AN ABSTRACT OF THE THESIS OF

Janine Ruth McFarland for the degree of Master of Arts in Interdisciplinary Studies in the co-departments of Anthropology, History, and Geography presented on February 1, 1989.

Title: An Analysis of Two Post-Mazama Flaked Stone Scatters in the Upper Deschutes River Basin of Central Oregon

Abstract approved: ______________________
Richard E. Ross

During the summer of 1986, an archaeological testing project was completed at seven prehistoric campsites primarily located in the upper Deschutes River Basin of central Oregon. Testing was focused on two low-density "lithic scatters", an archaelogical site type which is especially abundant in this obsidian-rich region but which, to date, has not been extensively studied. Excavations indicated that the obsidian flake scatters post-date the 6800 B.P. eruption of Mount Mazama and represent the remains of hunting camps focused along Fall River. The testing strategy employed provided an alternative approach to testing and evaluating the archaeological significance of obsidian flake scatters located throughout the pumice zone of central Oregon.

An Analysis of Two Post-Mazama Prehistoric Flaked Stone Scatters in the Upper Deschutes River Basin of Central Oregon

by

Janine Ruth McFarland

A THESIS

Submitted to

Oregon State University

in partial fulfillment of

the requirements for the

degree of

Master of Arts

in

Interdisciplinary Studies

Completed February 1, 1989

Commencement June 1989

APPROVED

Professor of Anthropology in charge of major

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Date Thesis is Presented: February 1, 1989

ACKNOWLEDGMENTS

First of all, I'd like to express a heartfelt thank-you to Carl M. Davis, Willamette Forest Archaeologist. Since my first year in 1985 on the Deschutes National Forest, Carl has unselfishly given hundreds of hours of his time to me in the interest of the Forest Cultural Resource Program. Carl has played many roles to see the completion of this work; editor, advisor, mentor, and friend. I do believe that Carl had this thesis written in his mind long before I had ever put a pen to paper.

The USDA Forest Service (Deschutes National Forest) provided both financial and technical support for this research. I would especially like to thank Jill Osborn, Forest Archaeologist; Walter Schloer, Ranger; and Arlie Holm, Cultural Resource Cordinator; on the Bend Ranger District. Several individuals associated with the Forest Service provided valuable assistance and encouragement throughout my tenure as the Bend District Archaeologist. Terral Brock, Soil Scientist, and Laurence Chitwood, Geologist, helped me to understand various aspects of forest soils, environmental and geological processes. Pierre DeSantis and Pam Kuhn, Engineers, provided mapping assistance, Pierre became a close friend after many field trips and learned to enjoy to map "all those pits". Other forest archaeologists including Mark Swift, Adam Stellmacher, LeRoy Steece, and Scott Stuemke provided discussion and assistance during the field work. Scott generously loaned his assistant, Jay Vanderford, to help draw many much-appreciated maps. My Fall River assistants, Lynne Ertle and Melissa Anderson were supportive in every way and helped me to maintain my sense of humor. Bend District timber staff, Ric Carlson and Jim Parker offered much help and insight to the prehistory and history of the area. Thanks to all of you.

Other people who provided their technical expertise include my brother Richard McFarland, who photographed the sites for me, and Natalie Herse who completed the artifact illustrations. Many other friends supported this work in different ways, David Dukes; Sara Scott, CH2M Hill Archaeologist; Dan Mattson, Warm Springs Tribal Archaeologist. Sara offered many informative insights on the lithic technology and prehistory of central Oregon. Dan offered some editorial comments, as well as, support in completing various maps.

I especially wish to express sincere thanks to my Committee members, Dr. Richard Ross, Lucy Skjelstad, Dr. Robert Frenkel, and Dr. Henry Sayre, for sharing their professional insights, and for their review of the draft of this thesis. Once again, Carl Davis helped this work immeasurably through his insights as a Forest Cultural Resource Manager.

Dr. J. Jeffrey Flenniken and Terry Ozbun (of Lithic Analysts, Pullman, Washington) contributed in a large part to the direction of this thesis research. Their capable abilities in the field of lithic technology has greatly broadened my viewpoint of the prehistory of central Oregon.

Many other professors and work colleagues have helped my career along the way. Dr. Roberta Hall, Dr. David Brauner, and Dr. Kenneth Beals of the O.S.U. anthropology staff; Dr. John Woodward of Mount Hood Community College; Smoke Pfeiffer; Dr. George Mead; and Ben Francy have all contributed in various ways to increase my knowledege of anthropology.

Lucy Skjelstad, Director of Horner Museum; Loretta Harrison, Assistant Director; and Rich Sullivan generously gave much time, knowledge, and friendship during my three years of seasonal tenure at the Museum.

And last, but certainly not least, I wish to acknowledge my mother, Kathryn McFarland for giving my son many long hours of love and care while I was working on this research, as well as, providing many back-breaking hours bending over the screen. Finally, to Dustin, I dedicate this thesis to you with much love. Thank you for being so patient whether you wanted to or not.

Fall River

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Chapter 1

Introduction

Research Objectives

Archaeological research in the Northern Great Basin region of central Oregon has largely been focused on highly-stratified rockshelters and caves (e.g., Bedwell 1973; Cressman 1942) or deeply buried occupation sites surrounding lakes and springs (e.g., Fagan 1974; Sampson 1985). Comparatively little attention has been paid to the numerous and abundant concentrations of chipped stone flakes and tools that represent the remains of highly transitory prehistoric hunters and gatherers. These archaeological sites, frequently called "lithic scatters", are found in nearly every environment of the Northern Great Basin (Figure 1). This lack of interest in lithic scatter research may, in part, be due to the lack of perishable materials, features, and other remains. Another reason may be that traditional archaeological excavation and analytical methods have not been especially productive at lithic scatter sites, thus diminishing their

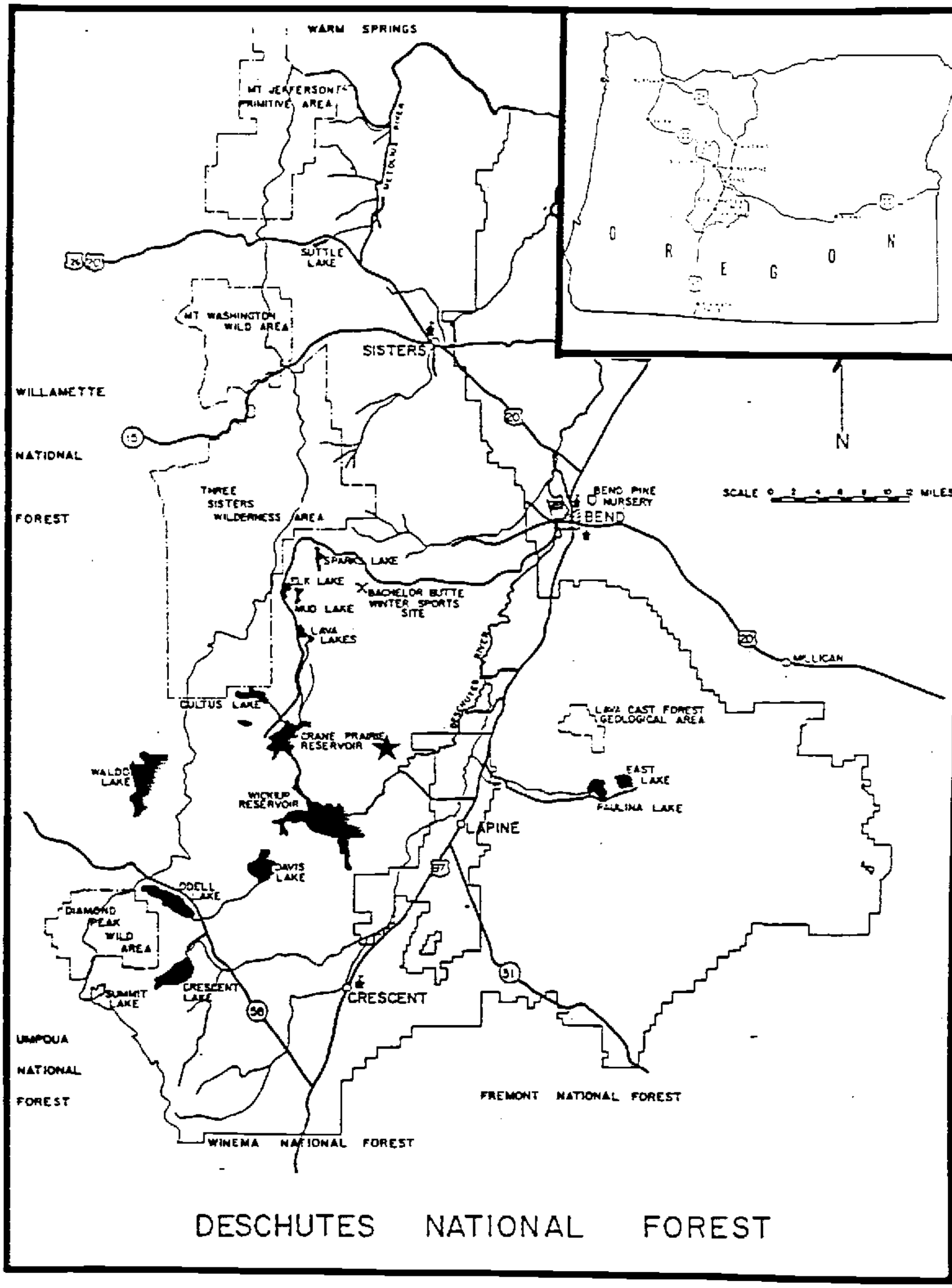

Figure 1. Location of study area marked by a ★. Location of the study area within the state of Oregon is inset in the upper right corner.

perceived interpretative importance (e.g., Cole 1977). In either case, a potentially rich source of archaeological site information has not received the detailed attention that it deserves.

However, the advent of "cultural resource management" (CRM) on public lands, rather than academically-based research, has recently turned increasing attention to lithic scatter sites in central Oregon. The long-ignored lithic scatter now lies in the way of planned timber sales, road construction, recreational developments, land exchanges, and other improvements. In order to comply with the various laws affecting prehistoric and historic properties on federal land, the archaeological community is now charged with the responsibility of determining the scientific research value of a variety of archaeological sites including lithic scatters, as well as recommending agency management options. This may entail redesigning proposed projects, further surface artifact collection, or detailed excavation. This new charge has been difficult to carry forth for several reasons:

1. Analytically, a diversity of opinion exists as to what exactly constitutes a "lithic scatter". For example, in central Oregon, flake scatters may range in area from several meters to several hundred acres (McFarland and Ertle 1986). Although it is now recognized that post-depositional processes and historic activities (especially railroad logging) are partly responsible for this widespread distribution of lithic debris (Davis and Scott 1986), these processes do not completely account for the archaeological patterning observed.

Obsidian quarries and extensive campsites are found throughout the upper Deschutes River basin. It seems reasonable to expect that over time, with repeated use by prehistoric peoples, many of these archaeological sites would grow to be quite large. This, to date, however, has not been the expectation of many archaeologists. The difficulties involved with where to draw site boundaries, and what to call a site (the "splitter versus lumper" debate) create on-going problems.

2. This problem leads into a methodological issue: what is the best way to realize the archaeological research value or potential of lithic scatters given their variable size, depth, and complexity? Given both time and budgetary constraints, these are the important issues which often drive site recovery through surface collection and/or excavation procedures. Some archaeologists have focused on discrete concentrations of lithic debris through the excavation of several small and comparatively deep excavation blocks in order to characterize prehistoric activity areas at these sites (Minor and Toepel 1983). Others have opened up more extensive excavation blocks to examine activity diversity across the site(s) (Ice 1962). Still other archaeologists maintain that extensive surface collections may yield as much information as excavation (Carl Davis, personal communication, 1987).

3. A third problem is determining the best means to describe and analyze lithic debitage and discarded tools once they are removed from the ground. To date, most archaeologists working in the central

Oregon area have focused on the morphological attributes of lithic assemblages, including the numbers, kinds, and shapes of various formed tools (e.g., Cole 1977; Minor and Toepel 1984). Recently, given the abundance of obsidian in this region, and the apparent technological continuity from "quarry to campsite" that can be observed in the archaeological record here (Scott 1985:67), archaeologists have begun to characterize the lithic reduction or tool manufacturing sequences as a means of attaining more precise chronological and functional data from lithic scatters (e.g., Flenniken 1987).

4. A fourth problem is that the archaeological sequences of the upper Deschutes River basin is poorly known. It is therefore difficult to place most lithic scatter sites in any chronological or explanatory context. Further, ethnographic information which might illustrate the lifeways and activities of the prehistoric Indian groups is comparatively sparse. Only general information exists about the Northern Paiute, Tenino, or Molala Indians who may have inhabited or used the upper Deschutes River Basin.

When combined, the four problems cited above make research at lithic scatters very difficult to undertake, especially under the rubric of "Cultural Resource Management". Despite the existence of several agency-developed programmatic "lithic scatter research designs and management plans", and the professional obligation to help "manage" lithic scatters in the face of numerous federal projects, there is limited professional consensus as to the best way to obtain archaeological information from prehistoric lithic scatter sites. As a result each new attempt to extract and interpret data from a lithic scatter creates new ideas, methods, and data.

With these problems in mind, the first objective of my thesis research was to address the methodological and analytical problems outlined above through the test excavations of a series of archaeological sites along the Deschutes and Fall River drainages in central Oregon. Specifically, this research grappled with the issues of how best to test excavate seven large, low-density lithic scatters, of which two are the focus of this thesis. A related thesis research issue is how best to analyze the lithic material recovered. On both accounts, a specific methodology was employed that contrasted somewhat with the traditional excavation and analytical procedures used in this region. The second objective was to tenatively characterize some aspects of post-Mazama prehistoric land use and settlement in the Upper Deschutes River Basin, using the data recovered from the excavations of the two lithic scatter sites.

The thesis research presented here, however, must be recognized as preliminary in nature. Site and artifact sample size were small; and excavations were largely dictated by the locations of planned Forest Service developments. Time and funding available for extensive technical analyses were limited. Therefore, the conclusions drawn must largely be viewed as a stepping stone for future research. On the other hand, the methods employed and the information gained during this research helps fill one of many information gaps concerning the archaeology of the upper Deschutes River Basin and demonstrates the fact that substantial progress can be made through careful study of sparse lithic scatter sites in this region.

Chapter 2

Environmental Overview

Location

The study area is located within the Upper Deschutes River Basin of central Oregon. Much of this river basin is located within land administered by the Deschutes National Forest. The Upper Deschutes River Basin lies on the northwestern periphery of the Great Basin, and at the far southern end of the Columbia Plateau. Fall River is a first-order tributary of the Deschutes River and marks the northern boundary of the La Pine Basin (Figure 2). The area is located within the High Cascade Physiographic Province (Chitwood 1985, Baldwin 1981). The upper Deschutes River basin, as a whole, can be characterized by distinctive physiographic, climatic, and biotic associations that reflect it's volcanic origins. The general characteristics of the Deschutes River Basin are summarized below.

Geology

The High Cascade Physiographic Province includes the area west of the Deschutes River to the crest of the north-south trending Cascade Mountain Range. The Cascades were formed during the Pliocene and are

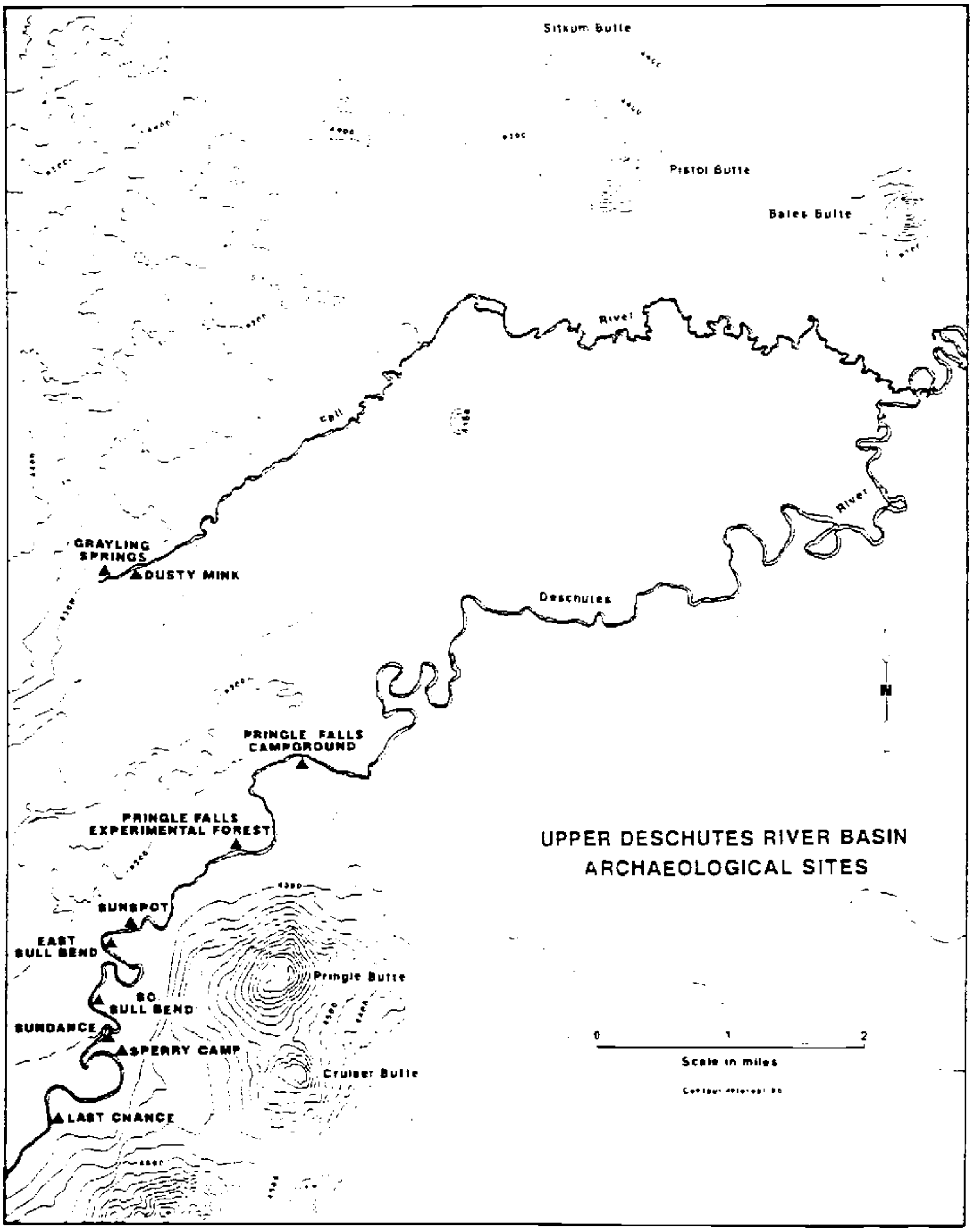

Figure 2. Location of archaeological sites within the Fall River drainage.

composed of many volcanoes that have been intermittently active during the last 15-20 million years. The eastern flanks are relatively gently sloping and less dissected in comparison with the western side of the Cascade Mountain Range (Baldwin 1981:61). In addition to volcanic activity, tectonic movement and glaciation have helped shape all of the major peaks in the central Oregon Cascades (Peterson et al. 1976). Many of these peaks are deeply scarred by Pleistocene glaciation and numerous glaciers are still present near the mountain peaks (Baldwin 1981:75).

The High Lava Plains Physiographic Province abutts the eastern slopes of the High Cascade Physiographic Province. This region's long volcanic history is readily apparent in the landscape of the Upper Deschutes River Basin. The High Lava Plains are aptly described by Baldwin (1981:131):

> The High Lava Plains extend eastward from the upper Deschutes River Valley to the eastern edge of the Harney Basin. The region is a relatively undeformed expanse of young lava flows dotted in places with cinder cones and lava buttes covered by sagebrush and, in places, by juniper.

Because the volcanic history of the High Lava Plains and Cascade Physiographic Provinces undoubtedly affected subsequent prehistoric settlement, it is appropriate to briefly discuss the last 15,000 years of local geologic activity and volcanism of the Fall River study area. The eruption of the Bachelor Butte-Lookout Mountain cinder cone chain from 13-15,000 years BP was a large-scale but local event (Figure 3). This north-south trending chain of cinder cones and lava

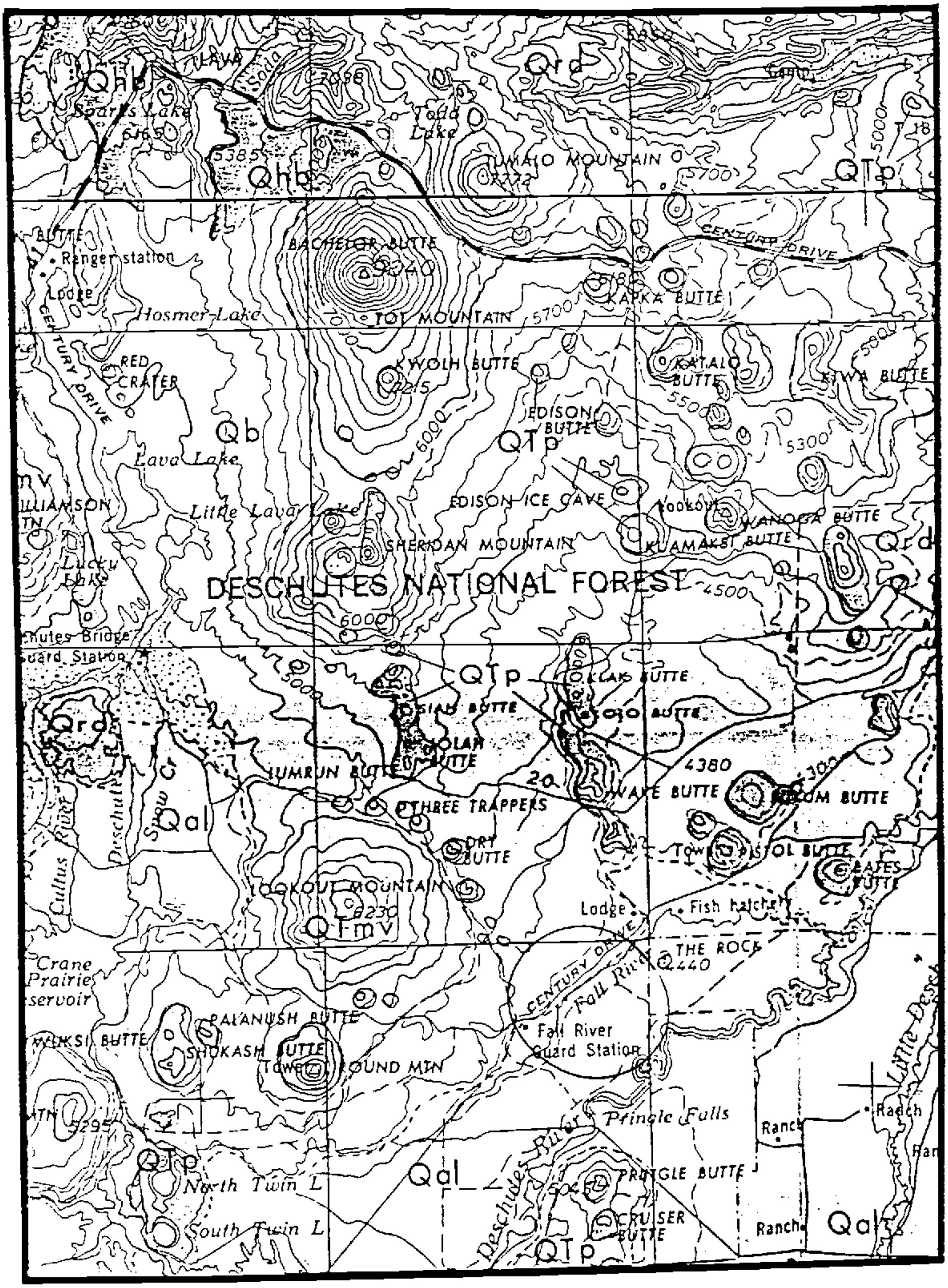

Figure 3. Physiographic setting of the study area which is enclosed with a circle. Map adapted from Peterson et. al. (1976).

flows is 17 miles long and erupted over a 2,000 year period shortly after the last glaciers in the area had receded (Chitwood, personal communication 1988). Lavas flowed westward against the eastern slopes of the Cascade Range, causing the damming of the shallow alpine lakes located in the High Cascades. The southern extent of these lavas is marked by the Fall River channel. These lavas have controlled the direction and dynamics of the stream erosion processes within the river drainage (Brock 1987).

Several terminal moraines located south of Lava Lakes and east of Mount Bachelor, are the result of glaciers that covered the entire Lava Lakes area with 500 to 1000 feet of glacial ice. These moraines provide evidence which helps to date the eruption of the Bachelor Butte-Lookout Mountain cinder cone chain. At least one disjunct moraine is near the base of Mount Bachelor and continues on its other side. Thus, the eruption of this chain must post-date the last Pleistocene glacial period (Chitwood, personal communication 1988; Brock 1986). The moraines include obsidian cobbles and basalts which may have provided a source of raw material for chipped stone tools.

In addition to forming the numerous alpine lakes, the Bachelor lavas drastically altered the free-flowing Deschutes River channel. Subsequently, the melt-off during the Anathermal period (Antevs 1955) eroded a enormous amount of sediment in the Fall River sub-basin. At least 100-200 feet of sediments were eroded out of the LaPine Basin during this time, while the newly formed volcanic chain remained relatively barren of soils except for imperceptible amounts of aeolian deposited glacial till (Chitwood, personal communication 1988).

The volcanic activity in both the Cascade Range and throughout the High Lava Plains has extensively influenced regional soil formation (Franklin and Dyrness 1988). Locally, the La Pine basin is typified by both volcanic and glacial episodes that have affected the soils in the project area. Post-glacial erosion, during the last 10-15,000 years, has created sediments consisting "primarily of stratified diatomaceous silts, sands, and fine gravels derived from the erosion of nearby basaltic shield volcanos of Pliocene and Pleistocene age," as well as, "volcanic air-fall deposits of basaltic to rhyolithic composition...lacustrine and fluvial sediments of Late Pleistocene age in the area of LaPine, Oregon occupy a basin between the axis of the Cascade Range and Newberry Volcano to the east" (Chitwood 1985:1). The minimum thickness of the sediments in this basin is 1360 feet based on a 1458 foot water well that was drilled in LaPine.

In addition to the large-scale regional devastation that occurred with the 6800 BP eruption of Mt. Mazama (Bacon 1983), many local eruptions of pumice and cinders from the Newberry Crater complex and other sources are distinctive and are valuable for relative dating of archaeological sites (Higgins 1969, Brock 1986, Scott 1985). Mehringer (1977:125) has noted "volcanic ashes serve as important Pleistocene stratigraphic marker through the Great Basin". The Newberry Crater complex is a good example of the recent Holocene volcanic activity that has occurred as recently as 1600 years ago in central Oregon. Newberry caldera lies 40 miles east of the Cascade crest and approximately 17 air miles from the Dusty Mink and Grayling Springs sites. The crater is part of the Paulina Volcanic Range, and has an estimated 250 parasitic cinder cones situated on its flanks (Brogan 1965:13). Within the crater, there are at least four to five distinctive obsidian flows dating between 6000 and 1300 years BP.

Two relatively recent local pumice eruptions at the Devil's Hill and Rock Mesa locations can be used to help date nearby archaeological campsites. Both have been dated by Scott (1987) between 2,000 and 2,300 years ago. White pumice from these two sources was identified by Brock (1987) during the Lava Lakes excavations, located at the headwaters of the Deschutes River (McFarland 1989) but none was found in the Fall River sites.

Another product of the regional volcanism is the numerous local obsidian sources that were used by the prehistoric peoples as raw material sources for chipped stone tool production (Skinner 1983; Swift 1986). The presence of numerous and abundant open-air lithic scatter sites attests to the importance of toolstone quarrying and manufacture (McFarland and Ertle 1986, McFarland 1988a; Flenniken and Ozbun 1988b; Davis and Scott 1986). In sum, the geological history of the upper Deschutes River Basin is important to consider archaeologically because: 1) volcanic materials are a basic component of site stratigraphy, 2) volcanics produce lava/obsidian flows used by prehistoric peoples, and 3) the deposits are useful for dating prehistoric sites.

Climate

The climate of central Oregon currently exhibits features of both the maritime and continental weather patterns (Franklin and Dyrness 1988). The region has cold-wet winters and warm-dry summers. The majority of precipitation occurs as winter snows and late fall thunder storms (Brock 1986). This region exhibits a wider temperature fluxuation than is present west of the Cascades, due to the influence on temperature consistency by continental air mass.

The "rain-shadow" effect created by the Cascade Mountains blocks precipitation moving east off the Pacific Ocean. This phenomenon contributes to the extreme aridity of central Oregon, where the average annual percipitation ranges from 10 inches along the Deschutes River north of Bend, to over 100 inches at the Cascade summit. These elevation differences have a great effect on local climate (Franklin and Dyrness 1988). Annual precipitation in the research area is estimated at 18 inches to 25 inches (Larsen 1976). Frosts can occur in any month of the year. At lower elevations, the growing season lasts for approximately eighty days during the summer. The average temperature at Bend, Oregon is 47.5° F, with a high of 105°, and as low as -25° F in the winter (Peterson et al. 1976:4).

In a temporal perspective, a broad-scaled three part post-glacial climatic sequence was developed by Antevs (1955) for the American West which has important bearing on the archaeological record of central Oregon. Antev's proposed three periods: 1) Anathermal

(9000-7000 years BP), the post-glacial cool and wet phase; 2) Altithermal (7000-45000 years BP), a warming and drying trend; and 3) Medithermal, the final 4500 years up to the present day where similar climatic conditions persisted throughout. While the sequence's general trends still apply to paleoenvironmental reconstruction in central Oregon, caution must be used in applying this scheme on a local level (Bryan and Gruhn 1964:307; Mehringer 1985:174).

Evidence for major environmental changes, between 7000 and 5000 years BP in the nearby Fort Rock Basin, has been documented by Cressman (1942) and Bedwell (1973). Subsequent analysis concerning the occurrence of faunal remains in relation to the deposition of Mt. Mazama supports the theory that a drying trend during the Altithermal was responsible for the changes in flora and fauna. Changes in faunal species during this time were the result of the "continued drought" conditions in conjunction with the eruption of Mt. Mazama (Grayson 1979:453).

