Long Term Histories and Archaeology of the Stave Watershed
Region of Southwestern British Columbia

By

Duncan McLaren
B.A., Simon Fraser University

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We accept this thesis as conforming
To the required standard

[redacted]

Dr. Quentin Mackie, Supervisor (Department of Anthropology)

[redacted]

Dr. April Nowell, Department Member (Department of Anthropology)

[redacted]

Dr. Wendy Wickwire, Outside Member (Department of History)

[redacted]

Dr. Marcus Milwright, External Examiner (Department of History in Art)

Supervisor: Dr. Quentin Mackie

ABSTRACT

This thesis explores multiple ways in which long-term history is constructed, described, and enacted. The goal of undertaking this research is to discover if different long-term historical approaches provide compatible perspectives of the past. Five different approaches to the late-Pleistocene and Holocene histories of the Stave Watershed region of British Columbia are investigated. These approaches include palaeo-environmental history, Coast Salish oral tradition, the cultural-historical sequence, and two sequences based on the analysis of surface collected archaeological data from fifty sites in the study area. The last two sequences employed the use of a seriation analysis to temporally order formed bifaces and site locations, and a cluster analysis to characterize different land-use and settlement patterns in the study area through time. The long-term histories are compared, contrasted, and tabulated to demonstrate the interrelatedness of sequences and to gain an understanding of the role of social memory in enacting tradition.

Examiners:

[redacted]

Dr. Quentin Mackie, Supervisor (Department of Anthropology)

[redacted]

Dr. April Nowell, Department Member (Department of Anthropology)

[redacted]

Dr. Wendy Wickwire, Outside Member (Department of History)

[redacted]

Dr. Marcus Milwright, External Examiner (Department of History in Art)

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This thesis is dedicated to Lesley, Finnbhar, and Guthrie.

Figure 1. Location of Study Area.

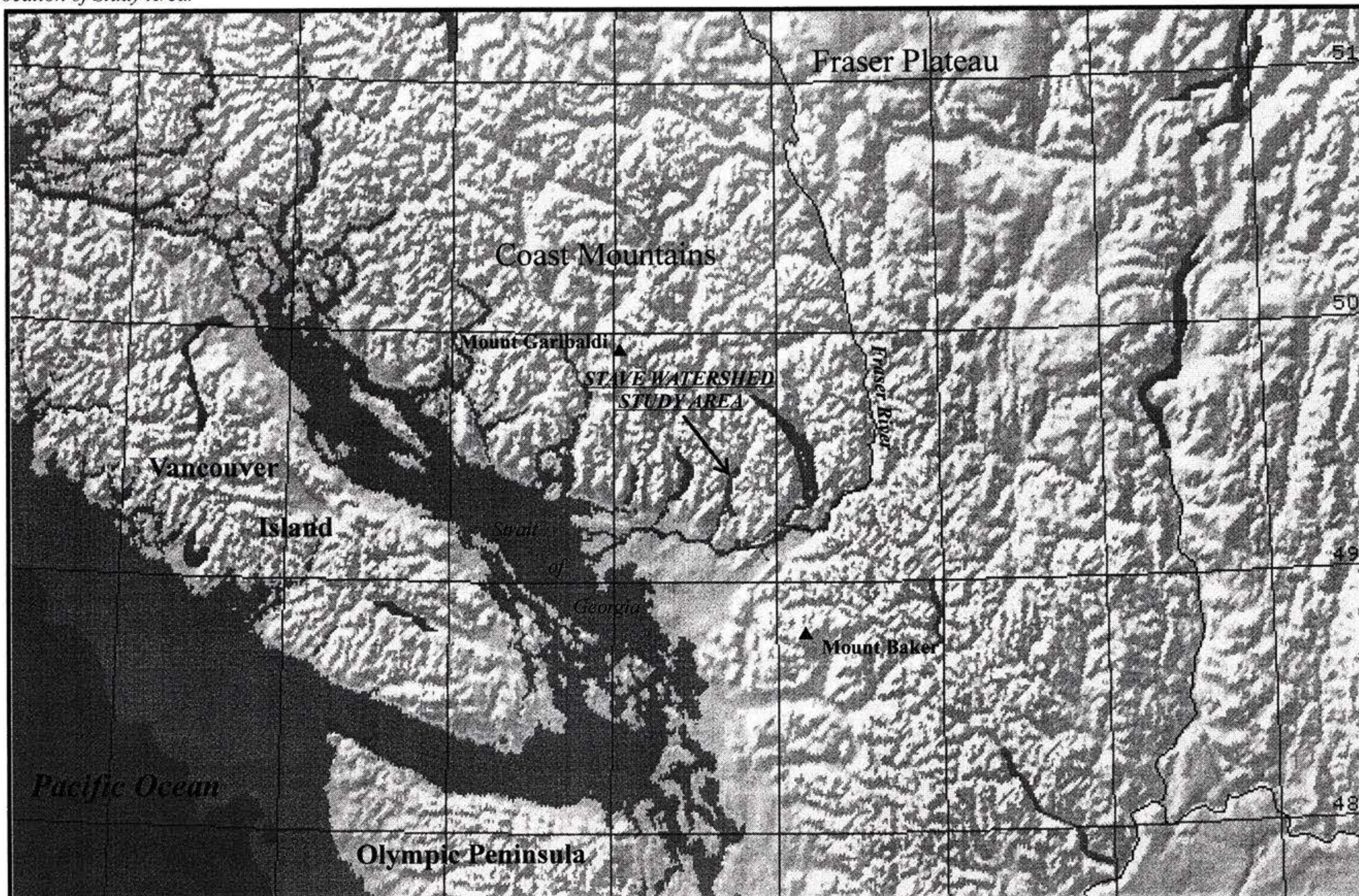
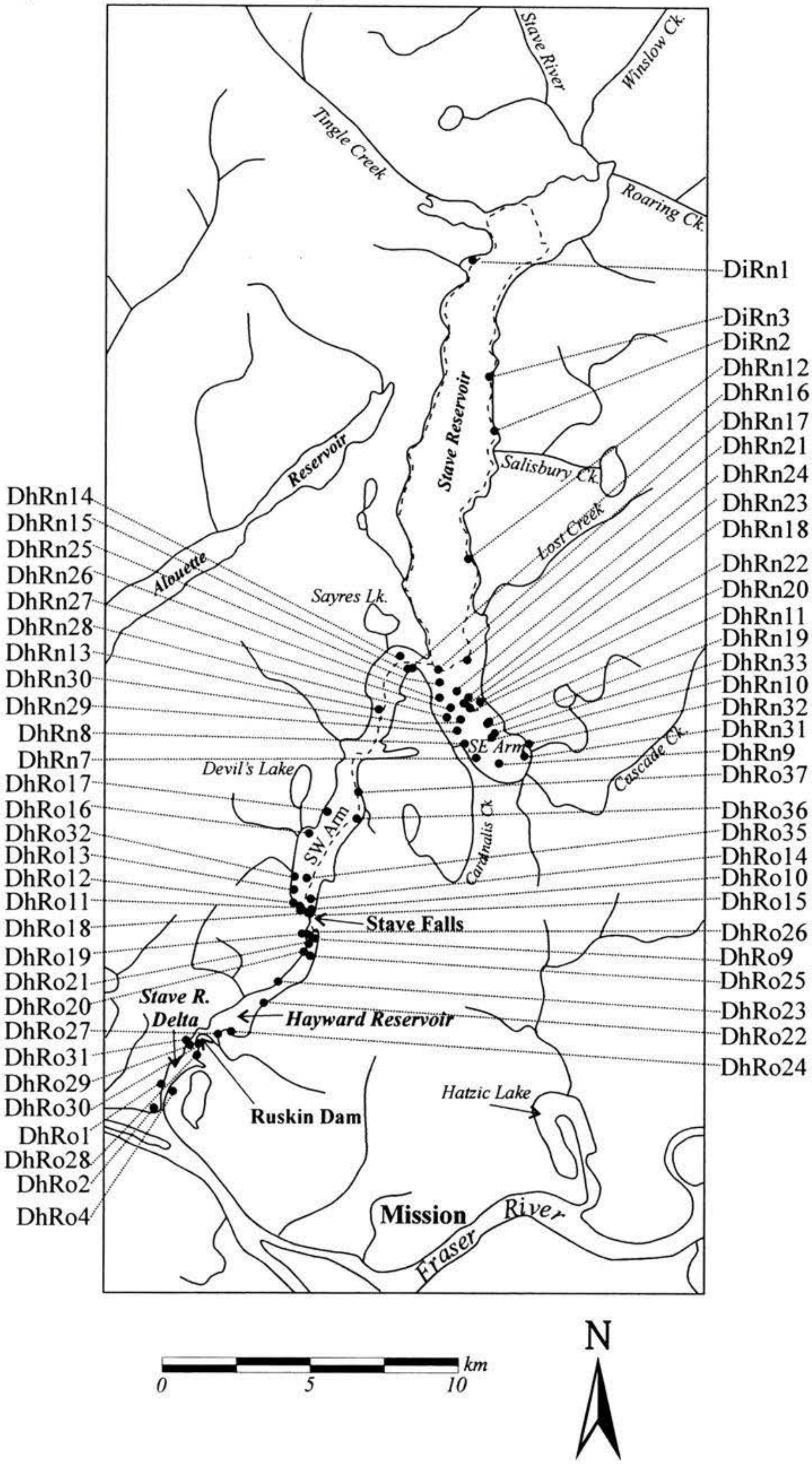


Figure 2. Archaeological Site Locations in the Study Area.



CHAPTER ONE - INTRODUCTION

Research Objectives

The objective of this thesis is to investigate the relationship of different long-term histories of the Stave Watershed region of British Columbia. Analytical strategies have been employed to elucidate long-term patterns of change and continuity in tool making and land-use practices from surface collected archaeological materials. These analyses are contextualized in relation to sequences of long-term palaeo-environmental change, culture-history, and oral history. Together, five very different long-term historical sequences are explored individually and then compared, providing a multifaceted and diachronic perspective of the landscape. The resulting tapestry of histories provides a means of investigating the role of social memory in the perpetuation of long-term cultural practices. This thesis revives the notion of tradition and the importance of recognizing it as negotiated and repeated by human actors generation after generation over long-term periods of time.

The diachronic analyses of manufacturing and land-use practices draw upon lithic materials collected from the Stave Watershed area to produce two sequences: 1) change and continuity in stylistic expression as conveyed in the manufacture of formed bifaces, and 2) an evaluation of long-terms trends and patterns in land-use activities based on tool function and manufacturing techniques employed across the landscape. The analysis of formed bifaces employs stylistic seriation to create a sequence of stylistic expression using this medium. The stylistic seriation method allows artifact clusters to be dated relatively, and this in association with cross-dating is employed to create sequences of site use. This sequence of site use is then employed to create a sequence of long-term land-use by applying it to the result of a synchronic analysis of land-use and settlement patterns.

The sequences used to contextualize the analyses are drawn from oral-historical, palaeo-environmental, and archaeological sources. The contextual sequences are not specific to the Stave Watershed area but are concentrated in a broader region including the lower Fraser River drainage and neighbouring regions. The contextual sequences have been compiled primarily through documentary research.

The seriation and long-term land use analyses, and the oral-historical contextual sequence are not ordered using absolute or a calendrical dating scheme. The temporality of these sequences is inherent in the sequences themselves. They are ordered chronologically in relative terms. The archaeological and the palaeo-environmental sequences have been formulated scientifically along an external temporal framework based primarily on radiocarbon analysis. Other temporal frameworks are drawn upon in the creation of the archaeological and palaeo-environmental sequences: the environmental sequence relies heavily upon stratigraphy and the archaeological sequence upon the stratigraphy, cross-dating, and the presence, absence, or relative frequencies of artifact and feature types. The palaeo-environmental and archaeological sequences are most often referred to in conventionalized radiocarbon years before present expressed as 'B.P.' throughout this thesis.

The Stave Watershed Study Area

The materials analyzed are from forty-nine of sixty known site locations in the Stave Watershed region of British Columbia. The specific areas that were surveyed during the course of field research were delineated by the heritage management scope of the projects that were undertaken (McLaren *et al.* 1997; McLaren and Maxwell 1998; McLaren *et al.* 1998; Eldridge and McLaren 1998; McLaren and Owens 2000). In particular, these studies focused primarily upon areas affected by hydroelectric operations. The materials located and collected are from the following sub-regions of the Stave Watershed: the inundation zone of Stave Reservoir, the inundation zone of Hayward Reservoir, and the shoreline of the Stave Delta (Figure 2).

The Fraser Valley region is the traditional territory of the Stó:lō people. The Stave Watershed is within the traditional territory of the Kwantlen First Nation. The Stó:lō people are sometime split into speakers of the Upriver and Downriver Halkomelem languages of the Salishan language family. The division between the upriver and downriver dialects occurs in the Stave/Hatzic vicinity (Mohs 1987) The Kwantlen were traditionally speakers of *Hun'qumyi'num'* (Downriver Halkomelem).

Due to the impact of epidemic diseases around the time of European expansion into the region (in the late 18th Century), the peoples of the villages at the mouths of the Stave River, Whonnock Creek, and Hatzic Lake were severely depopulated (Duff 1952). Those who survived amalgamated primarily with the Kwantlen (Duff 1952) who were renowned as being extremely influential in the lower Fraser Region (Hill-Tout 1903), and who eventually became effective middlemen in the fur trade when Fort Langley was established by the Hudson's Bay Company on the Fraser River in 1827. Due to the impacts of epidemic diseases in the Stave River area, there are few specific historical or ethnographic records of the traditional use or knowledge of the Stave Watershed with the exception of a recently compiled traditional use study (Dandurand et al. 1996). The

Stó:lō Atlas (McHalsie 2001: 150) provides only one Halkomelem place name for the entire Stave Watershed area: *Sx̱wòyeqs* which translates as "tribe died".

The northern slope of the Fraser Valley, through which the Stave River cuts, is the southern extent of the British Columbia Coast Mountain Range. This area is characterized by multiple biogeoclimatic zones as a result of the mountainous terrain: coastal Douglas-fir in the Fraser Valley, coastal western hemlock on the intermediate slopes around the montane lakes, mountain hemlock in the sub-alpine, and alpine tundra. Multiple ecosystems exist within each of the biogeoclimatic zones. The variability in resources that can found in these particular zones (and sub-zones) forms the basis for the prediction that the peoples who inhabited the region, since the retreat of the Cordilleran Ice sheet, gained knowledge of these areas through exploration, and that they travelled annually to different ecosystems at different seasons to take advantage of the resources specific to, or concentrated in, a particular region. As resource availability differs in regards to ecosystem, differing resource gathering strategies would have been employed in different regions. Settlement and land-use patterns would have been dependent on the knowledge and value of these resources, the seasons of relative optimality, and the distance travelled to gain access to the region. Significantly, changing environmental and cultural conditions through the late-Pleistocene and Holocene may have resulted in shifts in these settlement and land-use strategies.

As most intensive archaeological studies in the area have been conducted in proximity to the banks of the Fraser River, the Stave Watershed study area provides a unique perspective by being situated along the watercourse of a small river and lake system that feeds into the Fraser River. The materials collected from the Stave

Watershed are primarily from near river and lakeshore contexts. However, the study area, with the exception of the Stave Delta at mouth of the river, is located above and away from the Fraser River and is flanked by the high slopes of mountainous terrain. Prior to the archaeological inventory of Stave Reservoir the archaeological significance of the area was doubted: it was predicted that few sites would be found in such a marginal environmental setting (Wilson and Heap 1994). This prediction was due in part to the coastal bias of archaeologists working in the Fraser Valley area and the tradition of archaeological research to be oriented in close proximity to the Fraser. Most large archaeological excavation projects that have been conducted in the lower Fraser Valley have been conducted on the banks of the Fraser River itself (e.g. Crowes-Swords 1974; Patenaude 1985; Matson 1976, 1996; Mason 1994). Significantly, the archaeological cultures of the Fraser River Valley have been characterized based on their Fraser River and Gulf of Georgia oriented settlement and land-use patterns.

Recent archaeological studies being conducted in the Fraser River Valley region have been focussing attention away from the Fraser River and towards ecological zones located in higher altitudes areas in particular, the sub-alpine (Lepofsky *et al.*, in press), and alpine regions (Reimer 1999; Franck 2000). Other than the inventory work undertaken in the Stave Watershed, archaeological inventory work has been conducted in the Montane lakes regions that lie to the north of the Fraser River including Coquitlam Lake (Wright 1981; Wright 1996) and Alouette Lake (Howe 1991). The most extensive of these studies was conducted at Coquitlam Lake where material was collected from six lithic scatters deflated by the operations of Coquitlam Reservoir. Significantly, the geomorphological context in which these Coquitlam scatters were found suggested the possibility of great antiquity and raw materials found in the region reveal that people were ranging high into the Coast Mountains to gather raw materials (Wright 1996). Consequently, in terms of the possible antiquity of the sites in these montane lake regions Wright (1996: 205) suggests:

> The primary significance of the Coquitlam Lake sites remain their location, and the fact that they represent the first substantive prehistoric sites discovered from the high elevation coastal mountain lakes north of the Lower Mainland. These upland lakes may have figured in the early human exploitation of the area for they would have been among the first areas to become ice free (Souch 1989). In addition, such upland lakes would have been unaffected by the fluctuations in sea level that marked the onset and early history of the Holocene period along the coast. It is also possible that the resources available in Coquitlam Lake provided a variety and seasonal abundance that was unavailable in lower mainland settings. Thus the setting and resource base of upland lakes such as Coquitlam Lake may well have played a role in the early human settlement of British Columbia.

Wright (1996) goes on to suggest that other elevated montane lake valleys along the southern margin of the Coast Mountain, including Stave Lake, have high potential for early sites as well as later sites. The location of the study area provides a unique context in which long-term patterns of tool manufacturing and land-use can be assessed to understand the historical processes of the region.

Study Data

The materials studied were collected during inventory and impact assessment work undertaken at sixty different site locations in the Stave Watershed. The field methods used during the course of archaeological inventory and impact assessment projects in the watershed are described in detail elsewhere (McLaren *et al.* 1997; McLaren and Maxwell 1998; McLaren *et al.* 1998; Eldridge and McLaren 1998; McLaren and Owens 2000). All of the work carried out was conducted in conjunction with the Kwantlen First Nation. For the most part, access to the inundated zones of the watershed (Stave and Hayward Reservoirs) has only been possible when the reservoirs have been drawn down. Most of the sites located during inventory work were found by inspecting the surface of the inundated zone, in particular in areas where it is evident that more erosion than deposition has occurred. In areas of high deposition, deltas and low-lying saturated areas, lithic scatters were found to be less frequent, visibility being the key reason for this pattern. This surface inspection methodology is of particular importance as many apparently isolated artifacts were found, providing insight into human activities over a large portion of the landscape and away from major habitation and activity areas. The surface inspection methodology was also applied during the inventory of the non-inundated Stave Delta region of the watershed. This method was not as successful in the delta area but did result in the location of four previously unrecorded archaeological sites. The majority of the delta region is covered by thick grasses or has been developed for industrial purposes, providing serious obstacles to the surface inspection approach to archaeological inventory.

The majority of materials analyzed were collected from the surface scatters of deflated archaeological sites. Specific survey sampling strategies were not employed during the course of fieldwork. Rather, attempts were made to cover as much of the study area as possible using the surface inspection methodology. Collection strategies were not conducted in a controlled or sampling oriented manner. Early projects attempted to collect as much as possible from the inundation zones (McLaren et al. 1997; McLaren and Maxwell 1998; McLaren et al. 1998). A later project focussed on the collection of formed tools and artifacts to provide data on the stylistic and functional relationships of scatters (McLaren and Owens 2000).

Site datums were established for all sites. Scattered lithics were mapped to the site datums and, in most cases, collected. Detailed notes of exposed soils, locations of artifacts in relation to stump root exposure, and estimates of relative amounts of erosion from reservoir activities or other industrially related disturbances were also kept. Photography and video recording were also used in many instances to record visual aspects of selected sites.

During the course of analysis, 2,000 artifacts from the Stave Watershed were examined. Included in this collection is a wide variety of stone tool types and lithic debitage. Chipped stone tools predominate the collection, although some ground stone tools are also present. The range of raw materials used to construct these tools are very considerable including basalt, rhyodacite, chalcedonies, cherts, quartzites, and quartz crystal. This collection includes over 100 identifiable biface knives and projectile points, whole and fragments.

The earliest material from Stave Reservoir has typological similarities to the Inter-Montane Stemmed Point (11,000-9,000 BP)(Daugherty 1959; Rice 1972; Irwin and Moody 1977, 1978; Cressman 1977; Bryan 1980) and the Plano traditions (10,500-9,000 BP) (Frison 1978; Justice 1987). These traditions are not included in the typological make-up of the Old Cordilleran tradition, which is often described as being the oldest evidence of human occupation in the Fraser Valley region, but are instead characterized as a descendent of the Protowestern Tradition (Matson 1996). Some projectile points that resemble palaeo-Indian or Protowestern types have been collected from surface contexts in the Fraser Valley (Daugherty 1959; Fladmark 1982), but these isolated finds have been poorly documented, analyzed, or considered in regional chronological sequences. In addition to this early period material, a substantial portion of the diagnostic artifacts collected resemble materials from later time periods in the Fraser Valley from the Old Cordilleran to the Gulf of Georgia culture type (McLaren et al 1997; McLaren and Maxwell 1998; McLaren et al. 1998; Eldridge and McLaren 1998; McLaren and Owens 2000). The diversity and quantity of materials from the different site locations provide a unique opportunity to understand long-term human behaviour from a landscape-oriented perspective.

Chapter Orientation and Organization

The theoretical orientation of this thesis is eclectic and does not necessarily privilege one perspective over another. The patterns of human action uncovered in the sequences described have been organized (whether by previous investigators or through the analyses presented in this thesis) using different temporal frameworks and have been interpreted using different theoretical and methodological orientations. The analyses undertaken draw on cultural-historical theory and method for chronology building, interpretive archaeology for understanding built chronologies, and processual theory and methods to delimit and explain land-use patterns. This study is historical in that it investigates human behaviour through time and the manner in which tradition is enacted over long-term periods. However, unlike conventional historical approaches, this study remains archaeological rather than historical as it approaches long-term sequences with "an analytical emphasis on deeper currents, on collective instead of individual behaviour, and on socio-economic or ideological trends instead of institutional decisions and political acts" (Knapp 1992:2).

The contextual sequences draw from a number of different theoretical orientations. Chapter 2 presents a literature review of environmental histories of the study area. The human actors who have inhabited the Northwest Coast for millennia have been shaped by and have shaped this environment in many ways (Mackie 2001). Whether regarded as a backdrop and constraint of human action or an intimate part of the patterning of human spatial understanding, the environmental history is of particular importance in contextualizing the other histories presented in this study.

The third chapter presents the results of a literature review of archaeological sequences in the Fraser Valley region. An understanding of how the sequence for this area has been constructed and the reasons given for changes from one era to the next are central to this historical investigation. The importance of the presence and absence or relative frequencies of different types of cultural material is traced. Particular attention is paid to the manner in which technology, function, and style are blurred in the resulting diagnoses of culture types. In general, two schools of thought contribute to understanding the manner in which change was enacted during the sequence, those that focus on human contact through diffusion and migration as initiating change (e.g. Smith 1903,1907; Borden 1951, 1968, 1970), and those that rely on explanation of adaptation to environmental conditions (Fladmark 1975; Matson 1976; Schalk 1978; Matson and Copland 1995). These approaches are theoretically divided into the cultural-historical and the processualist schools of thought. The later of the two movements, the processualist approach, draws upon the sequence devised through cultural-historical methods, but differs in, and is more analytically inclined in its approach to explaining change. Alternative forms of depicting the cultural-historical sequence, where continuity, rather than change, is privileged, are discussed in relation to those sequences that focus on change.

Chapter 3 is an ethnographic literature review that focuses on oral historical narratives. This approach investigates how certain Central Coast Salish orators sequenced their stories. Three means of sequencing narratives were uncovered in this research: consensual remembering, genealogical ordering, and sequencing references. The sequences of these stories are then compared in a table much like the space-time grid developed by V. Gordon Childe (1929) in archaeological research in order to compare the temporal and spatial relationship of long-term history. This approach investigates a long-term history of the study area from a uniquely human perspective. It relies on social memory rather than the archaeological record for piecing together a regional sequence of events. Much like the archaeological record, it is assumed that there is a great possibility that materials have been lost to time. However, from the kernels that remain it is found that individual storytellers have conceptions of long-term sequences.

Chapter 4 presents the methodology and results of a seriation analysis of formed bifaces surface collected from the Stave Watershed area. This methodology provides a unique means of understanding the manner in which human behavioural patterns can remain consistent, or change gradually, for long durations and be identified in the archaeological record. The result is a sequence of formed biface manufacturing with an emphasis on the final or curative phases of production.

Chapter five presents the methodology and results of a functional and technological analysis of lithic materials collected from sites located in the Stave Watershed. This analysis relies on processual archaeological theory where differences in artifact clusters are seen as resulting from differences in land-use activities and changes being constrained by environmental conditions (Binford 1992; Pokotylo 1978; Magne 1975). This analysis demonstrates the manner in which people used the landscape of the study area at different times by identifying shifts in the location, function, or technology of land-use activities. For ordering site occupations, this analysis relies on the seriation described in chapter four. The purpose of the land-use analysis is to provide a means of understanding the long-term history of functional and technological activities.

The final chapter of this thesis brings together all of the long-term sequences identified and created to weave a tapestry of histories in an eclectic and diachronic diorama of the long-term history of the study area. As comparisons of histories are limited by differences in temporality, both narrative orientations and stylistic similarities figure prominently in the interpretation of results. The different sequences are evaluated in relation to patterns exhibited in the transmission of memory and practice through time as investigated and described by such researchers as Connerton (1989) and Fentress and Wickham (1992) in relation to oral history and public ceremony. This comparison brings considerations of the manifestations of social memory into the realm of archaeological understanding. This chapter demonstrates analyses of the materials collected from the Stave region provide a means for understanding various changes and continuities in the spatial patterning and representations of behaviour over extremely long time period of time. The resulting reconstruction provides a unique case study for understanding the relationship of archaeological inquiry and the notions of social memory, tradition, temporality, change, and stability in the Stave Watershed region.

CHAPTER TWO - ENVIRONMENTAL CONTEXT

Introduction

The landscape of the lower Fraser River drainage area has undergone significant shifts as a result of environmental factors over the last 15,000 years. Scientific researchers have used a number of different methods to gain an understanding of environmental conditions at given times in the past. With the results of this research they have been able to construct sequences of past environmental conditions. Stratigraphic analyses, palynological studies, and faunal identifications undertaken in combination with radiocarbon dating, have been used to form the backbone of a long-term environmental history. The following presents aspects of this historical sequence, pieced together from a number of different sources. The environmental sequences discussed have been ordered and summarized at the end of this chapter in Table 1. The historical sequence outlined here presents only the tail end of a much longer story. The sequence presented here begins at the height of the last major glacial event, after which there is a good deal of evidence for the interaction of human and environmental historical sequences.

Vashon Stade

The lower Fraser River drainage area was almost completely covered by glacial ice at the height of the Vashon Stade of the Fraser Glacial period 15,500-15,000 radiocarbon years ago (Armstrong 1981). The advance of glaciers during the Vashon Stade began 17,000 years ago, after a short one thousand year interglacial period, forcing most plants and animals, including Pleistocene megafauna, from the region (Lian and

Hickin 1992). The onset of glaciation was characterized by the growth and spread of glaciers from mountain valleys into the Fraser lowlands and eventually into the Gulf of Georgia and Puget Lowlands (Ryder and Clague 1989). The converging glaciers began to grow with cooling global climates until they reached a maximum at the 1,800m contour in the southern Coast Mountains and northern Cascades (Mathewes et al. 1970). Most of the topography of the study area was overridden by glacial ice at this time with the exception of nunataks or high mountain peaks and ridges surrounded by ice.

This glacial period was not limited to the lower Fraser Drainage area. Most of British Columbia was covered by glacial ice at this time. Although resulting from the convergence of multiple glaciers, the ice covering British Columbia is referred to as the Cordilleran Ice Sheet (Clague 1989a). This sheet extended from Northern Washington, Idaho, and Montana to the southern Yukon. East of the Rocky Mountains, the Cordilleran Ice sheet coalesced with the Laurentide Ice Sheet (a massive glacier spreading west and south from the Canadian Shield) during the period of the last major glaciation (Clague 1989b). At its maximum, the western margin of the Cordilleran Ice Sheet reached to the edge of the continental shelf in the Pacific Ocean with the exception of a few areas where ice-free glacial refugia are believed to have existed at least intermittently (Byun et al 1997; Heaton et al. 1996; Josenhans 1995; Cannings and Cannings 1996).

Due to the apparent lack of plant and animal communities in the lower Fraser Drainage area during the Vashon Stade, this period is not dated through radiocarbon samples. Rather it is bracketed by dates during the Port Moody Interstade which ended 17,000 years ago (Lian and Hickin 1992) with the dispersal of plant and animal communities into the area following rapid deglaciation 13,000 years ago (Mathewes et al. 1970). Terrestrial species spread into British Columbia from four different areas where they were able to survive during periods of glaciation:

> (1) the forests, grasslands, and shoreline habitats of coastal California, Oregon, and southern Wahington; (2) the tundra, forests and grasslands of the interior southwestern United States; (3) the forests and grasslands of the southwestern United States; and (4) the tundra and cold steppes of central and northern Yukon and Alaska [Cannings and Cannings 1996: 70].

Other species likely spread from the glacial refugia of the Western Margins of British Columbia. The first species to move into the lower Fraser Drainage area likely came from coastal areas to the south and Vancouver Island.

Post-Vashon Submergence

By 13,000 years ago ice had receded to the eastern Fraser Valley and likely still existed in the mountain valleys of the southern Coast Mountains (Armstrong 1981). Sea lion remains from Bowen Island have been dated to 13,180+/-90 (Harington 2001, c.f. Canadian Archaeological Radiocarbon Database) showing that marine fauna, including top predators, were quick to become established in deglaciated regions. Radiocarbon dates on organic materials collected during palaeobotanical and geological work demonstrate at least some of the montane lakes of the southern Coast Mountain were ice-free by 12,350 years ago (Mathewes 1973; Souch 1989). The palynological record from Marion Lake (located approximately 15km northwest of Stave Falls) indicates that lodgepole pine, spruce, and alder were the dominant tree species in the area before 12,350B.P. These vegetation communities shifted northwards from the south following deglaciation (Erlandson and Moss 1996). Pleistocene terrestrial fauna moved into the area rapidly, following the same general patterns of migration as plant communities, from southern coastal areas to the north. Large terrestrial mammal species dating to the late-Pleistocene have been found in the Gulf of Georgia and Puget Sound areas include giant sloth (Meltzer and Mead 1985), mastodon (Gustafson and Manis 1984), and bison (Mackie 1987). Shellfish species from the late Pleistocene suggest that the marine temperature was cooler than present (Hebda and Frederick 1990).

Rapid deglaciation was complemented by rapidly rising sea levels during the post-Vashon submergence. Stratigraphic marine deposits demonstrate that sea levels occurring 13,000 years ago were 175m higher than today (Mathewes et al. 1970). During this period the Stave Watershed would have been much like a fjord (Gilbert and Desloges 1992).

A massive volcanic eruption occurred at Glacier Peak in the northern Cascade Mountains around 12,000 B.P. (Harris 1976). Ash from this eruption spread over eastern Washington, Idaho, Montana, and southern British Columbia, but has not been identified in more westerly regions, and thus, likely had little effect on the study area.

Following the post-Vashon submergence a rapid drop in sea levels occurred during the post-Vashon emergence. By 12,000 years ago sea levels had dropped between to about 80m above current sea level and the rate of marine recession became slower (James et al. 2002). Between 12,000 and 11,500 the sea level regressed to 60m above present sea levels. Stave Lake would have been transformed from a fjord to a lake during this period.

