Winter 2017

Forager and Collector Strategies in the Yakima Uplands: An Analysis of Archaeological Assemblages from Testing Projects on the U.S. Army Yakima Training Center, WA.

John M. Davis
Central Washington University, davisjohn@cwu.edu

FORAGER AND COLLECTOR STRATEGIES IN THE YAKIMA UPLANDS: AN ANALYSIS OF ARCHAEOLOGICAL ASSEMBLAGES FROM TESTING PROJECTS ON THE U.S. ARMY YAKIMA TRAINING CENTER, WA.

A Thesis

Presented to

The Graduate Faculty

Central Washington University

In Partial Fulfillment

of the Requirements for the Degree

Masters of Science

Cultural and Environmental Resource Management

---

by

John M. Davis

March 2017

CENTRAL WASHINGTON UNIVERSITY

Graduate Studies

We hereby approve the thesis of

John M. Davis

Candidate for the degree of Master of Science

APPROVED FOR THE GRADUATE FACULTY

______________ ____
Dr. Steven Hackenberger, Committee Chair

______________ ____
Dr. Lisa Ely

______________ ____
Dr. James C. Chatters

______________ ____
Nathaniel Morse M.S.

______________ ____
Dean of Graduate Studies

ABSTRACT

FORAGER AND COLLECTOR STRATEGIES IN THE YAKIMA UPLANDS: AN ANALYSIS OF ARCHAEOLOGICAL ASSEMBLAGES FROM TESTING PROJECTS ON THE U.S. ARMY YAKIMA TRAINING CENTER, WA.

by

John M. Davis

March 2017

Despite nearly 40 years of testing projects on the Yakima Training Center, there remains little understanding of human adaptations and subsistence patterns through time in the Yakima Uplands. Additionally, there is a need for a managerial testing review. Assemblage data from fifty-one discrete components spanning the Holocene allowed an economic site type model to be built. Results indicate a shift towards intensive upland resource procurement systems beginning 2,200 cal B.P. Assemblage artifact dimensions do not correlate with Site Type but do reflect expected changes associated with a transition from forager to collector systems. Assemblage data only appear complete at $10m^3$ volume sampled. Radiocarbon records indicate cultural samples are heavily skewed towards post-2500 B.P. Geologic samples are more evenly distributed, with gaps likely attributable to depositional processes. Managerial recommendations for future testing and research were developed from the above analyses.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my committee chair, Dr. Steve Hackenberger. His assistance and guidance throughout this project was invaluable. I would also like to thank my committee members, Dr. Lisa Ely, Dr. James Chatters, and Nate Morse for their invaluable help. Paul Solimano and James Brown took time from their busy schedules to provide assistance. Last but not least, countless thanks go to my friends and family for their support in my new endeavor.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The US Army Yakima Training Center (YTC) comprises 327,000 acres of upland shrub-steppe habitat located in central Washington State. Established in 1951, the YTC is a live fire and maneuver military site. Because the YTC is managed by the Department of Defense, it falls under Section 106 guidelines of the National Register of Historic Places (NRHP). Section 106 of the NRHP requires Federal agencies to take into account the effects of their undertakings on historic properties. As a result of Section 106 and related guidelines, some of the most abundant and significant archaeological evidence of upland subsistence and settlement in the in shrub-steppe environments can be studied and protected on the YTC.

Humans have occupied the Yakima Uplands for at least 11,000 years, using the land for hunting, root and plant gathering, lithic procurement, and stone tool manufacturing (Gough et al. 1998, Hackenberger 2009). Over this time span, small mobile foraging bands developed into larger and more sedentary communities (Schalk and Cleveland 1983, Chatters 1987; Schalk, et al. 1994). The YTC has been host to large-scale archaeological surveys over the past 40 years, with over 1300 pre-contact and historic sites having been recorded (Hackenberger 2009). Thirteen archaeological testing projects have been completed since the late 1970’s, documenting over 60 sites.

Problem

Despite the massive amount of archaeological data produced by testing projects, no work has been undertaken to synthesize, analyze, and interpret the assemblage data. Thus, there is a critical need to assess whether testing methods allow insights into human land use through the Holocene in the Yakima Uplands. By assessing artifact dimensions in chronologically discrete archaeological assemblages, changes in subsistence and settlement adaptations spanning the Holocene may be inferred.

Purpose

The purpose of this research was to ascertain whether site types can be inferred through time based on artifact dimensions and site features from YTC assemblage data. Secondly, the methods employed by archaeologists in the testing projects were assessed for adequacy in producing data allowing for scientific analysis of perceived changes in Yakima Upland subsistence and settlement patterns. Thirdly, the radiocarbon dates collected from testing projects were compiled, calibrated, and graphed to identify distribution patterns and possible gaps in the record.

To meet these needs, the specific objectives addressed were:

Research Objective 1: *To compile archaeological data from test excavations to develop a database with suitable artifact sample sizes and provenience data for determining subsistence activities and site function*. This analysis was accomplished by identifying vertically and horizontally discrete assemblages with associated chronological markers. Artifacts and features were assessed to identify site tasks such as plant processing, animal processing, and stone tool manufacturing. Through analysis of site features, assemblage composition, and technological organization, temporal variation in the organization of settlement systems (transitions from mobile to logistic systems) was inferred.

Research Objective 2: To assess whether the testing methods employed in YTC projects have generated data suitable for scientific analysis to infer Yakama Upland land use through time. Testing sample size is known to influence assemblage data (Lyman 1991). Field provenience, adequate site report recording, and explicit laboratory methodologies are necessary to place artifacts in suitable classifications and temporal contexts confidently.

Research Objective 3: To build a database of radiocarbon assays from the YTC and perform a chronometric hygiene of those age estimates. Radiocarbon samples have been obtained from both cultural and geological contexts. Dates were plotted to identify possible gaps in both cultural and geological chronologies throughout the Holocene.

Given the above objectives, this thesis addresses the following research questions:

Research Question 1: *What can a comparison of observed changes in assemblage composition and site features from one time period to another reveal about site use?* Variation in assemblage composition and site features through the Holocene were compared to allow inferences regarding changes in mobility and subsistence patterns. Lithic assemblages associated with mobile, foraging cultures reflects technological efficiency, portability, and multi-use capabilities. Therefore, fewer total tool classes and higher assemblage evenness should be observed (Shott 1986). A shift to a semi-sedentary, collector culture is reflected in more specialized toolkits necessary to process a more diversified resource procurement and processing strategy (Kelley 1992). Assemblage analysis reveals higher tool-class richness and diversity, but less evenness, reflecting the need for specific tools to process targeted resources (Shott 1986, Nelson 1991). However, task specific site assemblages (such as those located in upland areas) may display evenness. Presence of earth ovens and millingstone are indicative of plant processing activities. Amounts of fire modified rock (FMR) and faunal remains are indicative of plant and animal processing. Higher amounts of FMR and faunal remains may indicate intensive use of animal resources greater than necessary for upland activities, thus signaling storage activities for future use at related riverine village sites (Prentiss et al. 2005).

Research Question 2: *What can the evaluation of the relationship between artifact samples size and assemblage richness tell us about site use and subsistence patterns?* Typically, assemblage richness may be influenced by assemblage size (Jones et al. 1983; Rhode 1988). Regression analysis and scatter plots can be used to identify the relationship between the number artifacts recovered and number of tool classes represented (Jones et al. 1983, Shennan 1997). The quality of data recording in site reports was reviewed in accordance to whether researchers used the same criteria for tool classification, whether assemblage data was recorded in context with chronological indicators, and the use of geoarchaeological techniques to help frame sites and components in a discrete chronological context.

Research Question 3: Are radiocarbon dates obtained from geologic or cultural contexts distributed evenly throughout the Holocene and representative of known cultural activity? Dates were calibrated and plotted to assess for sampling distribution.

Geological and cultural dates were separated to compare the number and distribution of all dates. Cultural dates were assessed to discern whether they were obtained from material from in situ features or from materials associated with anthropogenic components.

Significance

This thesis makes contributions to the study of the development of subsistence adaptations of the Yakima Uplands in particular and the Prehistory of the Southern Columbia Plateau in general. Although the region has been inhabited for thousands of years, and archaeologists have been attempting to understand it for decades (Chatters and Zweifel 1987, Boreson 1998, Beery 2002, Hackenberger 2009), many unanswered research questions remain regarding how resources were used, and how land use has evolved over time.

Systematic comparison of archaeological assemblages from CRM testing projects within a chronological framework opens up new research potentials for explaining shifts between foraging and collecting strategies. The workable research framework opens up a new scientific understanding of these adaptations which allows cultural resource managers to make more-holistic decisions regarding the conservation and management of key archaeological sites located on the YTC. These results will strengthen arguments for the scientific significance of sites and potential of protection under federal cultural resource management laws.

CHAPTER II

LITERATURE REVIEW

The theoretical orientation of my research is grounded in Binford's model of mobile foragers and logistic collectors (Binford 1980, 2001). Studies of Columbia Plateau adaptations often focus on transitions from foraging (mobile) to collecting (logistic) that took place between 4000 and 3000 years ago (Schalk et al. 1994, Hackenberger 2010). Several types of sites develop under collecting strategies (residential base, hunting task sites, fishing task sites, plant collecting task sites, and stone tool quarry/workshop sites), and the structure of residential sites becomes more complex (Chatters 1987). The basic assumption that archaeologists have been working from is that the toolkits and technological organization of hunter-gatherers are directly associated with land use patterns and changed over time as populations adapted to environmental and social conditions (Binford 1980). For example, house features and other costly structures are unlikely to be associated with mobile hunter-gatherer bands but are indicative of a shift to a sedentary, collector model. Similarly, cached deposits of stone tools may be indicative of regularized seasonal settlement patterns (Delacorte and Hildebrandt 1994).

Binford's (1980) argues that foragers "map onto" their resources, meaning that populations move their residences frequently in accordance with the proximity necessary to gather food resources. The food resources were gathered using a general, expedient model with no regard for storage. Collectors focus on food resources that can be collected in large quantity and stored. Collectors employ a logistical mobility whereby residences were changed much less frequently, and small groups of people are employed with the task of gathering large quantities of food resources for storage and later consumption (Chatters 1987).

Binford's forager-collector model was adapted for Northwest archaeology by Randall Schalk and Greg Cleveland in their archaeological report on the Lyon's Ferry site (Schalk and Cleveland 1983). Schalk and Cleveland put forth the theory that two main settlement and subsistence systems coexisted in the region: First, a broad-spectrum foraging (hunter-gatherer) system which was in place from 11,000 cal B.P. to 2,500-4,500 cal B.P. The second system was semi-sedentary foraging settlement system which evolved between 2,500 and 4,500 cal B.P.

Chatters cautions against interpreting Binford's forager-collector model as a one-dimensional linear continuum which is scaled with the ability to pinpoint adaptive patterns. Rather, he submits that adaptation should be viewed "as a multidimensional phenomenon varying along potentially independent axis" (1987:337). When viewing Binford's theory from this point-of-view, hunter-gather adaptations are clusters of points in time, rather than linear evolutions. By viewing adaptation through this paradigm, we may be able to piece together smaller interrelated pieces of evidence related to cultural and environmental adaptive change.

Chatters (1987) builds upon these theories in designing an assemblage analysis procedure. He breaks his analysis down to three main components: assemblage tool and feature diversity, interassemblage variability, and anatomic part distribution.

1.) Assemblage Tool and Feature Diversity: Chatters proposes that there will be a lower diversity of tools in field camps than base camps because tasks are narrowly divided at base camps and revolve around acquiring and processing food resources. Conversely, base camp activities vary over a wide range with multiple tasks performed. Therefore, a more diverse set of tools would be necessary to meet the needs. Similarly, house features such as hearths and ovens will be more prominent in a permanent base camp than temporary field camp.

2.) Interassemblage Variability: Based on Binford's (1980) theory that assemblages left by an organizational system should segregate into separate, distinct types, we should expect base camps and field camps to display high probability of assemblage similarity. This is due to expected on-site redundancy in labor in processing food sources. However, mobile bands procuring prey species were likely to employ an efficient variety of taxa to best suit the needs required to kill the prey. Thus, "mapping on" sites should display a higher degree of variability of taxa than semi-permanent camps.

Other research conducted on assemblage analysis has incorporated the variability and influence of sample size (Jones, et al. 1983, Rhode 1988, Delacorte and Hildebrandt 1994). Although larger samples sizes can also increase tool diversity, task sites often contain fewer types of tools and more expedient versions of tool types (Shott 1986). Thus, sites with a high diversity of artifacts often represent seasonal, or multi-season, residence sites that include greater amounts of domestic activity (Chatters 1987). Working within California and the Northern Great Basin, Delacorte and Hildebrandt (1994) provide one of the simplest and most practical methods for comparing assemblage composition, identifying activities and typing site functions.

Delacorte and Hildebrandt (1994) identify several types of subsistence and quarry activities and diagram the relationship between five types of sites:

1.) Simple Ground Stone Assemblage Sites (Plants)

2.) Complex Ground Stone Assemblage Sites (Plant processing and Residence)

3.) Quarry Sites (mining and testing stone tool materials)

4.) Complex Flaked Stone Assemblage Sites (Meat processing and residence with some tool workshop areas)

5.) Simple Flaked Stone Assemblage Sites (kill sites or small workshops)

Schalk et al. (1994) offer a significant refinement of the Schalk and Cleveland (1983) model of intensified land use, strategies, and archaeological assemblages. Houser (1996), expanding on Schalk et al. (1995), also builds a model of assemblage structure and artifact diversity for the Southern Plateau. His lists of assemblage traits and types are longer, but possibly over-complicated.

Salo (1985) proposed a model based on assemblages from the Chief Joseph Dam Project to identify toolkit functionality differences between forager and collector assemblages from Plateau sites. Through functional classification of site dimensions focusing on feature characteristics, the density of fire modified rock and faunal remains, and lithic assemblage diversity and richness, site types may be assigned.

Gough et al. (1998) built upon Salo's 1985 work to assign site types to assemblages excavated on the YTC. To measure occupation intensity and site type, features were delineated into three types. Density of bone, FMR, and debitage was assigned levels from 1-3 based on the amount recovered per volume excavated. Lastly, functional richness was calculated to assess stone tool diversity.

To justify the proposed study, it is possible to review examples of reports of test excavations that can be used to collect data sets and evaluate sample sizes and models of assemblage structure. These reports can also be cited for stratigraphic information and chronological evidence.

As a research note, although much large scale reconnaissance survey work has been completed on the YTC over the past 37 years, this thesis focuses on projects employing sub-surface testing methods. A primary goal of this research is to construct a chronological framework for the Yakima Uplands; therefore, reports containing assemblages from which discrete components with a firm date based on radiocarbon testing, stratigraphy, and/or diagnostic projectile points were targeted for analysis.

Despite Congress passing NHPA in 1966 and NEPA in 1969, Cultural Resource projects were not initiated on the YTC until 1976 when Maj. Robert E. Kavanagh conducted field reconnaissance survey work along Umtanum and Manashtash ridges for a U.S. Army underground cable project (Hartmann and Lindeman 1979).

Excavation projects began in 1978 by Washington State University's (WSU) Washington Archaeological Research Center under the direction of Glenn Hartmann (Hartmann and Lindeman 1979). The purview of the project included the excavation of ten sites in the Northeast section of the YTC along Hanson Creek, No Name Canyon, and Alkali Canyon. Projectile points from the Frenchman Springs, Quilomene Bar, and Cayuse Phases were recovered. However, research was hampered by a lack of visible stratigraphic profile, limiting authors' ability to assign the datable material associated with assemblages to a chronological marker. No radiocarbon dates were obtained.

Excavation of the Wa-pai-xie complex (45KT241), consisting of a small cave and rockshelter, was conducted by the University of Washington, Office of Public Archaeology, in 1978 under the direction of James Chatters (Chatters 1979). Though the cave had been heavily damaged by looters, archaeologists were able to identify three prehistoric occupations in the rockshelter. The occupations spanned 8000 years, representing Vantage, Frenchman Springs, and Cayuse Phases. Well-preserved faunal remains were associated with the Vantage Phase. Small bone fragments from a human burial were also recovered.

Central Washington Archaeological Survey (CWAS) tested five archaeological sites on Squaw Creek in (now L'mumma Creek) in the Northwest portion of the YTC) in 1979, again under the direction of Glenn Hartmann. The Squaw Creek location was chosen in hopes of recovering assemblages to use as a comparison to the Hansen Creek site excavated the year before. Projectile points representative of the Frenchman Springs and Cayuse Phases were recovered. There was no nominal tally of data, and no separation of artifacts recovered from land survey and excavation. No geoarchaeological data, including site stratigraphy, were recorded.

Three archaeological sites were tested in 1980 in the eastern part of the YTC in Cow Canyon, Sourdough Canyon, and Corral Canyon under the direction of Malcolm Sender of Wapora, Inc. (Sender 1981). Sites were excavated by arbitrary 5 or 10cm levels, depending on the number of artifacts recovered. Each artifact (excluding flakes) was recorded with a separate catalog number and spatial location within the excavation unit. Cold Springs, Frenchman Springs and Cayuse Phase projectile points were recovered from one test pit, but no material for dating or stratigraphic profile information was obtained in order to place these finds in discrete chronological units.

CWAS evaluated ten sites on the YTC under the direction of Dr. James Chatters in 1984 (Chatters and Benson 1984). The testing areas were located in the upper drainages of Badger Creek, Hanson Creek, Cottonwood Creek, and No Name Creek. Excavations identified nine datable occupations spanning approximately 4800 years from the Vantage through Late Cayuse Phases. Chronologies were based on a combination of radiocarbon dates, stratigraphic profiles, and/or temporally diagnostic projectile points. All artifacts were cataloged separately by trench and component. Lithic materials were analyzed and classified using categories established by

Plateau archaeologists. Natural and cultural stratigraphies were also recorded at all site locations.

Chatters returned to the YTC the following year and tested six sites in the Hanson Creek Drainage, located in the northeast corner of the YTC (Chatters and Zweifel 1987). Nine discrete stratigraphic units were identified among four of the sites. Occupations were determined to be representative of the late Vantage, early Frenchman Springs, and Late Cayuse Phases. All artifacts were recorded according to grid unit and vertical level. Artifacts larger than 3 cm were mapped *in situ.* Occupation features were excavated in separate units stratigraphically. Stratigraphic profiles were drawn in all excavation units, backhoe trenches, and exposed banks. Soil characteristics were recorded, and samples were collected for phytolith, pollen, and sediment analysis. Charcoal samples were obtained from the soil matrix and residential features from two sites. A total of nine radiocarbon age analyses were obtained.

Historical Research Associates, Inc. (HRA) conducted testing along the Selah Creek Drainage between 1991 and 1993 (King and Putnam 1994). Five sites were tested, yielding four distinct components. Five radiocarbon dates obtained, in conjunction with projectile points recovered, led researchers to assign all four components to a Cayuse Phase occupation.

Archaeological and Historical Services (AHS) of Eastern Washington University (EWU) test excavated five sites in 1994-94 under the direction of Jerry Galm (Boreson 1998). Sites were located in the Foster Creek, Johnson Creek, and Middle Creek drainages.

In 1997 Northwest Archaeological Associates, Inc. tested six sites (45KT924, 45KT1185, 45KT1189, and field numbers 2188-A, 2188-D and 25/9/5) in prehistoric lithic procurement areas on upland ridges, under the direction of Christian Miss (Miss 1999). As the site areas had been damaged due to Army vehicle maneuvers, the goals of the project were to address the

NRHP eligibility of the sites, to create a historical context of the lithic landscape of the Yakima Uplands and suggest to a cultural resource management plan for the affected areas. Two sites were located above an unnamed tributary to Lmumma Creek, three were located above Hanson Creek, and one overlooked Middle Canyon. As previous excavation projects on the YTC had focused on tributary and drainage basin locales, this project presented a new opportunity to test Upland sites previously identified by survey work.

Archaeological and Historical Services (AHS) of Eastern Washington University (EWU) tested two sites in 1998 (Gough 1999). Site 45KT1362 is located near the eastern boundary of the YTC in a tributary valley of lower Hanson Creek, while site 45KT726 is situated in the Johnson Creek valley in the Northeast portion of the YTC. Radiocarbon dates and stratigraphic markers indicate that 45KT1362-AU1 was occupied around 10,000 cal B.P. Site 45KT1362 yielded the largest early-Holocene assemblage recovered on the YTC.

An additional testing project conducted by AHS in 1998 included site 45KT950, located on lower Hanson Creek (Gough 1998). A feature containing lithic and faunal remains radiocarbon dated to early Vantage Phase was documented. Other site artifacts indicated use throughout the mid- to late Holocene.

HRA returned to the YTC to test six sites located along the North Fork of Lmuma Creek, and five other sites located along the northern, southern, eastern, and southern boundaries Beery 2002). Radiocarbon dates obtained from a shell midden indicate occupation beginning in the early Vantage Phase. Projectile points associated with Vantage, Frenchman Springs, and Cayuse Phase occupations were also recovered.

CHAPTER III

STUDY AREA

Geology

The YTC is situated in the northwest corner of the Yakima Fold Belt (YFB) subprovince of the Columbia Plateau, straddling the boundary of the Central Cascade and Columbia Plateau geologic provinces (Reidel et al. 1989). The YFB is composed of a series of anticlines within the Columbia River Basalt Group (CRBG) Miocene basalt flows. The CRBG flows were folded and faulted under north-south directed compression, forming the non-cylindrical, asymmetrical anticlinal ridges and synclinal valleys in a general east-west trend. A series of broad, flat basins separates the major anticlines, creating a fanning pattern across the YFB (Reidel, et al. 1989). Besides the CRBG, the rocks and sediments underlying the YTC include the Ellensburg Formation, the Thorp Gravel, and Quaternary alluvial, aeolian, fluvial, and Missoula flood sediments (Reidel et al. 2003).