Hansen (1942a, 1942b, 1946) has reconstructed the paleoenvironment for central Oregon area in his pioneering studies of peat-bog pollen. Hansen was the first to demostrate that the instability of Holocene vegetation was due to variations in local conditions rather than regional climatic trends. However, Hansen's climatic interpretations and Grayson's work with the Fort Rock cave faunal remains support Antev's geographically more encompassing scheme.

One of Hansen's study areas was Tumalo Lake, where a peat bog was core-sampled. Although this method antedates the more accurate radiocarbon method, the close proximity of Tumalo Lake to the Fall River area suggests that similar vegetative histories occurred. Tumalo Lake has a depositional history of approximately 15,000 years. Four major trends of vegetation succession are interpreted from the pollen profiles.

These trends are: (1) the initial cool-moist early Holocene period which provided a favorable climate for western larch and gave way to the establishment of early post-glacial lodgepole pine forests on glacially-derived palesols; (2) during the drier Altithermal period, these forests were replaced by yellow pine by the time of the Mount Mazama eruption at circa 7000 years BP, (3) this pumice and ash fall, however, sharply reversed this trend, and once again favored the rapid expansion of lodgepole pine forest, (4) for several thousand years following the eruption of Mt. Mazama, a return to the cool, moist conditions (Antev's Medithermal period) allowed lodgepole pine forests to be succeeded by the western yellow pine in the Tumalo Lake area (Hansen 1946).

Within the Fall River area, the deep layer of ash and pumice required a relatively long period of time to reestablish vegetation. (Brock, personal communication 1986). The significance of these unfavorable edaphic conditions has been documented in the Pumice Desert, which encompasses a five mile square area around Crater Lake where Mt. Mazama erupted. Due to the infertility of the soils and the severe temperature fluctuations, the surrounding lodgepole pine forests are only recently encroaching into this area (Horn 1968). These trends can also be expected for the Fall River area with respect to the local topography and the soil-moisture conditions.

Hydrology

The upper Deschutes River sub-basin includes all of the Deschutes River watershed above Benham Falls (Oregon State Water Resources Board 1961:50) including Fall River, the primary focus of this study. The Deschutes River which originates at Lava Lakes in the High Cascades. The Lava Lakes region is situated in glaciated uplands at 6800 feet above mean sea level (a.s.l.) and is geologically very young. The lakes are a part of a chain of lakes carved out by glaciers during the Pleistocene. During the Holocene, numerous lava flows dammed up these natural basins, forming small, comparatively shallow, alpine lakes. These lakes have no visible surface inflow.

The Deschutes River and most of its major tributaries drain the eastern slopes of the Cascade Mountains. The tributaries that maintain permanent flows include Little Deschutes River, Spring River, Fall River, and Paulina Creek. Paulina Creek is the only tributary that originates to the east of the Deschutes River.

Most of the surface water flows in perennial rivers that result from numerous spring sources. The upper Deschutes is a slow moving, meandering river with a very low gradient. The abundant air-laid pumice deposits, which are underlain by very permeable basalts, create a hydrological system in which "the overwhelming influence of groundwater exchange creates a very stable natural flow regime in the upper Deschutes River Basin" (McCammon 1980).

Volcanic activity has shaped the Deschutes river channel. Numerous ancient and recent lava flows have created a series of falls along this stretch of the river. For example, the rapids at Pringle Falls were formed by the 3-5 million years BP eruption of both Pringle Butte and the east-west trending cinder cone chain bordering this section of the Deschutes River. Subsequent deposition of the La Pine basin sediments had covered the base of the butte, through which the Deschutes River has now eroded (Chitwood, personal communication 1988). The Lava Butte lava flow is another significant geologic feature that has altered the course of the Deschutes River since 6100 years BP. Two extensive falls (Benham and Dillon) and several rapids were created by this eruption.

Historically, the Deschutes River had an even flow level which resulted from the deep springs and the heavy mantle of pumice in the river corridor. This pumice mantle can be compared to a sponge that rapidly absorbs surface run-off (Brogan 1965). However, annual spring run-off and precipitation probably swelled the river during this time of the year (Brock 1986). For a brief portion of the year, shallowly incised intermittant streams exist which help to define natural topographic features.

The damming and subsequent rechanneling of the Deschutes River above Benham Falls has contributed to the massive accumulation of soils, and the slow moving meandering channels of the Little Deschutes and the Deschutes River (Peterson et al. 1976). The combination of wide open topography and soil deposition in the Sunriver area, caused by the lava dam (Baldwin 1981:133), has formed broad alluvial meadows and favorable sloughs that appear to have been the focus of prehistoric inhabitation (McFarland and Davis 1985, Swift 1987).

Fall River flows in a shallow meandering channel that is only eight miles in length. This river is fed by underground springs which emit from a 10-15,000 year old lava flow that lies on the northern bank of this river (Chitwood, personal communications 1988). This river is the seventh largest tributary of the Deschutes River. Fall River owes its existence to a combination of permeable pumice soils that rapidly drain precipitation (so that there is little overland water flow), and underlying highly fractured lavas that absorb the water and carry it for miles underground. When this basalt bedrock encounters the impervious LaPine Basin sediments, the water is stored there. Springs, such as those at the heawaters of Fall River, were formed when the last glacial meltoff had eroded enough sediments to expose the basalt lavas which acted as a confined aquifer for the springs.

Topography

The study area is located along a series of terraces directly above the shallowly-incised channel of Fall River. The entire area surrounding Fall River is a gently sloping volcanic upland consisting of basaltic lavas of Holocene age. These lavas are derived from the previously noted Bachelor Butte-Lookout cinder cone chain (Brock 1986). Elevation within the study area ranges from 4260 feet to 4300 feet a.s.l.. The land lying to the south and the east of Fall River consists of nearly level glacial outwash plains and has little topographic relief.

The Dusty Mink site is located just downstream from the headwaters of Fall River, on a lower terrace that is surrounded by higher terraces. The main activity area of the Grayling Springs site is located within a depresssion surrounded by higher terraces. The two-terrace pattern is prevalent along the meanders of the present-day Deschutes and Fall River channels.

The geologically-older higher terraces which flank the river were formed though the alluvial deposition of the LaPine Basin sediments. During the early Pleistocene, 10-12,000 years BP, sheet gravels and sands were deposited upon these secondary terraces as a result of the glacial meltwater flooding and corresponding warmer climate. At this time, the large amounts of excess water caused the Deschutes River channel to overflow and thus to deposit soils along these secondary terraces. It is also possible that other glacial receding stages during the last 40,000 years of Wisconsin glaciation were responsible for the tremendous deposition and formation of the secondary terraces (Brock 1986). Chitwood (1985:1) has indicated that the exposure of 65 feet of sediments near Pringle Falls is a good example of the enormous deposition of materials due to the widespread effect of glacial meltoff. These sediments can be seen on all of the river-cut banks along the Deschutes River meanders from Wickiup Reservoir to Sunriver.

The lower terraces which lie directly adjacent to the river channel are much younger in age than the higher terraces. These lower and younger terraces date between 7,000 and 12,000 years BP (Brock 1986). Prior to the eruption of Mt. Mazama at 6,800 years BP (Bacon 1983), a grassy and boggy microenvironment existed on these lower terraces. Much of the initial deposition of the sands and gravels on these terraces occured during the final stages of the glacial meltoff. At this time, there was still an abundance of water in the region, even though the Deschutes River had begun to recede uniformly into its channel. Since the eruption of Mt. Mazama, the river channel has maintained its general river course, except near the Lava Butte area. Most of these lower terraces were stabilized by the deposition of the thick tephra mantle.

Vegetation

The region is blanketed with pumice derived from the 6800 year old eruption of Mt. Mazama and other volcanic eruptions, and is therefore called the "central Oregon pumice zone" (Volland 1985). The first pioneering attempt to describe the pumice soils and their effect on the subsequent vegetation in central Oregon was by Kerr (1913). Both Dyrness (1960) and Tarrant (1953) provide good overviews of the older pertinent literature.

The upper Deschutes River basin is located within the Ponderosa Pine (Pinus ponderosa) and Lodgepole Pine (Pinus contorta) Zones as defined by Franklin and Dyrness (1988:168). The ponderosa pine plant communities occupy moderately dry climatic areas. The distribution of this forest type is closely correlated to available moisture as noted by Franklin and Dyrness: "soil moisture regime is the most important single factor influencing the distribution of the climax vegetation types". Lodgepole pine grows in shallow depressions, frost pockets, and in moisture laden soils (Berntsen 1967, Dyrness 1960, Volland 1985, Dyrness and Youngberg 1966), while the ponderosa pine is favored by well-drained slopes. High moisture laden soils and low temperatures during the germination stages of ponderosa pine are limiting factors in its growth in low lying areas.

Leighty (1947) and Tarrant (1953:3), in their studies in the Pringle Falls Research Natural Area, document that the the occurrence of two pine types is due to topography and variations in soil drainage. Berntsen's (1967) research of temperature tolerances of the seedlings for both of these species has indicated that "lodgepole pine during the seeding emergence period is more resistant to low temperatures than ponderosa pine; thus, explaining in part the `frost pocket' distribution pattern of lodgepole pine in central Oregon". The distribution of lodgepole pine on broad flats and low-lying areas is due to soil moisture and cool nighttime temperatures (resulting from downslope movement of cold air). A similar frost pocket is situated at the headwaters of Fall River, where lodgepole pine has probably been the predominant species since the establishment of a vegetation community after the eruption of Mt. Mazama (Brock, personal communication 1986).

The importance of fire in shaping vegetation within this pumice zone has been stressed by virtually every ecologist and forester that has worked here. Historic fire suppression and logging practices conducted on National Forests since the turn of the century have changed the nature of the forest throughout the river basin. Before fire control was initiated about 1900, fires burned in these stands at intervals of four years (Bork 1985:13). Ponderosa pine's tolerance to high heat made it a natural climax species for most of the slopes surrounding the Fall River area in the Late Prehistoric period. Franklin and Dyrness (1988:180) noted that "periodic fires regulated the amounts of advance regeneration and resulted in the open, parklike stands". On lands adjacent to the Pringle Falls and Fall River areas, pure stands of Ponderosa pine once stood. These areas are now forested with rapidly invading lodgepole pine.

The forest type common to the Fall River area is Pinus ponderosa/Purshia tridentata plant community, which on well-drained pumice soils tends to have a sparse ground cover. Nearer the river corridor itself the Pinus/Purshia/Festuca plant community occurs on finer-textured soils derived from water-lain reworked pumice. Numerous ponderosa pine seedlings and saplings are present in the understory (Franklin and Dyrness 1988:176-177).

The history of stand disturbance and fire occurrence greatly affect the lodgepole pine forest types. This vegetation community is present to the south of Fall River on the nearly level glacial outwash plains. The history of stand disturbance from logging and fire occurence has had a great effect on the majority of these stands which are seral in nature (Franklin and Dyrness 1988:185; Bork 1985). Lodgepole pine is well known for its rapid invasion of severely disturbed sites which is why it is termed a "pioneer" species.

Vegetation along Fall River is typical of the low flanks of the eastern Cascades. A lodgepole pine and an bitterbrush plant community predominates the Fall River and La Pine Basin region. The lodgepole pine plant community has a life cycle that is 80-100 years. It is accompanied by old-growth ponderosa pine and a lush riparian zone along Fall River itself . "In the present Fall River setting, the lodgepole pine was fire-generated, and fire scars in adjacent stands indicate the area was burned in the early 1870's and again in the early 1890's" (Brock 1986).

Fauna

The meandering channels of the Deschutes River and Fall River provide a diverse riverine and riparian habitat for wildlife. Various species of waterfowl, raptors, rodents, furbearers, and large game mammals (including mule and blacktail deer, elk, and, occasionally, bear) inhabit the area at present. The Fall River area is designated as deer summer range. Both rivers lie along the northern waterfowl flyway of ducks and geese, and they provide resting places for the migrating fowl, although the present day Wickiup and Crane Prairie reservoirs provide better bird habitat than existed prehistorically for the area (Gary Milano, personal communication 1987).

The numerous lava-formed falls along the Upper Deschutes River prevent the upstream migration of anadromous fish. In historic times, an important trout fishery was located at Pringle Falls which contained resident fish including Bull Trout (Salvelinus confluentus), Rainbow Trout (Salmo gairdneri), and whitefish (Prosopium williamsoni).

Chapter 3

Previous Archaeology

Archaeological Background

Archaeological research in central Oregon began in the 1930s. This early research was focused on a small number of spectacular cave sites including Fort Rock Cave, Connelly Caves, and Cougar Mountain Cave No. 2, all of which have occupational sequences which predate 11,000 BP (Cressman 1942, Bedwell 1973) (Figure 4). The well-known Fort Rock Cave, made famous by Luther Cressman's excavations, is extremely important because it helped to establish the earliest known human occupation at 13,200 BP of the nearby Fort Rock Basin. All associated Paleo/Early Archaic cultural deposits found contained large, lanceolate-shaped projectile points probably used as thrusting spears.

Bedwell's later research at Fort Rock Cave indicated that during the time period from 11,800-7000 BP, a lakeshore/marshland cultural adaptation corresponded with a period of glacial meltoff. During this time (commonly known as the Anathermal phase), large lakes and marshes were formed in the Great Basin. Bedwell proposed the Western Pluvial Lakes tradition to characterize the lifeways of the ancient American Indians who utilized the rich lacustrine resources available to them.

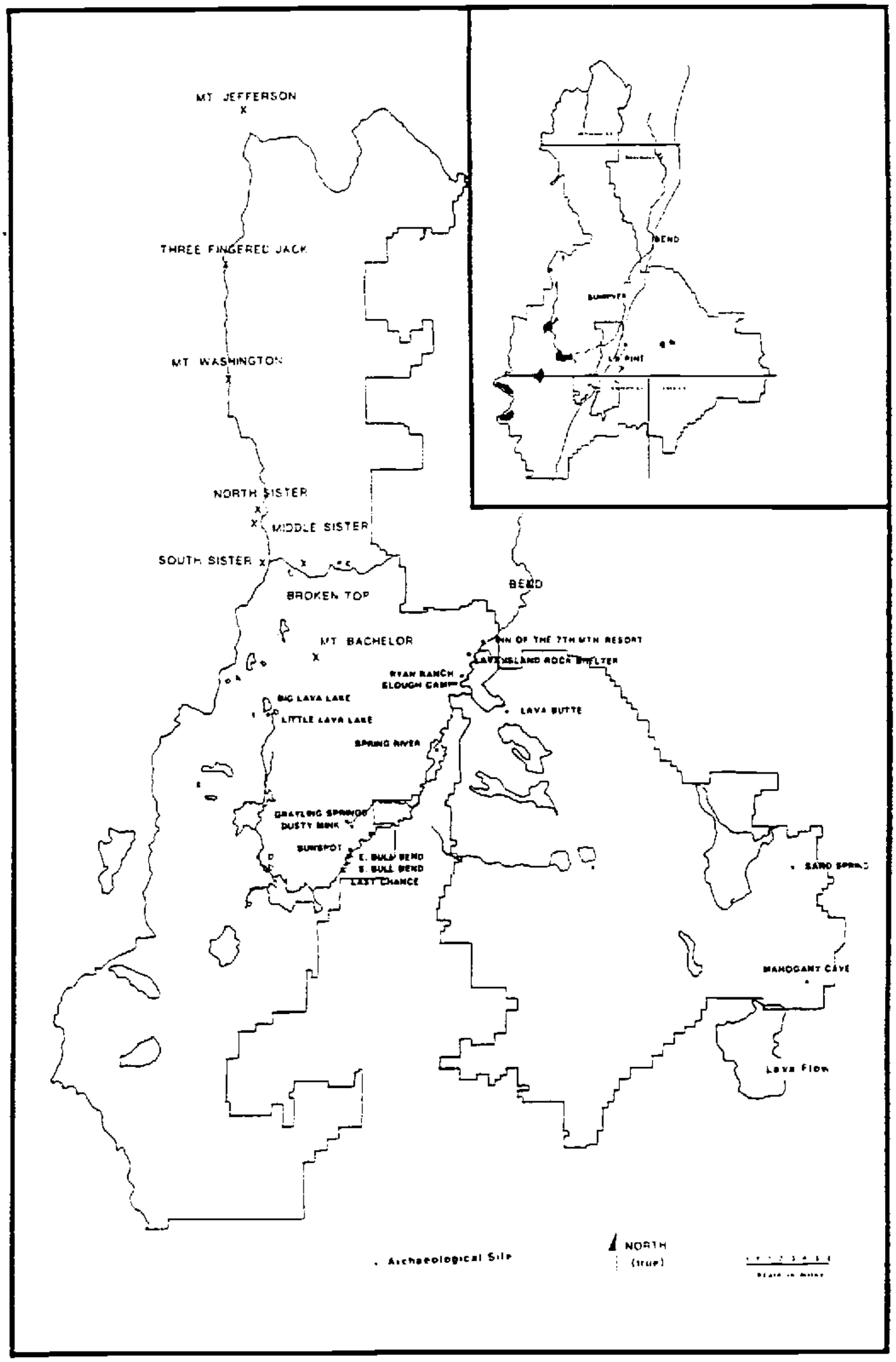

Figure 4. Location of archaeological sites within the Upper Deschutes River Basin.

No prehistoric sites dating to this time period have been found within the Upper Deschutes River Basin.

After 8000 years BP, the prevalence of broad-necked dart and (less numerous lanceolate) point styles, such as the Elko Series, mark the beginning of a new and more sophisticated weapon--the atlatl (Bedwell 1973). This time period is also marked by the increased use of plant processing which is evidenced by groundstone materials found in cultural deposits dating to that time period. Evidence for this time period in the upper Deschutes River region is limited to only four tentatively dated (post-7000 years BP) pre-Mazama occupation sites. These sites include three lakeshore open-air lithic scatters: East Odell Lake site (Cressman 1948), West Odell Lake site (Snyder and Davis 1984), and Crescent Lake Resort site (Steece, personal communication 1986). The remaining pre-Mazama site consists of two obsidian bifaces that were recovered along the Deschutes River, prior to the construction of Wickiup Dam, in glacial till overlaid by Mazama pumice (Cressman 1937). All of these sites are located on the southern end of the Deschutes National Forest.

All four early sites yielded little conclusive evidence for a pre-Mazama occupation due to two reasons: 1) the amount of stratigraphic mixing due to various transformational factors, and 2) the small size of the area investigated and amount of recovered cultural material. Much more scientific work needs to be conducted before any accurate conclusions can be drawn characterizing the climate, environment, or the PaleoIndian occupation of this region.

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From 7000-5000 BP, a period of warmer and drier climate, most of the lakes and major water sources in the Great Basin diminished. The onset of this period also coincides with the 6800 BP eruption of Mt. Mazama which deposited a thick mantle of pumice and ash throughout central Oregon. During this period, many of the cave sites, such as Fort Rock Cave, the Connelly Caves, and Dirty Shame Rockshelter, apparently were abandoned or little-used (Bedwell 1973, Aikens 1982).

During this time, however, human occupation of upland spring sites increased, as suggested by Scott (1984) and Fagan (1974). This shift in traditional settlement strategies may have been due to the lack of available water in the low elevational areas. In the Deschutes River Basin, evidence for post-Mazama occupation is more abundant. Sites such as Lava Butte, Lava Island Rockshelter, Cole's Sunriver sites, Sand Springs, East Lake, Lava Lakes, and others appear to fit into this time-frame as evidenced by the numerous recovered dart points, knives, milling equipment and other tools. Many of the projectile points are interpreted to be "Elko" points which have a wide geographic distribution throughout the Great Basin.

The Late Prehistoric period, from about 2000 to 200 years BP, is characterized archaeologically by an abundance of arrowpoints found in numerous sites throughout this region. These sites appear to represent the campsites of the Northern Paiute, Tenino, and other Indian groups who inhabited the Upper Deschutes River Basin at the time of contact.

At that time, the environment of this region was much as it is today. An overview of these various ethnographically-known tribes of central Oregon will be presented in the next chapter. Cultural assemblages dating to this period have been found at Lava Butte, Lava Island Rockshelter, Lava Lakes, the Lab/ Pringle Falls area, as well as at the Fall River sites.

Upper Deschutes River Basin Archaeology

Because the research area lies within the Upper Deschutes River Basin, the following discussion will be primarily concerned with archaeological sites that are known to this area. Until the late 1960s, information concerning prehistoric occupation of the central Oregon area was derived from caves and rockshelters and/or open stratified sites with deep middens (Bedwell 1973, Ross 1963, Ice 1962, Cressman 1948). These type of sites were recognized to be the most archaeologically rich and productive, as well as most easily interpreted. More problematic, prehistoric open-air lithic scatters and other "low visibility" sites (sites similar to the Grayling Springs and Dusty Mink) were not the focus of any systematic research. Most of the archaeological research which has been conducted in the upper Deschutes River drainage during the last 50 years (Figure 5) has been intermittent and project-related. Recently, a few attempts have been made to present general summaries of what is currently known about the prehistory of the area and the nature of the archaeological record (Davis and Scott 1986). Recent archaeological work largely comprises field surveys sponsored by state and federal agencies, particularly the Forest Service, to meet legal compliance prior to ground disturbing projects or developments (e.g., Osborne 1950; Cole 1977; Connally 1983; Carlson and Parker 1986, McFarland and Lindh 1985). Only recently have broad-scaled surveys been undertaken which attempt to provide widely encompassing archaeological information (Scott 1984, 1986; McFarland and Davis 1985, Swift 1987, McFarland and Stellmacher 1988). A brief summary of the most important research completed within the last several decades is presented below.

In 1948, the first comprehensive survey was conducted along the the upper Deschutes River basin, in wake of the proposed Benham Falls dam construction (Osborne 1950). This survey recorded numerous open-air lithic scatter sites along favorable terraces adjacent to the river. In addition to obsidian debitage and flaked stone tools, a few items of ground stone material were documented. The projectile points consisted of both dart and arrow points, indicating that these sites spanned at least several millennia of occupation. Osborne made an important observation pertaining to the local topography by suggesting that older occupations were found on the higher terraces, while more recent materials were found on the lower terraces. More recent surveys in this area confirm his findings, although unfortunately much of the surface ground stone and diagnostic chipped stone tools had been illegally collected since Osborne's research (McFarland, Bettendorf, and Stellmacher 1988).

The earliest major excavation of a stratified open-air lithic scatter site was conducted at Lava Butte, named after a well-known cinder cone and lava flow. This site lies approximately 17 miles northeast of the Fall River sites. Another lava flow adjacent to the site, contains a deep bedrock fault, which holds ice deposits and cool air throughout the year. This rich lithic scatter site was excavated in the early 1960s by Washington State University in advance of construction of a gas transmission line (Ice 1962). It yielded an extensive artifact assemblage that included approximately 400 whole and fragmentary points. The author listed a variety of tool types, which included both chipped and ground stone artifacts and placed limiting dates for the Lava Butte occupation as "set within reasonable accuracy at 1500 AD and 1800 AD". A recent re-analysis of the data suggests a different site interpretation (Davis and Scott 1984). According to this later interpretation, this site was apparently occupied by hunting and gathering groups that made use of the deer migration routes along the extensive lava flows from 4000 to as late as 200 years ago. This site probably functioned as a base camp where a variety of activities took place. The extensive occupation of Lava Butte sugggests that the Middle to Late Archaic groups used the wide variety of volcanic features inland from the river corridor within their seasonal subsistence.

In 1974, David Cole of the Oregon State Museum of Anthropology surveyed approximately 1000 acres in the proposed Sunriver development and located two small open-air lithic scatter sites. Excavations of these sites were done prior to completing the land exchange and resulted in the recovery of two side-notched dart points, obsidian lithic debitage, and bifacially-flaked tool fragments. Cole (1977) suggested that one site may date to 650 B.C. and A.D. 200, and may have been occupied by both Deschutes River and Great Basin peoples. A more recent survey of the Sunriver area determined that all of the cultural resource sites in that area consist of large, low-density lithic scatters (Swift 1987). The nature and composition of these sites is very similar to those located nearby along the Deschutes River on the Bend Ranger District (e.g., McFarland and Davis 1985; McFarland and Stellmacher 1988; McFarland, Bettendorf and Stellmacher 1988).

In 1984/85, two small scale testing projects were completed in advance of the Cascade Lakes Highway construction and a land exchange along the Little Deschutes River. Excavation of these small open-air lithic scatters yielded by now typical assemblages of obsidian debitage and a limited amount of formed tools. All of these sites were interpreted as short-term hunting camps where maintenance of chipped stone tools was carried out to the near exclusion of other activities (Pettigrew and Spear 1984, Jenkins 1985).

With the exception of Lava Butte, prior to 1986 only two major excavations were undertaken in the river valley, including Lava Island Rockshelter (Minor and Toepel 1984) and four prehistoric sites on land now belonging to the Inn of the Seventh Mountain Resort (Minor and Toepel 1983). Lava Island Rockshelter was excavated to mitigate the threat of vandalism and destruction. The four prehistoric sites were excavated at the Inn of the Seventh Mountain Resort to facilitate a land exchange between the Forest Service, and to test for cultural significance of known sites.

Lava Island Rockshelter is the only rockshelter site in the area that has been scientifically excavated. Many others which are known to have been destroyed through illegal excavations and their important scientific information is now lost. Lava Island was originally reported as having three separate occupations, the oldest of which predates 7000 years BP, based on a cache of lanceolate-shaped obsidian bifaces that was thought to be typologically similar to the Haskett point series of the northern Great Basin (Minor and Toepel 1984:85). Recent obsidian hydration measurements taken on several of the lanceolate bifaces indicates that they are no older than three thousand years (Carl Davis, personal communication 1985). This information, combined with the fact that considerable soil disturbance had occurred within the site deposits, suggests that this site was probably occupied no earlier than 4-5,000 years BP. The younger occupations are documented by the presence of an Elko and Rose Springs projectile point series, both of which are common from the northern Great Basin. The rare discovery of a nineteenth century (A.D. 1840) bark lined, cache pit, complete with charred ponderosa pine seeds, also seemed to point to a Great Basin occupation. The authors suggest that Northern Paiute groups occupied the cave in historic times.

The Inn of the Seventh Mountain lithic scatter sites are located less than 1/2 mile away from the upper Deschutes River. Preliminary testing yielded the obsidian lithic debitage and chipped stone tool assemblages. A limited number of dart points and biface preforms were recovered. Among other artifacts, a hopper mortar was collected. The authors indicated that these sites represent "temporary campsites used by aboriginal peoples ranging out from a base camp or village presumably located elsewhere in the Upper Deschutes River Valley" (Minor and Toepel 1983:61). Although more extensive excavations were undertaken in 1984, this work has yet to be reported.

Sara Scott's excavations at Sand Springs in 1982 are among the earliest attempts on the Deschutes National Forest to use the distinctive Newberry Crater pumice as a stratigraphic time marker. This volcanic pumice deposited in 1600 BP, effectively sealed the Sand Springs site into two distinct cultural horizons. This site has also been interpreted as having been occupied by Great Basin peoples. However, Scott's research also recognized the value of the lithic reduction studies in interpreting local prehistory. Lithic data suggests Sand Springs primarily functioned as a secondary reduction area where roughed-out bifaces were "cleaned up" for transportation to other areas. Hunting and tool refurbishment apparently were secondary concerns to both occupations at this site.

Six small scale test excavations were carried out by the Deschutes National Forest from 1983 to 1985 to facilitate project developments. Of importance to this research, Ryan Ranch, a site located along the Upper Deschutes River not far from Lava Island Rockshelter (Scott 1985), was characterized as a tool refurbishment site where the latter stages of biface tool manufacture took place. Obsidian debitage and an occasional chipped stone tool made up the site assemblage, which is typical of sites in this region. A survey indicated that this site was part of a larger site complex (McFarland and Stellmacher 1988, Scott 1985). In fact, this site and the adjacent Slough Camp site, appear to have been occupied for a considerable period of time, perhaps due to their favorable location nearby large sloughs, meadows, and the Deschutes River.

Flenniken's (1987) lithic technological analysis of the East Lake prehistoric site, located within the caldera of Newberry Crater, provided a model for the Late Archaic biface tool reduction sequence practiced by the prehistoric Indians in the Deschutes River area. East Lake is located close to major obsidian raw material resources. This site is a quarry procurement area where large biface flake blanks/cores were shaped from the existing obsidian boulders. Flenniken and Ozbun's (1988) second survey and preliminary testing of a few sites complemented these lithic reduction studies by providing a much needed understanding of the prehistoric quarrying process.

From 1984 to 1986, another unique archaeological site type in this obsidian rich area was investigated--prehistoric tool caches. Within the Upper Deschutes River Valley, cache sites consist of numerous (some reports indicate maybe even thousands) obsidian bifaces, flake blanks, and preforms which were stored together in a discrete location for future use (Scott et. al. 1986, Davis and Scott 1984, Stuemke 1987). The Pahoehoe, China Hat, and Sugar Caste caches all were located away from the river corridor, in the mountain foothills, lodegpole pine forest, and ajacent to a lava flow, respectively. These finds seem to be of relatively recent origin (dating to the last 3,000 years). The bifaces in these caches show extreme size and shape variability present within a single tool assemblage. Analysis of the Pahoehoe cache suggested these artifacts functioned as trade items, grave goods, or were placed in areas to be used on a seasonal basis as they were needed (Scott et. al. 1986).

Following the Fall River excavations in 1986 (described in this report), similar test excavations were conducted at eight prehistoric sites located adjacent to the Deschutes River in the Pringle Falls vicinity during the summer of 1987 (McFarland 1988b). These sites are located less than three miles southeast of the Fall River sites. The results from the investigations of the Pringle Falls sites offer additional data concerning the Late Prehistoric chipped stone tool assemblages and settlement patterns (McFarland 1988a). Four of the eight sites yielded enough cultural material to allow for comparisons between these two research areas which are discussed more thoroughly in later chapters.

Finally, extensive excavations were conducted under the direction of the author in 1987 at two sites located at the headwaters of the Deschutes River. One site is located on the southern shore of Big Lava Lake within the existing Forest Camp recreation site. The Forest Camp site was intially test excavated in 1985 to facilitate the construction of a campground loop (Davis and Lindh 1985). Subsequent testing in May of 1985 (Hamilton 1987), was done on a terrace located directly adjacent to Big Lava Lake. This preliminary testing yielded extensive cultural deposits to depths of over one meter. Further extensive testing of the site was undertaken prior to construction of a fish cleaning house. A total of 22 1 x 1 meter test units were excavated within the boundaries of the construction site. The Little Lava Lake site was also tested at the same time. Proposed development of the dispersed camping areas was the primary reason for the subsurface testing (McFarland 1989).