Sumas Glaciation

A minor glacial event occurred in the central Fraser Valley area after 11,500 B.P. (Abbotsford-Chilliwack area): the Sumas Glaciation. This glacial event has been traced as a glacial advance in the Fraser lowlands between 11,500 and 11,200 (Saunders et al. 1987; cf. Souch 1989). The Sumas glaciation seems to be an isolated event and may be the result of massive glacial surging (Armstrong 1981). This event seems to predate the global cooling Younger-Dryas period that occurred between 11,000 and 10,000 years B.P. (Erlandson and Moss 1996). Indeed, by 11,100 the same area covered by the Sumas glaciation is completely deglaciated (Saunders et al. 1987; cf. Souch 1989). The lowlands of the Fraser Valley were filled at this time by fluvial, deltaic, marine, lacustrine, and outwash sediments (Clague et al. 1983). Sea levels did not stabilize at this point but continued to regress until the reached approximately 12 meters below present day sea level 8,000 years B.P. when isostatic rebound as a result of glaciation finally ceased (Mathewes et al. 1970). The mouth of the Fraser River was further east than today where the Pitt and Fraser confluence, as the Fraser Delta had not yet formed.

The Stave Lake basin became deglaciated prior to the Sumas Glaciation and has remained so ever since. Sumas Ice entered the lower Stave River Valley but likely did not penetrate as far north as Stave Lake, although glacial ice may have dammed the lake for a period of time resulting in raised lake levels (Gilbert and Desloges 1992). Sumas ice also flowed into Hatzic Valley, and drainage during this period was northwards into Stave Lake (Gilbert and Desloges 1992; Ryder 1998). Following the retreat of Sumas Ice, drainage patterns reoriented and became similar to present flows.

Pleistocene to Holocene Transition and a Catastrophic Flood Event

The end of the Pleistocene and beginning of the Holocene period in the Fraser Valley is marked by the disappearance of the Sumas glacier 11,100 B.P. The turbulent changes of the landscape of the study area during the end of the Pleistocene lie in marked contrast with the gradual and minor changes of the Holocene period in terms of climate, biotic communities, and surficial geology. Pleistocene megafauna seem to disappear from the coastal regions at the end of the Pleistocene although the chronology of extinction is poorly understood (Erlandson and Moss 1996).

The late-Pleistocene/Holocene transition is marked with a major catastrophic flooding event. Conway et al. (2001) have found evidence that an ice dammed lake or lakes in the Fraser River system drained catastrophically between 9,800 and 9,160 radiocarbon years B.P. The result of this outburst drainage was the flooding of the lower Fraser Valley and Georgia Basin and the deposition of a thick layer of clay at the beginning of Holocene deposits on the floor of Georgia Strait.

Holocene

At the beginning of the Holocene there is an abrupt change in the climate and palynological record at Marion Lake. Cores from Marion Lake reveal that western hemlock and Douglas fir begin to appear in significant quantities just prior to 10,370 B.P. (Mathewes 1973). The climate during this period is interpreted as being warmer and drier than today (Mathewes and Heusser 1981). Other species begin to appear in the early Holocene period at Marion lake, including birch, western white pine, and traces of cedar (Mathewes 1973). The warm and dry climate of this era, known globally as the Hypsithermal, continues until 6,500 B.P when conditions became cooler and wetter. This shift in climatic conditions is coupled by an increase in the dominance of cedar in the vegetation communities at Marion Lake (Mathewes 1973).

By 6,500 most of the major native plant communities of the region had established themselves in the study area. Three glacial advances occur between 6,000-5,000 B.P., 2,300-1,900 B.P., and 900-100 B.P. (Ryder 1989). The last neo-glacial advance, known as the 'Little Ice Age' was the most pronounced. Although these periods are found in evidence of glacial advances, there seems to have been little effect of the vegetation communities of the area, other than at the onset of the neo-glacial which is associated with the establishment of cedar in the region (Anderson et al. 1989).

Sea levels in the region continued to drop during the first part of the Holocene era until they reached 12-13m below current sea level around 8,000 B.P. (Williams and Hebda 1991). Around 10,500 years the Fraser River emptied from a proto-delta into the fjord that extended up Pitt Lake (Clague et al. 1983). The Pitt Fjord was soon isolated from the sea by the deltaic growth of Pitt Meadows. The Fraser River then began to empty into the Fraser River in the New Westminister Region. After 7,960 years B.P. sea levels began to slowly rise. Concurrent with this rise in sea levels, the Fraser Delta expanded, extending the length of the Fraser River westwards from New Westminister (Clague et al. 1983). With a brief still stand at 5-5.5 meters below present sea level between 6,200 and 5,800 years B.P, the level of the sea continued a slow rise until 2,250 years ago when it reach its present day level (Williams and Hebda 1991; Williams and Roberts 1988).

In addition to the aggradation of the Fraser Delta there are several other prominent geological events that occurred during the Holocene period. However, unlike the large-scale upheavals of the late Pleistocene these events did not result in abrupt and massive scale changes to the morphology of the landscape. Some of the most prominent events that have occurred include volcanic eruptions and earthquakes. Mt. Garabaldi, appears to have been an active Volcano during the Pleistocene, but became dormant at the beginning of the Holocene (Harris 1976). Thirty-two other volcanic centers exist in the Garabaldi Belt (Souther 1977) including Mount Meager, which erupted 2,400 years B.P. and temporarily blocked the Lillooet River (Stasiuk 1996). Mt. Meager tephra is not found in the lower valley, but the damming of the Lillooet River may have had some implications downstream. Volcanoes of the northern Cascades have been relatively active during the Holocene. Mount Baker, which is visible from much of the Fraser Valley, has erupted numerous times during the Holocene. Four distinct Holocene tephra sets resulting from air-born pyroclastic ash are known and associated with Mount Baker. The last dates to 390 years B.P. (Harris 1976). The extent of these ash layers in the lower Fraser Valley is unknown and they are not described in stratigraphic analyses of Holocene cores from the Fraser Delta region (Luternauer et al. 1998). Mount St. Helens was relatively inactive during the Fraser Glaciation but has been periodically active on and off for the duration of the Holocene. Seven Mount St. Helen's tephra sets have been identified from various eruptions during the late Pleistocene and Holocene periods. (Mullineaux and Crandell 1981). Mount St. Helens Tephra Wn (508 years B.P.) and Yn (3,400 years BP) have distribution in southwestern British Columbia, but not as far west as the lower Fraser Valley (Clague 1989c). During the mid-Holocene, 5,700 B.P., Mount Rainier underwent a violent explosion that triggered a massive land-slide into the Puget Sound region and destroyed the summit of the mountain, causing great upheaval and transformation in the immediate surrounding area, but did not directly affect the lower Fraser River drainage area. The massive eruption of Mt. Mazama occurred in the Holocene around 6,600 years B.P. (Williams 1969). A distinct volcanic tephra from the Mazama eruption has been identified in southwestern British Columbia including the lower Fraser River drainage (e.g. Mathewes 1973). Air born ash fall is likely the greatest noticeable effect that this eruption had on the study area landscape.

Seismic activity during the late Pleistocene was dynamic during the unrest of the late Pleistocene period (Mathewes et al. 1970; Armstrong 1981). By comparison, the relative calm of the Holocene period, and the diminution of isostatic rebound by 8,000 B.P. likely resulted in fewer seismic events. Regardless, the study area is located in proximity to major tectonic faults and earthquakes do happen on a regular basis. Research into ancient earthquakes in the Victoria and Vancouver areas has revealed at least two large-scale earthquakes have occurred in the last 4,000 years (Clague et al. 1998). The earlier earthquake occurred 3,600 years B.P. and resulted in a slight emergence of the Fraser Delta. The later earthquake may have been of a magnitude of 8 or larger and occurred 1,700 years ago. Some uplift may also have occurred as a result of this later earthquake. Some small changes to the landscape may have occurred as a result of these earthquakes including landslides and liquefaction (Clague et al. 1998).

The late Holocene period is marked by the 'Little Ice Age' and was characterized by cooler climatic conditions worldwide. In the southern Coast Mountains glaciers began to enlarge and continued with little interruption until 100 years B.P. Global warming brought the end to this 'Little Ice Age' and glaciers began to recede between 100 and 150 years B.P.

In the Stave Watershed region deposition at the bottom of Stave Lake has doubled the Holocene average during the twentieth century. Gilbert and Desloges (1992) attribute this to the receding of Stave Glacier at the headwater of the watershed, although Ryder (1998) suggests that the damming and raising of Stave Reservoir in 1910 may also have contributed to this increased sediment load as a result of reservoir oriented erosion.

Table 1. Historical Sequence of Environmental Events

C14 YEARS BP	PERIOD	GLACIATION	SEA LEVELS	FAUNA	FLORA
17,000-13,000	Vashon Stade	Glacial maximum ice up to 2km thick in Fraser Valley			
13,000-12,000	Post-Vashon Submergence	Retreating Ice	Sea levels to 200m above present day sea levels and begin to drop.	Molluscs, Sea mammals.	Introduction of Lodgepole pine, Spruce, Mountain Hemlock, Alder, Willow, Soapberry
12,000 – 11,300	Post-Vashon Emergence	Retreating Ice	Sea Levels have dropped to 80-60m above present day sea levels.	Pleistocene Megafauna.	
11,300 – 11,000	Sumas Glaciation	Advancing Ice radiating out from the Sumas region	Continued regression.		
10,000-6,500	Hypsithermal	Glacial minimum	Drop to 12 meters below present sea levels and then begin a slow rise.	Lack of Pleistocene megafuana. Most fauna present in the area today are established.	Introduction of Western Hemlock, Douglas Fir, Birch. Soapberry disappears.
6,500 – 150	Neoglacial	Three subsequence small glaciatial periods	Steady rise to present day 2,250 years B.P.		Introduction of Cedar, Skunk Cabbage, Vine Maple.

CHAPTER THREE - ARCHAEOLOGICAL CONTEXT

Introduction

The following chapter presents a brief overview of how archaeologists working in the Gulf of Georgia region use material culture to create time periods and archaeological sequences. The structures of these sequences are characterized by distinct and separated time periods that are typically tabulated. This means of conceptualizing the cultural-historical sequence has influenced interpretation of past behaviours that privileges explanations of change. Alternative means of graphically ordering time period sequences can create a different insight into the archaeology of the area that include both tradition and change as important in the enactment of tradition over long periods of time.

The archaeological sequence of the Strait of Georgia area is well developed compared to other areas of the Northwest Coast and Plateau:

> The preponderance of published data and graduate theses dealing with this region overshadows all other parts of the province and Gulf of Georgia culture history effectively acts as a comparative type-sequence for the entire Coast, although its named cultural-chronological units (phases) are formally applicable only to the local region [Fladmark 1981: 102].

This sequence is in constant development and remains a primary focus of archaeologists working in the Fraser Delta and Gulf Island areas (Borden 1968, 1970; Mitchell 1971; Carlson 1970; Calvert 1970; Matson 1976). Components of this sequence have been drawn from both marine and river oriented sites in the Gulf of Georgia and Lower Fraser Valley region:

> Environmentally one of the most distinctive segments of the north Pacific coast of North America, the Strait of Georgia area (locally called the Gulf) was occupied at the time of contact by speakers of eight Salish languages comprising the Northern and Central Coast Salish. The cultures appear to have been based

> on river and marine resources supplemented by diversified hunting and gathering, and it seems likely that in their most general forms, ethnographic models will be applicable to at least the last 5,000 years [Mitchell 1990: 340].

Distinct sequences have been developed for the Fraser Canyon (Borden 1968, 1975; Archer 1980; Mitchell 1990; Mitchell and Pokotylo 1996) and Fraser Plateau (Sanger 1970; Richards and Rousseau 1987; Stryd and Rousseau 1996).

The Gulf of Georgia Archaeological Sequence

Illustrations of the Gulf of Georgia sequence are used to portray the relationships of different phases and culture types (for example Figure 1 and Figure 2). Local sequences are developed for distinct geographic areas such as the Fraser Delta or Gulf Islands (Figure 1 and Figure 2). Time periods in local sequences are referred to as phases and are used to reflect sub-cultural or different cultural manifestations in a given area (Burley 1980). Collections of sequences from localized area are generalized into regional sequences such as that developed for the Gulf of Georgia region and are referred to as culture types (Mitchell 1971, 1990; Burley 1980). Following Clarke (1968), Burley (1980:15) suggests that a culture type is characterized by a large number of artifact types that co-occur at a number of different site locations, and that these amalgamations are contemporaneous and limited to a specific geographical area. To gain a broader perspective, several regional sequences can be selected and tabulated to create culture area sequences, for example the regional sequence developed for the Northwest Coast (e.g. Fladmark 1982, Figure 6; Carlson 1983a, Figure 1:2).

Ideally, site based sequences (phases) are defined by relative amounts of artifact classes, feature types, and revealed cultural practices distinguished by stratigraphic layers (components). The straight lines that separate one phase from another in archaeological sequence tables approximate the stratigraphic differentiation between components. Each stratigraphic division encountered in excavation does not necessarily constitute a separate phase, as a phase is characterized by a number of artifact types. Again in the ideal situation, the basic level of comparison between groups of types is from one stratum to the next. Where a significant change in relative abundance or presence of types is noted, a change in phase may be identified. Radiocarbon dates acquired from samples associated with particular strata can then be used to give absolute dates for related phases and transitions between phases.

Once the cultural-historical sequence has been developed at a localized scale, subsequent archaeological findings in the same vicinity can be compared. Common patterns of types may result in the reinforcement of phases into a regional form or in the case of the Gulf of Georgia region, culture types. Ideally, comparisons of site level sequences are made possible by the stratigraphic relationships of relative frequencies of artifacts and through dates of strata (Clark 2000). Larger scale sequences may collapse different phases into larger time period such as 'complexes' or 'traditions'. With broader regionality, the divisions between time periods of the sequences become less associated with stratigraphic divisions and more dependent on radiocarbon dates and type frequencies. The larger the geographic scale being sequenced the further the generalized temporal units are from the stratigraphic sequences that formed the original basis for the division of phases. Significantly, subsequent archaeological research may be attributed to a given tradition or complex based on a radiocarbon date rather than a comparison of stratigraphic relationships and types frequencies. The regional sequence for the Gulf of

Georgia region includes five distinct culture types: Old Cordilleran, Charles, Locarno Beach, Marpole, and Strait of Georgia.

The Old Cordilleran culture type is best known from one excavated context in the lower Fraser Valley, at Glenrose Cannery, where the component dates between 8,000 and 5,000 years B.P. (Matson 1976). Other Old Cordilleran components in British Columbia are located at Milliken in the Fraser Canyon (Mitchell and Pokotylo 1996), Bear Cove on the North end of Vancouver Island (Carlson 1979) and Olcott sites in Washington State (Matson 1996). The oldest component at the Milliken site in the Fraser Canyon is included within this culture type dating from 9,000+/-150 radiocarbon years BP (Mitchell and Pokotylo 1996). Early archaeological remains from Fort Langley are also associated with the Old Cordilleran culture type (Porter and Copp 1993).

The Old Cordilleran material culture is characterized through flake stone tools, with some ground stone, and bone and antler tools. It is derived from an older tradition, referred to as the Protowestern, of which there has been no evidence found in the Gulf of Georgia area (Matson and Coupland 1995). This tradition is known from eastern Washington State as Windust (e.g. Rice 1972). The Old Cordilleran culture seems to have similar affiliations in eastern Washington State known as Cascade, Vantage, Indian Well, Olcott in the Seattle area, and Early Nesikep on the Fraser Plateau in British Columbia. Common material types associated with the Glenrose Cannery Old Cordilleran component include a preponderance of tools associated with a cobble reduction industry, foliate shaped bifaces, flake tools, a barbed antler point, bone awls, and antler wedges. Taking into account both sea level curves and archaeological research such as that undertaken by Easton and Moore (1991) where mid-Holocene deposits were found beneath the present day high tide line, the lack of evidence for early and mid Holocene occupation in the area is due to the submergence of sites from this period in coastal areas and river meanders and shifting levels in the Fraser Valley.

Archaeological investigations at Glenrose Cannery (Matson 1996) and Bear Cove (Carlson 1979) reveal similar artifact distributions and differences in faunal remains in the Old Cordilleran components. At Glenrose there is a greater reliance on land mammal, anadromous fish, and some marine resource. At Bear Cove marine fish and marine mammals are more common. Matson (1996) suggests that the pattern at Glenrose reveals an economy of the region was dependent on both coastal and terrestrial resources. This implies relative mobility to access inland resources, as compared to later time periods.

The Charles culture type is an amalgamation of the St. Mungo, Mayne, and Eayem Phases dating between 5,500 –3,300 years B.P. (Matson and Coupland 1995; Pratt 1992). Matson and Coupland (1995) list 12 excavated Charles components including the Maurer and Hatzic Rock sites that include structural features interpreted as households (Schaepe 1998; Mason 1994).

The Charles Culture period is characterized as developing from the Old Cordilleran and is suggestive of the development of a distinctive regional culture (Matson and Coupland 1995). The retention of a cobble reduction and tool industry and foliate shaped bifaces provide a link of continuity between the older and later periods. Stemmed bifaces are added to the Charles culture type. A microblade industry appears during the Charles period and there is an increase in the ground stone industry including points, beads, and incised stone (Pratt 1992). Pecked and ground stone tools are considered rare.

There is a well-developed bone and antler industry including tools such as awls, pins drills, chisels, barbs, unilaterally fixed harpoon point, decorative objects. Shell was also used as a raw material for tool manufacture and adornment (Pratt 1992). The shift from the Charles culture type to Locarno is subtle, although Pratt (1992) maintains that there is enough distinction between the two to allow them to be defined as temporal units. A mix of marine and land fauna continues into the Charles period, with some increase in reliance upon sea mammals (Pratt 1992). Structural remains are known from the Charles period components at the Maurer site (Schaepe 1998) and Hatzic Rock site (Mason 1994) providing insight into the household organization of this period. Evidence from burial complexes suggests that social stratification existed by this time (Brolly et al. 1999).

The Locarno Beach culture type is known from at least 28 components and dates between 3,300 and 2,400 B.P. (Matson and Coupland 1995). It is characterized by the following aspects: contracting stemmed points, foliate shaped points, a microlith industry, flaked slate and sandstone, pebble reduction industry and tools, thick ground slate knives, ground celts, labrets, net sinkers, unilaterally and bilaterally barbed harpoon points, toggling harpoon heads, antler wedges, and mussel shell celts (Mitchell 1990). Faunal remains from Locarno Beach sites suggest the continuation of a mixed terrestrial and marine based subsistence, modest woodworking industry and a more egalitarian society than associated with the Marpole culture type (Mitchell 1990), and possibly the earlier Charles culture type. The change from Locarno Beach to Marpole has been discussed by many scholars and attributed to various different causes from population replacement (Borden 1951) to environmental change (Mitchell 1971).

Figure 3. Cultural Historical Sequences for Subareas Within the Gulf of Georgia Region (after Burley 1980).

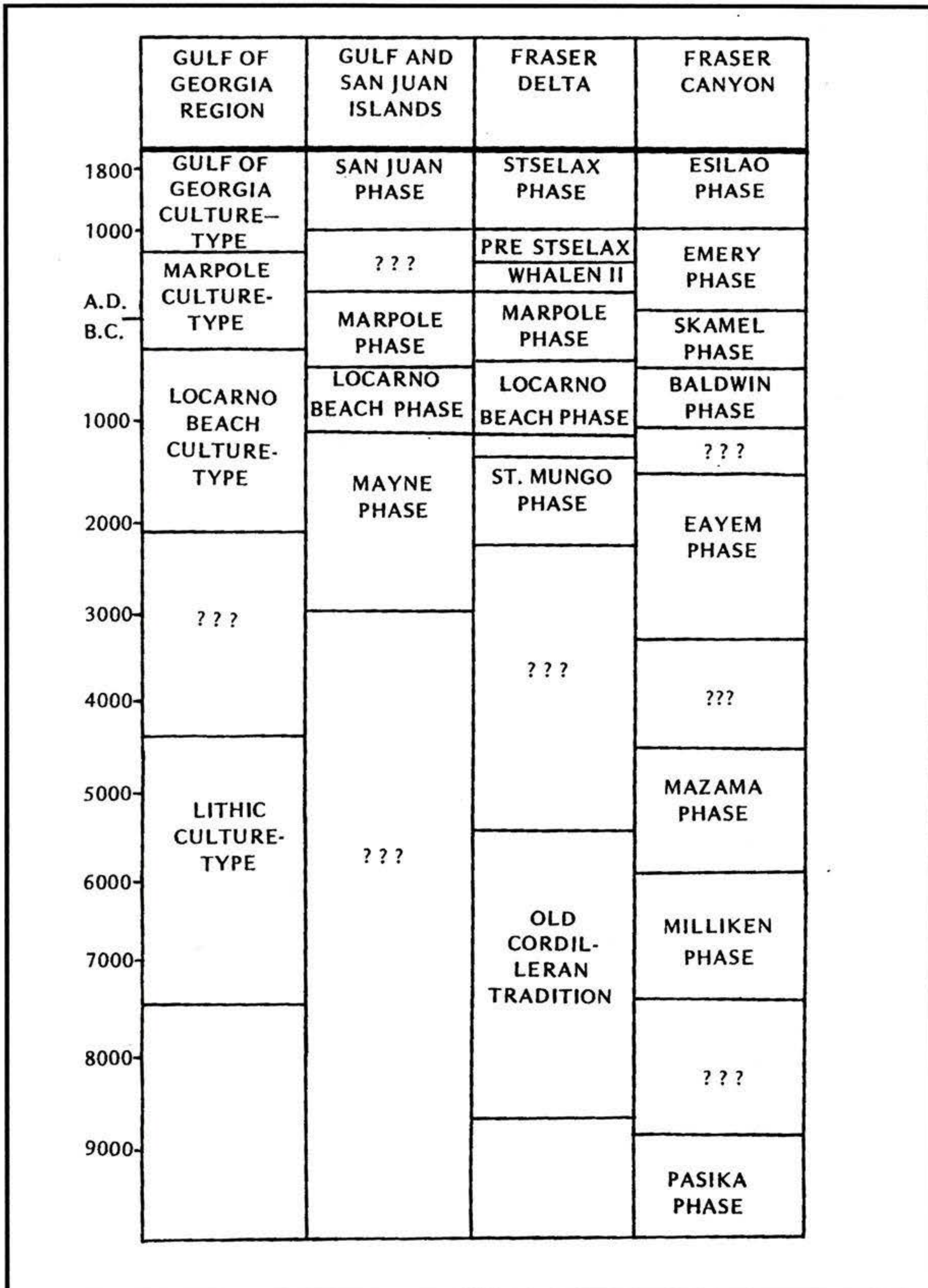
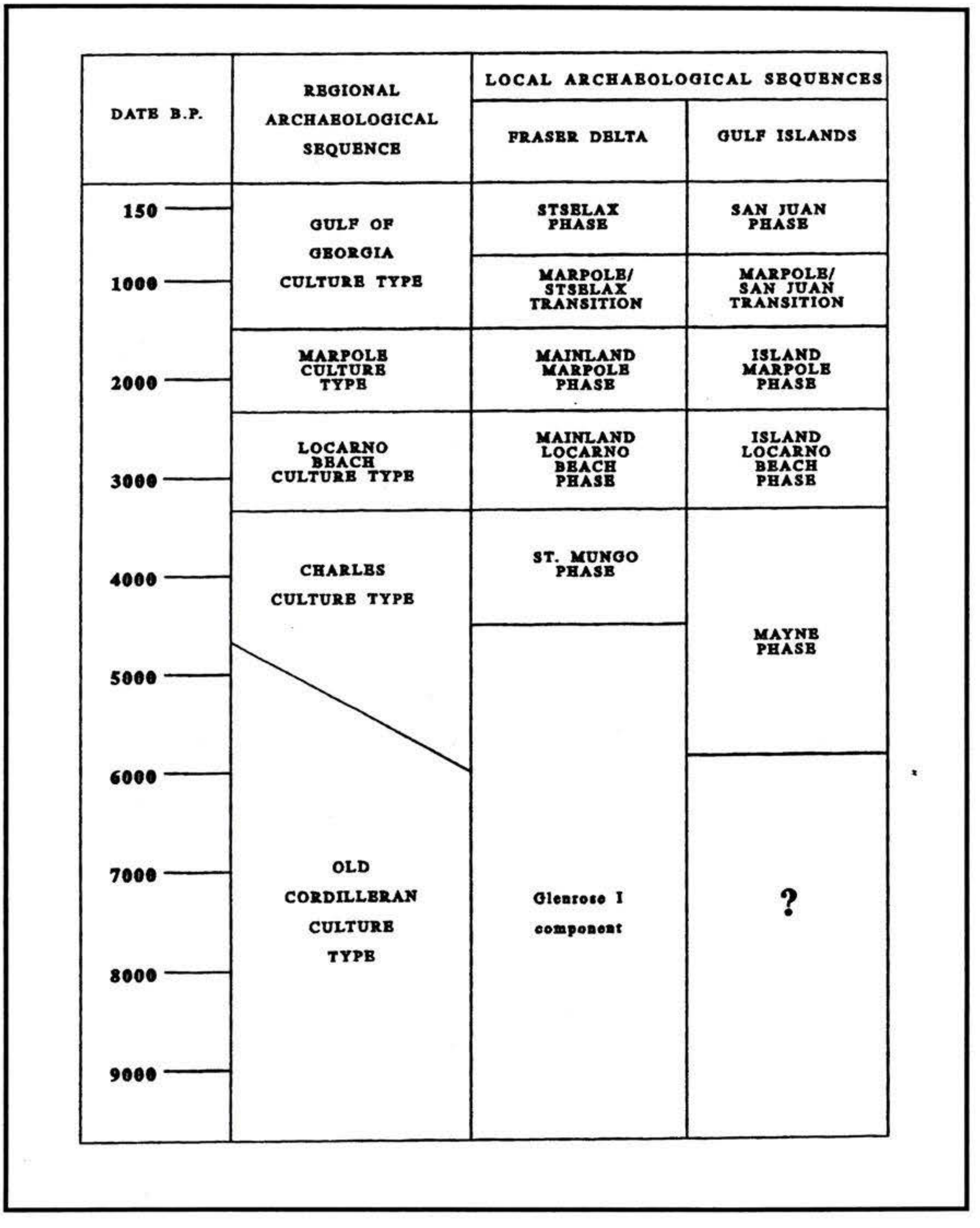


Figure 4. Archaeological Sequence for the Fraser River Delta (after Preckel 1991).



The Marpole culture type follows the Locarno Breach. Matson and Coupland (1995) list 40 sites with Marpole components that date between 2,400 and 1,400 B.P. Characteristic of the Marpole culture type include: stemmed, foliate, triangular, and notched chipped stone projectile points, microblade, leaf shaped and stemmed ground stone projectile points, thin ground slate knives, ground stone celts, shale and shell beads, labrets, hand mauls, abrader stones, pecked and ground bowls (often decorative), seated human figures, pipe bowls incised siltstone, bone awls non-toggling harpoons unilaterally barbed, antler wedges and sculpture, native copper, dentalia, rock cairn and earthen mound burials, skull deformation, and large post moulds (Mitchell 1990). Some researchers suggest that it is during this period that marked social differentiation and wealth differences become pronounced: "In some ways this period appears to be the peak of complexity, with artistic achievements not matched in later archaeological cultures, and good evidence of pronounced ascribed status differences" (Matson and Coupland 1995: 199). Faunal remains from Marpole period sites suggest similar land and resource use to that found amongst Coast Salish peoples in historic time (Burley 1980). The shift from the Marpole culture type to the Strait of Georgia culture type has been associated with population replacement (Borden 1951) but differences between the culture types are subtle making it difficult for archaeologists to distinguish reasons for the change from one to the next (Mitchell 1971; Burley 1980; Charlton 1980). Although changes in diffusion streams may account for some of the changes (Charlton 1980).

The final archaeological culture type is known as the Strait of Georgia culture type and lasts from the termination of Marpole until 200 years B.P when European explorers arrive and the Fur trade era began. According to Mitchell (1971) aspects of the

Strait of Georgia culture type are characterized as being essentially the same as those recorded by ethnographers who studied the peoples of the region (e.g. Duff 1952; Boas 1894; Suttles 1987; Barnett1955). This period seems to be less well known archaeologically than older periods. Distinctive aspects of the Strait of Georgia culture type include small triangular and often notched chipped stone projectile points, thin triangular ground stone points, ground slate knives, large ground stone celts, stone hand mauls, abrader stones, unilaterally barbed bone points, awls, composite toggling harpoon valves, bone pins, antler combs, mussel shell points, skull deformation, large post molds, and fortification features (Mitchell 1990). Mitchell (1971:46) suggests that subcultures separated into the North Straits, Central Straits and Fraser River, and Southern Straits inhabitants, have cultural distinctions with some time depth, at least for the duration of the Strait of Georgia culture type period.

Interpretation and the Sequence

There are several distinct characteristics of these graphically represented sequences and the manner in which they have had an influence on interpretion. Different time periods are compartmentalized as phases, culture types, and in other areas as horizons, complexes, or traditions. Distinct lines graphically delineate these temporal compartments from one another (Figure 1 and Figure 2). Usually the lines are drawn at an exact period in time or date. These illustrations often differ in regards to eras where there are gaps of knowledge. A question mark may be used to indicate that there is no data from a given time period, or the time periods may be generalized and joined by a diagonal line.

Archaeologists spend considerable amounts of time reinforcing or reorienting divisions in the sequence through statistical or synchronic analyses of type differences and associated radiocarbon dates (e.g. Matson 1974; Pratt 1992; Burley 1980; Clark 2000). At all levels of this exercise of building sequences, the compartmentalization of temporal units has a profound effect on the manner that archaeologists describe patterns of past behaviour. As a result, much of the focus in archaeological interpretation is placed on the reasons for change from one temporal unit to another. This interpretive focus has long been a part of archaeological research in the area.

Early researchers in the Gulf of Georgia area favoured models of migration and population replacement to explain changes between temporal units (e.g. Hill-Tout 1895; Smith 1907; Borden 1951). Charles Hill-Tout was one of the first archaeologists to work in the region. He conducted a series of excavations at the Marpole (Eburne) Midden near the mouth of the Fraser River (Hill-Tout 1895; Mitchell 1971). Hill-Tout identified two distinct components (representing different temporal periods) from his excavations. These components contained some differences in material types. From burials associated with each of these components, Hill-Tout suggested that there was some difference in skeletal morphology. Based on this evidence Hill-Tout concluded that the earlier of the populations was of Eskimo origins and that the later component could be attributed to migration from the Interior Plateau Salishan area.

Like Charles Hill-Tout, Harlan I. Smith was an early archaeological researcher in the Fraser River region. Smith conducted inventory work along the banks of the Fraser River and undertook excavations at the Marpole Midden and at Port Hammond and other sites. Smith found long patterns of continuity between components of the middens that he excavated. He found that the skeletal difference noted by Hill-Tout (1895) coexisted and could not be attributed to an early and a late population (Smith 1907). Smith conducted archaeological investigation on the Fraser Plateau as well as the lower Fraser River Valley, and in comparing the archaeological record of these two areas he concluded that there had been prolonged contact and communication between the two areas despite difficulty of navigation through the Fraser Canyon (Smith 1910). Some of Smith's interpretations are paradoxical. Robinson (1976) suggests that these conflicting modes of interpretation are a result of the influences of Franz Boas, architect of the Jesup North Pacific Expidition, through which Smith was employed. After analysing several crania from individual burials from the Marpole site, Boas reasserted the notion that two separate populations were represented, an 'Eskimo-like' and an 'interior-like'. Significantly, the preoccupation with change was privileged in interpretation over the field results.

This migration oriented interpretation of the culture-history of the area, with early 'Eskimo' origins followed by an influx of Interior Salish, influenced later research. In particular, the early interpretations of Charles Borden (1951) follow this line of reasoning. However, Borden later withdrew this interpretation as a valid explanation of the regions culture-history, primarily as a result of the overwhelming criticisms and accumulated evidence that suggested otherwise, in particular the discovery of the great antiquity of the Milliken site (9,000 B.P.) and the lack of interior traits among assemblages apparently attributed to the interior migration (Borden 1962).

