural typologies (e.g., Bettinger and Eerkens 1999; Justice 2002; Thomas and Bettinger 1976; Thomas 1981).

Heizer and Hester (1978) created the Berkeley Typology, which provides a temporal framework for Great Basin projectile points and uses weight to differentiate between arrowheads and dart points. They preferred weight over shape because the points they analyzed were often morphologically similar, but different in size. This typology is fraught with problems, such as its inability to establish geographic ranges for point styles and issues with weight not always being an appropriate measure to differentiate between dart and arrowheads (Thomas 1981). The Berkeley Typology included eastern Great Basin and western Great Basin point styles, addressing too many projectile points at once to be effective. Later typologies addressed these and other issues (Bettinger and Eerkens 1999:231; Justice 2002; Thomas 1981).

Thomas and Bettinger's (1976) first attempt at a projectile point typology was the Reese River Typology that, like the Berkeley Typology, was based on measurements to differentiate between points. The Reese River Typology relied on metric measurements of key morphological characteristics to distinguish between point types (Thomas and Bettinger 1976). Thomas (1981) later developed the Monitor Valley Typology (Thomas

1981), which is a temporal typology that uses specific morphological measurements like basal indentation ratio and length-to-width ratio to differentiate between Great Basin dart points and arrowheads (Figure 3.3). Thomas developed the Monitor Valley Typology (Thomas 1981) using 400+ artifacts from Gatecliff Shelter in Monitor Valley, Nevada (Thomas and Bettinger 1976; Thomas 1981; also Bettinger and Eerkens 1999; Heizer and Hester 1978; Thomas et al. 1976). Applying this typology to eastern California is problematic because some arrowheads have basal width measurements similar to dart points.

More recently, Justice (2002) created a cluster-based projectile point typology for California and the Great Basin that considers similarities in morphology, age, and geography. It is useful because Justice (2002) specifies the temporal and geographic range for each projectile point type and addresses variation within the styles.

My approach to establishing projectile point type and cultural affiliation (Me-Wuk or Washoe) was to use the Justice (2002) and Monitor Valley (Thomas 1981) typologies. Each point was identified by comparing them to the illustrations and written descriptions in Justice's book on multiple occasions and consulting my adviser, Dr. Edward Knell. To help verify the identifications, I then took the necessary measurements to run each applicable point type through the Monitor Valley Typology flow chart (Thomas 1981). The point identifications confirmed using the Monitor Valley Typology (Thomas 1981) were preferentially selected for further analyses, particularly geochemical sourcing.

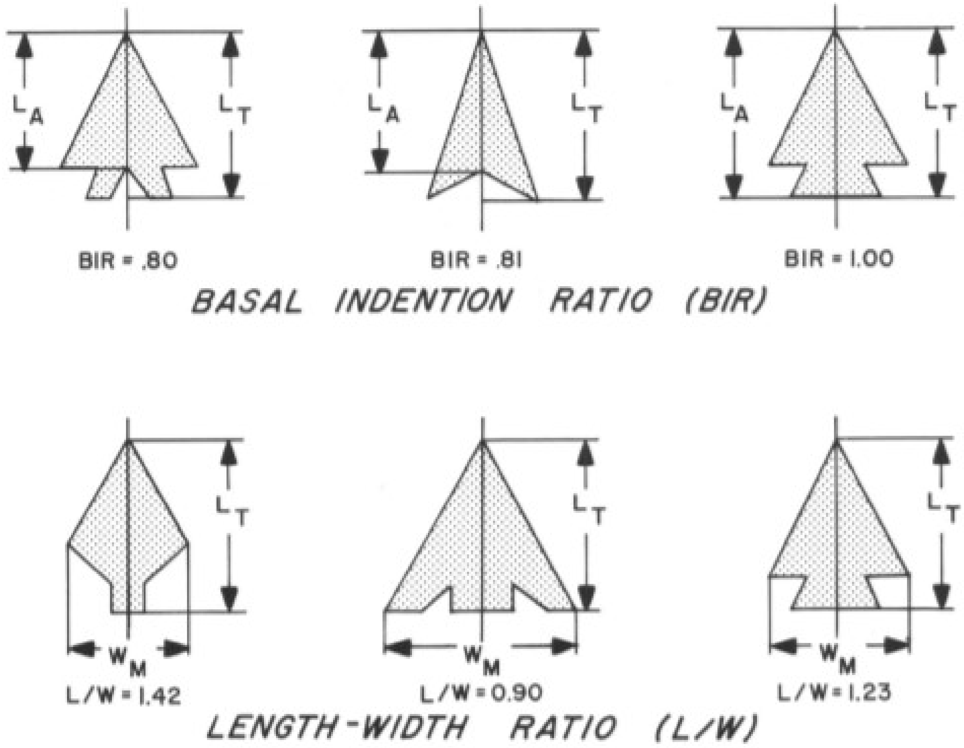

Figure 3.3. Metric measurements used in the Reese River Typology. Taken from Thomas et al. (1976:283).

I consulted several ethnographic and archaeological sources to determine which points were Me-Wuk and which were Washoe (Absher 2013; Barrett and Gifford 1933; Bloomer and Jaffke 2009; Elston et al. 1994; de Azevedo 1986; Levy 1978). These associations are established in Chapter 4.

Geochemical Sourcing

To address the test expectations, I submitted a sample of the obsidian points for geochemical sourcing analysis, specifically energy dispersive x-ray fluorescence (EDXRF). I identified the lithic raw material type (e.g., obsidian, chert, chalcedony, chert, quartz, quartzite, glass, jasper, felsite) of each point using the Chesterman (1990) and Hamblin and Howard (1967) geological comparative guides. The obsidian points, which account for most of the projectile collection and are amenable to geochemical sourcing, were set aside for potential submission for EDXRF analysis.

EDXRF establishes the chemical composition of a lithic artifact by causing its chemical constituents to fluoresce by exciting their electrons that then settle (Shackley 2011). These settled electrons fluoresce at different wavelengths and pertain to different chemical elements that can be individually measured, compared, and matched to profiles of known lithic sources from a region to determine the source location (Andrefsky 2005; Hall 1960; Parkes 1986; Shackley 2011). The ratio of strontium (SR) to zirconium (ZR) is commonly used to identify lithic materials to source, though other elements can be considered to refine the source identification (e.g., Fe:Mn or Zr:Nb).

Eighty-three (21.95% of the total collection) obsidian projectile points were geochemically sourced using EDXRF analysis at Dr. Richard Hughes' Geochemical Research Laboratory (Hughes 1992, 2007; Hughes and Smith 1993). Dr. Hughes has a large reference database for California and Great Basin obsidian sources. The method and results of Dr. Hughes' analysis are in letter reports dated June 12, 2017 and March 2, 2017 (Hughes 2017A, 2017B).

Chapter Summary

Provided in this chapter was background on projectile points, including a discussion of typological approaches in general (Binford-Bordes debate) and those specifically used to establish the types of points in the Rim Fire collection. These typologies include the Monitor Valley (Thomas 1981) and Justice (2002) typologies. The methods to identify the projectile points to type were discussed, as was the approach to geochemically sourcing the obsidian points using EDXRF. The Rim Fire projectile point collection is used to address if and/or how the lithic raw material sources used to make projectile points by the Me-Wuk and Washoe significantly varied by cultural affiliation, and whether significant variations occurred through time. These research questions are codified into two test expectations—the cultural affiliation and time test expectations—that are evaluated in Chapter 4.

CHAPTER 4

PROJECTILE POINT ANALYSIS

In this chapter, I present the analytical results as they pertain to the Rim Fire projectile point collection and test expectations evaluated for this thesis. First, I document the types of projectile points found in the Rim Fire collection, including their frequency and cultural affiliation (i.e., Me-Wuk, Washoe, or unknown). Second, I describe the districts of the Stanislaus National Forest (SNF) that the projectile points were found in, as well as general characteristics of the Rim Fire collection. And third, I discuss the projectile points submitted for EDXRF analysis and establish which lithic raw material sources the Me-Wuk and Washoe preferentially made their obsidian points from. Each of the three analyses contributes towards assessing the test expectations established in Chapter 3.

Rim Fire Projectile Point Collection

The 378 analyzed projectile points were divided into 35 distinct types using Justice's (2002) typology (see Table 4.1 for information regarding the types and their frequency, date range, documented geographic distribution, type description, and SNF district or districts where they were discovered; see Appendix A for complete information for each individual projectile point). Temporally, the points range from approximately 6000 cal. BC to the Historic period, and morphologically, range from lanceolate and stemmed to side and corner notched. The points range from 66.2-10.3 mm long and from

9.6-0.2 g in weight, and have variable flaking patterns and shapes (e.g., barbed, notched, bifurcated). Most are point types that typically come from California, but others likely came from as far east as the Bear River, Utah, as far south as northern Mexico, and as far north as Oregon and Idaho. Other point types are typically found across the American Southwest and Great Basin. Ultimately, the Rim Fire point collection is rather variable and could signal a significant degree of cultural exchange between Native communities through exchange, trade, and/or commerce.

As indicated in Chapter 3, I consulted both the Justice (2002) and Monitor Valley (Thomas 1981) typologies to provide additional confidence to my projectile point identifications. However, the Monitor Valley Typology (Thomas 1981) was not applied to each point because this typology does not include all of the point styles in the Rim Fire collection, and some points were not complete enough to accurately measure and apply the typology. Forty-nine points fit both typologies (see Table 4.2). Desert Side Notched points were most commonly verified (n = 36, 73%), followed by Cottonwood Triangular (n = 7, 14%), Humboldt Series, Elko Series, and then Rosegate Series points.

Eleven projectile points (eight Desert Side Notch Cluster, one Humboldt Cluster, one Rosegate Cluster, and one Western Triangular Cluster point) have general rather than the specific characteristics of a type/cluster, and were excluded from Tables 4.1 and 4.2. I placed an additional 125 points in an “indeterminate” category since they were not identifiable to a specific type or cluster. These were incomplete, unfinished, chipped/broken, heat spalled, or lacked key diagnostic attributes to categorize them as anything other than a generic projectile point.

To briefly summarize, the Rim Fire collection is highly variable with 35 distinct projectile point types that come from different areas of California and the Great Basin, and range from approximately 6000 cal. BC to the Historic period. This range of point types potentially indicates a substantial amount of mobility through the Sierra Nevada by different Native communities through time, that an extensive trade network was in place during this time, or both.

Table 4.1. Projectile Point Styles Identified in the Rim Fire Collection

Type	Approximate Calibrated Radiocarbon Age	Geographic Range	Traits	Frequency	Cultural Affiliation	SNF District
Borax Lake Widestem	6000-3000 BC (Early Archaic)	Most of California; parts of Arizona and Nevada	Square stemmed (straight or rounded base); haft element slightly contracting or expanding; short triangular blade; short and horizontal to downward shoulders; possible haft grinding; basal thinning	6	N/A	Groveland and Mi-Wok
Stanislaus Broad Stem	4700-4200 BC (Middle Archaic)	Most of California; parts of Arizona and Nevada	Broad and straight/expanding stems; straight/slightly concave base; basal thinning; some crushing on edge of haft; horizontal shoulders	7	N/A	Groveland
Pinto	6000-5000 or 3000 BC (Early to Middle Archaic)	American Southwest and all of California	Bifurcated/indented base; distinct basal ears that are rounded or square; straight-sided/contracting/expanding haft elements; horizontal/ downward shoulders; straight/ curving blades; some have serration; chevron flaking on one or both sides somewhat common; some oblique flaking; random pressure flaking; resharpening common	15	N/A	Groveland and Mi-Wok
Humboldt	6000 BC-AD 600 (Middle to late Archaic)	Great Basin; including Sierra Nevada Mountains	Lanceolate; triangular and concave base/basal notch; can have excurvate blade with small base; can be triangular with large base ears that are wider at the base; grinding on base or sides might be present; pressure flaking; oblique flaking; biconvex or flat cross sections	4	N/A	Groveland and Mi-Wok
Buchanan Eared	1000 BC-AD 700 (Middle to Late Archaic)	San Joaquin Valley and surrounding areas from central coast to eastern edge of Yosemite NP	Eared; expanding ears that can be straight or curved; deep basal notch/concave base; lanceolate; long; narrows above ears; biconvex cross section; oblique flaking from left to right and up to down	1	N/A	Groveland and Mi-Wok

Type	Approximate Calibrated Radiocarbon Age	Geographic Range	Traits	Frequency	Cultural Affiliation	SNF District
Mendocino Concave Base	3000-500 BC (Middle Archaic)	North central California Coast and portion of northern San Joaquin Valley	Lanceolate; no notches; excurvate blades; concave base; basal thinning	4	N/A	Groveland and Mi-Wok
Northern Side Notched	6000-5000 or 3000 BC (Early to Middle Archaic)	Most of Great Basin; half of Northern California; most of Nevada-California border	Lanceolate/triangular; thin; biconvex cross section; moderately deep/deep notches; notches just above ears; u-shaped notches/horizontal; concave/straight base; ears are square with round/sharp corners; base approx. same width as shoulders; basal thinning; blade is excurvate or straight	1	N/A	Groveland
Sudden Side Notched	4500-2000 BC (Middle Archaic)	Approx. Central Great Basin	Large haft element; straight/convex base; u-shaped notches that are shallow/ horizontal; varied notch angle; basal ears round/squared	5	N/A	Groveland
Jalama Side Notched	6000-3000 or 2500 BC (Middle Archaic)	Half of San Juaquin Valley; Central and South California Coast	Large; concave base; triangular; u-shaped notches; thick cross section; basal ears squared/ rounded; sometimes serrated; horizontal shoulders; pressure flaking; random or chevron flaking pattern; sometime grinding/crushing on haft element	6	N/A	Groveland
Diablo Canyon Side Notched	6000-3500 BC (Early to Middle Archaic)	Half of San Joaquin Valley; Central and South California Coast	Straight to convex base; basal ears variable in size and shape; slight concave bases uncommon but present; large and u-shaped notches and can be horizontal/diagonal; basal ears match generally; can end at an angle/upturned; basal grinding sometimes; biconvex or flat cross section	2	N/A	Groveland and Mi-Wok