Data derived from the two large, deeply stratified sites at Lava Lakes has provided a large assemblage of chipped stone tools that are used for a comparative local projectile point chronology (McFarland and Hamilton 1987). Both the Pringle Falls project and the Lava Lakes project located at the headwaters of the Deschutes River yielded a rich source of obsidian materials that were submitted for source determination and hydration analysis. The results from this analysis are not yet available, but the data will be used for future research.

Chapter 4

Cultural Uses

Ethnographic Occupation

The Upper Deschutes River Basin in central Oregon is located on the fringe of both the Columbia Plateau and the Great Basin culture areas and was inhabited by several different aboriginal groups in historic times (after 1800 AD). Ethnographic information about these various Indian groups was primarily gathered during this century long after disease had depleted their populations and the remaining bands were forced to settle on reservations. Because this information is only known on a very general basis, this chapter is more geographically encompassing than the preceeding discussion. Thus, as Davis notes (1985:1):

> The evolution of American Indian culture in central Oregon in known largely through archaeological studies. Books about Indian life written by Anthropologists at the turn of the century, and historical accounts written by EuroAmerican explorers, fur trappers, and settlers, all are of tremendous value for their descriptions of Indian culture.

Other ethnographic information was collected at the turn of the century and based on oral tradition gathered from a small number of Indian informants. Since these data reflect American Indian society during a time of severe cultural crisis, annihilation and change, they must be "measured against the accuracy of human memories" (Davis 1985:1). Consequently, this record is filled with conflicting accounts and may not entirely reflect prehistoric Indian society before it was dramatically effected by the Euroamerican settlement of the American West. However, as Scott (1985:11) notes, "ethnographic analogy does provide a "living" insight into the lifeways of the prehistoric people who once inhabited central Oregon that cannot be gained from the archaeological record alone."

Among the historically-known Indian cultures who once inhabited or used the study region, the most notable are the Tenino, Molala, and the Northern Paiute. These culturally and linguistically separate bands were reported through numerous sources to have occupied various locations within the Upper Deschutes River Basin in protohistoric and historic times. Each of these groups practiced a hunting and gathering economy. This lifestyle dictated that they remain mobile and to establish only semi-permanent camps to gather or collect needed food resources or to survive the long winter months. Each group emphasized different food groups as their major subsistence. The historic and anthropological accounts of these groups is confusing due to the increased tribal movements beginning around 1750 (Berreman 1937:7). Inter-group territory boundaries remain hazy and very general. Evidence suggests that several Indian groups utilized the resources in the Fall River drainage. Each of these Indian groups is briefly summarized below.

Tenino

The Tenino or Wayampum Indians occupied semi-sedentary villages along the Columbia River between The Dalles and the John Day River, and along the lower Deschutes River in north-central Oregon. These Sahaptin-speaking Indians subsisted primarily on fish, augmented substantially by root gathering, berry picking, hunting, and occasionally trading for products not available in this region (Murdock 1965:165). The Tenino are known to have traveled well up the Upper Deschutes River drainage in hunting parties (Murdock 1980). Various groups of Sahaptin-speaking Indians were friendly among themselves, as well as maintaining friendly relations with the Wasco and Klamath (Garth 1964:43, Spier 1930:24).

The Upper Deschutes River corridor was an important fisheries area to certain Wayampam families and groups. The Pringle Falls vicinity is included in the ceded lands, named in the Treaty With The Confederated Tribes and Bands of Middle Oregon (June 25, 1855). These ceded lands were the minimum resource land base the Wayampum bands considered as essential to maintain their traditional way of life. But it is important to note that even though the Wayampum used this vicinity, they did not do so exclusively (Daniel M. Mattson, personal communication 1989).

Recent documentation of oral histories of tribal elders at the Warm Springs Indian Reservation confirms the traditional utilization of the fisheries within the Pringle Falls vicinity by Wayampam families and bands. This area historically contained prime populations of Bull trout, an inland variety of Dolly Varden trout (Lem Mathison, personal communication 1989). In terms of fishing practices, the Wayampum utilized a variety of fishing technologies, including dams, traps, weirs, spears, and hooks, depending on the nature of the fishing site and the type of species (Suphan 1974:10).

The traditional fishery at Pringle Falls was still being used by EuroAmerican settlers at the turn of this century, as is documented in the following newspaper article of that time (Bend Bulletin, August 7, 1903):

> At Pringle falls, 30 miles south of Bend, is a natural fish trap. In July and August each year the lake trout are in such a hurry to get up to their spawning grounds-Davis and Odell lakes-that they get into the trap at the falls, <u>which many years ago the hand of man converted into an artificial one</u>, in the night time, and next morning they are dispatched with spears or clubs.
>
> These lake trout, or Dolly Varden, are very heavy, weighing from 5 to 20 pounds and vary in length from 24 to 37 inches They are found in the Deschutes from source to mouth, but the greatest numbers appear to be in the lakes and their vicinity... At this time the trap is surrounded by campers who make the most of their time by salting down barrel after barrel of the fish, the flesh of which is highly esteemed as that of the steelhead salmon. As the salmon does not come past the falls 30 miles north of us, this fish is a very good substitute... [emphasis added by the current author]

<u>Molala</u>

The Molala lived in the uplands area of the Cascades and focused much of their berry-picking, game hunting, and other activities along the mountains. When compared to the Tenino or Northern Paiute, little is known about the Molala. The Molala were a sparsely distributed aboriginal group who practiced a simple hunting and gathering lifeway. According to Murdock, the Molala occupied the Mount Hood-Deschutes area until 1820 (Murdock cited in Ray 1938:398). Berreman concludes (1937:45): "prior to 1750 the Molala occupied the greater part of the Deschutes River region and the eastern mountain slopes", an interpretation that is also supported by Spier (1927:360). According to MacKey (1972:63):

> There is agreement that originally their hunting area included part of the present Warm Springs Reservation, the middle Deschutes, and a mountainous area between Mt. Hood and Mt. Scott. However, some time around 1810-1820 they were driven out of this territory by the more numerous Tenino.

However, there is a wealth of conflicting documentation concerning Indian population movements in the nineteenth century and the exact placement of the Molala is confusing. Since this ethnohistorical and linguistic issue is well beyond the scope of this thesis, the reader is referred to Suphan's (1974) useful overview of the conflicting testimonies.

Ethnographic information about the Molala is mostly confined to linguistic data (i.e., Minor et. al. 1987). The limited ethnographic literature available indicates that the Molala can primarily be characterized as a hunting and gathering people who made use of the various berry and root resources, and small and large game animals, in the intermountain valleys and forested highlands of the eastern and western Cascades. This aboriginal society is now considered to be culturally extinct.

Northern Paiute

This well-known Great Basin Indian culture is characterized by a generalized adaptation to the harsh environment of the High Lava Plains and Great Basin. Because of relatively limited resources, Paiute were a wide ranging desert focused people who practiced a semi-nomadic lifestyle. Because of their flexible political organization and resource base, the extended family was the largest social unit. Intermarriage with surrounding families provided for a loose network of interrelationships throughout the region (Steward 1938).

It is generally believed that the Northern Paiute migrated northward into southeastern and central Oregon as part of the larger Numic expansion approximately 1000 years ago. This widespread migration of Numic-speaking people supposedly originated from somewhere in the southeastern Great Basin, an area now encompassed by Nevada and southern California. In addition to the close linguistic similarities of these various Numic (or Uto-Aztecan) speaking groups, researchers conclude that the Numic people can be traced archaeologically, based on the assumption that "Numic components can be roughly distinguished from Prenumic components by the presence in the former of small triangular (Desert Side-Notched and Cottonwood) projectile points" (Bettinger and Baumhoff 1982:490).

The organization of the Northern Paiute into small family bands gave them the flexibility to optimize their foraging of the widely scattered resources in the harsh Great Basin environment. Northern Paiute houses consisted of simply constructed shelters built on the surface of the ground. Plants gathered included a wide variety of seeds, roots, and pine nuts during the warmer months of the year. These foods were then processed as storable foods and were relied on to a very great extent throughout the year (Kelly 1932). Some hunting of deer, antelope, small rodents, rabbits, as well as, limited fishing also occured. In the winter, these bands settled in small villages nearby a reliable source of water (Stewart 1939).

The exact territories of Northern Paiute bands in central Oregon is important to this thesis research but, as with the Molala and Tenino, this information is contradictory or unclear. According to Steward (1938:270-271):

> Ogden, 1826-28, first described eastern Oregon. Their observations indicate that Shoshonean-speaking peoples covered most of Oregon and even reached the mouth of the Deschutes River, where they raided other tribes.

In fact, one band-the Hunipui (Juniper Deer Eaters) were known to have occupied the Deschutes River drainage in the Bend-Gateway-Prinville area and apparently ranged as far west as Mt. Jefferson (Blyth 1938:403). Steward and Wheeler-Voegelin (1974:185) both place the Oregon Paiute boundary on the east side of the Deschutes River.

Because various Shoshonean bands subsisted on different dietary staples according to the area they exploited, they are given place "names" according to their main source of food in a distinct geographic area. Thus, the name Juniper Deer Eaters fits well for the band which once inhabited the Deschutes River basin. However, delineation of these group names are a creation of anthropologists. Thus, membership and composition of these bands were as fluid and flexible as the Northern Paiute were wide-ranging, and the placement and territory of these name bands must be treated with some caution.

The language similarities of the entire Numic population has led to much confusion in separating the Northern Paiute from the horse-mounted Shoshoneans of eastern Idaho. Northern Paiute bands throughout the arid American west were commonly referred to as "Snakes", to denote Shoshone-speaking Indians, by early explorers such as Lewis and Clark and Peter Skene Odgen, and later by anthropologists. Thus, "both the earliest historic accounts and the testimony of Indian informants depicts all the Shoshone-speaking Indians of southeastern Oregon as Northern Paiute, without horses or arms until after 1850" (Stewart 1939:144). This too then, is a source of confusion scholars face when trying to locate the original homelands of Northern Paiute peoples.

Some of the early evidence has led anthropologists (e.g., Berreman 1937, Spier 1930:4) to suggest that pressure from "Snake" raids forced Molala and Tenino tribes north and west into the southern Columbia Plateau and western Cascades and Willamette Valley. However, Blyth

(1938:405) notes that there is "no evidence which indicates the expansion of the Paiute bands at the expense of Sahaptin groups in the first half of the nineteenth century, except for occasional raids."

In sum, as will be discussed later, there is still no strong candidate for the historic American Indian habitation of the upper Deschutes River basin during the protohistoric and historic periods. The Northern Paiutes remain the most probable group based on more plentiful ethnographic and historical data but some archaeological sites in the river valley may just as well have been used or inhabited by the Tenino living and traveling in a north/south axis along the Deschutes River. The lack of practically any good information make the Molala very enigmatic in terms of their original aboriginal territory and conjectured migrations, if they happened at all.

Historical Uses

EuroAmerican exploration of central Oregon began with the Hudson's Bay Company and the fur trade. Peter Skene Odgen traveled through the area on a trapping and exploring mission, and led a group of trappers into the Deschutes River country during 1825-26. While the Ogden expeditions were never financially successful, many trappers and explorers were to follow.

Nathaniel J. Wyeth continued the exploration of the Deschutes River, passing through Dillion, Benham, and Pringle Falls, during 1834-35. Subsequently, in the year 1843, John C. Fremont was sent by the United

States Army topographic engineers to explore areas of Oregon, including the Shelvin Park area nearby Bend. Fremont, with the help of Kit Carson and Billy Chinook, made his way through Klamath Marsh, and later east to Summer Lake and Lake Abert.

These early EuroAmericans preceeded later stockmen and homesteaders. Unlike the fertile Willamette Valley that experienced the earliest wave of pioneer settlers, central Oregons homesteading era did not begin until the late nineteenth century. Uncharted, largely waterless central Oregon was not generally chosen by the earlier pioneers as a main travel route on their way to the Willamette Valley during the first waves of emmigration.

By the late 1870s, the booming livestock markets, made it profitable to ship by rail or trail cattle from adjacent regions (the Willamette Valley and the gold-fields of northeastern Oregon) to take seasonal advantage of the Deschutes Valley's rich grasses and meadows. This lead to the establishment of early pioneer ranches. In fact, the gold rush in northeast Oregon provided impetus to supply the hungry miners with meat products and a steady market for beef developed (Vaughan 1981:19). Although this era was relatively short-lived, it marked the first permanent Euroamerican settlement of the Upper Deschutes River Valley.

In 1916, the region experienced its first major industrial development with the establishment of the Shevlin-Hixon and Brooks-Scanlon logging and mill operations in Bend. The establishment of these two large sawmills concurrently with the railroad operations, made investment in the area a successful venture for various entrepreneurs (Deschutes County Historical Society 1985:40). Shevlin-Hixon had the initial control of the Fall River area. Central Oregon grew rapidly in population and development as the logging industry prospered. As stated by Brogan (1965:254):

> "Bend was no longer an agriculture town at the edge of the pines; it was now a mill town and growing rapidly. Its growth became phenomenal in the history of Oregon. The coming of the lumbering industry resulted in an increase of 910 per cent in population from 1910 to 1920."

Fall River History

The Fall River fish hatchery was located in its present location and became operational by 1924 (Mathisen 1980). No references were found to indicate any similar installation at the head of the river. Irrigation farther downstream occured in 1910 when the Fall River Irrigation Company began construction of water lines to irrigate 3000 acres of nearby settlers' land (Bend Bulletin 1910).

The original Fall River Guard Station served as an adminstrative and public service site. Today, another guard station, which was built in the 1930s, now occupies a location next to the headwaters, and primarily serves as housing for seasonal fire crews. Recreational sites were developed in conjunction with the new station at Fall River, and this early historic use of the immediate headwaters has, no doubt, contributed to much surface collecting of prehistoric artifacts.

Current Uses

The upper Deschutes River basin continues to grow as a popular recreational area on the Deschutes National Forest. This area supports numerous recreational activities. The greatest impact on archaeological sites located adjacent to the river occurs from early spring to late fall. Activities are recreationally oriented in and around the river corridor.

Other Forest Service-related activities occur annually along the upper Deschutes River basin. A variety of timber salvage and sanitation projects are undertaken to combat damage inflicted by the mountain pine beetle and to improve the cycle of productivity of the forest. Woodcutters annually salvage beetle-killed lodgepole pine for their winter wood supply. A variety of special use permits are issued which range from seasonal recreational activities to commercial livestock grazing.

All of these recreational and Forest Service-related activities have had an adverse impact on the archaeological sites in the Upper Deschutes River Basin, especially those located along the river corridor or significant lava flows. As the popularity of this region increases, the destruction of cultural sites will also continue. Today these archaeological sites, located along the river corridor, are currently being compacted, eroded, disturbed and destroyed by dispersed and undeveloped camping, timber harvest, road building and collecting.

Illicit excavation and surface artifact collecting of archaeological sites has been (and continues to be) the greatest contributor to site destruction in central Oregon (Davis et. al. 1988). These activities are not likely to stop until public awareness of cultural resource values and laws improves, additional law enforcement monitoring is implemented, and the black market trade is abated (Dennis Shrader and Tom Russell, personal communication 1988). The Upper Deschutes River Basin will increasingly be subjected to human activity which will further impact archaeological resources.

Chapter 5

Methodology

Project Background and Site Discovery

The presence of archaeological sites along the Upper Deschutes River and its tributaries has been known for some time. In fact, prehistoric sites have been avidly collected from for many decades by artifact collectors. Early pioneer families associated with the Shevlin-Hixon logging era (approximately 1916-1950) were known to have organized "arrowhead" hunting parties for Sunday outings (Carl Davis personal communication, 1986). However, it wasn't until the late 1970's before a small number of these sites were professionally reported.

Prior to this thesis research, all cultural resource investigations within the Fall River drainage were project-oriented, and very site specific. The first recorded cultural resource survey of the Fall River drainage was conducted in 1980 by Central Oregon Community College (Swanson 1980). Survey results indicated the presence of four historic sites and one prehistoric site located at the headwaters of Fall River.

A compliance-level cultural resource survey in the area was completed by the Forest Service in 1985. Survey results indicated the presence of four additional open-air lithic scatters along the Fall River drainage (McFarland and Lindh 1985). Following this cultural resource survey, all of these prehistoric sites were managed and protected through project "avoidance". However, due to the competing resource concerns and the fact that these large, consolidated sites occupy much of the upper Fall River drainage, the 1986 evaluation project was implemented by the Forest Service to determine the research value of these prehistoric sites on which management and protective measures could be based (McFarland 1986). The results from this project are partially presented in this thesis.

Field Methods

The archaeological site testing program was undertaken by Forest Service archaeologists, local community volunteers, and youths employed by the Central Oregon Intergovernmental Council. Carl Davis, Deschutes National Forest Archaeologist, was the Project Director. The author, Bend District Archaeologist, was the Field Supervisor. The testing of the seven prehistoric sites along the Fall River drainage was accomplished between July 1 and August 21, 1986.

All seven prehistoric sites consist of large, open-air lithic scatters. These sites, ranging in size from 11 to 126 acres, are evidenced by a light scatter of obsidian flaking debitage and an occasional chipped stone tool. Combined, all seven sites totaled to

241 acres. The sites are located adjacent to Fall River, on a variety of topographic features. These include gently sloping floodplains and a series of lower and higher terraces similar to those found along the Deschutes River.

Within each open-air lithic scatter, obsidian flakes were intermittently scattered over wide areas. It was often impossible to establish boundaries between sites. The extent of the surface deposits was not reflected by surface evidence because of the unconsolidated pumice soils which heavily conceal the surface lithic evidence. In short, it was difficult to assess what constituted a site and what did not. In an attempt to grapple with this problem, a comprehensive testing strategy was used in the 1986 Fall River Project.

Initially, the placement of the subsurface testing units within each of the seven sites was dictated by favorable topographic features, even if lacking surface cultural material. Thus, the area tested included not only flake concentrations, but also intervening space consisting of surrounding light, dispersed obsidian scatters. In short, along the Fall River drainage, these sites were evaluated by disregarding surface evidence as the primary indicator of prehistoric occupation and excavating large numbers of subsurface sampling units.

A series of 1 x 1 meter test units and 50 x 50 centimeter test probes were used as sampling units. A combined total of 240 1 x 1 meter test units and 50 x 50 centimeter test probes were excavated within the boundaries of the seven sites. The majority of the units and all of the probes were excavated to an arbitrary depth of 50 centimeters. Several of the 1 x 1 meter test units at each of the sites were excavated to a depth of over 70 centimeters to probe below the Mazama ash.

All test units and probes were excavated using shovels and trowels. Vertical control was kept in 10 centimeter arbitrary levels due to the lack of discernable stratigraphy in the unconsolidated Mazama tephra. Line levels were used to measure depth below surface. All recovered cultural material was provenienced by unit/level. Baulks were maintained at each corner of the 1 x 1 meter test units, while one baulk was used in each of the 50 x 50 centimeter test probes. All fill was screened through 1/8 inch wire mesh. It is likely that the majority of the lithic debitage and some tool fragments would have been lost if a larger mesh screen had been used.

In addition to the probes and units that were systematically placed parallel to the river bank at each of the sites, a number of probes were excavated perpendicular to the stream channel. This was done in order to sample the site area away from Fall River and to penetrate deeper into the forest. Most units and probes were placed at five to ten meter intervals. However, some twenty meter intervals were also used, and represent the greatest distance between each of the test units.

The discovery of fire hearths, features, or organic remains is a rare occurrence at all lithic scatter sites found within the Upper Deschutes River Basin due perhaps to the high acidity and/or the unconsolidated nature of the volcanically derived soils. No archaeological features were found during the site testing.

All cultural materials were collected and processed in the laboratory. Artifacts were washed, cataloged, and placed in plastic bags for storage. Presently, all cultural material is retained by the Deschutes National Forest. Black and white photographs, color slides and color photographs were taken of all seven sites. All sites were mapped by Forest Service Engineers.

Thorough subsurface sampling recovered very little cultural material at five of the seven sites. We were consistently surprised at the relatively low densities of flakes, ranging from 10 to 57 flakes at each of the sites. These flakes were sporadically dispersed across the sites. Vertical placement of the flakes exhibited the same random pattern and inconsistency. No concentrations of lithic debitage were recovered from any particular unit. Nor were any formed tools recovered at any of these five sites excavated during the project. The results of the testing at these sites are reported elsewhere (McFarland 1986), and are not considered further in this thesis research.

Information obtained from the testing program indicated that minimal archaeological information was contained within the boundaries of the five sites, and research efforts were focused elsewhere. Test excavations were then focused at two sites near the headwaters of Fall River, which seemed to be the most likely area for intensive prehistoric occupation due to the presence of freshwater springs.

Description of Study Sites

The Dusty Mink (35-DS-502) and Grayling Springs (35-DS-381) sites are located approximately twenty miles southwest of Bend, Oregon on the Bend Ranger District, Deschutes National Forest. Legal descriptions for the sites are: Dusty Mink site SE 1/4, SE 1/4, NE 1/4, Section 10, Township 21 South, Range 9 East; Grayling Springs site SW 1/4, SW 1/4, NE 1/4, Section 10, Township 21 South, Range 9 East, Willamette Meridan (Figure 5). Both archaeological sites are situated at the headwaters of Fall River at an elevation near 4280 feet a.s.l. (Figure 6).

Dusty Mink Site (35-DS-502)

Dusty Mink is a small lithic scatter located on a low terrace adjacent to Fall River, at an elevation of 4260 feet a.s.l. Lodgepole pine, antelope bitterbrush, and Idaho fescue are the dominant vegetation, in addition to the riparian plant resources available at the waters edge.

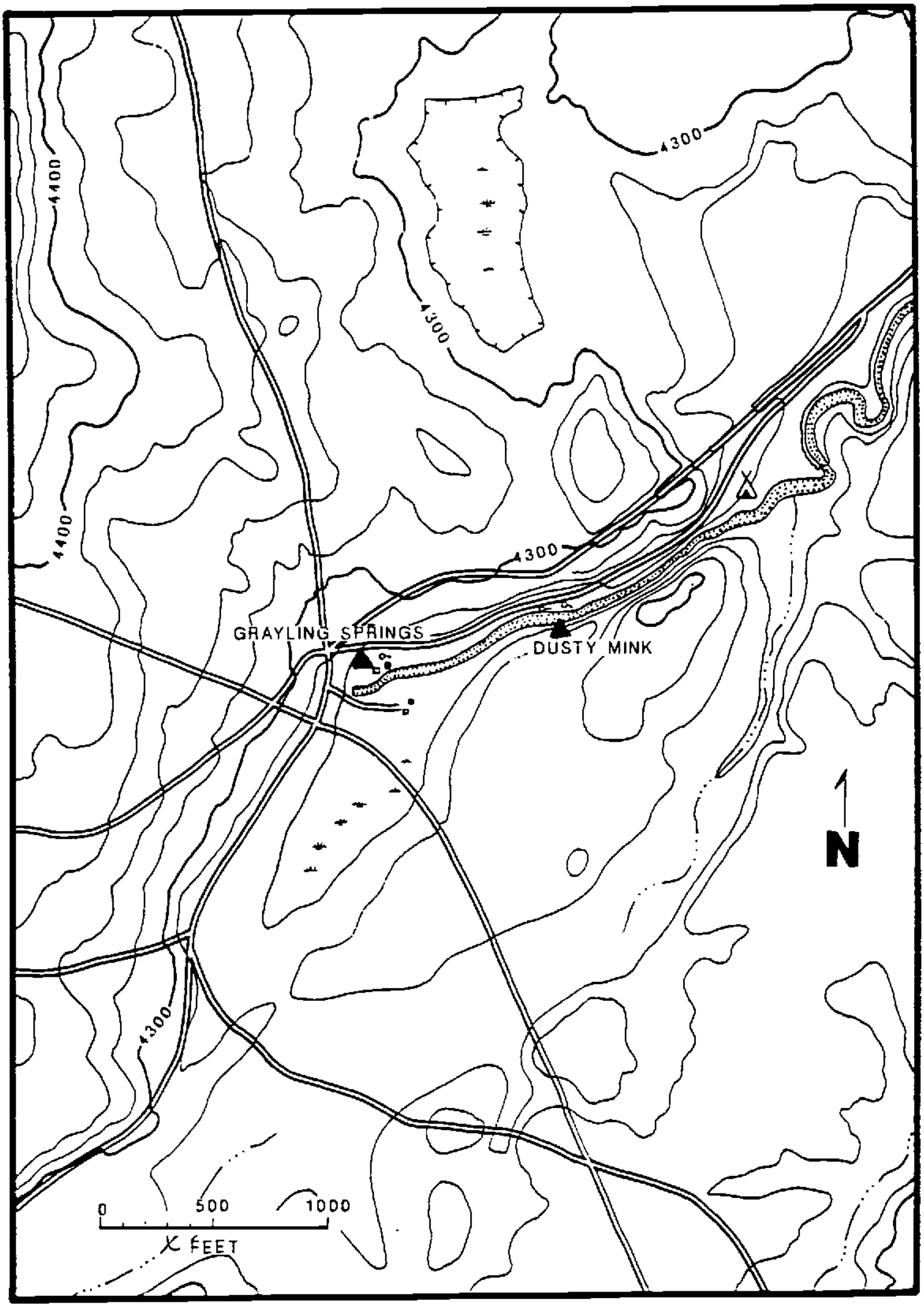


Figure 5. Archaeological sites defined on topographic map.

Figure 6. Headwaters of Fall River. View northwest.

A large test excavation block containing 39 1 x 1 meter units was excavated on the lower terrace (Figure 7, 8). Two of these 1 x 1 meter units were excavated to a depth of 50 centimeters below ground surface, while the remainder were excavated to a depth of 30 centimeters below ground surface. Approximately twenty meters to the west of the large excavation block, a single 1 x 1 meter test unit was excavated to a depth of 50 centimeters below ground surface. Little cultural material was recovered from this last unit.

Fourteen 1 x 1 meter units were excavated along the southern-lying higher terraces that bordered the Dusty Mink site and the adjacent Fall River channel. These units yielded little cultural material, and were all were abandoned after being excavated to a depth of 50 centimeters.

Grayling Springs Site (35-DS-381)

The Grayling Springs prehistoric site encompasses the headwaters of Fall River, where several reliable and abundant freshwater springs produce a reliable water source. The springs emit from a separate and local 10,000-15,000 old lava flow (Chitwood, personal communication, 1987). The site elevation is 4280 feet a.s.l.

The area immediately adjacent to, and north of, the headwaters of Fall River is located on a well-developed floodplain, characterized with wet-meadow grasses and lush riparian vegetation. Lodgepole pine is

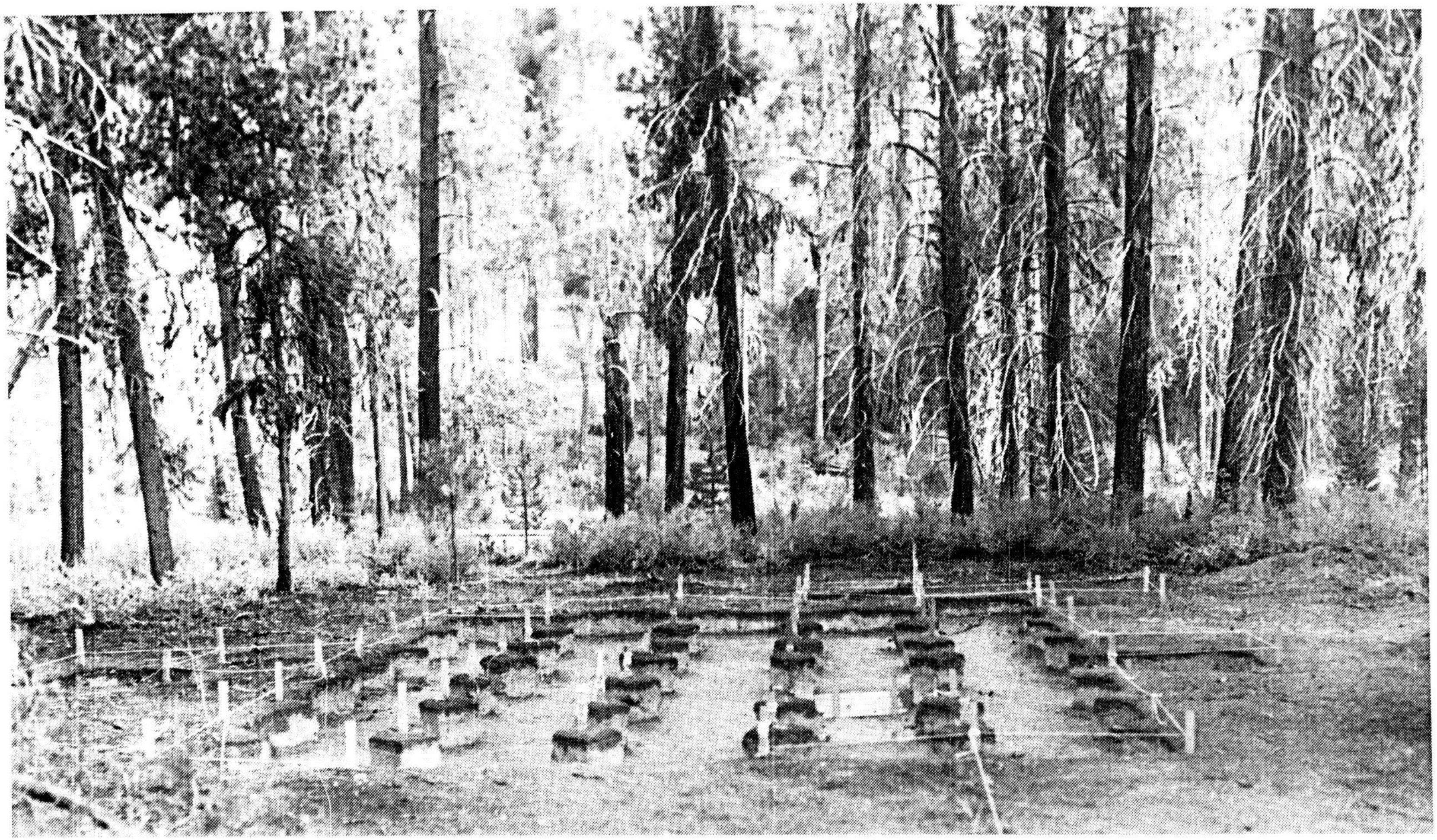


Figure 7. Dusty Mink excavation block. View north.