Later researchers provide different reasons for the change from one period to another. Rather than migration, they argue for in *situ* adaptation to explain changes from one period to another. Although explanations of change are key to these researchers' perspectives, they acknowledge a strong element of continuity between phases. These explanations seem to have been first proposed at the site level and then integrated into a more regional perspective (Figure 3). King (1950) develops a chronology based on materials excavated from Cattle Point near Victoria. King's temporal periods followed the processes of adaptation from a primarily land based subsistence economy to a full marine adaptation. Carlson (1970) suggests that the change from the Marpole to the San Juan Phase in the Gulf of Georgia area could be the result of the addition of new techniques for exploiting the environment. Mitchell (1971) looks to subtle environmental changes and technological innovation to account for differences between culture types and also considers influence from neighbouring areas. Ames (1991:936) summarizes that "archaeologists working on the Northwest Coast have identified demographic change, intensification of subsistence production and the evolution of storage and sedentism" as reasons for change. Matson and Coupland (1995) suggest that changes from one period to another are a result of technological adaptation to resource availability.

Alternative Forms of Graphic Sequencing

For researchers interested in documenting change, the typical style of charted temporal sequences is useful. Patterns of long-term material continuity are not as easily interpreted from these charts. Some archaeologists have attempted to represent graphically long-term histories of different material types in the lower Fraser River region that emphasize continuity (e.g. Fladmark 1982; Carlson 1983a). These representations seem to differ in respect to the bounded and divided appearance of the typical charts employed in creating archaeological sequences. However, no attempts are made to interpret of the processes or enactment of continuity.

Carlson's (1983a) chart (Figure 3) presents outlines of chipped stone points in the lower Fraser River Region and Gulf Islands based on a selection of sites. It depicts linear divisions between time periods. But the drawings demonstrate great similarities and subtle changes between the artifacts depicted.

Fladmark's (1982) chart of Selected Artifact Chronologies, Gulf of Georgia, British Columbia (Figure 4) does not separate the sequence using bold-lines. Rather, it relegates the identification of culture type to the side margins of the table. The primary flow of the table is sequence oriented. The divisions divided by archaeologists are less clear. Individual artifact histories become more distinctive. Different traditions can be identified as permeating through different temporal periods. Each tradition, whether stylistic, technological, or functional has its own history irrespective of the relative frequencies of types used to create the temporal divisions. When viewed in this manner, the reasons for change from one archaeological culture type to another become more difficult to explain. The patterns of continuity seem overwhelming. Few archaeologists however, have attempted to explain the reasons for this continuity.

Kenneth Ames (1991) provides no graphic representations, but suggests that different aspects of late period society (e.g. specialization, stratification, population density, artistic styles) on the southern Northwest Coast have different durations in the archaeological record. Significantly, Ames (1991) asserts that multiple and diachronic explanations for the development of these different histories are necessary.

The manner in which sequences are conceived tends to structure archaeological interpretation:

> Because archaeology is a historical science, time is a major dimension of variation that must be considered ... although chronological units are the tools by which we divide time, chronological divisions are not natural. The infinity of time means that chronological units can and should be more variable than they are [Ramenofsky 1998: 84].

This comment is significant as it demonstrates the need for multiple chronological units to create a diverse understanding of long-term history. The use of differing and multiple chronological units will privilege continuity and change in different ways, thus allowing for a more comprehensive and inclusive means of understanding long-term historical practices.

Conclusions

This chapter has summarized the archaeological sequence of the Gulf of Georgia region with particular attention focused on the manner in which archaeologists graphically represent this sequence. This sequence is well developed and researched but tends to draw upon a single perspective of ordering chronology with distinct and separated chronological units. The cultural-historical perspective has focused explanation and understanding of the past on patterns of change. Continuity, although assumed to be a factor in the archaeological sequence is not explored, explained, or understood. Alternative means of depicting sequences suggest that alternative means of understanding chronological relationships in the study area exist and need to be explored to a fuller extent. There remains much value in the established sequence, which can be used as a cross-referencing and comparative index for other temporal schemes.

Figure 5. Chipped Point Sequence from the Lower Fraser Region and Gulf Islands (after Carlson 1983a)

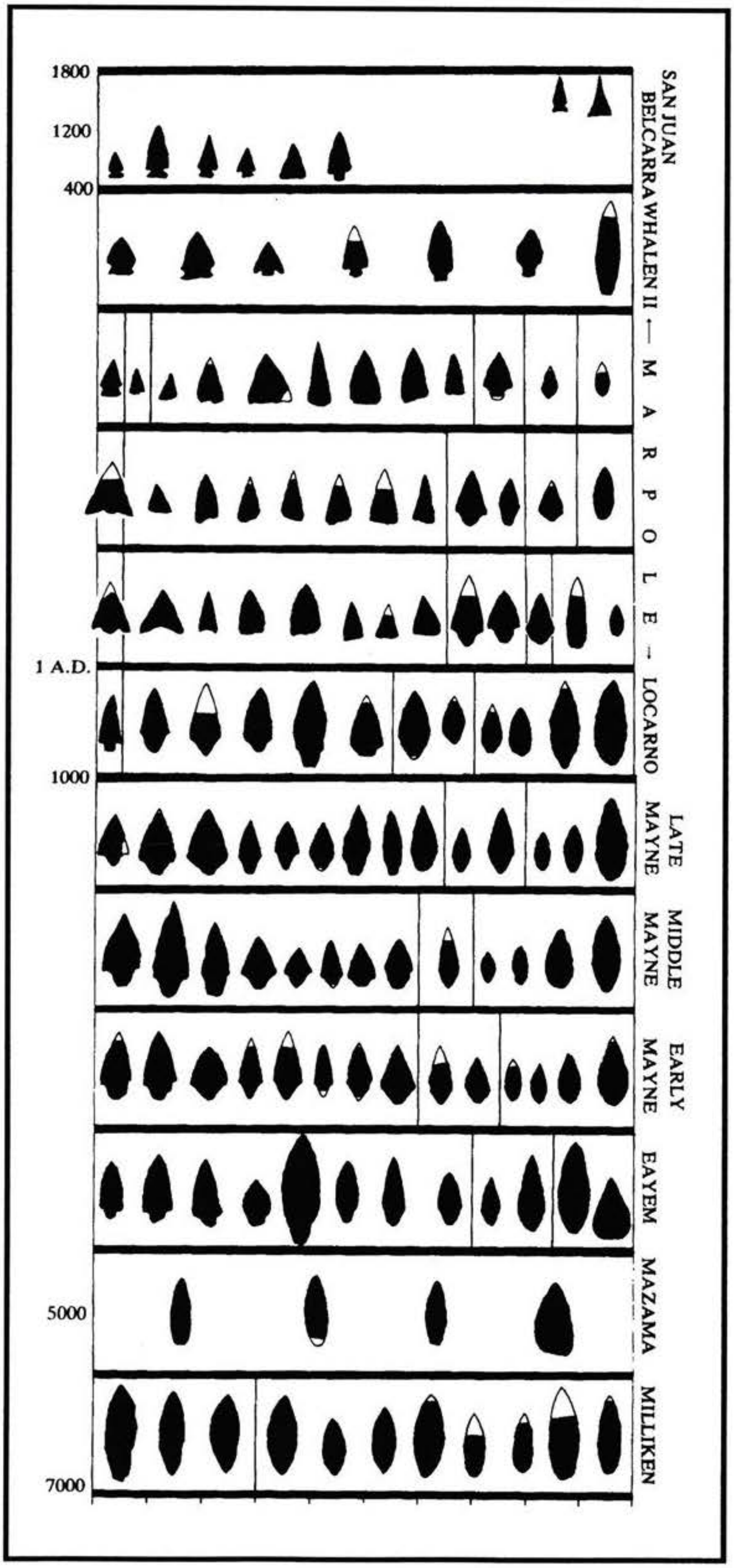
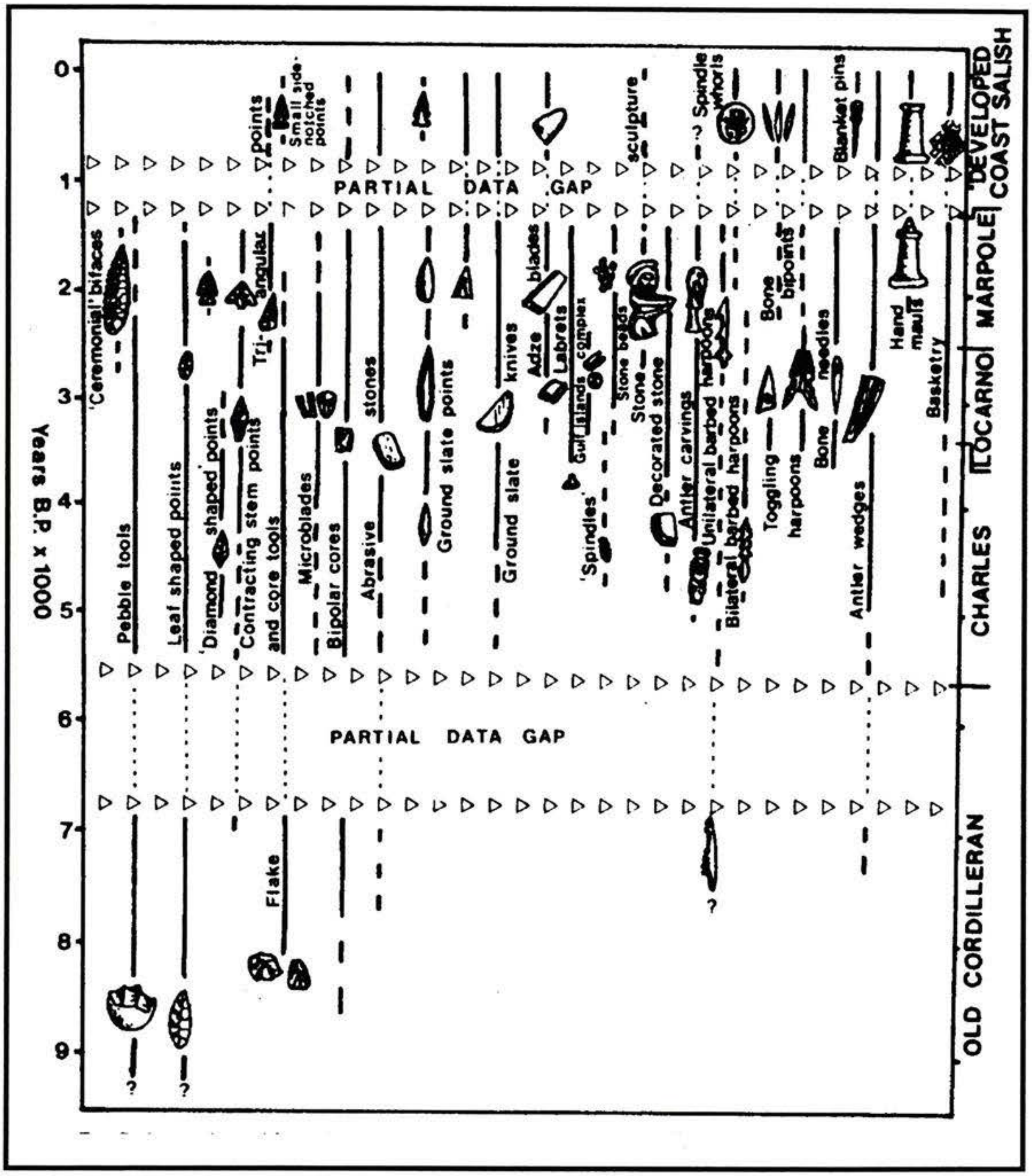


Figure 6. Selected Artifact Chronologies, Gulf of Georgia (after Fladmark 1981).



CHAPTER FOUR - ORAL HISTORICAL CONTEXT

Introduction

The goal of this chapter is to explore the manner in which recorded Salishan oral narratives provide insights into the sequence of human history in the Fraser River region of Southwestern British Columbia. Six different sources of oral narratives are analyzed for this particular project revealing three types of ordering systems: 1) consensual remembering, 2) genealogical referencing, and 3) sequencing references. By tracing these sequences and comparing them through tabulation the commonalities in the unfolding of past events are clearly demonstrated (Table 2). The tabulated sequence relates to palaeo-ecological, geological, and archaeological patterns, and as such, provides unique insight into the events of the human past of the Fraser Valley.

The oral narratives reviewed for this chapter are primarily from the region traditionally occupied by Mainland Halkomelem speakers (Upriver and Downriver dialects). Two sources are from the close neighbours of the Stó:lfl, one related by a Squamish speaker (a separate Salishan language community related to Nooksack), and Lummi (a Straits Salish dialect).

One factor that links these groups and other Coast Salish speakers and yet differentiates them from most other Northwest Coast peoples is the legendary transformer figure(s), *X̲ex̲á'ls*. *X̲ex̲á'ls* appears as the protagonist and sometimes the antagonist of many historical narratives. *X̲ex̲á'ls* is often referred to in the plural and sometimes in the singular. *X̲ex̲á'ls* is "the collective name for the powerful transformer siblings – three sons and one daughter of black bear and red-headed woodpecker" (Carlson et al. 1997).

The use of the singular, *X̱á:ls*, is a recent development possibly as a result of Christian influences in the region (McHalsie et al. 2001).

History through Language

Language is a means through which the social memory of a particular group of people is conveyed, shared, and transmitted. Many different types of speech events can be used to convey the past. As Duranti (1997:286) explains "speech events are where communities are formed and held together." Oral-historical narratives are particularly powerful social bonding mechanisms. They provide means through which commonly shared notions of time and space can be expressed. Consequently, when

> we remember, we represent ourselves to ourselves and to those around us. To the extent that our 'nature' – that which we truly are – can be revealed in articulation, we are what we remember (Fentress and Wickham 1992:7).

The use of chronological references to order such remembrances enables them to be articulated linguistically and hence be re-remembered. Thus, the rendering of past as a sequence of events in the past is in and of itself an important means through which communities are bonded.

All speech and narration has some inherent temporal properties. Duranti (1997:336) suggests that there is a temporality of speaking, where "details are slowly revealed one at a time, giving different participants a chance – although by no means assuming the same authority or linguistic ability – to affect the construction of a story and the moral identities of its character." Where details are slowly revealed one at a time a sequence of events is cast. This sequence may involve cyclical patterns, blurring the beginning back in the end. The sequence does not necessarily have to end at the beginning, although it might be said that at the end of every sequence there is, by necessity, a new beginning.

Galloway (1993:613-614) identifies linguistic devices that work to aid in building the temporality of Halkomelem narratives. He found that many narratives and stories that he collected and analyzed feature sentences that began with coordinating conjunctions: "these indicate subsequent events and serve to carry on and structure the narrative (Galloway 1993:613)." Significantly, the sequence of events in the narrative does not rely on the temporality of language alone, but is aided by the employment of sentences beginning with coordinating conjunctions such as "After he left…" or "Now, once this had occurred…" Consequently, various passages of a particular narrative are clarified as being a part of a sequence of events.

Two different narratives sometimes share common reference to particular events that occurred in the past. The shared references are often a link (a conjunction of sorts) between narratives forming a sequential relationship between the different narratives. Alternatively, one narrative may have a reference that relates it temporally to all narratives. For example, "in the beginning" is a statement that suggests that there are no narratives that come before this narrative. These types of references are referred to in this chapter as 'sequencing references'. A narrator's use of a sequencing reference demonstrates that he/she is conscious of the temporal order of events within and between narratives.

Sources

All of the oral narratives reviewed for this study were recorded in the last 125 years. A survey of sources yielded six collections of stories that are most relevant to the stated goals of this project. They came from the following published sources: Charles Hill-Tout (1897), Charles Hill-Tout (1903, reprinted 1978), Bernhard Stern (1934), Diamond Jenness (1955), Eloise Street (1974), and Geraldine McGreer Appleby (1961).

Several Central Coast Salishan narratives were found in amalgamations of stories from across North America (Morgan 1974; MacFarlan 1974; Mélancon 1967; Jenness 1960; Teit 1917). In these collections, there is little contextual information given as to the informants or the process of translation. Overall, there was not enough material to draw large conclusions about to the relative chronology of the stories written.

All other sources included narratives exclusively from the Stó:lō region or neighbouring areas. Some of these sources were found to be more useful than others for this analysis. In many instances these sources provided over-arching temporal sequences related by narrators (Jenness 1955; Hill-Tout 1897; Hill-Tout 1903, reprinted 1978); or they provided enough common references between individual narratives to place them in a relative sequence (Stern 1934; Appleby 1961; Street 1974). These sources form the backbone of this analysis.

The Narrators

The purpose of this section is to provide some insight into the process by which oral/aural transmitted information is textualized and to emphasize the narrator's influence in the story. It is without a doubt that the context of performance and the relationship of the narrator and the recorder (listener) helped to shape the overall sequences presented in the narratives. This section may also help the reader understand the nature of the sources analyzed for this project.

Mul'ks

The clearest description of a performative context for storytelling appears in Hill-Tout's (1897) Notes on the Cosmogony and History of the Squamish. Hill-tout (1897:85) described storyteller *Mul'ks* as follows:

> I received a cordial reception at the hands of the chief men of the tribe, and on learning what I wanted they brought out of retirement the old historian of the tribe. He was a decrepit creature, stone-blind from old age, whose existence until then had been unknown to the good bishop, who himself has this tribe in charge. I am disposed, therefore, to think that this account has not been put into English before. I first sought to learn his age, but this he could only approximately give by informing me that his mother was a girl on the verge of womanhood when Vancouver sailed up Howe Sound at the close of last century. He would therefore be about 100 years old. His native name, as near as I could get it, is "Mul'ks." He could not understand any English, and his archaic Squamish was beyond my poor knowledge of the language, it was necessary to have resort to the tribal interpreter. This account, as a result will be less full and literal.

Sqtcten et al.

In his article, The Ethnological Studies of the Mainland Halkomelem, A Division of the Salish of British Columbia, Hill-Tout (1903, reprint 1978) includes a section on the Kwantlen in which he describes his informants as follows:

> In my studies of the Kwantlen I was assisted by a native named August *Sqtcten*, of the Fort Langley Reservation, an intelligent and thoughtful Indian, who had been trained in his younger days in the mission school of the Oblate Fathers, and who had a very tolerable knowledge of English; by Jason Allard, a fairly educated half-breed; and to a less extent an elderly Indian women named Mrs. Elkins [Hill-Tout (1903) 1978: 67].

Chief Sepass

Eloise Street worked with Chief *K'Hhalserten* Sepass over a four-year period beginning in 1911. Sepass was born in the Kettle Falls region of what is now Washington State in 1847 and, as a child, moved to the Sardis region of the Chilliwack Valley after smallpox decimated the Colville peoples of the Kettle Falls region. Sepass relates stories that often refer to events in the lower Fraser River region, influences from the plateau region are evident.

> The Chief said that his family group were connected to the Nooksaaks in the state of Washington, that in British Columbia they married Cowichan or Thompson tribes people, and that they could "talk to the Susquatches" – Hairy Giants said to range the Coast Mountains. He had seen a giant skeleton in Chilliwack ... In the days of the Sun ceremonies, still celebrated every four years at the beginning of white penetration and settlement (later inevitably to be overridden by the pressure of the new regime), Chief Sepass was host to a large gathering from Pacific Coastal settlements. This was the occasion for particular rites, songs and dances, and parleys on matters of administrative concern. Two songs were sung each taking four days, *The Song of Nations*, a history, and *The Song of Generations*, a genealogy." [Street 1974:12-13].

Hillaire et al.

In 1934 Bernhard Stern produced a monograph on the Lummi Indians of Northwest Washington in which he includes mention of his key informants:

> The author is especially indepted to Joseph Hillaire, a Lummi Indian whose sincere interest in preserving the traditions of his people made him an eager and intelligent informant. Among other members of the tribe who served as informants were August Martin, Matt Paul, and Mrs. Matt Paul, William McClusky, Timothy Jefferson, and Frank Hillaire [Stern 1934:9].

Stern does not clarify which individuals told him the stories presented in the ethnography.

Old Pierre

Anthropologist Diamond Jenness visited Katzie in February of 1936 (Jenness 1955). There he worked with old Simon Pierre who he describes in some detail in the Faith of a Coast Salish Indian (Jenness 1955). Suttles (1955:5) remarks in an introduction to the monograph that

> Nowhere did he [Jenness] find the religious beliefs of the Indians so well integrated, or the rites so well interpreted, as by Old Pierre, a man about 75 years of age who enjoyed a wide and honourable reputation as medicine man both on Vancouver Island and on the Mainland.

Splockton

Geraldine McGreer Appleby collected stories from Joe Splokton, a Tsawwassen storyteller. In 1946 and 1947, she published some of these in The Optimist Newspaper of Lander B.C. These stories were reprinted in Tsawwassen Legends (Appleby 1961).

Translation

The narratives reviewed had been translated into English. There are many problems associated with translating these materials into English. Most obvious is how little information is given about the process of translation itself. For example, the narratives recorded in Hill-Tout (1903) and Stern (1934) provides no explanation regarding the processes of translation. In other instances, some notes on translation are given.

Hill-Tout (1897) described some of his translation problems, in particular the role of a translator in the process:

> ...he began his recital in a loud high pitched key, as if he were addressing a large audience in the open air. He went on without pause for about ten minutes, and then the interpreter took up the story. The story was either beyond the interpreters power to render into English, or there was much in it he did not want to relate to the white man, for I did not unfortunately get a fifth of what the old man had uttered from him, and it was only by dint of questioning and cross-questioning that I was enabled to get anything like a connected narrative from him at all [Hill-Tout 1897:85-86].

Eloise Street similarly includes such detail in her work with Chief *K'HHalserten* Sepass. In this case the translator was Street's mother, Sophia Street:

> ... I was surprised when a tall Indian appeared suddenly through the trees and sat on the other end of the log. Without a glance at me, he began to speak in a musical flow that continued for some minutes. He stopped and turned to look full at me. It was Chief Sepass. In scanty English, he asked me to take his songs and put them in a book. I agreed, and at our home during the next four years, my

> mother translated the songs ... During the four years, speaking mostly in Salish, the Chief gave various pieces of information ... [Street 1974:12].

Similarly, Old Simon Pierre's stories were translated by Simon Pierre Jr. to Diamond Jenness in 1936 (Jenness 1955). Little else is given regarding the context of translation.

The process of transcribing, rewriting, and editing various stories that were collected during interview is a major part of the process of translation. Often decisions that were made are not clear, and some translators may distort or change important aspects of various narratives. Chief Sepass was particular about the form that the English transcriptions of his tales took (Bierwert 1999:94). He ensured that Street recorded the lines of his tales using appropriate rhythm. This stands in contrast to the rambling, dictation style transcriptions of Old Pierre's narratives recorded by Jenness (1955).

The order in which tales are placed has an effect on how they may be read. Stern (1934) presents Lummi tales sequentially, from oldest to most recent, but it is not clear whether the tales were narrated in that particular order. Significantly, as Duranti (1997:161) suggests, "Transcription is a selective process, aimed at highlighting certain aspects of the interaction for specific research goals". Furthermore, the research goals of the translator may be different from those of the narrator. Consequently, the resulting text may highlight aspects seen by translator as important and may downplay aspects view as important by the narrator.

Many of these storytellers were practicing Christians. Therefore, there are Christian influences in many of these stories (Suttles 1987; Bierwert 1999). Some may be concerned that such influences may take away from the 'traditional' content of these histories. Indeed, the conventionalization of elements or new ways of perceiving the past into old stories is a common and ongoing character of oral histories (Fentress and Wickham 1992). Despite the incorporation of new metaphors, certain themes, mnemonic devices, or structures may remain constant over very long periods of time. This is also a common characteristic of oral histories (Lord 1981). This study seeks to discern, and therefore to privilege, long-standing traditions. Rather than highlighting Christian, or other influences, this study relies on a comparative structural analysis of the relative temporal sequences of historical events. This approach allows oral historical sequences to be compared and contrasted with the sequences of other long-term histories from the same area (see CHAPTER SEVEN - DISCUSSION AND CONCLUSIONS).

The Chronological Ordering of Oral Narratives

The following presents examples of ordering and sequencing patterns employed in the published stories identified above. This analysis reveals three types of ordering systems: 1) consensual remembering, 2) genealogical referencing, and 3) sequencing references

The Chronological Consensus of Mul'ks Narration

Hill-Tout provides rich information about how *Mul'ks* orders the sequential pattern of his stories:

> Before the old man could begin his recital, some preparations were deemed necessary by the other elderly men of the tribe. These consisted in making a bundle of short sticks, each about six inches long. These played the part of tallies, each stick representing to the reciter a particular paragraph or chapter in his story. They apologized for making these, and were at pains to explain to me that these were to them what books were to the white man. These sticks were now placed at intervals along a table round which we sat, and after some animated discussion between the interpreter, who acted as master of ceremonies,

> and the other older men as to **the relative order and names of the tallies**, we were ready to begin [Hill-Tout 1897:85, emphasis mine].

This passage is the only reference to such ordering and is shows that 'chapters' and relative order was agreed upon consensually.

Kwantlen Genealogy

Kwantlen genealogy, linking of a remembered sequence of ancestors with various epics, is an important means of ordering events of the past. This provides means for diachronic oriented examinations and explanations of the past. For example, Hill-Tout (1903, reprinted 1978:69) notes that:

> Of their origin they give various mythical accounts. Among the Kwantlen proper the first man was called Swaniset, meaning "to appear or come in a mysterious manner." He was *ten sweyil* 'descendent of the sky', who suddenly appeared on the Fraser River. Another account makes the first man a *ten tumah* 'descendent of the earth'. This latter is possibly an adaptation of the Mosaic account of the first man. With him were created all the tools and utensils, and also the Coquitlam tribe as his slaves. His name is given as *Swkelselem*. The *siam*-Kwantlen [chiefly family] have a genealogical record of their chiefs for nine generations: (1) *Skwelselem* I (2) *Skelselem* II (3) *Skwelselem* III (4) *Ctalsitet*, afterwards changed to *Skwelselem* IV (5) *Sqtcten* I (*Skwelselem* IV dying without male issue the *siam*-ship passed to his sisters son; hence the change of name.) (6) *Sqtcten* II, afterwards changed to *Stltimten*, which has reference to thunder (The story in connection with the change of name was forgotten. The name is a *sulia* name). (7) *Sqtcten* III (8) *Sqtcten* IV (9) *Sqtcten* V, who is the present chief. The original signification of these names seems to be forgotten.

Many events that took place during the course of the existence of various ancestors are remembered in reference to this lineage. Hill-Tout (1903, reprinted 1978:70) reports that when "*Skwelselem* II was chief there was a mighty conflagration spread all over the whole earth, from which few people and animals escaped". Hill-Tout goes on to suggest that this event refers to "some volcanic phenomenon". During the time of *Skwelselem* III he notes there was a flood resulting in the separation of the Nooksack tribe from the Squamish. A large snowstorm of long duration occurs during the time of *Skwelselem* IV resulting in widespread starvation. Franz Boas (1894) recorded several genealogies in the Lower Fraser River area. Boas (1894:456) notes that these lineages were very important to the people of the Lower Fraser River region:

> Evidently historical traditions are preserved relatively faithfully by these tribes. This is shown particularly clearly in the care which is taken in preserving the pedigree of Chiefs.

This genealogical approach to temporal ordering may not have direct relationship to the temporality of average human generations. As James Fentress and Chris Wickham (1992:80) suggest:

> These lineages and genealogies function not only as a source of information about 'real' ancestors, but also to situate a group as a clan or kinship group in relation to other such groups. In other words, lineages and genealogies also situate a group within a system of symbolic classification represented by totemic and mythological figures.

Unfortunately, Hill-Tout (1903) published only two full Kwantlen narratives, neither of which featured the *siam*-genealogy. In fact, the first narrative begins: "Once upon a time" (likely Hill-Tout's choice of an opening). Regardless, as discussed above, enough information is given in the section on genealogy to construct a relative sequence of historical events.

The Sequence in Sepass's Tales

Many of the stories recorded by Eloise Street of Chief Sepass exhibit important sequencing references that connect the temporality of one narrative by making temporally oriented references to other stories, some of which have obvious Christian influences. For example, in "*The Beginning of the World*", a reference is used that relates this story to all other narratives about the world. It is implied that this story relates the beginning of the world:

Long, long ago
Before anything was,
Saving only the Heavens,
From the seat of his golden throne
The Sun God looked out on the Moon Goddess
And found her Beautiful [Street 1974: 30].

In another narrative, "*The Slollicum, Lake Mystery*", a sequencing reference is used linking this narrative to a future event by employing foreshadowing:

Many years ago
Before the first thought
Of the oldest man … [Street 1974:49]

In "*K'Hhalls, the Sun God*", the sequencing reference described the order of creation taking this narrative back to the beginning of the world and before:

K'Hhalls made Tsee-ah-khum, the sun,
And Thuh-galtz, the white moon.
K'Hhalls made Kwah-sil, the stars,
And Tsuh-khil-ghil-um, the coloured rainbow [Street 1974:55].

In "*Tsee-o-hil, Mankind*", foreshadowing is used to order this story temporally as occurring before the return of *K'Hhalls* at a later time:

And K'Hhalls said:
"Let him have the earth for a while.
Let him see what he can do.
Let him build a great people on earth.
I will come back."

And K'Hhalls slept [Street 1974: 57].

In the story "*Miktzal the Painter*", the sequencing reference refers to the time when *K'Hhalls* is absent, thus placing the events of this story before the time of *K'Hhalls* return:

Miktzal laughed loud and long
As he looked at the bird folk,
Eager and waiting.

His painter's eye glinted with mischief.
He said:
"K'Hhalls is asleep; Why may I not be K'Hhalls
For a little while?"
He turned to his paint bowls. [Street 1974:59]

Several other narratives relate transformations undertaken by an awakened *K'Hhalls*. For example, a large-scale flood event occurs in which humans are buried in the mud. The following narratives suggest post flood events:

From "*Quait-Tzal Spahtz*", the Grizzly Bear

Tsee-o-hil
Lay buried in the mud… [Street 1974:75]

From "*Khwat-Say-Lum*", the Salmon Baby

When the flood was gone
And the banks of the streams
Rose out of the mud … [Street 1974:84]

Considered in concert, there is a consistent order between these narratives presented in Sepass Tales as revealed through the employment of sequencing references. The narratives of Chief Sepass demonstrate that there are many different ways in which sequencing references can be employed. Key passages relate these stories temporally to large-scale historical occurrences: the beginning, the sleeping of *K'Hhalls*, the transformation, and the flood.

Linking Lummi Narratives

There are similar sequencing patterns in the Lummi narratives recorded by Stern (1934), though these are not as clearly defined as those in the Sepass Tales (Street 1974). Once again 'the beginning' is a key reference point. For example, from "*In the Beginning*" the actions of the first two humans placed on this earth are related,

> Two Brothers were placed upon this earth. They first landed in the vicinity of Somane. There they discussed the problem of getting a livelihood. They concluded that salmon would not come to this place so they moved south ... to both brothers, *Xelas*, the Transformer had given some important gifts – the salmon, the reef-net, the spear, *suin* and fire [Stern 1934:107].

Forshadowing is also employed. For example in "*The Origin of Fire Making*" events occur before the coming of *Xelas*:

> While the Indians were assembled at *Xanetan* they heard of the coming of *Xelas*, the transformer. They prepared to welcome him with a feast [Stern 1934:108].

Old Pierre's Katzie Genesis

Diamond Jenness's (1955) "*Katzie Book of Genesis*" featuring Old Pierre's historical narrative of the Katzie people, presents one of the most clearly and concisely ordered sequential paralleling of events. This account includes a succession of many intertwined events ordered sequentially and is presented as a single narrative. Jenness (1955) attributes the ordering of this narrative to Old Pierre himself. In his storytelling, Pierre draws on genealogy and sequencing referenced to present his story of creation. The "Genesis" is described by Old Pierre as "not a mere fairy-tale, but the true history of my people, as it was taught to me in my childhood by three old men whom my mother hired to instruct me" (Jenness 1955:10). Pierre employs themes and metaphors that are suggestive of Christian influences as well.

The following example is the commonly used opening for narratives about the creation of the first human beings:

> When the Lord Above created these first human beings, the land was strangely different from what it is now ... in the waters of the sea and the rivers there were clams and mussels, but no salmon, eulachon, or sturgeon, no seals, and no sea-lions [Jenness 1955:10].

Another sequencing reference involves the tracing of environmental changes such as the introduction of certain animals into the area:

> He then led her to the water's edge and said: 'My daughter, you are enamoured of the water. For the benefit of generations to come I shall now change you into the Sturgeon" [Jenness 1955:12].