Type	Approximate Calibrated Radiocarbon Age	Geographic Range	Traits	Frequency	Cultural Affiliation	SNF District
Kelsey Creek Barbed	4000-2500 BC (Middle Archaic)	Northern California Coast; extending to Oroville; CA	Medium to large; corner notched; expanding stem; barbs; notches can be wide to narrow and are deep; narrow neck width; pressure flaking; variation in blade shape; can be short and narrow with no shoulders	5	N/A	Groveland
Mayacmas Corner Notched	2500-500 BC (Middle Archaic)	Northern California Coast; extending to Oroville; CA	Corner notched; triangular; notches low; barbs horizontal/a little downward and may project upward; bases straight/convex; notches deep but can be shallow; pressure flaking with random or chevron patterns; some have large flake scars near tip	2	N/A	Groveland
Rossi Expanding Stem	2500 or 2000 BC to AD 100 (Middle Archaic)	California Coast from Sacramento to Del Rey Hills	Large; thick; biconvex cross section; max width approximately equal to max length; bases straight/convex; large and excurvate blade; horizontal/downward shoulders; stem constricted above base; neck less wide than base; sharpening above shoulders; barbs can become more prominent with resharpening; can be slightly serrated; pressure flaking	1	N/A	Groveland
Martis Corner Notched	1000 BC to AD 650 (Middle to Late Archaic)	Central Sierra Nevada into Nevada	Large and round notches; most notches are deep but can be less so and result in an expanding stemmed appearance; some can appear to be side notched; blades ex/incurvate; edges can be ragged/straight/serrated; no basal grinding; basalt primary material; pressure flaking; some might have left side unflaked	1	Washoe	Groveland
McGillivray Expanding Stem	2500-500 BC (Middle Archaic)	Central Sierra Nevada to Southern California Coast	Long and narrow blade; narrow neck; expanding stem; hafting element small; biconvex cross section; short shoulders; shoulders can be horizontal/ downward/upward; can be serrated; distinct flaking on edges; crushing/grinding can be on sides of base; can have oblique pressure flaking from top left to lower right on both sides	2	N/A	Groveland

Type	Approximate Calibrated Radiocarbon Age	Geographic Range	Traits	Frequency	Cultural Affiliation	SNF District
Vandenberg Expanding Stem	2500 BC to AD 500 (Middle Archaic)	California Coast from Sacramento almost to Mexico	Highly variable; contracting stem with approx. straight lateral margins; triangular blade; varied shoulder barbs; large size variation; thin blade edges relative to width; sharp edges; stem may come to point/wide and truncated with flat base; wide and narrow haft elements; indentation at shoulder; barbs can nearly go to base or very short; sometimes serrated; blade edges can be straight/excurvate/ revurvate; blades can be short and wide or long and narrow; tips sharp and can be needle/ drill like with indenting just below tip; pressure flaking; flaking patterns random or chevron	2	NA	Groveland and Mi-Wok
Houx Contracting Stem	2500 BC to AD 500 (Middle Archaic)	Northern Central California Coast	Triangular blade; wide contracting stem; shoulders/ barbs variable in size; blade edges usually straight sometimes in/excurvate; highly variable stems; stems can have sharp corners and truncate/ straight base edge; shoulders can be straight or go up or down and can be asymmetric or have only one; pressure flaking; random or chevron flaking pattern or sometimes oblique	5	N/A	Groveland
Sierra Contracting Stem	3000-2000 BC (Middle Archaic)	North and Central Sierra Nevada going into Nevada	Triangular blade; wide to narrow contracting stem; stems can appear straight; base can be flat/round/pointed; cross sections flat or biconvex; fine serration common; blades can be straight/recurvate; shoulders can go up or down or be horizontal; repeated resharpening	2	N/A	Groveland
Yosemite Contracting Stem	2450 BC to AD 450 (Middle Archaic)	Central California	Contracting stem; oblique pressure flaking from top left to lower right; triangular stem with varied length and generally straight sides; shoulders can go up or down; pressure flaking; biconvex to flat cross section	1	N/A	Groveland

Type	Approximate Calibrated Radiocarbon Age	Geographic Range	Traits	Frequency	Cultural Affiliation	SNF District
Gypsum	2000-800 BC (Middle to Late Archaic)	Southern central California; most of the Great Basin; parts of northern Mexico	Triangular; contracting stem; haft element expands to meet the blade; max. width at neck or shoulder and haft juncture; stem variable in length and sometimes longer than the blade; sometimes serrated; pressure flaking	2	N/A	Groveland
Elko Eared	1500 or 1300 BC to AD 600 or 700 (Middle to Late Archaic)	California; most of the Great Basin; parts of northern Mexico	Corner notched; concave base/basal notch that is deep; basal ears; narrow and deep notches; blade edges convex to straight or incurvate; biconvex cross section; shoulder barbs wider than basal ears; basal ears varied in shape; random to chevron flaking pattern; sometimes serrated	3	N/A	Groveland and Mi-Wok
Elko Corner Notched	1500 or 1300 BC to AD 600 or 700 (Middle to Late Archaic)	California; most of the Great Basin; parts of northern Mexico	Triangular; corner notched; straight base; variable in notch depth, width, and angle; deep and narrow notch openings; fine pressure flaking; biconvex prominent shoulders that go down; sharp barbs wider than the basal ears; basal ears varied; random to chevron flaking pattern; blade sharp; sometimes serrated; does include some side notched	1	N/A	Groveland
Rose Spring Corner Notched	AD 500-1300 (Late Prehistoric)	Great Basin	Narrow; triangular; haft element variable; pressure flaking; irregular chevron flaking; corner notched; contracting to straight stem	8	Washoe	Groveland
Eastgate Expanding Stem	AD 700 or 600-1300 (Late Prehistoric)	Most of Great Basin	Wide; triangular; deep notches; squared shoulder barbs; narrow expanding stem; base straight to convex; notches angled inward; blade edges sharp; pressure flaking	10	Washoe	Groveland
Stockton Expanding Stem	AD 700-1100 or 1500 (Late Prehistoric)	Central California and western central Sierra Nevada	Small; narrow; haft element can be narrow; corner notched or nearly straight stemmed; pressure flaking; serration decreasing in size towards tip; serration tends to be shallow; maximum width typically at shoulder	1	N/A	Groveland

Type	Approximate Calibrated Radiocarbon Age	Geographic Range	Traits	Frequency	Cultural Affiliation	SNF District
Malaga Cove Leaf	AD 500-1300 (Late Prehistoric)	Southern California Coast to Tulare Lake	Leaf shaped; small; can be teardrop shaped with narrow rounded base to bi-points; bi-convex cross-section; thin to thick straight blade; finely serrated; random pressure flaking	3	N/A	Groveland
Cottonwood Triangular	AD 900 (Late Prehistoric) to the Historic Period	Southwest, California, and parts of Oregon and Idaho	Relatively small; lightweight; triangular catchall type; isosceles through equilateral triangle; blade can be straight to excurvate to incurvate; base may be slightly convex to concave	12	Washoe and Me-Wuk	Groveland and Mi-Wok
Canalino Triangular	AD 1300 or 1500 to 1830 (Late Prehistoric to Historic)	Southern California Coast	Triangular; elongated isosceles with concave bases; previously described as swallow tailed; can have widening basal ears; blade may come in just above ears; concave for entire width of base and is deep; can be narrow with downward ears; sometimes fine serration; pressure flaking in random or chevron pattern	5	N/A	Groveland
Desert Side Notched	AD 1100 or 1300 to 1900 (Late Prehistoric to Historic)	Most of Great Basin; eastern California; parts of Mexico	Small; triangular; side notched; catchall category; no basal notch; isosceles to equilateral; straight to concave base; notches below midpoint of blade; angular ears; notches narrow and deep; generally symmetric; narrow neck; blade can be straight to incurvate; pressure flaking	11	Washoe	Groveland and Mi-Wok
Sierra Side Notched	AD 1250 or 1300 to 1900 (Late Prehistoric to Historic)	Most of Great Basin; eastern California	Third notch in center of base that is same size as side notches; triangular; straight to concave base; unique angles on basal ears and base edges; usually no rounded edges; pressure flaking; sometimes asymmetric or with shortened corners	13	Me-Wuk	Groveland
Delta Side Notched	AD 1500-1800 (Late Prehistoric to Protohistoric)	Sierra Nevada and eastern San Joaquin Valley Foothills	Isosceles triangle with deeply concave base; base can be a smooth arc or v-shaped; some not serrated; can be large; pressure flaking; biconvex	26	Me-Wuk	Groveland

Type	Approximate Calibrated Radiocarbon Age	Geographic Range	Traits	Frequency	Cultural Affiliation	SNF District
Redding Side Notched	AD 1600 or 1700 to early 1900s (Late Prehistoric to Historic)	Around Redding, CA	Triangular; slightly curved notches low on form; notches usually expand on interior and go up; bell shaped; excurvate blade that sometimes recurves at tip; thin and fragile; chevron and irregular flaking pattern	7	N/A	Groveland
Bear River Side Notched	AD 750-1350 (Late Prehistoric)	Around Great Salt Lake, UT, to Wilson Butte Cave, ID	Small; narrow neck; triangular; base large relative to the rest of the point; edges of blade and base can be straight to slightly convex; notches horizontal/ parallel/narrow; pressure flaking	2	N/A	Groveland
Panoche Side Notched	AD 1500-1850 (Late Prehistoric to Historic)	South central and Southern California Coast to the western Sierra Nevada	Isosceles triangle; deep notches high above base; sometimes in middle of the sides; notches generally large relative to point; narrow neck; notches can be wider than deep; notch angle can be acute; base edges generally concave but can be straight; pressure flaking; thick cross sections	14	N/A	Groveland
Gunther Barbed	AD 800-1200 (Late Prehistoric)	From Tulare Lake, CA, and into Oregon	Wide and triangular blade; long barbs; contracting stem; can be straight; base may be squared/ rounded/pointed; stem and base length variable; barbs can extend below base; pressure flaking	19	N/A	Groveland

Table 4.2. Projectile Point Identifications Confirmed Using the Monitor Valley Typology (Thomas 1981)

Monitor Valley Typology Type	Monitor Valley Typology ^{14}C Date Range	Points Confirmed
Desert Side-notched	Post AD 1300	36
Cottonwood Triangular	Post AD 1300	7
Humboldt Series	~3000 BC - AD 700	3
Elko Series	1300 BC – AD 700	2
Rosegate Series	AD 700 - 1300	1
Total		49

Geographic Distribution

The Rim Fire projectile points were found at 88 different sites: with 76 from Groveland District sites (86.3%) and 12 from Mi-Wok District sites (13.7%) (Figure 4.1). The frequency of sites in each district differs due to the vegetation and fire susceptibility patterns. The Groveland District is dominated by dry chaparral (e.g., manzanita, poison oak, scrub brush) that is prone to intense burning, and exposed more land to the archaeologists working the Rim Fire than in the Mi-Wok District. By contrast, the Mi-Wok District primarily contains mixed conifer forest that burns less intensely, making it more difficult for archaeologists to find artifacts. This difference is evident in Figure 4.2 where the Groveland District has many more projectile points than the Mi-Wok District, both in total number and nearly every lithic raw material type (excepting jasper and sedimentary rock).

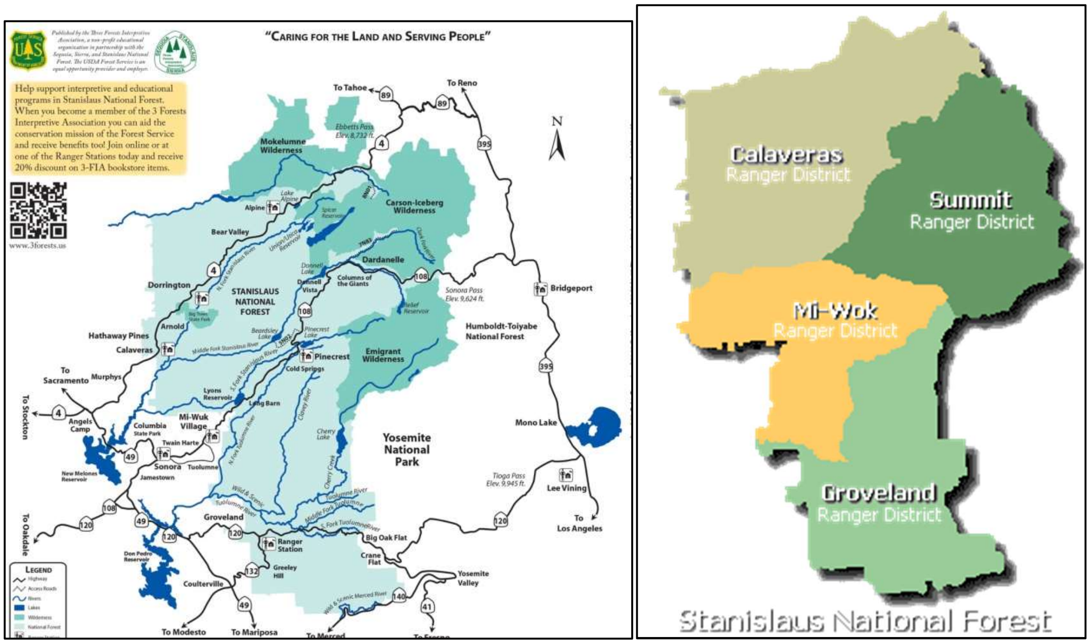

Figure 4.1. (left) Location of Stanislaus National Forest showing rivers and highways (left), and the Stanislaus National Forest ranger district map (right). From www.fs.usda.gov

Obsidian projectile points dominate the collection (n = 308, 83.9%), with 10 other lithic raw material types represented by just 57 projectile points. The less common raw materials include basalt (n = 21 or 5.6% of the total projectile points), quartzite (n = 16, 4.3%), chert (n = 8, 2.1%), fine-grained volcanics (n = 4, 1%), quartz (n = 2, 1.0%), jasper (n = 2, 0.5%), glass, felsite, and sedimentary rock (1 each for a combined 0.6% of the total collection). Obsidian was clearly the favored raw material type.

<u>Cultural Affiliation Attribution</u>

This section pivots from summarizing the Rim Fire Collection to focus on analysis, particularly establishing which projectile points are Sierra Me-Wuk and which are Washoe. Establishing cultural affiliation is important because I use this information in Chapter 5 to evaluate the Cultural Affiliation Test Expectation posed in Chapter 3.