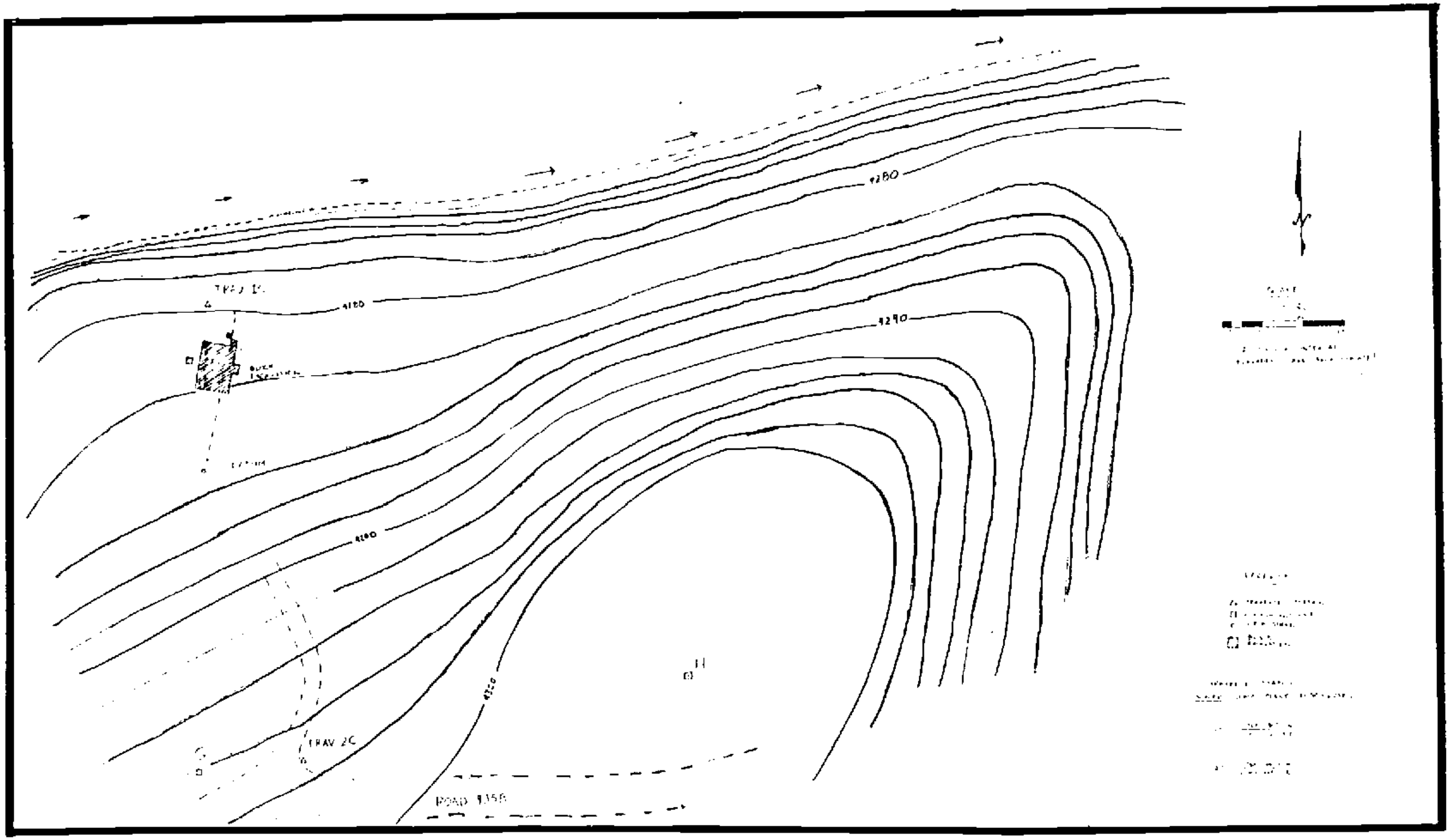


Figure 8. Dusty Mink site excavation map.

the dominant tree species. Numerous old-growth and regenerated stands of ponderosa pine exists on nearby slopes and higher river terraces. Antelope bitterbrush and Idaho fescue is the dominant understory species. An early Forest Service Guard Station and warehouse (circa 1920s-1930s) are located on the site indicating the location's continuing desirability for human habitation.

The site extends on the southern bank of Fall River to a marshy draw which divides Grayling Springs from the Dusty Mink site. These two sites lie less than 1/8 mile apart. To the southwest, lies are heavy lodgepole pine thickets. Numerous small springs are located downstream for nearly a mile along the northern bank of the river.

Fourteen 1 x 1 meter test units were excavated in the headwaters area, and adjacent toe slopes and floodplain. The depths of these units ranged from 30 centimeters to 120 centimeters at which point bedrock, or sterile glacial outwash deposits, were encountered.

Four of these units were excavated as a 2 x 2 meter block adjacent to the initial spring sources for Fall River (Figure 9). Lava bedrock was encountered at 60-70 centimeters below ground surface, which caused the excavations at this block to be terminated. Further away, three lines of 50 x 50 centimeter probes were excavated along the southern and northern banks of the river to define subsurface horizontal boundaries of the site. These 39 probes were excavated to a depth of 50 centimeters each. Little cultural material was recovered.

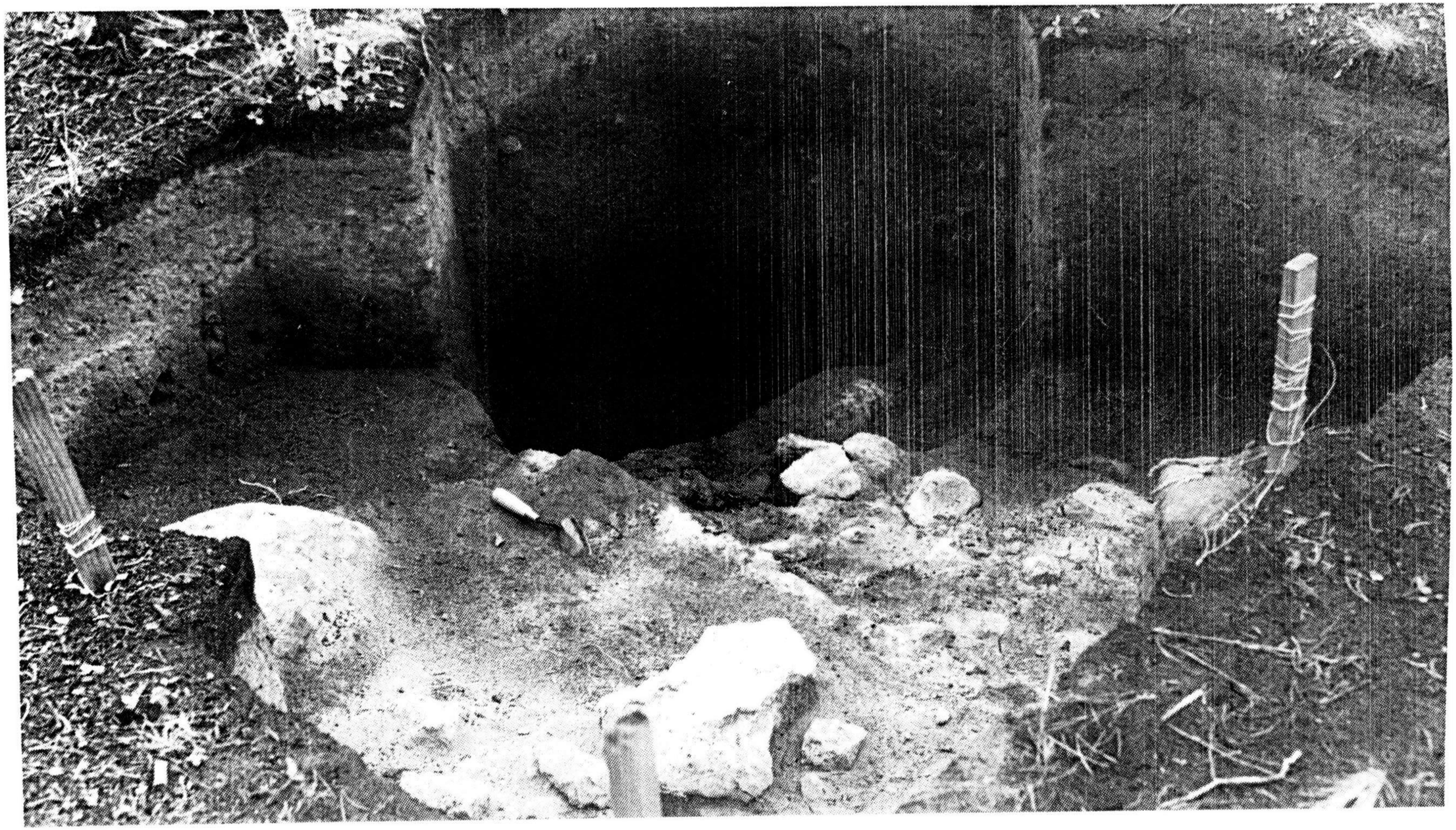


Figure 9. Grayling Springs site 2 x 2 meter excavation block. View southwest.

Despite the fact that relatively high densities of lithic debitage were recovered from randomly-spaced 1 x 1 meter units placed near the river channel and springs, it was felt that the main flaking station for Grayling Springs had not yet been discovered. This proved to be the case as evidenced by a unit later excavated in the antelope bitterbrush/Idaho fescue plant community, away from the grassy floodplain and persistant mosquitos. This 1 x 1 meter unit, excavated to a depth of 50 cm, yielded a prolific number of obsidian flakes.

An additional block of twenty-nine units were excavated adjacent to this test unit, to a depth of 30 centimeters below ground surface (Figure 10). Six 50 x 50 centimeter probes were placed north and east from this block excavation to more clearly define site boundaries (Figure 11). A decrease in cultural material found in these probes, as well as in the other 1 x 1 meter units excavated within the perimeter of the headwaters, indicates that the heaviest concentration of cultural material within Grayling Springs prehistoric site lay within this block excavation.

Analytic Methodology

Stratigraphy

Stratigraphic profiles were examined at the Graylings Springs and the Dusty Mink site by a Forest Service soil scientist (Brock 1986). This scientist selected samples at 10 centimeter intervals to maintain control of any discernable changes in the sediments from the surface

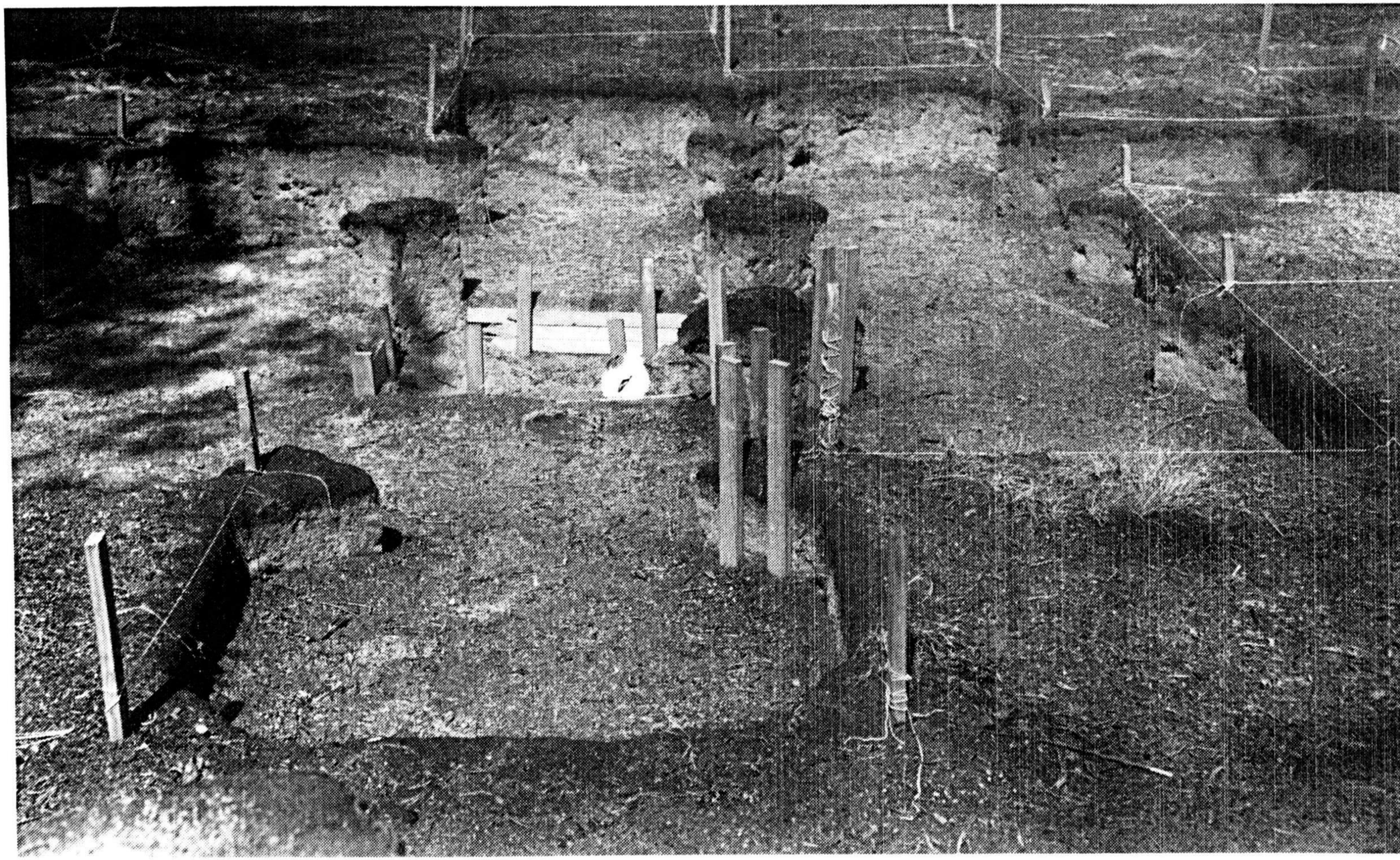


Figure 10. Grayling Springs site excavation block. View east.

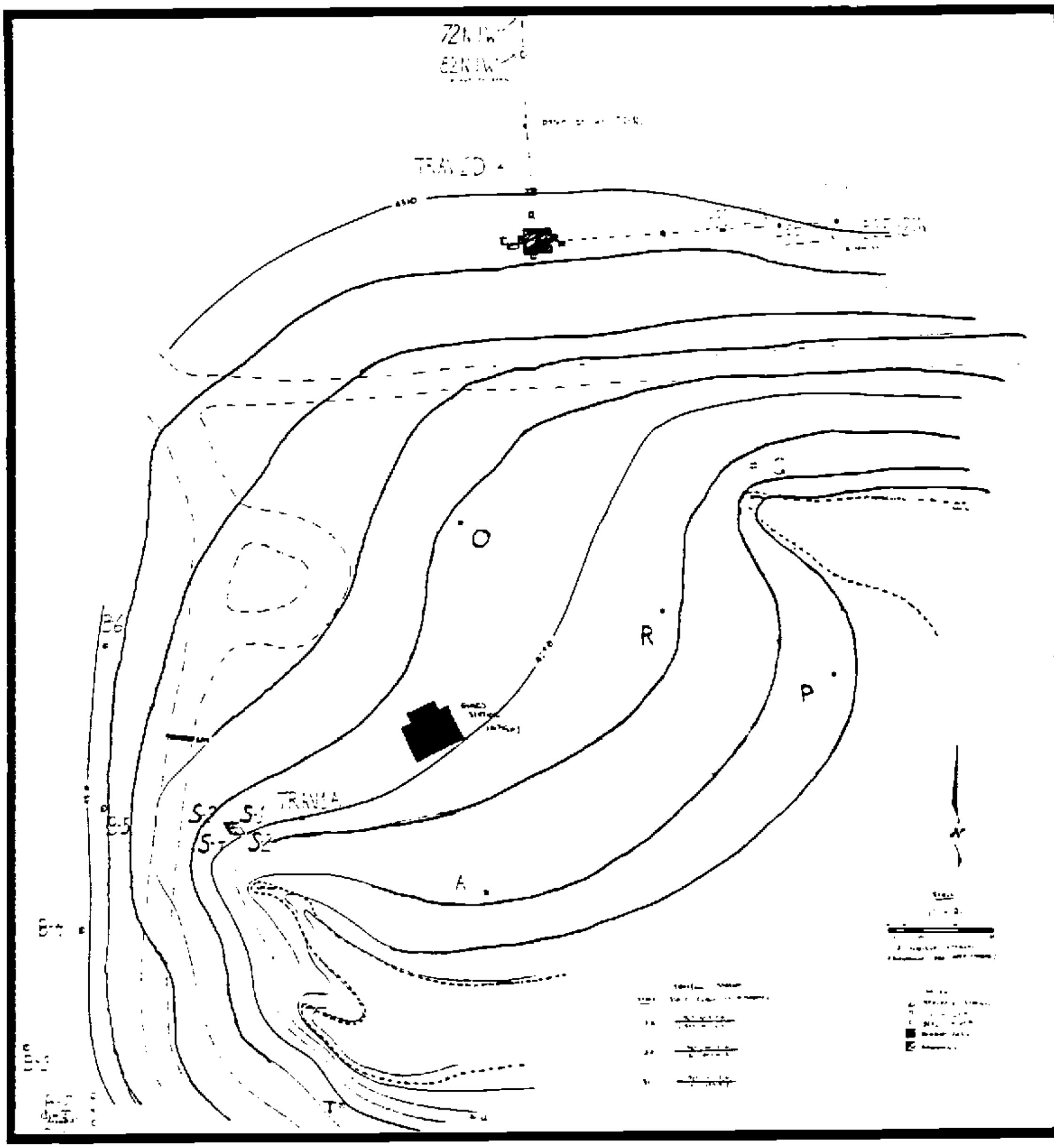


Figure 11. Grayling Springs site excavation map.

to the bottom of the excavation. This analysis was undertaken to determine the compositional and depositional changes found in the sites' stratigraphy. The results of these studies are discussed in the following section.

Lithic Reduction Studies

Prehistoric artifacts recovered from the Dusty Mink and Graylings Springs sites consist mainly of prehistoric chipped stone waste (debitage) and formally-shaped chipped tools.

Lithic studies have shown that it is possible to determine the stages of biface reduction, and subsequently their tool maufacturing sequence(s) that were being used at a particular site (Flenniken 1987, Flenniken and Ozbun 1988b, Raymond 1986, Womak 1977). Using lithic technological data it is possible to identify: 1) the type(s) and stage(s) of lithic technological industries that were used at the sites, 2) the types of stone tools that were being produced or refurbished on the two sites, and 3) whether or not "these technologies varied chronologically or whether they remained consistent through time." (Flenniken, 1987:10)

The lithic debitage and formed artifacts from the Dusty Mink and Grayling Springs sites were analyzed according to a technological reduction model developed by Dr. J. Jeffrey Flenniken and Terry Ozbun of Pullman, Washington, and further elucidated in Flenniken's (1987:11) East Lake research. The model was developed to analyze the lithic debitage by placing flakes into categories that corresponded to their stage in manufacture. Only technologically diagnostic flakes--those that retained most of their platforms and a majority of their midsections and/or distal ends--were included in the analysis. These diagostic flakes were categorized according to flake type through the use of a variety of indicator traits (i.e. absence of cortex, platform types, size and curvature, number and orientation of dorsal scars, presence/absence of original detachment scars). Flake fragments lacking attributes for positive identification were counted, but not included in the analysis.

Detailed analysis shows that these collections exhibit six stages of an obsidian biface reduction technology. Examples of each type can be found in Figure 12 and their definitions of stages are taken from Flenniken's initial East Lake report (1987):

Early stage bifacial thinning flakes: A percussion flake removed from a biface during primary reduction. These flakes have few dorsal surface scars, are slightly curved or twisted in long-section, have single-faceted or multifaceted platforms, and are usually the largest thinning flakes produced during the biface manufacture. These flakes are produced as a result of making large bifaces symmetrical.

Late stage bifacial thinning flakes: Flakes produced during the final stages of percussion flaking. These flakes have numerous scars on their dorsal surface, are almost flat in long section, usually exhibit feather termination, and have multi-faceted platforms.

Early stage pressure flakes: The first series of pressure flakes removed from a biface. These flakes have multiple scars on their

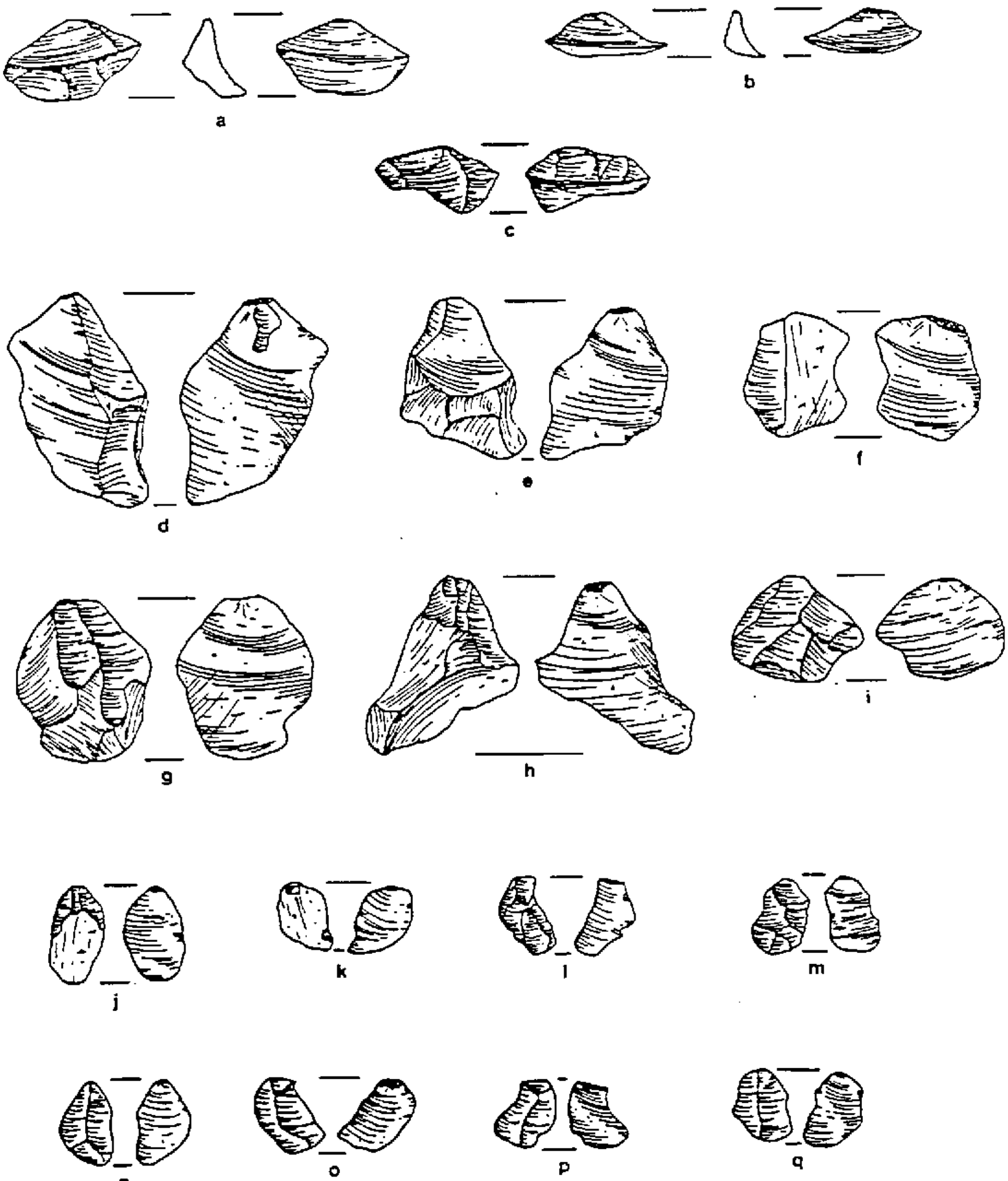


Figure 12. Examples of technological debitage categories for the Fall River sites (taken from Flenniken 1988:49). a, alternate flake; b-c, margin removal flakes; d-f, early biface reduction flakes; g-i, late bifacial thinning flakes; j-m, early pressure flakes; n-q, late pressure flakes. Reduced 25%.

dorsal surface, are twisted in long-section, are small, and their platforms form an oblique angle with the long-axis of the flake. These flakes are produced as a result of regularizing the biface by pressure.

Late stage pressure flakes: Flakes produced during the final pressure flaking episodes. They are small, parallel-sided, have one dorsal arris, are slightly twisted in long-section, and have multi-faceted, abraded platforms.

<u>Notch flake</u>: A pressure flake with its platform situated in a depression and fan-shaped in plan-view. Flakes produced as a result of manufacturing a notch in a biface.

<u>Alternate flake</u>: A flake that is much wider than it is long, triangular in cross-section, and produced as a result of creating a bifacial edge from a square edge on a given piece of stone.

<u>Margin removal flake</u>: Half-moon shaped fragments of a bifacial edge produced as mistakes when the knapper strikes the biface too hard and too far from the margin. The biface margin is thin and weak, but the biface does not bend or break.

<u>Shatter</u>: Cubical and irregularly shaped pieces of lithic material frequently lacking well-defined platforms (positive or negative). In the current analysis, this category also includes flakes that

are too small to positively identify either the ventral or dorsal plane surfaces.

These definitions encompass the flake categories that were used in the analysis of the Fall River sites; more complete glossaries can be found elsewhere (e.g., Flenniken 1987; Flenniken and Ozbun 1988a; 1988b).

X-Ray Fluorescence Spectrometry (XRF)

The technique of XRF is an increasingly important area of study in lithic scatter research (Davis and Scott 1986, Hughes 1986). Obsidian is a volcanically-derived glass that varies in composition due to the distinct nature of each magma chamber. The majority of these volcanic episodes are geographically and chemically distinct, thus each obsidian source often contains varying proportions of mineral elements (Hughes 1986). Thus, each known obsidian source can be chemically fingerprinted.

Thirty obsidian chipped stone tools and flakes were chemically characterized by x-ray fluorescence spectrometry (XRF) analysis to determine their original geological source(s). These thirty samples (fifteen from each site) included temporally diagnostic tools, tool fragments, and flaking debitage, and were randomly selected from each stratigraphic level to test the possibility that selected quarry areas may have changed over time. Identification of the source areas may reveal the potential trade and/or travel routes of the prehistoric peoples who inhabited the Fall River drainage.

Obsidian Hydration

The same thirty chipped stone tools and flakes subjected to XRF analysis were "cut" for hydration rind measurements. Hydration analysis was conducted to estimate the relative age(s) of the Dusty Mink and Grayling Springs site assemblages by measuring obsidian hydration rinds since manufacture on a sample of the artifacts. Thomas Origer performed this analysis and his methodology is discussed in Appendix A.

The obsidian hydration method involves measuring the size of the hydration rind on a specimen of obsidian. This rind develops on the freshly exposed obsidian surface and grows over time as the environmental exposure of the obsidian surface draws water from its interior. The rate of hydration is a function of effective ground temperature, chemical composition, and time (Friedman and Long 1976). Hydration data must be used in a relative rather than an absolute sense, because fluctuating temperatures and differing chemical compositions of obsidians affect hydration readings. There is no existing hydration curve for central Oregon. Currently, source-specific and site-specific hydration rates do not exist for most of the obsidians in the region, let alone individual sites, such as Grayling Springs and Dusty Mink, where obsidian artifacts are found.

Given the lack of organic remains at the sites, a comparison of the hydration dating results against the typological cross-dating of the projectile points does provide some idea of site age. It may also give some indication of the validity of developing a hydration chronology for central Oregon, which has been done for some sites located in the western Cascades (Lindburg-Muir 1988). These analyses also help to assess the amount of stratigraphic mixture in each site.

Chapter 6

Research Results

Stratigraphy

As with all sites in the Upper Deschutes River Basin, air-deposited tehpra is the primary stratigraphic component of the Dusty Mink and Grayling Springs sites (Figure 13,14). This volcanic tephra was deposited by the Mt. Mazama eruption of 6800 years BP (Bacon 1983). Only two other local pumice eruptions from the Devil's Hill and Rock Mesa sources are distinctly represented in sites at Lava Lakes, which is the headwaters of the Deschutes River (Brock and Chitwood personal communications, 1987). The Mazama tephra has been heavily reworked by biological and mechanical processes: such processes as 1) windthrown tree uprooting (especially widespread for the shallowly rooted lodgepole pine in the area), 2) frost heaving, and the accompanying wind and water movement, and 3) rodent activity. These factors have mixed the tephra to approximately 70 centimeters below surface, to the underlying glacial outwash deposits.