The Ellensburg Formation overlies and interfingers with the CRBG (Reidel, et al. 1989). It is composed of siliciclastic and volcaniclastic sedimentary rocks that supply a source of cryptocrystalline silicates (CCS) (Adams 2014). CCS is also often referred to by the general term of “chert,” which includes opal, chalcedony, jasper, and petrified wood. The YTC contains hundreds of documented outcrops of chert. As a result, chert represents almost the entirety of stone tool material found at archaeological sites on the YTC (Flenniken et al. 1997, Miss 1999, Adams 2014).

In an effort to build an alluvial chronology on the YTC, several archaeologists and geomorphologists have analyzed the depositional and erosional events of the major drainage basins (Galm et al. 2000). The drainages are marked by deeply incised channels with steep side-walls. Holocene alluvium, interbeds within the CRBG, basalt flows, and volcanic ash are often exposed. Environmental variation throughout the Holocene is believed to be responsible for much of the erosional downcutting, aggradation, and channel shifts evident in the study area (Galm et al. 2000). Volcanic ashes identified on the YTC are listed in Table 1.

Table 1: Calibrated Ages of Volcanic Tephras seen on the YTC (Galm et al. 2000)

Source	Dat (cal B.P.)
Mount St. Helens	1980
Mount St. Helens-W	515
Mount St. Helens-Y	3770
Mazama	7627
Glacier Peak	13,075
Mount St. Helens-J	12,835-13,815
Mount St. Helens-S	15561

The Columbia and Yakima Rivers flow through the YFB, just outside the boundary of the YTC. The Yakima River flows south along the West boundary of the YTC; the Columbia River flows south to southeast along the east boundary. Several smaller tributaries flow through the YTC and drain into the rivers. Johnson, Hanson, and Alkali creeks flow east and drain into the Columbia. Selah, Burbank, and Lmumma creeks flow west towards the Yakima River (Galm et al. 2000)

The Columbia Basin shrub-steppe region lies in a vegetation zone defined by Daubenmire (1988) as *Artemisia tridentata - Agropyron spicatum* (big sagebrush/bluebunch wheatgrass), whereby sagebrush and grasses are the predominant covers on slopes and hilltops. Over 600 plant species have been documented on the YTC (Hackenberger 2009). The introduction and spread of noxious weeds, including tumble mustard (*Sisymbrium* spp.), knapweed (*Centaurea* spp.), cheatgrass (*Bromus tectorum*), and Russian thistle (*Salsola kali*), has left an indelible mark on the modern YTC landscape (Daubenmire 1988). Steppe plants utilized as food by indigenous populations include blue-eyed grass (*Sisyrinchium* spp.), sedges (*Carex* spp.), balsamroot (*Balsamorhiza* spp.), sunflower (*Helianthus annus*), and hawksbeard (*Crepis* spp.) (Hackenberger 2010). Grasses known to yield edible seeds include Indian ricegrass (*Oryzopsis hymenoides*), needlegrass (*Stipa* sp.), squirreltail grass (*Elymus elmoides*) and fescue (*Festuca idahoensis*). Lithiophyte species present on the YTC include bitterroot (*Lewisia rediviva*), desert parsley (*Lomatium* spp.), yellow bells (*Fritilleria pudica*), and wild onion *(allium* spp.) (Hackenberger 2009)

The YTC is also home to wide range of fauna which has been utilized in both prehistoric and current times. Mammal species include elk (*Cervus elephus)*, mule deer (*Odocoileus hemionus*), jackrabbits (*Lepus californicus*), cottontail rabbits (*Sylvilagus* spp.), northern pocket gophers (*Thomomys talpoides*), and beaver (*Castor canadensis*). Bird species include sage grouse (*Centrocercus urophasianus*), sharp-tailed grouse (*Tympanuchus phasianellus*), and California quail (*Callipepla californica*). Fish species include numerous species of salmon (*Oncorhynchus* spp.), sucker (*Catostomus* spp.), northern pikeminnow (*Ptychocheilus oregonensis*), peamouth (*Meilocheilus caurinus*), and mountain whitefish (*Prosopium williamsoni*). Columbia River shellfish species include freshwater pearl mussels (*Margaritinopsis falcata*), Rocky Mountain ridgeback mussels (*Gonidea angulata*) and the thin-shelled floater mussel (*Anodota* spp.) (Chatterz and Zweifel 1987; King and Caywood 1994; Lyman 1998).

Cultural Chronology

The YTC is part of the Mid-Columbia section of the southern Columbia Plateau. The cultural sequence for the Mid-Columbia was originally developed by Earl Swanson (1962), based largely upon archaeological excavations conducted along the Columbia River near Vantage in the 1950's. Swanson's original three-phase sequence was expanded to five phases by Charles Nelson (1969) based on findings at the Sunset Creek site. Radiocarbon dates obtained from the Sunset Creek site allowed Nelson to delineate cultural phase transitions at a finer temporal scale (Nelson 1969). The chronologies have remained fairly constant in the past 45 years, with two early phases (Clovis and Windust) added in later years (Galm 1981). Further radiocarbon testing has allowed archaeologists to refine chronologies, identify occupation trends, and delineate subphases within the cultural sequence (Galm 1981; Andrefsky 2004).

The cultural evolution of the Columbia Plateau begins with early cultures (12,835 cal B.P. to 3,770 cal B.P.) consisting of small populations of highly mobile groups focused on hunting and or fishing for subsistence, with little to no evidence of permanent residences or storage. Assemblages consist of simple tools and have high inter-site redundancy. Beginning around 3,770 ca. B.P., an organizational settlement and subsistence shift to semi-sedentism was marked by the emergence of an increased dependency on aquatic resources, food storage, and permanent to semi-permanent residences (Schalk and Cleveland 1983; Schalk et al. 1994).

<u>Mid-Columbia Cultural Sequence</u> (Galm et al. 1981, as summarized by King and Putnam 1994:15-17)

Windust Phase (8890-12835 cal B.P.): The Windust Phase is characterized by small, mobile bands of foragers/collectors that exploited plant and animal resources during a seasonal round (Chatters 1986). The few cultural deposits known from this phase are generally small and exhibit low artifact densities. Large shouldered and large basal-notched lanceolate projectile points are diagnostic of this phase.

Vantage Phase (8890-4490 cal B.P.): Vantage Phase peoples were highly mobile, opportunistic foragers adapted primarily to riverine environments (Chatters 1986, Galm et al. 1985). Archaeological data from this phase suggest that fish had become an important subsistence resource. Archaeological sites of the Vantage Phase are generally discovered along river and stream margins. Projectile points diagnostic of this phase include large, unstemmed lanceolate forms.

Frenchman Springs Phase (4490-2570 cal B.P.): The Frenchman Springs Phase is characterized by the introduction of semi-subterranean houses and the presence of specialized stations for hunting, root collecting, and plant processing. Archeologists have suggested that the ethnographic Plateau pattern emerged by the end of this phase (e.g., Nelson 1969). Several styles of smaller, contracting stemmed projectile points are diagnostic of this period.

Cayuse Phase (2570-0 cal B.P.): During the Cayuse Phase, inhabitants of the Columbia Plateau wintered in large, nucleated villages of 50 pit houses or more (Chatters 1986). In the spring, people dispersed to gather roots, and in the fall and winter, small parties established hunting stations in the uplands. This seasonal round became increasingly diverse and better organized over time, and trade with coastal groups was common. By about 200 years ago, the introduction of diseases reduced Native American populations and led to significant changes in the settlement and subsistence patterns of native Columbia Plateau groups.

The historic period began approximately 250 cal B.P. with the appearance of Euro-Americans via exploration and fur trading. Euro-American settlement brought new disease, technology, and the introduction of the horse. Increased migration led to established farmstead and livestock grazing. The beginning of the 20th century saw railroad and highway transportation systems developed at a rapid pace, which increased European migration (Chatters and Pokotyo 1998).

Climate and Human Adaptations

The paleoclimate of the region is a critical component for understanding prehistoric cultures of the Columbia Basin. Chatters (1998) provides the most comprehensive outline of climatic conditions that may have influenced changes in subsistence and residence mobility. The Early Period, from 11,000-8000 cal B.P. was marked climatically by a high amount of seasonal variation. Human activity in the Northern and Eastern Plateau is indicated by numerous lithic scatters. In the Southern Plateau, there is evidence of small-scale residence camps along the middle Columbia. The people of the era were small groups of nomadic foragers whose subsistence was largely determined by seasonal and climatic conditions (Chatters 1998).

The climate Middle Period (8000-4000 cal B.P.) was more maritime, allowing conifer forests to spread to lower elevations and also helping propagate root plants. People primarily subsisted on ungulates, small mammals, and fish. Tubers became a larger part of the diet, and tool usage became more streamlined and efficient. Sites on the lower Thompson and middle Columbia show signs of sedentary, year-round settlements. The majority of human activity was in the lowlands, although humans did begin occupying mountain valleys in the Northern Plateau (Chatters and Pokotyo 1998).

The Late Period (after 4000 ca. B.P.) saw glaciation reduce temperatures dramatically, causing the continuing spread of conifers. By 4000 cal B.P. people had shifted to a storage-dependent method of sustenance. The cooler temperatures decreased large game populations and increased the use of salmon. Houses became larger and deeper throughout the plateau, exhibiting a higher frequency of permanent settlement. From 2500 to 1000 cal B.P. the climate became warmer and drier. Humans began accessing higher elevations for food sources, including bison. Numerous settlements cropped up along rivers, and there is evidence that people began to manage the ecology in the uplands through fire. There was also an increasing diversity of lithics found which may indicate increased interaction among neighbors (Chatters and Pokotyo 1998).

CHAPTER IV

METHODS

The data for this thesis was obtained from a broad archival review of all archaeological studies that have been completed on the YTC over the past 40 years. In total, excavation results from 74 sites were compiled from 14 testing projects completed between 1978 and 2002 (Appendix A). From these sites, a total of 223,282 lithic artifacts were recorded, of which 2,209 were classified as tools, and 221,073 pieces of debitage.

Several challenges arose when attempting to assign dates to recovered assemblages. For example, some site assemblages were not recorded in context with radiocarbon dates obtained from cultural materials in a test unit; that is, all artifacts from all levels of multiple test units at a site location were tallied together, making it impossible to discern whether they were associated with the radiocarbon date obtained from a single test unit. A second challenge was that several researchers did not record surface collection assemblages separately from sub-surface assemblages. In many instances, it represented a lost opportunity as authors identified datable artifacts and/or obtained radiocarbon dates from in situ test unit cultural features, destroying any resolution within the dataset. Finally, there was no uniform classification system used by the authors in the different reports. In most cases, the authors did not disclose or include the artifact classification definitions or projectile point key used for artifact analysis.

This thesis focused on lithic tool assemblage data, site features, faunal remains, testing methods, and chronological components. Chronological components were assigned based upon radiocarbon dates, stratigraphy, and/or diagnostic projectile points. Faunal remains were identified in a presence/absence format, but not tallied by species for analysis. All radiocarbon dates were tallied in a separate table for additional analysis.

Assemblage Dating

The primary objective of this thesis is to assign chronological dates and corresponding cultural phases to horizontally or vertically discrete assemblages identified from the site report archives. A combination of radiocarbon dates, site stratigraphy, and diagnostic projectile points were utilized to assign dates to assemblages (See Appendix B). This objective allows assemblages to be ordered and grouped for analysis by the Mid-Columbia cultural sequence (Table 2).

Table 2: Assigned Cultural Phases

Date Range (cal B.P.)	Cultural Phases
0- 1380	1 (Late Cayuse)
1380-2570	2 (Early Cayuse)
2570-4490	3 (Frenchman Springs)
4490-6840	4 (Late Vantage)
6840-8890	5 (Early Vantage)
8890-12835	6 (Windust)

When possible, dates assigned to assemblages by site report authors were utilized. When dates were not reported by site authors, a thorough analysis of the data tables, recording methods and reported chronological markers were assessed to ascertain whether assemblage data were sufficient for me to place components with a chronological category confidently.

Site Types by Assemblage Structure

Building on the work by Salo (1984) and Gough et al. (1998), assemblage structure was assessed based on site activities encompassing plant processing, animal processing, and lithic manufacturing. Ultimately, seven site types were used for comparison (Table 2). These were broken into five major site types, two with subtypes a and b. To first ascertain whether plant processing activities occurred, sites were assessed for presence or absence of millingstones and earth ovens. To measure the intensity of oven activities, sites were assessed for amounts of FMR (high= >2 kg/m3, low=<2 kg/m3, or none. To measure the intensity of animal processing, sites were assessed by amount of faunal remains (high= >100 fauna count/m3, low=10-99.9 fauna count/m3, or 0-9.99 fauna count/m3= none) Seven site types were identified and are summarized in Table 3.

Table 3: Features Considered for Each Site Type.

Site Type	Millingstone	Ovens	Fire Modified Rock (kg)	Bone (count/m^3)
1	Present	Present	X > 25	> 10
2	Present	Absent	0 < x < 25	= 0
3a	Absent	Present	X > 25	> 10
3b	Absent	Present	0 < x < 25	> 10
4a	Absent	Absent	X > 25	> 10
4b	Absent	Absent	0 < x <25	> 10
5	Absent	Absent	X = 0	< 10

The specific descriptions of each site types are as follows:

Site Type 1: Millingstone with Formal Oven, High FMR, High to Low Bone

Site Type 2: Millingstone, No Formal Oven, High to Low FMR, No Bone

Site Type 3a: Ovens/Hearths with no Millingstone, High Amount of FMR, and High to Low Amount of Bone

Site Type 3b: Oven/Hearth with No Millingstone, Low Amount of FMR, High to Low Amount of Bone

Site Type 4a: No Formal Oven/Hearth/Millingstone, High Amount of FMR, High to Low Amount of Bone

Site Type 4b: No Formal Oven/Hearth/Millingstone, Low Amount of FMR, High to Low Amount of Bone

Site Type 5: No Formal Oven/Hearth/Millingstone, No FMR, Little to no Bone

Assemblage Structure and Artifact Dimensions

Lithic artifacts were placed into 14 classes (Appendix B). Within the various reports, the number of artifact classes differed, ranging between eight and thirty-two. This is likely attributable to the varying degrees of training and theoretical background of artifact analysts. Not all reports included classification definitions or projectile point keys. Ultimately, artifacts were grouped into a common key used by Plateau archaeologists, as defined by Chatters (1984) (Appendix B). As a result, many of the artifact classes were grouped together, which may result in some loss of data resolution.

To measure the lithic manufacturing activities present, ratios of biface and cores to debitage were calculated. Ratios greater than .005 were categorized as high. Ratios less than .005 were categorized as low. To account for differing classification schemes used by site report authors, formed tools were condensed to eight categories. To test for richness and diversity, the total number of formed tools verses number of tool types was assessed.

Assemblage Structure Accounting for Sample Size

To account for the effect of excavation sample size on each artifact dimension, the cores to debitage ratio, biface to debitage ratio, cores to debitage ratio, total types of tools, fauna classes present, and fauna species present were all plotted against excavation volume and area.

Chronometric Hygiene

All radiocarbon assays obtained in testing reports were identified. Radiocarbon ages were calibrated using Calib 7.10 software (Stuiver et al. 2017). The 1-sigma, 2-sigma, and median values were plotted to create box-and-whisker graphs.

CHAPTER V

RESULTS

Fifty-one horizontally or vertically discrete units were identified from ten reports (Table 4; Appendix B). Assemblages from four reports were not utilized due to a combination of lack of field provenience, data recording provenience, and/or adequate chronological data. Cultural Phases were assigned by radiocarbon date when available. If no radiocarbon date was reported, a combination of diagnostic projectile point or stratigraphic profile of testing unit was used. Sites from Table 3 were placed into Site Types from Table 4. Results are presented in Table 5.

Table 4: Assemblage Dates

Author	Date	Site	Unit	14^{C} Age	Projectile Point Age	Stratigraphy	Age Analysis
Chatters	1979	45KT241	A			0-4000	
Chatters	1979	45KT241	B			7000-4500	0-400
Chatters	1979	45KT241	C			8000-7000	8000-7000
Sender	1981	45YK332			150-4000		150-4000
Chatters	1986	45KT239			150-2500		2500-1000
Chatters	1986	45KT252		440+/-60	150-2500		150-2500
Chatters	1986	45KT285			1120-1400		1120-1400
Chatters	1986	45KT291	A		4000-5000		4000-5000
Chatters	1986	45KT291	B		300-2000		300-2000
Chatters	1986	45KT566			1000-2500		1000-2500
Chatters	1986	FC-2			1000-2500		1000-2500
Chatters	1987	45KT285	I	260+/-50	150-500		150-500
Chatters	1987	45KT252	I	460+/-60	150-500		150-500
Chatters	1987	45KT291	I		150-2000		150-2000
Chatters	1987	45KT252	IIe2		3000-4500	3500-4000	3000-4500
Chatters	1987	45KT252	Iiw		3000-4500		3000-4500
Chatters	1987	45KT252	Q		3000-4500		3000-4500
Chatters	1987	45KT285	II	4120+/-350	3000-4500		3000-4500

Table 5: Assemblage Dates (continued)

Author	Date	Site	Unit	14^C Age	Projectile Point Age	Stratigraphy	Age Analysis
Chatters	1987	45KT291	II		150-4000		150-4000
Gough	1998	45KT950	b		4500-8000		4500-8000
Boreson	1998	45KT979		1630-2730 (6 dates)	0-4000		0-4000
Boreson	1998	45KT980			0-4000		0-4000
Boreson	1998	45KT1003			1500-8000		1500-8000
Boreson	1998	45KT1011			150-2000		150-2000
Gough, et al	1998	45KT979	A1	370+/-60, 570+/-60	150-2000	150-570	150-2000
Gough, et al	1998	45KT979	A2	>1500-1860< B.P	150-2000	570-1860	150-2000
Gough, et al	1998	45KT979	B1			150-1900	0-1900
Gough, et al	1998	45KT979	B2	1900 +/-70	150-2000	150-1900	150-2000
Gough, et al	1998	45KT979	C1	70+/-60, 120+/-40	150-2000	<830	150-2000
Gough, et al	1998	45KT979	C2	1180+/-80	150-2000	>830-<1180	150-2000
Gough, et al	1998	45KT979	C3	<1630 BP	150-2000	< 1630	150-2000
Gough, et al	1998	45KT979	C4	</-1630BP		< 1630	< 1630
Gough, et al	1998	45KT980	AU 1	460+/-80 BP-20+/-60 BP	150-1500		150-1500
Gough, et al	1998	45KT980	AU 2	1890 +/- 60 BP-2340 +/- 60 BP	150-5000		150-5000
Gough, et al	1998	45KT980	AU 3	2340+/-60	1500-4000		1500-4000
Gough, et al	1998	45KT980	AU 4	3070 +/-160 BP		2000-4500	2000-4500
Gough, et al	1998	45KT1003	AU 1	1730 +/- 60 BP			1730 +/- 60 BP
Gough, et al	1998	45KT1003	AU 2		150-4000		150-4000
Gough, et al	1998	45KT1003	AU 3	3550 +/- 60 BP	2000-4000		2000-4000
Gough, et al	1998	45KT1003	AU 4	4820 +/- 60 BP	4000-8000		4000-8000
Gough, et al	1998	45KT1011	AU 1	120 +/-60 BP	0-2000		150-2000
Gough, et al	1998	45KT1011	AU 2	310 +/-60 BP			150-2000
Gough, et al	1998	45KT1011	AU 3	930 +/-70 BP		150-2000	150-2000
Gough, et al	1998	45KT1012	AU 1	120 +/- 80 BP	500		150-500
Gough, et al	1998	45KT1012	AU 2		500	150-500	150-500
Gough, et al	1998	45KT1012	AU 3	1880+/-60 BP	2000	150-2000	150-2000
Gough	1999	45KT1362	I	6130 +/-40 B.P.	6000-11000	6000-11000	6000-11000
Gough	1999	45KT726			0-5000		0-5000
Beery	2002	45YA641	TU23-A	1430+/-50	0-1500		0-1500
Beery	2002	45YA641	TU23-B		4500-8000		4500-8000

Table 6: Assigned Site Types on the YTC

Site Type	Description	Site Number	Age for Analysis	Volume	Total Tools	Types of Tools	Debitage Index	Report Date	Author
1	*Millingstone with Formal Oven, High FMR, High to Low Bone*	45KT979-C2	Late Cayuse	0.3	1	1	LCHB	1998	Gough, et al
		45KT285-I	Late Cayuse	17.2	22	2	LCLB	1987	Chatters
		45KT980	Late Cayuse	19.5	13	4	LCHB	1998	Boreson
		45KT980-AU1	Late Cayuse	21	9	5	LCHB	1998	Gough, et al
2	*Millingstone, No Formal Oven, High to Low FMR, No Bone*	45KT241-B	Early Vantage	0.4	0	0	HCLB	1979	Chatters
		45KT291-A	Late Vantage	1.4	6	3	LCLB	1986	Chatters
		45KT291-I	Late Cayuse	7.8	3	2	HCLB	1987	Chatters
		45KT1003-AU3	Fr Springs	2.2	1	2	LCLB	1998	Gough, et al
		45KT285	Early Cayuse	10.1	12	4	LCLB	1986	Chatters
3a	*Ovens/Hearths with no Millingstone, High Amount of FMR, and High to Low Amount of Bone*	45KT252-I	Late Cayuse	5	0	0	LCLB	1987	Chatters
		45KT979	Early Cayuse	15.7	9	2	LCHB	1998	Boreson
		45KT979-C4	Late Cayuse	1.8	1	1	LCLB	1998	Gough, et al
		45KT1011-AU3	Late Cayuse	1.9	0	0	LCLB	1998	Gough, et al
		45KT979-A2	Early Cayuse	10.5	16	6	LCLB	1998	Gough, et al
		45KT1011-AU1	Late Cayuse	3.9	7	2	LCHB	1998	Gough, et al
		45KT980-AU4	Fr Springs	8	2	3	HCLB	1998	Gough, et al