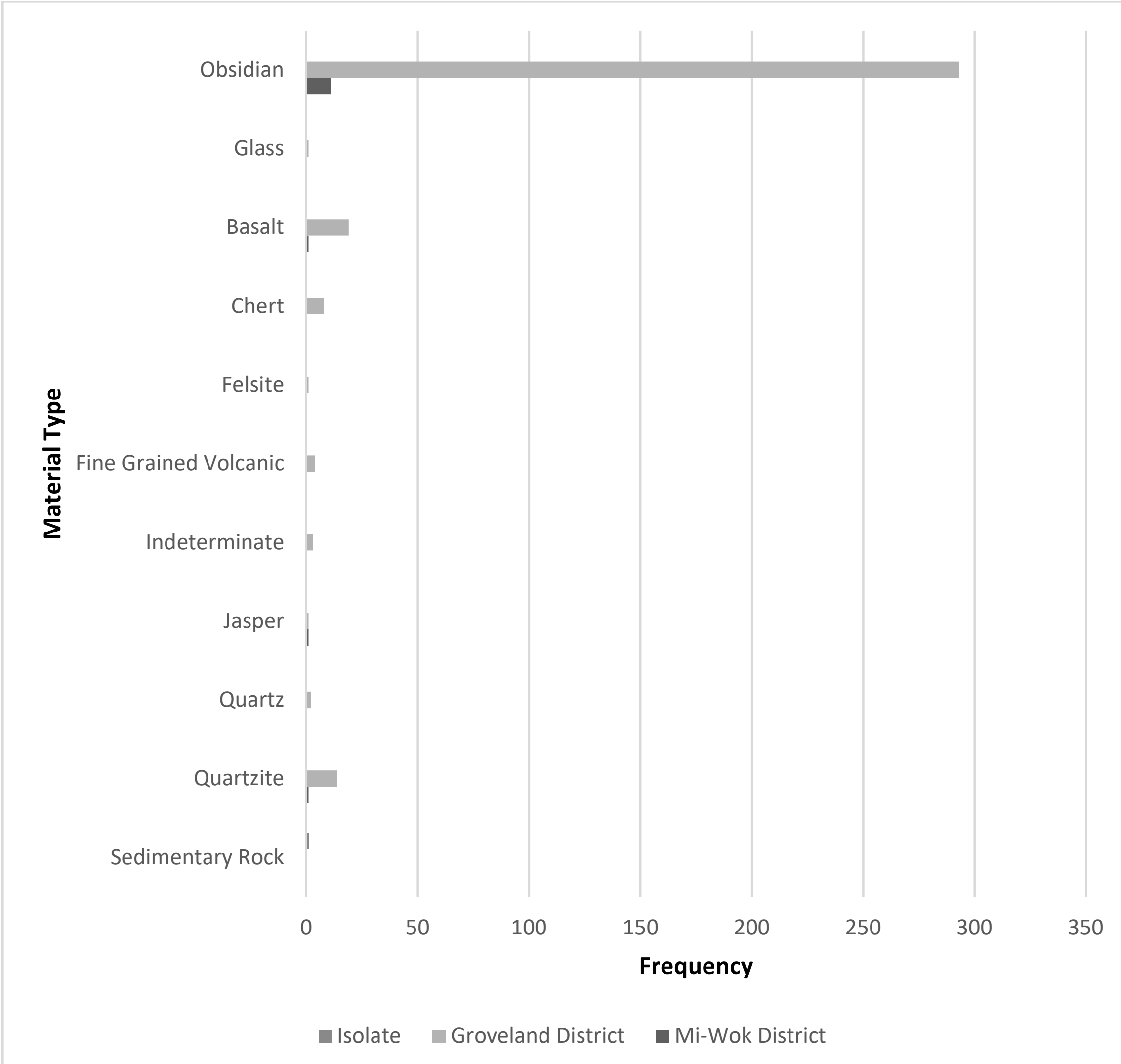

Figure 4.2. Projectile point material type by district.

I relied on the published ethnographic and archaeological literature to establish cultural affiliation. This was easier for the Washoe than for the Me-Wuk which there is comparatively sparse documentation, even compared to the Me-Wuk from other areas (Levy 1978:399). The lack of information partly resulted from the Gold Rush, which prevented information from being gathered before a significant portion of the population was lost (James and Graziani 1975:68). Consequently, the projectile point types attributed to the Me-Wuk are not specifically mentioned in the ethnographic literature;

however, their association with the Me-Wuk can be reasonably inferred when using contextual information and ethnographic sources for other Native communities. Because of the difficulty in associating particular projectile point types to the Me-Wuk and Washoe, only a few types are considered.

The ethnographic literature indicates that the Me-Wuk and Washoe made Cottonwood Triangular projectile points (Barrett and Gifford 1933:298; Elston 1971; Price 1963) as early as AD 900 and into the Historic Period (Justice 2002). While both Native communities made Cottonwood Triangular points, this type is not identified by name in the literature for the Me-Wuk. Barrett and Gifford (1933:298) attribute a photograph of projectile points depicting Cottonwood Triangular points (Figure 4.3) to the Me-Wuk, and I follow their lead in assuming that the Me-Wuk made this point type. Price (1963:84) and Elston (1971) also attribute Cottonwood Triangular points to the Washoe. Cottonwood series points are often associated with other point styles known to be used by the Washoe, such as Eastgate projectile points (Hester and Heizer 1973:10).

Figure 4.3. Cottonwood Triangular projectile point in Barrett and Gifford (1933:298).

Desert Side Notch points (Figure 4.4) are known from Me-Wuk archaeological sites (Levy 1978), though it is unclear if they are a general type or subtype. This lack of specificity leads me to associate two Desert Side Notch subtypes—Delta Side Notched and Sierra Side Notched with the Sierra Me-Wuk. Delta Side Notched (AD 1500-1800; Late Prehistoric to protohistoric) projectile points are attributable to the Me-Wuk because they originated in the Sacramento-San Joaquin River Delta region (Baumhoff and Byrne 1959:38), which was inhabited by the Bay and Plains Me-Wuk (Levy 1978:399). Since this subtype originated outside the SNF it suggests that Me-Wuk relatives living outside the SNF taught their kinsman to make these points when they interacted during trade or mobility, or were brought to the area by transplants from the Coastal Me-Wuk or Sierra Me-Wuk. More importantly Barrett and Gifford's (1933) pictures of what appear to be Delta Side Notch points are important for establishing the cultural affiliation of this point type because they were collected from ethnographically known Me-Wuk sites.

Figure 4.4. Delta Side Notch projectile points from Barrett and Gifford (1933:298).

The Sierra Side Notch point type (AD 1250 or 1300 to 1900; Late Prehistoric through Historic period) is attributable to the Sierra Me-Wuk due to its widespread recovery from areas inhabited by the Me-Wuk (Justice 2002). A Sierra Side Notch point (Figure 4.5) in Barrett and Gifford (1933:298) from a known Me-Wuk site supports this interpretation.

Figure 4.5. Sierra Side Notch projectile point from Barrett and Gifford (1933:298).

Desert Side Notch, Eastgate Expanding Stem, and Rose Spring Corner Notch points are all attributed to the Washoe. Desert Side Notched points (AD 1100 or 1300 to 1900; Late Prehistoric through the Historic period) are associated with the Late King's Beach temporal phase (150-700 BP or AD 1300-1850), which is associated with the Washoe (Absher 2013; de Azevedo 1986; Price 1963:88; Elston 1971; Elston et al. 1994). These points are often associated with the Washoe, even when the King's Beach phases are not directly mentioned (Absher 2013; de Azevedo 1986; Price 1963:88; Elston 1971; Elston et al. 1994). The Eastgate Expanding Stem (AD 700 or 600-1300) and Rose Spring Corner Notch (AD 500-1300), as well as Rose Spring and Eastgate Expanding Stem types, are associated with the Early King's Beach temporal phase (700-1300 BP), and are also associated with the Washoe (Absher 2013; Elston 1971; Elston et al. 1994; Hutchins and Simmons 2000).

Following these expectations, 61 points are attributable to the Me-Wuk, Washoe, or both (Table 4.3; data tabulated from Table 4.1): 21 are Me-Wuk (25.3%), 33 are Washoe (39.7%), and 7 are attributable to both the Me-Wuk and Washoe (8.4%). Together, these projectile points account for 73.5% of the total sample.

Three projectile point types are attributed to the Me-Wuk: Delta and Sierra Side Notch, and Cottonwood Triangular points (Figure 4.6). Delta and Sierra Side Notch points are present in nearly similar proportions (just over one third), with Cottonwood Triangular points somewhat less common. These point types are fairly evenly distributed.

Table 4.3. Projectile Point Cultural Attributions.

Native Community	Projectile Point Type	Calibrated Date Range	Frequency
Me-Wuk	Delta Side Notch	AD 1500-1800	10
	Sierra Side Notch	AD 1250 or 1300 to 1900	11
Sub-Total			21
Washoe	Desert Side Notch	AD 1100 or 1300 to 1900	24
	Eastgate Expanding Stem	AD 700 or 600-1300	5
	Rose Spring Corner Notch	AD 500-1300	4
Sub-Total			33
Me-Wuk and Washoe	Cottonwood Triangular	AD 900 to Historic Period	7
Sub-Total			7
Total			61

Four projectile point types are attributed to the Washoe: Desert Side Notch, Eastgate Expanding Stem, Cottonwood Triangular, and Rose Spring Corner Notch (Figure 4.7). Most are of the Desert Side Notch variety, followed by Eastgate Expanding Stem, Cottonwood Triangular, and then Rose Spring Corner Notch projectile points.

The cultural affiliation assertions assume that the affiliated projectile point types were created by the Sierra Me-Wuk and/or Washoe of the SNF. This is an assumption because the lands inhabited by the Me-Wuk and Washoe extend into or lie within the

SNF, but they were not the only Native communities whose traditional territories encompassed the lands that are now part of the SNF.

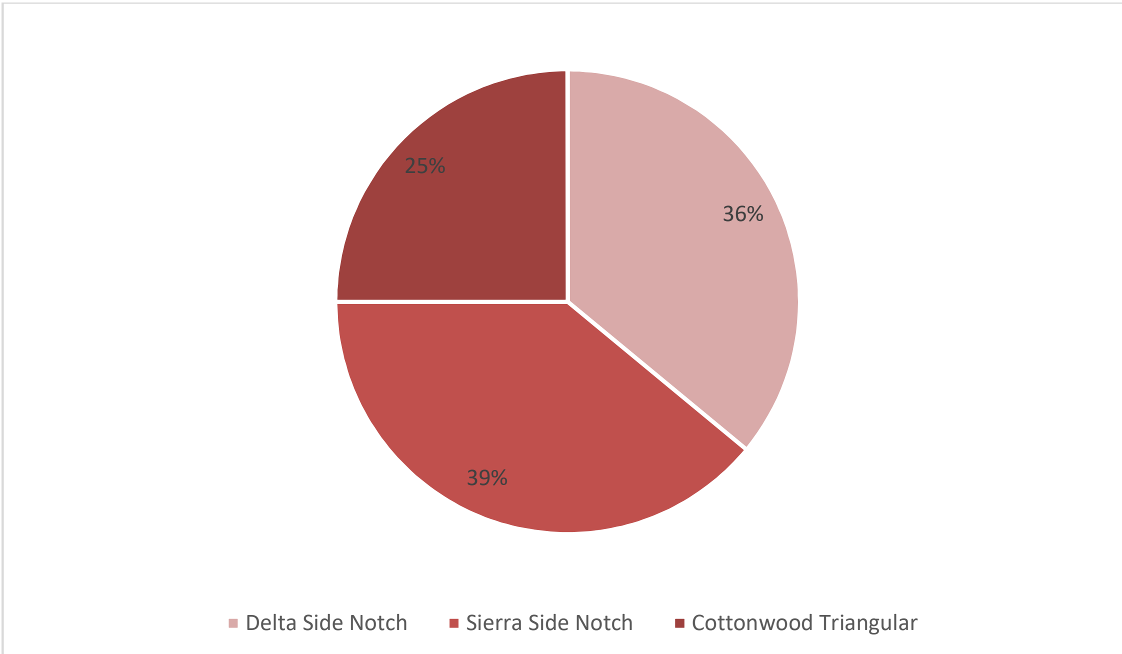

Figure 4.6. Me-Wuk projectile points by type and percentage.

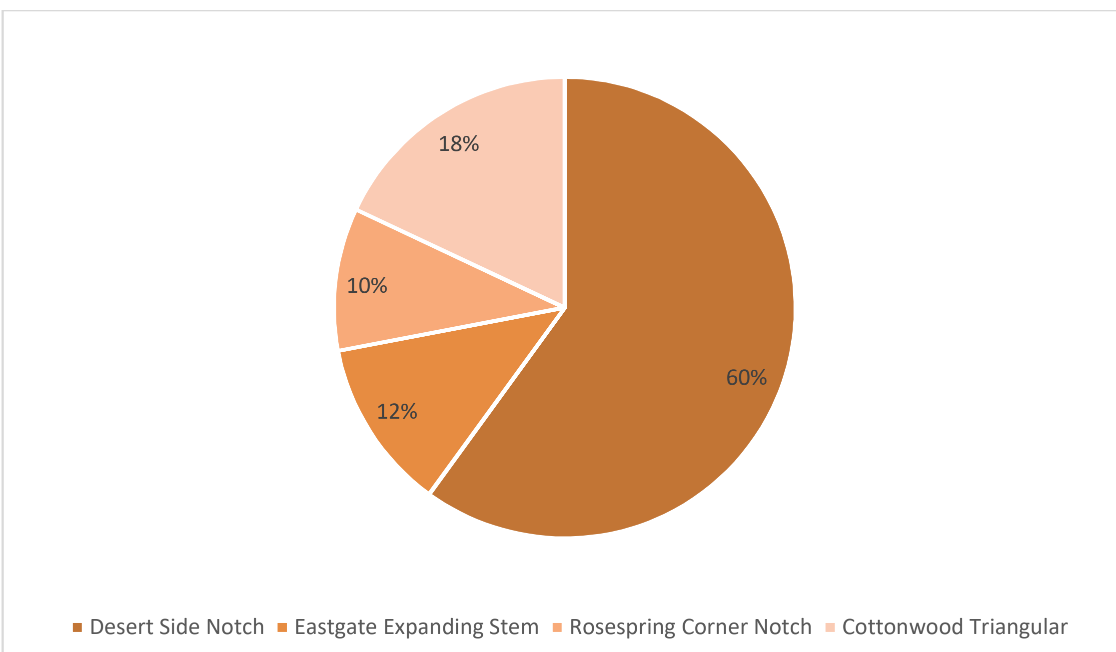

Figure 4.7. Washoe projectile points by type and percentage.

Other Native peoples lived there intermittently and likely discarded some projectile points. Sorting out which other Native peoples were in the SNF, when, and for how long is beyond the scope of this thesis and is probably not knowable. Consequently, it is an assumption that any one point was made or used by a Me-Wuk or Washoe who lived in the SNF. Moreover, the projectile point styles attributed to the Me-Wuk and Washoe are found in a wide geographic area and presumably manufactured by the Native peoples of those areas (Fowler et al. 1973). However, because the Me-Wuk and Washoe inhabited the region where the projectile points were collected during the Rim Fire, it is reasonable to assume that the culturally affiliated points were made and used by the Me-Wuk and/or Washoe rather than another group.