Beneath the Mazama is a buried palesol, a rich dark-brown soil containing waterworked sands and small pebbles which, in the depositional terrace setting, resemble alluvium (Brock 1986). Pieces

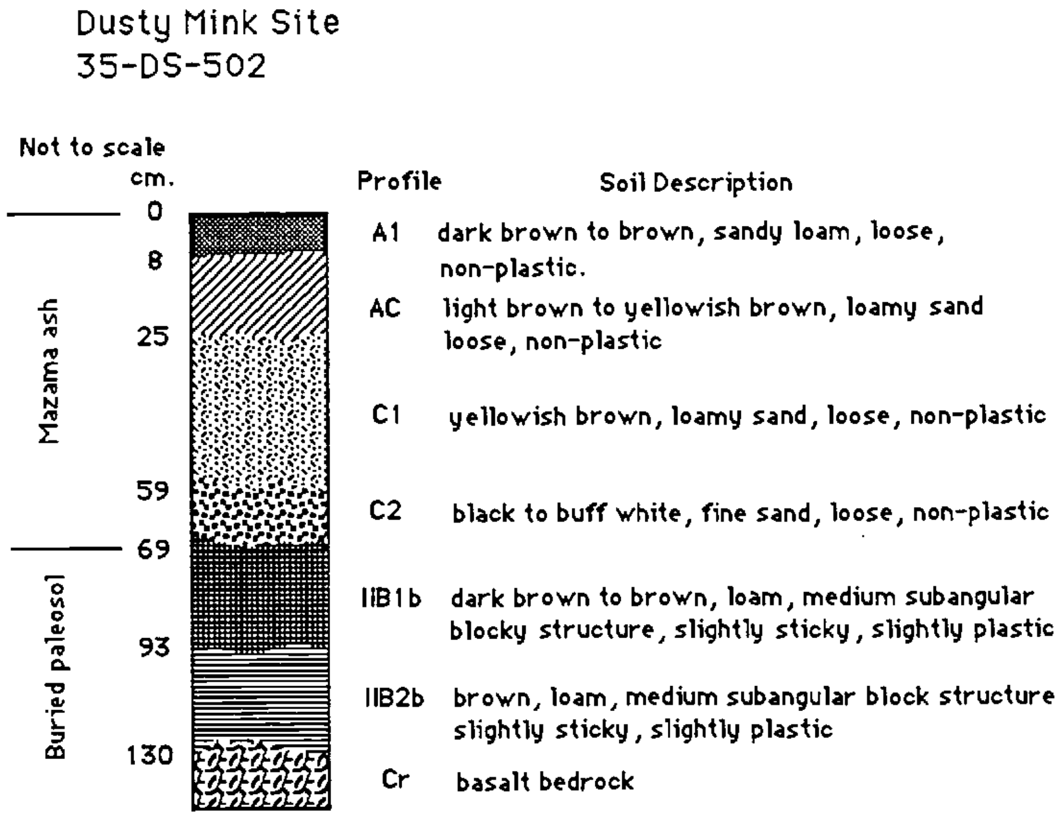


Figure 13. Dusty Mink site stratigraphic profile.

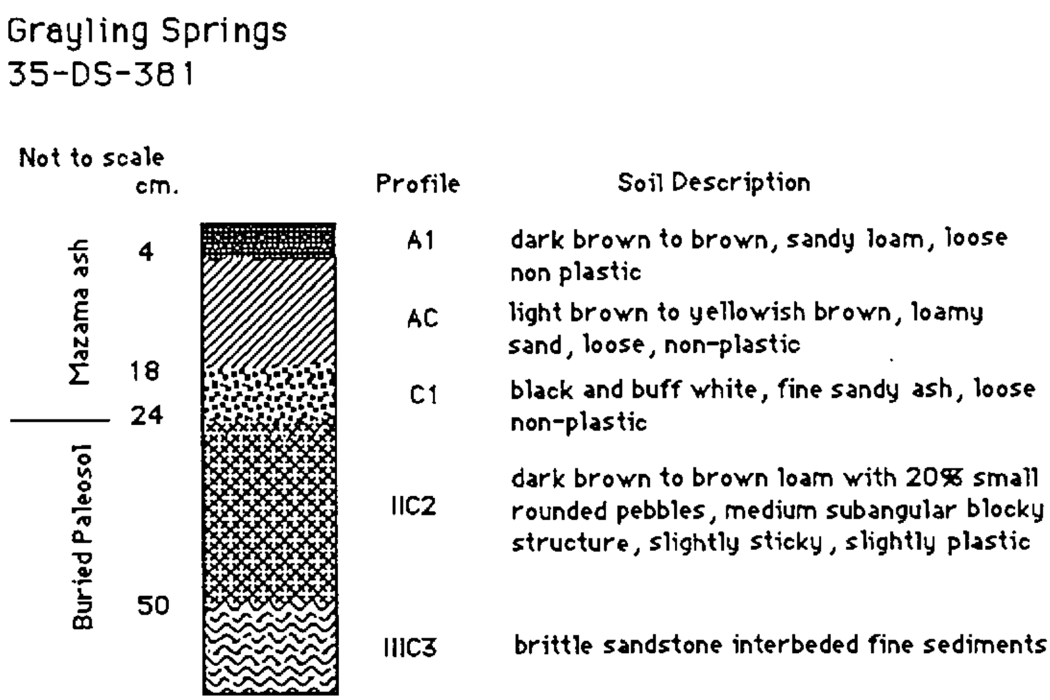


Figure 14. Grayling Springs stratigraphic profile.

of tephra, combined with occasional pockets of pumice, appear both above and below the blurred Mazama interface in all test pits dug below 70 centimeters. Other factors that have disturbed cultural material and changed the character of the soil to a depth of nearly 20 cm include historic and modern logging, construction and maintenance of the Forest Service Guard Station, and recreational use.

Brock (1986:2) describes both sites' stratigraphy as follows:

> The Mazama ash has been weathered and mixed with organic matter in the surface 8 cm with fine tree roots extending to 25 cm. Below this level, the soils become loose due to lack of structure and roots and show less weathering with increased depth. At the 59 cm level, the "salt and pepper" deposit from the original vent clearing eruption of Mt. Mazama remains but is discontinuous due to deep mixing from root disturbances.
>
> Soils that form on the lowlying positions have similar surfaces but the buried palesol is markedly different. The following profile characterizes the soil profile common to the first terrace above the channel of Fall River.
>
> What is apparent with this profile is the influence that water has played on the changes within the profile. The surface 4 cm contain small water worked pebbles that may be slope wash from the upper adjacent positions. The layer from 4 to 18 cm is ash that has been thoroughly reworked by roots, frosts, and rodents. Between the 18 and 24 cm layer is the "salt and pepper" strata that was discussed in the earlier profile. The buried palesol contains waterworked sands and small pebbles ....

The bulk of the cultural material from the Dusty Mink site lies within the top 30 centimeters, while the majority of the Garyling Springs site assemblage lies within the top 40 centimeters of the strata.

Chipped Stone Assemblage Analyses

A total of 18,960 pieces of lithic debitage and 59 formed artifacts, were recovered from the Dusty Mink and Grayling Springs sites. Ninety-eight percent of this material was composed of obsidian, which is not surprising given the abundance of obsidian sources in the local area (Skinner 1983). The remaining small amount of cultural materials were composed of crypto-crystalline silica (varieties of commonly known jasper and chalcedony) and andesitic basalts.

The lithic analysis of the Dusty Mink assemblage involved the examination of the total recovered debitage (443 flakes), and eighteen of the formally shaped chipped stone tools which was recovered from the 1986 excavations (see Appendix C).

Lithic analysis of the Grayling Springs site assemblage involved the examination of 6594 flakes (36 % of the total 18,467), or 11 1 x 1 meter units (a 27 percent sample of the total 41 1 x 1 meter units excavated), and all of the 59 flaked stone tools that were recovered from the 1986 excavations. One of the projectiles was surface-collected from the 1985 field survey (see Appendix C).

Dusty Mink Prehistoric Site (35DS502)

Projectile Points

A total of nine whole or fragmentary projectile points were recovered from Dusty Mink (Figure 15a-g, 16c, 17a, Table 1). All of these specimens were recovered from the excavation block. Many of these projectiles are fragmentary and are believed to represent various stages of reworking or "rejuvenation".

All projectile points (except one) are small, thin corner-notched specimens, which were probably fashioned as arrowpoints. The exception consists of a large, stemmed obsidian point (Figure 17a) that may represent a dispatching spear or may be an example of prehistoric "scavenging" of dart points from the nearby Grayling Springs prehistoric site (this site appears to contain an earlier Archaic component, as will be discussed below). One of the arrowpoints is composed of basalt, the remainder are obsidian. Examination of the four arrowpoint preforms indicates that the entire arrowpoint manufacturing system used by the Late Prehistoric peoples is represented at this site. Neck widths of the eight smaller specimens range from .4 to .5 mm, with a mean of .5 mm, which indicates they fall into the range for arrowpoints (Corliss 1972).

Projectile Point Preforms

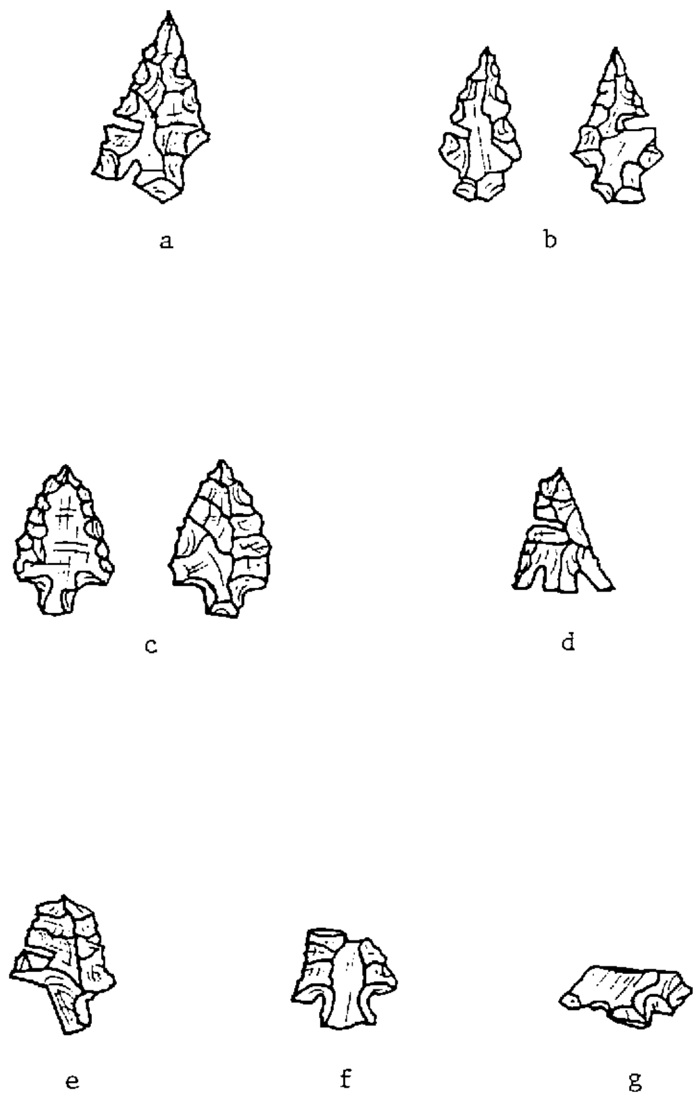


Figure 15. Projectile points from the Dusty Mink site. Actual size.

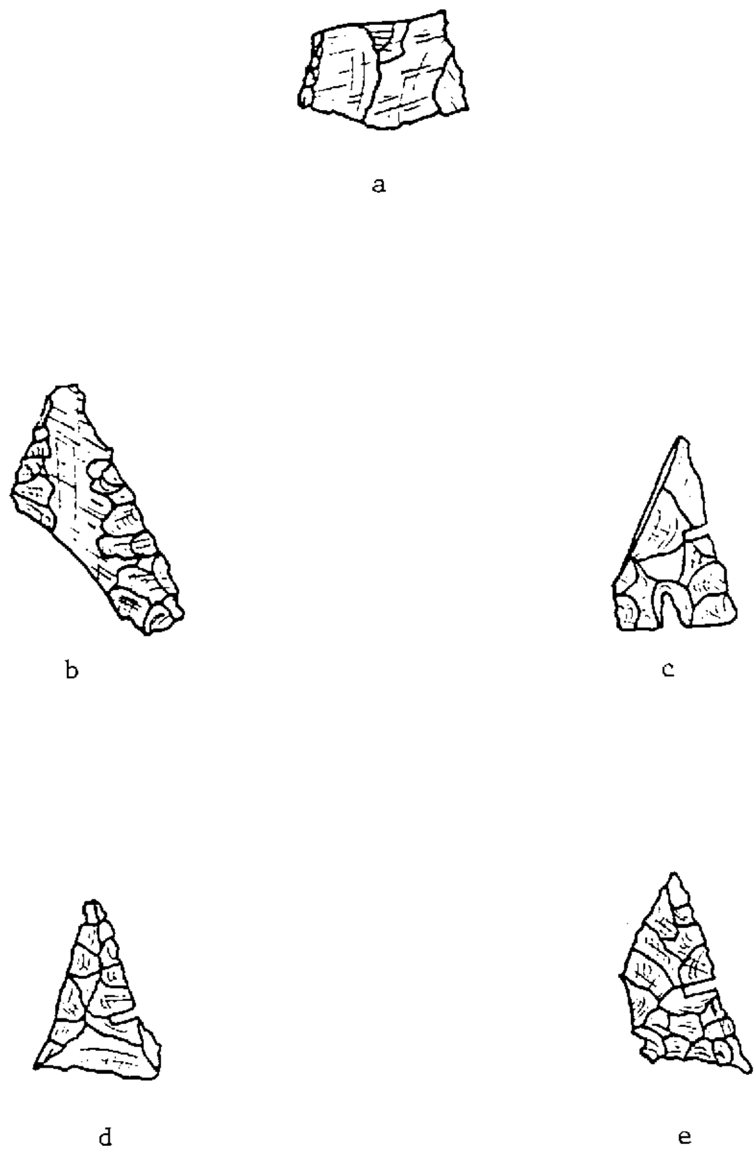


Figure 16. Dusty Mink point preforms and projectile (c). Actual size.

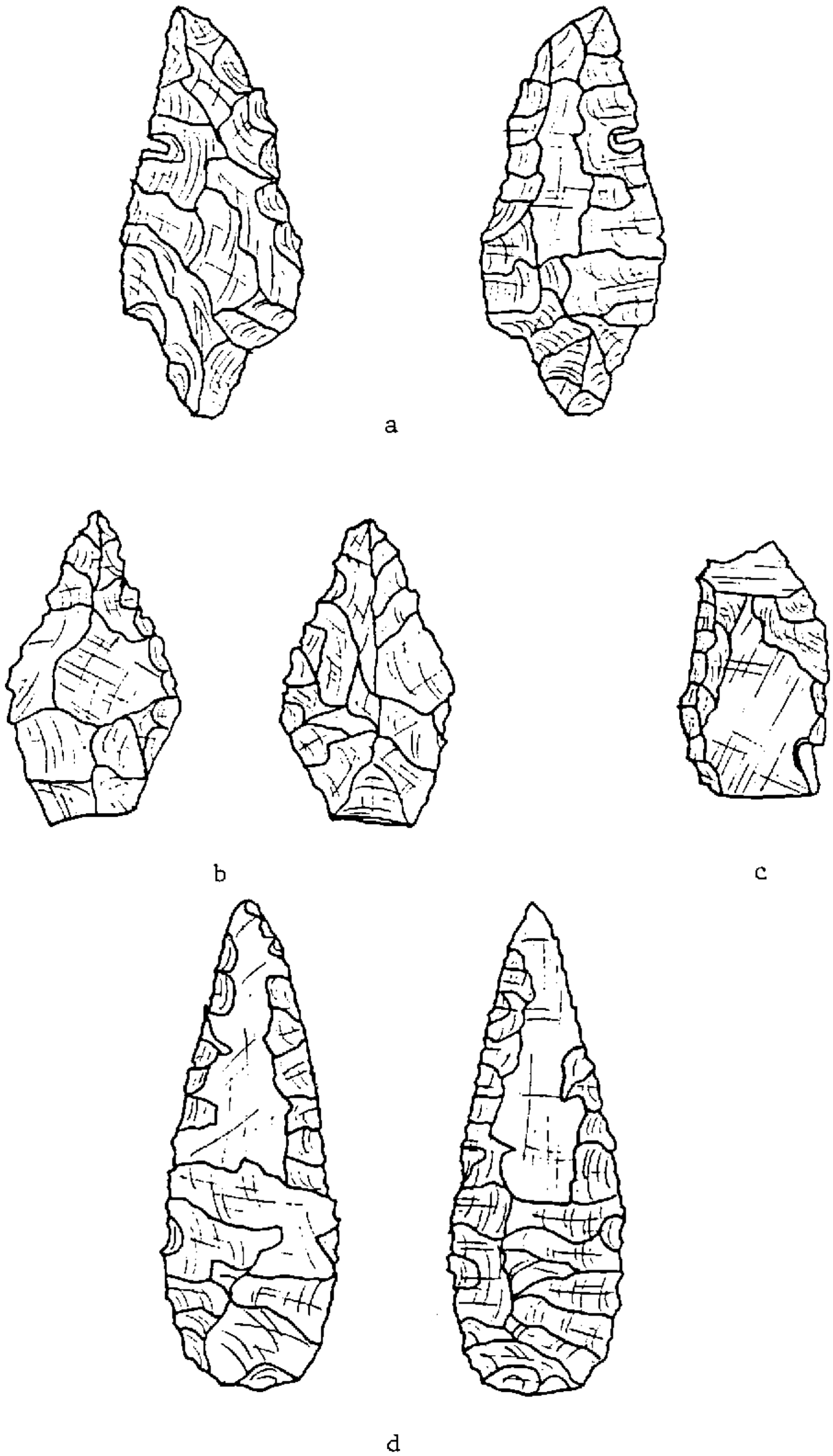


Figure 17. Bifaces from the Dusty Mink site.

Actual size.

Table 1. Projectile point attributes for the Dusty Mink and Grayling Springs sites.

Field Specimen #	Type	L	W	NW	TH	Site
2	ob/dartpoint?	8.5	3.5	2.4	.9	D.M.
3	ob/arrowpoint	1.9	1.5	.5	.3	D.M.
14	ba/arrowpoint	2.0	1.7	.5	.2	D.M.
19	ob/arrowpoint	*1.3	1.2	.5	.3	D.M.
22	ob/arrowpoint	*1.7	1.7	.4	.2	D.M.
23	ob/arrowpoint	*1.8	1.4	.5	.3	D.M.
24	ob/arrowpoint	2.2	1.5	.5	.3	D.M.
26	ob/arrowpoint	*	1.5	.5	.2	D.M.
32	ob/arrowpoint	2.6	*1.0	.5	.2	G.S.
53	ob/arrowpoint	2.5	2.0	.6	.4	G.S.
47	ob/dartpoint	3.4	*1.7	.8	.4	G.S.
61	ccs/dartpoint	*3.4	2.0	1.4	.7	G.S.
82	ob/dartpoint	*2.9	2.1	1.0	.5	G.S.

ob=obsidian, ba=basalt, ccs=crypto-crystalline silcate
* indicates fragmented portion

A total of four fragmentary obsidian projectile point preforms were recovered (Figure 16a,b,d,e). These projectile point preforms were derived from flakes that were produced by percussion-flaking from a biface core. These preforms were then pressure flaked around the edges of the flake blank for preliminary shaping. Two of these preforms were broken during notching, one of which was slightly pressure flaked and notched, apparently because for some modern-day flintknappers, notching is more difficult then the finishing pressure flaking process (J. Flenniken, personal communication 1987). The other point preform had a more finished appearance. It appears that the knapper apparently tried to notch it and failed. Another flake blank was apparently broken during its initial shaping. The final preform is more finished in appearance, but apparently its final shape was deemed too small to warrant notching.

Complete Bifaces

Three unbroken bifaces were recovered (Figure 17b-d). One is composed of a inclusion-riddled obsidian material, one is of basalt and one of obsidian of a simiiiar material to that of the projectile points. Only one of these bifaces was found in the block excavation. This angular-shaped, percussion-flaked basalt specimen is broken on one end (Figure 17c). Its breakage pattern (perverse fracture) shows that it is production-related. This specimen was the only tool displaying both cortex and evidence of a negative detachment scar. These features indicate the flintknapper's use of an unrefined biface blank--a tool manufacturing stage which is rare at Dusty Mink. The angular nature of the tool suggests that the flintknappers found the material unsuitable for further reduction and thus, it was rejected.

The other two finished bifaces were surface-collected from the higher terraces near the excavation block. One specimen is randomly percussion-flaked to two roughly-shaped tapered ends (Figure 17b). The presence of a perverse fracture on one end suggests that this specimen was initially shaped on one end until its break encouraged the knapper to reverse ends and remove several pressure flakes, giving the artifact a "graver" appearance.

The last obsidian biface was recovered several hundred meters downstream from the Dusty Mink site. This artifact also shows evidence of a large detachment scar on one surface and retains its initial striking platform. The specimen is delicately, but randomly, pressure flaked, and is slightly curved in profile (Figure 17d). Its lanceolate shape and size is very similar to other bifaces found in large cache sites in this region (Scott et.al., 1986).

Biface Fragments

Three obsidian biface fragments were recovered (Figure 18a-c). All were produced on relatively small, thin flakes and were pressure flaked in a random fashion. They appear to represent the final products of projectile point production. One of the specimens exhibits overlapping pressure flake scars, while the other two fragments still retain evidence of their original negative detachment

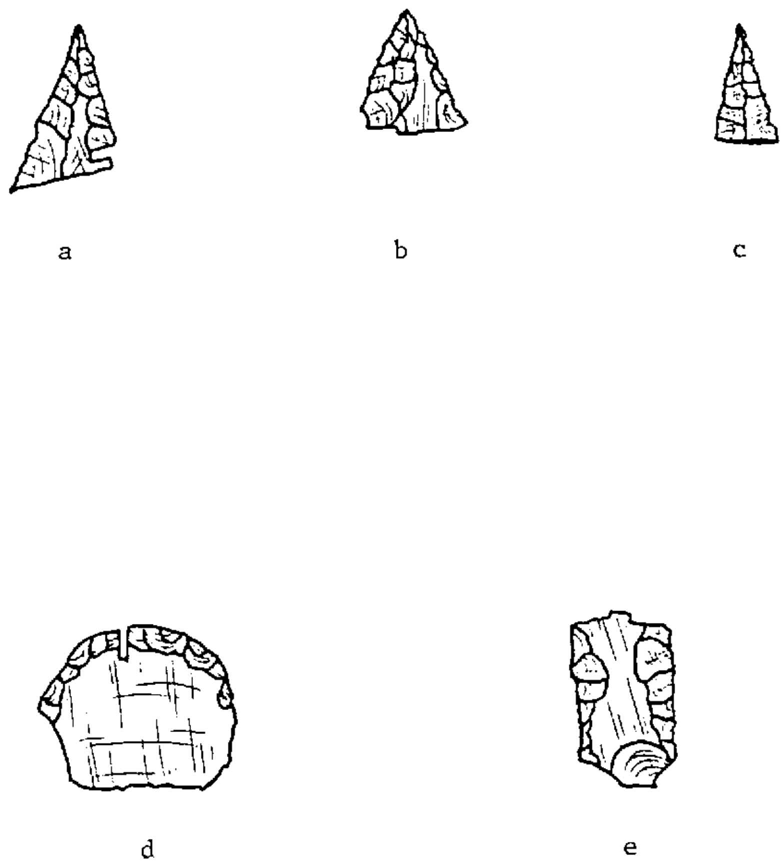


Figure 18. Formed artifacts from the Dusty Mink site. a-c, biface fragments; d-e, utilized flakes. Actual size.

scar. Patination is present on the detachment scar of one, but not on the pressure-flaked margins. This suggests that the flake was scavenged from another site (perhaps Grayling Springs) and re-used at this site. One biface was likely broken during point resharpening, while the other was broken during the initial shaping of a point flake blank.

Utilized Flakes

Four utilized flakes, identified by more than 5 mm width of uniform pressure flake removal or nibbling fractures along at least one margin, were recovered from Dusty Mink. All four flakes are small, thin tools which exhibit random flake removal or use-wear. Two are bifacially-worked along one or both lateral flake edges (Figure 18e). Two are unifacially worked (one even appears similar in morphological appearance to a "thumbnail" scraper, but is not as steep-edged, [see Figure 18d]). Two of the four flakes show patina except for the >5 mm nibbling/flaking.

Chipped Stone Debitage

A total of 443 pieces of lithic debitage were obtained from the Dusty Mink site. The flintknappers at the Dusty Mink site produced 94 % of their flaked stone artifacts with obsidian. Basalt (3 %), and crypto-crystalline silica (3 %) were represented in much smaller quantities. The majority of the recovered debitage from Dusty Mink is non-diagnostic flake fragments (71%). Sixty-three percent of the remaining diagnostic assemblage consists of early and late stage pressure flakes (Figure 19). The other flake types consists of late stage biface thinning flakes and notch flakes. On the other hand, early stage bifacial thinning, margin preparation/alternate flakes, and shatter materials are noticeably small in number (Figure 20).

Miscellaneous

One lipped biface thinning flake was recovered. This flake is the result of a knapper's misdirected blow which removed part of the biface core margin.

The last non-typable artifact consists of a crypto-crystalline silicate flake fragment. This fragment has a series of 3 or 4 pressure flakes and exhibits several "potlids" on both plane surfaces which is evidence that the flake has been burned. Both natural and cultural phenomena can cause potlidding on silicate materials. The specimen could have been "cooked" prehistorically to enhance flakeability, or burned by natural phenomena such as a forest fire. Unfortunately, this artifact lacks the combination of a varying waxy/dull lusters on different flake surfaces, which might help to provide more positive identification.

Grayling Springs Prehistoric Site (35DS381)

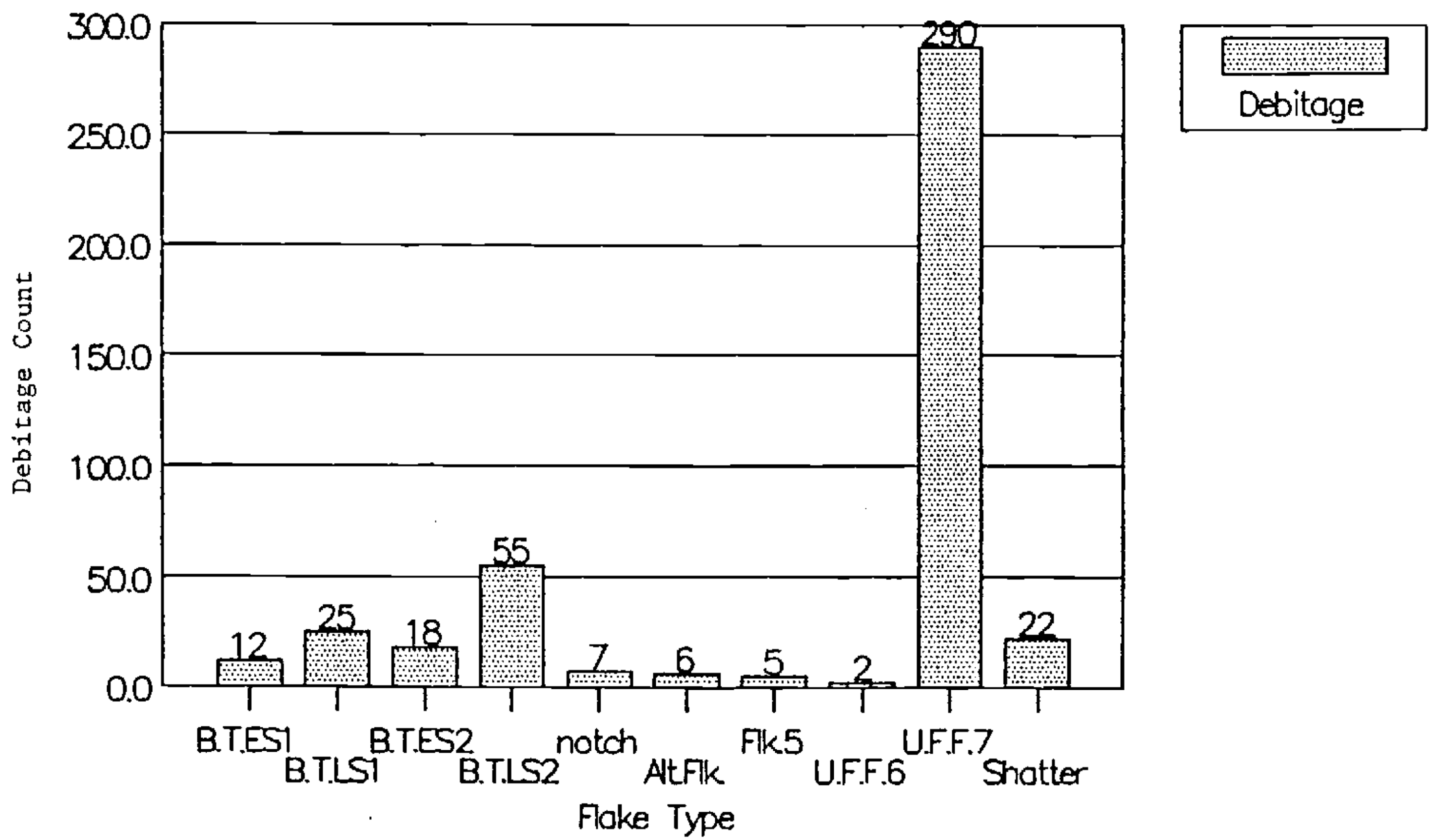
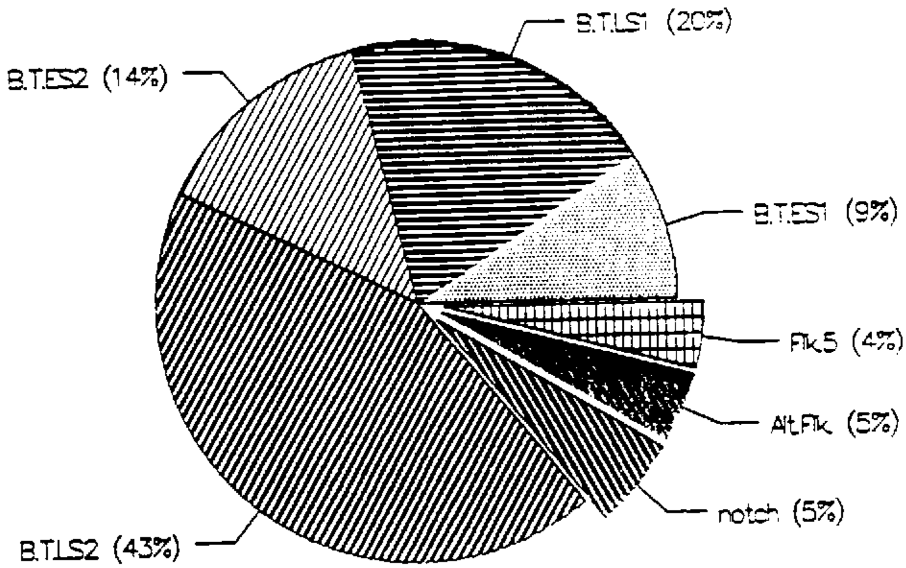
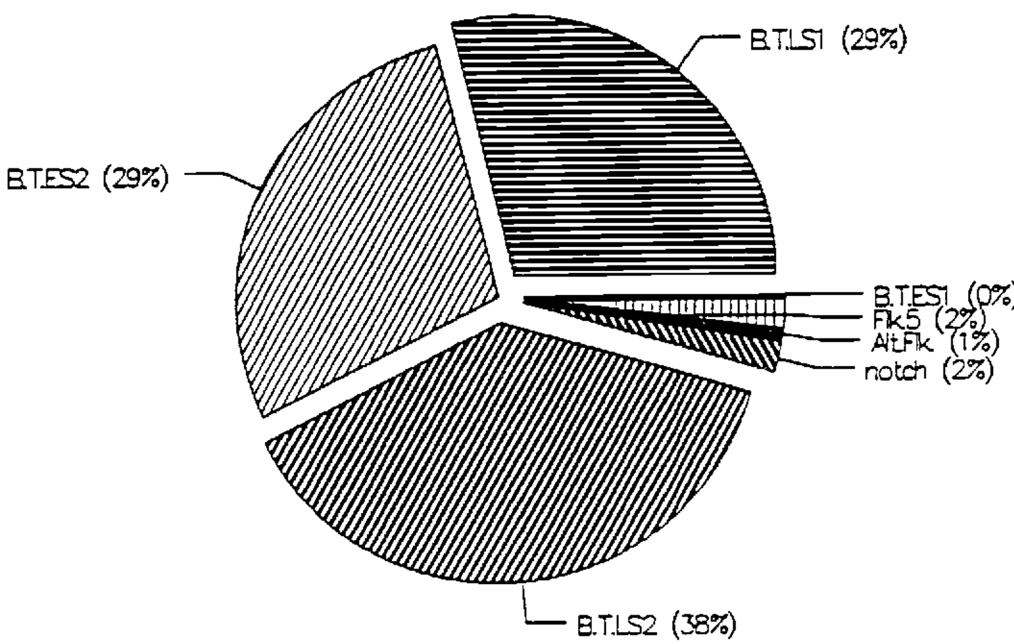


Figure 19. Results of the technological debitage analysis from the Dusty Mink site.