Table 7: Assigned Site Types on the YTC (continued)

Site Type	Description	Site Number	Age for Analysis	Volume	Total Tools	Types of Tools	Debitage Index	Report Date	Author
3b	*Oven/Hearth with No Millingstone, Low Amount of FMR, High to Low Amount of Bone*	45KT979-A1	Late Cayuse	24.6	6	1	LCHB	1998	Gough, et al
		45KT1011	Early Cayuse	1.9	1	2	LCHB	1998	Boreson
		45KT1012-AU2	Late Cayuse	4.6	0	0	LCLB	1998	Gough, et al
		45KT979-C1	Late Cayuse	17.8	72	6	LCHB	1998	Gough, et al
		45KT1003-AU2	Early Cayuse	28.6	6	3	LCLB	1998	Gough, et al
4a	*Absence of Plant Materials, High Amount of FMR, High to Low Amount of Bone*	45KT252	Early Cayuse	5.8	2	2	LCLB	1986	Chatters
		45KT1003	Early Cayuse	13	2	2	LCHB	1998	Boreson
		45YA641-TU23-B	Late Cayuse	2	1	1	HCLB	2002	Beery
		45KT285-II	Fr Springs	25.8	11	3	LCLB	1987	Chatters
		45KT1011-AU2	Early Cayuse	0.6	0	0	LCLB	1998	Gough, et al
4b	*No Millingstone, No oven, Low FMR, Low to High Bone*	45KT950-b	Early Vantage	3	2	2	LCLB	1998	Gough
		45KT291-B	Late Cayuse	1.6	1	1	LCLB	1986	Chatters
		45KT291-II	Fr Springs	5.2	5	1	LCHB	1987	Chatters
		45KT979-B1	Early Cayuse	3.8	0	0	HCLB	1998	Gough, et al
		45KT1012-AU1	Late Cayuse	1.6	0	0	LCLB	1998	Gough, et al
		45YA641-TU23-A	Late Cayuse	4	0	0	LCHB	2002	Beery
		45KT980-AU2	Early Cayuse	23	41	7	LCLB	1998	Gough, et al
		45KT1003-AU1	Early Cayuse	18.7	1	2	LCLB	1998	Gough, et al
		45KT726	Late Vantage	1.7	2	1	LCLB	1999	Gough

Table 8: Assigned Site Types on the YTC (continued)

Site Type	Description	Site Number	Age for Analysis	Volume	Total Tools	Types of Tools	Debitage Index	Report Date	Author
5	*No Plant Processing, No FMR, Little to no Bone*	45YK332	Fr Springs	0.52	7	3	LCLB	1981	Sender
		45KT239	Early Cayuse	4.9	3	2	HCLB	1986	Chatters
		45KT252-IIe2	Fr Springs	4	2	1	LCLB	1987	Chatters
		45KT252 -iIiw	Fr Springs	4	3	1	LCLB	1987	Chatters
		45KT241-A	Early Cayuse	1.6	3	2	LCHB	1979	Chatters
		45KT241-C	Late Vantage	1.6	0	0	LCLB	1979	Chatters
		45KT566	Early Cayuse	3.4	3	2	LCLB	1986	Chatters
		FC-2	Early Cayuse	3.7	4	2	LCHB	1986	Chatters
		45KT979-B2	Early Cayuse	16.3	7	2	LCHB	1998	Gough, et al
		45KT979-C3	Late Cayuse	2.5	3	2	LCHB	1998	Gough, et al
		45KT980-AU3	Early Cayuse	20	9	5	LCLB	1998	Gough, et al
		45KT1003-AU4	Early Vantage	6.2	5	4	LCHB	1998	Gough, et al
		45KT1012-AU3	Early Cayuse	5.1	0	0	LCLB	1998	Gough, et al
		45KT1362	Windust	2	3	3	LCLB	1999	Gough

Site Type Definitions

The following sections describe how the sites on the YTC fall within the designated Site Types.

Site Type 1: Millingstone with Formal Oven, High FMR, High to Low Bone

Presence of millingstone with a formal oven, high to low levels of bone, and high amounts of FMR was identified at three sites. All three sites fall in the Late Cayuse Phase. Number of types of tools (5) was highest in the component (45KT980-AU1) with lowest total number of tools (9). The component with the highest number of tools, 45KT285-I, (22) contained the lowest number of types of tools (2). All three components contained low cores to debitage ratios. Two components contained high biface to debitage ratios. Based on presence of millingstone and earth ovens, along with higher amounts of FMR and bone, these sites likely represent base camps with both plant and animal processing and plant processing activities. Likewise, the emphasis on late stage lithic reduction activities, as displayed by high biface to debitage ratios, fall in line with Late Cayuse collector system strategies. All three sites were excavated at high sample volumes (17.2, 19.5, and 21 m^3).

Site Type 2: Millingstone, No Formal Oven, High to Low FMR, No Bone

The presence of millingstone with no formal oven, high to low amounts of FMR, and absence of bone was identified in six component assemblages. The six components span the later four cultural phases, representing nearly 5000 radiocarbon years. Sample volume ranged between 0.3 and 10.1 m^3, which could explain the varying amounts of FMR and faunal material recovered. Total formed tools recovered ranged from 0-12. Two sites contained high core to debitage ratios, while only one site contained a high biface to debitage ratio. Based on the presence of millingstone, but no oven or bone and low FMR, along with the low tool diversity, these sites were likely plant extraction and processing bases, as well as tool manufacturing stations.

Site Type 3a: Ovens/Hearths with no Millingstone, High Amount of FMR, and High to Low Amount of Bone

Seven sites were identified under Type 3a (45KT252-I, 45KT979, 45KT979-C4, 45KT1011-AU3, 45KT979-A2, and 45KT1011-AU1, and 45KT980-AU4). Radiocarbon dates were obtained from all seven sites, placing four sites in the Late Cayuse, two sites in the Early Cayuse, and one site in the Frenchman Springs Phases. Testing volume ranged between 1.8 and 15.7 m^3. Two sites with low amounts of bone were tested with the lowest sample size (1.8 and 1.9 m^3). Five of the sites contained low tool diversity (0-2 tool types), while one site contained high tool diversity (6 types). The Frenchman Springs site (45KT980-AU4) was the only site with a high core to debitage ratio. One Late Cayuse (45KT1011-AU1) and one Early Cayuse (45KT979) site contained high biface to debitage ratios. Hearths were present at two of the sites, which could indicate higher levels of animal processing activities than plant processing. The evidence of both plant and animal processing activities and high amounts of FMR may represent base camps with plant and animal processing, but no evidence of plant extraction activities.

Site Type 3b: Oven/Hearth with No Millingstone, Low Amount of FMR, High to Low Amount of Bone

Five sites were identified as falling under Site Type 3b (45KT1011, 45KT1012-AU2, 45KT979-C1, and 45KT1003-AU2). Two sites were assigned to the Early Cayuse, while three sites were tentatively assigned to the Late Cayuse. The two sites with low bone were sampled with the lowest volumes (1.9 and 4.6 m^3), while the two sites with high amounts of bone were tested at substantially higher volumes (17.8 and 28.6 m^3). Four sites contained low tool diversity (1-3 tool types), while one contained high diversity (6 tool types.) The site with high diversity yielded 72 total formed tools, the most of any component in the study. All five sites contained low core to debitage ratios. Three sites contained high biface to debitage ratios. The high bone amount may indicate high animal processing activities.

Site Type 4a: No Formal Oven/Hearth/Millingstone, High Amount of FMR, High to Low Amount of Bone

Five sites were identified as falling under Site Type 4a (45KT252, 45KT1003, 45YA641-TU23-B, 45KT285-II, and 45KT1011-AU2). Cultural Phases represented include Frenchman Springs, Late Cayuse, and Early Cayuse. Sample size volumes varied widely, from 0.6 to 25.8 m^3. All six sites contained low tool diversity (0-3 tool types). Total tool types were recovered in low numbers, with five of the six sites yielding two or fewer tools. One site (45KT285-II) excavated at 25.8 m^3, yielded 11 formed tools. Only one site (45YA641-TU23-B) contained a high core to debitage ratio, while one site (45KT1003) contained a high biface to debitage ratio. The absence of plant processing activities and limited hearth data indicate less intensive cooking activities and shorter occupation. It is, however, possible that evidence of formal hearth features was destroyed by post-depositional processes.

Site Type 4b: No Formal Oven/Hearth/Millingstone, Low Amount of FMR, High to Low Amount of Bone.

Nine sites spanning the Late Vantage to Late Cayuse Phases were assigned to Site Type 4b. Eight of the nine sites contained low tool diversity (0-2 tool types) and low amounts of total tools recovered (0-5). One site (45KT980-AU2) yielded seven tool types and 41 total tools recovered. High core and low biface to debitage ratio was observed in one site from the Early Cayuse Phase. Two sites contained low core and high biface to debitage ratios, the remaining six contained low core and low biface to debitage ratios. The overall pattern of high amounts of bone, but low amounts of FMR, indicates lower intensity and shorter occupation periods for this site type.

Site Type 5: No Formal Oven/Hearth/Millingstone, No FMR, Little to no Bone.

Fourteen sites were identified under Site Type 5, spanning all six cultural phases. Low amounts of bone were recovered in ten of the sites, while no bone was recovered from the other four. Only one site (45KT239) contained a high core to debitage ratio. Assigned to the Early Cayuse Phase, Chatters and Benson (1986) identified it as a lithic manufacture station. Low diversities of formed tool types predominate in this site type, with twelve assemblages containing low diversity, and two high diversity. Though evidence of tool manufacturing was identified at six sites, the overall pattern identified is indicative of shorter occupation and intensity.

Site Types and Relative Date

Site Types were plotted against Time Period on a histogram to help delineate variation through time (Figure 1).

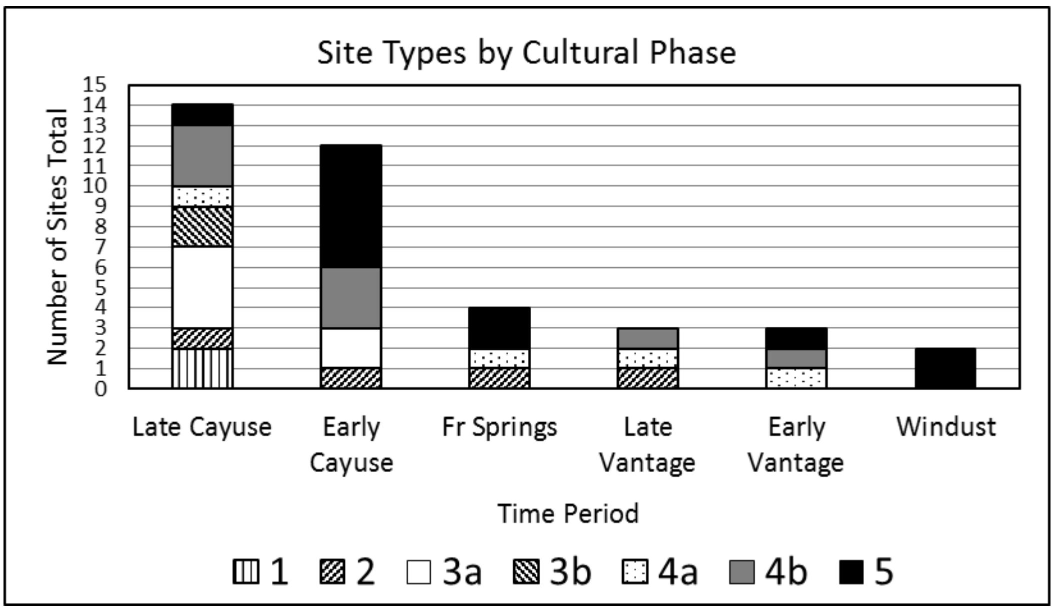

Figure 1: Histogram of the total number of site types by cultural phase.

Type 1 Sites were only identified in the Late Cayuse which could be indicative of late-period site intensification activities spanning a broad range of subsistence activities. Site Type 2 is distributed equally between the Late Vantage to Late Cayuse Phases, each of which contains one site. Four 3a Type sites are present in the Late Cayuse, and two additional sites are present in the Early Cayuse. Site Type 3b occurs only in the Late Cayuse, with three sites identified. Three Site Type 3b are present in the Late Cayuse but do not occur in any earlier phases. Type 4a occurs once in each of the Late Cayuse, Frenchman Springs, Late Vantage, and Early Vantage

Phases. As these sites are indicative of animal processing, this supports the hypothesis that sites in the Yakima Uplands were used as temporary hunting stations through time. Site Type 4b occurs three times each in The Early and Late Cayuse Phases, and once each in the Early and Late Vantage Phases. Similar to Site Type 4a, the distribution of sites identified across the mid- to late Holocene supports animal procurement and processing as a primary focus of activities in the uplands. Site Type 5 is the most common type found on the YTC, occurring over a span of 10,000 radiocarbon years, with all six cultural phases represented. The Early Cayuse Phase is the most represented, with five sites.

Assemblage Structure and Artifact Dimensions

To assess assemblage structure and artifact dimensions, ratios of cores and bifaces to debitage, and total types and numbers of tools were plotted against both site type and cultural phases to elicit possible dependent relationships.

Five site types were identified as containing much high biface to debitage ratios relative to cores to debitage ratios (Figure 2). The single outlier with a high ratio of both biface and core to debitage was a Vantage Phase component (45KT291-II) which Chatters and Zweifel (1987) posited was an early stage reduction station due to the large quantity of cores and discarded broken bifacial blanks. Other large groupings of note include the four sites with high cores to debitage ratio and no presence of bifaces, indicative of an emphasis on early stage reduction activities. Conversely, seven sites contain high ratios of biface to debitage with little to no presence of cores, indicative of a focus on late stage reduction and tool maintenance activities. A third cluster reveals higher levels higher ratios of biface to debitage is associated with lower ratios of cores to debitage. This indicates many sites were used in later stage manufacturing and tool maintenance, with lower levels of early stage reduction activities. There is no discernable pattern correlating site type to the core and debitage ratios.

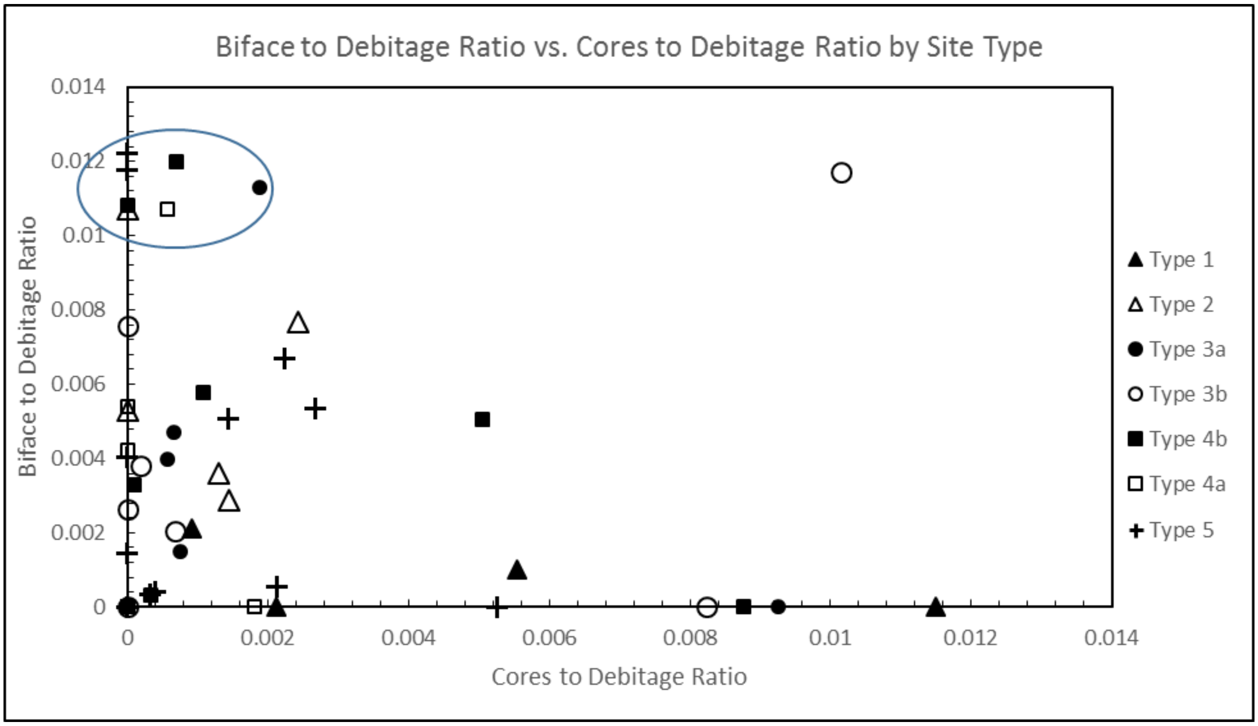

Figure 2: The relationship of bifaces and cores relative to debitage. The figure displays the relationship of biface to debitage and cores to debitage ratios by site type. The circle represents cluster of sites with high biface to debitage ratios.

By plotting the biface to debitage ratio against the cores to debitage ratio by cultural phase, a clear pattern emerges (Figure 3). Five of the six sites with high biface to debitage ratios were assigned to the Late Cayuse Phase, and the sixth to the Early Cayuse Phase. This supports the hypothesis that collector systems post-2500 cal B.P. employed a systematic economy focused on later stage reduction at base camps. The five sites with high core to debitage ratios, but no bifaces present, span the Early Vantage to Late Cayuse Phases. This demonstrates the focus on raw material procurement and early stage reduction through 8000 radiocarbon years of time on the YTC. The single outlier with both high biface and high core to debitage ratios was a Frenchman Springs manufacturing station.

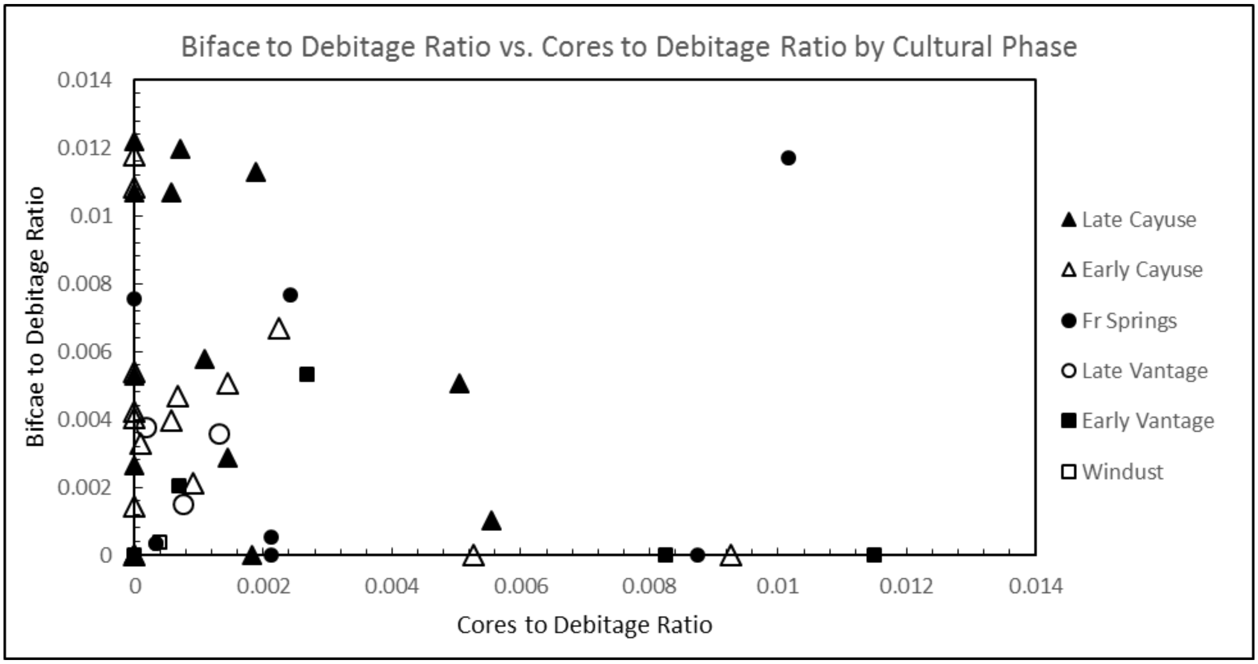

Figure 3: Relationship of biface and cores relative to debitage according to assigned cultural phase.

The log of total formed tools was plotted against the log of the total number of tool types recovered from each site according to Site Type (Figure 4). A large cluster contained two or fewer classes of formed tools and less than 10 total formed tools in the assemblages. This may be a reflection of a simple toolkit necessary for upland resource tasks. One extreme outlier (45KT979-C1) yielded 72 formed tools and six tool types. Falling under Site Type 3b, Gough et al. (1998) posited the site was primarily used for lithic reduction and animal processing. Component 45KT980-AU2 yielded 41 formed tools and seven tool types and is also represented on the chart as an outlier. There is no apparent patterning by site type.