Geochemical Sourcing Results

The 83 obsidian projectile points submitted for EDXRF came from five sources: Bodie Hills, Casa Diablo (Lookout Mountain and Sawmill Ridge), Mono Craters, Mt. Hicks, and a source chemically similar to Lookout Mountain from the Casa Diablo area (Figures 4.8 and 4.9). Figure 4.8 was created in ArcMap to illustrate the distribution Rim Fire obsidian projectile points in relation to their source locations. All of the obsidian projectile points are displayed but are separated into two frames because the UTM location coordinates for the projectile points were recorded (i.e., collected) in UTM zones 10 and 11. Since most of the SNF and collected artifacts are from Zone 11, this zone is depicted in the large frame. The scale needed to display this information caused some data points to obscure others.

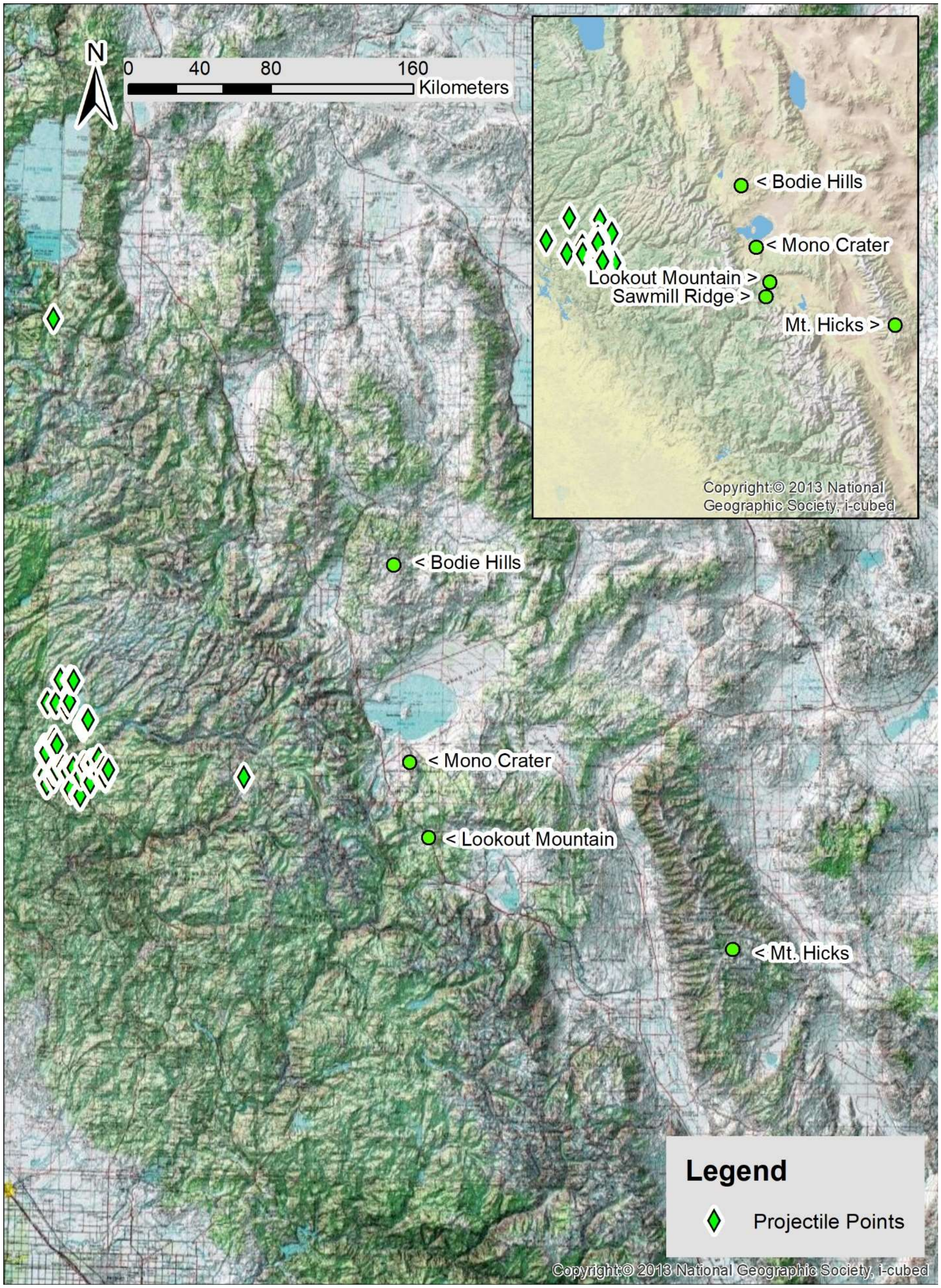

Figure 4.8. Map depicting the location of obsidian sources identified in the Rim Fire projectile point collection.

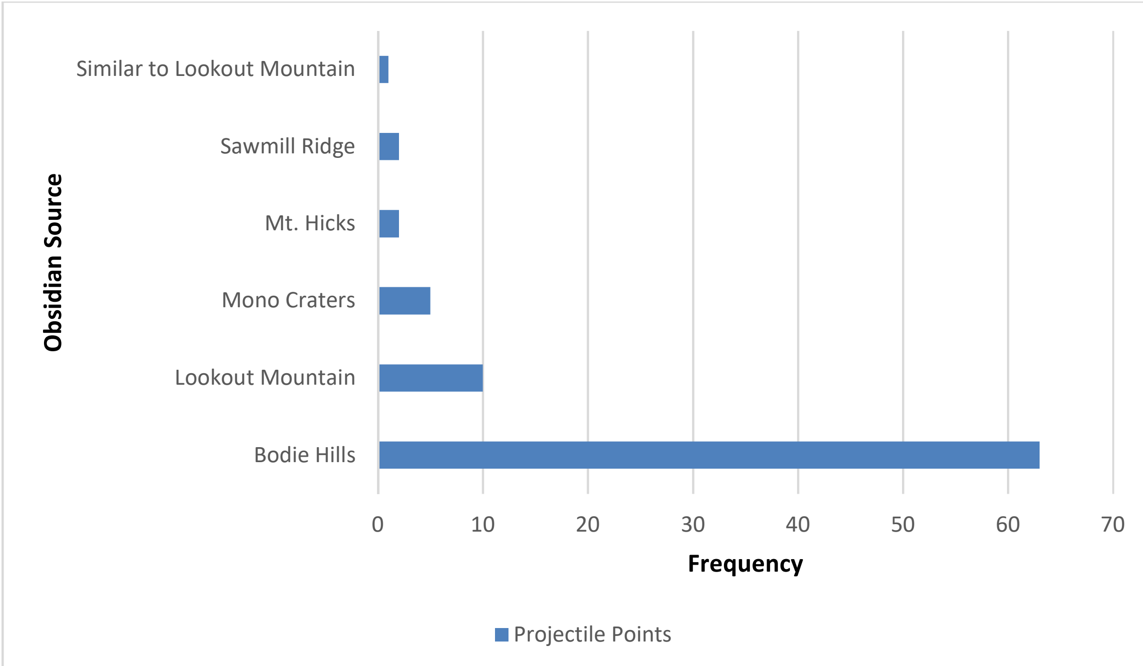

Figure 4.9. Frequency of obsidian projectile points by source.

The source chemically similar to Lookout Mountain is almost an exact match but varies enough to prevent its identification to that source. Most points (n = 63, 765.9%) are from the Bodie Hills source, followed by Lookout Mountain (n = 10, 12%), Mono Craters (n = 5, 6%), Mt. Hicks and Sawmill Ridge (2 each; 2.5% individually or 5% of the total sample), and then the Lookout Mountain lookalike (n =1, 1%).

Table 4.4 provides the frequency of each projectile point type, district, and cultural affiliation among the points submitted for EDXRF. The 63 Bodie Hills obsidian projectile points are presented by 15 styles: 17 points are affiliated with the Washoe, 11 with the Me-Wuk, 4 with both Native communities, and 31 are unaffiliated with either Native community. All but three (95%) of the Bodie Hills obsidian points are from the Groveland District; the rest are from the Mi-Wok District. The 11 points made from Lookout Mountain obsidian represent 5 types: 2 points are associated with the Me-Wuk, 4 with the Washoe, and 5 are unaffiliated with either Native community. All are from the Groveland District. The Lookout Mountain lookalike point is from the Groveland District and is affiliated with the Me-Wuk. The five Mono Craters obsidian points were found in the Groveland District: 1 is associated with the Me-Wuk, 1 with the Washoe, 2 with both Native communities, and 1 with neither Native community. Neither of the two Mt. Hicks obsidian points are affiliated with the Me-Wuk or Washoe. There are two Sawmill Ridge obsidian points: 1 is associated with both the Me-Wuk and Washoe, whereas the other is not affiliated with either Native community. Both of the Sawmill Ridge obsidian points were found in the Groveland District.

The variety of point types, obsidian sources, and number of points unaffiliated with the Me-Wuk or Washoe suggests that several other cultural groups or Native communities utilized the same obsidian sources as the Me-Wuk or Washoe and occasionally inhabited the SNF. This implies that a substantial amount of interaction occurred among the various cultural groups in the SNF and likely resulted from differential access to key resources (Thiery et al. 2016), trade, exchange, mobility, and/or land use patterns.

Obsidian Source Selection by Cultural Affiliation

Figure 4.10 displays the pattern of obsidian source selections among those points affiliated with the Washoe and Me-Wuk. The Washoe substantially selected Bodie Hills obsidian over the other obsidian types to make projectile points (n = 26, 79%), with Lookout Mountain (n = 6, 18%) and Mono Craters (n = 1, 3%) obsidian considerably less common. The Me-Wuk likewise preferred Bodie Hills obsidian for projectile points (n = 17, 81%), with considerably fewer made from Lookout Mountain (n = 3, 14%) and

Mono Craters (n = 1, 5%). Cottonwood Triangular points, which were made by both Native communities, indicate a slightly different pattern. Cottonwood Triangular points made from Bodie Hills obsidian are again most common (n = 4, 57%), followed by Mono Craters (n = 2, 29%) and Sawmill Ridge (n =1, 14%); none were made from Lookout Mountain. Likewise, none of the Native community affiliated points are made from Mt. Hicks.

The Me-Wuk and Washoe made more points from Bodie Hills obsidian than any other source, which could signal easier access to or a strong preference for this source compared to the others. Close proximity to or easy access to a particular raw material source often accounts for such imbalances in the proportion of lithic raw materials at sites or in assemblages. This does not appear to be the case here since straight line distance measurements (determined by measuring the straight line distance between the discovery location of each projectile point from its respective source using the GIS measuring tool and averaging the respective distances) indicate that points made from Bodie Hills obsidian were transported an average distance of 88.43 km from their source, which is not substantially different from the distance to Lookout Mountain at 88.23 km, Mono Craters at 82.70 km, and Sawmill Ridge at 84.17 km.

Table 4.4. Frequency of EDXRF Projectile Points by Source, District, and Cultural Affiliation

Source	Frequency	Point Type	District	Cultural Affiliation
Bodie Hills	2	Bear River Side Notch *2**	Groveland	Washoe
	1	Buchanan Eared	Isolate	N/A
	2	Canalino Triangular	Groveland	N/A
	4	Cottonwood Triangular	3 Groveland, 1 Mi-Wok	Washoe and Me-Wuk
	8	Delta Side Notch	Groveland	Me-Wuk
	10	Desert Side Notch	9 Groveland, 1 Mi-Wok	Washoe
	2	Eastgate Expanding Stem	Groveland	Washoe
	1	Elko Corner Notched	Groveland	N/A
	3	Elko Eared	1 each Groveland, Mi-Wok & Isolate	N/A
	2	Gunther Barbed	Groveland	N/A
	3	Humboldt	Groveland	N/A
	10	Panoche Side Notch *(7*)*	Groveland	N/A
	3	Redding Side Notch *(2*)*	Groveland	N/A
	3	Rose Spring Corner Notch	Groveland	Washoe
	9	Sierra Side Notch	Groveland	Me-Wuk
Lookout Mountain	2	Delta Side Notch	Groveland	Me-Wuk
	1	Desert Side Notch	Groveland	Washoe
	2	Eastgate Expanding Stem	Groveland	Washoe
	4	Redding Side Notch *(2*)*	Groveland	N/A
	1	Rose Spring Corner Notch	Groveland	Washoe

Source	Frequency	Point Type	District	Cultural Affiliation
Lookout Mountain?	1	Sierra Side Notch	Groveland	Me-Wuk
Mono Craters	1	Canalino Triangular	Groveland	N/A
	2	Cottonwood Triangular	Groveland	Washoe and Me-Wuk
	1	Eastgate Expanding Stem	Groveland	Washoe
	1	Sierra Side Notch	Groveland	Me-Wuk
Mt. Hicks	1	Humboldt	Isolate	N/A
	1	Panoche Side Notch	Groveland	N/A
Sawmill Ridge	1	Cottonwood Triangular	Groveland	Washoe and Me-Wuk
	1	Panoche Side Notch	Groveland	N/A
Total	83			

* The number of projectile points verified as Desert Side Notch using the Monitor Valley Typology.

Least Cost Path analysis (Taliaferro et al. 2010), rather than straight line distance, is usually performed to establish the most accessible lithic raw material source but was not feasible for this analysis. However, when considering basic principles of Least Cost Path analysis, it is apparent that river drainages in the area, like that of the Stanislaus River (see Figure 4.8), and small mountain valleys lead almost directly to the Bodie Hills obsidian source. Access to the other sources, by comparison, are less direct and presumably more difficult and longer travel corridors. The direct access of travel corridors to the Bodie Hills obsidian source may be entirely or partially responsible for the higher frequency of this obsidian in the Rim Fire collection.