Events in Pierre's narratives are organized temporally by employing foreshadowing. For example, in the following excerpt, the future coming of *Khaals* is prophesied after *Swanesets* work is accomplished:

> Thus *Swaneset* accomplished two great deeds for the benefit of mankind: he brought eulachon down from the sky, and he brought the sockeye salmon from a far-away country ... A rumour now reached the Indians on the Lower Fraser that three brothers, accompanied by twelve servants, were coming from the west to finish *Swaneset*'s work [Jenness 1955:21].

Another example of sequencing reference is the means through which Old Pierre temporally links human activities to catastrophic events.

> Slowly the Indians multiplied again **after** the great flood, and the Lord Above who was watching them saw once more they were too numerous in the land [Jenness 1955: 33, emphasis mine].

Old Pierre employs many sequencing patterns. These sequencing references act much in the same manner as the coordinating conjunctions that Galloway (1993) noted in many Upriver Halkomelem narrative speech events: devices and tools used to connect the narrative into an integral and temporal structure. Pierre's sequencing tools have much in common with those recorded by Street (1974) and Stern (1934).

Old Simon Pierre's recounting of the "*Katzie Book of Genesis*" to Diamond Jenness is of great value in terms of understanding the relative chronology of historical events. As Suttles (1955:6) states:

> …the integration of the myths themselves into a coherent cycle is rare, if not unique among the Coast Salish. The plots and incidents exist in other bodies of myths but remain separate elements. And the coherent explanation of the social and the ceremonial in light of this cycle of myths is so unusual that Jenness asks whether it is the normal expression of Katzie culture or the expression of the genius of a single man, Old Pierre. Regardless of the answer, the expression itself has intrinsic value. It reveals at least one possible interpretation of Katzie myth and Katzie life.

Certainly in terms of a cohesive sequence of historical events, Old Pierre's narratives are extremely detailed in their relative chronological ordering. However, the integration of the stories into "a coherent cycle" is not necessarily rare or unique as has been demonstrated by the ordering devices used in the other narratives analyzed.

Joe Splockon's Orderings

Joe Splockton ordered his narratives much in the same manner as the narrators, above. For example, in "*The Legend of the First Tsawwassen Settler*" the sequencing reference refers to the first man, ordering other stories about human as occurring after the events of this story:

> *Tsaatzen* is the man in the Delta totem. He was the first man to discover and live in this part of the country. He came from up in the hills [Appleby 1961:21].

The "*Legend of the Cranberry Bog*" similarly describes the appearance of the first white man in the region:

> This legend of long ago begins with a story about a man it is said was the first white man to arrive in this neighbourhood. Some claim that the first white man was called Portugee Joe [Appleby 1961:37].

The "*Legend of the Dancing Fisherboy*" describes the events that occurred when first man at Tsawwassen had become old, thus placing the events of this story in relative temporal order with other events:

> The first man at Tsawwassen was an old man. Now, according to stories of olden times – and some believe them still – there were three persons going around the world: three brothers, who could change anyone into anything they wished [Appleby 1961:51].

Anthropological Orderings of Salishan Narratives

The existing ethnographic research on this subject explains that Halkomelem speakers recognize two different types of narratives. The first, *sx̲wox̲wiyám* is a narrative that relays events of the distant past. It is often described or conveyed as the "mythological past" (Galloway 1993; Suttles 1990; Carlson et al. 1997; Bierwert 1999). Alternatively, the *sqwélqwel* is a "historical narrative, narrative of recent events, or news" (Galloway 1993:613). The *sx̲wox̲wiyám* and the *sqwélqwel* are often intertwined in single narratives, making it difficult to classify narratives as being either one or another:

> This stems primarily from the fact that both types of narratives illustrate various realities that often exist simultaneously. The narratives shared by the Stó:lō often do not make a distinction between a distant history that was and a contemporary history that is, or a distant history that is unreal and a contemporary history that is real. There is no line drawn between the mythical/supernatural/spiritual and the natural/ordinary that cannot be bent. Even the inferred difference between the past and the present, or a supernatural versus a natural experience, can be blurred (yet the distinction between a *sx̲wox̲wiyám* and a *sqwélqwel* are clear to Stó:lō elders) [Carlson et al. 1997:193].

Carlson et al. (1997) struggle to identify exactly where the distinction between these two narrative types lies. Both he and Galloway's (1993) explain the dichotomy as a case of 'real' versus 'unreal' or 'mythical' versus 'historical', which, is not necessarily the distinction made by Salishan speakers. An important differentiation between these two types of narratives is the placement of the narrator in the relation to the story. Whereas the *sqwélqwel* often includes reference to the narrator in the narrative, for example personal pronouns such as "I" or "my cousin", such personal signifiers tend to be absent from *sx̲wox̲wiyáms*.

In his discussion of Central Coast Salish mythology, Wayne Suttles (1990:466) divides historical sequences into two distinct eras:

> In the myths there was an age when the world was different, its people were like both humans and animals of the present age, and it was full of dangerous monsters. The myth age ended when *xé'ls* the Transformer came through the world, transforming monsters and other myth-age beings into rocks and animals, and setting things in order for people of the present age.

Suttles makes no more discussion of historical sequences than this.

Results

The results of this temporal analysis of oral historical sources for the study area in question are presented in Table 2. The narrators' sequences have been placed in columns. Similar eras are organized into rows. It includes episodes that were temporally linked by the narrators. Common temporal occurrences are linked across rows of the table where possible. The far left column provides a means of delineating each era. Some suggestive conclusions can be drawn from the chronological sequences embedded in narratives. The table reveals, through cross-referencing, that a common pattern of historical sequencing was employed by a number of different narrators, from different places, recorded at different times.

A very general summary of the common pattern of sequences includes the following episodes. 1) The world was created or drained of the water at the beginning. 2) The first people were placed in a landscape relatively devoid of resources. 3) The landscape was transformed in various ways – most noteably during the time of *Xals* who changed the landscape, biotic, and cultural realms into forms that are recognized today. 4) The transformation was followed by a massive flood that inundated much of the landscape. 5)When floodwaters receded the animals and people go about re-establishing themselves. 6) Cooler climatic conditions make life difficult for human inhabitants. 7) Great sickness follows and takes a heavy toll on the population. 8) The next occurrence is the arrival of Europeans. Chief Joseph (born in approximately 1825) related a similar historical sequence to Franz Boas in the late 1800's (Boas 1895, reprinted 2002:160).

Themes reappear and repeat themselves often through the course of these sequences, in particular, the recurrence of the destruction and reconstruction of human communities. Such repeated themes have contributed to the classification of the narratives into cycles (e.g. Suttles 1955). There is also a linear trajectory present in the narratives.

Researchers have often dichotomized cyclical and linear chronologies into non-Western (or subordinate) and Western (or dominant) modes of temporal classification (eg. Connerton 1989: 19-20). For example, Hymes (1990) characterizes Northwest Coast people's conceptions of temporality in the following manner:

> It would be a mistake to think of a strict linear sequence, one age wholly replacing another. It would be more useful to think of a center and a periphery. There is indeed the great divide of transformation, when beings that are humanlike in voice and action became entirely animal, being overcome and diminished or simply choosing to take on their later characteristics and habitats … the established world is the center, which the events and beings of the narratives encircle at a distance. One can go out to the periphery, as on a quest for spiritual power (Elmendorf 1984:290). The periphery can come closer, as in the winter season, when power may be displayed in dramatic dance and song, and myths brought to life in words. Especially when the myths are travels of a trickster or transformer, they bring within the confines of the winter house origins in a world of summer.

The findings of this analysis suggest that elements of both temporal frameworks (linear and cyclical) present themselves in many different ways in the narratives analyzed. Indeed, the temporality of language would preclude that any linguistically based communication can recognize both cyclical and linear time frameworks. Cyclical narratives may contain linear attributes, just as linear narratives can contain cyclical attributes. It must be stressed that one does not necessarily exclude the other.

The basic premise of Table 2 employs a chart similar to space-time grids used by culture-historians in archaeology. Linklater (1993) used a similar chronology of Cree stories from Northern Manitoba using a culture-historical space-time grid. Bruce Trigger (1989) attributes the first use of space-time grids in archaeology to V. Gordon Childe (1932). Childe's chart detailed the archaeology of Europe "in terms of a complex mosaic of culture" (Trigger 1989:170). It became the prototypes for the format that archaeologists adopted to demonstrate approximations of chronological and geographical relationships between archaeological cultures. Such charts are of particular use to archaeologists as they provide a means through which to display visually the differences and similarities of archaeological cultures through time. Such charts can also be useful in displaying the relative histories of oral narratives. The chart created from this analysis provides a visual means of displaying the mosaic of different narrator's sequences of past event.

Conclusion

The objective of this analysis of recorded oral narratives demonstrates how historical events have been ordered by Salishan storytellers over the last 100 years. The results of this analysis reveal several different ways in which sequences are produced: 1) consensual remembering, 2) genealogical referencing, and 3) sequencing references. As demonstrated in Table 2, the narrators remembered strikingly similar relative sequences of historical events. The tabulation of these relative sequences allows for a comprehensive, ordered, and long-term perspective of events that occurred in the past as related through oral history. This provides a means of comparing the oral historical sequence to the other long-term temporal ordering of events from the same area (See CHAPTER SEVEN - DISCUSSION AND CONCLUSIONS).

Table 2. Space-Time Grid of Oral Historical Sequences from the Central Coast Salish Region.

Mul'ks – Squamish 1897	**Hillaire et al. – Lummi 1928-29**	**Joe Splockton – Tsawwassen 1946-47**	**Sqtcten et al. – Kwantlen 1903**	**Simon Pierre – Katzie 1936**	**Chief K'Hhalserten Sepass – Chilliwack 1911.**	**Oral Historical Era**
-In the beginning there is water everywhere and no land.					-*K'HHalls* creates the sky, thunder, lightening, fierce wind, sun, moon, stars, rainbow.	-The beginning.
-The Great Spirit makes land appear, lakes and rivers, trees, animals and the first man.	-Two brothers placed on this earth.	-*Tzaaten* came to Tsawwassen from the hills. -Tsawwassen was an Island at this time.	-*Swaniset* is the first human to appear in the area. - *Skwelselem* I.	-Creation of groups of people (including *Swaniset*), leaders, and sun, moon, season's and rainbow. -Only clams and mussels for people to eat.	-Sun and moon's longings mingle and create the world. -Sun's letter of love to moon falls and creates land. -Moon's tears creates the water. -From thoughts, longings, and loving came trees and flowers. -Moon and Sun leap into the sky and their new love creates humans. -*K'HHalls* sees the first human from the sky.	-The first humans.
			- *Skwelselem* II. - Possible Volcanic eruption (may be related to the shattering of Sheriden Hill described by Simon Pierre).	-Three white rocks created. -Creation of the north and west winds *Sxwa'yxwey* mask (and other masks) given to Musquem. -Creation of sturgeon and owl-like bird. -Pitt meadows drained and sloughs created. -*Swaniset* climbs arrow ladder to the world above. -Swaniset shatters Sheriden Hill. -Seagulls created. -Eulachon created. -Swaniset plays *lehal*. -Many animals are human in form. -Swaniset marries sockeye daughter. -Swaniset brings salmon up the Fraser.	-*K'HHalls* sleeps. -Mankind walks the earth in defiance of *K'HHalls*. -*Miktzal* paints the birds.	-Before the tranformation.
	-*Xelas* grants gifts to the first people: the salmon, reef-net, spear, deer and fire. -Xelas convinces Mt. Baker's wife, *Whateth,* to lie down.	-The first man at Tsawwassen was an old man. -Three brothers arrive and begin to changes things. -Old man is changed into a deer.		-*Khaals* comes from the West. -Begins to transform people into rocks. -Prophesizes that Tsawwassen island will become joined to the mainland. -Changes people into animals (raven, mink, wolf, kingfisher, racoon, crane, supernatural beings, sucker fish, beaver, muskrat, sandhill crane, goats, cranes, geese, eagle, wolf, black bear, grizzly, deer, seals).	-*K'HHalls* awakes. Turns *Sky-ak* (the magician) into mink. -*K'Hhalls* creates the sucker from Gekt the boaster (similar to the creation of deer in Pierre). -Turns were-wolf into mosquitos.	-The age of transformation

Mul'ks – Squamish 1897	Hillaire et al. – Lummi 1928-29	Joe Splockton – Tsawwassen 1946-47	Sqtcten et al. – Kwantlen 1903	Simon Pierre – Katzie 1936	Chief K'Hhalserten Sepass – Chilliwack 1911.	Oral Historical Era
				-Deer fence invented. -Deer fence forbidden. -Thunder controlled by *sya'ykwel.*		World trans-formed.
-Great Spirit makes the waters rise and all are drowned except for *Cheatmuh*, son of the first man *Ka-la'na*, and his wife.			*Skwelselem* III. Great flood overwhelms the people and shatters the tribes.	Flood. Refuge on Golden Ears and Mt. Cheam.	-Flood. -Humans die. -*K'HHalls* watches from the sun. -*K'HHalls* calls human from the mud after the deluge. -*K'HHalls* sleeps again.	The great flood.
-The population re-establishes itself				-The population re-establishes itself.	-Grizzly awakes and remembers the days before the flood. -Hy-o-hah-lah takes Grizzly to the world above. -Squirrel, sunk, raccoon, mink, and grouse rescue Grizzly. -Different tribal groups are created. -Grizzly remembers salmon from the days before the flood. -Beaver and friends travel to salmon village on the ocean. -Bring salmon up river.	After the flood.
-*Cheatmuh* dies and the Great Spirit sends a great snow-storm. -The snow covered everything. Starvation and cold.			-*Skwelselem* IV. -Great famine occurs caused by a prolonged snowstorm. -The Coquitlam are forced across the river from New Westminister.	-Cold and snow sent. -Starvation ensues.		The great snow.
-The population re-establishes itself			-*Sqtcten* I	-The population re-establishes itself		After the snow.
-Salmon become covered with sores and blotches. -A loathsome skin disease breaks out			-*Sqtcten* II -*Sqtcten* III	-News from the east of a great sickness.		The great sickness.
-Vancouver arrives		-Portugee Joe arrives and marries an Indian woman and lives on Reed Island.	-*Sqtcten* IV -*Sqtcten* V	-Europeans arrive on the Fraser.		The Arrival of Europeans.

CHAPTER FIVE - SERIATION ANALYSIS

Introduction

A temporal analysis of the materials collected from Stave Reservoir is in some ways a difficult task as these materials have been surface collected. Archaeologists pride themselves on their careful excavation techniques so as to ensure that spatial orientations and stratigraphy can be properly delineated to demonstrate temporal relationships between materials and features. Radiocarbon samples must be taken with great care from undisturbed subsurface contexts to ensure reliable dating. When faced with materials that have eroded from their subsurface and stratigraphic contexts these usual means of deriving chronological relationships are defeated, although antiquated methods of analysis were developed to attempt such chronology building. Prior to the development of most absolute dating methods, archaeologists tended to rely upon relative dating methods to derive chronologies from their excavations and collections. Common types of relative dating included stratigraphy, cross-dating, and seriation. Stratigraphy is of particular use for materials were found in subsurface contexts. Cross-dating and seriation are methods that are not necessarily dependent on stratigraphic relationships. Seriation was employed in the following analysis to determine a relative chronology of formed bifacial tools. The results of the seriation analysis provide a unique means of understanding long-term patterns of human behaviour. Materials from dated contexts were also included in the seriation analysis to cross-reference and verify the accuracy of the resulting sequence.

Seriation

Seriation is a means of placing material culture in a chronological order to gain an understanding of the relative sequence of artifact types for a given area. It is a form of analysis that assumes that styles of material items wax and wane in popularity over time. The root of the word seriation is 'series'. A definition of seriation is as follows:

> the arrangement of archaeological materials in a presumed chronological order on the basis of some logical principle other than superposition … The logical order on which the seriation is based is found in the combination of features of styles or inventory which characterizes the units, rather than the external relationships to the units themselves (Rowe 1961:326).

Marquardt (1978: 266) suggests that seriation is not necessarily limited to ordering data chronologically:

> Seriation is a unidimensional ordering technique used to arrange items in a series such that the position of an item, relative to other items, reflects its similarity to those items. Although it need not necessarily be a chronological ordering technique, archaeologists have made frequent use of seriation to arrange units along a temporal dimension … Seriation can be carried out either by directly rearranging the rows (units) of a data matrix or by manipulating a similarity matrix derived therefrom.

In a comprehensive review of the history of seriation, Rouse (1967:157) defines it as "the procedure of working out a chronology by arranging local remains of the same cultural tradition in the order which produces the most consistent patterning of their cultural traits". A seriation analysis, he notes, has five distinct elements:

1. Units are seriated.
2. Traits characterize those units and serve as the criteria of seriation.
3. The traits and units reflect a cultural tradition.
4. The area in which units are found must reflect the cultural-tradition.
5. The historical pattern which is distinctive of the tradition and against which the traits are matched.

These elements are discussed in the next section in relation to the conditions undertaken for the following seriation analysis.

Seriation is a method that fell from favour with the invention of radiocarbon dating in 1949 (Trigger 1989:304). Nonetheless, many researchers continue to use this method, as it is non-destructive and suited to dating material that cannot be radiocarbon dated (e.g. surface scatters). Recently, statistics and computer applications have been developed to assist in seriating data (Marquardt 1978). This study employed a statistical software program called WINbasp (1998, Bonn Archaeological Software Package) to enter data and construct the seriation sequence.

The data-set used for the seriation analysis was formed bifaces: chipped stone projectile points and bifacial knives. In total, 116 artifacts were categorized, illustrated, and compared.

Units of Seriation

There are a variety of units that can be seriated. These are fabrication units (artifacts, graves or buildings), deposition units (refuse collections, caches), and occupation units (seasonal sites, habitation sites, components) (Rouse 1967). The units employed in this project are fabrication units as they are artifacts.

These tools analyzed were collected from 26 sites in the Stave Watershed area. The purpose of seriating these objects was to gain an understanding of the relative chronology of tools, sites, and the landscape of the study area. As such, these fabrication units are taken to be representative of the temporality of deposition and occupation units.

The Criteria of Seriation

Classification is a means by which a collection of artifacts can be divided into modes or types (Rouse 1960). It is implied that the attributes of an artifact type or mode will have integral similarities. Certain types and modes will have different attributes from other types and modes. The difference in between types and modes is one of scale. Modes refer to choices that are made by the manufacturers of artifacts. These choices can reflect two broad categories of modes (Rouse 1960:315). *Conceptual* modes refer to the material, shape, and decoration of the artifact. *Procedural* modes refer to the procedures followed in making and using artifacts. In this manner a single artifact is an amalgamation of conceptual and procedural modes. Types can be defined as "a complex of modes which is diagnostic of a certain class of artifacts and which serves to differentiate that class from all other classes" (Rouse 1960:315-316). As types are dependent on aggregates of modes, it is logical that the analysts identify and classify modes prior to formulating types that are based on those modes on the basis of similarities (Rouse 1967:171).

The seriation analysis relies on comparing different modes. The reason for choosing modes, as opposed to types, at the comparative level was to enable a more rigorous seriation analysis, from which classes could be defined (Marquardt 1978). As such, the seriation provides a means through which a typology can be generated in a rigorous and more inductive manner than in the judgmental grouping of modes into types. The resulting typology is based on a continuum rather than mutually exclusive categories of types. This means of classification, based on a continuum, was more typically found amongst late 19th-Century practitioners of seriation:

> Montelius contented himself with the fact that every key point of his series was corroborated by a significant series of finds – and he knew that here the nucleus of a type exists and that at those divisions of the scale of the forms where finds are rarer, the periphery of the type is to be found; then there can be a free space, and interval, and perhaps a smooth transition to the periphery of another type. There is no need to construct a boundary line [Klejn 1982:58].

The modes used in this study are based on the procedural modes of biface reduction techniques and the conceptual modes of style. It is perhaps impossible to separate procedural and stylistic modes from one another as in many instances they are intertwined in the finished artifact. In this analysis, a particular mode is referred as an attribute. Variations on a particular mode are referred to as variables. Thus, an attribute can have multiple variables.

The criteria of modes for this analysis draw from typologies used by other archaeologists working with similar materials. Similar to the Stave Study area, although situated in the Northern Cordillera of the Yukon Territory, Gotthardt's (1988) study compiled a sample consisting of surface lithic scatters in which suspected palaeo-Indian and later period styles of projectile points. Her typology is built primarily from the sequences of bifacial manufacturing techniques described through archaeological experiments conducted by Callahan (1979). Although she did not conduct a seriation analysis, Gottardt's typology is well suited to such an analysis. Many of the following attributes are better defined through illustration than textual description, so I have included diagrams for this purpose. I also draw on the work of Sanger (1970) to create this typology. In particular, I use attributes of general outline and form from Sanger's typology of projectile points from the Fraser Plateau region of British Columbia.

Stage of Manufacture

All bifacial knives and points were examined for information concerning their stages of manufacture. Callahan's (1979) criteria for distinguishing the stages of biface manufacture drew from relative edge angles of particular tools. This strategy was based on experimental stone tool production. Gotthardt (1988:188) found that the stage of manufacture affected the expression of other features. Not surprising, this is partly a reflection of the stage of production. She controlled the effects of these attributes by separating stage classes into broader categories. Gotthardt (1988) describes the stages of biface manufacture as follows:

- Stage 1 – Blank Selection, a piece of raw material selected for the commencement of biface manufacturing.
- Stage 2 - Initial edging with primary intent to produce edge angles of between 55° and 75°. Preparation for subsequent flaking, so that bifaces become thinner rather than narrower.
- Stage 3 – Primary thinning. Production of the desired section and cross-section. Edge angles are between 40° and 60°.
- Stage 4 – Secondary thinning. Achievement of a flattened cross-section. Edge angles are between 25° and 45°.
- Stage 5 – Shape/outline achieved.
- Stage 6 – Production of the haft element and retouching.

The categorization of bifaces as "rough" or "preforms" does not necessarily imply that they were not functional tools. Scraping, cutting, and chopping activities may have been performed with tools from these stages. Regardless, in many cases rough bifaces reflect the rejected attempts to manufacture finished bifaces, and are representative of manufacturing strategies only. Variation in style will be minimal in regards to stage 3 and 4 bifaces as the shape and form are highly dependent upon the morphological characteristic of bifacial reduction technology and raw material being used. Stage 5 and 6 bifaces are involved in styling the shaping finished product: final thinning, forming the haft element, and retouching.

In this analysis, the basis on which a formed biface was distinguished from that of an unfinished biface follows the classification suggested by Johnson (1989:124). Formed bifaces were classified as such based on there being a lack of cortex and having straightened lateral margins rather than excessively wavy or irregular margins. All other bifaces were classified as biface preforms.

Flake scars to center

This attribute tracks the tendency of final biface thinning flake removal. Where finishing biface thinning flakes were found to extend to the medial axis of the tool, or beyond, the tool was recorded as possessing this attribute even if fine retouch was noted along the later margins of the tools. Where the final flake scars do not penetrate to the medial axis, this attribute was recorded as absent.

Outline of Flake Scars

The outline of finishing flake scars is not dependent on the morphological or design constraint of bifacial production (Gotthardt 1988: 181). For these reason this attribute is a reflection of stylistic trends or individual choice (conceptual mode). Variability in the final stages of flake scar removal can be attributed to different strategies of manufacture. Gotthardt distinguishes four variants:

a) Expanding: flake scars are placed at regular intervals along the margins of the tool and tend to expand to the distal-most end of the flake scar.

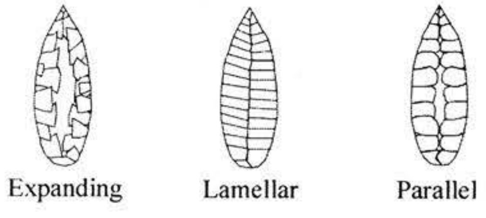
b) Parallel: flake scars are placed at regular intervals along the margins of the tool, do not expand and do not follow the ridge formed by the previous flake removed but are struck from a platform prepared below or above the margins of neighboring scars.

c) Lamellar: flake scars are placed at regular intervals; platforms tend to be placed so as to allow the force of the flake removal to follow the lateral edge of an adjacent flake scar removal.

d) Variable: flake scars are irregularly placed along the edge of the biface to straighten the edge and/or to thin the biface at chosen locations.

Expanding, parallel, and lamellar flake scars patterns are not exclusive and it was sometimes necessary to record the presence of two of these variants for a single artifact. These multiple patterns may be the result of re-sharpening or curation after breakage.

Figure 7. Examples of Flake Scar Outline Variables.



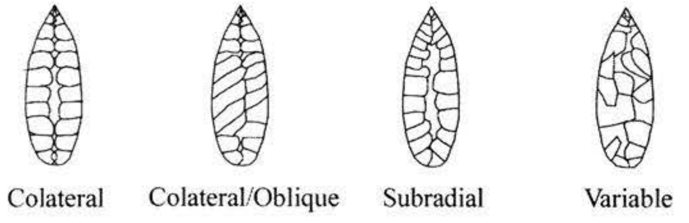
Orientation of Flake Scars

The orientation of flake scar removal is not dependent on the morphological constraints of biface production, rather, this is a highly stylistic variable, in finishing and curating bifaces. Gotthardt (1998:298-299) describes four strategies of this variable.

These strategies of flake scar orientation are described in terms of their orientations in respect to the longitudinal access of the tool. In some instances combinations of these strategies were noted and recorded as such.

a) Co-lateral: flake scars regularly removed perpendicular to the medial axis.
b) Sub-radial: flake scars regularly removed perpendicular to the margin of the tool.
c) Oblique: flake scars regularly removed diagonally to the longitudinal axis.
d) Random: Irregular placement of final flake scars.

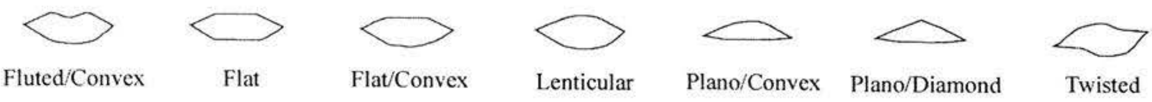
Figure 8. Example of Flake Scar Orientation Variables.



Cross-Section

The cross-section of finished artifacts is related to the flaking strategies adopted by the artisan and the morphological character of bifaces themselves. The following cross-sectional variants were recorded:

Figure 9. Examples of Cross-section Variables.



Order of Flake Removal

The order of flake scar removal is based on Gotthardt's (1988) usage who suggests that the order of flake scar removal is associated with cross-sectional morphology. She suggests that these strategies are "free to vary in response to individual choice or cultural convention" (Gotthardt 1988:181).

a) Unifacial Flake Removal: a technique of bifacial reduction which involves, for each stage of reduction, the completion of flake removal (shaping/thinning) on one face of the blank or preform before the opposite face is flaked. All margins are used.

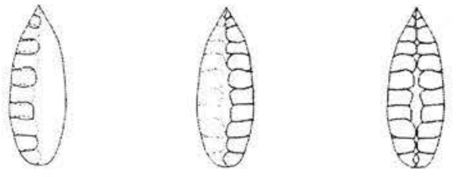
b) Alternative Flake Removal: a variant of the above technique in which one face of the biface is flaked from one margin; on the opposite face, flaking proceeds from the opposite margin.

c) Alternating Flake Removal: flakes are removed on the preform in an alternating fashion from both faces along the entire edge of the biface.

d) Straightening Order of Flake Scar Removal – employs different forms of flake scar removal in order to achieve a straightened edge.

e) Variable Order of Flake Scar Removal – flakes are removed variably.

Figure 10. Examples of Order of Flake Scar Removal Variables.



Alternating Alternative Unifacial

Flake #/l

This attribute is used to provide a means of measuring the relative amount of bifacial working on each tool. The flake scar number/length ratio was found to be more useful by Gotthardt (1988:301) than a measurement of average flake scar width. This measurement is flexible as it can be applied to both complete and broken artifacts. The following categories were used based on the ratio of flake #/length:

- S/L2 0.24-0.499,
- S/L3 0.5-0.799,
- S/L4 .75-.999,
- S/L5 1+.

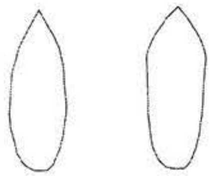
End Thinning

This attribute was recorded as either present or absent on specimens with intact basal portions. In this context, end thinning refers to the removal of thinning flake scars from the basal margin and parallel to the medial axis of the tool.

Form

This attribute refers to the general outline of the tool. In most cases a near complete artifact was needed in order to record this attribute. The following general forms were used: foliate, lanceolate, notched, pentagonal, stemmed, and triangular. In some cases it was necessary to record more than one basic form for a particular artifact. For example, a point could be both notched and triangular. Foliate and lanceolate points were distinguished from one another based on the position of the widest point. In foliate forms the widest point tended to be situated at the middle or closer to the base of the artifact, in lanceolate artifacts the widest point tended to be situated between the middle and the tip of the artifact or were characterized by long, parallel, and straight blade margins. Notched forms were recorded where side or corner notching was noted but not for basal indentation.

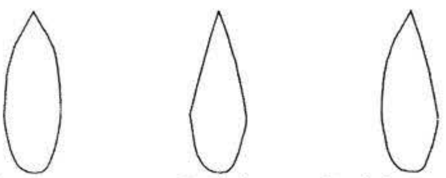
Figure 11. Difference Between Foliate and Lanceolat Forms



Blade

The blade refers to the lateral margins of the bifacial tools from the shoulder or widest point to the tip. The general shape of the blade was characterized as excurvate, straight, or straight/excurvate (straight along one margin and excurvate along the other).

Figure 12. Examples of Blade form Variables.



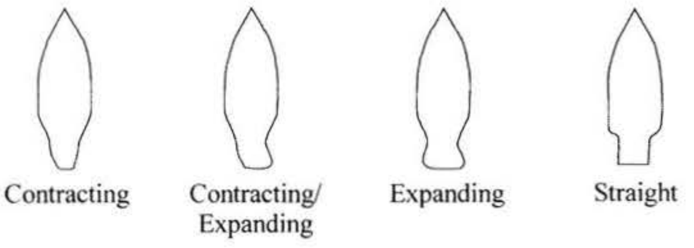
Denticulate blade

Where pressure flaking had been used along the margins of the bifacial tools to produce a serrated edge, it was recorded as having a denticulate (tooth-like) blade.

Stem

The stem shape attribute refers to artifacts that have been classified as stemmed. Stemmed artifacts tend to have narrower basal-lateral margins than blades, the two areas being distinctly separated from one another by prominent shoulder. The following stem types were recorded as different variables of this attribute:

Figure 13. Examples of Stem Type Variables.



Basal Width

This characteristic is the width of the basal margin. The basal width employed can have a relationship to the type of hafting employed, but not necessarily in regards to the breadth of the hafting mechanism. This measurement was measured in millimeters and is organized into the following variables of this attribute:

- W1 0-4.99mm
- W2 4-9.99mm
- W3 10-14.99mm
- W4 15-19.99mm
- W5 20-24.99mm
- W6 25+

Basal Margin

Several different variables were recorded for the basal margin of the bifacial tools analyzed. The following variables of this attribute were recorded:

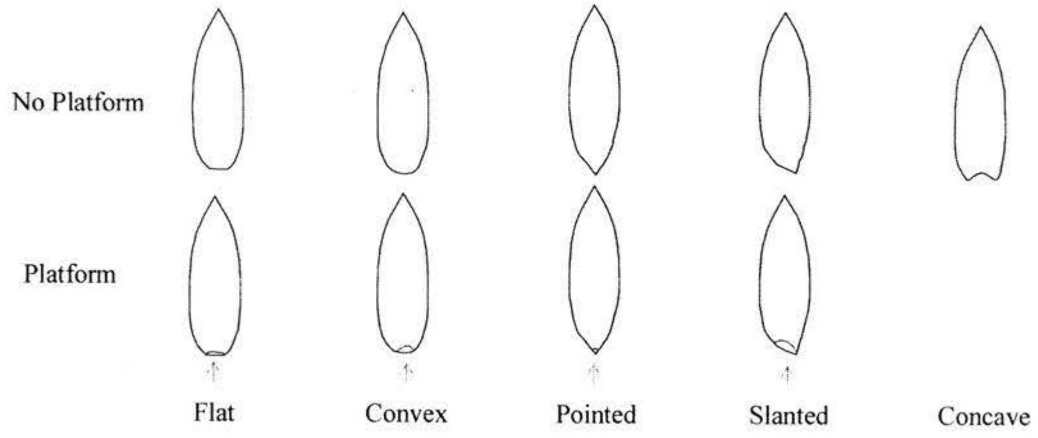
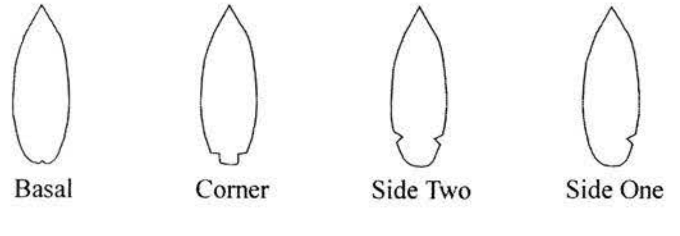


Figure 14. Examples of Basal Form Variables.