Dusty Mink site



Grayling Springs site

Figure 20. Diagnostic lithic debitage frequencies from both sites.

Projectile Points

A total of five whole or nearly complete projectile points (Figure 21a-e, Table 1), and four projectile point basal fragments (Figure 22a-d) were recovered from the Grayling Springs site. The relatively small number of projectile points recovered may be partly attributed to the surface collecting that has taken place at this Forest Service Guard Station and popular recreation area.

Two of the whole specimens and the one basal fragment typologically appear to be small Late Prehistoric arrowpoints. The others are Archaic period dart points. Each is described below by component:

Two narrow-necked arrowpoints were recovered from either within the block excavation, or the 2 x 2 meter unit located directly adjacent to the spring. Both points are small corner-notched projectiles that were made on thin, slightly curved obsidian flakes (Figure 21d-e). Pressure-flaking is random across the blades of these specimens. Neck widths range from 5 to 6 mm, with a mean of 5.5 mm, which indicates they fall into the range for arrowpoints (Corliss 1972). Both of these points have been extensively resharpened which accounts for their incurving blade margins.

The points are typologically similar to the Rosespring and Harder point series of the surrounding areas which are, respectively, radiometrically dated to 1350 and 840 A.D., and 2500 and 500 years BP (Heizer and Hester 1978; Sampson 1985; Leonhardy and Rice 1970). In

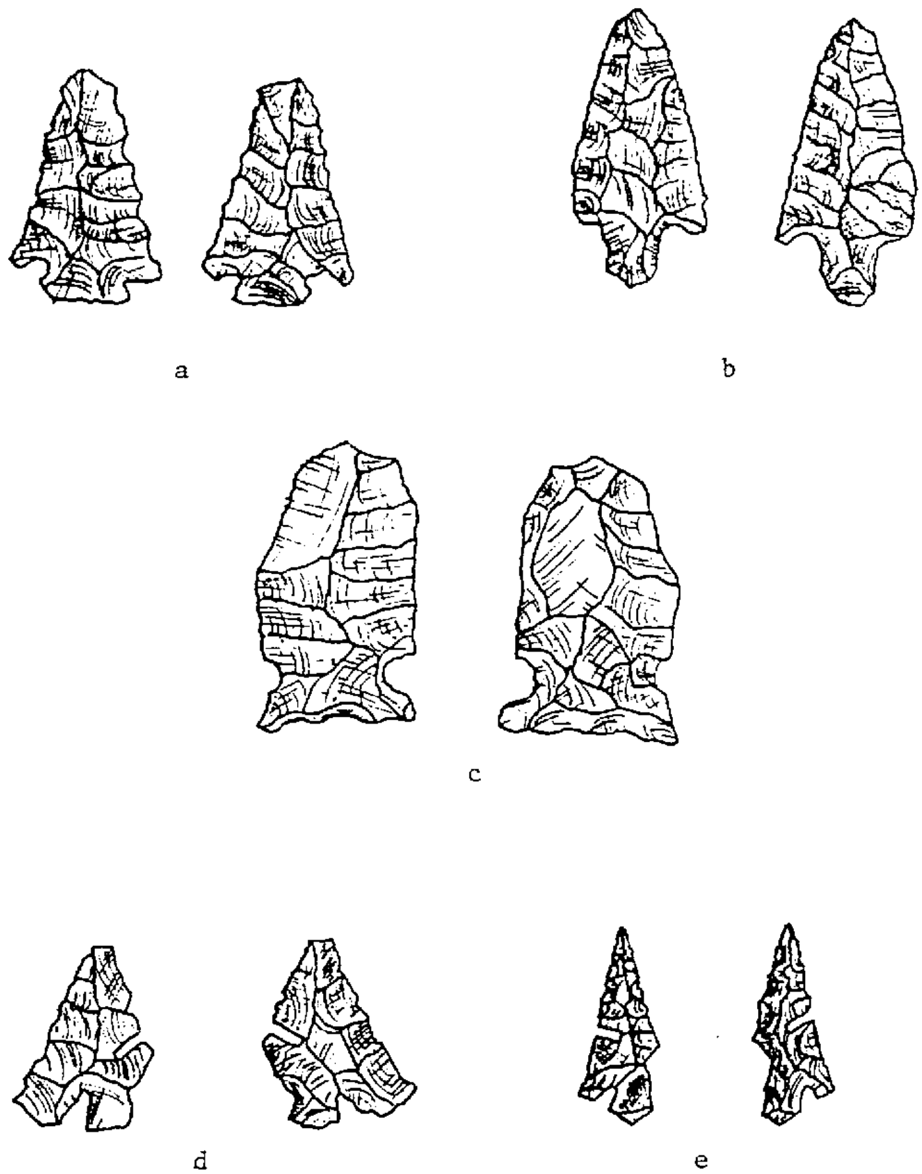


Figure 21. Projectile points from the Grayling Springs site. Actual size.

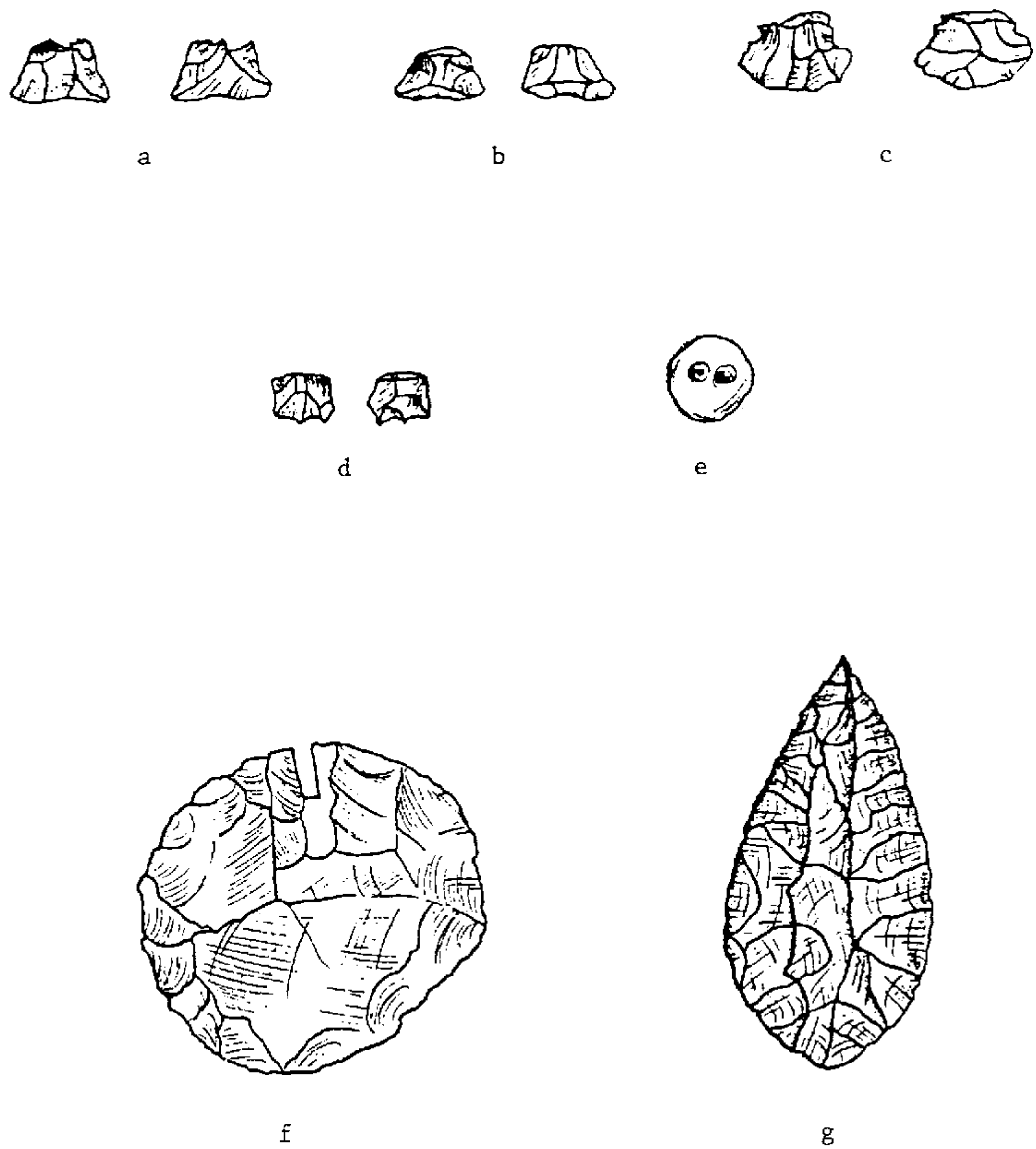


Figure 22. Formed artifacts from the Grayling Springs site. a-d, projectile point basal fragments; e, shell button; f, uniface; g, solidified wood biface. Actual size.

the Upper Deschutes River Basin, similar late period points have been recovered from Lava Island Rockshelter (Minor and Toepel 1984), Lava Butte (Davis and Scott 1984), Lava Lakes (McFarland 1989), the Lab/Pringle Falls Project (McFarland 1988b), and assorted surface sites on the Bend Ranger District.

The other three projectile dart points are larger specimens made on biface blanks. Two of these are corner-notched specimens made on comparatively thick flakes (Figure 21a-b). These two other specimens was flaked using both diagonal and random flaking. Both of these points have relatively broad stems formed by large corner notches. Their bases have been slightly thinned by the removal of small longitudinal flakes and exhibit subtle basal grinding. Both projectiles have been heavily reworked as indicated by their inward curving blade margins and overlapping flake scars.

The third is well-flaked across the blade with parallel and diagonal flaking that intersects midway across the plane surfaces. This remaining projectile point is the only specimen made of crypto-crystalline silica (Figure 21c). This specimen is the only side-notched point in the collection and exhibits a large "potlid" on one plane surface. The tip and a portion of the blade margin are missing. The projectile was made on a very thick flake (perhaps a finely thinned down biface), and a series of small pressure flakes and/or heavy basal grinding is apparent on one side of the distal end. Apparently, this point may be an example of "prehistoric scavenging".

Neck widths for these dart points ranged from .8 to 1.4 mm., with a mean range of 1.1 mm., indicating they fall into the neck width range for atlatl dart points (Corliss 1972). The points are typologically similar to the Elko and the Northern Side-Notched point series of the Great Basin and Columbia Plateau, which are radiometrically dated to 7000 and 2000 A.D.. In the upper Deschutes River Basin, similar specimens have been recovered Lava Island Rockshelter (Minor and Toepel 1984), Lava Lakes (McFarland 1989), Lava Butte (Ice 1962), and the Sundance site from the Lab/Pringle Falls projects (McFarland 1988b).

Projectile Point Fragments

Four obsidian projectile point basal fragments were also recovered from the large excavation block. Three of these have comparatively large bases (Figure 22a-c), suggesting that they were also from dart points. The point remnants were apparently too fragmentary to be considered for re-use and were discarded. All of the breaks apparent on the proximal ends appear as step or hinge fractures which were most likely broken during use, rather than manufacture (Flenniken and Raymond 1986). Varying degrees of basal-thinning are evident on these basal fragments by the removal of pressure flakes or basal grinding.

The fourth basal fragment appears to be a arrowpoint (Figure 22d), but its small size and lack of notching scars precludes any definite assignment to either category. The presence of two longitudinal flake scars on one plane, and several small flake scars on the other, is suggestive of the basal thinning done to facilitate hafting.

One obsidian projectile point ear (not listed above) was recovered. Its small size tenatively suggests it was an arrowpoint. It appears to have been broken while being resharpened.

Projectile Point Preforms

Two projectile point preform fragments were recovered. One preform consists of the tip of a arrowpoint blank (Figure 23a). A series of small pressure flakes were removed from its lateral margins. Its breakage apparently was due to manufacturing as evidenced by a perverse fracture.

The other appears to have been a dart point preform (Figure 24b). It was made from a roughed-out blank, rather than a small flake struck from a biface core as was the arrowpoint preform. Both plane surfaces have been refined through random percussion-flaking techniques. A series of smaller longitudinal flaking and grinding was done at the base for thinning purposes. This preform was also broken during manufacture as evidenced by the fracture type. An inclusion is evident on the fracture plane, and apparently could not withstand the force of the flintknapper's blow, causing it to break.

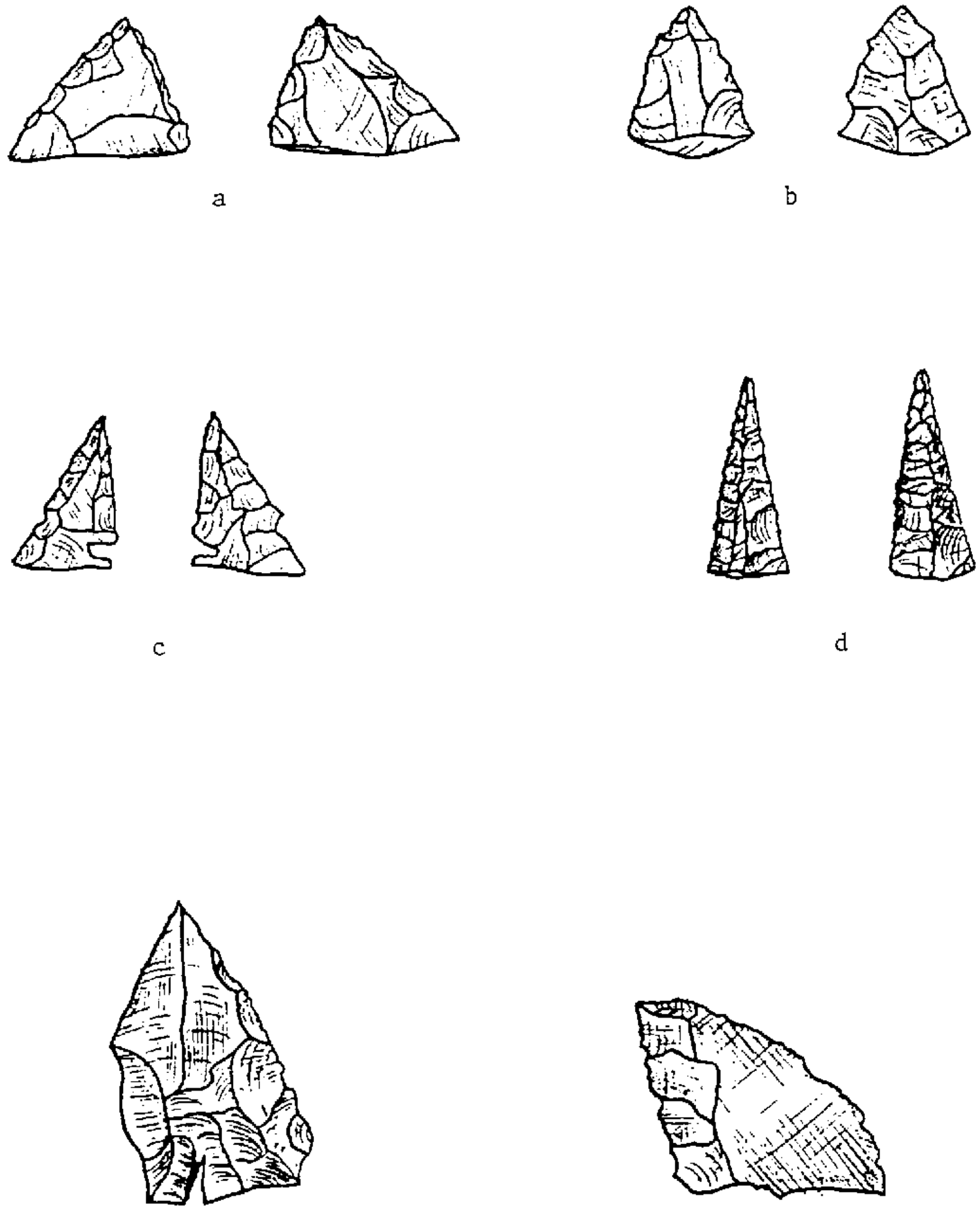


Figure 23. Biface ends (a-d) and flake tools (e-f) from the Grayling Springs site. Actual size.

Complete Bifaces

One complete biface was recovered from the large excavation block. This biface is unusual in that it is composed of solidified (or petrified) wood that has longitudinal stripes varying in color from brown to pink (Figure 22g). The specimen still retains the original striking platform on its distal end, and many of its initial shaping percussion flake scars. The same end that retains the striking platform also exhibits a small amount of basal grinding. A series of random pressure flakes have been removed from one lateral side on both plane surfaces, creating a steep-sided edge. Patination is present on one side. The durability of crypto-crystalline silicate and solidified wood may have made them desirable choices for tasks requiring strong edges such as animal hide preparation.

Biface Fragments

The biface fragment class has been divided into two main categories; 1) pressure flaked midsections/ends, and 2) percussion flaked fragments/ends.

Pressure Flaked

Midsections

Two finished biface midsections were recovered. One is a small, thin specimen that is similar in size and flaking technique to the other arrowpoints from this site. The other is composed of a yellowish-grey crypto-crytalline silicate (ccs), and appears to represent a thin projectile point midsection. Both specimens exhibit random pressure-flaking across their plane surfaces. The ccs midsection is about twice as wide as the obsidian specimen, thus, it may represent a dart point midsection.

Biface Ends

Twelve biface ends were recovered from the Grayling Springs excavations. These were separated into two groups based on their thickness, degree of refined flaking, flake orientation and shape.

Group 1 consists of eight biface ends that are delicately pressure flaked to a fine point and may represent projectile point tips that were broken during resharpening (Figure 23d). One is composed of a yellow crypto-crystalline silicate while the remainder are of obsidian. All were produced on very thin flakes, each measuring .2 mm in thickness. The majority of these specimens were randomly-flaked, although one unusually fine tip exhibits both diagonal and random pressure flake removal on the blade surfaces.

Group 2 consists of four, pressure flaked biface ends produced on relatively thick flakes measuring .4 mm in thickness. These specimens have an unfinished appearance and probably represent point preforms or other tool types broken during an earlier stage of manufacture (Figure b-c). The size of two of the four suggests they were dart point tips broken during resharpening. Their large size and relatively well-flaked blades indicates they were probably in use as tools prior to being broken.

Percussion Flaked

Nine percussion flaked biface fragments were recovered. Six of these specimens were extremely fragmented and mpossible to place in a more definitive category. These specimens appear to represent manufacturing errors. One is composed of basalt, the remainder are obsidian. All of these exhibit random flaking and are produced on relatively thick flakes.

Three percussion flaked biface fragments were separated into a class different from the above specimens, due to their considerably larger size and diagnostic attributes. All are composed of obsidian and exhibit random flaking. Two appear to be exhausted biface blanks or flake cores that are too ill-shaped to be thinned for tool utilization, or further used as a source of flake blanks (Figure

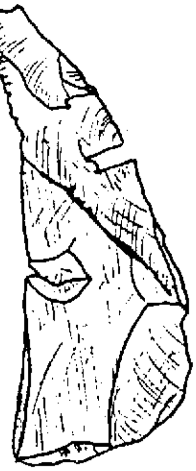
24c-d). The third appears to be the basal section and lateral edge of a flake blank (Figure 24a). These specimens are likely the remnants of the biface cores or blanks that were transported to this site from quarry locations or other sites along the Deschutes River. At this site, they were utilized as a source of expedient flake blanks for projectile points, other tools, or used "as-is".

Flaked Unifaces

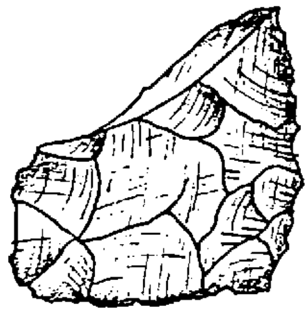
The uniface tool class includes all chipped stone tools which are flaked across one plane surface only. One specimen is assigned to this category (Figure 22f). This tool was intentially shaped with regular, but random, flaking for 6.4 mm on one working edge. Step-fracturing and the absence of two oval-shaped flakes on the opposite plane surface appear to be the result of use-wear and suggest that the edge did not stand up well to the scraping/cutting tasks. This specimen was produced on a large early stage biface thinning flake that still retains evidence of its negative detachment scar on its dorsal surface. The entire circumference of the tool has been pressure flaked to some degree (a 13.5 mm length).

Utilized Flakes

The utilized flake tool category includes flakes that exhibit greater than a 5 mm worked/used margin on at least one edge of the specimen. Because these flakes exhibit a great range of variation in size, shape and extent of flaking, this category is a "catch-all" for a variety of

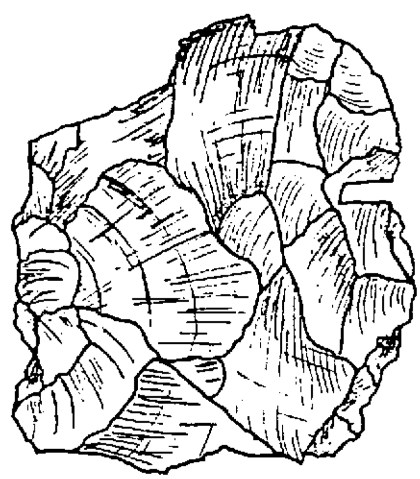


a



b

c



d

Figure 24. Grayling Springs site biface fragments. a, flake blank; b, dart point preform; c-d, exhausted cores.

types. Specimens assigned to this category were either unifacially or bifacially-flaked and are evidenced by the uniform removal of small pressure flakes, or by use-wear which can be seen through either polish or severe step-fracturing. However, post-depositional factors (cattle, logging) can also alter flake edges, making these assignments tenative (Flenniken and Haggarty 1979).

Four specimens are assigned to this class (Figure 23e-f). Use wear on their margins ranged from .8 mm to 3.8 mm. Two of these were either used "as-is", or quickly worked along one edge in an expedient manner. The other two were either bifacially or unifacially-worked across one or both plane surfaces of the flake, with further nibbling apparent along one of their edges.

Chipped Stone Debitage

A total of 18,467 pieces of lithic debitage were recovered from Grayling Springs. The assemblage is almost entirely composed of obsidian (over 98%), although a few pieces of crypto-crystalline silica, and basalt (1% and less than 1% respectively), were found. It is important to first note that the projectile points recovered from the site indicate that two, temporally separate occupations may have occurred at Grayling Springs. Thus, different manufacturing systems may have been employed. However, the density distributions of lithic material did not indicate any clear stratigraphic separation of cultural components, due in part to the bioturbation that has occurred at the site. Therefore, the entire assemblage was treated as a whole. More extensive excavations and detailed lithic analysis of the lithic assemblage may reveal different reduction sequences by time period, as suggested by the two categories of projectile points.

The majority of the sampled lithic debitage (73%) consisted of non-diagnostic flake fragments. Of the remaining sample, approximately 29% of the assemblage is composed of late stage bifacial thinning flakes. Early and late stage pressure flakes (67%) make up the majority of the remaining diagnostic debitage (Figure 20). The remaining assemblage consists mostly of notching flakes, margin removal flakes, and alternate flakes (Figure 25).

Miscellaneous

Two pieces of debitage warrant special attention due to their uniqueness. One is a heat-treated crypto-crystalline silicate flake fragment with pot-lids and a varying waxy/dull lusters on flake surfaces. This flake suggests that the Grayling Springs inhabitants were heating silicate materials to increase their flakability. However, no other evidence, such as a fire hearth or fire cracked rock, was found.

The other specimen is the sole example of a primary decortication flake at Grayling Springs. This flake is covered with cortex (the weathered exterior of unaltered rocks) on its dorsal surface. It is relatively thick and flat in profile. Two small pressure flakes were removed from one end.

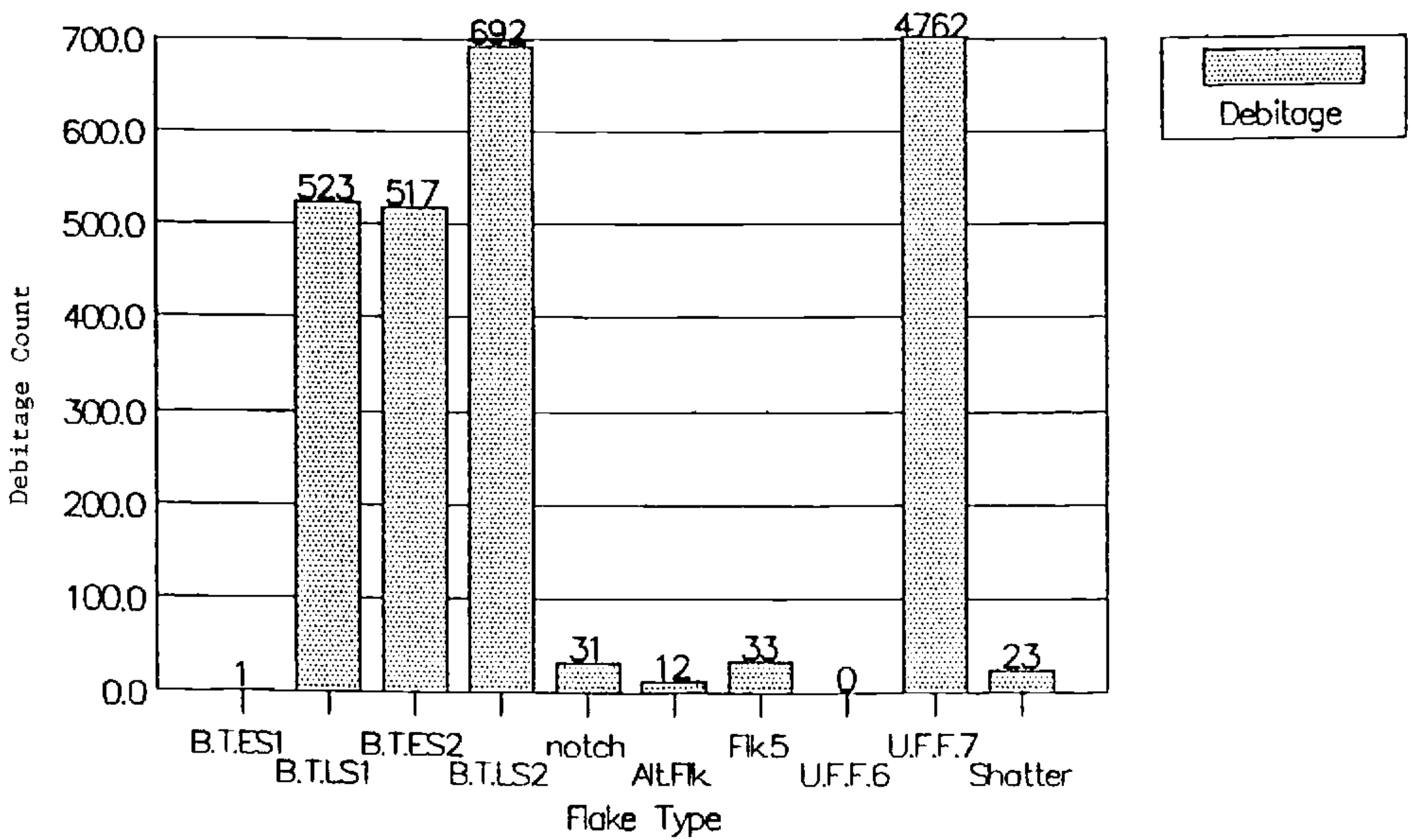


Figure 25. Results of the technological debitage analysis from the Grayling Springs site.

These flake categories clearly indicate that the lithic technological system at Grayling Springs emphasized the latter stages of tool manufacture and refurbishment rather than the initial stages of tool production.

Perishable Artifacts

Only one artifact made of organic material was recovered from Grayling Springs. It consists of a hand-drilled shell button which was found within the top 2-3 cm of the duff layer (Figure 22e). This small, thin button measures 1.1 x 1.2 mm in diameter. The two delicate hand-drilled holes averages .2 mm in size. The button's uneven surface is due to the natural surface of the shell. It's white color is enhanced by a pearly luminescent hue. The two holes are conical shaped and the natural layers, characteristic of shell materials, are evident. This artifact represents the only perishable prehistoric item discovered at either site. It is not certain whether the button is of prehistoric or historic origin.

A limited amount of nondescript historic and contemporary artifacts were intermixed with the Grayling Springs site deposits.