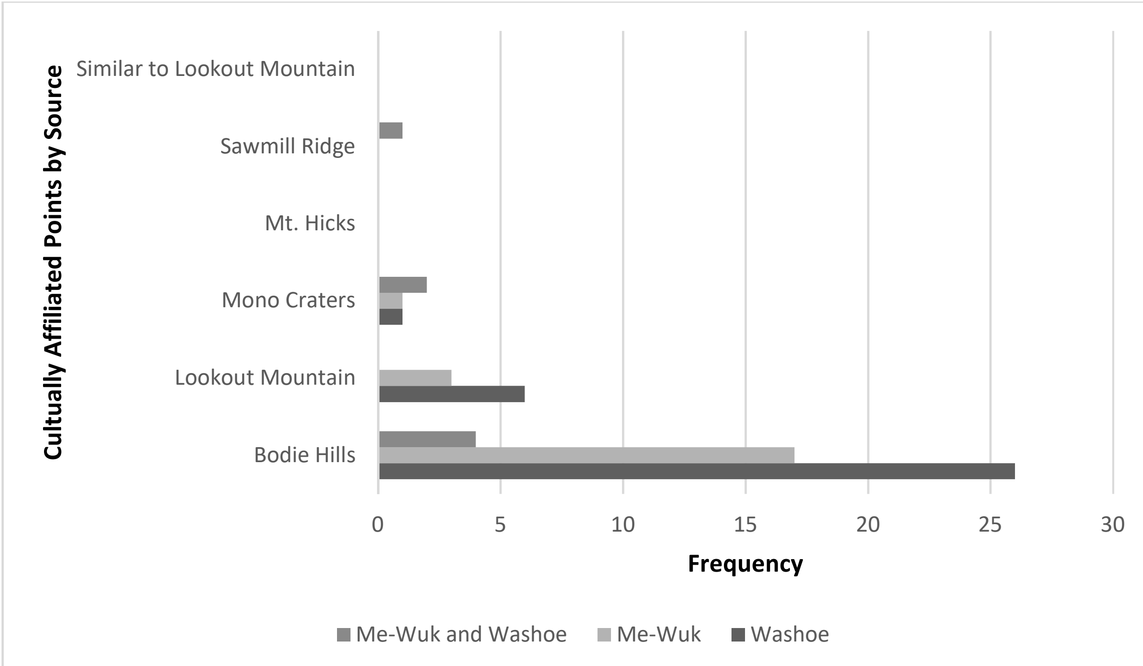

Figure 4.10. Points by obsidian source and cultural affiliation.

Chapter Summary

The Rim Fire recovery efforts netted 378 projectile points that represent 35 different projectile point types, most of which are California projectile point types with some Great Basin types that range in age from 6000 BC to the Historic period (19th century). Obsidian is the most common raw material type (n = 308), with trace amounts of other raw material types. Bodie Hills obsidian is the most commonly used obsidian source for the projectile points and is, not surprisingly, represented by the widest variety of point types. Five other obsidian sources were used to a lesser degree (most to least common): Lookout Mountain, Mono Craters, Mt. Hicks, Sawmill Ridge, and a source similar to Lookout Mountain. Analyses show that the Me-Wuk and Washoe made projectile points using these six sources, with Bodie Hills obsidian (26 Washoe, 17 Me-Wuk points) again represented to a greater degree than the other obsidian types. Reasons for preferring Bodie Hills obsidian over the other sources are uncertain (e.g., controlled access to other raw material sources, trade, exchange, mobility, and/or land use patterns), though the similar distances between the source areas from the SNF suggest that distance to source is not the underlying factor behind the preference for Bodie Hills obsidian. However, easier access along the river drainages, such as the Stanislaus River, to the Bodie Hills source possibly influenced its frequency in the Rim Fire collection.

CHAPTER 5

DISCUSSION

In this chapter I interpret and discuss the results presented in Chapter 4 to evaluate the cultural affiliation and temporal test expectations developed in Chapter 3, and to place the results in broader context. To address the cultural affiliation and temporal test expectations, I explore whether the proportion of Me-Wuk and Washoe obsidian points significantly vary by source area and through time, respectively. The chapter concludes by explaining, where possible, the underlying causes for the trends inferred from the test expectation results, and what they indicate concerning the influx of outsiders (Europeans and Euroamericans) to the SNF.

Test Expectations

This section uses the results in Chapter 4 to evaluate the test expectations and make inferences regarding Late Prehistoric through Historic period lifeways in the Stanislaus National Forest (SNF). Recall that the projectile points in the EDXRF sample are: (1) Late Prehistoric, Protohistoric, and/or Historic in age; (2) types known to be made by the Me-Wuk, Washoe, or both; and (3) types with known distributions in the SNF. Six projectile point types meet these requirements: Cottonwood Triangular, Delta Side Notch, Desert Side Notch, Eastgate Expanding Stem, Rose Spring Corner Notch, and Sierra Side Notch.

Cultural Affiliation Test Expectation

The cultural affiliation test expectation predicts that differences occur in the obsidians selected by the Me-Wuk and Washoe to make projectile points. I expect preferential use of obsidian from areas where they shared commonalities (language, kinship, and/or culture) with other local Native communities. The Me-Wuk should significantly select California obsidians over those from the Great Basin. California sources include those on the eastern or western slopes of the Sierra Nevada and any sources to the west within California. Thus, the Me-Wuk should preferentially have selected obsidian sources accessible from their higher altitude territory significantly more than other sources, such as Mono Craters, Obsidian Dome, Casa Diablo, and Mono Glass Mountain. Conversely, I expect that the Washoe preferentially obtained obsidian from California and Great Basin sources, resulting in no significant difference between the frequency of obsidian from the two regions. Obsidian sources favored by the Washoe would include Bodie Hills, Mt. Hicks, Silverpeak, and Queen. Based on these expectations, a higher number (richness) of Great Basin sources should be represented in Washoe rather than Me-Wuk assemblages.

The data to address this test expectation come primarily from Table 5.1 and are graphically displayed in Figure 5.1. Figure 5.1 clearly indicates that both Native communities preferred Bodie Hills obsidian over the other obsidian sources. Among other obsidian sources the Me-Wuk made more projectile points from Mono Craters and Sawmill Ridge obsidian than the Washoe, whereas the Washoe used more Lookout Mountain than the Me-Wuk. The obsidian similar to Lookout Mountain is represented only among the Me-Wuk point types.

A chi-square test indicates no significant difference in the proportion of Me-Wuk and Washoe projectile points made from the different obsidian sources ($X^2 = 1.01$, df = 7; $p = 0.77$; $p > 0.05$; Table 5.2). A Fisher's Exact test comparing the proportion of Bodie Hills obsidian (the most common source) to all other obsidian sources likewise indicates no significant difference in the obsidian sources selected by the Me-Wuk and Washoe to make projectile points ($X^2 = 0.07$, df = 3; $p = 0.80$). The lack of significant variation results from Me-Wuk and Washoe hunters having exclusively selected California obsidians to make projectile points (Figure 5.3), when I instead expected that many Washoe points would also be made from Great Basin obsidians when in fact none were. In fact, 70% of the projectile points identified to source using EDXRF were discarded just 80-90 km from their source location (see Chapter 4), indicating that linear distance to source did not significantly influence Me-Wuk and Washoe obsidian procurement (though, it appears that Bodie Hills obsidian was the least costly to procure). The lack of significant difference in the proportion of obsidian selected by the Me-Wuk and Washoe indicates the cultural affiliation test expectation is unmet and incorrect.

Why the Washoe did not use Great Basin obsidian in the SNF is unclear. It is possible that the Paiute, who share a border with the Me-Wuk and Washoe and have many shared cultural similarities with the Washoe, facilitated access (through trade or shared access to key resources) to more California obsidian than I anticipated. It could also be that the Washoe obtained California obsidian from the Me-Wuk or had shared access to the California obsidian sources when in close proximity to Me-Wuk territory, which is possible since the Me-Wuk and Washoe generally had friendly relations (see Chapter 2). A combination of these factors is also possible.

Table 5.1. Frequency of Me-Wuk and Washoe Projectile Points by Obsidian Source and Point Type

Projectile Point Type	Obsidian Source	Frequency
Me-Wuk		
Cottonwood Triangular	Bodie Hills Mono Craters Sawmill Ridge	4 2 1
Delta Side Notch	Bodie Hills Lookout Mountain	8 2
Sierra Side Notch	Bodie Hills Mono Craters Similar to Lookout Mountain	9 1 1
Total		28
Washoe		
Cottonwood Triangular	Bodie Hills Mono Craters Sawmill Ridge	4 2 1
Desert Side Notch	Bodie Hills Lookout Mountain	21 3
Eastgate Expanding Stem	Bodie Hills Mono Craters Lookout Mountain	2 1 2
Rose Spring Corner Notch	Bodie Hills Lookout Mountain	3 1
Total		40

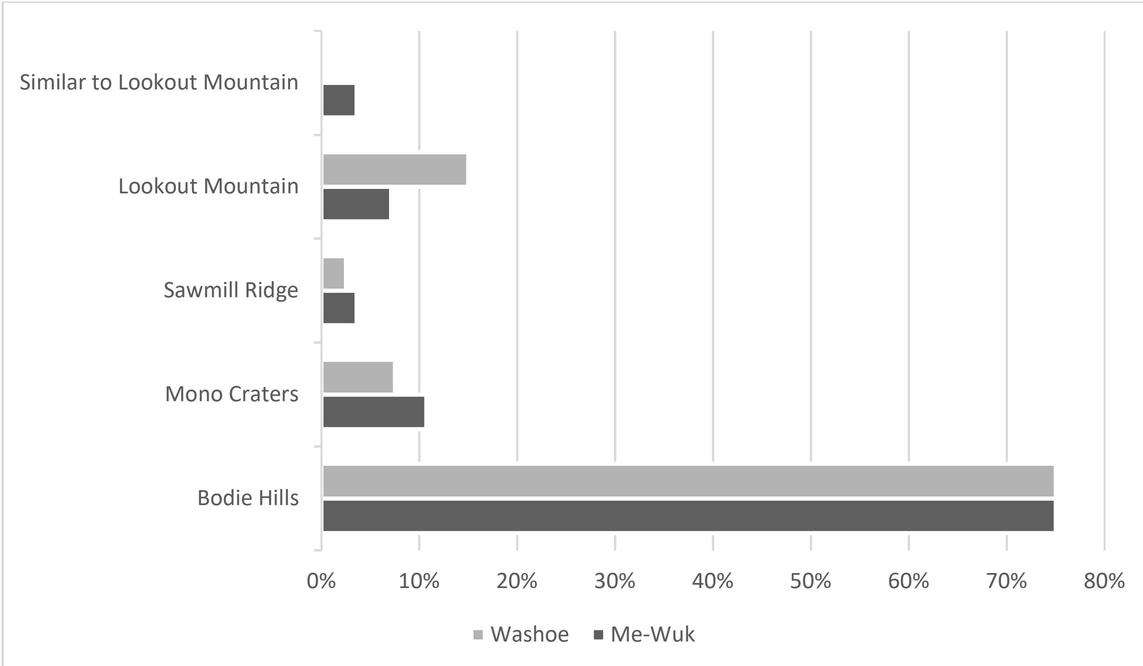

Figure 5.1. Percentage of Me-Wuk and Washoe projectile points by source.

Table 5.2. Me-Wuk and Washoe Projectile Point Chi-Square Test.

Obsidian Source	Me-Wuk Points	Washoe Points	Total
Bodie Hills	21	30	51
Mono Craters	3	3	6
Sawmill Ridge	1	1	2
Lookout Mountain	2	6	8
Total	27	40	67
Expected Values			
Bodie Hills	20.55224	30.44776	
Mono Craters	2.41791	3.58209	
Sawmill Ridge	0.80597	1.19403	
Lookout Mountain	3.223881	4.776119	
p-value	0.775253		

** This chi-square test and many of those that follow have more than 20% of cells with a value less than 5 in violation of the test rules (Agresti 2018; Salkind 2014); consequently, conclusions of the statistical results should be considered cautiously.*

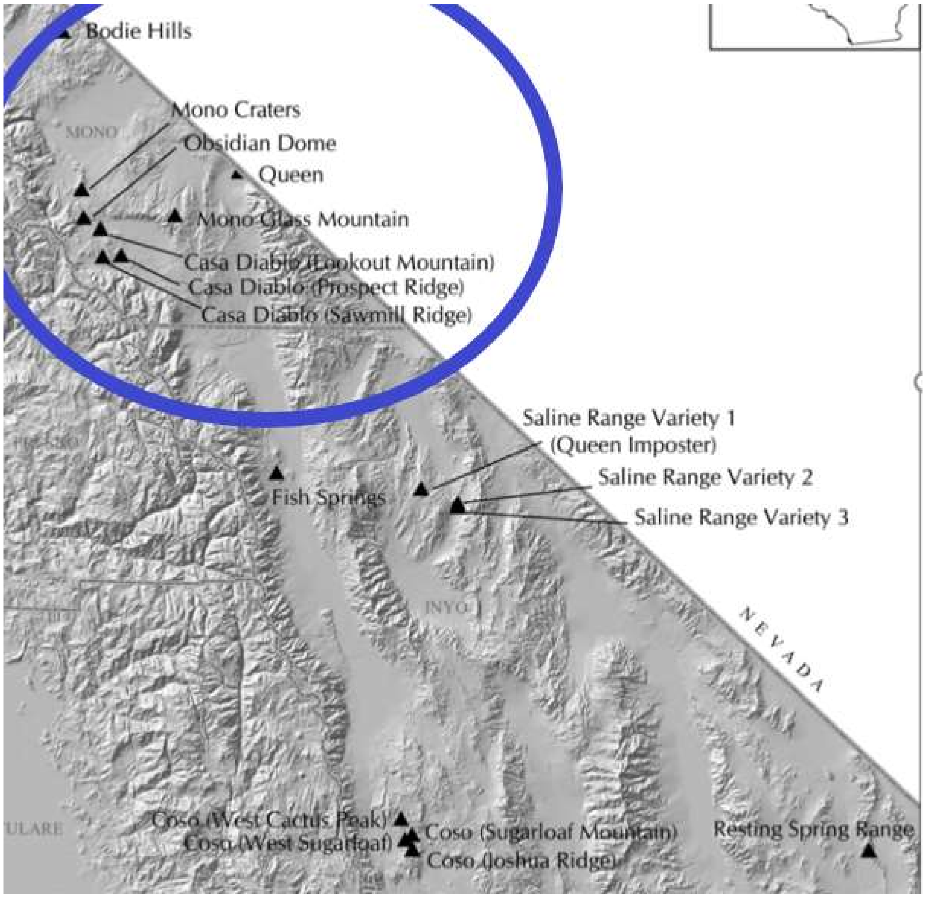

Figure 5.2. California obsidian sources used by the Me-Wuk and Washoe. Taken from http://www.sourcecatalog.com/image_maps/image_maps.html.