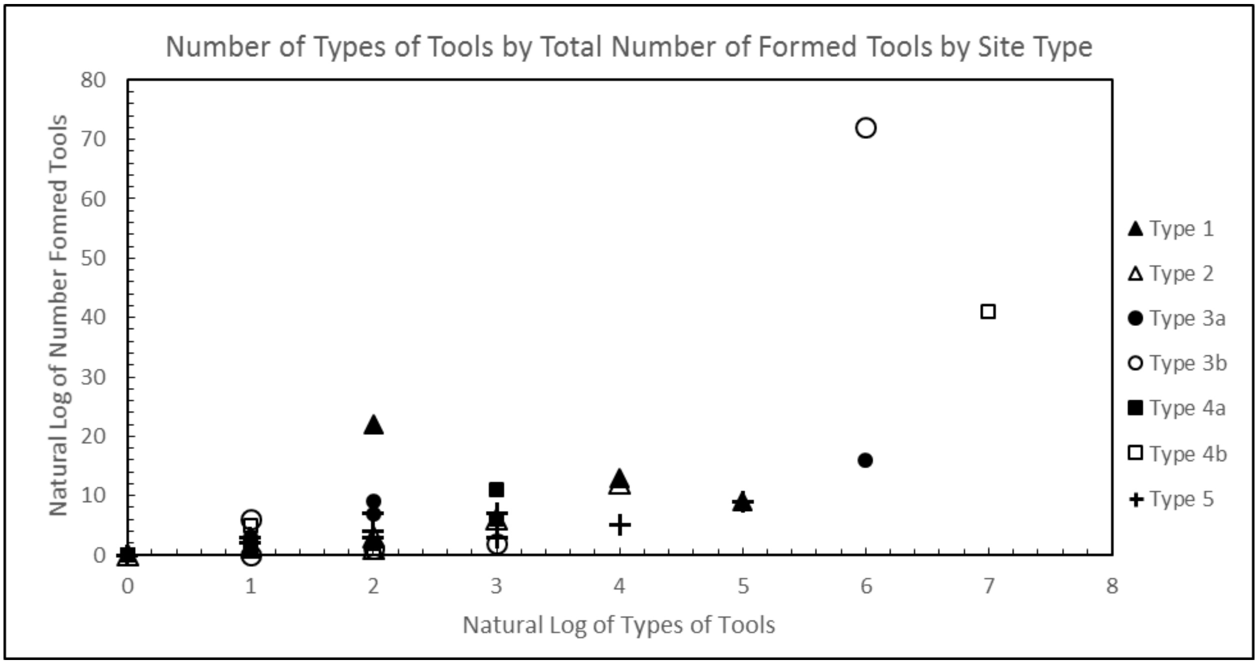

Figure 4: The number of types of tools are plotted against the total number of formed tools according to site type.

When the log of types of tools is plotted against the log of total formed tools, a clear pattern emerges (Figure 5). The four sites with the highest number of total formed tools and types of tools are in the Early and Late Cayuse Phases. The high assemblage richness is consistent with collector strategies requiring tool sets necessary for a greater number of tasks.

Assemblage Structure Accounting for Sample Size

To account for the influence of excavation sample size on assemblage characteristics, assemblage dimensions were plotted against site volume and area excavated.

The ratio of cores to debitage was plotted against volume to test for the effects of sample size (Figure 6). A grouping of eight sites indicates high cores-to-debitage recovered with excavation volumes under $8m^3$ at each site, indicative of early-stage tool-manufacturing stations. Large-volume excavation sites and most excavated at low volume contain very low ratios of

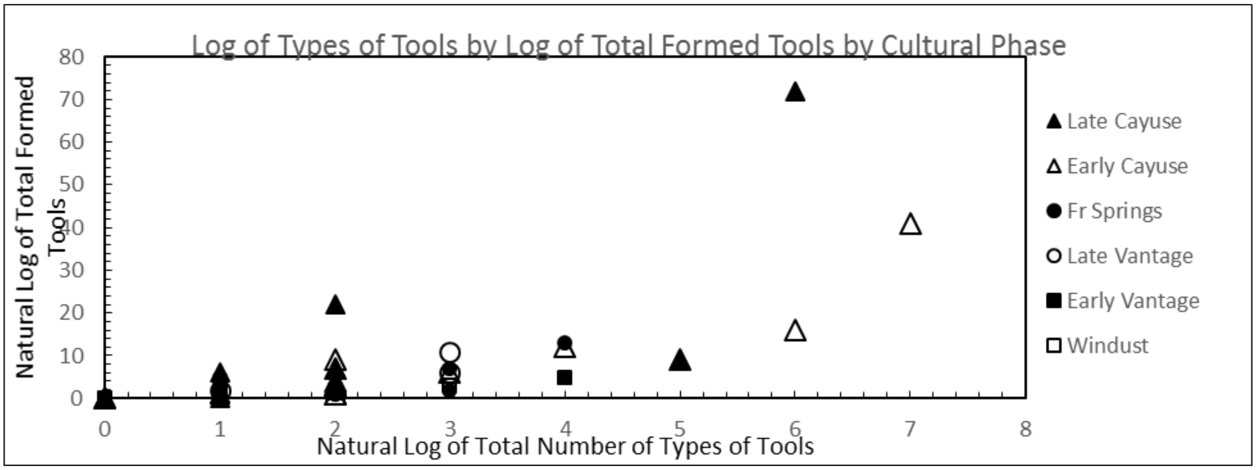

Figure 5: The number of types of tools are plotted against the total number of formed tools according to assigned cultural phase.

cores to debitage. Many of the large-volume sites targeted base stations. Thus the findings support the general trend that early-stage tool manufacturing occurred at more specialized stations. However, the high cores-to-debitage ratios in the low-excavated sites may be a result of sample error, as the five sites with the highest ratios yielded low total counts of artifacts. There is no discernable relationship between Site Type and cores-to-debitage ratios.

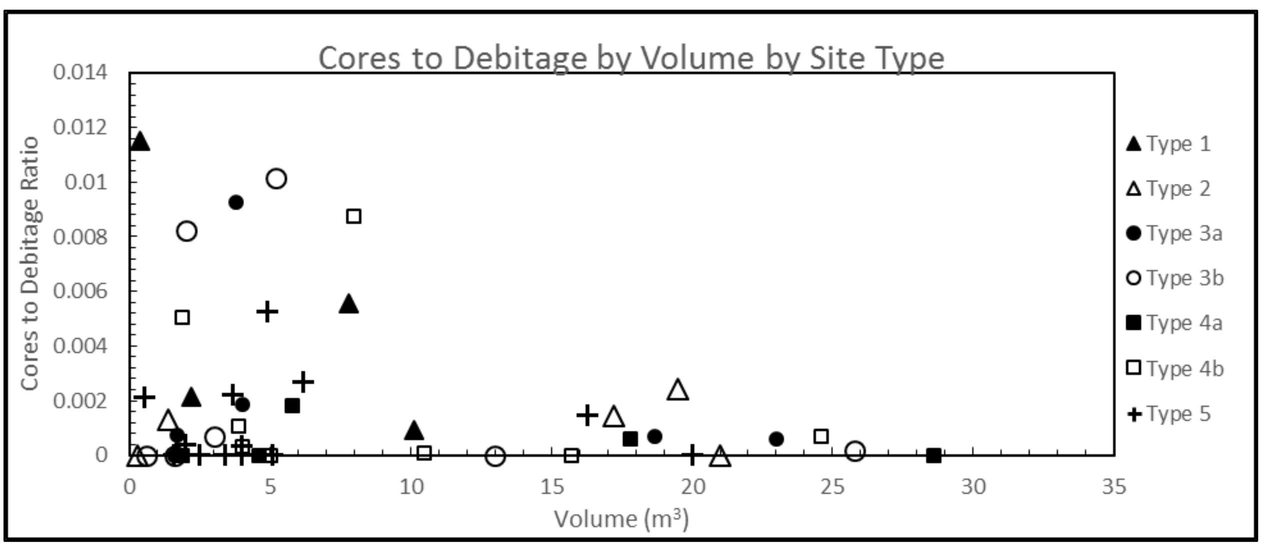

Figure 6: Relationship of cores to debitage ratio to volume excavated (m^3). Data are presented according to assigned site type.

When cores-to-debitage ratios are plotted against volume excavated by cultural phase, four of the five sites with the highest ratios are shown to be from pre-Cayuse Phases (Figure 7). The trend may be indicative of early stage reduction activities being integrated with other site activities during the Frenchman Springs and Early Vantage Phases. Again, the ratios could be due to sampling bias, as shown by two Frenchman Springs sites excavated at greater than 10 m^3 exhibiting lower ratios.

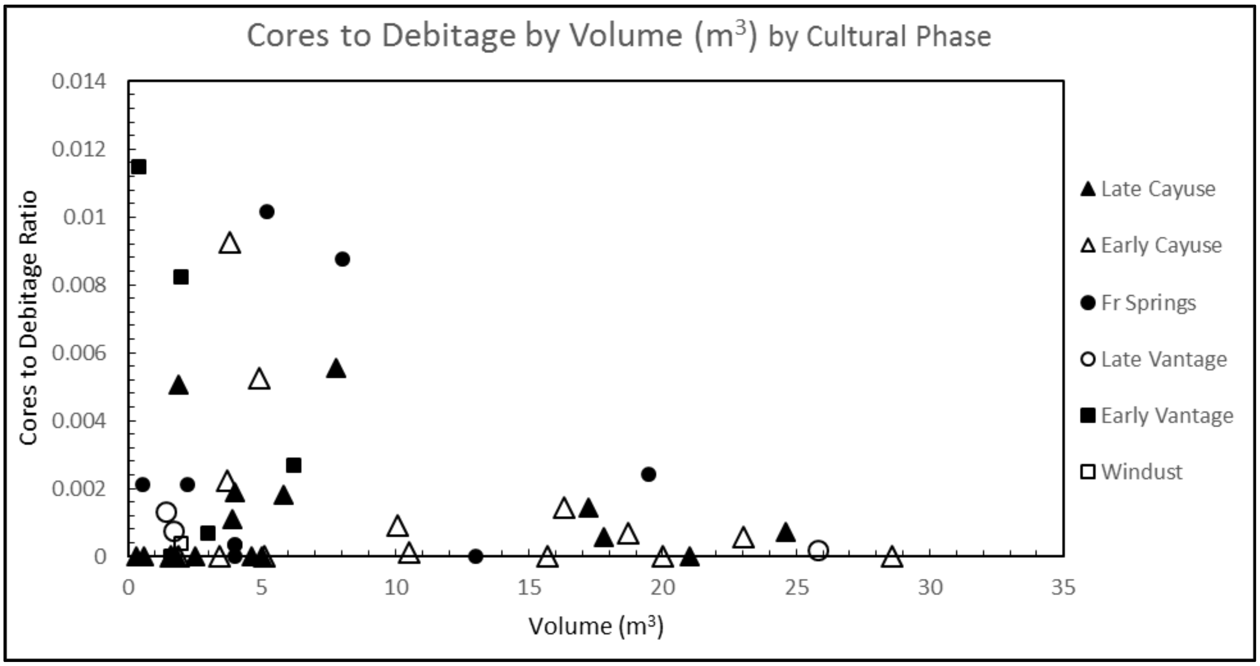

Figure 7: Relationship of cores to debitage relive to volume excavated (m^3). Data are presented according to assigned cultural phase.

The ratio of bifaces-to-debitage was plotted against volume to test for sample size by Site Type (Figure 8). A cluster of five sites with very high indices with under 7 m^3 excavated indicate expedient late stage tool production at a smaller hunting station. Three different Site Types are represented in the cluster. High volume sites (>15m^3) exhibit presence of bifaces as

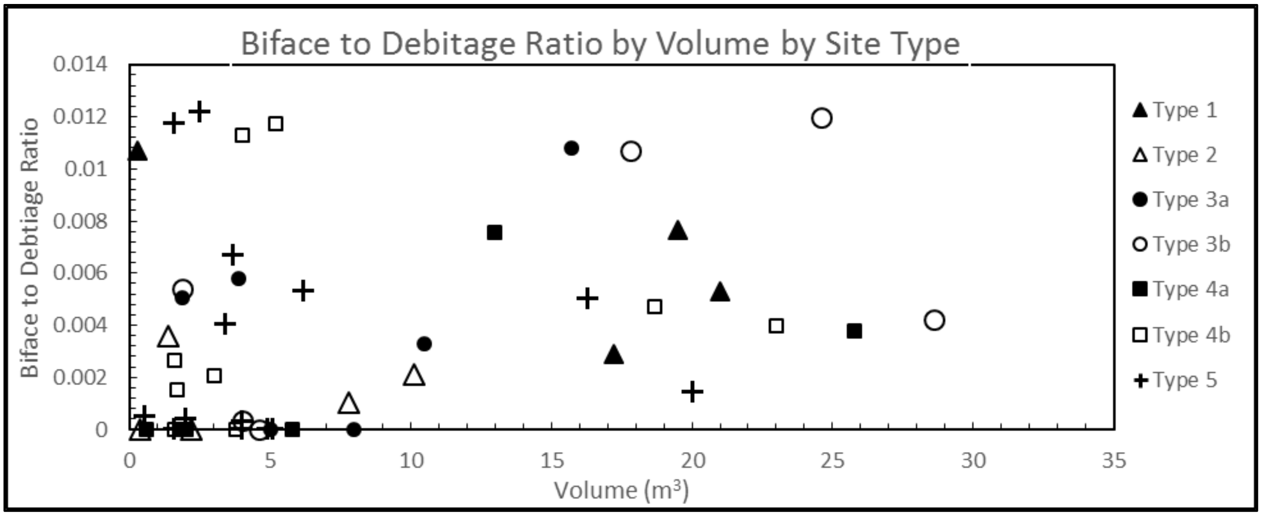

Figure 8: Relationship of bifaces to debitage ratio to volume excavated (m^3). Data are presented according to assigned site type.

ratios ranging from .0015 to .012 between five different cultural phases, illustrating that there is no discernable correlation between increased sample volume and biface-to-debitage ratios.

Biface to debitage ratio was plotted against volume to identify patterns by cultural phase (Figure 9). A clear pattern emerges of Early and Late Cayuse sites displaying the highest ratios across sample size. Two Frenchman Springs sites also display high ratios to volume. All pre-Frenchman Springs Phase sites contain low ratios to volume. As only one pre-Frenchman Springs site was excavated at greater than $8m^3$ volume, sample size may be affecting ratios in early sites.

The total count of fauna specimens was plotted against volume to tease out possible patterns (Figure 10). One site outlier (45KT979-C1) contained over 23,000 counts of fauna. Removing the outlier helped tease out patterns with the rest of the data set. Units with over 5,000 counts of fauna recovered were all excavated with at least 10 m^3. Only two of 34 (6%) of components excavated with less than $10m^3$ volume yielded more than 1000 faunal artifacts. Both components, 45YA641-TU23-A and 45KT1011-AU1, were an extremely dense shell and

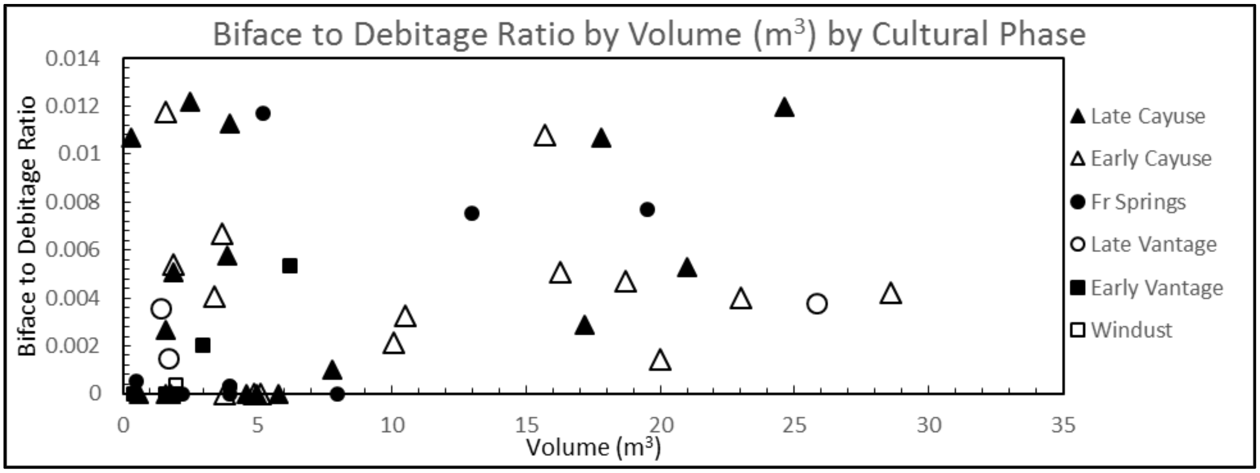

Figure 9: The relationship of the biface to debitage ratio by volume excavated (m^3). Data are presented according to assigned cultural phase.

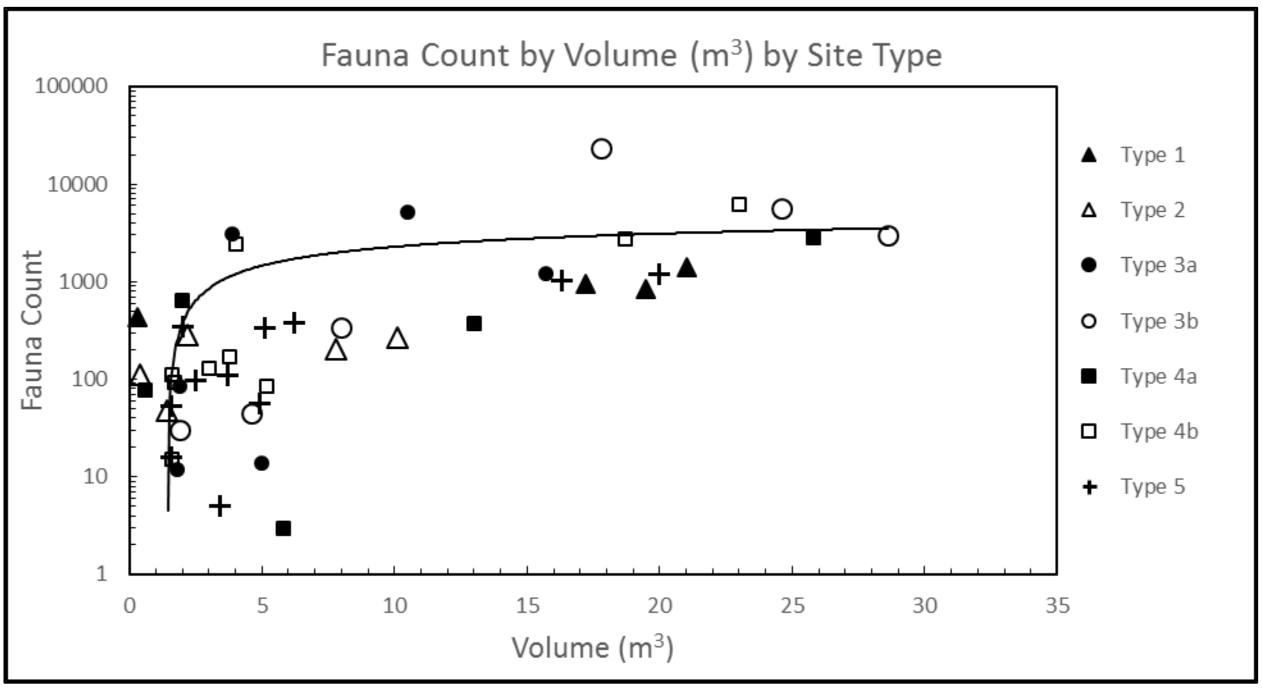

Figure 10: Relationship of total fauna count to Volume Excavated (m^3). Data are presented according to assigned site type.

animal middens, respectively. While a clear pattern illustrates that all sites excavated at greater than $10m^3$ yielded high amounts of bone, there is no discernable pattern between Site Types.

Fauna count was also plotted against volume by cultural phase (Figure 11). Early and Late Cayuse sites produce the highest amount of bone and are also represented by the majority of sites excavated at greater than 10m^3. While sample size obviously influences the recovery of faunal remains, older sites may also be underrepresented due to natural decay processes.