Lithic Reduction Sequences

Dusty Mink Prehistoric Site

The large block excavation at Dusty Mink revealed that the site is quite small. Because the recovered archaeological materials do not support multiple components or occupations, the site is considered to be a single homogenous analytic entity. The lithic evidence obtained from Dusty Mink indicates that maintenance and production of projectile points was the sole task of the site's occupants. These lithic materials relate completely to the tertiary reduction stages of the biface tool making process. The site might best be considered a segregated reduction location as defined by Flenniken (1988:234); "as an area on or near, forming an archaeological site where a knapper or knappers produced artifacts by flintknapping. An SLR exhibits debitage from a single flintknapping event." The lack of features, firehearths, or discernible differences in the pumice soils supported this conclusion. No organic remains such as tools or items of bone, shell, metal or plant material were recovered.

The lithics suggest that the late stages of biface reduction industry are represented here. The flake categories represented clearly indicate that the lithic technological system at Dusty Mink emphasised the latter stages of tool manufacture and refurbishment, rather than the initial stages of tool production or material procurement. This is further supported by the recovery of a limited tool kit that consists mainly of discarded arrowpoints, a few point preforms and miscellaneous biface fragments.

Grayling Springs Prehistoric Site

As expected, the 30 meter excavation block, as well as the 13 surrounding 1 x 1 meter units, yielded more substantial archaeological deposits than did the Dusty Mink site. The recovered lithic assemblage(s) suggest two different periods of occupation; 1) Middle to Late Archaic, and 2) Late Prehistoric. Each of these occupations is characterized by their slightly different biface tool reduction techniques.

A portion of the tools and debitage assemblage suggest that atlatls and dart points were used by the earliest inhabitants of the spring sources. At local quarry areas, the Archaic occupants percussion flaked large flakes into rough blanks. These large flake blanks with minimal modification were transported into Grayling Springs from quarry areas. As noted by Flenniken (1987:25): "most bifacial blanks were manufactured for transportation away from the East Lake for use at other locations such as the Grayling Springs Site". At the Grayling Springs site, these rough flake blanks were further thinned and shaped by percussion flaking into preforms (Figure 26). Diagnostic debitage resulting from this stage of manufacture was early and late stage biface thinning flakes, some margin removal flakes. Because of the unrefined nature of the original flake blank, original detachment scars are still visible on many dorsal surfaces of various

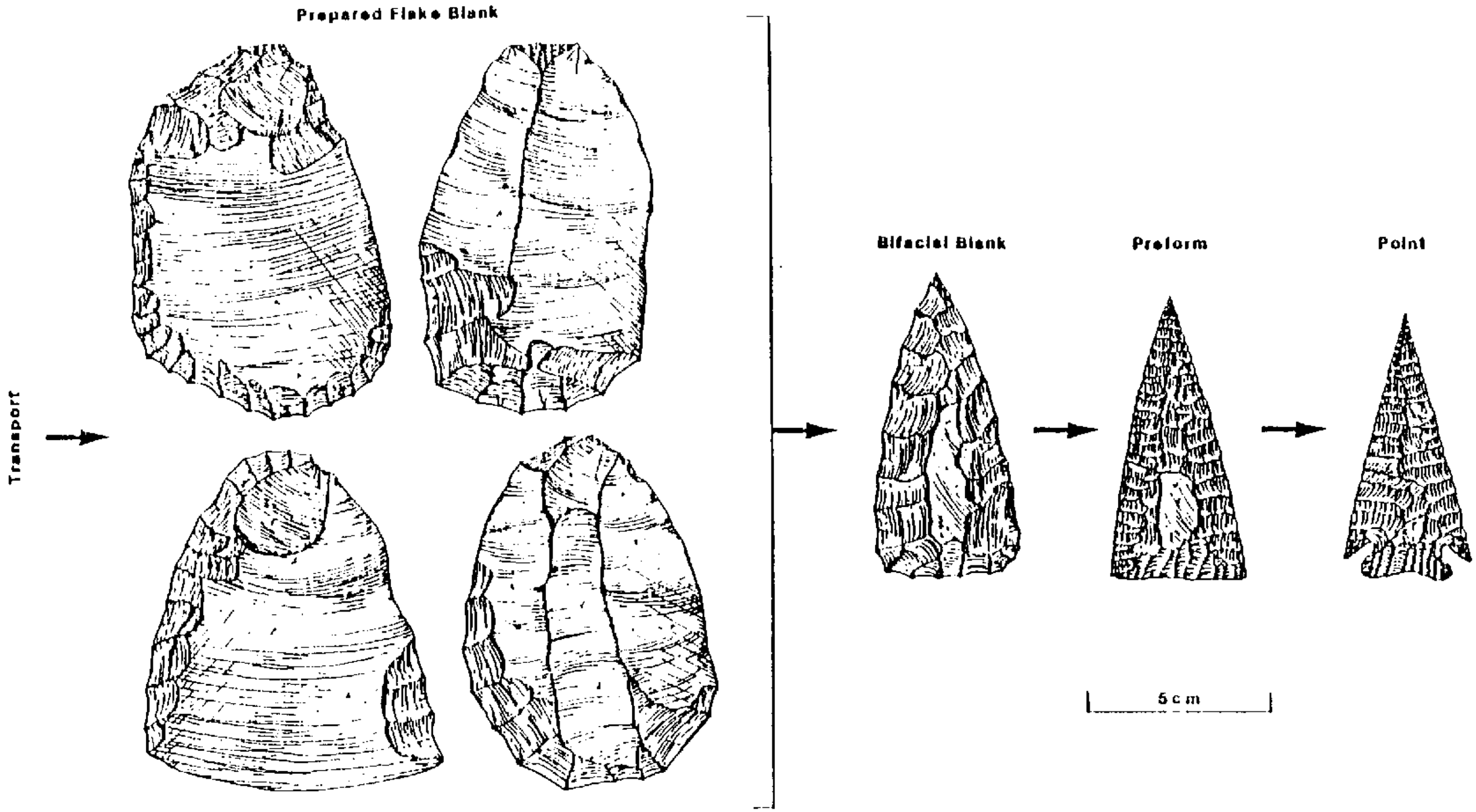


Figure 26. Archaic lithic technological reduction sequence (taken from Flenniken and Ozbun 1988:40). Not to scale.

flakes. These preforms were then subsequently pressure flaked and notched into dart points. An abundance of early and late stage pressure flakes result from the stages of dart point manufacture. The three recovered dart points were used and refurbished until they were discarded.

The Late Prehistoric occupants of the Grayling Springs site used a slightly different biface reduction sequence than was used by the earlier inhabitants,though it is the same biface reduction sequence was used by inhabitants of Dusty Mink. The key distinction is that more refined biface flake cores were transported into the site from the quarry sources (Figure 27). At the site, these cores were percussion flaked to create smaller flake blank fragments. Smaller quantities of late stage bifacial thinning flakes and margin removal flakes representing this stage of manufacture were recovered from the Dusty Mink site. Original flake detachment scars are noticeably absent on most of the debitage. The flake blank fragments were then delicately pressure-flaked around their lateral margins into point preforms. The preforms were notched, and finally pressure flaked into finished arrowpoints producing abundant early and late stage pressure flakes. Interestingly, both the pressure and notching flakes appear to be much smaller than pressure flakes resulting from dart point manufacture. However, it was difficult to quantify this impression, and more refined lithic reduction studies are needed beyond the scope of this work.

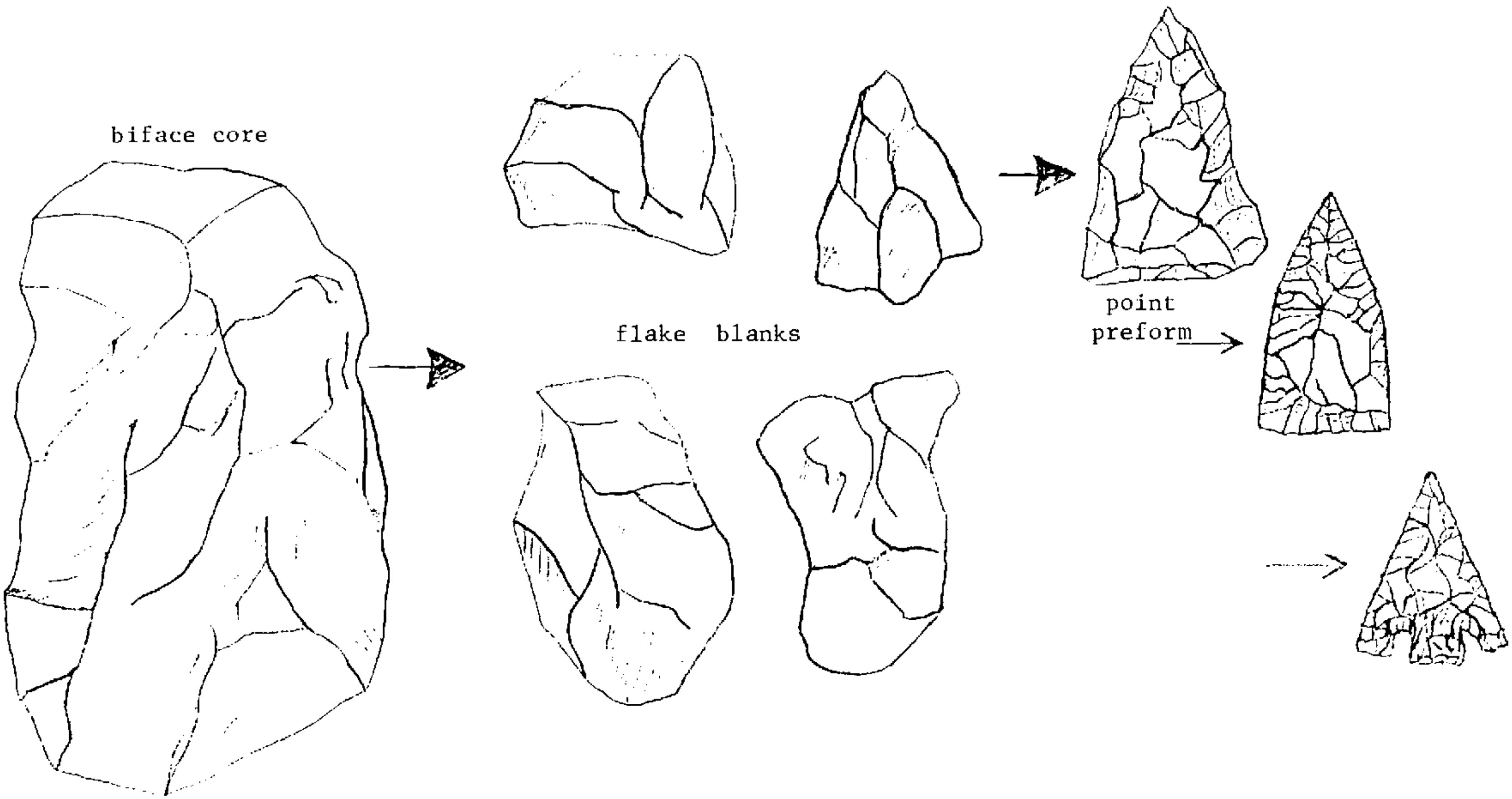


Figure 27. Late Prehistoric lithic technological reduction sequence.

X-Ray Fluorescence Spectrometry

Thirty obsidian artifacts recovered from the Dusty Mink and Grayling Springs sites were submitted to Dr. Richard Hughes of Sonoma State University for trace element analysis.

At the Dusty Mink site, nine of the specimens came from the Newberry Crater source, which lies 15 miles to the east of the site (Appendix A). Two specimens came from either the McKay Butte or Quartz Mountain sources. Which are also local sources located near the flanks of Newberry Crater. Currently, the chemical profiles of both sites overlap and are therefore difficult to separate. Two specimens came from the Three Sisters (Obsidian Cliffs) source. One specimen came from Silver Lake/Sycan Marsh area. The quarry source of one specimen is unknown (Table 2).

At the Grayling Springs site, thirteen of the specimens came from Newberry Crater, one came from either McKay Butte or Quartz Mountain, one specimen remains unidentifed (Table 3).

Thus, twenty-two of the resulting geochemical profiles were found to match the trace element profile of "generic" from Newberry Crater, whose flows date from approximately 6000 to 1300 years before present. None of the artifacts could be specifically assigned to "Big Flow" obsidian, which is the only distinctive source that can be identified within the numerous obsidian sources present within the Caldera. The source data are useful for several reasons:

Table 2. Obsidian X-Ray Fluorescence Spectrometry sources reported by artifact type for the Dusty Mink site. See Appendix A for obsidian X-Ray Fluorescence Spectometry results.

Artifact Type	Level	Source
proj. point	1	Silver Lake/Sycan Marsh
proj. point	1	Three Sisters/Obsidian Cliffs
point frag.	1	Newberry Volcano
biface frag.	1	Three Sisters/Obsidian Cliffs
utilized flk.	1	Newberry Volcano
proj. point	2	Newberry Volcano
point preform	2	Newberry Volcano
point frag.	2	Newberry Volcano
utilized flk.	2	McKay Butte/Quartz Mountain
biface frag.	2	Newberry Volcano
proj. point	3	unknown
proj. point	3	Newberry Volcano
point frag.	3	McKay Butte/Quartz Mountain
biface frag.	3	Newberry Volcano
utilized flake	3	Newberry Volcano

Table 3. Obsidian X-Ray Fluorescence Spectometry sources reported by artifact type for the Grayling Springs site. See Appendix A for obsidian X-Ray Fluorescence Spectometry results.

Artifact Type	Level	Source
biface frag.	1	Newberry Volcano
biface frag.	1	Newberry Volcano
biface frag.	1	McKay Butte/Quartz Mountain
flake	1	Newberry Volcano
proj. point	2	Newberry Volcano
proj. point	2	Newberry Volcano
biface frag.	2	Newberry Volcano
biface frag.	2	Newberry Volcano
biface frag.	2	Newberry Volcano
flake	2	Newberry Volcano
biface frag.	3	Newberry Volcano
biface frag.	3	unknown
uniface	3	Newberry Volcano
flake	3	Newberry Volcano
flake (utilized?)	8	Newberry Volcano

1. They indicate that at both Grayling Springs and Dusty Mink, obsidian quarrying were very localized. The obsidian at both sites is not the product of long distance transport or trade, with the exception of the one Sycan Marsh specimen.

2. Source data from Newberry Crater indicate that the sites can be no older then 6000 BP, the age of the oldest obsidians in the Crater proper.

Obsidian Hydration

The thirty artifacts analyzed for source location were also submitted to Thomas Origer for hydration rind measurement (Appendix B) to estimate relative age(s) of the artifacts and/or duration of site occupation. The mean rind measurements for Dusty Mink site artifacts ranged in thickness from 1.1 microns to 2.6 microns and averaged 1.6 microns (Table 4). The mean rind measurements for Grayling Springs artifacts ranged in thickness from 0.8 microns to 3.0 microns and averaged 1.8 microns (Table 4). These thin rind measurements indicates that the artifacts from both sites are of recent origin. With the exception of Friedman and Long's (1976) experimental work with Newberry Crater obsidian, source and site-specific obsidian curves do not exist for most obsidian flows, let alone prehistoric sites, in central Oregon. If the the mean rind averages from both sites is compared with Friedman and Long's hydration rate for "generic" Newberry obsidian (about 3 microns per 1000 years), they

Table 4. Mean obsidian hydration rind measurements reported by excavation level. See Appendix B for obsidian hydration analysis results.

Dusty Mink Site (35DS502)

Level	Rind Thickness (microns)					Average Thickness
1	2.3	1.2	1.2	*	*	1.6
2	1.1	1.3	1.3	2.4	*	1.5
3	1.2	1.8	1.3	2.6	1.4	1.7
					total site average:	1.6 microns

Grayling Springs Site (35DS381)

Level	Rind Thickness (microns)						Average Thickness
1	2.0	2.1	0.8	*			1.6
2	1.0	2.3	1.4	1.4	2.3	*	1.7
3	2.3	2.2	2.4	1.2			2.0
8	3.0						3.0
						total site average:	1.8 microns

* no hydration rind measurement possible

appear to be about 500 years old. Obviously the data resulting from the hydration dating analysis must be treated very cautiously. Vertical patterning of the rind measurements appears to be indiscriminant.

Chapter 7

Summary of Occupations

Dusty Mink Site

Age

The age of Dusty Mink may be inferred from three lines of evidence: 1) hydration dating, 2) projectile point typology, and 3) sediments. The average thickness of the fifteen obsidian rind measurements is 1.6 microns. According to Friedman and Long's hydration dating curve, developed for generic and local Newberry Crater obsidian, this indicates the site is less than 1000 years old. This information, combined with the apparent late dates of the predominantly small arrowpoints, and the relatively high position of the cultural material within the post-6800 years BP Mt. Mazama tephra, suggests that this site was occupied relatively late in prehistoric times.

Site Utilization

This site has been previously defined as a segregated reduction area which was probably occupied for only one or two short visits by groups of Late Prehistoric Indians (Flenniken 1988:234). Dusty Mink was probably occupied by a select few of the band while they were out hunting, away from the base camp. On the other hand, given the close proximity of a prehistorically rich fishery, these few may have used their leisure time for retooling hunting kits while fishing nearby.

In either case, the number of discarded, exhausted arrow points and broken preforms suggest that the lithic industry used by the occupants focused on the the extreme latter end of the biface reduction technology. This limited range of tool types, as well as the quantitative assessment of total recovered site assemblage (18 tools, 441 individual pieces of lithic debitage), is a strong indication that the Dusty Mink Indians' most important activity was focused on the maintenance and tool refurbishment of their hunting equipment.

Seasonality of Occupation

Floral or fauna archaeological material remains often constitute the strongest evidence for infering seasonality of occupation. Unfortunately, organic remains were absent from Dusty Mink. Other than deriving inferences based on elevation, the Dusty Mink site does not offer good evidence for seasonality. Assuming climatic conditions were similiar during the last 3000 years, it seems likely that this site was inaccessible during the winter months and that the occupants of Dusty Mink visited the site in the late spring, summer, or fall. If these Indians were fishing nearby, it is likely that they may have concentrated in the local area from July to August to take advantage of the freshwater trout runs.

Source Analysis

Obsidian source information taken from the fifteen specimens yielded informative results. Newberry Crater was the primary source area of obsidian used by the Dusty Mink occupants. The majority of obsidian materials from both the Dusty Mink and Grayling Springs sites came from generic Newberry Crater obsidians. As noted, these obsidians erupted no earlier than 6000 years BP, thus providing a limiting date on the use of the Crater obsidians, as well as, providing additional evidence for site(s) occupation late in prehistoric times. Obsidian materials came also came from Three Sisters (Obsidian Cliffs), Silver Lake/Sycan Marsh, and closer by, the McKay Butte/Quartz Mountain sources (Figure 23). Thus, these Late Prehistoric Indians were procuring materials from a approximately 130 mile area.

Grayling Springs Site

Age

Determining the chronology of the Grayling Springs site depends on the same three age indicators that were used for the Dusty Mink site. Nearly identical to the Dusty Mink site, the average obsidian rind

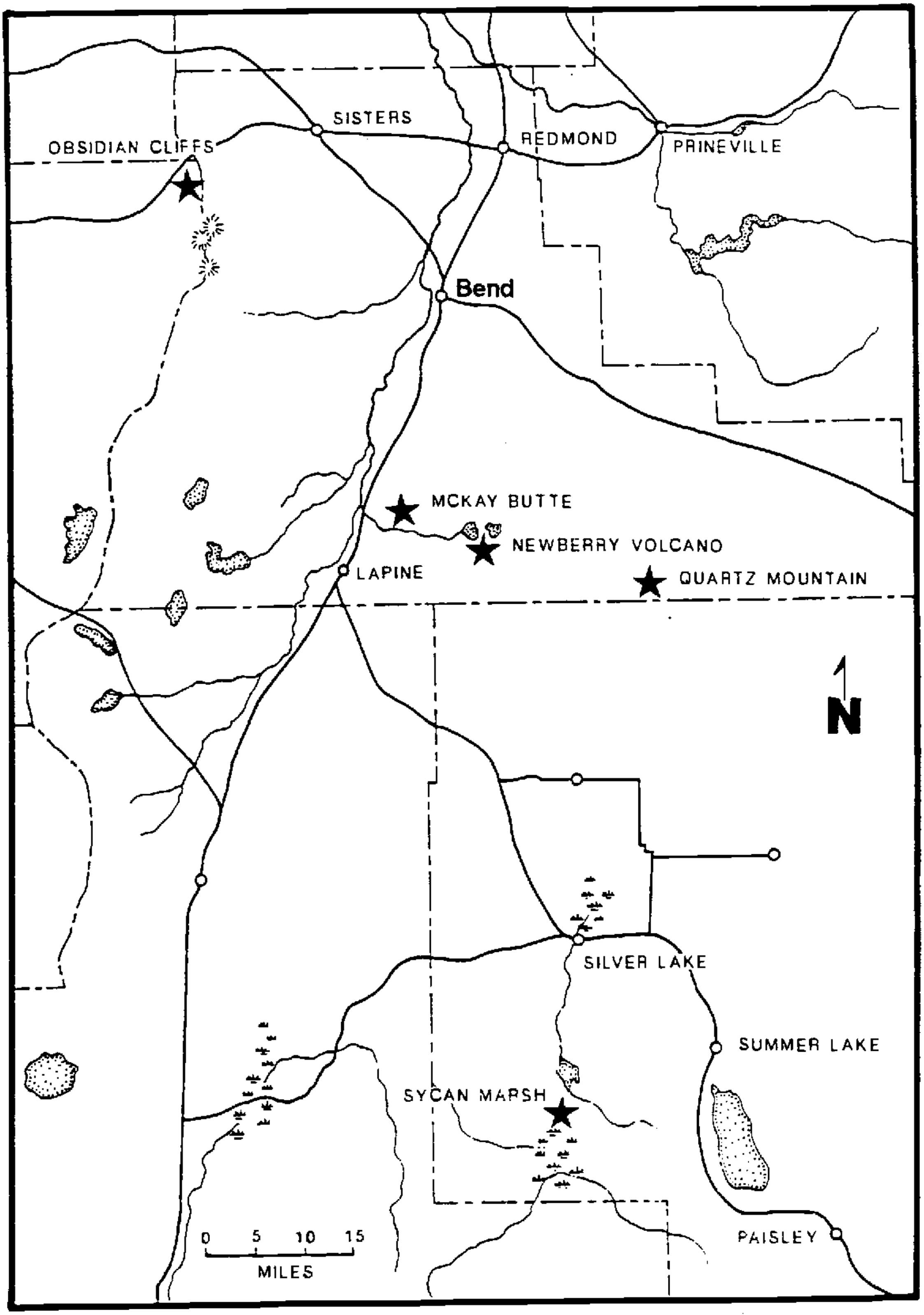


Figure 28. Obsidian source locations for the Fall River archaeological sites.

thickness of the fifteen specimens submitted for analysis from this site is 1.8 microns. The presence of dart projectile points and their biface lithic reduction sequence tenatively suggests an earlier Archaic occupation of this site. This is not surprising, considering the presence of the reliable and abundant freshwater springs. however, it must be emphasised that the extensive mixing of the strata made it difficult to separate this occupation from the Late Prehistoric component. Because the majority of the archaeological evidence from both of these sites is Late Prehistoric in nature, the following discussion will emphasize this time frame. Late period arrow points, arrow preforms, and other tools were also recovered. These smaller projectile points are identical to those found at the Dusty Mink site, and probably date to relatively late in prehistoric times.

Except for these diagnostic projectile points and their respective preforms, the stratigraphic mixing of cultural materials prevented separating the majority of the site's assemblage into two different occupation periods. Even when accounting for this widespread mixing, the cultural material lies within the top 40 centimeters of the post-6800 BP Mt. Mazama tephra. In sum, age estimates taken from the hydration rind data, comparative projectile point typologies, and shallowly buried cultural deposits indicates that this site is probably no older than 2-3000 years.

Site Utilization

This site yielded a larger variety of lithic debitage and flaked stone tools than the Dusty Mink site. Obsidian is the primary raw material used for stone tool manufacturing, but crypto-crystalline silicate, basalt, and solidified wood are found in small quantities. This site yielded a variety of bifaces, biface fragments, projectile points, one uniface, and an unusual shell button. Archaic and Late Prehistoric cultural sequences are suggested by the latter stages of bifacial reduction technology evidenced at this site. These are slightly different biface industries, focused on an expedient projectile point technology, as well as, producing other needed tools. Aside for the refurbishment of projectile points, the archaeologically-recovered artifacts may have functioned in tasks such as animal hide working and meat processing, or given the proximity to a trout-laden river, for fish processing. Other activities, such as plant processing, may also have been important. The narrow focus of the entire assemblage limits the functional interpretations of this site, and may be the result of: 1) a sampling bias; 2) poor organic artifact preservation in the acidic soils, or 3) surface collection of many of the flaked and ground stone artifacts. Despite these limitations, the Grayling Springs site appears to have functioned as a multi-use base camp, where perhaps several families could have camped for short periods of time.

Seasonality of Occupation

If current snowfall is any indication of what weather conditions might have been like, winter occupation at the Grayling Springs site is not likely. Once again, archaeological evidence for plant processing and/or fishing activities is currently lacking or not interpreted from either of these sites. As noted by Scott (1985a:56) in her study of six similiar lithic scatters in the Upper Deschutes River Basin:

> The conservation of obsidian materials at Ryan Ranch and other sites along the Deschutes River suggests the sites were occupied during periods when the quarries were inaccessible or snowbound--late fall through winter. However, the lithic data may simply point to an emphasis on other activities such as the production of pershibles and the maintenance of a complete set of tools. In short, the evidence is currently ambiguous.

Source Analysis

Source data taken from the fifteen obsidian specimens indicates the overwhelming use of the Newberry Crater generic obsidian by the site's inhabitants. Only one specimen came from either the McKay Butte/Quartz Mountain source. While the sample size is admittedly small, these findings suggest that the Grayling Springs occupants made use of the nearby and abundant obsidian sources, located approximately fifteen miles to the east (Figure 28).

Internal Comparisons

Although an earlier Archaic component has been suggested at Grayling Springs, the similarities between the later component of that site and the artifact assemblege recovered from Dusty Mink are not surprising. Both sites contain cultural deposits that date to the Late Prehistoric time period. The preponderance of obsidian flaking debitage and broken tools suggests that the domestic use of these camps was primarily refurbishment of hunting tool kits. The Grayling Springs site seems likely to have functioned as a "living area",where food preparation and shelter construction may have occurred. In contrast, the Dusty Mink site assemblage suggests a sole function of retooling.

Obsidian hydration measurements were done on 30 recovered tools and flakes (15 from each sites). Most of the hydration readings from the Dusty Mink site clustered from 1.1 to 2.6 microns. Most of the hydration readings from the Grayling Springs site ranged from 0.8 to 2.4 microns. Although a correlating hydration curve has not been establised for central Oregon, tentative conclusions can be offered. A comparison of their thin hydration bands from other sites in the Northern Great Basin is the only alternative available for relative dating. This data, in conjunction with projectile point styles, and the shallow location of the cultural materials in the post-6800 year old reworked Mt. Mazama tephra, suggests that the sites were occupied relatively late in prehistory. Therefore, the sites are probably no older than 2000 to 3000 years.

As both the Graylings Springs and Dusty Mink sites are of a similar late occupation, and are geographically close, it is not unreasonable to believe that they may have been occupied by the same cultural bands. Source information supports this conclusion. Sampled obsidian materials from both sites confirm that Newberry Crater was the primary geologic source for lithic procurement. Both sites also had McKay Butte/Quartz Mountain sources in common. Other material at the Dusty Mink site sources to Obsidian Cliffs (Three Sisters), and Silver Lake/Sycan Marsh. Thus, the primary quarry area is located only 15 miles to the east of these sites. The wide variety of source locations seen in the Dusty Mink sample may be due to the fact that these materials are shaped into projectile points. Projectile points are a likely trade item, and thus may be dispersed over a wide area. Also, the continual resharpening of hafted points until they were ultimately discarded, suggests that this tool type may have been retained over longer distances than other stone tool types.

Other similarities exist between these sites. Both exhibit a noticeable lack of organic materials, probably as a result of the widespread acidic tephra soils. The Fall River lithic industries were heavily emphasized towards the latter stages of biface tool reduction, when tool refurbishment and projectile point manufacture were the flint knappers primary task.

Testing the sites along Fall River provided an opportunity to analyze possible settlement patterns of the Late Prehistoric Indians. The focus of prehistoric occupation along the Fall River drainage was on the low-lying terraces and flood plains near the actual spring sources, rather than on the higher terraces and rolling benches. The seasonality of occupation is unknown, but may have been in late spring, summer, or early fall.

The mixing of occupation components is a problem common at both rockshelters and open-air lithic scatters. Vandalism of surface artifacts further confuses the interpretation of archaeological deposits. Thus, the Fall River sites are valuable as time markers and provide good descriptive data on a segment of the Late Prehistoric record.

Chapter 8

Summary and Conclusions

Evaluation of Test Excavation Procedures

The test excavations completed at seven open-air lithic scatter sites located along the Fall River drainage provided an opportunity for extended research on the little-known archaeology of the Upper Deschutes River Basin. This testing strategy was successful in delineating site boundaries and identifying subsurface cultural deposits. This method of research provided a means to investigate and describe open-air lithic scatter sites. In this case, two sites chosen for more intensive study were partially excavated and examined through two large test unit blocks. Despite the fact that the excavated sample size was small when compared to the overall area of the sites, the methods employed provided an abundance of archaeological material with which to characterize the nature of the prehistoric occupation at the Fall River headwaters.

Late Prehistoric Land Use in the Upper Deschutes River Basin

Two sites, located adjacent to the headwaters of Fall River, yielded portions of chipped stone tool kits consist of fragmented obsidian projectile points, point preforms, expediently worked flakes, and a variety of diagnostic debris. Small amounts of cypto-crystalline silicate and basalt were recovered.

No organic material suitable for reliable radiocarbon dating was recovered from either of these sites. Lithic debris and tools are shallowly buried in the reworked Mazama tephra as opposed to being deeply buried within it or the underlying paleosol; therefore, both sites most likely post-date the 6800 years before present eruption of Mt. Mazama.

At the Grayling Springs site, an older Archaic occupation was found, which contained both dart points and a dart point preform. These points were used with an older atlatl weapon system. Aside from the an occasional negative detachment scar found present on various flakes, indicating rough flake blanks rather than the more-refined biface core reduction technology, the extensive mixing of the strata made it difficult to separate this occupation from the Late Prehistoric component. Because most of the archaeological evidence from both of these sites is Late Prehistoric in nature, the following discussion will emphasis this time frame, with some contrasts between the two possible cultural chronologies.