Removals

Two types of removals were recorded: notching and indentation. Notching refers to the intentional removal of small notches in the margins of biface points for hafting purposes. Indentation refers to smaller intentional removals and was recorded as Basal Indentation. Three types of notching were recorded: Corner, Side Two, and Side One.

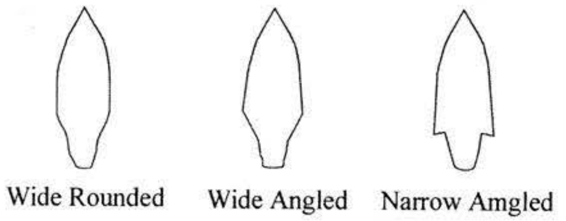
Figure 15. Examples of Removal Variables.



Shoulders

Shoulders refer to the intersection point between the blade margins and the basal lateral or stem margins of a biface. Shoulders are generally located at the widest place of the biface. Three shoulder variables were recorded: Wide Rounded, Wide Angled, and Narrow Angled.

Figure 16. Examples of Shoulder Variables.



Basal Grinding

This attribute was recorded for any point base that displayed basal lateral grinding or basal margin grinding. Grinding was used to dull the sharp basal edges to aid in handling and hafting. Crushed basal lateral and basal edges were characterize by dulled and often slightly rounded or bevelled margins.

Length of Complete Specimens

The length of all complete specimens was measured in millimeters; fragments were not measured. These measurements were taken to distinguish the relative length of complete specimens. The following categories were used to organize these measurements:

Leng1 – 0-29.9mm

Leng2 – 30-59.9mm

Leng3 – 60-89.9mm

Leng4 – 90+mm

Tradition in Seriation

According to Rouse (1967), the idea of "tradition" suggests that there are elements of continuity through time. This implies that in order to conduct a seriation, criteria must be transmitted from one generation to the next revealing pattern of continuity. Some type of transmission must occur between each generation for the entire period being studied. Both Rowe (1961) and Rouse (1967) maintain that the material being seriated must reflect the persistence of a culture-tradition in space.

Seriation also depends on change in style that results from many factors including diffusion, migration, and independent invention. If no change occurred, seriation would not be possible. Where tradition is a key factor of seriation, the results of a seriation analysis provide an intriguing means of understanding the manner by which tradition operates over long-term periods of history. In particular, it traces the expression of tradition in a multitude of different temporal contexts.

Area in Seriation

It is Rouse's (1967:178) contention that a seriation analysis is best carried out in a limited geographical area. A broad based spatial analysis may reflect spatial rather than temporal trends in variation. However, no precise guidelines are provided as to how small an area is needed to produce an accurate seriation. Furthermore, migration, travel, trade, intermarriage and the diffusion of ideas will intermix the traditions of neighbouring areas.

Limiting seriation analysis to a particular region allows the investigator to explore the relationship of technological traditions to a given landscape. The traditions of neighbouring areas can also be seriated using the same criteria and then compared thus providing insight into regional relations and the diffusion of traditions from one region to another (Gopher 1994).

The materials seriated in this analysis are all from a limited geographical area, the Stave Watershed. These materials are compared to materials from the Glenrose Cannery (Matson 1976; Matson 1996) site that lies 50km west of the mouth of the Stave River. The distance between the mouth of the Stave River and the Glenrose Cannery site is one day by canoe.

Patterns of Seriation

There are several patterns of seriation in archaeology: frequency seriation, occurrence seriation, and stylistic (or phyletic or developmental) seriation (Lyman et 1998:242). All of these types of seriation are suited to building chronological sequences from material remains, although certain patterns of seriation are better suited to given conditions.

Stylistic seriation, based on the principle that "the constituent modes, type, or phases have an inherent order" (Rouse 1967:188), was used in this analysis. The study draws on two factors: traditional stylistic attributes that link one time period to another, and changed attributes that differentiate one time period from another. Changes in attributes may in turn become convention, and thus, act as a "tradition" although, a recent addition to the sequence. The key to this pattern of seriation is "to prove the succession of styles by gradually changing character of the contents of [units] differing in age" (Uhle

1903, cf. Lyman et al. 1998:241). Hence, stylistic seriation is a method whereby tool style, decoration, and context are concurrently analyzed in order to produce a stylistic history.

The stylistic seriation approach is important, not only in chronology building, but also in understanding the manner in which people enact tradition over long-term periods of time. Consistency in style can be attributed to social mechanisms that maintain tradition: remembering, transmission, and repetition. It is through continuity that one era is tied to the next. Variability in style can be attributed to many possible factors including forgetting, innovation, adaptation, diffusion, and migration.

The principle of style is one that has long been debated in archaeology. Different researchers have characterized style in different ways (Boast 1997). Wobst (1977) suggests that style is complex and multifaceted and is the aspect of material culture that is a medium of information exchange. Weissner (1990) suggests that style is expressed in both functional and decorative attributes of material culture whose meaning changes depending on the social context. Tilley (1991) draws parallels between the expression of style in material culture and the inscription of speech, where style and its relationship to function are understood in relation to linguistic referents. Boast (1997:191) suggests that the concept of style has little use beyond "a vernacular distinction between social forms distinguished within a consumerist society". Clearly, the concept of style in understanding past life-ways depends on the manner in which style is conceptualized.

The use of the term 'style' in the construction of this analysis refers to the general shape and size of various attributes. An understanding of the meaning or identity conveyed through style in the past is not attempted. Underlying the notion of style in the employment of seriation is the assumption that people in the past negotiated tradition and change with their materials. As Boast (1997:182-183) suggests

> ...the identification of style, the categorization of similarity and difference in material objects, is represented through the properties of the object itself. That the stylistic properties of an object are a matter of replication of conventionalized forms, whether arising from social structures or conventional ways of living in the world. Style depends on a strongly normative position, a position that reflects the object's coming into being as a representative of the 'way of doing'. This representation must, by necessity, be more replicative than referential.

Significantly, the results of a seriation analysis can present a long-term perspective of the manner in which people interact with the replication of tool traditions as inscribed in templates, remembered in ideals, and negotiated in different temporal contexts. Consequently, this approach is not intended to explore the true nature of style, but rather the long-term replication or change of attributes as represented by the negotiation of tradition through a material medium.

Analytical Steps and Results

Several steps were taken in order to conduct the seriation analysis. The bifaces collected were separated into preforms and formed bifaces. The variables of each formed biface were recorded on a spreadsheet. Attributes were selected according to the criteria of seriation set out in this section. Once data had been tabulated, it was imported into the statistical software program WINbasp. Each of the artifacts analyzed was illustrated in order to aid in visualizing the results of the analysis. Illustrations were drawn using the conventions outlined by Addington (1986).

Seriation Results

The seriation process operates by ordering units with similar variables closer to one another, and moving units with different variables away from one another. The basic underlying premise of the seriation program employed is as follows:

- WINbasp first tabulates the incidences of units and types as entered.
- An algorithm is then used to calculate the mean position for the incidence of variables for each column.
- The columns are then ordered according to their means.
- The same process is then undertaken for the rows.
- These steps are repeated, shifting the rows and column until no improvements in correlation, as measured using Spearman's rank correlation, are possible.
- The numbers of repetition used are expressed as iterations.

The result of the seriation is a scatter plot that resembles a linear regression. Spearman's correlation coefficient is expressed as a number between -1 and 1 where numbers closer to 1 indicates a linear relationship between units and attributes. If it is hypothesized that the reasons for variation between units and attributes is due to change through time, then a coefficient of closer to '1' or '-1' suggests that there is change through time, although the direction of temporality is unknown. A correlation close to '0', suggests a lack of correlation between variables.

The results of the analysis undertaken are present in Figure 17. Spearman's rank correlation of compactness for the resulting seriation is 0.5962 compared to an input correlation of –0.0065. Compactness refers to the overall linearity of the correlation of tabulated points where a score of 1 indicate compact linearity and a score of zero, no linearity. The resulting correlation of 0.5962 in this analysis demonstrates that there is some change amongst the relative ordering of artifacts and changes in variables. However, the change is not highly compact suggesting that some of the artifacts or variables used may not be temporally diagnostic or related in a linear fashion.

As some of the artifacts used in this analysis were not complete, it is possible that some error has been introduced into the resulting seriation. One would expect such error to manifest itself as the separation of tip fragments, basal fragments, midsections, and complete specimens along the linear axis of the seriation. More fragments do occur at one end of the seriation, but no sorting of fragment type seems to have occurred. Some of the attributes used in this analysis are found on all fragments and complete specimens, such as Flake Scars to Center, Outline of Flake Scars, Orientation of Flake Scars, Cross-Section, Order of Flake Removal, Flake Scar Number/Length and the use of these attributes likely helped in balancing the seriation results.

The Direction of Time Plotted

The seriation analysis plots a temporal sequence but does not predict the direction in which the sequence flows. The artifacts at the top of the page may be the oldest or the youngest. To determine the direction of flow, at least two artifacts of known age must be identified within the sequence. Formed biface DhRo28:54 occurs at one end of the seriation. This is a distinct type of projectile point that is small triangular and side notched. This type of projectile point is well known is the area and dates to the latest archaeological period (1500-200 years B.P.) in the lower Fraser Valley region (Charlton

1980) and on the Fraser Plateau (Richards and Rousseau 1987). Formed biface DhRo26:35, is one of the only artifacts from a dated and excavated context included in the analysis. It is from a stratigraphic layer that dates to 2,530+/-40 BP (Beta-110058). From these two markers it is possible to determine the flow of the sequence indicated on Figure 17. With this information the sequence produced can be traced along both X axis and Y axis of the graph. The direction of the sequence is plotted as an arrow on Figure 16.

The relative temporality of the different units is graphically represented in the artifact illustrations Figure 18 through Figure 35. These illustrations are ordered according to the seriation sequence produced in Figure 17. The first illustration is of the oldest formed biface according to the analysis and the last illustration is of the latest. Those in between follow in sequence. With a few exceptions, most of the artifacts analyzed are included in the illustrations. These illustrations provide a graphic means of understanding the seriated order of the artifacts and attributes (Figure 18-Figure 35, pages 88-105).

Figure 17. Results of Seriation Analysis (For Enlargement see Appendix A).

Formed Bifaces

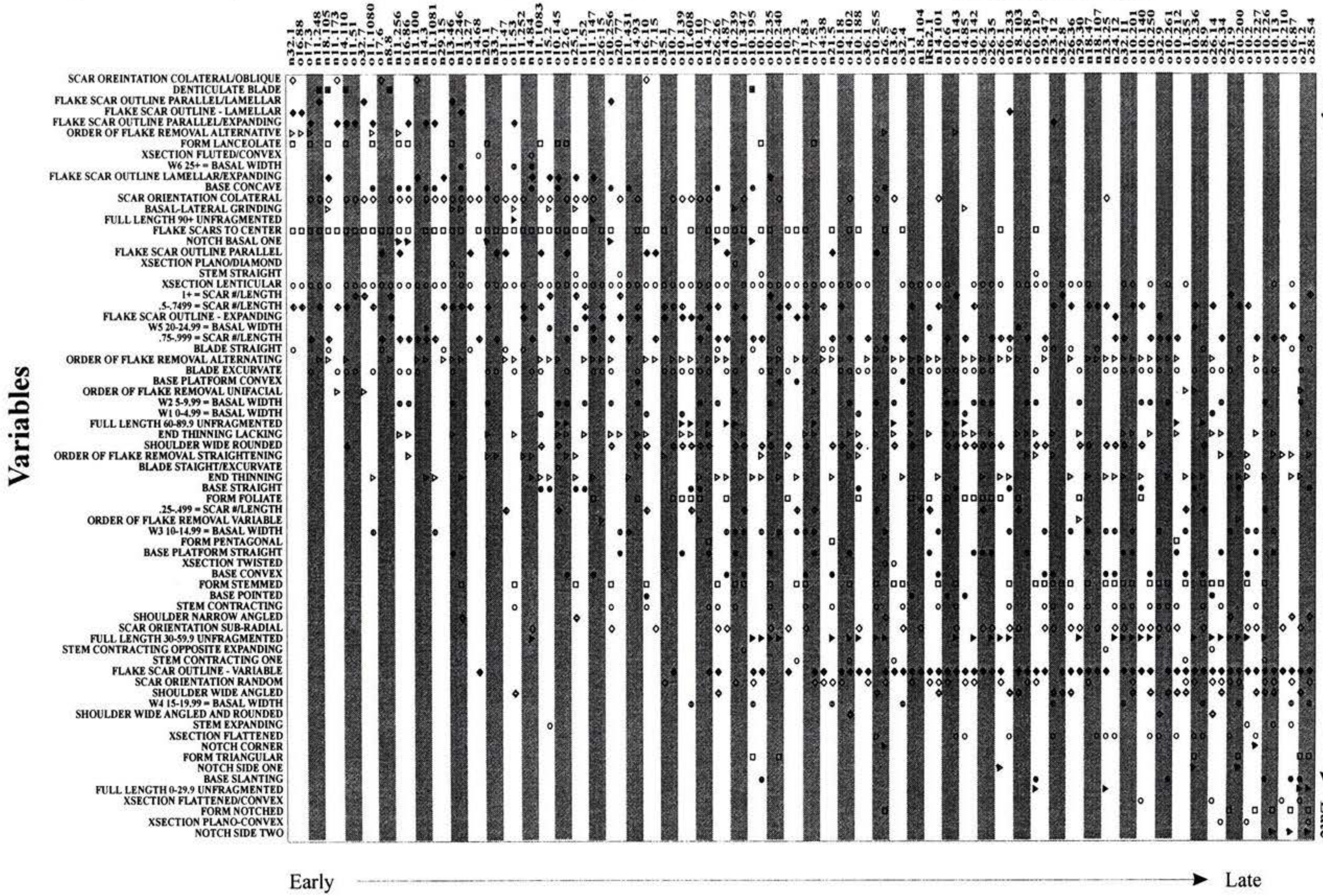


Figure 18. Illustrations of Artifacts Used in Seriation Analysis.

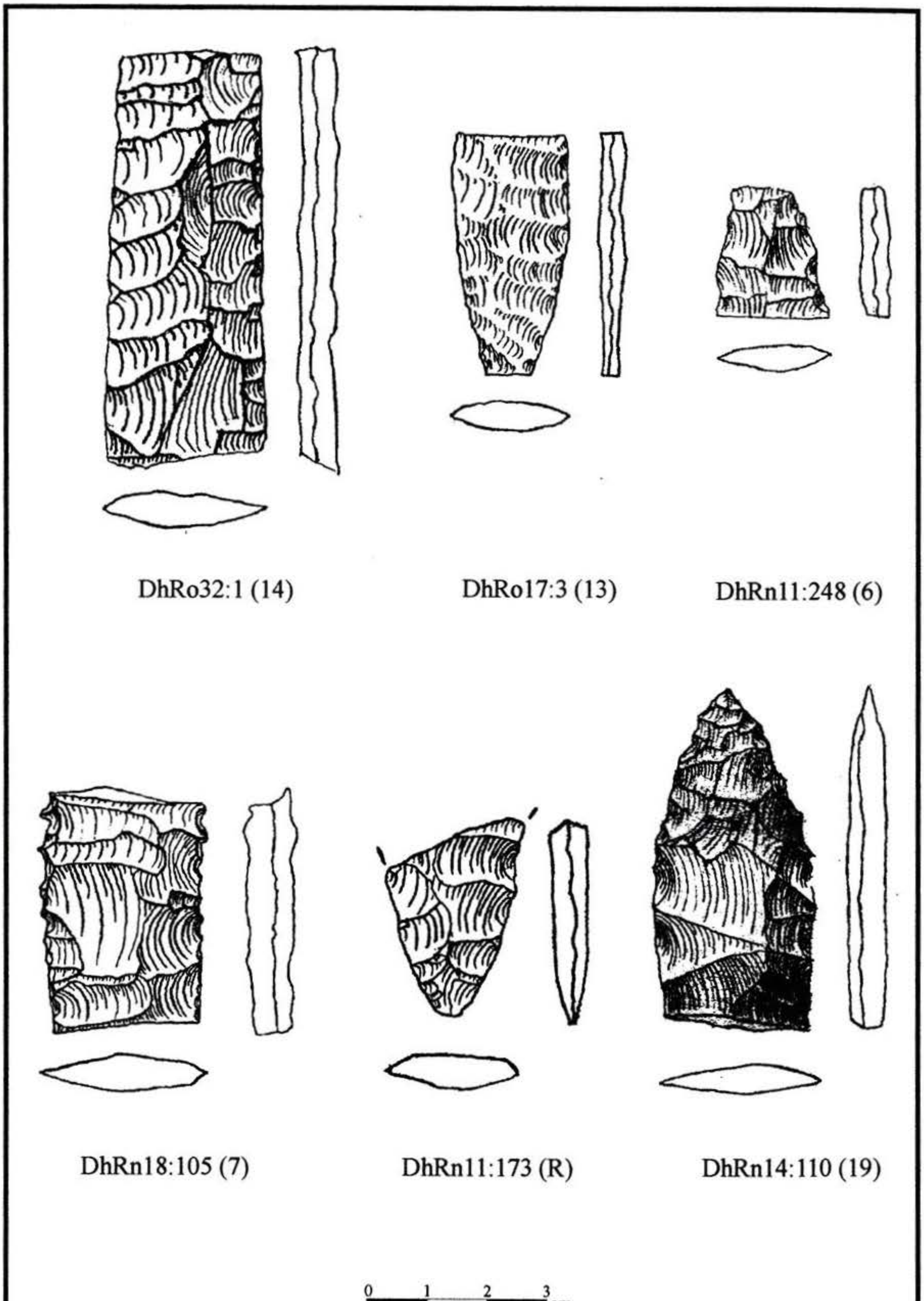


Figure 19. Illustrations of Artifacts Used in Seriation Analysis.

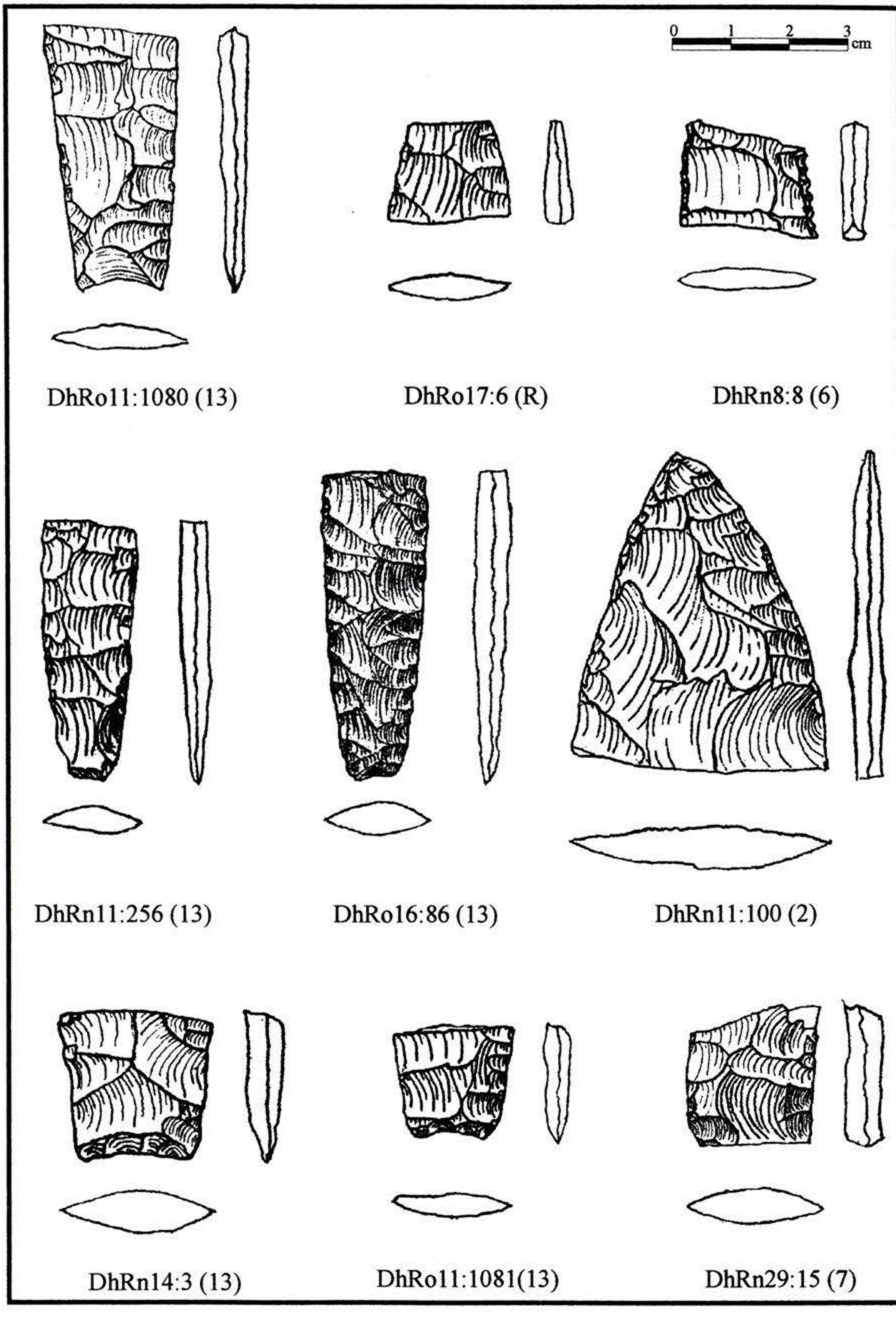


Figure 20. Illustrations of Artifacts Used in Seriation Analysis.

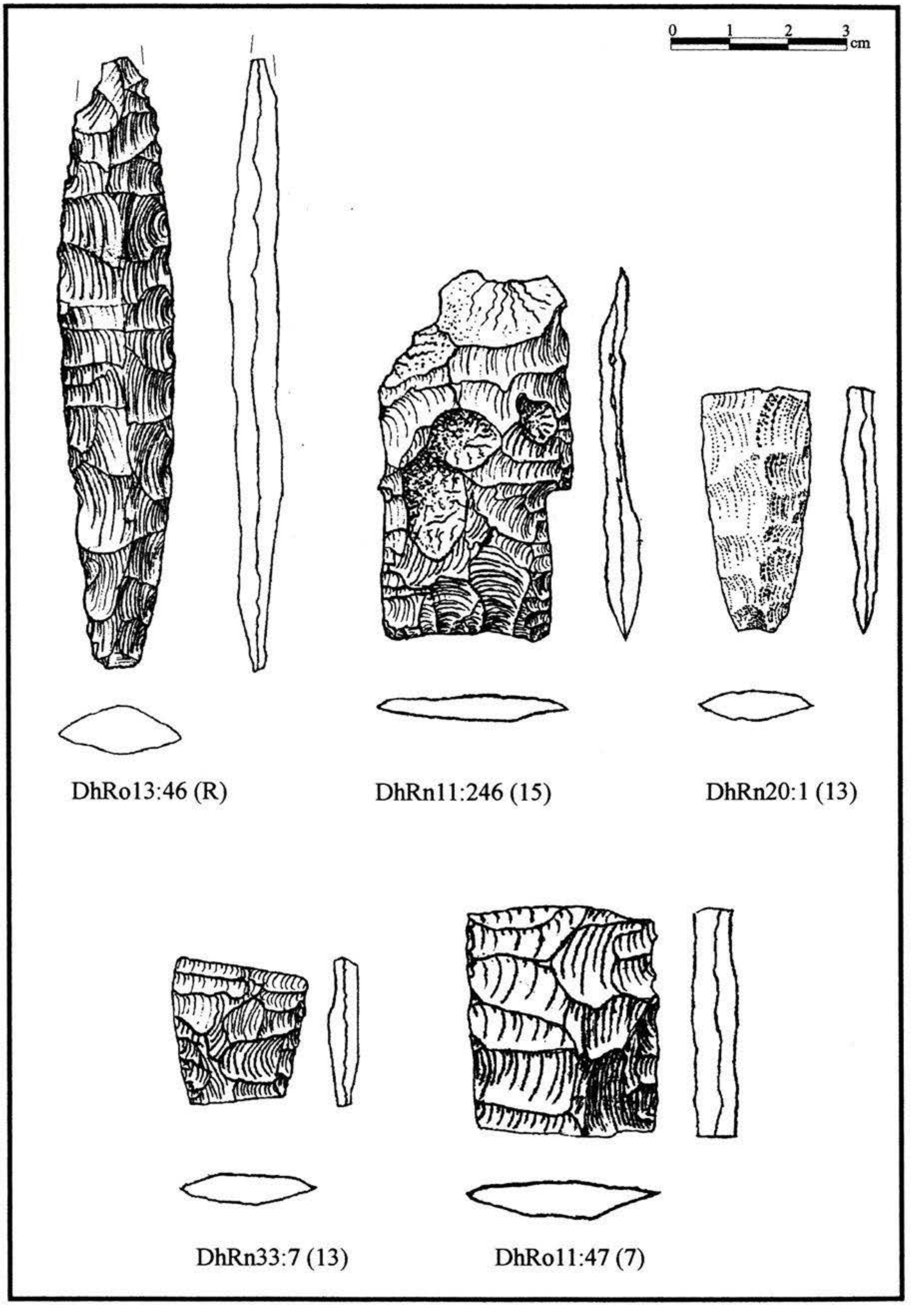


Figure 21. Illustrations of Artifacts Used in Seriation Analysis.

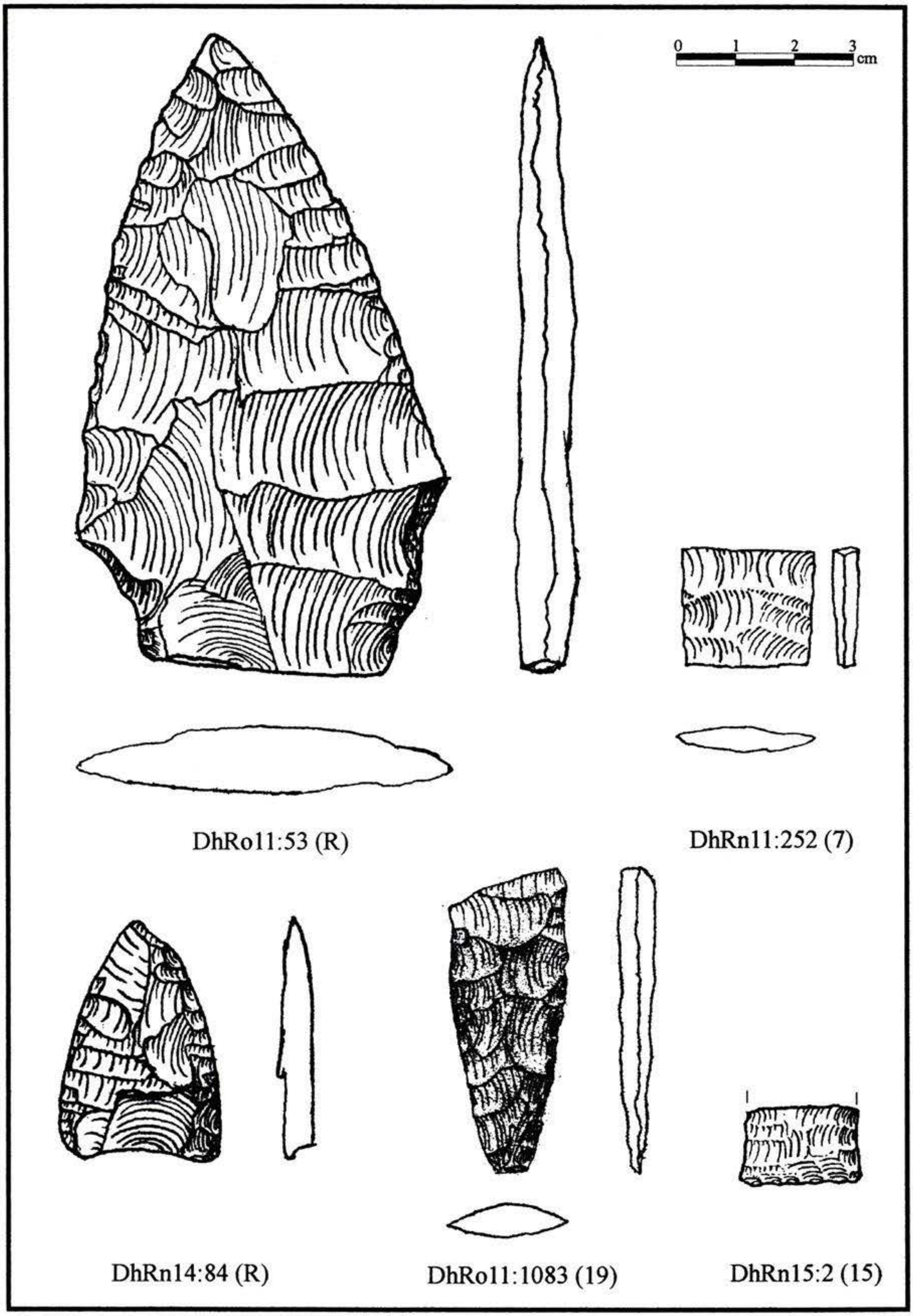


Figure 22. Illustrations of Artifacts Used in Seriation Analysis.