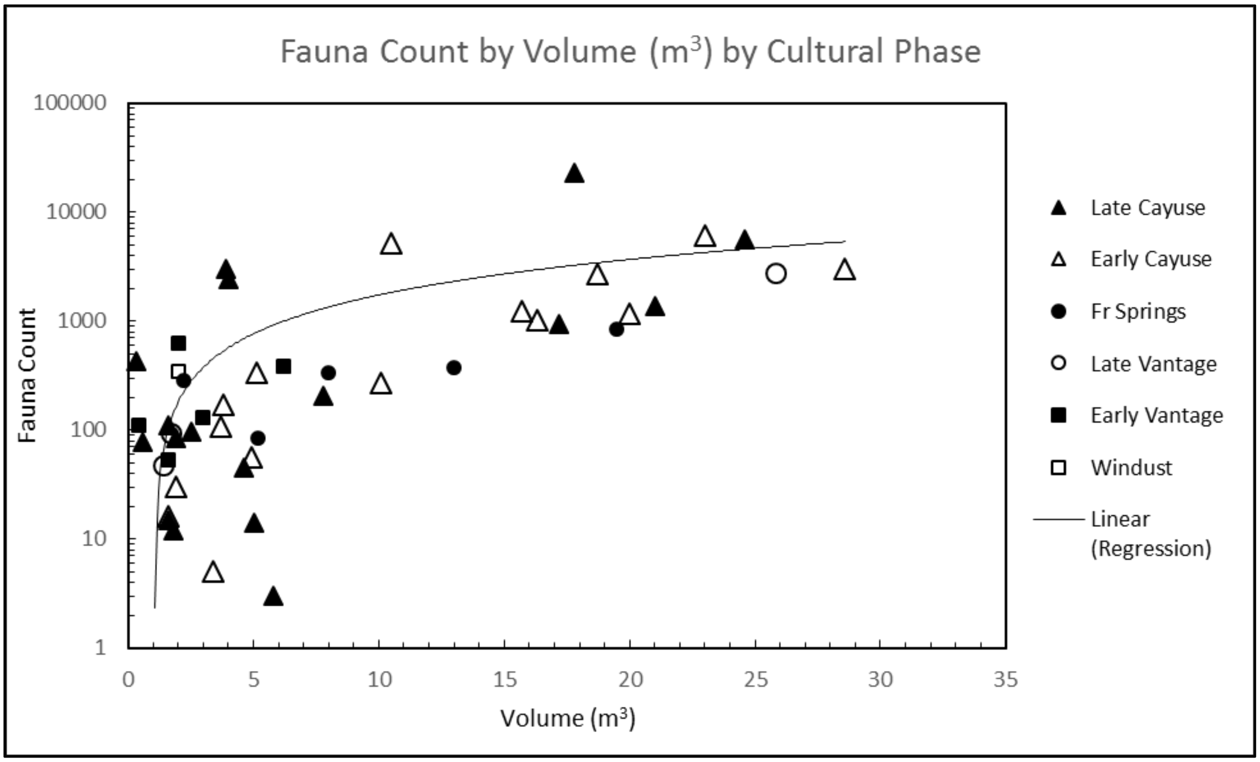

Figure 11: Fauna count is plotted relative to volume excavated (m^3). Data are presented according to assigned cultural phase.

Types of tools recovered were plotted against excavation volume to test for sample size effect (Figure 12). Six of the seven sites containing four or more types of tools were excavated with at least 10m^3. Only one site (45KT1003-AU4) excavated with less than 10m^3 yielded more than three tool types. This again raises the issue of sampling error, as to whether site components were fully excavated.

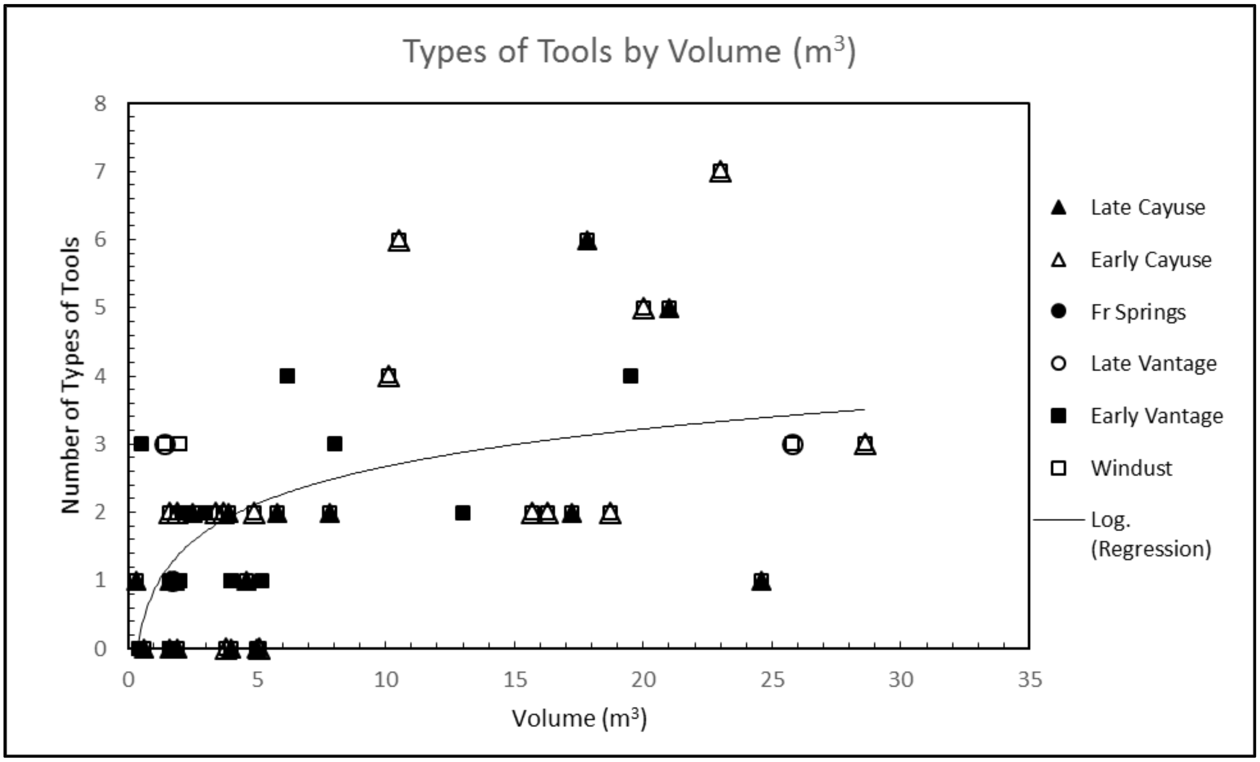

Figure 12: Relationship of Types of Tools to Volume Excavated (m^3). Data are presented according to assigned site type.

Log of total formed tools was also plotted against volume by cultural phase (Figure 13). All sites with high total formed tools (except for one Frenchman Springs and one Early Vantage site) were assigned to Early and Late Cayuse Phases and excavated at greater than $10m^3$ volume. While sample size clearly influences total formed tools recovered, the possibility that higher amounts of formed tools could be recovered in pre-Cayuse Phase sites cannot be ruled out.

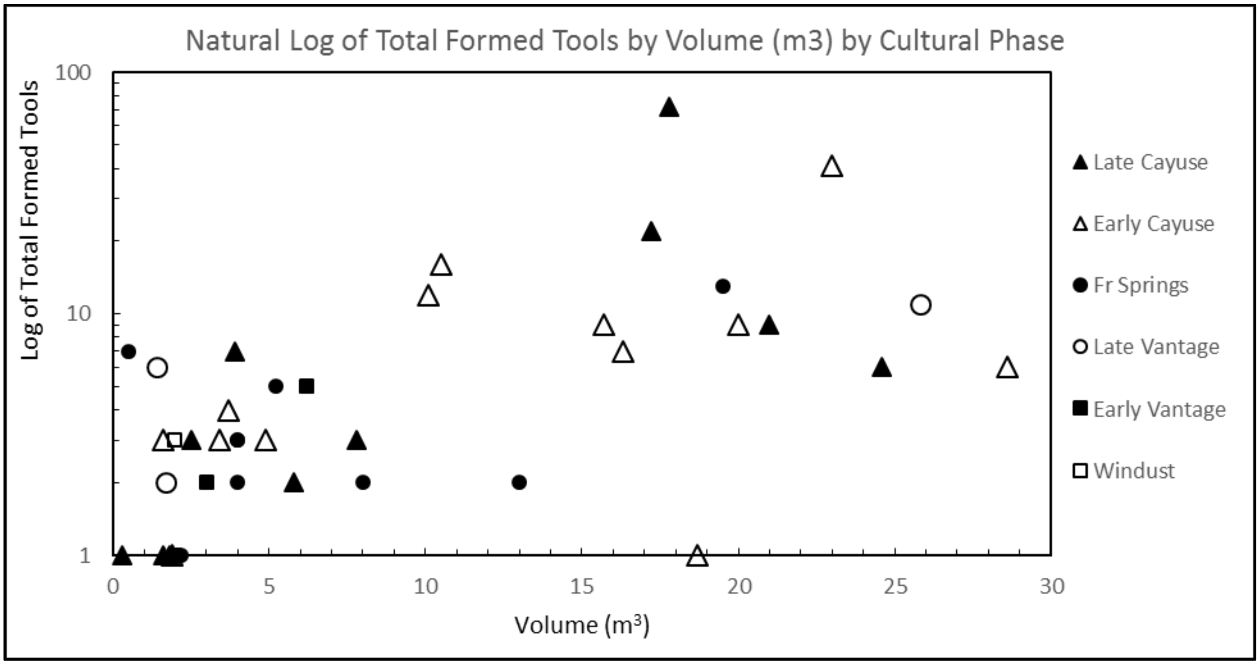

Figure 13: Total number of formed tools are plotted against excavated volume (m^3). Data are presented according to assigned cultural phase.

Chronometric Hygiene

A total of 108 radiocarbon dates were obtained in the testing projects reviewed for this research (Appendix C). The uncalibrated dates were calibrated using Calib 7.10 software (Stuiver et al. 2017). The 1-sigma and 2-sigma high, low, and median values were calculated. Five dates obtained in

projects produced uncalibrated dates near 0 B.P. and could not be calibrated. The calibrated values were used to generate histograms of dates in 500-year intervals and to plot box-and-whisker plots. In the box-and-whisker plots, the box represents the 2-sigma error range, while the whisker represents the 1-sigma error range. As a note, several radiocarbon assays were collected from a single occupation in several testing projects. These are noted in Appendix C. No effort is made to select for accuracy, and I've chosen not to average them in the data presentation. The only site where this would be significant is 45KT1362 (Sentinel Gap) where multiple dates from a single, brief occupation represent the sole early Holocene cultural site on the YTC.

Fifty-six dates were associated with cultural features, while 47 dates were obtained from geologic materials (Figure 14). A side-by-side comparison of geologic and cultural dates shows a much more continuous distribution of geologic dates compared to cultural dates. Cultural dates

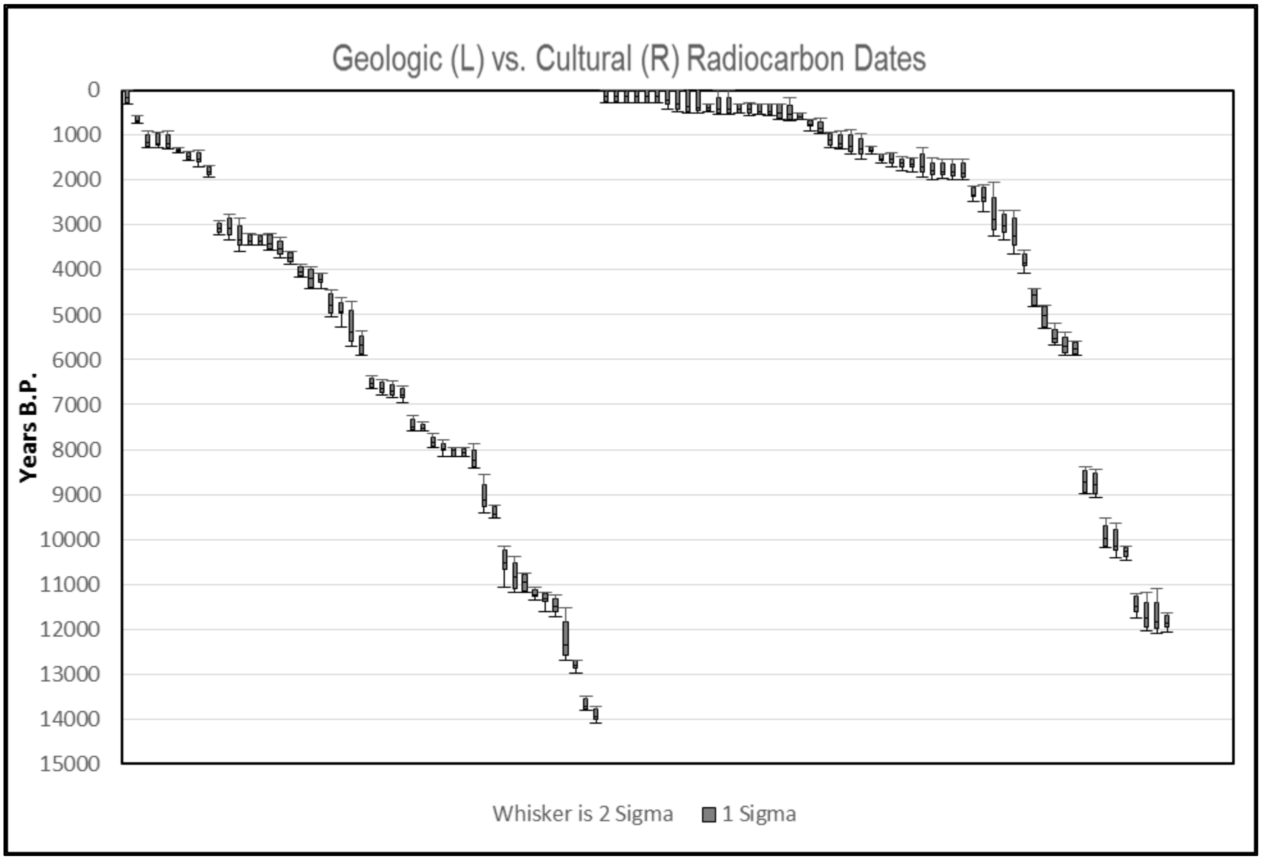

Figure 14: Distribution of geologic and cultural radiocarbon dates (cal B.P.).

are skewed to the late period, and sizeable gaps in the early-to mid-Holocene (8500-6000 cal B.P.) are apparent. A noticeable gap in the geologic 2000-3000 cal B.P. range is present.

The box-and-whisker plot (Figure 15) illustrates the calibrated range of all 56 cultural dates. Overall, the pattern clearly emphases younger time periods, as 47 dates represent time periods between 0-6000 cal B.P., while only six dates are represented between 6000-12000 cal B.P. The largest concentration of cultural dates is in the late Cayuse period (14 between 0- 500 B.P.). The remainder of the Cayuse Phase (500-2570 cal B.P.) is represented by 24 dates. Altogether, 38 of the 56 cultural radiocarbon dates (68%) obtained in testing projects fall within the Cayuse Period. The Frenchman Springs phase (2570-4490 cal B.P.) is represented by eight dates. The Vantage Phase (4490-8090 cal B.P.) is also represented by eight dates, all falling in the late subphase. No cultural dates have been obtained from the 6670-8090 cal B.P. period of the early Vantage subphase. The Windust Phase (8890-12835 cal B.P.) is represented by seven dates. Overall, the calibrated range of cultural dates exhibits a non-random distribution, heavily skewed towards the later periods and showing apparent abandonment of the YTC uplands during the early Vantage Phase. No cultural dates have obtained in nine of the 24 500-year intervals.

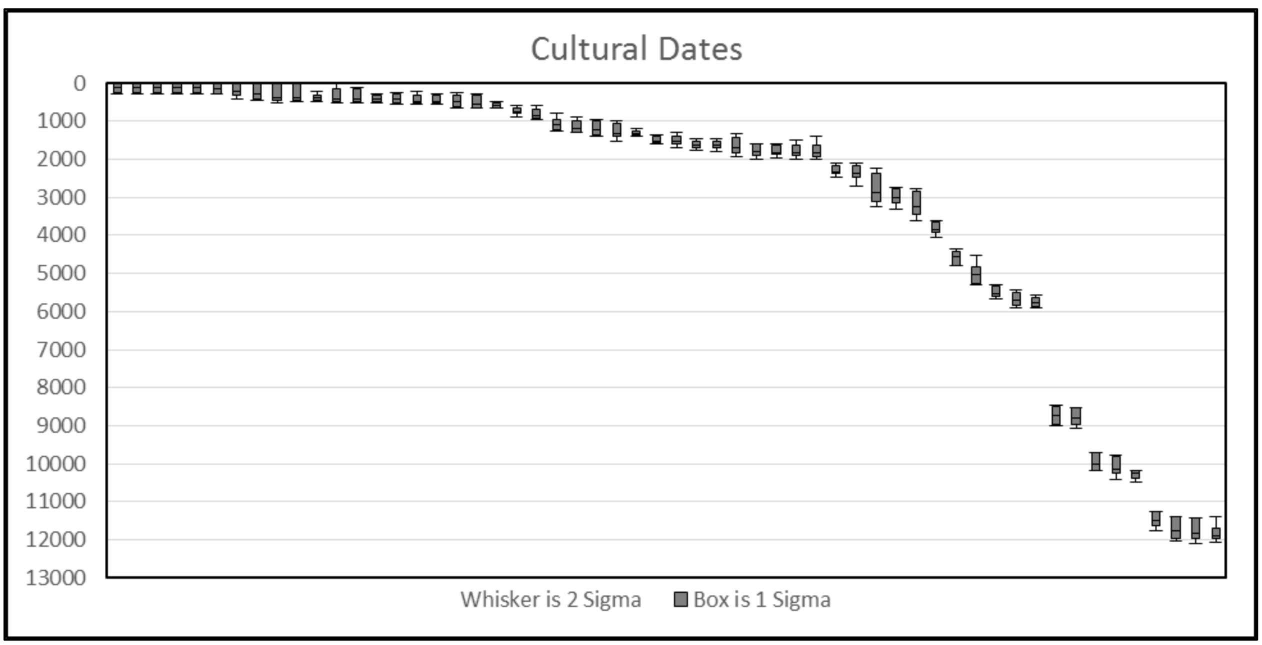

Figure 15: Distribution of cultural radiocarbon dates through Holocene (cal B.P.).

This box-and-whisker chart illustrates the calibrated range of all 47 geologic dates (Figure 16). The general trend through time indicates a near-random distribution of non-cultural dates. This may reflect the general goal of obtaining non-cultural dates evenly through time to build a comprehensive stratigraphic chronology. The one significant gap in the record is between 2000-3000 cal B.P. Galm et al. (2000) attribute the gaps to significant eolian and colluvial sediments creating a discontinuity in stratigraphic records. Likewise, intensive erosional episodes are also documented in the Plateau region during this time period and are likely to have affected alluvial sequences (Chatters 1984; Galm et al. 2000).

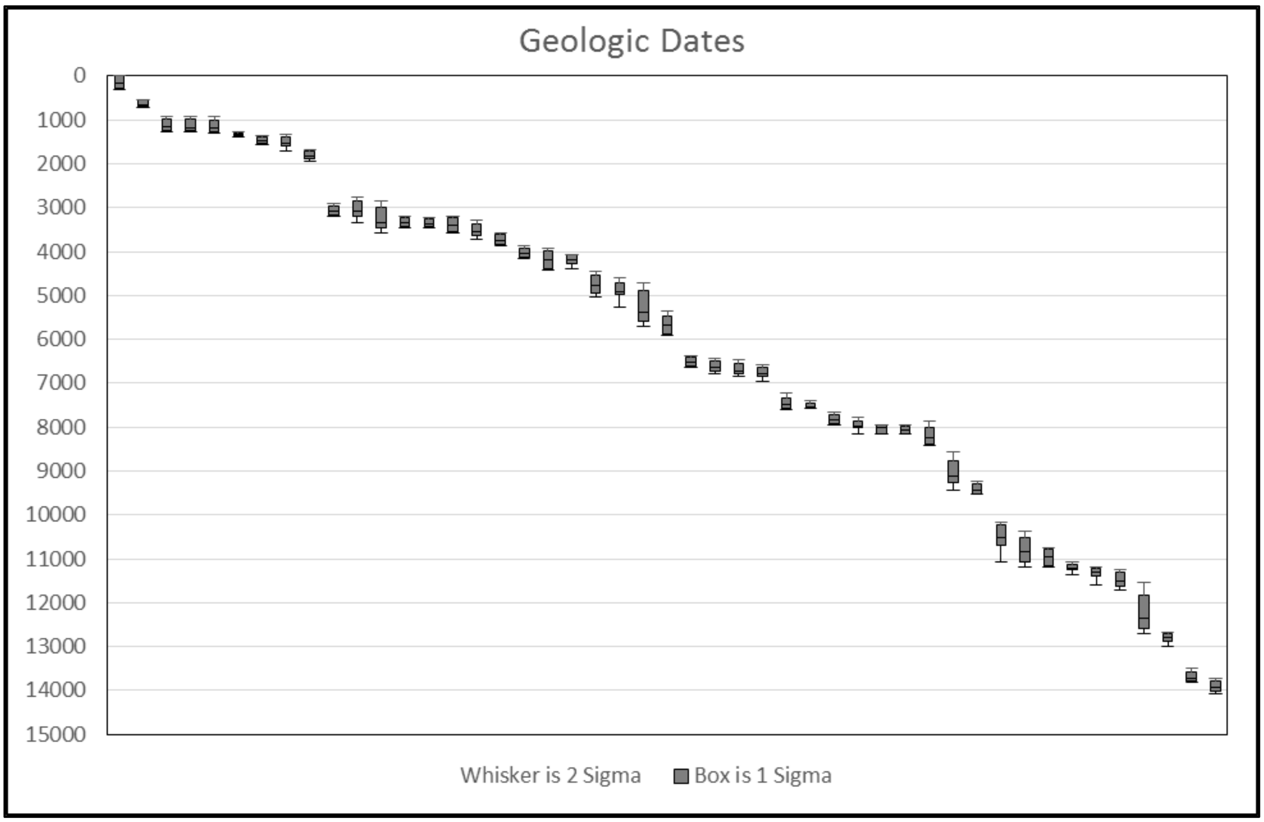

Figure 16: Geologic radiocarbon dates from the YTC (cal B.P.).