Time Test Expectation

The time test expectation anticipates that Me-Wuk and Washoe projectile points were made from different lithic sources through time due to changes in climate, territory, neighbors, and/or trading partners. Climate oscillations during the MCA and/or LIA potentially altered mobility patterns and access to lithic material sources (Absher 2013; Basgall 1989; Eerkens et al. 2008; Schieber and Finley 2011; Skinner et al. 2004; Smith 1990; Talieferro et al. 2010; Whitaker et al. 2008). The movement of other Native people and Euroamericans into Me-Wuk and Washoe territory potentially increased competition for lands with obsidian sources, thereby altering prior raw material procurement practices (e.g., Barrett 1933; Bettinger 1982; Justice 2002:24). Given the increasingly complex social and political factors, I expect that the Me-Wuk and Washoe used a wider variety of obsidian sources earlier than later in time since there was less competition and/or fewer issues with access to obsidian sources (Johnson and Lorenz 2006; Justice 2002).

Furthermore, because the Washoe experienced less variation in language and were more closely affiliated with other Great Basin Native people, I expect they maintained improved access to the regional obsidian sources later in time than the Me-Wuk. The Washoe should thus have significantly more obsidian sources represented than the Me-Wuk (see Morgan 2009).

This section establishes, in accordance with the test expectation, whether the proportion of obsidian sources used by the Me-Wuk and Washoe significantly varied over time (Table 5.3). To establish distinct time periods, I consider the Late Prehistoric period to be the "early" time period, Protohistoric the "middle" time period, and Historic the "late" time period. Due to sample size issues I only consider the projectile points made from Bodie Hills obsidian using statistics, but consider all sources later in this section. A chi-square test considering the proportion of Bodie Hills obsidian projectile points by time period and cultural affiliation indicates significant variation ($p = 0.00061$) (Table 5.4), implying that the Me-Wuk and Washoe utilized this obsidian differently over time.

To further evaluate temporal differences among all of the obsidian sources, Figures 5.3-5.5 display the frequency of projectile points made from Bodie Hills, Lookout Mountain, and Mono Craters obsidian over time. These figures count each instance that a Me-Wuk or Washoe projectile point is identifiable to the early, middle, and/or late time period for a particular obsidian source (see Hill 2013 and Todd 1991 for examples of this counting method). For example, if a projectile point type (e.g., Sierra Side Notch) was in use during the early, middle and late time periods it was counted once for *each* time period for that obsidian source. Eastgate Expanding Stem points were only in use during the early time period and thus were counted just once for the early time category.

Table 5.3. Me-Wuk and Washoe Projectile Point Time Ranges

Source	Frequency	Point Type	Date Range	Time Range	Cultural Affiliation
Bodie Hills	4	Cottonwood Triangular	AD 900 to Historic Period	Late Prehistoric to Historic	Washoe and Me-Wuk
	8	Delta Side Notch	AD 1500-1800	Late Prehistoric to Protohistoric	Me-Wuk
	21	Desert Side Notch	AD 1100 or 1300 to 1900	Late Prehistoric to Historic	Washoe
	2	Eastgate Expanding Stem	AD 700 or 600-1300	Late Prehistoric	Washoe
	3	Rose Spring Corner Notch	AD 500-1300	Late Prehistoric	Washoe
	9	Sierra Side Notch	AD 1250 or 1300 to 1900	Late Prehistoric to Historic	Me-Wuk
Lookout Mountain	2	Delta Side Notch	AD 1500-1800	Late Prehistoric to Protohistoric	Me-Wuk
	3	Desert Side Notch	AD 1100 or 1300 to 1900	Late Prehistoric to Historic	Washoe
	2	Eastgate Expanding Stem	AD 700 or 600-1300	Late Prehistoric	Washoe
	1	Rose Spring Corner Notch	AD 500-1300	Late Prehistoric	Washoe

Source	Frequency	Point Type	Date Range	Time Range	Cultural Affiliation
Lookout Mountain?	1	Sierra Side Notch	AD 1250 or 1300 to 1900	Late Prehistoric to Historic	Me-Wuk
Mono Craters	2	Cottonwood Triangular	AD 900 to Historic Period	Late Prehistoric to Historic	Washoe and Me-Wuk
	1	Eastgate Expanding Stem	AD 700 or 600-1300	Late Prehistoric	Washoe
	1	Sierra Side Notch	AD 1250 or 1300 to 1900	Late Prehistoric to Historic	Me-Wuk
Sawmill Ridge	1	Cottonwood Triangular	AD 900 to Historic Period	Late Prehistoric to Historic	Washoe and Me-Wuk
Total	61				

The Me-Wuk and Washoe manufactured different projectile point types from Bodie Hills obsidian through time (see Table 5.3). The Me-Wuk made Cottonwood Triangular and Sierra Side Notch points from Bodie Hills obsidian through all time periods, but Sierra Side Notch points mainly late in time and Delta Side Notch points during the early to middle time periods.

The Washoe made Rose Spring Corner Notch and Eastgate Expanding Stem projectile points from Bodie Hills obsidian early in time, but Desert Side Notch points through all periods. Figure 5.3 summarizes these data as percentages and indicates that the Me-Wuk used Bodie Hills obsidian consistently during the early and middle periods, but less during the late period. Conversely, the Washoe used more Bodie Hills obsidian in the early period with a decline to the middle period and late time period.

Table 5.4. Bodie Hills Obsidian Projectile Point Age Distribution Chi-Square Test.

Point Type by Age Range	Me-Wuk Points	Washoe Points	Total
Late Prehistoric	0	5	5
Late Prehistoric to Protohistoric	8	0	8
Late Prehistoric to Historic	13	25	38
Total	21	30	47
Expected Values			
Late Prehistoric	2.23404	3.19149	
Late Prehistoric to Protohistoric	3.57447	5.10638	
Late Prehistoric to Historic	16.9787	24.2553	
p-value	0.00061		

**More than 20% of cells are less than 5, so the results should be interpreted cautiously.*

The Me-Wuk used Lookout Mountain obsidian consistently during the early and middle periods, but not at all late in time (Figure 5.4). The data for Lookout Mountain obsidian and the other obsidian sources will be displayed by frequency due to their smaller sample sizes in comparison to Bodie Hills obsidian. The Washoe used Lookout Mountain obsidian more consistently, but with a slight spike early in time. The primary difference is that the Me-Wuk used Lookout Mountain obsidian to make Delta Side Notch points early in time, whereas the Washoe used it to create Desert Side Notched points during the middle period and Eastgate Expanding Stem and Rose Spring Corner Notch points early in time. The Lookout Mountain lookalike obsidian source is represented by just one Sierra Side Notch projectile point, which was used by the Me-Wuk during all time periods.

Mono Craters obsidian was used by the Me-Wuk consistently from early to late in time based on the presence of Sierra Side Notch and Cottonwood Triangular points

(Figure 5.5). The Washoe used Mono Craters obsidian to make an Eastgate Expanding Stem point, which is associated with the early period and Cottonwood Triangular points that were used through all time periods.

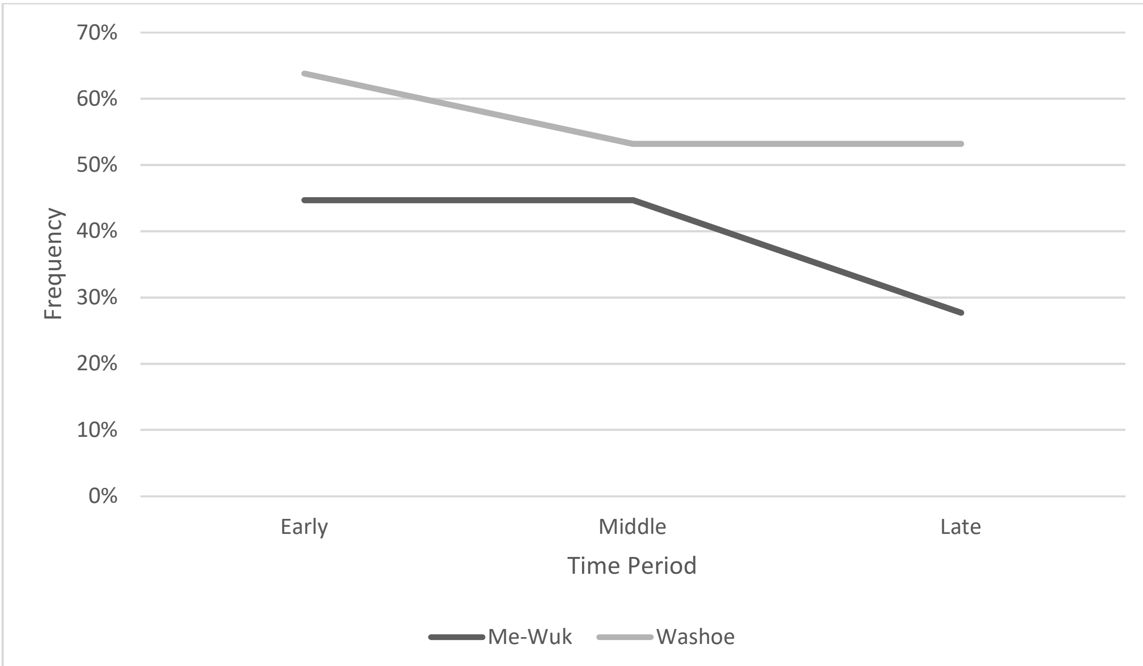

Figure 5.3. Bodie Hills obsidian: Projectile point time periods by cultural affiliation.

The Washoe thus used Mono Craters obsidian to a slightly greater degree early than late in time. Sample size is an issue with the Mono Craters obsidian points, so the patterns noted here should be considered cautiously. The Sawmill Ridge source, in contrast to the other sources discussed previously, was used by the Me-Wuk and Washoe from early to late in time for one Cottonwood Triangular point as illustrated in Table 5.3. Due to the small sample size for both the Mono Craters and Sawmill Ridge source they will not be considered further.

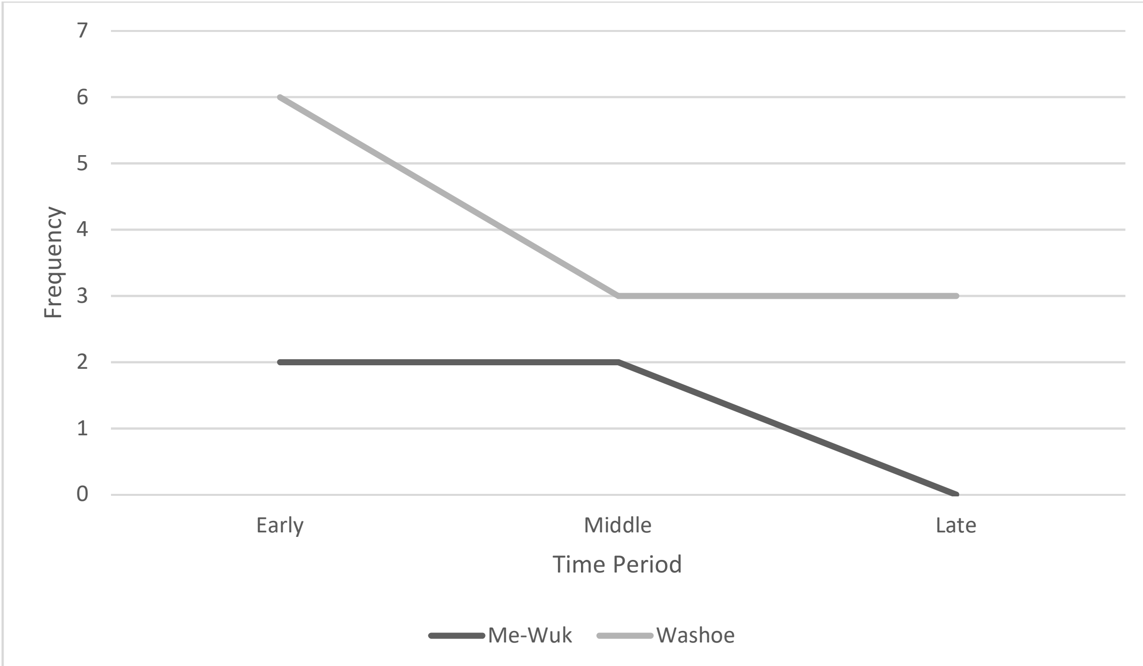

Figure 5.4. Lookout Mountain obsidian: Projectile point time periods by cultural affiliation.

To summarize Figures 5.3-5.5, the Me-Wuk and Washoe used Bodie Hills obsidian to make various projectile point types throughout the early, middle, and late periods. The Washoe, however, used somewhat less Bodie Hills obsidian during the early and middle periods, and the Me-Wuk used less during the middle and late periods (see Figure 5.3). Use of Lookout Mountain obsidian followed a similar trend to Bodie Hills obsidian (see Figure 5.4). The change in use after the Protohistoric or middle period marks the beginning of the Historic Period, and the arrival of Europeans and Euroamericans to the area that seemingly disrupted or altered their procurement patterns or access to these obsidian sources.

The time test expectation also predicted that because the Washoe experienced less variation in language and were more closely affiliated with other Great Basin Native communities they maintained improved access to the regional obsidian sources later in time than the Me-Wuk and should thus have significantly more obsidian sources represented than the Me-Wuk.

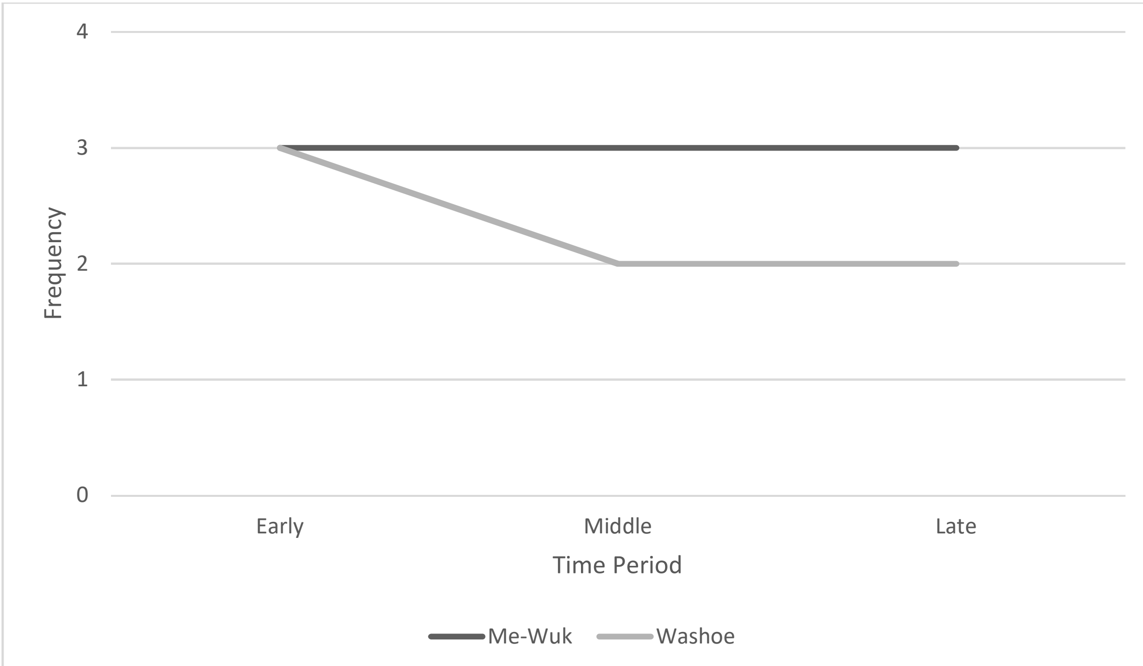

Figure 5.5. Mono Craters obsidian: Projectile point time periods by cultural affiliation.