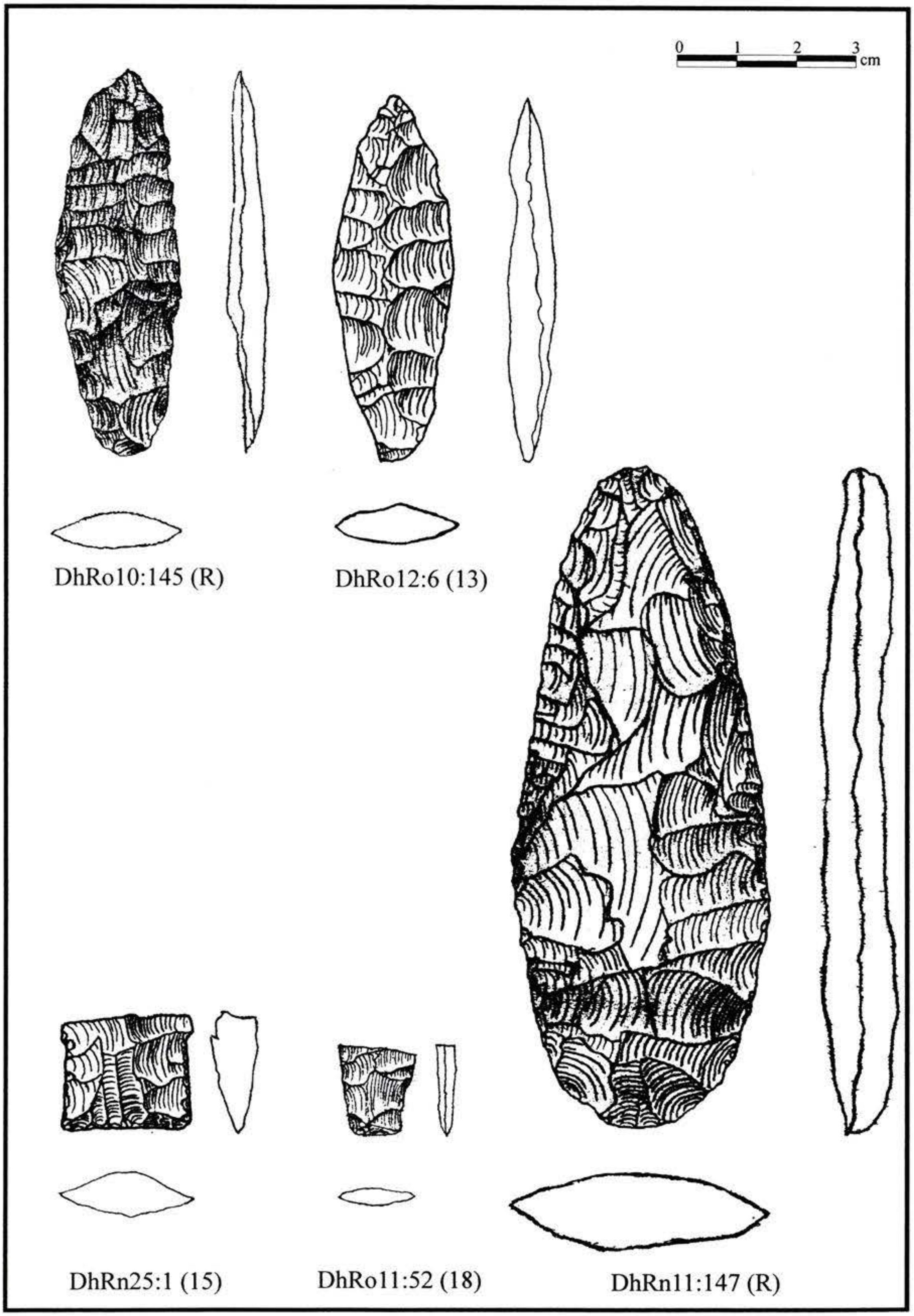
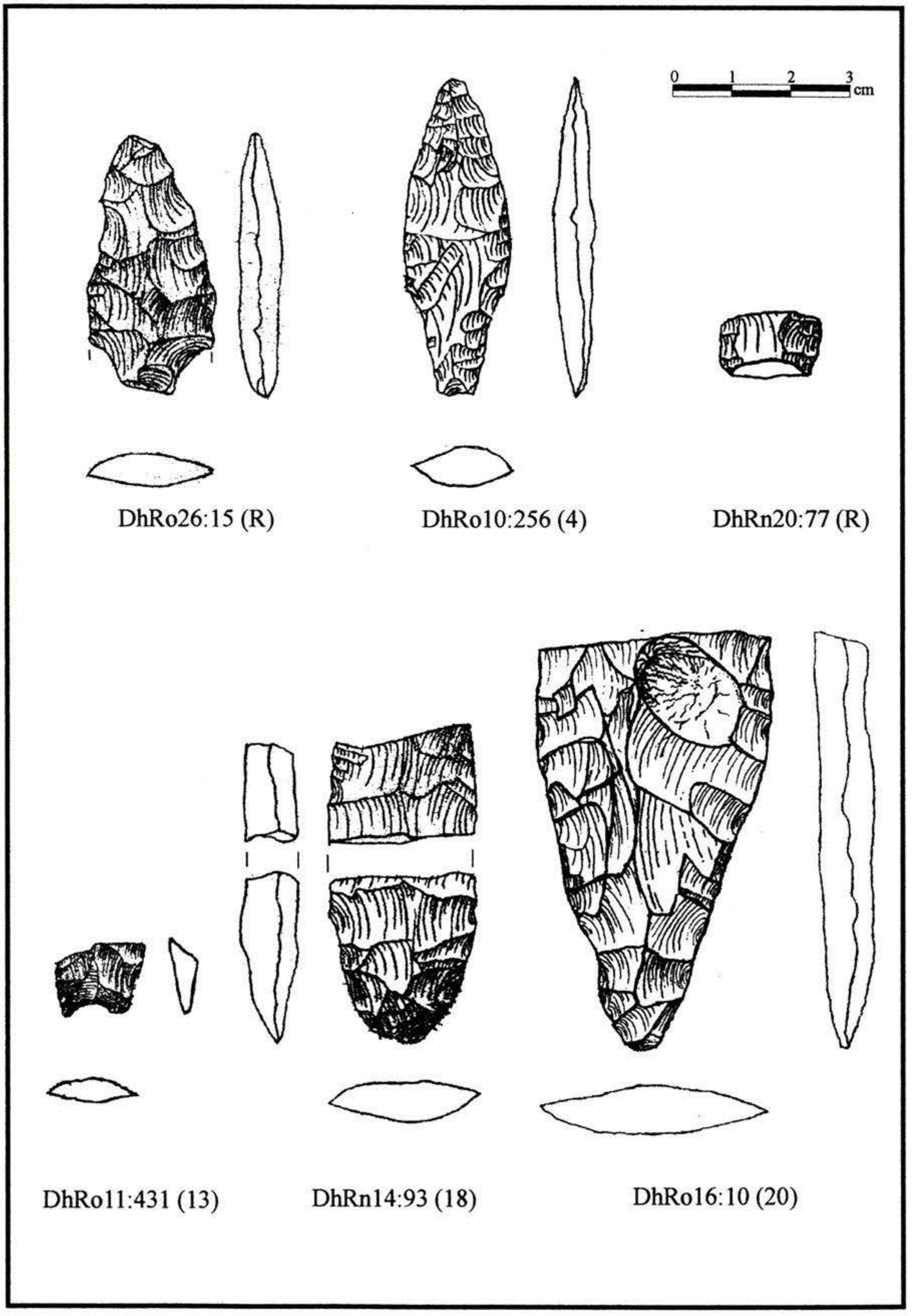


Figure 23. Illustrations of Artifacts Used in Seriation Analysis.



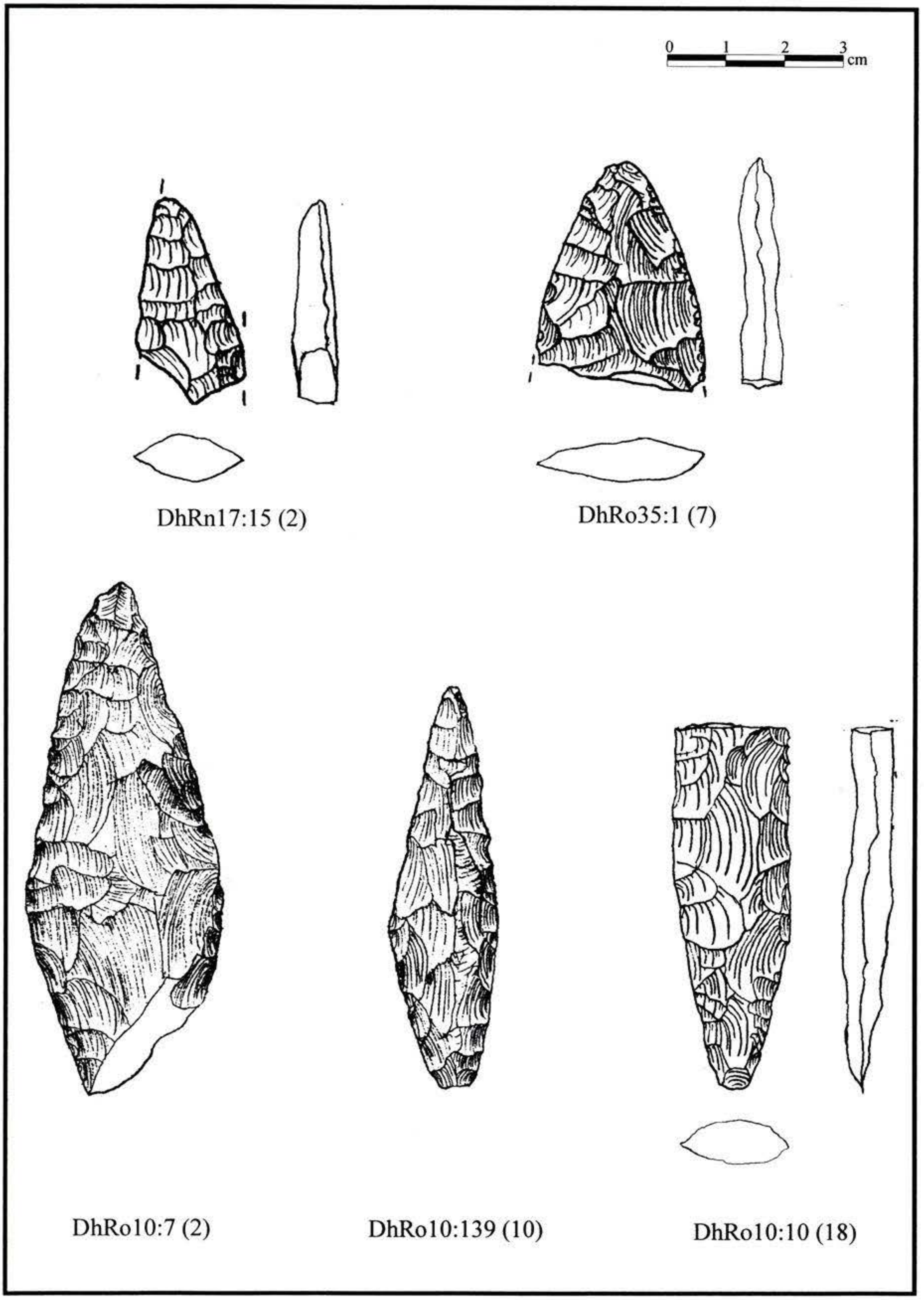


Figure 24. Illustrations of Artifacts Used in Seriation Analysis.

Figure 25. Illustrations of Artifacts Used in Seriation Analysis.

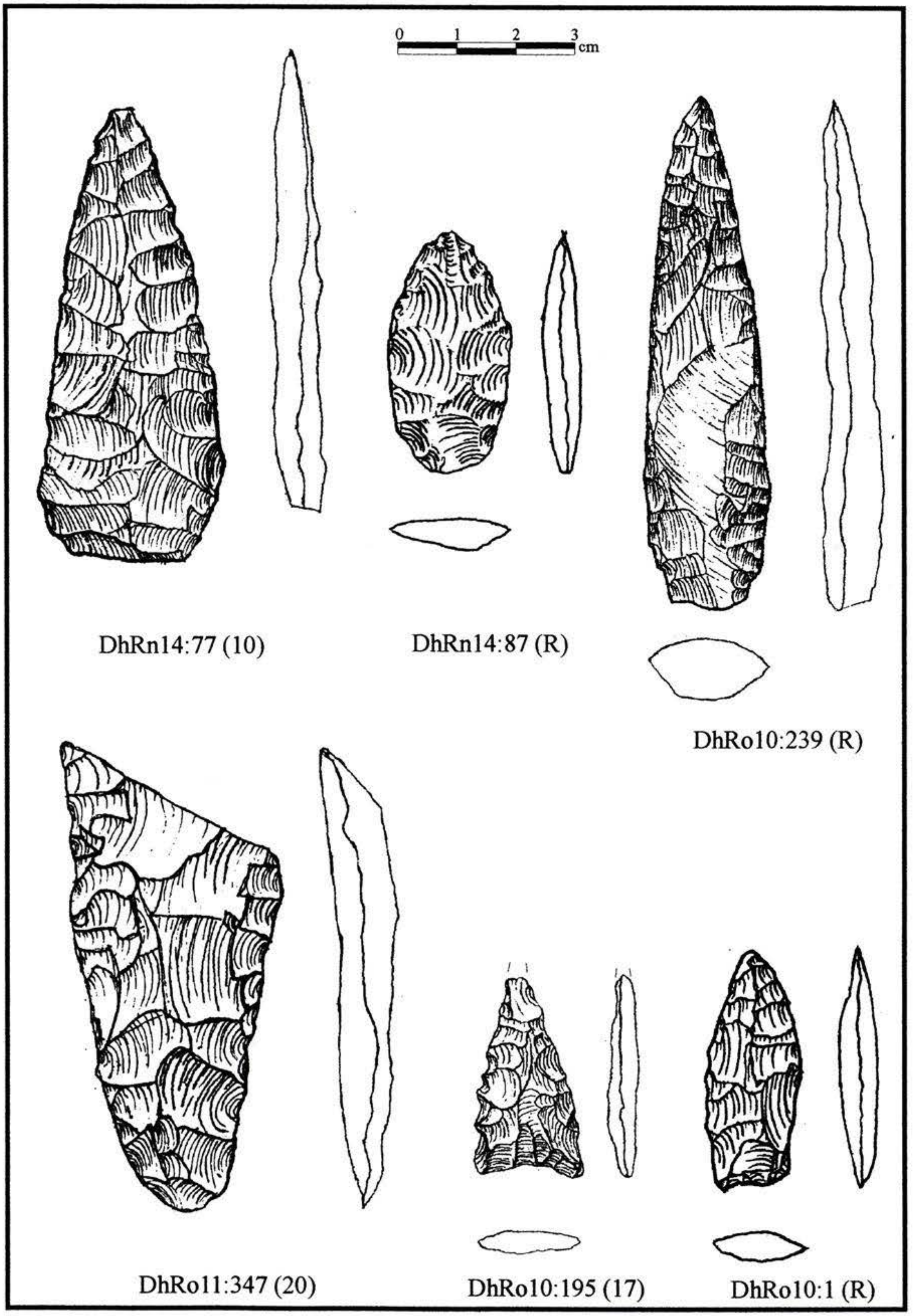


Figure 26. Illustrations of Artifacts Used in Seriation Analysis.

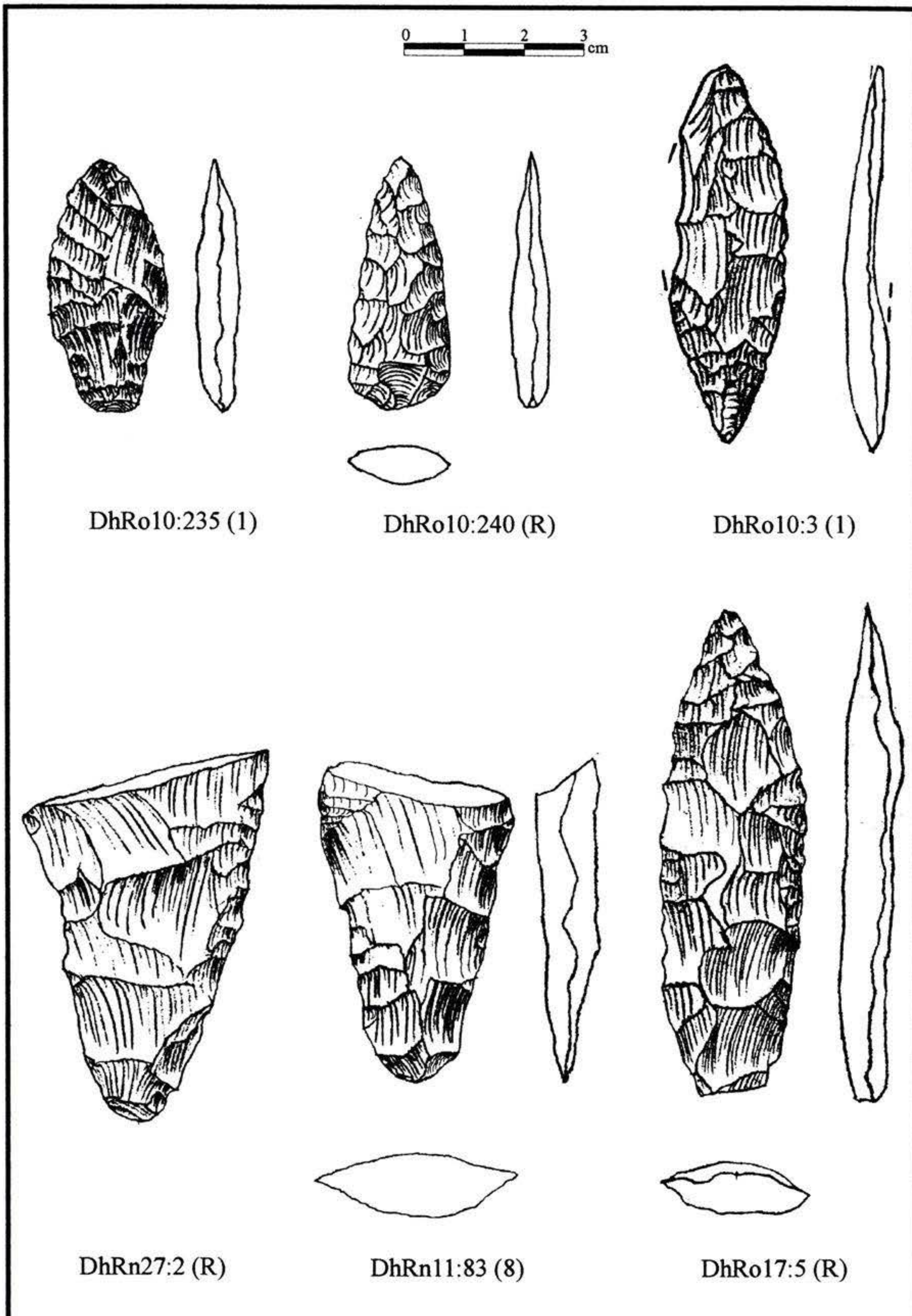


Figure 27. Illustrations of Artifacts Used in Seriation Analysis.

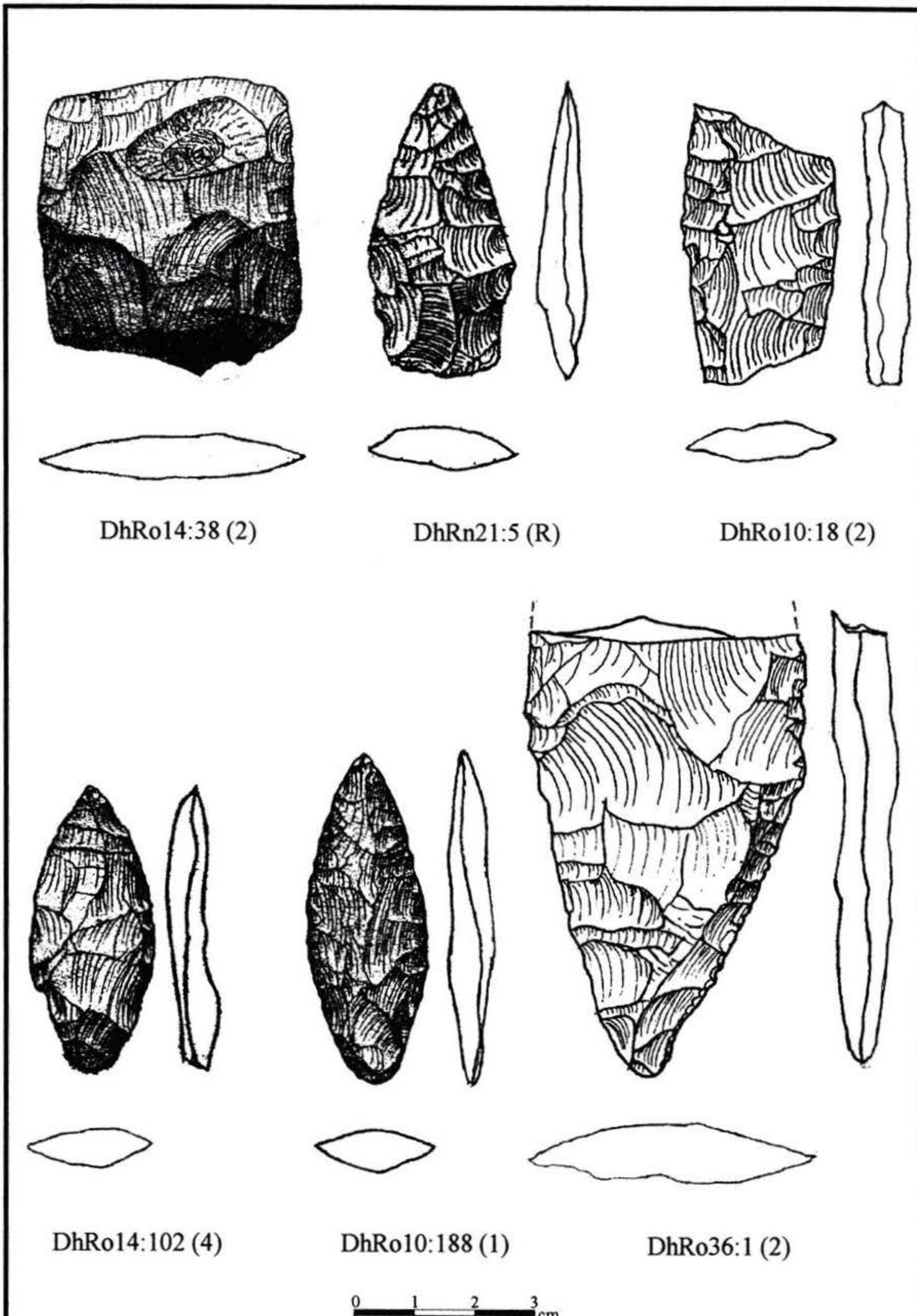


Figure 28. Illustrations of Artifacts Used in Seriation Analysis.

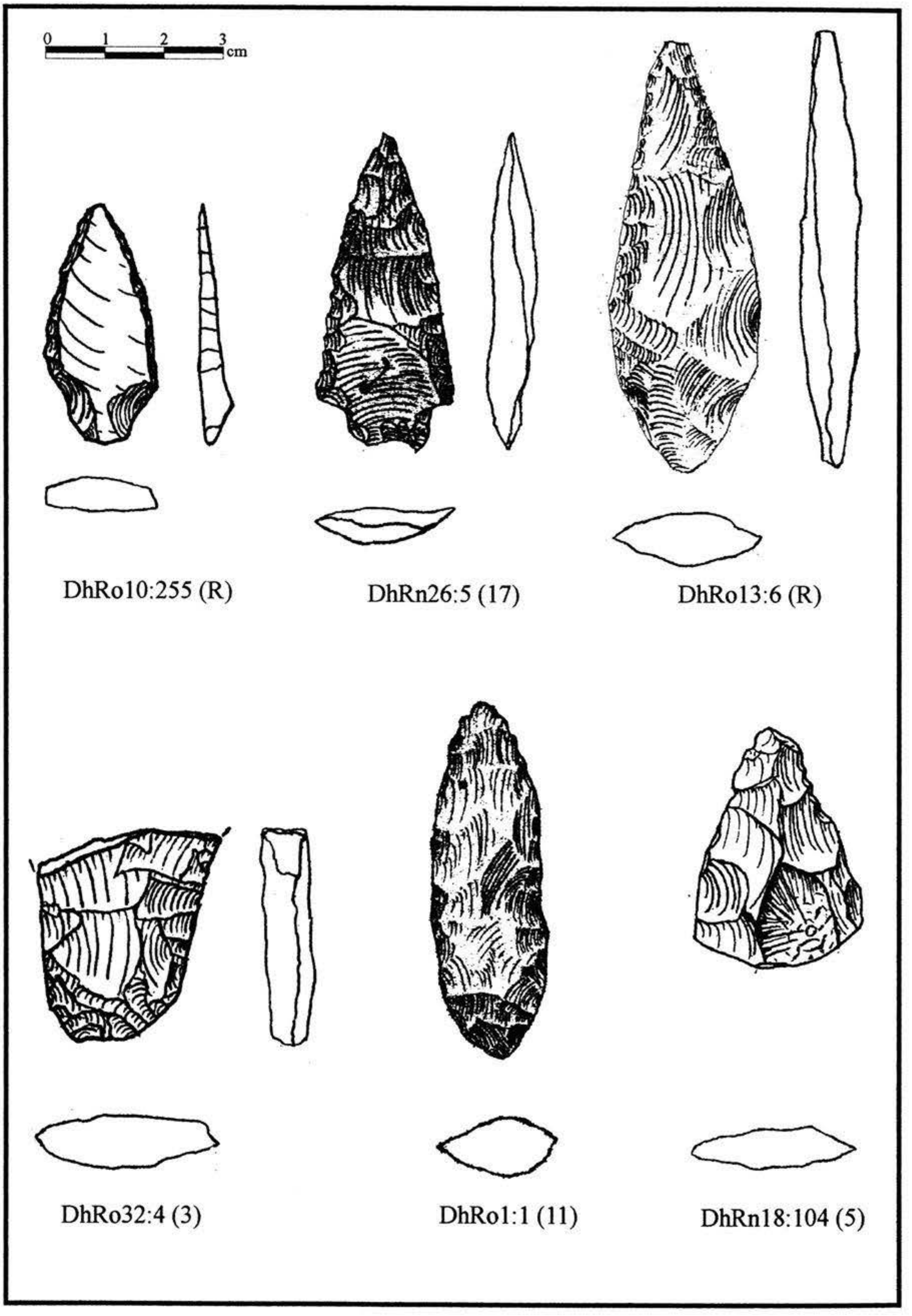


Figure 29. Illustrations of Artifacts Used in Seriation Analysis.

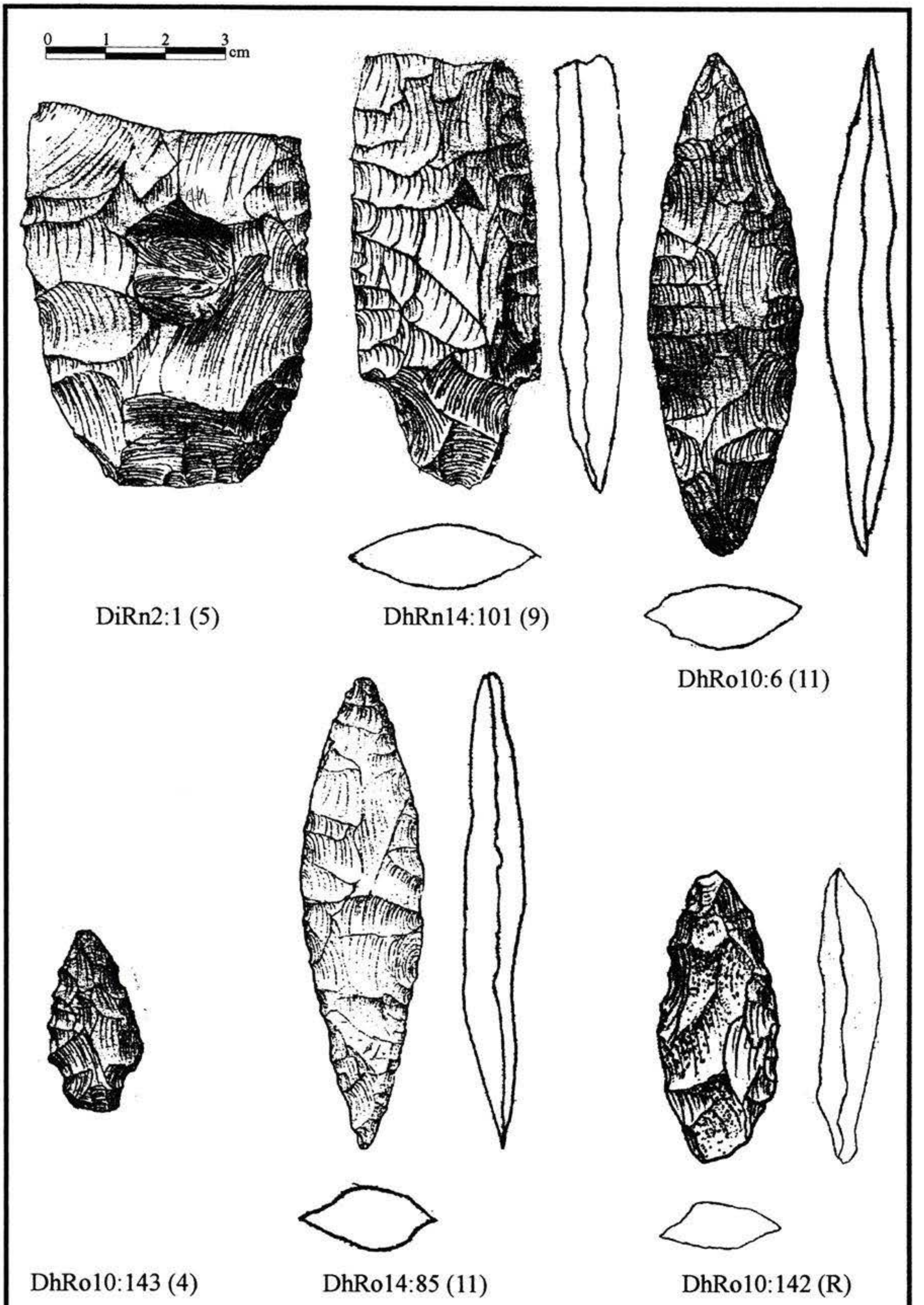


Figure 30. Illustrations of Artifacts Used in Seriation Analysis.

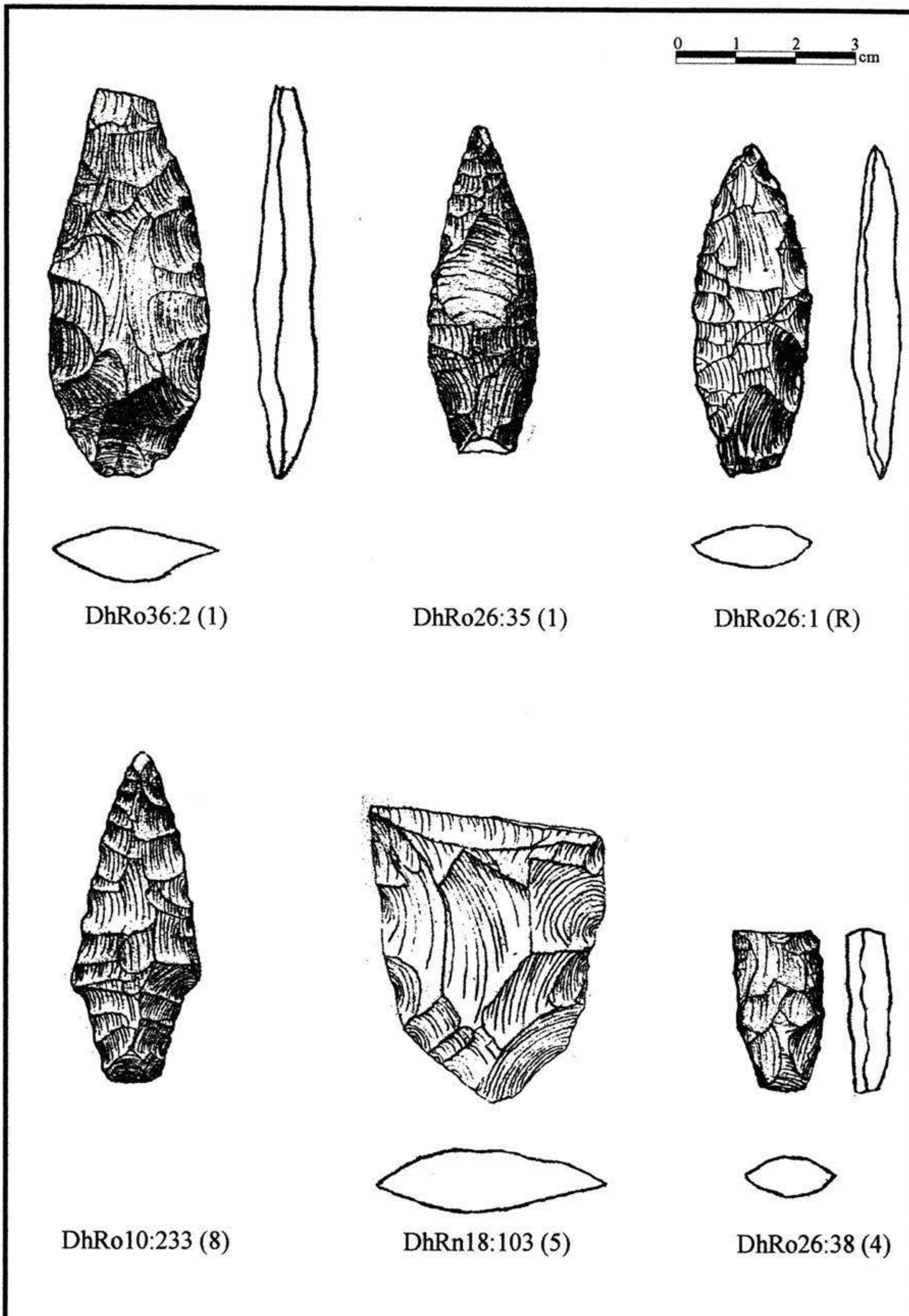


Figure 31. Illustrations of Artifacts Used in Seriation Analysis.