A comparison between cultural dates obtained from materials obtained in situ cultural features and materials believed to have been associated with anthropogenic activity at the sites reveals more patterns with radiocarbon dating methods (Figure 17). Of the 37 cultural dates obtained between 0-2500 cal B.P., 31 were obtained from *in situ* cultural features. However, of the 18 dates obtained from cultural materials older than 2500 cal B.P., only half were from i*n situ* cultural features. This disparity further illustrates the gap in building a comprehensive cultural chronology on the YTC through the Holocene.

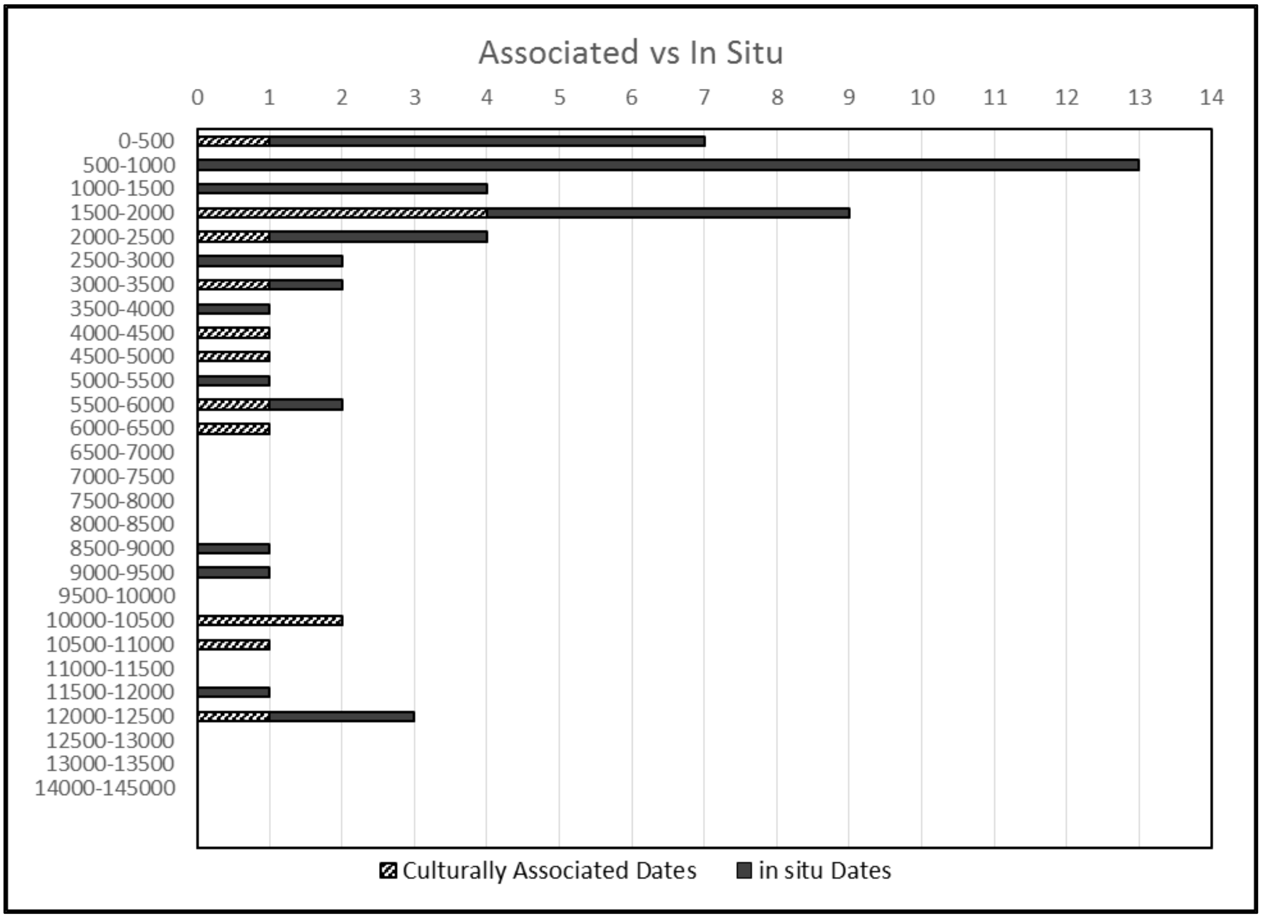

Figure 17: Histogram of total number of cultural dates divided into 500-year increments.

CHAPTER VI

DISCUSSION AND CONCLUSION

Assemblage and Site Type Analysis

Artifact dimensions and feature characteristics from fifty-one discrete components were used to identify and chronologically group seven site types. Data resolution did not allow for robust statistical analysis. However, the study did show the Site Type model to be a useful application when approaching research involving a coarse data set. Research questions from Chapter 1 can be addressed.

Research Question 1: What can a chronological comparison of assemblage composition and site features reveal about changes in upland logistics and mobility?

At a coarse scale, the Site Type model revealed results consistent with the expectation that sites from later phases would show greater tool diversity and site use intensity between post-2500 cal B.P. However, there was no discernable relationship between Site Type and artifact dimensions. Site Types encompassing plant processing and high levels of animal processing are found in greater abundance post-2500 cal B.P. The presence of earth ovens at in the Late Cayuse mirrors Dancey's (1974) Wood Box Spring findings of intensive plant processing in the Late Cayuse subphase. Literature indicates the shift to intensive upland plant processing on the Plateau begins between 3500-2500 B.P (Chatters 1995; Prentis et al. 2005). However, the lack of sites excavated on the YTC associated with that time phase does not allow inferences to be made in this key transitional phase. The above findings support conclusions that foraging strategies shift to collecting strategies in the Yakima Uplands by 2000 cal B.P.

Toolstone assemblages demonstrate Pre-2000 cal B.P. assemblages are generally richer (more tool types), with less variability among assemblages. The Post-2000 cal B.P. assemblages are generally less rich with greater variability between assemblages. The total number of formed tools is higher after 2000 cal B.P. These assemblages also have more projectile points, which make up a slightly higher proportion of each formed tool assemblage. A high ratio of biface to debitage is common after 2000 cal B.P. The above findings support conclusions that foraging strategies shift to collecting strategies in the Yakima Uplands by 2000 cal B.P.

Sample Size and Assemblage Richness

Research Question 2: What can the evaluation of the relationship between excavation sample size and assemblage structure tell us about site use and subsistence patterns?

The influence of sample size on assemblage data is apparent throughout all time phases and site types. Assemblage data only appear complete when sites were excavated with $10m^3$ volume or more. All sites with 10 or more total tools recovered were sampled at minimum10 m^3 volume excavated. Conversely, all sites with no formed tools recovered were excavated with 5 m^3 or less volume excavated. Through time, only one site was excavated with greater than 6.5 m^3 was solidly placed in pre-2000 cal B.P. time phase. This raises serious questions as to whether the lack of sites older than 2000 cal B.P. is a reflection of actual human land use through time or sample error. Although sites that date to before 2500 cal B.P. often have smaller excavation sample sizes, sites dating Post-2500 cal B.P. were excavated with large sample sizes. The sample sizes are adequate to show differences between sites that date to 2500 and 2000; therefore, the samples are adequate to support that collecting strategies appear in the Yakima Uplands by 2000 cal B.P.

Geological and Cultural Radiocarbon Chronologies

Research Question 3: Are radiocarbon dates collected from geologic or cultural phenomena distributed evenly throughout the Holocene and representative of known geological and cultural activity?

Radiocarbon dates show a generally even distribution of geologic dates through time with few gaps in the 2000-3000 cal B.P. and >10000 cal B.P. ranges. *In situ* cultural dates are greatly skewed towards pre-2500 cal B.P. sites, with very few dates in the mid-to-late Holocene period. No cultural dates have been obtained from the 6670-8090 cal B.P. period of the early Vantage subphase. Absence of dates from earlier intervals likely represents sampling error. However, cultural hiatuses may also be explained by environmental factors (Chatters 1995). There are two gaps in the geological record. The first significant gap occurs between 2000-3000 cal B.P. As there are known cultural dates from this time period, the lack of geological dates represents overall reduced alluvial deposition, erosional episodes distorting stratigraphic sequences, or sampling error in the alluvial sequence. A second gap of 500 years occurs at 6000-6500 cal B.P. which coincides with the larger gap in cultural dates. It is possible that this gap in the geological record represents the lack of alluvial deposition and/or underrepresentation of aeolian deposits likely accumulating at this time. The lack of geological dates between 10-10.5 and 12-12.5 may also be a lack of alluvial deposition and/or underrepresentation of aeolian deposits likely accumulating at this time. The radiocarbon chronology shows that upland collecting sites are not missing due to the geology and sufficient cultural dates from 2500 cal B.P. Therefore, the radiocarbon chronology of both geological and cultural phenomena support the conclusion that collecting begin by 2500 cal B.P.

Management Considerations

The above conclusions pertaining to research questions have a significant bearing on site evaluation and management strategies. The strategies are delineated according to the three major objectives of this thesis: Assemblage and Site Type Analysis, Sample Size and Assemblage Richness, Chronometric Hygiene.

Assemblage and Site Type Analysis

Looking at Table 5 we need additional examples of components for site types 3a and 3b. Because all but one these components have only been identified in the Cayuse Phase, it is especially important to find any that may date earlier. It is also essential to identify these site types to study whether the FMR is associated with formal ovens or less formal hearths. FMR studies could also focus on the presence of boiling stones. In addition to a thorough fauna analysis, it would be especially important to attempt to recover botanical remains associated with plant processing.

No doubt, major contributions to site evaluation and documentation of site assemblages can be accomplished by going back into repository collections to systematize classification of artifacts and generate more accurate data for artifact frequencies and ratios. As noted in Chapter 4, a major hindrance of the study was a lack of common (or even disclosed) tool classification system. Tool categories across reports ranged between eight and 32. The necessity of collapsing formed tool classes to a lowest common denominator of eight may have resulted in some tools being placed into incorrect groups. Additionally, projectile point keys used varied between reports. It is recommended that an agreed-upon classification system and projectile point key be established as policy for artifact analysis conducted from YTC collections. An analysis of projectile points from major assemblages using the Lower Columbia typology key developed by Carter (2010) would be a first step in tightening the chronology of many YTC assemblages. As researchers often used projectile points to assign dates to components due to lack of funding for radiocarbon dates, controlled analysis of projectile points would assist in confirming temporal assignments in sites on the YTC. Analyses of the major assemblages using a common classification system would also likely yield consistent results. Focus on technological, functional, and raw material characteristics should be emphasized. Results from analyses would not only improve resolution in temporal land use patterns on the YTC but also open up possibilities of linking research to the major assemblages recovered from sites on the Columbia River likely associated with Yakima Uplands resource gathering.

All collections should be revisited to confirm the assemblage and site type assignments. Collections from sites collected by Flenniken et al. (1997) and others are worthy of re-examination to tease out site provenience, site type, and structure.

Sample Size and Assemblage Richness

The results of our assemblage and site type analyses suggest that while shovel probing and limited testing may be useful for determining site integrity, the evaluation of sites according to Criterion D require excavations of larger 1x1 test units and greater than 10m^3 volume. Adequate excavation sample is especially important to recover suitable data for the presence and absence of features for Pre-2500 cal B.P. sites. One strategy may be to identify sites which do not have well-developed components overlaying earlier components where overburden can be removed for efficiencies in reaching lower components.

It is also apparent that excavations with 10m^3 reveal larger samples of artifacts and larger samples of several tool types. The volume of excavation may not always influence the total number of artifacts recovered. Therefore, in selecting sites for evaluation, it may be advantageous to select sites where components have higher densities of artifacts while avoiding components with possible deflation. Numbers of tool types/technologies (e.g. formed tools vs. ground), faunal remains, and *in situ* site features at quantities that allow for scientific assessment were recovered from the largest excavations.

It is obvious that it would be beneficial to have larger samples of artifacts from all assemblages and components from early periods. As we expect all of these components will be smaller in size, it is relatively more important to develop larger sample sizes for the Frenchman Springs Phase. This initiative is essential because we need better data for numbers types of projectile points and other formed tools. As a result of increased sample size, we would expect to obtain additional cultural radiocarbon dates. While these sample sizes can be developed from identified Site Type 1 and 2 components, it would be especially useful to recover these larger samples from any as yet unidentified components of site type 3a and 3b.

Geological and Cultural Radiocarbon Chronologies

Results also indicate that all future testing projects should include more radiocarbon dating of charcoal and bone. In the absence of these materials, thermoluminescence dating should be a priority. There are eight major drainages on the YTC. Three of these drainages with cultural components especially lack cultural radiocarbon chronologies. A systematic effort should be made to follow up on the Fogiol project to identify deposits that date to the 2000-3000 and 11,000-12,000 cal B.P. periods. Extra effort should be devoted to identifying and testing cultural deposits that date to the Early Vantage subphase. Although there are cultural dates in Late Vantage and Frenchman Springs Phases, it is important to increase the number of dates in earlier Frenchman Springs that represent resource intensification associated with cultural changes on the Plateau from 2000-3500 cal B.P. While additional dates could be obtained from additional testing, the revisiting of curated assemblages from pre-2500 cal B.P. sites could also help fill the gap. Dates obtained from charcoal and/or bone are known to have been recovered from in situ cultural features should be pursued to help build the cultural chronology in earlier time phases.

Management Recommendations

Recommendation 1: Inventory sites and identify components that belong to Frenchman Springs Phase and Early Vantage subphase.

Recommendation 2: Revisit collections of sites that may have components in the Frenchman Springs and Early Vantage Phases. Complete more systematic analysis of formed tools (including projectile point key), debitage, fauna, and (when present) FCR. Special emphasis on the study of collections of Hartmann and Lindeman 1979, Hartmann and Stephenson1980, and Flenniken et al. 1997.

Recommendation 3: Revisit and systemize artifact analysis for sites in Late Vantage subphase, specifically 45KT44 and 45KT315.

Recommendation 4: Find any site to help fill the gap in geological and cultural radiocarbon dates in Windust Phase.

Recommendation 5: Revisit all fauna remains from major excavations of sites post-6000 B.P. Complete systematic report and database to identify changes in small vs. large game hunting.

Recommendation 6: Incorporate testing programs from 2002-present in all above efforts.

Recommendation 7: Build a digital archive of all site records, reports, notes, and collection information from 1979-present.

REFERENCES CITED

Andrefsky, William

2004 Material and Context for a Culture History of the Columbia Plateau. In *Complex Hunter-Gatherers: Evolution and Organization of Prehistoric Communities on the Plateau of Northwestern North America,* edited by William C. Prentiss and Ian Kuij, pp. 23-35. The University of Utah Press, Salt Lake City.

Bamforth, Douglas B.

2002 Technological Efficiency and Tool Curation. *American Antiquity*, 51(1):38-50.

Berry, Derek

2002 *National Register Eligibility Testing of Eleven Prehistoric Archaeological Sites, Yakima Training Center, Kittitas and Yakima Counties, Washington*. Historical Research Associates: Missoula.

Binford, Lewis R.

1980 Willow Smoke and Dogs' Tails: Hunter-gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45(1):4-20.

Binford, Lewis R.

2001 *Constructing Frames of Reference: An Analytical Method for Archaeological Theory Building Using Hunter-Gatherer and Environmental Data Sets*. University of California Press, Berkeley.

Boreson, Keo, editor

1998 *Evaluation of Cultural Resources in Construction Impact Areas, Yakima Training Center, Expansion Area Kittitas County, Washington.* Vol. 1. Eastern Washington University Reports in Archaeology and History 100-88. Archaeological and Historical Services, Cheney.

Carter, James A.

2010 A Typological Key for Projectile Points from the Central Columbia Basin. *Archaeology in Washington* 16:3-24.

Carter, James A and Trent DeBoer

2002 *Results of a 38,7332-Acre Cultural Resource Inventory on Yakima Training Center, Kittitas and Yakima Counties, Washington*. Historic Research Associates: Seattle.

Chatters, James

1979 *Exploratory Excavations at the Wa-Pai-Xie Archaeological Site Complex, 45KT241*. University of Washington, Submitted to the Department of the Army, Contract No. DAKF57-78-M-A889

1984 *Human Adaptation Al01 the Columbia River 4700-1600 BP: A Report of Test Excavation at River Mile 590, North Central Washington*. Research Reports 84(1). Central Washington University, Ellensburg.

1987 Hunter-Gatherer Adaptations and Assemblage Structure. *Journal of Anthropological* Archaeology 6:336–375.

1995 Population Growth, Climatic Cooling, and the Development of Collector Strategies on the Southern Plateau, Western North America. *Journal of World Prehistory* 9:341-400.

1998 Environment. In *Plateau*, edited by Deward E. Walker. pp. 29-48. Handbook of North American Indians, Vol. 12, William C. Sturtevant, general editor, Smithsonian Institution, Washington D.C.

Chatters, James C. and David L. Pokotylo
1998 Prehistory: Introduction. In *Plateau*, edited by Deward E. Walker. pp. 73-80. Handbook of North American Indians, Vol. 12, William C. Sturtevant, general editor, Smithsonian Institution, Washington D.C.

Chatters, James C. and James R. Benson
1986 *Test Excavation and Evaluation of Ten Prehistoric Archaeological Sites in the Multipurpose Range Complex, Yakima Firing Center, Washington*. Prepared for U.S. Army corp. of Engineers, Contract No. DACA-67-85-D-0034.

Chatters, James C. and Matthew K. Zweifel
1987 *Archaeology of Eight Sites in the Multipurpose Range Complex, Yakima Firing Center, Washington*. Central Washington Archaeological Survey, Central Washington University: Ellensburg.

Delacorte, Michael G. and William Hildebrandt
1994 *A Research Design for the Evaluation and Treatment of Archaeological Sites Along the Tuscarora Gas Transmission Pipeline Between Malin Oregon and Tracy, Nevada.* Far Western Anthropological Research Group, Inc. Reno, Nevada.

Flenniken, J. Jeffrey, James D. Gallison, and Fennelle D. Miller
1998 *Historic Context and Evaluation Criteria for Determining National Register Eligibility of Lithic Debitage Dominated Sites on the Yakima Training Center, Yakima and Kittitas Counties, Washington.* Lithic Analyst: Pullman, Washington. DoD Contract# DACA67 96-M-0783

Franklin, Jerry F. and Christopher T. Dyrness
1988 *Natural Vegetation of Oregon and Washington*. General Technical Report PNW-GTR-008 Pacific Northwest Forest and Range Experiment Station, United States Forest Service, Portland.

Galm, Jerry. R., Stan Gough, and Fred L. Nials
2000 *Project Fogoil Alluvial Chronology, Yakima Training Center, Kittitas and Yakima Counties, Cheney, Washington*. Eastern Washington University, Department of Geography and Anthropology.

Gough, Stan
1998 *Archaeological Test Excavations at Site 45KT950, Yakima Training Center, Kittitas County, Washington.* Short Report 589. Archaeological and Historical Services, Eastern Washington University, Cheney.
1999 *Archaeological Test Excavations at Sites 45KT1362 and 45KT726, Yakima Training Center, Kittitas County, Washington*. Eastern Washington University Reports in Archaeology and History 100-109. Archaeological and Historical Services, Cheney

Gough, Stan, Jerry Galm, and Sara Walker
1998 *Yakima Training Center Expansion Area Archaeology: Investigations in the Johnson Creek Drainage Basin Kittitas County, Washington.* Eastern Washington University Reports in Archaeology and History 100-93. Archaeological and Historical Services, Cheney.

Hackenberger, Steve
2009 *Middle Columbia River Archaeology: Archaeological Research, Context Statement, and Regional Archaeological Overview for the Yakima Training Center, Kittitas and Yakima Counties, Washington.* ICI Services Corporation, LLC. Dumfries, VA and US Army. DoD Contract# W912DQ-07-D-0021

Hartmann, Glenn D. and Garry Owen Stephenson.
1980 *Cultural Resources Reconnaissance and Testing on the Yakima Firing Center, Yakima and Kittitas Counties, Washington, Phase II*. Central Washington Archaeological Survey, Central Washington University: Ellensburg.

Hartmann, Glenn D. and Glen W. Lindeman
1979 *Cultural Resources Survey and Testing on the Yakima Firing Center, Yakima and Kittitas Counties, Washington, Phase I.* Washington Archaeological Research Center, Washington State University: Pullman.

Houser, M. C.
1996 *A Prehistoric Overview of Deschutes County.* Prepared for the Deschutes County, The Cities of Bend and Sisters and the State Historic Preservation Office. Ms. on file. Oregon State Historic Preservation Office, Salem.

Kelly, Robert L.
1992 Mobility/Sedentism: Concepts, Archaeological Measures and Effects. *Annual Review of Anthropology* 21:43-66.
1995 *The Foraging Spectrum: Diversity in Hunter-Gatherer Lfeways.* Smithsonian Institution, Washington D.C.

Leonard, Robert D., and George Thomas Jones
1989 *Quantifying Diversity in Archaeology*. Cambridge University Press, Cambridge.

Lyman, R. Lee
1991 *Prehistory of the Oregon Coast: The Effects of Excavation Strategies and Assemblage Size on Archaeological Inquiry*. Academic Press, San Diego.

Miss, Christian J.
1999 *Yakima Training Center National Register Eligibility Testing: Upland Opportunistic Lithic Procurement and Quarry Sites, Kittitas County, Washington.* Draft report submitted to the U.S. Army Corps of Engineers, Seattle District, by Northwest Archaeological Associates, Inc., Seattle, Washington

Nelson, Charles, M.
1969 *The Sunset Creek Site (45KT28) and Its Place in Plateau Prehistory*. Report of Investigations No. 47. Laboratory of Anthropology, Washington State University, Pullman.