This prediction does not hold true because both Native communities not only used just four obsidian sources (Table 5.5), but used the same obsidian sources—Bodie Hills, Lookout Mountain, Mono Craters, and Sawmill Ridge—to make projectile points throughout time, except for the similar to Lookout Mountain obsidian that was used by the Me-Wuk only in the Historic Period. Moreover, the obsidian sources are not spread across California and the Great Basin as expected—all of the Me-Wuk and Washoe points are from obsidian sources located 80-90 km from their discovery locations in California (see Chapter 4) and spatially clustered in the same general area (Figure 5.6). Thus, the Washoe did not obtain obsidian for projectile points from significantly more source areas as was predicted—this aspect of the time test expectation is rejected.

Table 5.5. Obsidian Sources Used by Time Period and Cultural Affiliation.

Time Period	Obsidian Sources Used	Total
Me-Wuk		
Late Prehistoric	Bodie Hills, Lookout Mountain, Mono Craters, Sawmill Ridge	4
Protohistoric	Bodie Hills, Lookout Mountain, Mono Craters, Sawmill Ridge	4
Historic	Bodie Hills, Similar to Lookout Mountain, Mono Craters, Sawmill Ridge	4
Washoe		
Late Prehistoric	Bodie Hills, Lookout Mountain, Mono Craters, Sawmill Ridge	4
Protohistoric	Bodie Hills, Lookout Mountain, Mono Craters, Sawmill Ridge	4
Historic	Bodie Hills, Lookout Mountain, Mono Craters, Sawmill Ridge	4

What Does It All Mean?

The findings presented here and in Chapter 4 indicate that the Me-Wuk and Washoe in the SNF relied extensively on obsidian obtained from the east-central portion of the Sierra Nevada in California for their projectile points. Statistical analysis of the proportion of Me-Wuk and Washoe projectile points made from Bodie Hills, Mono Craters, Sawmill Ridge, Lookout Mountain, and a source similar to Lookout Mountain did not significantly differ from each other according to the cultural affiliation test expectation. The time test expectation revealed, however, that the proportion of Bodie Hills obsidian points created by the Me-Wuk and Washoe statistically varied through time, with a reduction in the use of Bodie Hills and Lookout Mountain obsidian beginning after the Protohistoric period (i.e., during the Historic period). I argue here that the reduction in obsidian use is the result of substantial European and Euroamerican expansion into the SNF and Me-Wuk and Washoe territory as evident in the Rim Fire collection studied for this thesis.

Reasons for the reduction in Bodie Hills and Lookout Mountain obsidian late in time may be explained by considering events of the Protohistoric and Historic periods. Recall from Chapter 2 that the influx of Europeans and Euroamericans into the Sierra Nevada (Chartkoff 2001; de Azevedo et al. 1963; Downs 1963; Hall 1978; Madley 2016; Miksicek et al. 1996) resulted in the displacement of existing Native communities, altered mobility and subsistence strategies, and resulted in substantial population loss. I propose here that this influx altered Me-Wuk and Washoe use of Bodie Hills and Lookout Mountain obsidian, much as has been documented during the Historic and Colonial periods in Arizona and Coastal California (Millhauser et al. 2011; Panich 2016; Scheiber and Finley 2011; Sobel 2012; Stemp et al. 2011).

Having found that the influx of Europeans and Euroamericans affected Me-Wuk and Washoe obsidian procurement patterns (at least at the Bodie Hills and Lookout Mountain sources), I now consider whether the alternative possibilities noted in Chapter 1 contribute to or better explain the observed pattern. Environmental variability could affect procurement patterns (whether by direct or indirect access) if hunter-gatherers procured obsidian from different areas and elevations during, for example, events like the LIA when glaciers prevented access to particular sources. I consider environmental variability to be a noncontributing factor since the same four obsidian sources were used throughout time and the obsidian in the Rim Fire collection was all procured from a relatively localized area (80-90 km). I also proposed that changes to the relationship between the Me-Wuk, Washoe, and their neighbors might affect obsidian procurement patterns.

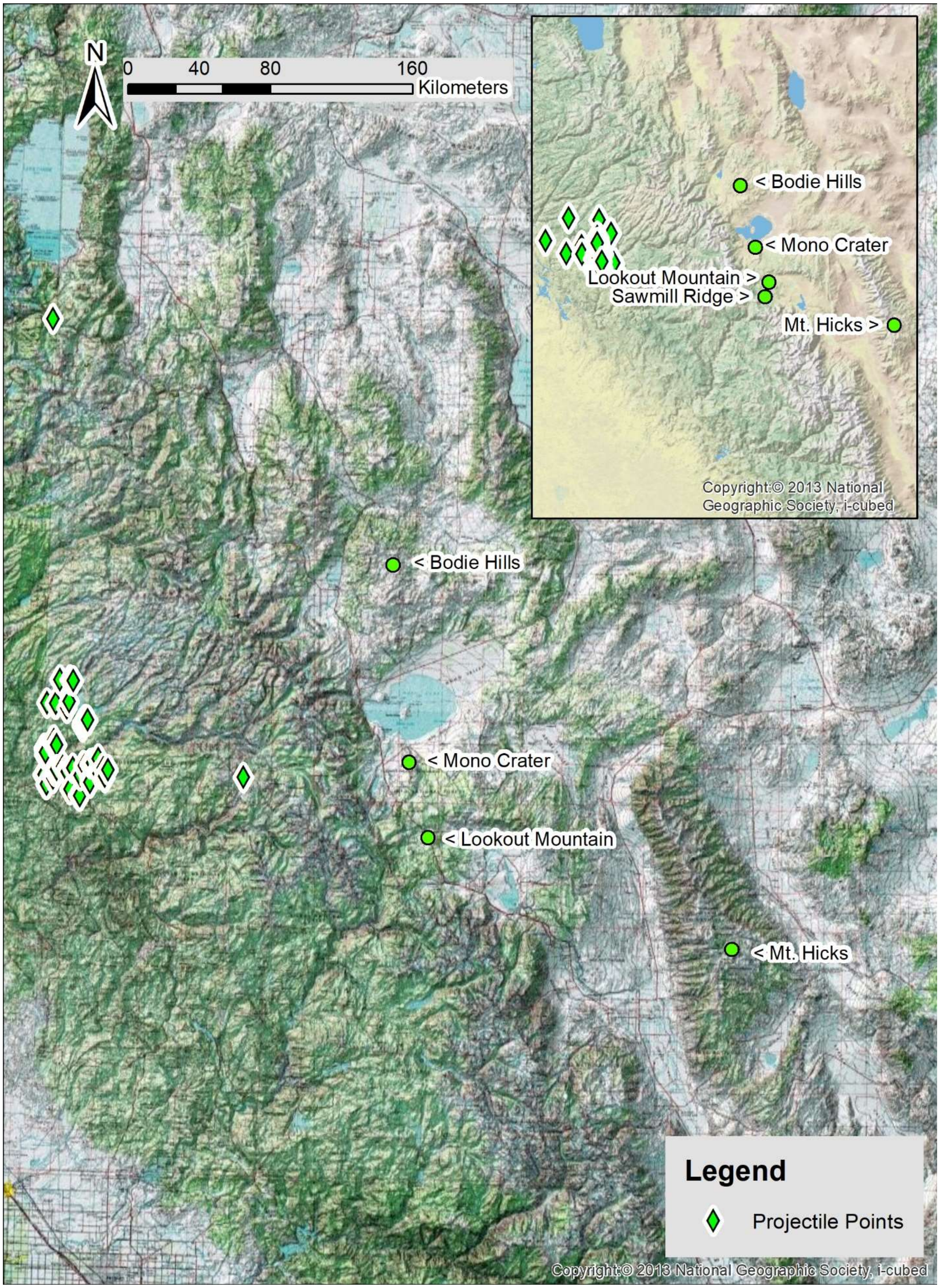

Figure 5.6. Map depicting the projectile points and obsidian sources represented in the Rim Fire projectile point collection.

I reject this as well because not only is there not enough information to assess these relationships, but the Me-Wuk and Washoe used the same four obsidian sources through time as might occur if relationships with their neighbors did not greatly vary through time. Lastly, I proposed that differences in controlled access, mobility, and/or trade influenced the obsidian procurement strategies of the Me-Wuk and Washoe. I lack the data to directly consider these factors because they require additional data sets and a different research focus. However, information presented in Chapter 2 reveals scenarios where altered availability or controlled access to obsidian may underlie the patterns inferred in this thesis. For example, the Washoe preferred isolation and avoided the outsiders who came to their territory, and the Me-Wuk were displaced and the resource structure altered during the Gold Rush. These transformations to their settlement pattern potentially altered their access to river drainages and mountain valleys that served as travel corridors to obsidian sources (e.g., Bodie Hills, Lookout Mountain). How and to what extent these transformations altered Me-Wuk and Washoe obsidian procurement or trade patterns remain unclear and require additional research to address. However, the temporal changes in obsidian procurement noted in this thesis (see Figures 5.4 and 5.5) do coincide with the influx of Europeans and Euroamericans into the Sierra Nevada.

Why the proportion of Me-Wuk and Washoe projectile points manufactured from Bodie Hills and Lookout Mountain obsidian changed at the time of European and Euroamerican expansion into the Sierra Nevada is not entirely clear. One possibility relates to differences in prey availability through time (e.g., Hildebrandt and McGuire 2002). Specifically, as animal populations were depleted with the arrival of ever-increasing numbers of Euroamericans and Europeans to the Sierra Nevada during the

Protohistoric and Historic periods, it possibly shifted Me-Wuk and Washoe subsistence to a greater reliance on acorns and possibly small animals as a food source during lean years or periods of time when competition for reduced prey populations increased. Separately or in addition, the Me-Wuk and Washoe potentially responded to the domesticated livestock, non-traditional food sources (e.g., wheat flour, bacon, bread), and introduced tools and materials (e.g., glass, steel knives, guns) brought by Europeans and Euroamericans by modifying their subsistence, settlement, and obsidian procurement patterns. In fact, increased reliance on these resources possibly reduced (as is the case among the Me-Wuk; Figure 5.4) or stabilized (as is the case among the Washoe; Figure 5.5) the number of obsidian projectile points needed for their toolkits, resulting in the reduced reliance on obsidian projectile points through time.

The conclusions of this thesis are indicative of the need for further study of obsidian procurement patterns in the SNF and Native peoples of the Sierra Nevada in general. Evidence presented in this thesis supports the notion that the influx of Europeans and Euroamericans during the Protohistoric and Historic periods influenced obsidian procurement patterns, but the specifics of how exactly these changes came about are not entirely clear. Without additional data and further study, no further conclusions or more refined views of these patterns can be generated. In the future, other archaeologists may choose to further this research and add to the data already generated for this thesis, advancing our understanding of obsidian source use patterns in the Sierra Nevada and providing further insight into the transitional effects of Europeans and Euroamericans on Native peoples.

CHAPTER 6

CONCLUSION

The obsidian procurement patterns of the Late Prehistoric to Historic Me-Wuk and Washoe Native communities of the Sierra Nevada, who once inhabited the lands of the Stanislaus National Forest (SNF), were analyzed using the 378 projectile points collected during the 2013 Rim Fire. More specifically, I assessed if the arrival of outsiders (Europeans and Euroamericans) altered the obsidian procurement patterns of the Me-Wuk and Washoe in the SNF. To address this, I developed the cultural affiliation test expectation that considered if the obsidian for Me-Wuk and Washoe projectile points came from different sources due to variations in their territories, language, inter-community relationships, and other factors. A second test expectation, the time test expectation, considered whether the proportion of Me-Wuk and Washoe obsidian projectile points varied through time (Late Prehistoric to Historic) and why.

Chapter 1 introduced the questions and test expectations that were evaluated, as well as the origins and background of the 378 projectile points collected during the Rim Fire. Chapter 2 provided critical environmental and cultural background about the Sierra Nevada mountain range. It began by describing variability in the climate and resource structure (plant, animal, and mineral resources) encountered by the Me-Wuk, Washoe, and other Native communities in the region. Following this was a detailed description of the known prehistoric and ethnographic evidence (e.g., material culture, familial organization, language) regarding the Me-Wuk and Washoe, as well as what is known about their interactions with other California and Great Basin Native communities (e.g., Paiute, Maidu, Yokuts, Mono). Further historic evidence was provided regarding the exposure of the Me-Wuk and Washoe to the influx of Euroamericans and Europeans during the Gold Rush, which served as the impetus for me to evaluate if this influx impacted their obsidian procurement patterns.

Chapter 3 described the methodology, beginning with a definition of what projectile points are and how they were used prehistorically. Next, I described the projectile point typology used for this thesis—Monitor Valley (Thomas 1981) and Justice (2002)—and the EDXRF procedures used to geochemically source 83 of the obsidian projectile points.

The results are presented in Chapter 4 and indicate that the collection contains 35 different projectile point types, most of which are California types with some Great Basin types. The points range from 6000 BC to the Historic period (19th century), and are highly variable with lanceolate, stemmed, side and corner notched varieties. Obsidian was the most common raw material type (n = 308), with trace amounts of basalt, quartzite, chert, fine-grained volcanic, jasper, and glass. To facilitate the test expectations, ethnographic and archaeological information was used to affiliate the projectile point types with the Me-Wuk (Sierra Side Notch, Delta Side Notch, Cottonwood Triangular) and Washoe (Desert Side Notch, Eastgate Expanding Stem, Rose Spring Corner Notch, Cottonwood Triangular). Results of the EDXRF analysis reveal that the obsidian projectile points are made from Bodie Hills, Mono Craters, Casa Diablo's Lookout Mountain and Sawmill Ridge, Mt. Hicks, and a source similar to

Lookout Mountain. Bodie Hills obsidian is the most common source in the collection and was heavily used by the Me-Wuk and Washoe.