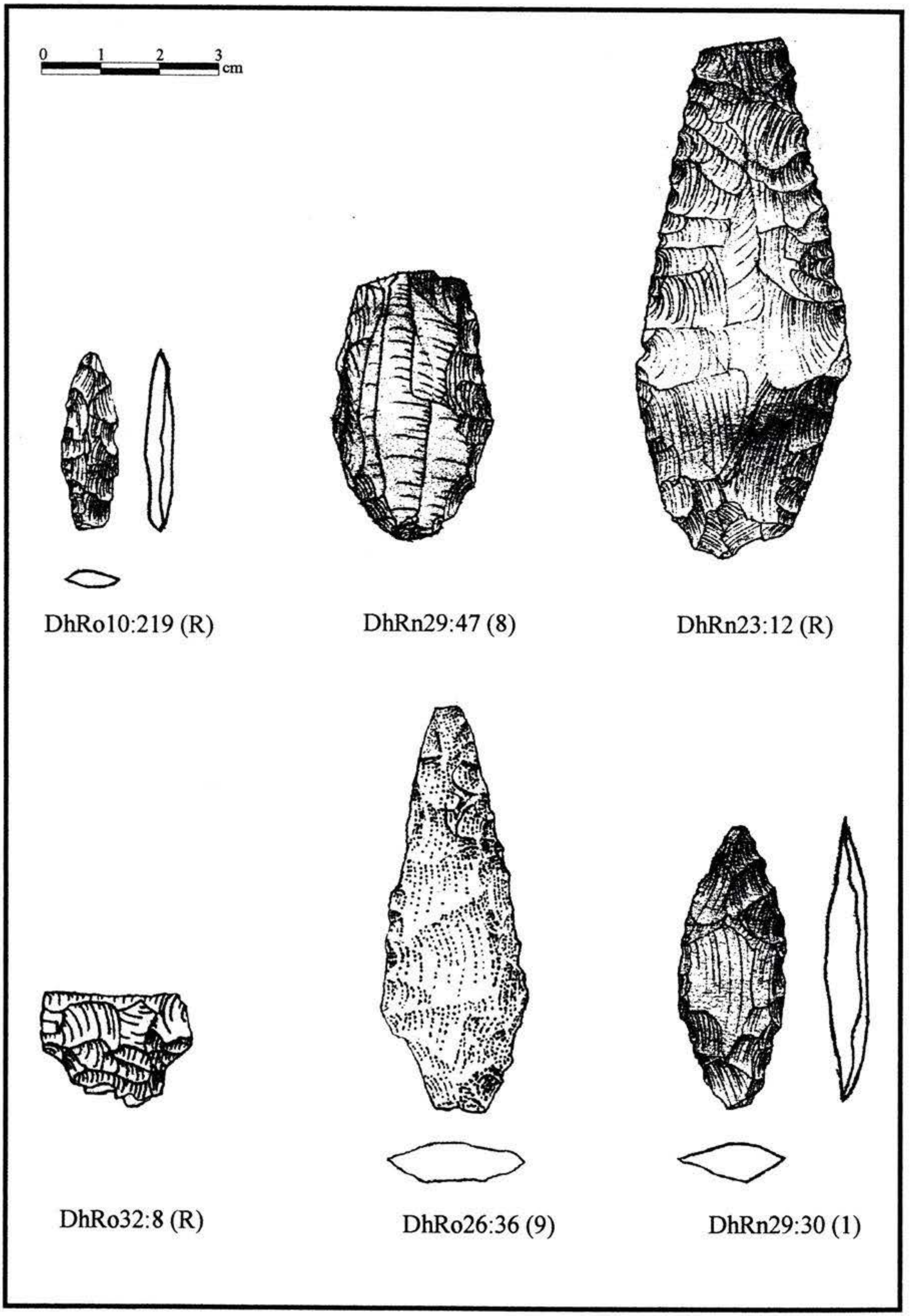
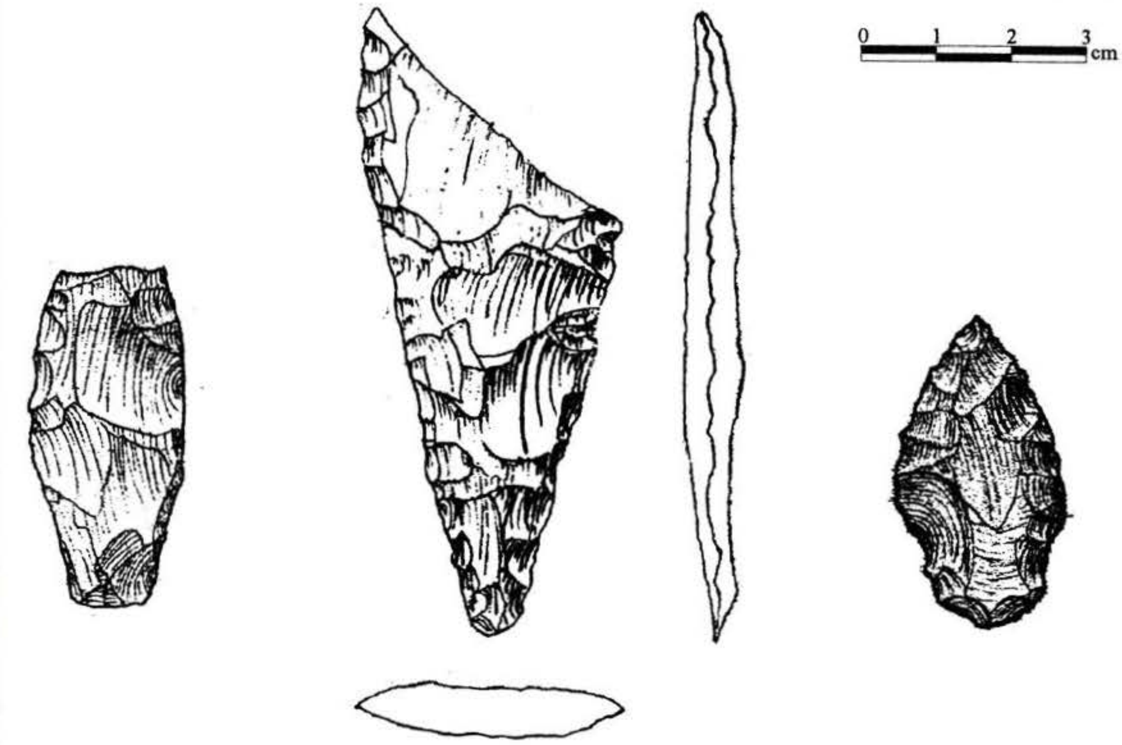
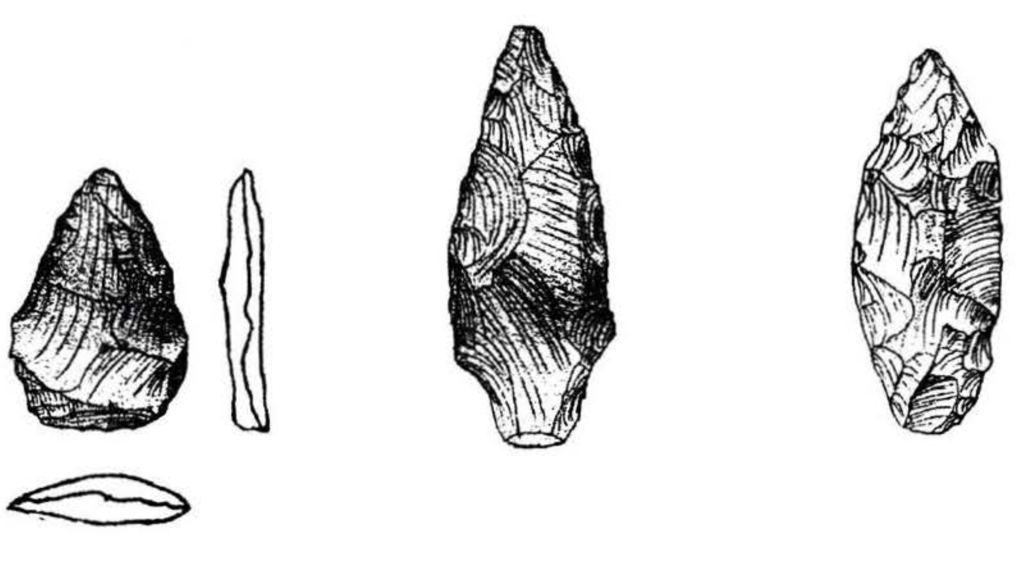


Figure 32. Illustrations of Artifacts Used in Seriation Analysis.



DhRn18:47 (9) DhRn18:107 (R) DhRn24:12 (8)



DhRo32:11 (4) DhRo10:201 (9) DhRo10:140 (1)

Figure 33. Illustrations of Artifacts Used in Seriation Analysis.

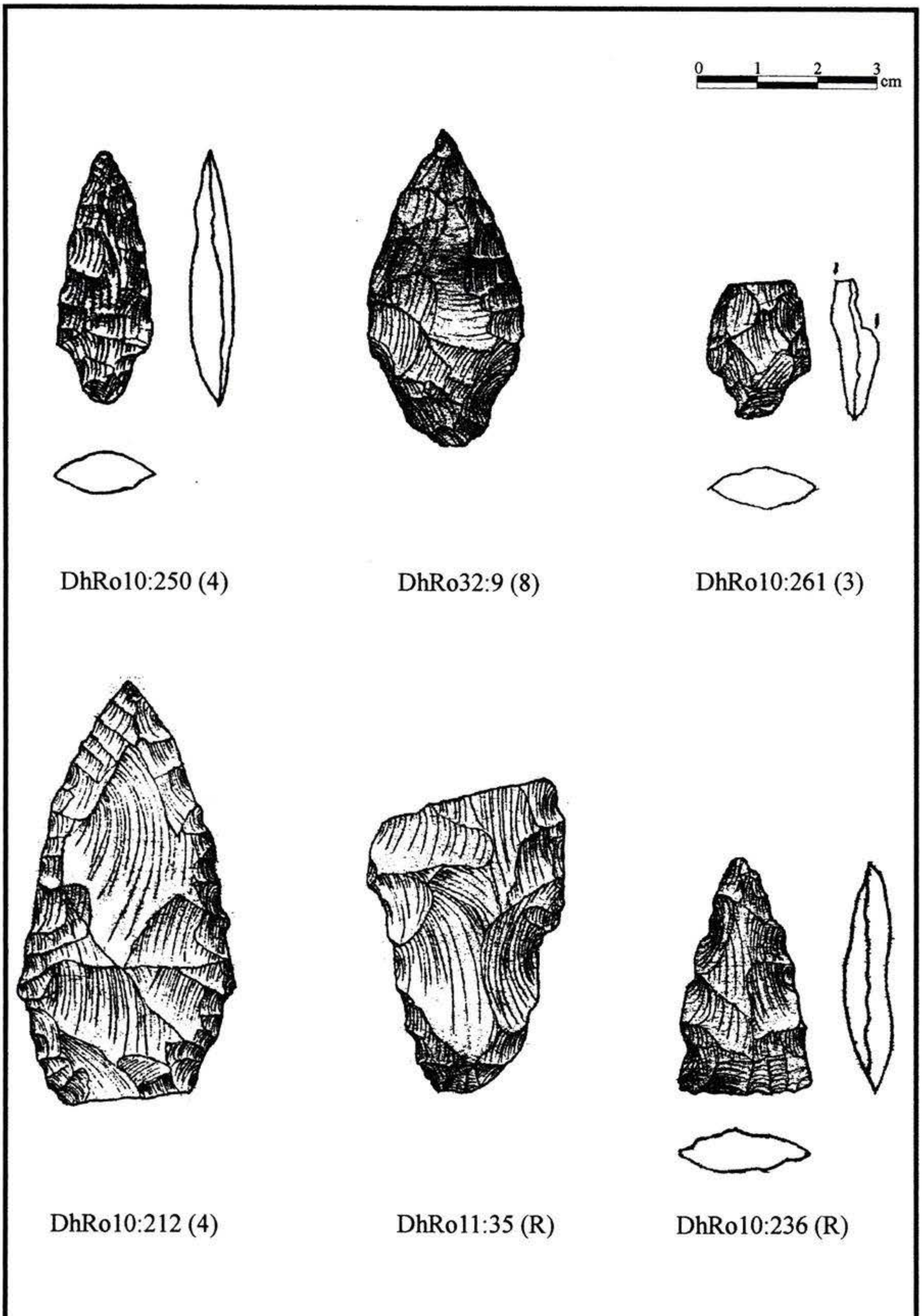


Figure 34. Illustrations of Artifacts Used in Seriation Analysis.

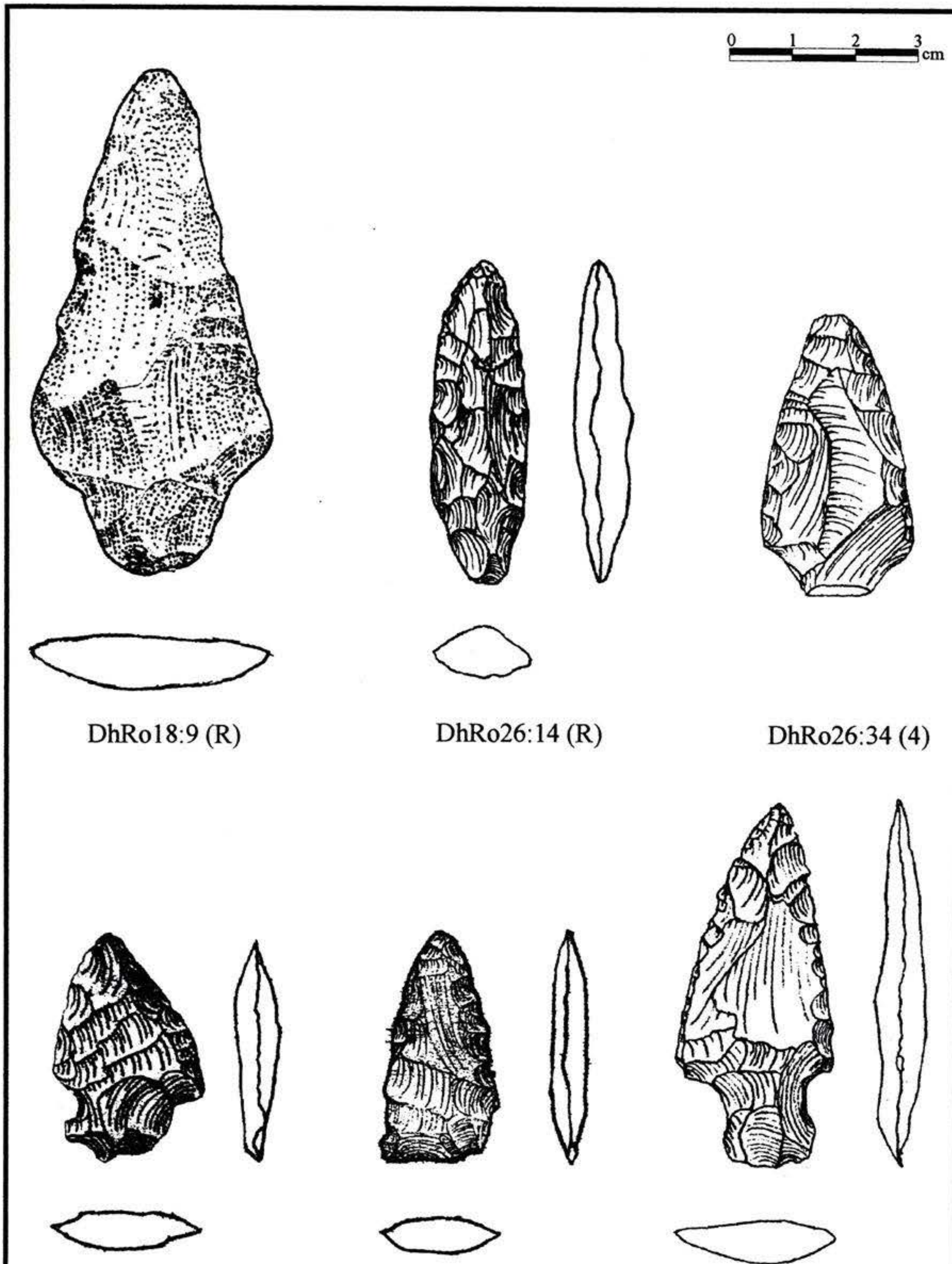
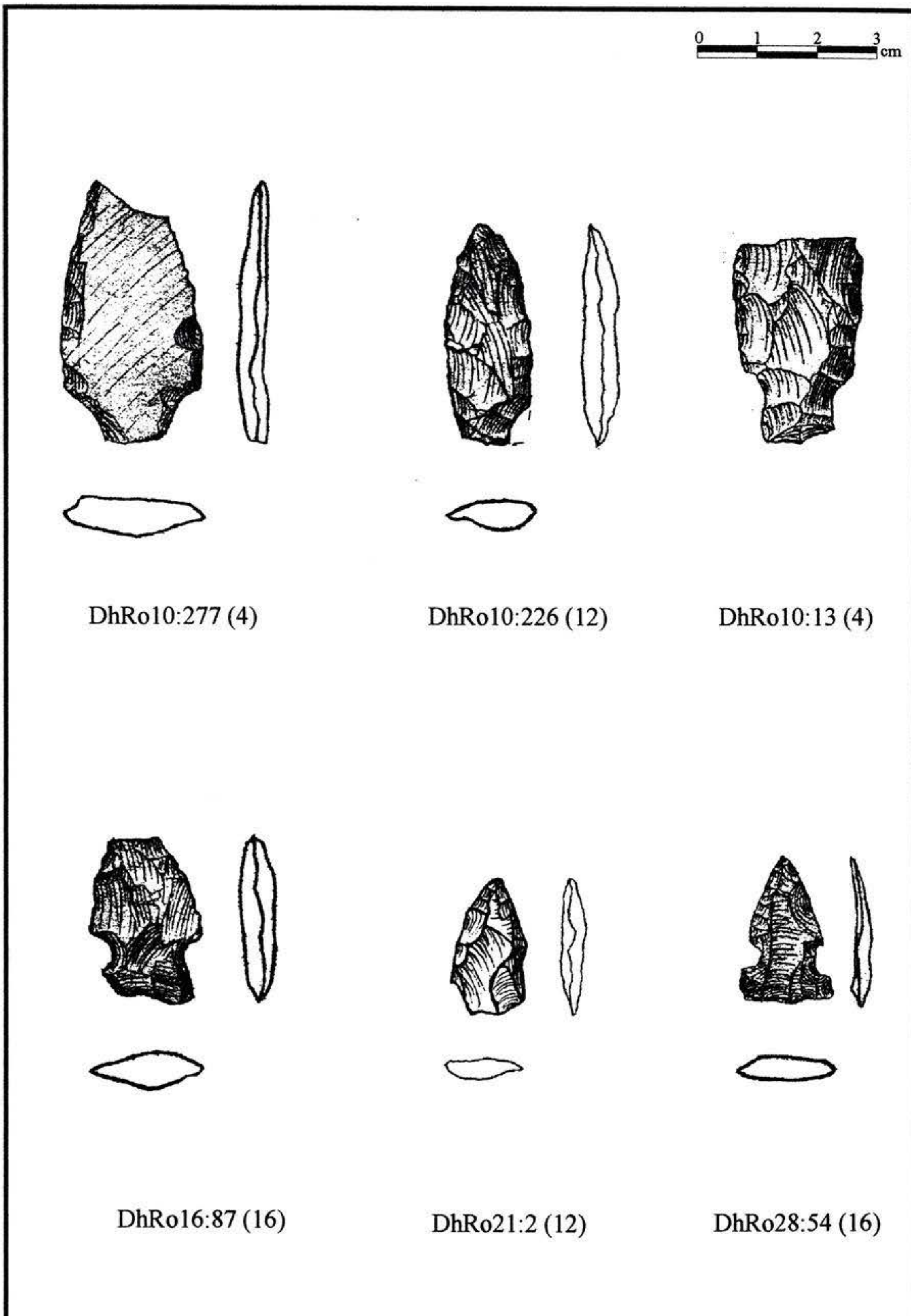


Figure 35. Illustrations of Artifacts Used in Seriation Analysis.



Verifying the Temporality of the Seriation Results

It remains uncertain from the seriation analysis exactly how well the sequence produced reflects temporal change and what type of temporal relationships can be distinguished from the sequence. To check the temporality of the sequence, materials from three well-established components at the Glenrose Cannery Site were added to the analysis. These materials are a selection of formed bifaces, mostly fragments, from the Old Cordilleran, St. Mungo, and Marpole components. These components have been excavated from subsurface and dated contexts (Matson 1976, 1996). The results of the seriation analysis with formed bifaces from the Glenrose Cannery Site is depicted in Figure 36.

It is clear from this diagram that the general flow of the seriation follows the same trajectory as the sequence of components at Glenrose. However, there is considerable overlap between the St. Mungo and Marpole material. The reason for this may be a result of the inclusion of variables lacking temporal resolution. There may also be considerable overlap in traditions between these two periods making distinguishment difficult and suggesting that late period biface manufacturing traditions were long lived.

Of particular interest are several objects from the Stave material that occur before artifacts from the Old Cordilleran component at Glenrose. Some of the materials that occur in this part of the sequence have stylistic similarities to formed bifaces of the Plano tradition on the Western Plains (Frison 1983; Kooyman 2000) and the Western Stemmed Tradition on the Plateau and Great Basin (Bryan 1980; Willig and Aiken 1988). There are also objects from the Stave materials that occur after the last Marpole materials which would likely fall into the Strait of Georgia culture type when the shift from atlatl to bow arrow technology became pronounced (Charlton 1980).

The Relative Chronology of Attributes

To evaluate the temporality and variability of different attributes, Figure 17 was produced maintaining the relative order of artifacts and variables, but listing the variables in alphabetical rather than temporal order. By doing this it becomes clear that the attributes analyzed show different patterns through time. The following describes the temporality of variables

- The Number of Flake Scars Divided by Length (Scar#/Length) attribute demonstrates a marked degree of temporal continuity. With the exception of the 0.25-0.499 Scar#/Length variable, all of the variables for this attribute occur across the sequence. The 0.25-0.499 variable does not occur in the earlier apart of the sequence.
- The presence of Basal-Lateral Grinding is limited to the early through middle part of the sequence.
- The Basal Margin attribute is characterized by the early presence of Concave, Straight, and Platform Straight forms. By the middle part of the sequence all variables are present. The Slanting Base form is the last to appear. All variables with the exception of the Concave Base form endure until the latter part of the sequence.
- Two Blade Form variables show consistency through time with both Straight and Excurvate blades spanning the entire sequence.

- The presence of Denticulate Blades seems to limited to the earliest parts of the sequence with the exception of one occurrence in the middle part of the sequence.
- Endthinning, and the lack of end thinning demonstrate continuity through time with both variables being found throughout the sequence.
- The typical shape of Flake Scar Outlines displays marked temporal variability. Occurrences of Parallel/Lamellar, Parallel/Expanding, and Lamellar outline variables cluster in the earlier part of the sequence. The Expanding and Parallel variables occur in the early and middle periods. The Variable form of flake scar outline is limited to the middle and later part of the sequence. The Variable form is the only type found in the later periods.
- Flake Scars to Center of the artifact do not occur in later periods.
- The basic form of the tools analyzed shows a marked degree of variability through time. Lanceolate shaped tools are common in the early part of the sequence and occur in the middle of the sequence but are not found in later times. Stemmed forms do not occur as early as the lanceolate types but do have early manifestations. The Stemmed form continues well into the later parts of the sequence. Foliate forms are somewhat restricted to the mid part of the sequence, although they do persist into later periods. The Triangular and Pentagonal forms appear after the Foliate form and are repeated in later time periods. The Notched forms are concentrated in the latter part of the sequence.

- The Length of Complete Biface Tools shows some variability with the smallest category 0-29.9mm being restricted to the latest time periods.
- The Removals attribute shows distinct differences through time. Those artifacts with basal indentation were found to be restricted to the earlier part of the sequence. All notched forms occur after the midpoint of the sequence.
- There is continuity in the Order of Flake Scar Removal. With the exception of the alternative pattern of flake scar removal, all variables occur across the temporal sequence. The alternative form does not occur in the later part of the sequence. The alternating form is by far the most frequent variable.
- There is considerable variability in Flake Scar Orientation attribute. Both Co-lateral/Oblique and Co-lateral forms occur early but not late in the sequence. Sub-radial and Random forms of this attribute occur in the middle period and continue through to later times.
- The Shoulder form seems to show little temporal variation. There is a consistent persistence of all forms with the exception of the Wide Angled and Rounded form that is represented by a small sample and is restricted to the later part of the sequence.
- The Stem Form attribute shows moderate variability through time. The Straight and Contracting Stem form occur earliest in the sequence. The Straight Stem form does not continue into the later part of the sequence.

- The Basal Width attribute shows consistency though time with most variables occurring throughout the sequence. The three occurrences of the largest basal width category (25mm +) are found in the earliest part of the sequence only.
- The Cross-Section Form Attribute has elements of continuity and variability. The Lenticular form cross-section occurs throughout the sequence and is the most common occurring form. The Fluted/Convex and Plano/Diamond Cross-Section forms are restricted to early time periods. The Twisted Cross-Section is found in middle period only. The Flattened, Flattened/Convex, and Plano/Convex forms occur in the later part of the sequence.

This analysis provides a means of identifying common variables associated with different parts of the temporal continuum. It also allows for the identification of variables that form a common thread of tradition throughout the entire sequence.

Improving Linearity

An attempt was made to improve the correlation coefficient of the seriation by selectively removing attributes that demonstrated little temporal variation. The following variables were removed and the seriation was rerun including the material from Glenrose Cannery: Scar#/Length, Blade Form, End Thinning, Order of Flake Scar Removal, and Basal Width.

A greater correlation (0.7234) was achieved by removing these attributes. However, there is little difference in the temporal resolution between this seriation and the previous as indicated by the ranges of materials from Glenrose Cannery (Figure 39).

This suggests that tradition and repetition of attributes was strongly correlated with artifact types in later periods making temporal resolution difficult.

A Diagram of Relative Site Chronology

As the bifacial points analyzed originate from a number of different archaeological sites, it is also possible to infer a relative temporality of archaeological site locations from the sequence of artifacts collected from those sites. Where two or more artifacts have been analyzed from the same site location, it is possible to associate a relative temporal span with a given site location. To create a relative chronology of sites in the Stave Watershed, the ordering of formed bifaces (on the X-Axis of Figure 16) was separated by site and then the ordering was plotted to demonstrate the relative chronology of the archaeological sites (Figure 37).

Figure 36. Seriation Results with Formed Bifaces from the Glenrose Cannery Site (For Enlargement see Appendix B).

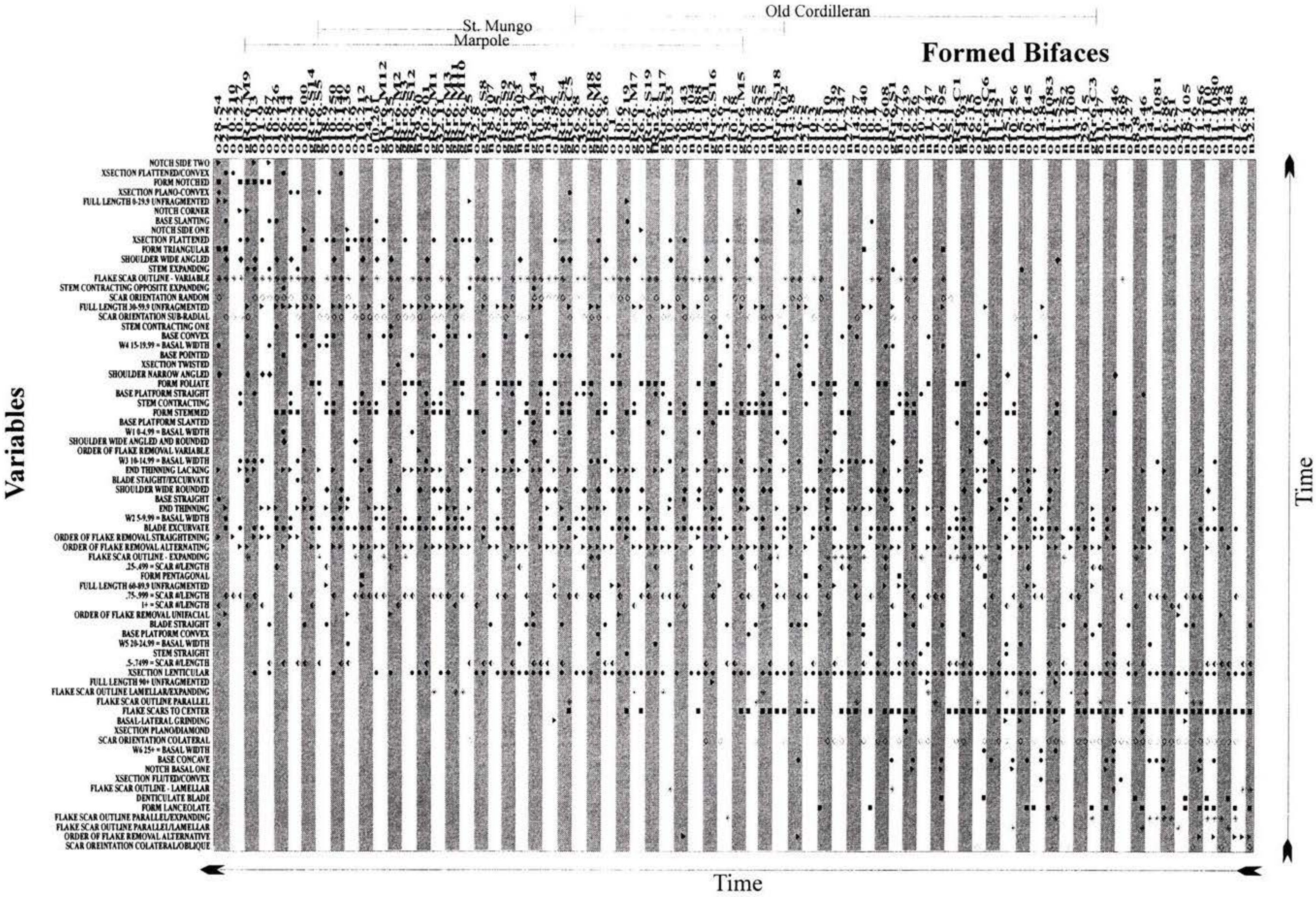


Figure 37. Relative Ages of Site Locations in the Stave Reservoir Area.