Prentiss, William C., James C. Chatters, Michael Lenert, David S. Clarke, and Robert C. O'Boyle
2005 The Archaeology of the Plateau of Northwestern North America During the Late Prehistoric Period (3500-200 B.P.): Evolution of Hunting and Gathering Societies. *Journal of World Prehistory* 19(1):47-118.

Reidel, Stephen P., Barton S. Martin, and Heather L. Petcovic
2003 The Columbia River Flood Basalts and the Yakima Fold Belt. Western Cordillera and Adjacent Areas. Edited by TW Swanson. *Geological Society of America Field Guide* 4:87-105.

Reidel, Stephen P., Karl R. Fecht, Michael C. Hagood, and Terry L. Tolan
1989 The Geologic Evolution of the Central Columbia Plateau. *Geological Society of America Special Papers* 239:247-264.

Rhode, David
1988 Measurement of Archaeological Diversity and the Sample-Size Effect. *American Antiquity* 53(4):708-716.

Salo, Lawr
1985 Large Scale Analytic Units: Chronological Periods and Site Types. In *Summary of Results, Chief Joseph Dam Cultural Resources Project, Washington*, edited by Sarah K. Campbell, pp. 183 -222. Report submitted to the U. S. Army Corps of Engineers , Seattle District. Office of Public Archaeology, Institute for Environmental Studies, University of Washington, Seattle.

Schalk, Randal F. and Greg Cleveland
1983 A Sequence of Adaptations in the Columbia-Fraser Plateau. In *Cultural Resource Investigations for the Lyons Fish Hatchery, Lyons Ferry, Washington*, edited by Randall F. Schalk, pp. 11 - 56. Laboratory of Archaeology and History, Project Report No. 8. Washington State University, Pullman.
1983 *Cultural Resource Investigations for the Lyons Ferry Fish Hatchery Project, Near Lyons Ferry, Washington*. Washington State University Pullman Lab or Archaeology and History.

Schalk, Randall F. and Ricky G. Atwell
1994 *Research Design for Prehistoric Archaeology. In Archaeological Investigations, PGT0PG&E Pipeline Expansion Project, Idaho, Washington, Oregon, and California; Volume 1 Project Overview, Research Design and Archaeological Inventory*. Prepared for Bechtel Corporation. San Francisco. INFOTEC Research, Inc., Fresno, California; and Far Western Anthropological Research Group, Inc., Davis, California.

Schalk, Randall F., Ricky G. Atwell, Robert U. Bryson, Clayton G. Lebow, Nancy D. Sharp, Craig Skinner and Andrew J. Bailey
1994 Archaeological Investigations. In *PGT-PG&E Pipeline Expansion Project Idaho, Washington, Oregon, and California.* edited by Michael. Moratto. pp. 5.1-5.40. Synthesis of Findings, Vol. 4. M. J. Moratto, general editor, INFOTECH Research, Inc., Davis, California. Submitted to Pacific Gas Transmission Company, Portland, Oregon.

Schott, Michael
1986 Technological Organization and Settlement Mobility: An Ethnographic Examination. *Journal of Anthropological Research* 42(1):15-51.

Stuiver, M., P. J. Reimer, and R. Reimer
2017 CALIB 7.1 [WWW program] at http://calib.org, accessed April 2, 2017.

Swanson, Early H., Jr.
1962 *The Emergence of Plateau Culture*. Occasional Papers of the Idaho State College Museum, No. 8. Idaho State College, Pocatello.

VanPool, Todd L. and Robert Leonard
2010 *Quantitative Analysis in Archaeology*. Wiley-Blackwell, New York.

APPENDIX A

CRM PROJECT REPORTS REVEIWED

Author	Site	Year	Tools	Flakes	Volume
Chatters	45KT241	1979	6	245	14.35
Hartman-Stephenson	45KT245	1979	4	1003	7.8
	45KT244	1979	4	550	?
	45KT242	1979	4	809	?
Hartman-Stephenson	45KT239	1979	8	2995	5.4
	45KT249	1979	0	2258	?
	45KT240	1979	11	2328	?
	45KT252	1979	2	243	?
	45KT297	1979	1	199	?
	45KT281	1979			
Hartman and Lindman	45KT326	1980	4	556	7.6
	45KT328	1980	1	98	1.8
	45KT334	1980	7	2615	7.8
	45KT207	1980	9	649	3.9
	45KT338	1980	7	372	3.6
Sender	45YK323	1981	18	116	0.35
	45YK325	1981	1	577	0.15
	45YK332	1981	40	1849	0.25
Chatters and Benson	FC-2	1986	10	455	3.7
	45KT239	1986	4	194	4.9
	45KT250	1986		55	1.2
	45KT252	1986	15	2763	5.8
	45KT276	1986	8	632	4.8
	45KT277	1986	1	90	1.6
	45KT285	1986	37	3319	10.1
	45KT291	1986	35	3799	3
	45KT556	1986	1	1564	2.1
	45KT566	1986	6	252	3.4
Chatters and Zweifel	45KT252	1987	5	6328	14.78
	45KT276	1987	5	2333	4.8
	45KT285	1987	121	13585	43.85
	45KT291	1987	91	6152	13
Flenniken et al.	45KT299	1997	7	387	?
	45KT338	1997	13	529	?
	45YA533	1997	20	1663	?
	45YA579	1997	3	255	?
	45YA569	1997	0	7	?
	YTC1988	1997	0	8	?

Author	Site	Year	Tools	Flakes	Volume
	YTC170/01	1997	0	123	?
King and Putnum	45YA176	1994	9	45	1
	45YA211	1994	0	0	2.3
	45YA212	1994	0	91	9.3
	45YA305	1994	6	93	3.2
	45YA314	1994	16	659	5.3
Gough et al	45KT979	1998	609	19886	75.1
	45KT980	1998	576	39660	72
	45KT1003	1998	119	5788	55.7
	45KT1011	1998	63	3015	6.4
	45KT1012	1998	25	393	11.3
Gough	45KT950	1998	6	1467	7.555
	45KT1362	1998	22	18311	4.525
	45KT726	1998	10	1332	1.7
Miss	25/9/5	1999	36	6766	2.2275
	2188	1999	52	22139	2.1875
	45KT924	1999	39	15657	0.438
	45KT1185	1999	59	16107	1.7875
	45KT1189	1999	3	1049	0.36
Beery	45KT1129	2002	0	13	0.74
	45KT1130	2002	0	29	0.63
	45KT1163	2002	1	148	1.55
	45KT1164	2002	3	211	1.71
	45YA627	2002	1	22	1.01
	45KT629	2002	2	3697	2.19
	45KT1165	2002	1	8	1.22
	45YA600	2002	0	11	1.35
	45KT1131	2002	0	672	0.64
	45YA641	2002	32	1271	8.18
	45KT44	2002	10	578	9.475
		Totals	2209	221073	

APPENDIX B

SITE DATA

Author	Date	Site	Volume	Area	C14 Date	Age Analysis	Relative Age	Plant site type	FMR/m3	Bone/ m3	Biface/Core Deb Index
Chatters	1979	45KT241-B	0.4	2		7000-4500	5	2	0	1	HCLB
Chatters	1986	45KT291-A	1.4	3		4000-5000	4	2	1	1	LCLB
Chatters	1987	45KT291-I	7.8	10		150-2000	1	2	1	1	HCLB
Gough, et al	1998	45KT1003-AU3	2.2	4	3550 +/- 60 B.P.	2000-4000	3	2	1	2	LCLB
Chatters	1986	45KT285	10.1	17		1120-1400	2	2	2	1	LCLB
Gough, et al	1998	45KT979-C2	0.3	8	1180+/-80	150-2000	1	1	0	2	LCHB
Chatters	1987	45KT285-I	17.2	4	260+/-50	150-500	1	1	2	1	LCLB
Boreson	1998	45KT980	19.5	16		150-4000	1	1	2	1	LCHB
Gough, et al	1998	45KT980-AU1	21	9	460+/-80 B.P.-20+/-60 B.P.	150-1500	1	1	2	1	LCHB
Sender	1981	45YK332	0.52	1		150-4000	3?	5	0	0	LCLB
Chatters	1986	45KT239	4.9	10		2500-1000	2	5	0	0	HCLB
Chatters	1987	45KT252-IIe2	4	8		3000-4500	3	5	0	0	LCLB
Chatters	1987	45KT252 -IIw	4	10		3000-4500	3	5	0	0	LCLB
Chatters	1979	45KT241-A	1.6	2		150-4000	2?	5	0	1	LCHB
Chatters	1979	45KT241-C	1.6	2		8000-7000	5	5	0	1	LCLB
Chatters	1986	45KT566	3.4	14		1000-2500	2	5	0	1	LCLB
Chatters	1986	FC-2	3.7	4		1000-2500	2	5	0	1	LCHB
Gough, et al	1998	45KT979-B2	16.3	20	1900 +/-70	150-2000	2	5	0	1	LCHB
Gough, et al	1998	45KT979-C3	2.5	4	<1630 B.P.	150-2000	1	5	0	1	LCHB
Gough, et al	1998	45KT980-AU3	20	4	2340+/-60	1500-4000	2	5	0	1	LCLB
Gough, et al	1998	45KT1003-AU4	6.2	8	4820 +/- 60 B.P.	4000-6000	4	5	0	1	LCHB
Gough, et al	1998	45KT1012-AU3	5.1	24	1880+/-60 B.P.	150-2000	2	5	0	1	LCLB
Gough	1999	45KT1362	2	1	10120±60	6000-11000	6	5	0	1	LCLB
Gough	1998	45KT950-b	3	1.5		4500-8000	5	4b	1	0	LCLB
Chatters	1986	45KT291-B	1.6	4		300-2000	1	4b	1	1	LCLB

Author	Date	Site	Volume	Area	C14 Date	Age Analysis	Relative Age	Plant site type	FMR/m3	Bone/ m3	Biface/Core Deb Index
Chatters	1987	45KT291-II	5.2	12		150-4000	3?	4b	1	1	LCHB
Gough, et al	1998	45KT979-B1	3.8	8		150-1900	2	4b	1	1	HCLB
Gough, et al	1998	45KT1012-AU1	1.6	4	120 +/- 80 B.P.	150-500	1	4b	1	1	LCLB
Beery	2002	45YA641-TU23-A	4	2	1430+/-50	150-1500	1	4b	1	1	LCHB
Gough, et al	1998	45KT980-AU2	23	44	1890 +/- 60 B.P.- 2340 +/- 60 B.P.	150-5000	2	4b	1	2	LCLB
Gough, et al	1998	45KT1003-AU1	18.7	32	1730 +/- 60 B.P.	1730 +/- 60 BP	2	4b	1	2	LCLB
Gough	1999	45KT726	1.7	1		150-5000	4	4b	1	2	LCLB
Chatters	1986	45KT252	5.8	13	440+/-60	150-2500	1	4a	2	0	LCLB
Boreson	1998	45KT1003	13	13		1500-3000	3?	4a	2	1	LCHB
Beery	2002	45YA641-TU23-B	2	1		4500-8000	5	4a	2	1	HCLB
Chatters	1987	45KT285-II	25.8	16	4120+/-350	3000-4500	4	4a	2	2	LCLB
Gough, et al	1998	45KT1011-AU2	0.6	4	310 +/-60 B.P.	150-2000	1	4a	2	2	LCLB
Gough, et al	1998	45KT979-A1	24.6	56	370+/-60, 570+/-60	150-2000	1	3b	0	2	LCHB
Boreson	1998	45KT1011	1.9	3		150-2000	2?	3b	1	1	LCHB
Gough, et al	1998	45KT1012-AU2	4.6	20		150-500	1	3b	1	1	LCLB
Gough, et al	1998	45KT979-C1	17.8	28	70+/-60, 120+/-40	150-2000	1	3b	1	2	LCHB
Gough, et al	1998	45KT1003-AU2	28.6	56		150-4000	2?	3b	1	2	LCLB
Chatters	1987	45KT252-I	5	8	460+/-60	150-500	1	3a	2	1	LCLB
Boreson	1998	45KT979	15.7	9	1630-2730 (6 dates)	150-4000	2	3a	2	1	LCHB
Gough, et al	1998	45KT979-C4	1.8	4	</-1630B.P.	< 1630	1	3a	2	1	LCLB
Gough, et al	1998	45KT1011-AU3	1.9	4	930 +/-70 B.P.	150-2000	1	3a	2	1	LCLB
Gough, et al	1998	45KT979-A2	10.5	56	>1500-1860< B.P	150-2000	2	3a	2	2	LCLB
Gough, et al	1998	45KT1011-AU1	3.9	16	120 +/-60 B.P.	150-2000	1	3a	2	2	LCHB
Gough, et al	1998	45KT980-AU4	8	16	3070 +/-160 B.P.	2000-4500	3	3b	2	1	HCLB

Author	Date	Site	Volume	Area	C14 Date	Earth Oven/Plant	Hearth	Earth Oven/Plant	Bone Conc	FMR	Projectile Points	Knives	Scrapers
Chatters	1979	45KT241-B	0.4	2									
Chatters	1986	45KT291-A	1.4	3			y				3	3	
Chatters	1987	45KT291-I	7.8	10							1	2	
Gough, et al	1998	45KT1003-AU3	2.2	4	3550 +/- 60 B.P.					2	1		
Chatters	1986	45KT285	10.1	17			Y		Y	2	3	7	2
Gough, et al	1998	45KT979-C2	0.3	8	1180+/-80	Y		Y	Y		1		
Chatters	1987	45KT285-I	17.2	4	260+/-50	Y		Y		3	13	9	
Boreson	1998	45KT980	19.5	16		Y		Y		4	11		
Gough, et al	1998	45KT980-AU1	21	9	460+/-80 B.P.-20+/-60 B.P.	Y		Y	Y	4	4	2	
Sender	1981	45YK332	0.52	1							5	1	
Chatters	1986	45KT239	4.9	10							2	1	
Chatters	1987	45KT252-IIe2	4	8							2		
Chatters	1987	45KT252 -IIw	4	10							3		
Chatters	1979	45KT241-A	1.6	2							1		
Chatters	1979	45KT241-C	1.6	2									
Chatters	1986	45KT566	3.4	14							3		
Chatters	1986	FC-2	3.7	4							2	2	
Gough, et al	1998	45KT979-B2	16.3	20	1900 +/-70		Y				7		
Gough, et al	1998	45KT979-C3	2.5	4	<1630 B.P.						2		1
Gough, et al	1998	45KT980-AU3	20	4	2340+/-60					1	1		3
Gough, et al	1998	45KT1003-AU4	6.2	8	4820 +/- 60 B.P.					1	2		
Gough, et al	1998	45KT1012-AU3	5.1	24	1880+/-60 B.P.				Y				
Gough	1999	45KT1362	2	1	10120±60				Y				1
Gough	1998	45KT950-b	3	1.5					Y	2	1		
Chatters	1986	45KT291-B	1.6	4							1		
Chatters	1987	45KT291-II	5.2	12							5		
Gough, et al	1998	45KT979-B1	3.8	8			Y						
Gough, et al	1998	45KT1012-AU1	1.6	4	120 +/- 80 B.P.					3			

Author	Date	Site	Volume	Area	C14 Date	Earth Oven/Plant	Hearth	Earth Oven/Plant	Bone Conc	FMR	Projectile Points	Knives	Scrapers
Beery	2002	45YA641-TU23-A	4	2	1430+/-50		Y			3			
Gough, et al	1998	45KT980-AU2	23	44	1890 +/- 60 B.P.- 2340 +/- 60 B.P.				Y	4	20	5	5
Gough, et al	1998	45KT1003-AU1	18.7	32	1730 +/- 60 B.P.					4	1		
Gough	1999	45KT726	1.7	1							2		
Chatters	1986	45KT252	5.8	13	440+/-60						2		
Boreson	1998	45KT1003	13	13							2		
Beery	2002	45YA641-TU23-B	2	1					Y		7		
Chatters	1987	45KT285-II	25.8	16	4120+/-350		Y		Y	3	4	5	
Gough, et al	1998	45KT1011-AU2	0.6	4	310 +/-60 B.P.					2			
Gough, et al	1998	45KT979-A1	24.6	56	370+/-60, 570+/-60	Y		Y	Y		6		
Boreson	1998	45KT1011	1.9	3		Y		Y		2	1		
Gough, et al	1998	45KT1012-AU2	4.6	20		Y		Y		2			
Gough, et al	1998	45KT979-C1	17.8	28	70+/-60, 120+/-40	Y		Y	Y	4	54	10	
Gough, et al	1998	45KT1003-AU2	28.6	56		Y		Y		4	5		1
Chatters	1987	45KT252-I	5	8	460+/-60	Y		Y		4			
Boreson	1998	45KT979	15.7	9	1630-2730 (6 dates)	Y	Y	Y	Y	4	9		
Gough, et al	1998	45KT979-C4	1.8	4	</-1630B.P.	Y	Y	Y		4			
Gough, et al	1998	45KT1011-AU3	1.9	4	930 +/-70 B.P.	Y		Y		1			
Gough, et al	1998	45KT979-A2	10.5	56	>1500-1860< B.P	Y	Y	Y	Y	4	9	2	1
Gough, et al	1998	45KT1011-AU1	3.9	16	120 +/-60 B.P.	Y		Y		4	7		
Gough, et al	1998	45KT980-AU4	8	16	3070 +/-160 B.P.	Y		Y		4		1	

Author	Date	Site	Drill	Perforators	Gravers	Spokeshaves	Unifaces	Formed Tools	Types of Tools	Milling stone	Hammerstone
Chatters	1979	45KT241-B						0	0	1	
Chatters	1986	45KT291-A					3	6	3	1	
Chatters	1987	45KT291-I						3	2	1	1
Gough, et al	1998	45KT1003-AU3					1	1	2	1	1
Chatters	1986	45KT285					2	12	4	1	1
Gough, et al	1998	45KT979-C2						1	1	4	
Chatters	1987	45KT285-I						22	2	1	5
Boreson	1998	45KT980	1	1			10	13	4	2	
Gough, et al	1998	45KT980-AU1			2	1	3	9	5	1	
Sender	1981	45YK332	1					7	3		1
Chatters	1986	45KT239						3	2		
Chatters	1987	45KT252-IIe2						2	1		
Chatters	1987	45KT252 -IIw						3	1		
Chatters	1979	45KT241-A				2		3	2		
Chatters	1979	45KT241-C						0	0		
Chatters	1986	45KT566					1	3	2		
Chatters	1986	FC-2						4	2		
Gough, et al	1998	45KT979-B2					1	7	2		
Gough, et al	1998	45KT979-C3						3	2		
Gough, et al	1998	45KT980-AU3		3	2		5	9	5		2
Gough, et al	1998	45KT1003-AU4	1		1	1		5	4		1
Gough, et al	1998	45KT1012-AU3						0	0		
Gough	1999	45KT1362			1	1		3	3		1
Gough	1998	45KT950-b			1			2	2		
Chatters	1986	45KT291-B						1	1		
Chatters	1987	45KT291-II						5	1		
Gough, et al	1998	45KT979-B1						0	0		
Gough, et al	1998	45KT1012-AU1						0	0		
Beery	2002	45YA641-TU23-A						0	0		
Gough, et al	1998	45KT980-AU2		1	7	3	19	41	7		

Author	Date	Site	Drill	Perforators	Gravers	Spokeshaves	Unifaces	Formed Tools	Types of Tools	Milling stone	Hammerstone
Gough, et al	1998	45KT1003-AU1					1	1	2		
Gough	1999	45KT726						2	1		
Chatters	1986	45KT252					1	2	2		1
Boreson	1998	45KT1003					4	2	2		
Beery	2002	45YA641-TU23-B						1	1		
Chatters	1987	45KT285-II			2			11	3		5
Gough, et al	1998	45KT1011-AU2						0	0		
Gough, et al	1998	45KT979-A1					7	6	1		
Boreson	1998	45KT1011					2	1	2		
Gough, et al	1998	45KT1012-AU2					2	0	1		
Gough, et al	1998	45KT979-C1	1	6		1	8	72	6		2
Gough, et al	1998	45KT1003-AU2					2	6	3		
Chatters	1987	45KT252-I						0	0		
Boreson	1998	45KT979					13	9	2		
Gough, et al	1998	45KT979-C4				1		1	1		
Gough, et al	1998	45KT1011-AU3						0	0		
Gough, et al	1998	45KT979-A2		2	2		18	16	6		
Gough, et al	1998	45KT1011-AU1					2	7	2		1
Gough, et al	1998	45KT980-AU4		1			2	2	3		