Chapter 5 evaluates and interprets the two test expectations that underlie this research. The cultural affiliation test expectation considered if differences in language, territory, neighbors, etc. influenced Me-Wuk and Washoe obsidian procurement strategies. Statistical analyses and frequency plots reveal no significant difference in the proportion of obsidian projectile points made by the Me-Wuk and Washoe by source area. This finding led me to reject the cultural affiliation test expectation and implication that Native community differences influenced Me-Wuk and Washoe obsidian procurement strategies. The time test expectation considers if the obsidian procurement patterns of the Native communities varied temporally. The analyses reveal that the Me-Wuk and Washoe statistically significantly reduced their use of Bodie Hills and Lookout Mountain obsidian beginning with the Protohistoric period and into the Historic period. This change, as revealed among projectile points, corresponds to the time when Europeans and Euroamericans came to the SNF in large numbers. I propose herein that the influx of Europeans and Euroamericans substantially reduced prey availability or altered subsistence practices due to the introduction of new food resources and/or possible hunting materials, potentially causing the Me-Wuk and Washoe to rely more heavily on acorns, small animals, new food resources, or materials/tools that did not necessarily require the use of projectile points. In this scenario, as the need for projectile points lessened it somehow shifted the Me-Wuk and Washoe obsidian procurement patterns. This explanation is hypothetical and needs testing, but generally fits what might occur when new groups enter an area and marginalize the existing groups.

APPENDIX

PROJECTILE POINT DATA TABLE

ID	Justice Type	Justice Time Depth	Monitor Valley Type	Monitor Valley Time Depth	Material	Likely Cultural Affiliation	XRF Source	Distance from Source
05-16-4397-002	Buchanan Eared	1000 BC- AD 700	NA	NA	Obsidian	Washoe	Bodie Hills	80.06 km
05-16-4397-065	Elko Eared	1500 or 1300 BC to AD 600 or 700	Elko Eared	1300 BC – AD 700	Obsidian	Washoe	Bodie Hills	87.68 km
05-16-4397-099	Humboldt	6000 BC- AD 600	Humboldt	Circa 3000 BC - AD 700	Obsidian	Washoe	Mt. Hicks	176.67 km
51-0015/4030-9-001	Elko Eared	1500 or 1300 BC to AD 600 or 700	Elko Eared	1300 BC – AD 700	Obsidian	Washoe	Bodie Hills	86.39 km
51-0334-001	Cottonwood Triangular	AD 900 to the Historic Period	NA	Post AD 1300	Obsidian	Both	Bodie Hills	95.1 km
51-0426-001	Desert Side Notch	AD 1100 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Bodie Hills	105.4 km
54-0034-037	Cottonwood Triangular	AD 900 to the Historic Period	NA	Post AD 1300	Obsidian	Both	Mono Craters	84.01 km

ID	Justice Type	Justice Time Depth	Monitor Valley Type	Monitor Valley Time Depth	Material	Likely Cultural Affiliation	XRF Source	Distance from Source
54-0034-037b	Rose Spring Corner Notch	AD 500-1300	Not Rosegate Series	AD 700 - 1300	Obsidian	Washoe	Bodie Hills	94.46 km
54-0034-040	Canalino Triangular	AD 1300 or 1500 to 1830	NA	NA	Obsidian	NA	Mono Craters	84.01 km
54-0034-043	Desert Side Notch	AD 1100 or 1300 to 1900	NA	Post AD 1300	Obsidian	Washoe	Bodie Hills	94.46 km
54-0034-045	Panoche Side Notch	AD 1500-1850	NA	NA	Obsidian	Me-Wuk	Bodie Hills	94.46 km
54-0034-063	Cottonwood Triangular	AD 900 to the Historic Period	NA	Post AD 1300	Obsidian	Both	Mono Craters	84.01 km
54-0034-086	Sierra Side Notch	AD 1250 or 1300 to 1900	NA	NA	Obsidian	Washoe	Bodie Hills	94.46 km
54-0034-096	Sierra Side Notch	AD 1250 or 1300 to 1900	NA	NA	Obsidian	Washoe	Mono Crater	84.01 km
54-0034-106	Sierra Side Notch	AD 1250 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Bodie Hills	94.46 km
54-0034-119	Humboldt	6000 BC- AD 600	NA	NA	Obsidian	Washoe	Bodie Hills	94.46 km
54-0034-125	Panoche Side Notch	AD 1500-1850	NA	NA	Obsidian	Me-Wuk	Sawmill Ridge, Casa Diablo Area	90.06 km
54-0034-127	Sierra Side Notch	AD 1250 or 1300 to 1900	NA	NA	Obsidian	Washoe	Lookout Mountain, Casa Diablo Area	89.51 km
54-0034-137	Panoche Side Notch	AD 1500-1850	NA	NA	Obsidian	Me-Wuk	Bodie Hills	94.46 km

ID	Justice Type	Justice Time Depth	Monitor Valley Type	Monitor Valley Time Depth	Material	Likely Cultural Affiliation	XRF Source	Distance from Source
54-0034-144	Redding Side Notch	AD 1600 or 1700 to early 1900s	Desert Side Notch	Post AD 1300	Obsidian	NA	Bodie Hills	94.46 km
54-0034-145	Sierra Side Notch	AD 1250 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Bodie Hills	94.46 km
54-0034-146	Desert Side Notch	AD 1100 or 1300 to 1900	NA	Post AD 1300	Obsidian	Washoe	Bodie Hills	94.46 km
54-0034-152	Rose Spring Corner Notch	AD 500-1300	NA	NA	Obsidian	Washoe	Bodie Hills	94.46 km
54-0057-004	Redding Side Notch	AD 1600 or 1700 to early 1900s	Desert Side Notch	Post AD 1300	Obsidian	NA	Lookout Mountain, Casa Diablo Area	92.49 km
54-0081-001	Elko Eared	1500 or 1300 BC to AD 600 or 700	Elko Corner Notch	1300 BC – AD 700	Obsidian	Washoe	Bodie Hills	80.06 km
54-0086-001	Desert Side Notch	AD 1100 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Bodie Hills	80.06 km
54-0087-001	Delta Side Notch	AD 1500-1800	NA	NA	Obsidian	Me-Wuk	Bodie Hills	80.06 km
54-0167-002	Delta Side Notch	AD 1500-1800	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	90.32 km
54-0307-002	Delta Side Notch	AD 1500-1800	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	80.19 km
54-0307-003	Sierra Side Notch	AD 1250 or 1300 to 1900	NA	NA	Obsidian	Washoe	Bodie Hills	80.19 km
54-0307-007	Delta Side Notch	AD 1500-1800	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	80.19 km

ID	Justice Type	Justice Time Depth	Monitor Valley Type	Monitor Valley Time Depth	Material	Likely Cultural Affiliation	XRF Source	Distance from Source
54-0335-006	Panoche Side Notch	AD 1500-1850	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	86.81 km
54-0337-001	Bear River Side Notched	AD 750-1350	Desert Side Notch	Post AD 1300	Obsidian	NA	Bodie Hills	85.35 km
54-0340-002	Delta Side Notch	AD 1500-1800	NA	NA	Obsidian	Me-Wuk	Bodie Hills	85 km
54-0349-002	Sierra Side Notch	AD 1250 or 1300 to 1900	NA	NA	Obsidian	Washoe	Bodie Hills	87.91 km
54-0350-001	Rose Spring Corner Notch	AD 500-1300	NA	NA	Obsidian	Washoe	Bodie Hills	86.86 km
54-0350-008	Canalino Triangular	AD 1300 or 1500 to 1830	NA	NA	Obsidian	NA	Bodie Hills	86.86 km
54-0352-001	Panoche Side Notch	AD 1500-1850	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	84 km
54-0369-001	Panoche Side Notch	AD 1500-1850	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	80.68 km
54-0395-002	Eastgate Expanding Stem	AD 700 or 600-1300	NA	NA	Obsidian	Washoe	Lookout Mountain, Casa Diablo area	80.90 km
54-0408-001	Panoche Side Notch	AD 1500-1850	NA	NA	Obsidian	Me-Wuk	Mt. Hicks	160.42 km
54-0409-004	Bear River Side Notched	AD 750-1350	Desert Side Notch	Post AD 1300	Obsidian	NA	Bodie Hills	85.34 km
54-0409-005	Delta Side Notch	AD 1500-1800	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Lookout Mountain, Casa Diablo Area	82.65 km
54-0442-003	Sierra Side Notch	AD 1250 or 1300 to 1900	NA	NA	Obsidian	Washoe	Bodie Hills	96.49 km

ID	Justice Type	Justice Time Depth	Monitor Valley Type	Monitor Valley Time Depth	Material	Likely Cultural Affiliation	XRF Source	Distance from Source
54-0442-005	Sierra Side Notch	AD 1250 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Bodie Hills	96.49 km
54-0579-002	Desert Side Notch	AD 1100 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Lookout Mountain, Casa Diablo Area	96.40km
54-0596-001	Humboldt	6000 BC- AD 600	Not Humboldt	NA	Obsidian	Washoe	Bodie Hills	89 km
54-0620-001	Desert Side Notch	AD 1100 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Bodie Hills	82.39 km
54-0625-001	Delta Side Notch	AD 1500-1800	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	81.04 km
54-0625-004	Eastgate Expanding Stem	AD 700 or 600-1300	NA	NA	Obsidian	Washoe	Bodie Hills	81.04 km
54-0625-008	Delta Side Notch	AD 1500-1800	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	81.04 km
54-0625-010	Eastgate Expanding Stem	AD 700 or 600-1300	NA	NA	Obsidian	Washoe	Lookout Mountain, Casa Diablo area	85.21 km
54-0625-014	Panoche Side Notch	AD 1500-1850	NA	NA	Obsidian	Me-Wuk	Bodie Hills	81.04 km
54-0661-001	Gunther Barbed	AD 800-1200	NA	NA	Obsidian	NA	Bodie Hills	89.84 km
54-0661-003	Desert Side Notch	AD 1100 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Bodie Hills	89.84 km
54-0661-004	Redding Side Notch	AD 1600 or 1700 to early 1900s	Desert Side Notch	Post AD 1300	Obsidian	NA	Bodie Hills	89.84 km
54-0666-002	Canalino Triangular	AD 1300 or 1500 to 1830	NA	NA	Obsidian	NA	Bodie Hills	89.48 km

ID	Justice Type	Justice Time Depth	Monitor Valley Type	Monitor Valley Time Depth	Material	Likely Cultural Affiliation	XRF Source	Distance from Source
54-0685-007	Delta Side Notch	AD 1500-1800	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	87.15 km
54-0685-012	Redding Side Notch	AD 1600 or 1700 to early 1900s	NA	NA	Obsidian	NA	Lookout Mountain, Casa Diablo Area	96.96 km
54-0685-018	Panoche Side Notch	AD 1500-1850	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	87.15 km
54-0853-102	Cottonwood Triangular	AD 900 to the Historic Period	NA	Post AD 1300	Obsidian	Both	Bodie Hills	Apprx. 90 km
54-0853-106	Redding Side Notch	AD 1600 or 1700 to early 1900s	NA	NA	Obsidian	NA	Bodie Hills	Apprx. 90 km
54-0853-108	Desert Side Notch	AD 1100 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Bodie Hills	Apprx. 90 km
54-0853-118	Desert Side Notch	AD 1100 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Bodie Hills	Apprx. 90 km
54-0853-121	Cottonwood Triangular	AD 900 to the Historic Period	NA	Post AD 1300	Obsidian	Both	Bodie Hills	Apprx. 90 km
54-0853-122	Desert Side Notch	AD 1100 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Bodie Hills	Apprx. 90 km
54-0853-123	Cottonwood Triangular	AD 900 to the Historic Period	NA	Post AD 1300	Obsidian	Both	Bodie Hills	Apprx. 90 km
54-1037-001	Panoche Side Notch	AD 1500-1850	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	90.6 km
54-1252-002	Gunther Barbed	AD 800-1200	NA	NA	Obsidian	NA	Bodie Hills	90.86 km

ID	Justice Type	Justice Time Depth	Monitor Valley Type	Monitor Valley Time Depth	Material	Likely Cultural Affiliation	XRF Source	Distance from Source
54-1252-004	Redding Side Notch	AD 1600 or 1700 to early 1900s	Desert Side Notch	Post AD 1300	Obsidian	NA	Lookout Mountain, Casa Diablo Area	92.67 km
54-1252-006	Panoche Side Notch	AD 1500-1850	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	92.67 km
54-1555-004	Cottonwood Triangular	AD 900 to the Historic Period	NA	Post AD 1300	Obsidian	Both	Sawmill Ridge, Casa Diablo Area	78.29 km
54-1773-002	Delta Side Notch	AD 1500-1800	NA	NA	Obsidian	Me-Wuk	Lookout Mountain, Casa Diablo area	85.24 km
54-1773-005	Rose Spring Corner Notch	AD 500-1300	NA	NA	Obsidian	Washoe	Lookout Mountain, Casa Diablo area	85.21 km
54-1773-006	Panoche Side Notch	AD 1500-1850	Desert Side Notch	Post AD 1300	Obsidian	Me-Wuk	Bodie Hills	81.04 km
54-1819-002	Sierra Side Notch	AD 1250 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Bodie Hills	84.98 km
54-1819-004	Eastgate Expanding Stem	AD 700 or 600-1300	NA	NA	Obsidian	Washoe	Mono Craters	77.5 km
54-1819-009	Eastgate Expanding Stem	AD 700 or 600-1300	NA	NA	Obsidian	Washoe	Bodie Hills	87.77 km
54-1819-010	Redding Side Notch	AD 1600 or 1700 to early 1900s	NA	NA	Obsidian	NA	Lookout Mountain, Casa Diablo Area	83.33km
54-1819-013	Sierra Side Notch	AD 1250 or 1300 to 1900	NA	NA	Obsidian	Washoe	Bodie Hills	87.77 km
54-1819-014	Elko Corner Notched	1500 or 1300 BC to AD 600 or 700	Not Elko Series	1300 BC – AD 700	Obsidian	Washoe	Bodie Hills	87.77 km

ID	Justice Type	Justice Time Depth	Monitor Valley Type	Monitor Valley Time Depth	Material	Likely Cultural Affiliation	XRF Source	Distance from Source
54-1819-016	Desert Side Notch	AD 1100 or 1300 to 1900	Desert Side Notch	Post AD 1300	Obsidian	Washoe	Bodie Hills	87.77 km
54-1874-001	Humboldt	6000 BC- AD 600	Humboldt	Circa 3000 BC - AD 700	Obsidian	Washoe	Bodie Hills	94.46 km

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