A wide variety of late period projectile points were recovered from both sites. Based on their small size and narrow neckwidth, most can safely be considered arrowpoints. All of the points resemble the Rosespring point type of the Northern Great Basin, and to a lesser extent, late phase Columbia Plateau styles. Radiocarbon dates from a variety of sites indicate these point styles are less than 2000 years in age. The points are similiar to those found in other late period sites on the Upper Deschutes River Basin, such as at Lava Butte, Sand Springs, Lava Island Rockshelter, Pringle Falls sites, as well as at sites in surrounding areas (Davis and Scott 1984, Scott 1984, Minor and Toepol 1984, McFarland 1988c).

A sample of obsidian tools and debris submitted for obsidian hydration dating and source locating indicated that many of the artifacts are made of "generic" obsidian from Newberry Crater, whose flows date in time from approximately 6000 to 1300 years before present. These same pieces yielded hydration rims ranging from 0.8 to 2.6 microns. The mean band width of 30 samples taken from the two sites is 1.7 microns, indicating that the artifacts are likely of recent origin.

In sum, the predominance of the small, late arrowpoints, hydration/source information, and the stratigraphic positioning of cultural material in the Mazama tephra suggest that these sites are no older than 2,000 years before present.

The large number of broken projectile point preforms, resharpened and discarded arrowpoints, and the abundance of pressure flakes at the Grayling Springs site suggest that teritary lithic reduction activities, including retooling and refitting of points on wooden shafts, were principal site activities. The lack of flaked stone scrapers, drills and other types of tools at the Dusty Mink site suggests that this variety of activities was not undertaken. These sites are similiar to many other prehistoric hunting camps found along the Upper Deschutes River and its first-order tributaries, suggesting that prehistoric peoples ranged from both base camps and more commonly, short-term encampments, to conduct a variety of hunting and gathering activities.

Based on the character of the lithic assemblages recovered, the Dusty Mink site appeared to have been a transitory hunters' camp. While the Grayling Springs site probably functioned in a similar fashion, it may also have served as a base camp, where more extensive activities took place. For example, the site may have been located adjacent to a favored fishery, just as the close-by Pringle Falls area was known to be in historic times. However, the archaeological record does not support this. This may be due to the lack of preservation, or it may reflect the true prehistory of the area.

More specifically, lithic technological evidence suggests that these low-density lithic scatter sites were created by Late Prehistoric groups with similiar lithic technological systems. They evidently made use of the local and abundant quarries in Newberry Crater, and used similiar secondary lithic reduction techniques for point production. Obsidian biface cores apparently were transported from the quarry sources in the High Cascades and Newberry Crater. At Late Prehistoric sites along the Deschutes and Fall Rivers, these cores were flaked to produce flake blank fragments. Once the flake blank fragments were taken from biface cores, they were pressure flaked into point preforms and finished arrowpoints. These arrowpoints were used again and again, until it was impossible to resharpen them any longer, and they were discarded.

In summary, the lithic industries at these sites suggest that tool manufacturing efforts were focused on producing projectile points. Whether this activity was the result of immediate hunting activities or retooling weapons during leisure time is not known. Again, no bone, ground stone, or other diagnostic tools were found, but the narrow focus of the lithic assemblages suggests the sites were perhaps hunters' encampments.

How characteristic these various sites are in Late Prehsitoric settlement systems in the Upper Deschutes River Basin is currently problematic since a large regional archaeological data base has yet to be established. Currently, all sites investigated within the Upper Deschutes River Basin appear to post-date the most recent Mt. Mazama eruption. Late Prehistoric sites, such as those found in my study area, are especially plentiful, particularly on low terraces adjacent to the Deschutes River and its tributaries, and adjacent to the members of old river channels. Earlier Archaic material, denoted by the prevalence of larger corner-notched and side-notched points, is less common, though a number of investigated sites have yielded "Elko" variety dart points which are dated between 6-2000 years before present (e.g., Ice 1962, McFarland 1989).

Similar dart points have been recovered at two lithic scatter sites that were test excavated in 1987, located adjacent to the headwaters of the Deschutes River and Lava Lakes. These intensively-used campsites yielded much older archaeological materials (e.g., large corner-notched dart points), and thus older site chronologies than most open-air lithic scatters in the Upper Deschutes River Basin. In contrast to other prehistoric sites excavated over the last several years along the mainstream of the Deschutes River, both of these sites contained near continuous cultural deposits to depths of 100 centimeters below ground surface. However, despite these findings, Middle Archaic and Pre-Mazama sites, characterized by large side-notched and lanceolate points, are rare.

Whether this apparent riverine focus of these Late Prehistoric occupants is an accurate interpretation or merely reflects sampling bias is unknown. Certainly, a number of factors come into play: For example, Archaic period sites may be buried under Mazama and other Holocene tephra deposits or they may be situated on geologically older and higher terraces where testing has not been focused.

Despite potential sampling bias, the Late Prehistoric site patterning still seems to be distinctive from the earlier Archaic occupation found in the Deschutes River Basin. That is, much of this Archaic occupation, denoted by the prevalence of what are provisionally termed "Elko" assembleges, appear to be focused away from the river in the pine forest around ice caves and lava flows. Lava Butte (Ice 1962), Mahogany Cave (Scott 1985a), and East Lake (Flenniken 1987), are good examples of heavily occupied sites located deep within the forest away from any dependable water source except water found in ice caves and possibly isolated springs. In contrast, Late Prehistoric sites are highly concentrated around the Deschutes River and its main-stem tributaries.

An examination of cultural resource survey records from the Bend Ranger District strongly supports this pattern, though these data have yet to be quantified and closely analyzed. Generally, records show, that of all the approximately 250 known sites on the Bend Ranger District, some 85% are found within a quarter mile of the Deschutes River or its tributaries, then some Late Prehistoric sites are found around springs and cave features deep within the Cascade Mountain Range. Further, the majority of diagnostic projectile points recovered at these sites are arrowpoints similiar to the Rosespring and related point styles.

Until more extensive excavations and further surveys are undertaken, it will not be possible to answer the question of how intensive the Late Prehistoric settlement was in the Upper Deschutes River Basin. However, currently available information does provide an opportunity to briefly speculate upon the prehistoric use of the river basin during this time period:

1) It appears the late period inhabitants focused their settlement along the mainstream of the Deschutes River and its

first-order tributaries. As noted, this is somewhat different than the preceding Archaic occupations.

2) Their familiarity with local obsidians and the homogeneous nature of the lithic scatters suggests that indigenous populations occupied this region. They contain much local obsidian from Newberry Crater and the Cascades, and these sites extend well into the high Cascade Mountain Range.

3) Although many current archaeological interpretations tend to consider Late Prehistoric sites the product of the Northern Paiute, the riverine-focus of the Late Prehistoric groups, suggests that many of these sites, and in a sense, this settlement system, is attributable to Indian groups other than the Northern Paiute. In fact, while the Northern Paiute did inhabit the Deschutes River Valley, these low-density lithic scatters could also be a product of a more river-focused group, such as the Tenino, or the Molala who were well-adapted to the Cascade foothills.

Future research strategies should be directed towards gaining a greater knowledge of the rich material culture of these Late Prehistoric period peoples through furthur excavations of sites and rockshelters. This data could be augmented through more reliable organic dating, use of museum collections, and interpretations of traditional use-area information obtained from local Indian tribes.

In conclusion, much remains to be learned about the prehistory of the Upper Deschutes River Basin. Holocene volcanics, and as well as modern disturbances, such as historic railroad logging, have altered the topography, and hence, the archaeological record of the central Oregon area. Conventional methods of ground survey used by archaeologists to discover sites are only partially effective in this region. This thesis has proposed a research strategy that tackles this problem. The strategy discounted the importance of surface lithics as indicators of prehistoric occupation and focused primarily on subsurface evidence in delineating site boundaries and locating occupation deposits. In fact, if this method had not been used at the Dusty Mink site, it would not have been located by surface survey. During the 1985 ground survey, no surface lithics were noted in the vicinity of the block excavation. Only during the 1986 project was the lower terrace area tested, and yielded evidence of a important Late Prehistoric archaeological site. A similar situation holds true at the Grayling Springs site, where the main lithic deposits were found through extensive subsurface testing over broad areas, rather than surface survey.

Lithic Scatter Testing and Research: Problems and Prospects

In addition to producing valuable archaeological research information, the Fall River project also yielded data valuable for evaluating some of the methodological issues surrounding "lithic scatter" research. Specifically, the results of the Fall River project should be weighed against the four methodological issues outlined in the Research

Objectives section in Chapter 1. Each of these four research concerns is disussed below:

1. The Fall River project generated important data regarding the age-old issue of how to best define the boundaries of lithic scatter sites in obsidian-rich environments. Initially, a total of seven archaeological sites were defined in a survey along the Fall River drainage (McFarland and Lindh 1985). So as to not make totally arbitrary and subjective site boundary divisions, sites were defined using topographic features and, to a lesser extent, surface archaeological evidence. As a consequence, all of the sites encompassed rather large areas (some several hundred acres) by comparable definitions of lithic scatters in the Deschutes River basin (e.g., Minor and Toepel 1984) and elsewhere in Oregon (Leland Gilsen, personal communication, 1987).

The site testing strategy involved excavating numerous test pits within the boundaries of each site following an axis parallel to the Fall River (McFarland 1986). Additional units were placed perpendicular to this axis in order to determine the extent of buried cultural material in the forested area away from the banks of the river. Of importance, units were placed at regular intervals within each site with NO special regard for areas where lithic material was visibly concentrated on the surface of the site.

The results of this strategy have been discussed in the Forest Service testing report (McFarland 1986) and this thesis. In sum, of the seven sites tested, only two produced concentrations of buried cultural material. And at the these two sites (Dusty Mink and Grayling Springs), surface evidence was minimal to non-existent. Only the systematic placement of test excavation units in surface artifact-poor areas revealed the location of these extensive and buried cultural deposits. Therefore, five sites proved to be large (and apparently badly disturbed) surface manifestations; only two sites proved to be buried archaeological sites.

Of course, the situation described above is the reason that ALL test excavations are undertaken at any site. The point here is that excavation strategies must not only focus on the visible concentrations of surface lithic material (which may, in fact, only be fortuitously exposed "segregated reduction loci" or stone working areas) but thoroughly examine intervening areas where lithic material may not be visible. Defining tight site boundaries ("splitting" rather than "lumping") based on surface lithic material may impose arbitrary limits on testing strategies and bias accurate interpretation of lithic scatters and the type of prehistoric land use they represent.

It is important to note that sampling bias may have skewed the results described above; in short, although site areas were extensively tested, it is possible that some concentrations of buried lithic material were missed. Future project-initiated testing by the Forest Service may yield the locations of other small, lithic reduction and site activity areas. However, the current testing results give some confidence in the current delineation of sites along the Fall River. In any case, this potential sampling problem does not detract from my principal point that <u>surface evidence is not a good indicator of subsurface cultural deposits in the pumice zone of central Oregon.</u>

2. The second methodological issue concerns the best way to test excavate or extract information from lithic scatters. It too can be addressed using Fall River project data. During the Fall River project, standard excavation procedures were used--single testing units and probes followed by more extensive excavation blocks. With the exception of the Lava Butte site (Ice 1962), few sites in this region have been as extensively dug under the auspices of a testing program. In fact, in compliance language, the fieldwork done at Fall River is commensurate with, or exceeds, many site mitigation programs (Carl Davis, personal communication 1989).

However, it is important to consider that the size of both excavation blocks at Dusty Mink and Grayling Springs are quite small when compared to the overall size of the site, as defined through site testing and to a much lesser extent, surface evidence and topography. When viewed in this way, the excavated sample from each site is less than twenty percent. Further, the block excavations helped to precisely define segregated reduction and activity areas, yielded stratigraphic information and enough projectile points to identify site age and possible cultural affiliation, and produced a systematic sample of lithic debitage to characterize the lithic reduction sequences at both sites. Through this test excavation strategy, the

Forest Service now has enough information to assess the scientific value of both sites. More importantly, we now know enough about the sites to ask meaningful, problem-oriented research questions if and when the sites are further excavated through formal data recovery excavations.

Whether this same level of information could have been obtained through a series of 1 x 1 meter units or smaller test excavation blocks scattered here and there throughout the sites is open to debate. Certainly, using the traditonal testing approach, it is always difficult to tie together the information obtained from individual testing units and it is impossible to tell very precisely the age or function of the site. This testing approach seems to invoke more pleas for a larger site sample, and more testing and research, than any substantive data. Data recovery plans developed on the basis of such testing reports are often nothing more than the recognition that the "site will probably produce something if we dig more"--hardly a problem-focused way to go about full-scale excavations and site mitigations (Carl Davis, personal communication, 1988).

In sum, the approach to lithic scatters taken at Fall River is somewhat non-traditional in that it used large excavation blocks at the test excavation phase in order to both recognize and characterize large, dispersed lithic scatters in central Oregon. Whether this approach is more useful in both long-term research and cultural resource management is still open to debate. Quantitative comparisons of recovery techniques and research results are needed. The Fall River project data will be useful in this effort.

3. The third issue concerns how best to analyze lithic data from sites predominated by lithic debitage and discarded stone tools. As discussed in preceeding chapters, the approach taken in the Fall River project was to focus on 1) morphological (and to some extent, technological) descriptions of formed tools; and 2) technological descriptions of lithic debitage. In regard to the latter, a technological classification key developed by Flenniken (1987) was followed.

This methodology provided precise information about the types of lithic reduction and tool refurbishment strategies at each site. The lithic data allowed for the tentative delineation of two prehistoric habitations at Grayling Springs. The research provides comparative data for similar and on-going lithic studies in central Oregon--an important avenue of research since the bulk of the archeological record in this region is stone tools and obsidian flakes.

Whether this same caliber of information would have been generated by following traditional (morphological) approaches to lithic studies in central Oregon--size grading lithic debitage, emphasizing regional cross-comparsions of projectile points--is open to debate. Certainly, analytical techiques are dependent upon the research questions being asked and my research interest, especially in terms of the recovered lithic debitage, was stone tool technology. However, detailed technological study of the lithic debitage from both sites provided insights into both site age and site function that might not have been realized through simple and standard classifications. Again, evaluating the comparative merits of using both technological and morphological debitage and tool classification systems will be an important area of research in central Oregon archaeology.

4. Finally, the Fall River lithic scatters were not especially helpful in establishing a prehistoric chronology in central Oregon. Both date to the late Prehistoric period, that is, to sometime after about 2000 BP, although an earlier Archaic occupation has been tentatively identified at Grayling Springs. Deeper, better stratifed, open-air prehistoric sites, such as the Lava Lakes site complex (McFarland 1989) need to be excavated before the chronological sequence in central Oregon can be firmly established. On the other hand, enough of the Fall River sites were excavated to characterize the age (and nature) of their prehistoric habitations. They are not "lost in time or space", as are many other lithic scatters in this region which have been only minimally excavated or which have produced few temporally-diagnostic tools or radiocarbon dates (e.g., Minor and Toepel 1984; Scott 1985a). In this sense, these lithic scatters DO add to a more comprehensive understanding of Deschutes River basin prehistory and DO show how lithic scatter research can have important bearing on developing models of local and regional prehistoric settlement and human land use.

In conclusion, the thesis research presented here must be recognized as one of the many steps needed to develop more effective site excavation and analytical strategies in central Oregon. It must also be recognized that much of the data are preliminary in nature; site and sample size were small; excavations were largely dictated by the locations of planned Forest Service developments. Time and funding available for extensive technical analyses were limited. Additionally, low-density lithic scatter sites need to be linked with other site types such as rockshelters, quarry and cache sites, in order to establish a more complete picture of the prehistoric lifeways in the Upper Deschutes River Basin. In this endeavor, it seems logical to work backwards in time by first gaining an understanding of Late Prehistoric land use before focusing research on the preceeding Archaic occupations. This can only be done by assembling the essential building blocks of good descriptive archaeology with the use of lithic reduction studies, x-ray flourescence sourcing and hydration dating, and soils/site formation data.

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APPENDICES

Appendix A. X-ray flourescence analysis results, letter report from Richard E. Hughes (1987).

Sonoma State University
Academic Foundation, Inc.

ANTHROPOLOGICAL STUDIES CENTER
CULTURAL RESOURCES FACILITY
707 664-2381

February 12, 1987

Mr. Carl M. Davis
Forest Archaeologist
Willamette National Forest
P.O. Box 10007
Eugene, Oregon 97440

Dear Carl:

Enclosed you will find xerox copies of three summary tables presenting x-ray fluorescence data generated from the analysis of 40 artifacts from three archaeological sites (Fall River project [n=30], Ray Cache [n=4], and Sugar Cast Cache [n=6]) on the Deschutes National Forest, Oregon. The analyses were conducted pursuant U.S.D.A. (Deschutes National Forest) Purchase Order No. 43-04GG-6-365, under Sonoma State University Academic Foundation, Inc. Account 6081, Job X86-45.

Laboratory investigations were performed on a Spectrace™ 5000 (Tracor X-ray) energy dispersive x-ray fluorescence spectrometer equipped with a Rh x-ray tube, a 50 kV x-ray generator, 1251 pulse processor (amplifier), 1236 bias/protection module, a 100 mHz analog to digital converter (ADC) with automated energy calibration, and a Si(Li) solid state detector with 150 eV resolution (FWHM) at 5.9 keV in a 30 mm^2 area. The x-ray tube was operated at 30.0 kV, .30 mA, using a .127 mm Rh primary beam filter in an air path at 200 seconds livetime to generate quantitative data for elements Zn - Nb. Concentration values for Ba were generated by operating the x-ray tube at 50.0 kV, .35 mA, with a .38 mm Cu filter in an air path at 300 seconds livetime. Data processing for all analytical subroutines is executed by a Hewlett Packard Vectra™ microcomputer with 640K RAM; operating software and analytical results are stored on a Hewlett Packard 20 megabyte fixed disk. Trace element concentrations were computed from a least-squares calibration line established from analysis of 25 international rock standards certified by the U.S. Geological Survey, the U.S. National Bureau of Standards, the Geological Survey of Japan, and the Centre de Recherches Petrographiques et Geochimiques (France). All trace element values on the enclosed summary tables are expressed in quantitative units (i.e. parts per million [ppm] by weight), and these were compared directly to values for known obsidian sources that appear in Higgins (1973), Hughes (1985, 1986), Hughes and Mikkelsen (1986), Jack (1976), Jack and Carmichael (1969), and Skinner (1983). The locations of all obsidian sources identified in the site assemblages appear in Hughes (1985: Map 2; 1986: Maps 3 and 8) and Skinner (1983).

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Artifacts were "assigned" to obsidian sources on the basis of similarities in diagnostic trace element concentration values (i.e., ppm values for Rb, Sr, Y, Zr and, when necessary, Ba). Since the enclosed data tables present the source attribution for each specimen, it is unnecessary to repeat this information.

It is clear, however, that the vast majority of specimens were fashioned from volcanic glasses occurring in the Newberry Volcano, a finding which is not particularly surprising given the abundance of artifact quality glasses occurring at these sources, and their proximity to the sites. Lesser amounts of more distant obsidian from the north (Three Sisters [Obsidian Cliffs]), south (Silver Lake/Sycan Marsh), and east (McKay Butte/Quartz Mountain; Cougar Mountain) round out the inventory. The Cougar Mountain source attributions were corroborated by running the specimens a second time to generate Ba ppm values. The concentration values obtained for specimens FS-7, FS-12 (from the Sugar Cast Cache) and RC-4 (1291.3 ±16.1, 1250.9 ±16.4, and 1241.1 ±16.1, respectively), in concert with Rb, Sr, Y, and Zr ppm values, indicated a clear match with obsidian of the Cougar Mountain geochemical type (cf. Hughes 1986: Table 11).

As I discussed in my letter of April 22, 1986 (detailing the results of analysis of obsidian from the Pahoehoe Cache, Lava Island Rockshelter, and the China Hat Cache), it is not possible to effectively separate Quartz Mountain obsidian from that occurring at McKay Butte using ppm values for these seven trace elements. I'm currently working on a program subroutine which will allow non-destructive measurement (in ppm concentration units) of another "diagnostic" element (manganese), but the calibration is not yet complete. Consequently, for the present, I have not attempted to make a finer distinction between these two sources.

I hope this information will help in your analysis of these site materials. Please contact me if I can be of further assistance. Tom Origer will return the specimens to you when he has completed the obsidian hydration analyses.

Richard E. Hughes, Ph.D.
Senior Research Archaeologist

February 12, 1987
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Specimen Number	Trace Element Concentrations							Obsidian Source (Chemical Type)
	Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	
FS-2	87.6 ±7.0	21.9 ±3.8	120.7 ±5.2	6.2 ±3.3	46.5 ±2.3	338.3 ±5.4	18.3 ±3.5	SILVER LAKE/ SYCAN MARSH
FS-3	41.6 ±13.9	13.2 ±8.4	80.5 ±5.5	116.3 ±3.9	21.5 ±2.9	100.8 ±4.9	6.9 ±4.3	THREE SISTERS (OBSIDIAN CLIFFS)
FS-4	54.1 ±7.1	18.5 ±3.7	78.7 ±5.0	118.2 ±3.1	19.2 ±2.3	97.7 ±4.2	10.8 ±4.3	THREE SISTERS (OBSIDIAN CLIFFS)
FS-5	59.8 ±7.2	20.7 ±3.7	133.3 ±5.2	61.5 ±2.9	36.1 ±2.3	280.3 ±5.0	14.8 ±3.5	NEWBERRY VOLCANO
FS-6	55.6 ±8.2	18.2 ±4.4	131.5 ±5.4	66.7 ±3.1	39.6 ±2.5	285.0 ±5.5	12.4 ±3.7	NEWBERRY VOLCANO
FS-7	63.4 ±7.9	20.2 ±4.1	127.8 ±5.4	42.1 ±3.0	41.1 ±2.5	269.8 ±5.4	11.0 ±3.7	UNKNOWN
FS-8	63.1 ±6.9	18.3 ±3.9	133.1 ±5.2	62.2 ±3.0	34.5 ±2.3	212.5 ±4.7	11.6 ±3.5	McKAY BUTTE/ QUARTZ MOUNTAIN
FS-12	56.8 ±8.2	17.1 ±4.4	135.5 ±5.4	62.9 ±3.1	38.7 ±2.4	291.3 ±5.4	15.2 ±3.6	NEWBERRY VOLCANO
FS-19	66.3 ±9.4	18.8 ±5.1	136.7 ±5.8	61.9 ±3.3	40.0 ±2.8	295.6 ±6.3	23.1 ±3.8	NEWBERRY VOLCANO
FS-22	45.5 ±9.9	18.5 ±4.6	133.1 ±5.5	59.4 ±3.2	36.8 ±2.6	278.9 ±5.7	13.5 ±3.8	NEWBERRY VOLCANO
FS-23	62.4 ±8.4	19.1 ±4.4	145.5 ±5.6	68.3 ±3.2	37.2 ±2.6	225.9 ±5.3	14.1 ±3.7	McKAY BUTTE/ QUARTZ MOUNTAIN
FS-24	70.4 ±8.7	17.7 ±4.8	144.8 ±5.7	66.0 ±3.3	37.3 ±2.7	299.6 ±6.1	21.1 ±3.8	NEWBERRY VOLCANO
FS-25	57.7 ±8.2	16.0 ±4.8	140.2 ±5.5	62.7 ±3.1	37.3 ±2.5	285.8 ±5.6	13.3 ±3.7	NEWBERRY VOLCANO
FS-27	49.5 ±8.2	17.9 ±4.1	124.3 ±5.4	60.4 ±3.1	37.8 ±2.5	271.0 ±5.3	16.2 ±3.6	NEWBERRY VOLCANO
FS-29	54.6 ±6.8	21.1 ±3.4	118.9 ±5.1	73.3 ±3.0	35.9 ±2.3	249.0 ±4.8	11.7 ±3.4	NEWBERRY VOLCANO
FS-32	65.2 ±8.5	21.9 ±4.0	125.5 ±5.6	62.1 ±3.2	36.6 ±2.6	260.6 ±5.7	12.5 ±3.9	NEWBERRY VOLCANO
FS-36	64.8 ±6.5	19.9 ±3.6	131.7 ±5.2	59.8 ±3.0	41.5 ±2.3	281.7 ±5.0	13.8 ±3.4	NEWBERRY VOLCANO

* All trace element values in parts per million (ppm).
± Counting error and fitting error uncertainty at 200 seconds livetime.

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Specimen Number	Trace Element Concentrations Zn*	Ga*	Rb*	Sr*	Y*	Zr*	Nb*	Obsidian Source (Chemical Type)
FS-40	55.4 ±7.6	19.6 ±3.8	124.7 ±5.3	56.9 ±3.0	38.6 ±2.4	282.0 ±5.3	21.1 ±3.5	NEWBERRY VOLCANO
FS-41	69.9 ±6.5	19.4 ±3.6	128.1 ±5.3	60.9 ±3.0	37.8 ±2.3	289.8 ±5.1	18.1 ±3.4	NEWBERRY VOLCANO
FS-42	52.1 ±7.3	17.3 ±3.8	133.0 ±5.3	59.0 ±3.0	37.8 ±2.3	275.8 ±5.1	17.7 ±3.5	NEWBERRY VOLCANO
FS-44	53.3 ±7.0	16.3 ±4.0	131.6 ±5.2	57.5 ±3.0	36.5 ±2.4	272.7 ±5.0	15.6 ±3.5	NEWBERRY VOLCANO
FS-45	62.0 ±7.4	19.3 ±3.8	144.5 ±5.4	62.1 ±3.0	37.0 ±2.4	209.4 ±4.8	9.7 ±3.6	McKAY BUTTE/ QUARTZ MOUNTAIN
FS-46	73.5 ±7.7	21.9 ±4.0	145.4 ±5.6	63.6 ±3.2	38.5 ±2.6	301.6 ±6.0	16.8 ±3.8	NEWBERRY VOLCANO
FS-50	60.7 ±6.8	17.8 ±3.8	129.5 ±5.2	63.2 ±3.0	39.5 ±2.3	276.5 ±5.0	15.7 ±3.5	NEWBERRY VOLCANO
FS-51	54.3 ±7.0	16.2 ±4.1	65.3 ±5.1	51.4 ±3.0	38.7 ±2.3	111.6 ±4.4	14.5 ±3.5	UNKNOWN
FS-53	54.9 ±7.4	18.5 ±3.7	131.3 ±5.3	57.0 ±3.0	37.4 ±2.4	266.4 ±5.1	17.9 ±3.5	NEWBERRY VOLCANO
FS-58	69.2 ±8.3	22.5 ±4.1	146.0 ±5.7	64.1 ±3.3	38.8 ±2.7	300.3 ±6.2	19.3 ±3.8	NEWBERRY VOLCANO
FS-59	61.5 ±7.9	18.1 ±4.6	140.9 ±5.6	64.9 ±3.2	40.5 ±2.6	298.8 ±5.8	20.6 ±3.7	NEWBERRY VOLCANO
FS-60	53.2 ±6.9	18.2 ±3.6	120.4 ±5.2	60.3 ±3.0	39.1 ±2.3	268.5 ±5.0	18.7 ±3.4	NEWBERRY VOLCANO
FS-61	61.1 ±6.7	18.1 ±3.7	128.6 ±5.3	63.6 ±3.0	40.3 ±2.3	288.0 ±5.1	15.1 ±3.5	NEWBERRY VOLCANO
RC-1	70.6 ±7.0	18.3 ±3.9	112.0 ±5.2	4.8 ±4.6	42.4 ±2.4	320.7 ±5.3	13.9 ±3.5	SILVER LAKE/ SYCAN MARSH
RC-2	82.2 ±6.7	19.2 ±3.7	114.7 ±5.2	8.4 ±3.0	44.0 ±2.4	326.5 ±5.3	15.3 ±3.5	SILVER LAKE/ SYCAN MARSH
RC-3	76.5 ±6.9	20.1 ±3.7	119.6 ±5.2	7.8 ±3.0	50.1 ±2.4	334.6 ±5.5	13.2 ±3.5	SILVER LAKE/ SYCAN MARSH
RC-4	72.8 ±6.5	20.1 ±3.4	91.0 ±5.1	36.8 ±2.8	46.1 ±2.3	127.0 ±4.3	8.4 ±3.5	COUGAR MOUNTAIN

* All trace element values in parts per million (ppm).
± Counting error and fitting error uncertainty at 200 seconds livetime.

Appendix B. Obsidian hydration analysis results, letter report from Thomas M. Origer (1987).

Sonoma State University
Academic Foundation, Inc.

ANTHROPOLOGICAL STUDIES CENTER
CULTURAL RESOURCES FACILITY
707 664-2381

Carl Davis, Forest Archaeologist
Willamette National Forest
Box 10007
Eugene, Oregon 97440

February 16, 1987

Dear Carl:

This letter reports hydration band measurements for 40 obsidian specimens that you submitted for hydration and source analysis. The specimens were from three locations on the Deschutes National Forest, Oregon. The source work was completed by Richard Hughes and the results are presented in a separate report. The work was completed pursuant to Purchase Order No. 43-04GG-6-365 issued by the Deschutes National Forest to the Sonoma State University Academic Foundation, Inc.

The specimens were subjected to hydration analysis at the Sonoma State University, Obsidian Hydration Laboratory. The procedures used by the SSU Obsidian Hydration Lab for thin section preparation and hydration band measurement are described below.

Each specimen was examined in order to find two or more surfaces that would yield edges which would be perpendicular to the microslide when preparation of the thin section was completed. Two small parallel cuts were made at an appropriate location along the edge of each specimen with a four inch diameter circular saw blade mounted on a lapidary trimsaw. The cuts resulted in the isolation of small samples with thicknesses of approximately one millimeter. The samples were removed from the specimens and mounted with Lakeside Cement to prenumbered petrographic microslides.

The thickness of each sample was reduced by manual grinding with a slurry of #500 silicon carbide abrasive on a glass plate. The grinding was completed in two steps. The first grinding was terminated when the sample's thickness was reduced by approximate 1/2, thus eliminating micro-chips created by the saw blade during the cutting process. Each slide was then reheated, which liquified the Lakeside Cement, and the samples inverted. The newly exposed surface was then ground until a final thickness of 30 to 50 microns was attained.

The final thickness of each thin section was determined by the "touch" technique, whereby a finger was run across the slide, onto the sample, and the sample's thickness determined by feel.

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