Author	Date	Site	Cores	Bifaces	Debitage	Core/Debitage Ratio	Biface/Debitage Ratio	Artiodactyl	Carnivore	Fish	Mussel	Lagomorph	Vole	Ground Squirrel
Chatters	1979	45KT241-B	1	0	87	0.01149425	0	Y	N	N	N	Y	N	N
Chatters	1986	45KT291-A	4	11	3063	0.00130591	0.00359125	Y	Y	Y	N	Y	N	Y
Chatters	1987	45KT291-I	27	5	4872	0.00554187	0.00102627	Y	N	Y	N	Y	N	N
Gough, et al	1998	45KT1003-AU3	2	0	941	0.0021254	0	Y	N	N	N	Y	N	Y
Chatters	1986	45KT285	3	7	3297	0.00090992	0.00212314	Y	N	Y	N	Y	Y	Y
Gough, et al	1998	45KT979-C2	0	2	187	0	0.01069519	Y	N	N	N	N	N	Y
Chatters	1987	45KT285-I	11	22	7651	0.00143772	0.00287544	Y	N	Y	N	Y	Y	Y
Boreson	1998	45KT980	6	19	2475	0.00242424	0.00767677	Y	Y	Y	N	Y	Y	Y
Gough, et al	1998	45KT980-AU1	0	16	3028	0	0.00528402	Y	N	Y	N	Y	Y	Y
Sender	1981	45YK332	4	1	1878	0.00212993	0.00053248	N	N	N	N	N	N	N
Chatters	1986	45KT239	1	0	190	0.00526316	0	Y	Y	N	N	Y	N	Y
Chatters	1987	45KT252-IIe2	0	0	120	0	0	Y	N	N	N	Y	N	Y
Chatters	1987	45KT252 -IIw	2	2	6116	0.00032701	0.00032701	Y	N	N	N	Y	Y	Y
Chatters	1979	45KT241-A	0	1	85	0	0.01176471	N	N	N	N	N	N	N
Chatters	1979	45KT241-C	0	0	73	0	0	Y	N	N	N	N	N	N
Chatters	1986	45KT566	0	1	248	0	0.00403226	N	N	N	N	N	N	N
Chatters	1986	FC-2	1	3	448	0.00223214	0.00669643	Y	Y	N	N	Y	N	Y
Gough, et al	1998	45KT979-B2	2	7	1386	0.001443	0.00505051	Y	Y	N	N	Y	N	Y
Gough, et al	1998	45KT979-C3	0	1	82	0	0.01219512	Y	N	N	N	N	N	Y
Gough, et al	1998	45KT980-AU3	0	29	20210	0	0.00143493	Y	N	N	N	Y	N	Y
Gough, et al	1998	45KT1003-AU4	2	4	749	0.00267023	0.00534045	Y	N	N	N	Y	Y	Y
Gough, et al	1998	45KT1012-AU3	0	0	165	0	0	N	N	N	N	N	N	N
Gough	1999	45KT1362	3	3	7645	0.00039241	0.00039241	Y	N	N	N	N	Y	N
Gough	1998	45KT950-b	1	3	1467	0.00068166	0.00204499	Y	N	Y	Y	N	N	N
Chatters	1986	45KT291-B	0	2	756	0	0.0026455	N	N	N	N	Y	N	Y
Chatters	1987	45KT291-II	13	15	1280	0.01015625	0.01171875	Y	N	Y	N	Y	N	Y
Gough, et al	1998	45KT979-B1	1	0	108	0.00925926	0	Y	N	Y	N	Y	Y	Y
Gough, et al	1998	45KT1012-AU1	0	0	137	0	0	N	N	N	N	Y	N	N
Beery	2002	45YA641-TU23-A	1	6	531	0.00188324	0.01129944	Y	N	N	N	N	N	N

Author	Date	Site	Cores	Bifaces	Debitage	Core/Debitage Ratio	Biface/Debitage Ratio	Artiodactyl	Carnivore	Fish	Mussel	Lagomorph	Vole	Ground Squirrel
Gough, et al	1998	45KT980-AU2	9	62	15580	0.00057766	0.00397946	Y	Y	Y	N	Y	Y	Y
Gough, et al	1998	45KT1003-AU1	1	7	1493	0.00066979	0.00468855	Y	Y	N	N	Y	Y	Y
Gough	1999	45KT726	1	2	1332	0.00075075	0.0015015	Y	N	N	N	N	N	N
Chatters	1986	45KT252	5	0	2754	0.00181554	0	N	N	N	N	Y	N	N
Boreson	1998	45KT1003	0	5	662	0	0.00755287	Y	Y	Y	N	Y	N	Y
Beery	2002	45YA641-TU23-B	3	11	364	0.00824176	0	Y	N	N	N	Y	N	N
Chatters	1987	45KT285-II	1	21	5536	0.00018064	0.00379335	Y	Y	Y	N	Y	Y	Y
Gough, et al	1998	45KT1011-AU2	0	0	45	0	0	N	N	N	Y	N	N	N
Gough, et al	1998	45KT979-A1	1	17	1418	0.00070522	0.01198872	Y	Y	Y	N	Y	Y	Y
Boreson	1998	45KT1011	0	1	185	0	0.00540541	Y	N	Y	N	N	N	N
Gough, et al	1998	45KT1012-AU2	0	0	91	0	0	Y	N	N	N	Y	Y	N
Gough, et al	1998	45KT979-C1	4	74	6914	0.00057854	0.01070292	Y	Y	Y	Y	Y	Y	Y
Gough, et al	1998	45KT1003-AU2	0	11	2603	0	0.00422589	N	Y	N	N	Y	Y	Y
Chatters	1987	45KT252-I	0	0	43	0	0	Y	N	N	N	Y	N	Y
Boreson	1998	45KT979	0	42	3882	0	0.01081917	Y	N	Y	N	Y	Y	Y
Gough, et al	1998	45KT979-C4	0	0	15	0	0	Y	N	N	N	N	N	N
Gough, et al	1998	45KT1011-AU3	1	1	198	0.00505051	0.00505051	N	N	N	Y	N	N	N
Gough, et al	1998	45KT979-A2	1	32	9772	0.00010233	0.00327466	Y	N	Y	N	Y	Y	Y
Gough, et al	1998	45KT1011-AU1	3	16	2772	0.00108225	0.00577201	Y	N	Y	Y	Y	N	Y
Gough, et al	1998	45KT980-AU4	5	0	571	0.00875657	0	Y	N	N	N	Y	N	Y

Author	Date	Site	Gopher	VolumePerToolType	VolPerTotalTools	DebitagePerVolume
Chatters	1979	45KT241-B	N	#DIV/0!	#DIV/0!	0.0045977
Chatters	1986	45KT291-A	Y	0.46666667	0.23333333	0.00045707
Chatters	1987	45KT291-I	Y	3.9	2.6	0.00160099
Gough, et al	1998	45KT1003-AU3	N	1.1	2.2	0.00233794
Chatters	1986	45KT285	N	2.525	0.84166667	0.00306339
Gough, et al	1998	45KT979-C2	Y	0.3	0.3	0.00160428
Chatters	1987	45KT285-I	Y	8.6	0.78181818	0.00224807
Boreson	1998	45KT980	Y	4.875	1.5	0.00787879
Gough, et al	1998	45KT980-AU1	Y	4.2	2.33333333	0.00693527
Sender	1981	45YK332	N	0.17333333	0.07428571	0.00027689
Chatters	1986	45KT239	Y	2.45	1.63333333	0.02578947
Chatters	1987	45KT252-IIe2	N	4	2	0.03333333
Chatters	1987	45KT252 -IIw	Y	4	1.33333333	0.00065402
Chatters	1979	45KT241-A	N	0.8	0.53333333	0.01882353
Chatters	1979	45KT241-C	N	#DIV/0!	#DIV/0!	0.02191781
Chatters	1986	45KT566	N	1.7	1.13333333	0.01370968
Chatters	1986	FC-2	Y	1.85	0.925	0.00825893
Gough, et al	1998	45KT979-B2	Y	8.15	2.32857143	0.01176046
Gough, et al	1998	45KT979-C3	Y	1.25	0.83333333	0.0304878
Gough, et al	1998	45KT980-AU3	Y	4	2.22222222	0.00098961
Gough, et al	1998	45KT1003-AU4	Y	1.55	1.24	0.0082777
Gough, et al	1998	45KT1012-AU3	N	#DIV/0!	#DIV/0!	0.03090909
Gough	1999	45KT1362	N	0.66666667	0.66666667	0.00026161
Gough	1998	45KT950-b	N	1.5	1.5	0.00204499
Chatters	1986	45KT291-B	Y	1.6	1.6	0.0021164
Chatters	1987	45KT291-II	N	5.2	1.04	0.0040625
Gough, et al	1998	45KT979-B1	Y	#DIV/0!	#DIV/0!	0.03518519
Gough, et al	1998	45KT1012-AU1	N	#DIV/0!	#DIV/0!	0.01167883
Beery	2002	45YA641-TU23-A	N	#DIV/0!	#DIV/0!	0.00753296

Author	Date	Site	Gopher	VolumePerToolType	VolPerTotalTools	DebitagePerVolume
Gough, et al	1998	45KT980-AU2	Y	3.28571429	0.56097561	0.00147625
Gough, et al	1998	45KT1003-AU1	Y	9.35	18.7	0.01252512
Gough	1999	45KT726	N	1.7	0.85	0.00127628
Chatters	1986	45KT252	N	2.9	2.9	0.00210603
Boreson	1998	45KT1003	Y	6.5	6.5	0.01963746
Beery	2002	45YA641- TU23-B	N	2	2	0.00549451
Chatters	1987	45KT285-II	Y	8.6	2.34545455	0.0046604
Gough, et al	1998	45KT1011-AU2	N	#DIV/0!	#DIV/0!	0.01333333
Gough, et al	1998	45KT979-A1	Y	24.6	4.1	0.01734838
Boreson	1998	45KT1011	N	0.95	1.9	0.01027027
Gough, et al	1998	45KT1012-AU2	N	4.6	#DIV/0!	0.05054945
Gough, et al	1998	45KT979-C1	Y	2.96666667	0.24722222	0.00257449
Gough, et al	1998	45KT1003-AU2	Y	9.53333333	4.76666667	0.01098732
Chatters	1987	45KT252-I	N	#DIV/0!	#DIV/0!	0.11627907
Boreson	1998	45KT979	Y	7.85	1.74444444	0.00404431
Gough, et al	1998	45KT979-C4	Y	1.8	1.8	0.12
Gough, et al	1998	45KT1011-AU3	N	#DIV/0!	#DIV/0!	0.00959596
Gough, et al	1998	45KT979-A2	Y	1.75	0.65625	0.0010745
Gough, et al	1998	45KT1011-AU1	N	1.95	0.55714286	0.00140693
Gough, et al	1998	45KT980-AU4	Y	2.66666667	4	0.01401051

APPENDIX C

RADIOCARBON DATA

Author	Sample #	Cultural	Cultural Feature	Age-Uncal	Cal B.P.	2s Low	2s Median	Histo Dates	2s High
Flenniken et al.	Beta 100993	N	NN	3180 ± 70	3230-3565	3230	3404	3500	3565
Flenniken et al.	Beta 100994	N	NN	3130 ± 110	3030-3218	3007	3332	3500	3589
Flenniken et al.	Beta 100995	N	NN	3300 ± 80	3362-3718	3362	3533	3500	3718
Flenniken et al.	Beta 100996	N	NN	4330 ± 60	5040-5104	4726	4919	5000	5260
Flenniken et al.	Beta 100997	N	NN	5950 ± 70	6635-6968	6635	6784	7000	6968
Flenniken et al.	Beta 100998	N	NN	7430 ± 110	8017-8413	8017	8246	8000	8413
Chatters and Zweifel	Beta14897	N	NN	1260 ±70	1027-1165	1003	1189	1000	1302
Gough (fogoil)	Beta 140157	N	NN	1580 ±40	1387-1552	1387	1469	1500	1552
Gough (fogoil)	SR-5499, CAMS 65972	N	NN	1440± 40	1291-1398	1291	1337	1500	1398
Gough (fogoil)	Beta 140163	N	NN	3700 ±40	3922-4151	3922	4039	4000	4151
Gough (fogoil)	SR-5503, CAMS 65981	N	NN	11910 ±40	13567-13810	13567	13732	14000	13810
Gough (fogoil)	SR-5504, CAMS 65978	N	NN	12090 ± 40	13784-14089	13784	13943	14000	14089
Gough (fogoil)	Beta 140162	N	NN	8420 ± 70	9280-9537	9280	9439	9500	9537
Gough (fogoil)	SR-5000, CAMS 65979	N	NN	9630± 40	10922-11105	10784	10950	11000	11177
Gough (fogoil)	Beta 140165	N	NN	7160 ±50	8027-8071	7865	7981	8000	8153
Gough (fogoil)	SR-5501, CAMS 65980	N	NN	7250 ±40	7988-8078	7983	8076	8000	8167
Gough (fogoil)	SR-5502, CAMS 65983	N	NN	6650 ±40	7452-7517	7444	7530	7500	7587
Gough (fogoil)	Beta 140159	N	NN	7210 ±50	7953-8160	7953	8023	8000	8160
Gough (fogoil)	Beta 140160	N	NN	8160 ±100	8817-9130	8777	9123	9000	9425
Gough (fogoil)	Beta 140158	N	NN	7010 ±50	7723-7946	7723	7849	8000	7946
Gough (fogoil)	Beta 140161	N	NN	6590 ±70	7373-7446	7332	7492	7500	7592
Gough (fogoil)	SR-5497, CAMS 65973	N	NN	5890 ±50	6660-6747	6565	6712	6500	6849
Gough (fogoil)	SR-5498, CAMS 65974	N	NN	1890 ±50	1824-1939	1710	1832	2000	1942
Gough (fogoil)	Beta 139122	N	NN	3800 ±80	3976-4418	3976	4195	4000	4418
Gough (fogoil)	Beta 139121	N	NN	4250 ±80	4703-4857	4531	4786	5000	5034
Gough (fogoil)	Beta 139123	N	NN	5730 ±50	6410-6641	6410	6528	6500	6641
Gough (fogoil)	Beta 140170	N	NN	9810 ±60	11124-11354	11124	11227	11000	11354
Gough (fogoil)	Beta 139125	N	NN	10480 ±150	11888-12295	11834	12348	12500	12710
Gough (fogoil)	Beta 139126	N	NN	9520 ±120	10518-11186	10518	10854	11000	11186
Gough (fogoil)	Beta 139127	N	NN	9320 ±120	10765-10933	10231	10526	10500	11066
Gough (fogoil)	Beta 139128	N	NN	9910 ±50	11397-11502	11215	11313	11500	11601
Gough (fogoil)	SR-5505, CAMS 65985	N	NN	3140 ±40	3283-3379	3247	3364	3500	3449
Gough (fogoil)	Beta 140164	N	NN	10940 ±70	12706-12986	12706	12808	13000	12986

Author	Sample #	Cultural	Cultural Feature	Age-Uncal	Cal B.P.	2s Low	2s Median	Histo Dates	2s High
Gough (fogoil)	SR-5506, CAMS 65984	N	NN	10020 ±40	11315-11718	11315	11508	11500	11718
Flenniken et al.	Beta 100991	N	NN	200 ± 20	152-178	0	172	0	296
Flenniken et al.	Beta 100992	N	NN	1190 ± 70	969-1268	969	1186	1000	1268
Flenniken et al.	Beta 100999	N	NN	1220 ± 60	1019-1155	989	1148	1000	1281
Flenniken et al.	Beta 101987	Y	Y	1710 ± 50	1640-1758	1522	1621	1500	1776
Flenniken et al.	Beta101988	Y	Y	2310 ± 50	2224-2368	2154	2328	2500	2464
Chatters and Zweifel	Beta14896	Y	Y	440 ± 60	368-482	315	483	500	551
Chatters and Zweifel	Beta19349	Y	Y	250 ± 50	187-263	0	298	500	464
Chatters and Zweifel	Beta20050	Y	N	4070 ±50	4615-4726	4424	4572	4500	4812
Chatters and Zweifel	Beta 14897	Y	Y	1260 ±70		1003	1189	1500	1302
Chatters and Zweifel	Beta19350	Y	Y	4400 ±100	4824-5314	4824	5027	5000	5314
King and Putnum	WSU4431	Y	Y	370 ± 80	221-350	157	409	500	535
King and Putnum	WSU4432	Y	Y	400 ±80	291-548	291	433	500	548
King and Putnum	WSU4429	Y	Y	365 ± 80	219-350	154	405	500	534
King and Putnum	WSU4430	Y	Y	310 ±80	137-250	0	374	500	514
King and Putnum	WSU4433	Y	Y	510 ± 80	374-466	327	539	500	664
Boreson	Beta67357	N	NN	2930 ±90	2244-2485	2183	2471	2500	2736
Boreson	Beta67358	N	NN	705 ± 50	592-667	557	662	500	729
Boreson	Beta67356	N	NN	3470 ±50	3612-3865	3612	3745	3500	3865
Gough, et al	85236	Y	Y	370 ±60	307-510	307	414	500	510
Gough, et al	85237	Y	Y	570 ±60	514-657	514	593	500	657
Gough, et al	85239	Y	Y	430 ±60	368-478	315	472	500	544
Gough, et al	70937	Y	Y	1860 ±80	1782-1970	1605	1791	2000	1987
Gough, et al	79035	Y	Y	1900± 70	1661-1826	1629	1840	2000	1997
Gough, et al	79034	N	NN	3130 ±50	3219-3450	3219	3347	3500	3450
Gough, et al	85241	Y	Y	70 ± 60				0	
Gough, et al	85238	Y	Y	120 ±40	91-213	9	125	0	274
Gough, et al	92335	Y	Y	830± 60	759-870	671	753	1000	907
Gough, et al	85240	Y	Y	1180 ±80	956-1275	956	1108	1000	1275
Gough, et al	79039	N	Y	1630 ±70	1378-1699	1378	1526	1500	1699
Gough, et al	79038	Y	Y	2730 ±150	2404-2812	2381	2861	3000	3232
Gough, et al	79036	N	NN	4930± 100	5519-5734	5470	5682	5500	5909
Gough, et al	85245	Y	Y	90± 60	90-189	8	122	0	277
Gough, et al	85248	Y	Y	20 ±60				0	
Gough, et al	85244	Y	Y	80 ±60	91-213	9	119	0	274
Gough, et al	85247	Y	Y	230 ±40	193-252	0	211	0	429
Gough, et al	85242	Y	Y	460 ±80	452-601	312	494	500	639

Author	Sample #	Cultural	Cultural Feature	Age-Uncal	Cal B.P.	2s Low	2s Median	Histo Dates	2s High
Gough, et al	90756	Y	Y	1890 ±60	1818-1889	1639	1829	2000	1986
Gough, et al	85246	Y	Y	2340± 60	2441-2525	2156	2378	2500	2697
Gough, et al	85243	Y	Y	3070 ±160	3239-3623	2855	3251	3500	3631
Gough, et al	85249	Y	Y	1730 ±60	1532-1813	1532	1647	1500	1813
Gough, et al	82179	Y	N	3550 ±60	3795-3903	3646	3840	4000	4060
Gough, et al	85250	Y	N	4820± 60	5389-5520	5328	5534	5500	5659
Gough, et al	85251	Y	N	5020 ±60	5632-5667	5620	5769	6000	5907
Gough, et al	85253	Y	Y	120± 60	86-218	3	134	0	282
Gough, et al	85254	Y	Y	310 ±60	218-337	0	384	500	502
Gough, et al	85252	Y	Y	930 ±70	714-840	705	843	1000	960
Gough, et al	85255	Y	Y	120 ±80	0-286	0	142	0	286
Gough, et al	85256	Y	N	1880 ±60	1761-1857	1629	1818	2000	1968
Gough (fogoil)	Beta 140174	Y	N	1630 ±40	1412-1610	1412	1528	1500	1610
Gough (fogoil)	Beta 139130	Y	N	1640 ±60	1523-1667	1399	1539	1500	1697
Gough (fogoil)	Beta 139129	Y	N	2870 ±110	3030-3425	2764	3013	3000	3326
Gough (fogoil)	Beta 133663	Y	Y	10160 ±60	11502-11687	11411	11831	12000	12084
Gough (fogoil)	Beta 113664	Y	Y	10010± 60	11269-11752	11269	11501	11500	11752
Gough (fogoil)	Beta 113665	Y	Y	10130 ±60	11486-11683	11405	11767	12000	12026
Gough (fogoil)	Beta 140166	Y	Y	330± 40	305-484	305	392	500	484
Gough (fogoil)	Beta 140167	Y	N	10±40				0	
Gough (fogoil)	Beta 140168	Y	N	120 ±40	91-213	9	123	0	274
Gough (fogoil)	Beta 140169	N	NN	2930 ±40	3077-3195	2959	3080	3000	3207
Gough (fogoil)	Beta 140172	Y	N	9100 ±60	10324-10450	10178	10261	10500	10477
Gough (fogoil)	Beta 139124	Y	N	9010 ±90	9849-10040	9793	10145	10000	10400
Beery	GX-26743	Y	Y	1430 ±50	1272-1412	1272	1335	1500	1412
Beery	GX-26740	Y	Y	4950 ±80	5538-5701	5492	5697	5500	5902
Beery	GX-26741	Y	Y	7880 ±90	8499-8745	8481	8725	8500	8997
Beery	GX-26742	Y	Y	7940 ±100	8803-9051	8540	8798	9000	9071
Miss	122924	y	N	60 ±80				0	
Miss	122925	Y	N	0				0	
Miss	122925	Y	N	1400 ±110	1071-1531	1071	1317	1500	1531
Miss	122925	Y	N	1780 ±100	1473-1626	1418	1704	1500	1930
Gough	124167	Y	N	10180 40	11706-12054	11706	11880	12000	12054
Gough	124168	Y	N	8880 70	9721-9957	9708	9995	10000	10196
Gough	124169	N	NN	3810 40	4272-4344	4086	4203	4000	4405
Gough	124701	N	NN	4680 150	5109-5302	4892	5381	5500	5714
Gough	124170	N	NN	5840 50	6634-6762	6501	6653	6500	6773
Carter and Greiser	133843	Y	Y	1330 ±100	1015-1223	984	1240	1000	1412