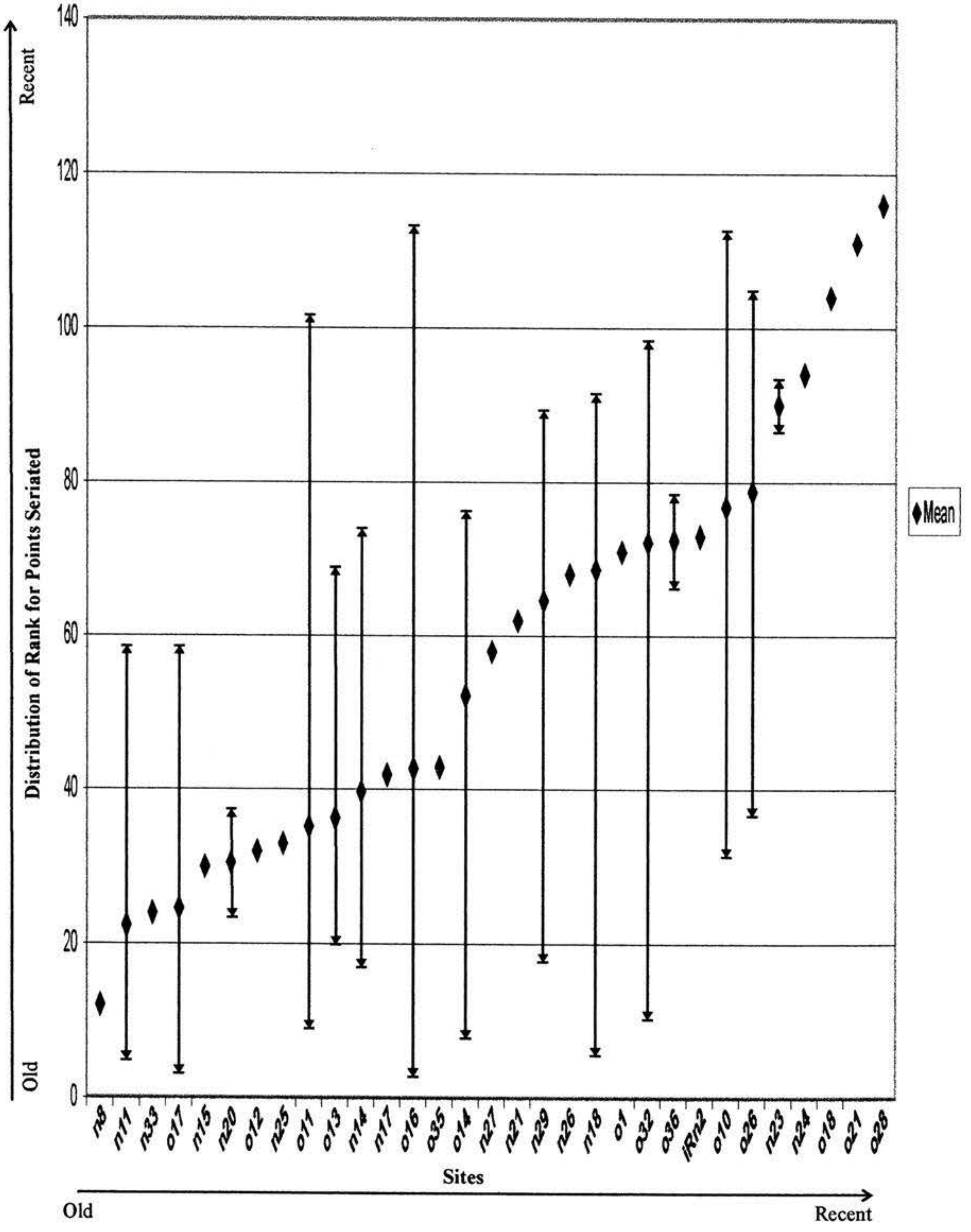


Figure 38. Temporality of Formed Biface Attributes (See Appendix C for Enlargement).

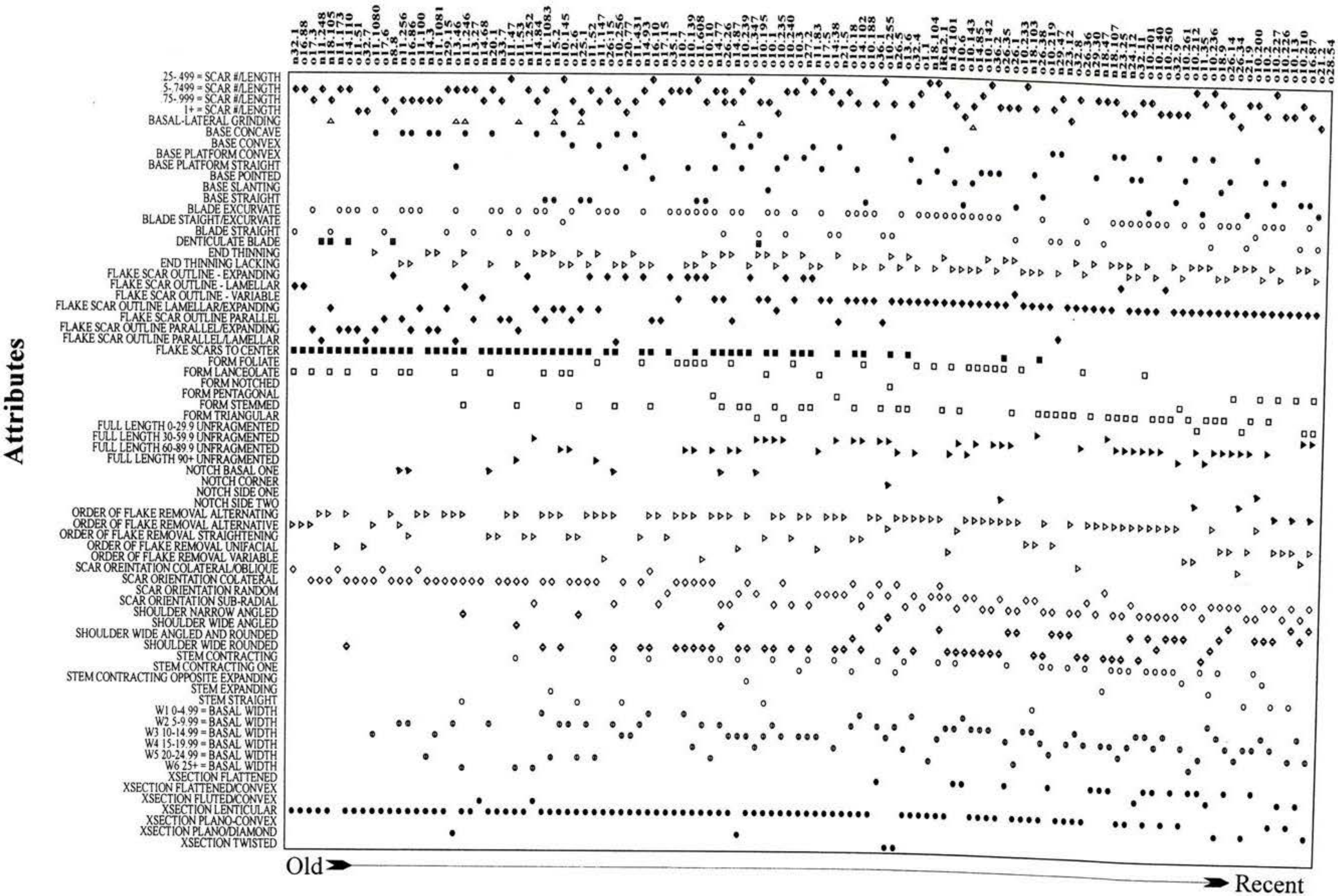
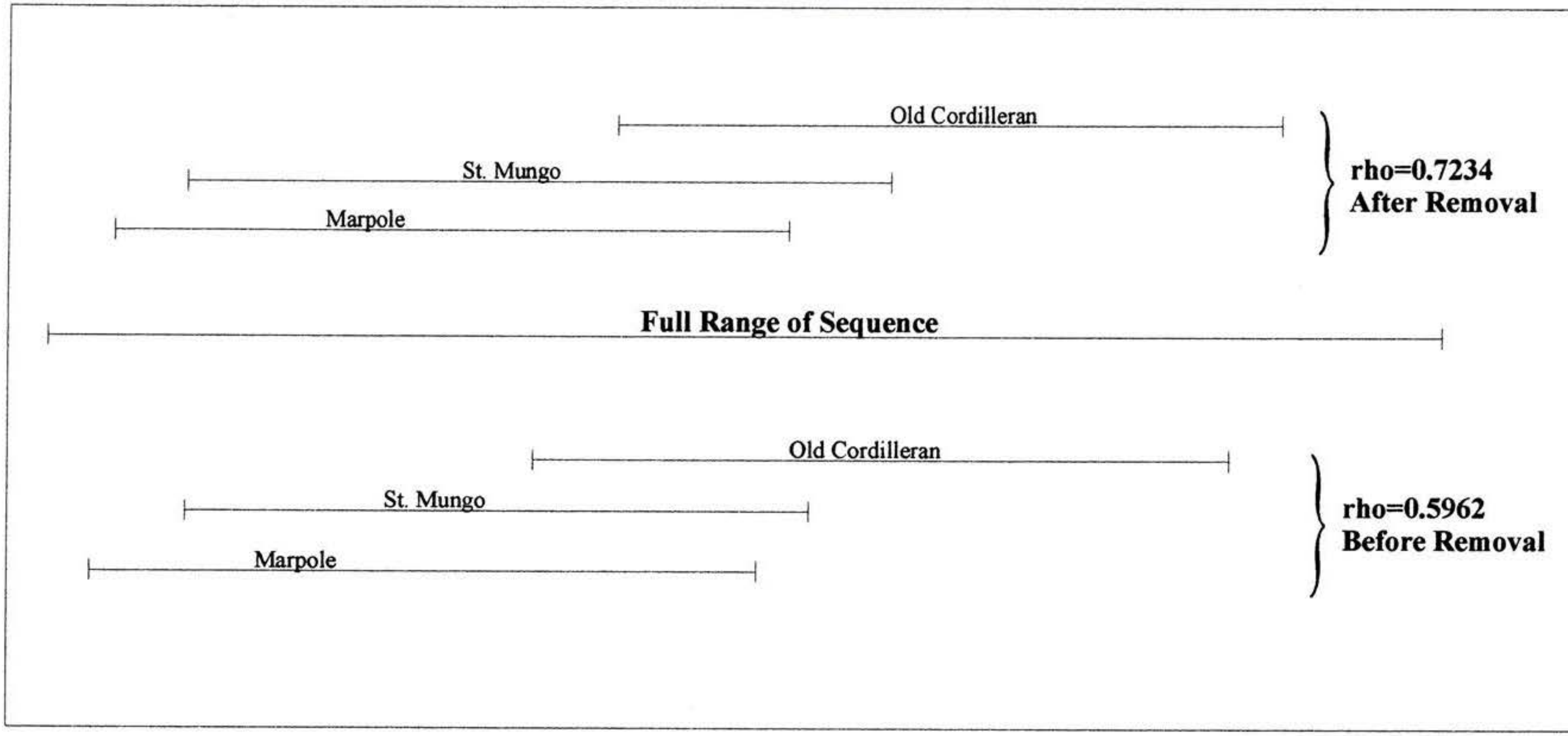


Figure 39. Temporal Resolution After the Selective Removal of Attributes.



Formed Biface Types and Relative Temporality

The formed biface attributes analyzed in the seriation were also submitted to a cluster analysis. The cluster analysis was undertaken with the aid of the statistical software program WINbasp (1998). The Jaccard Coefficient was used to measure similarity and differences between the attributes of each object: "the Jaccard coefficient divides the number of attributes common to two entities by the sum of this number and the number of mismatches. It accounts for the variation in the number of attributes per entity" (WINbasp 1998). The clustering software then employs the Jarvis (1977) shared nearest neighbour algorithm to relate units spatially. This algorithm accounts for local connectivity and global structure. The results are expressed as a spanning tree diagram showing spatial relationships when different numbers of near neighbours are considered.

A total of 20 types were distinguished by the clustering analysis. Thirty-three formed bifaces were left as residuals, not associating closely with any of the clusters (Figure 40). The relative temporality of these clusters is presented in (Figure 41). Cluster numbers have been included in brackets alongside the illustrations presented in Figure 18 through Figure 35. Details regarding the attributes of each type are presented in Appendix E. The following provides a summary of the attributes of the twenty clusters and are listed in relative temporal order from earliest type to latest.

Some clusters are predominated by fragments and are grouped more so on flake scar morphology than general shape and size. Where possible, formed biface types as defined through this clustering exercise are cross-referenced to similar types from dated contexts or attributed to particular archaeological temporal divisions.

Alternating Lamellar Point Fragments (Cluster 14)

Two projectile point fragments were classed into Cluster 14. This class is characterized by lamellar flake scar outlines in form and an alternative form of flake scar removal. Both fragments have a moderate amount of bifacial working, are lenticular in cross-section, and have finishing flake scar that extend to the medial axis of the fragment.

Co-laterally Flaked Biface Fragments (Cluster 6)

Four formed biface fragments are included in Cluster 6. All of these fragments are characterized by finishing flake scars removed to the medial axis of the object, lenticular cross-section, and collateral flaking. Two of the four midsections were classed as having denticulate lateral margins. These objects are fragments similar to aspects of complete formed bifaces described in Cluster 13.

Co-laterally Flaked, Lanceolate Shaped Point Fragments (Cluster 19)

Two formed bifaces are included in Cluster 19. These artifacts have co-lateral flake scar orientations, excurvate blades, flake scars to the center of the artifact, alternating order of flake scar removal, and lanceolate form. The objects are fragments very similar to objects described in Cluster 13.

Co-laterally Flaked, Lanceolate Shaped Points and Fragments with Basal Indentations (Cluster 13)

Ten formed bifaces were grouped into Cluster 13. These objects are characterized by being primarily co-laterally flaked, with small basal indentations, flake scar to the medial axis, and lenticular cross-sections. Flake scar outlines tend to be parallel or parallel/expanding in shape. Types similar to these artifacts are known from the Protowestern Tradition including the Inter-Montane Stemmed Point Tradition (Bryan

1980; Carlson 1983b) that dates 11,000-9,000 radiocarbon years B.P. (Willig and Aikens 1988).

Straight Blade Point Fragments (Cluster 7)

Six formed biface fragments are included in Cluster 7. Characteristic of this type include fragments with parallel lateral blade margins, and tend to have finishing flake scar to the medial axis, and a collateral flake scar orientation.

Point Bases with Straight Sided Stems (Cluster 15)

Three biface stem fragments are include in Cluster 15. These fragments are characterized as having basal-lateral grinding, end thinning, collateral flaking, and straight basal lateral margins. Types similar to these are associated with the Inter-Montane Stemmed Point Tradition (11,000-7,000 Radiocarbon years B.P.) (Bryan 1980, Carlson 1983b) and also the Cody (9,200-8,800 radiocarbon years BP) and Alberta (9,500-9,000radiocarbon years B.P.) complexes on the plains (Frison 1983; Kooyman 2000).

Point Fragments with Expanding Flake Scar Outlines and Co-lateral Flake Scar Orientations (Cluster 18)

The three formed biface fragments in Cluster 18 are relatively different in general form from one another. They are clustered as they share expanding flake scar outlines, lack basal end thinning, have co-lateral flake scar orientation, and flake scars to the medial axis of the artifact. At least two of these objects are similar to those associated with Cascade tradition (Bryan 1980) and have affinities with the foliate bifaces from the Old Cordilleran Component at Glenrose Cannery (8,150-5,500 radiocarbon years B.P.)(Matson 1976) and the Milliken Phase at Milliken (9,000-6,500 radiocarbon years B.P.)(Carlson 1983b; Mitchell and Pokotylo 1996).

Point Fragments with Alternating Order of Flake Scar Removal and Lanticular Cross-Section (Cluster 2)

The six formed biface fragments in this cluster seem to lack explicit diagnostic criteria. They all share an alternating order of flake scar removal and lenticular cross-sections. These are the first objects in the sequence that lack flake scars to the medial axis of the biface. Several are large foliate bifaces and are similar to materials from the Old Cordilleran components at Glenrose (Matson 1976; Matson 1996) and Milliken (Mitchell and Pokotylo 1996).

Large Basal Portions of Stemmed Points with Low Bifacial Working (Cluster 20)

Two formed biface stems were grouped into Cluster 20. These stems are characterized by flake scars to the medial axis, a low degree of bifacial working, a lack of end-thinning, and wide rounded shoulders.

Co-laterally Flaked Points with Wide Rounded Shoulders and Asymmetrical Shoulders (Cluster 10)

Two formed bifaces are included in Cluster 10. These bifaces are characterized by a lack of end thinning, co-laterally oriented flake scars, asymmetrical wide rounded shoulders, and flat platform basal margins.

Points with Straight Blades and Convex Bases (Cluster 17)

Two formed bifaces are included in Cluster 17. These objects are characterized by their convex basal margins, straight blades, end thinning, random orientation of flake scar removal, variable flake scar outline, and moderate amount of bifacial working. One of the objects has many similarities with formed bifaces from the Early Nesikep Tradition (7,000-4,500 B.P.) (Stryd and Rouseau 1996).

Bipointed thick foliate points (Cluster 11)

Three formed bifaces are included in Cluster 11. These three bifaces are foliate shaped with pointed bases, excurvate blades, random orientation of flake scar removal, and variable flake scar outlines. Similar types are associated with the Milliken Phase in Fraser Canyon (9,000-6,500 radiocarbon years B.P.)(Carlson 1983b; Mitchell and Pokotylo 1996) but are also common in later time periods.

Contracting Stem Point Bases with Subradially Oriented Flake Scars (Cluster 3)

Three formed biface stems are included in Cluster 3. These fragments are characterized by a sub-radial order of flake scar removal, contracting stem, end thinning, and a variable flake scar outlines. The objects in this cluster are relatively different in size and relative form and end thinning is moderately or ephemerally present. Otherwise these objects are similar to those in Cluster 9 and Cluster 4.

Stemmed Points Lacking End-Thinning (Cluster 4)

There are eleven stemmed points in Cluster 4. These points are characterized by a contracting stems, pointed basal margins, excurvate blade margins, a lack of end-thinning and variable outlines of flake scar removal. Similar types are associated with Charles (5,500-3,500 B.P.), Locarno Beach (3,500-2,500 B.P), and Marpole (2,500-1,500 B.P) culture types (Boehm 1973, Mitchell 1990, Burley 1980, Charlton 1980).

Large Bifacial Fragments with Variable Flake Scar Outlines and Low Bifacial Working (Cluster)

Three bifaces are included in Cluster 5. All three are large biface fragments with variable outline of flake scars and a low degree of bifacial working. Considering the size of these objects, they may be biface preform fragments with straightened lateral margins and as such were classified as formed bifaces.

Foliate Bifaces with Sub-radial Flake Scar Orientations (Cluster 1)

Six formed bifaces are included in Cluster 1. The foliate bifaces are characterized by sub-radial flake scar orientations, excurvate blade margins, and variable flake scar outlines. These foliate bifaces are distinguished from other foliate types based on flake scar orientations and outlines. Similar types are associated with Charles (5,500-3,500 B.P.), Locarno Beach (3,500-2,500 B.P), and Marpole (2,500-1,500 B.P) culture types (Boehm 1973, Burley 1980, Charlton 1980) but may also occur in earlier time periods (e.g. Carlson 1983a).

Contracting Stem Points with Sub-radial Flake Scar Orientation and Moderate Width of Basal Margin (Cluster 8)

Five formed biface are included in Cluster 8. These contracting stem bifaces are characterized by moderately wide basal margins and sub-radial flake scar orientations. Three of the five contracting stem points have flattened cross-sections.

Stemmed Points with Variable Outlines of Flake Scar Removal and Moderate Bifacial Working (Cluster 9)

Five formed bifaces and fragments are included in Cluster 9. These large stemmed bifaces are characterized by variable outline of flake scar removal, moderate bifacial working, and moderate basal width.

Straight Bladed Points with Wide Bases (Cluster 16)

Three formed bifaces are included in Cluster 16. These formed bifaces are characterized by wide basal margins, straight blade margins, variable flake scar outlines, and sub-radial flake scar orientation. Similar triangular and side notched forms are found from Marpole (2,500-1,500 radiocarbon years B.P.) and Gulf of Georgia (1,500-200 radiocarbon years B.P.) culture type components (Mitchell 1990; Burley 1980; Charlton 1980).

Small Wide Angle Shouldered Points with Slanted Basal Margins (Cluster 12)

Two small formed bifaces are included in Cluster 12. These bifaces are characterized by excurvate blade margins, wide angled shoulders variable outline of flake scar removal, and slanted basal margins.

Figure 40. Results of Cluster Analysis of Formed Bifaces.

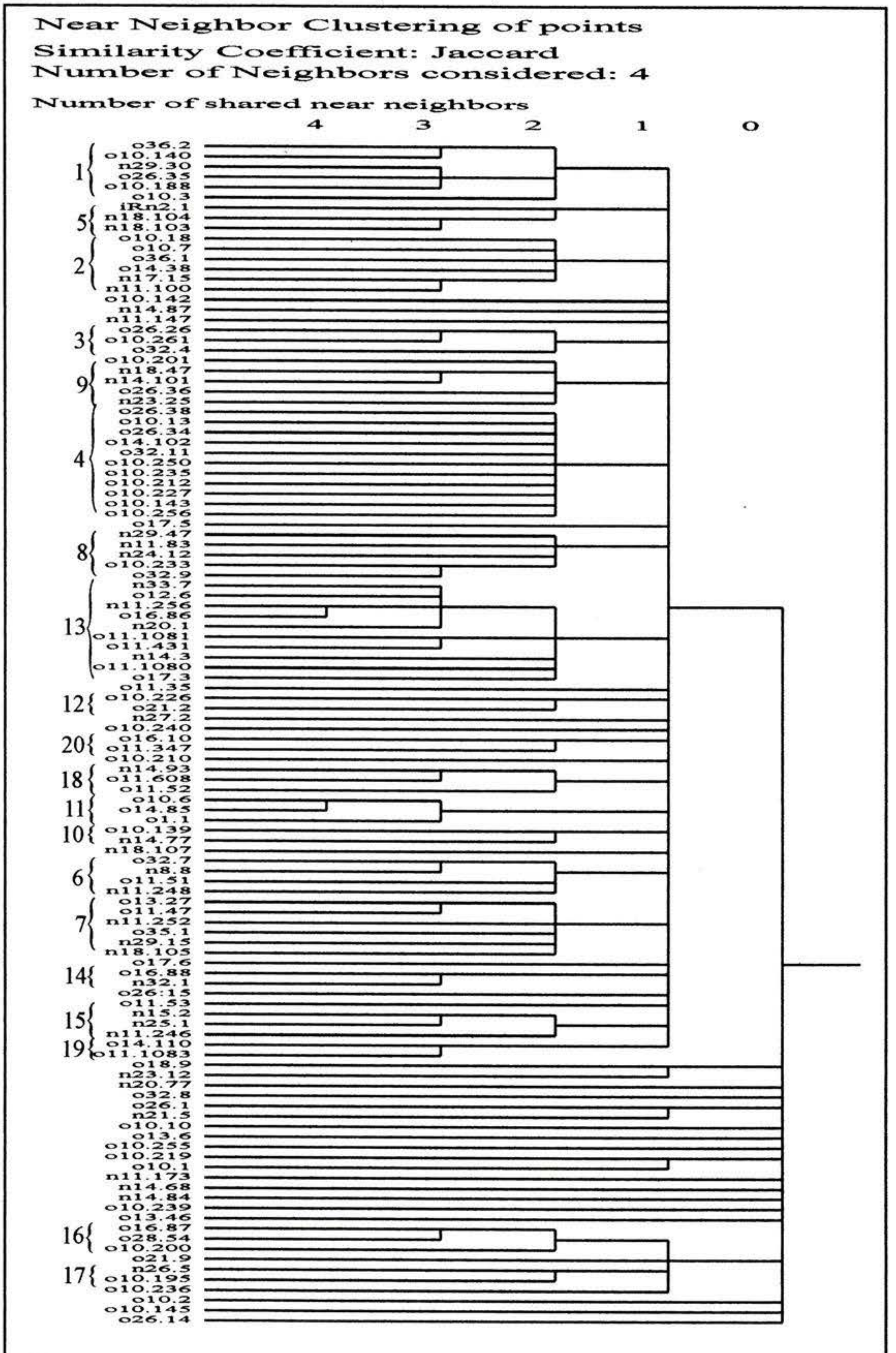
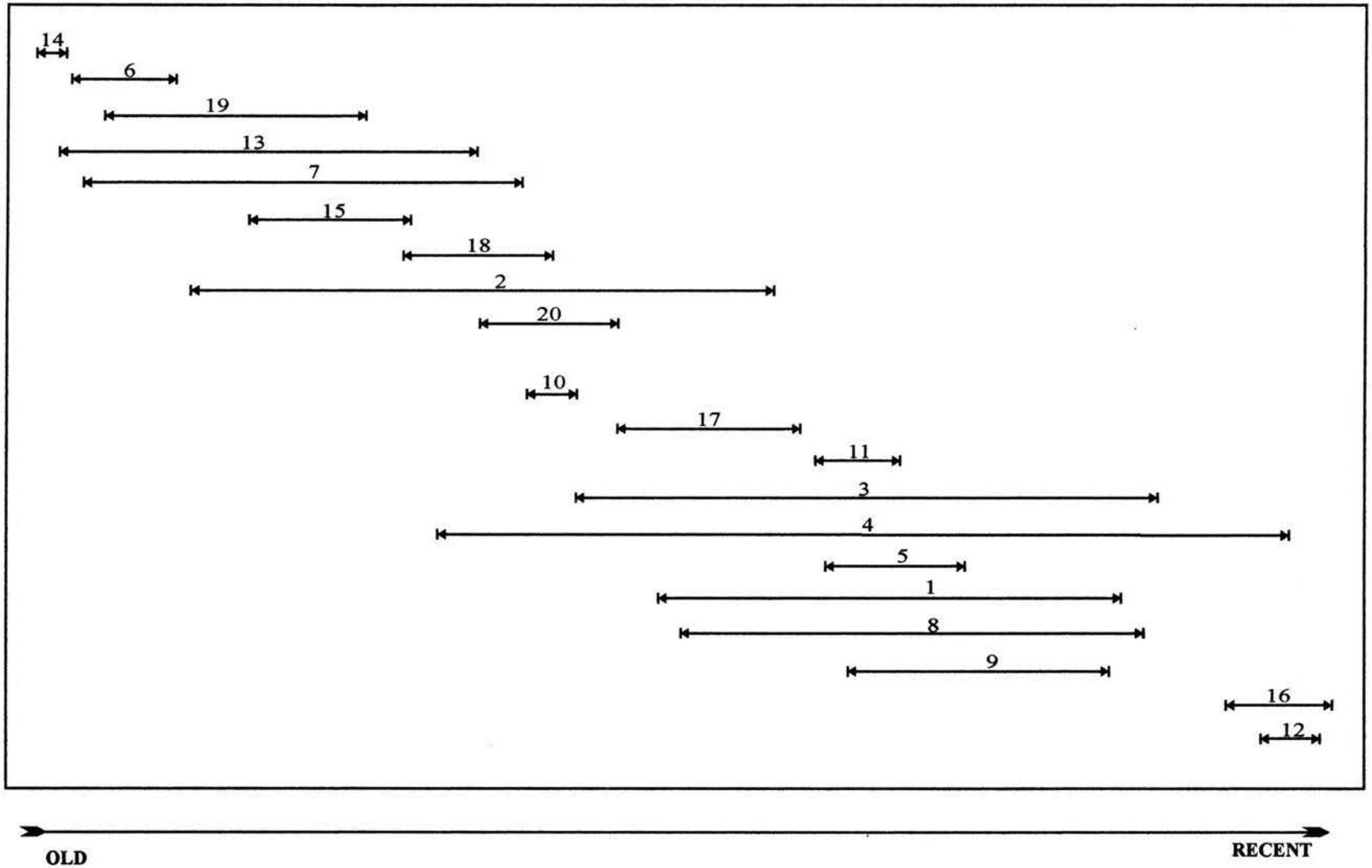


Figure 41. Relative Temporality of Formed Biface Types (Clusters).



Conclusion

The sequence of formed biface attributes demonstrates a thread of long-term interrelatedness. The first objects found in the sequence are unique in the quality of manufacture, with great care and craftsmanship used to produce the co-lateral flake scar orientation and lamellar, parallel, or expanding flake scar patterns. With subtlety and temporal overlap, this level of craftsmanship changes in the middle part of the sequence and flake scar outlines and orientation change with a greater reliance on variable flake scar outlines, and sub-radial and random orientations. At the end of the sequence there is subtle and overlapping change in biface form. Notched and triangular forms replace the stemmed and foliate forms characteristic of the middle part of the sequence. In the cluster analysis many of the formed bifaces found in this part of the sequence were left as residuals. It is possible that the introduction of bow and arrow technology in the latter part of the sequence produced this effect. Despite these changes in the sequence, there is very long term continuity in several of the attributes analyzed: Straight and Expanding Blade forms, Alternating Order of Flake Scar Removal, Contracting and Foliate Forms, Variability in Basal Width and Number of Flake Scars Divided by Length, and the Lenticular Cross-Section.

This analysis has been compared to the known archaeological sequence of the region through cross-referencing. Types found in all phases and culture types of the lower Fraser Valley region were identified. In addition, the initial part of the sequence is classified as being older than the comparative materials from the Old Cordilleran component at the Glenrose Cannery Site, suggesting that these materials predate this component and are best associated with the antecedent Protowestern Tradition.

Persistence and change in tool making traditions are the basis of stylistic seriation. As different traditions can have variable lengths of fluorescence through time, the flow of temporality is less predictable and regularized than a sequence produced through stratigraphic divisions and radiocarbon dates. Temporality becomes rooted in tradition rather than objectified time. Significantly, the results of the seriation analysis provide a unique perspective of the long-term history of the study area. The sequence allows for the delineation of sites, artifacts, and attributes along temporal lines, although the continuity of tradition and repetition of attributes demonstrated by the seriation makes it difficult to clearly define one temporal period from another. Consequently, the sequence based on tradition does not privilege change at the expense of continuity as both are of necessity.

CHAPTER SIX - LAND USE ANALYSIS

Introduction

This following analysis of archaeological materials collected from the Stave watershed area was undertaken to determine if changes in land-use strategies over time could be discerned. The underlying principle of the following analysis is that sites with similar artifact types and frequencies suggest that similar types of land-use were being practiced. Different patterns of artifact types from assemblage suggest that there are different land-use practices being undertaken. A cluster analysis is used to organize sites based on the similarity and differences of the artifacts collected there from. By applying the relative temporal sequence developed in Chapter 5, a history of changing and sustained land-use patterning is illustrated.

Recently, permutations of similar methods have been attempted by different researchers to demonstrate significant changes in land-use and settlement patterns (e.g. Dewar and McBride 1992; Cowan 1999). The combination of seriation and land-use pattern approaches is described by Binford (1992) as paradoxical, although he characterizes it as a dominant methodology in landscape approaches to archaeology. Binford (1992) disagrees with this classical approach to landscape archaeology primarily because such approaches have not adequately accounted for differences in the remnants of temporal and functional variation. Variations in archaeological patterns can be interpreted as the result of temporal shifts in trends or as functional differences of site use that are not necessarily differentiated temporally. It is thus necessary to define which archaeological attributes reflect temporal variation and which attributes reflect functional variation. Otherwise researchers fall into a conundrum where they have to choose between temporal or spatial explanation for variation. The end result, according to Binford, is that the researchers tend to fall back on temporal explanations for variation while discounting possible spatial/functional explanations. To address these concerns, two distinct data sets have been used to conduct the different methodological approaches of this analysis. Debitage and broad categories of formed tool types are used to compare relationships of site function to gain a perspective on land-use and settlement patterns. Attributes of formed bifaces were used to measure temporal variation in intended stylistic forms (Chapter 5). The culmination of results from both analytical procedures allows for the intended objective of gaining an understanding of land use and settlement patterns in the study area through time.

Another limiting factor of this type of analysis is that researchers resort to single functional descriptions for site locations, even though it is possible that site function may change over time (Wandsnider 1992). The methodology for this analysis was designed to measure tendencies of site location for particular functions, but does not discount the possibility of multiple occupations and changing site functions.

Land Use and Settlement Patterns

By associating patterns of lithic detritus with human behaviour, it is necessary to first understand the types of behaviour that can be described. Archaeologists often turn to ethnographic analogy in order to gain insight into behavioural patterns across a particular landscape. For example, based on ethno-archaeological research Binford (1980) characterizes two primary strategies used by peoples engaged in economies dependent on hunting and gathering: foragers and collectors. Foragers tend to move their *residential base camps* frequently throughout the year. From these camps, resource-gathering expeditions are made to various *locations* on a daily basis. Residential base camps and locations are specific site types that are characteristic of foraging groups who tend not to store foods. Foraging groups are found primarily in tropical and high arctic regions (Binford 1980). By contrast, collectors, found primarily in the more temperate and sub-arctic regions, store and cache food to ensure that they are adequately provisioned during months of lean times, such as the winter. Binford (1980:10-12) suggests that three additional types of sites are used by collectors including *field camps*, *stations*, and *caches*:

> A field camp is temporary operational center for a task group. It is where a task group sleeps, eats, and otherwise maintains itself while away form the residential base ... Stations are sites where special purpose task groups are localized when engaged in information gathering, for instance the observation of game movement...Caches are common components of a logistical strategy in that successful procurement of resources by relatively small groups for relatively large groups generally means large bulk. This bulk may be transported to consumers, although it may on occasion serve as the stimulus for repositioning the consumers.

It is inferred that the different activities occurring at each of these different site types will leave distinct, and perhaps discernable, archaeological assemblages. It should be noted that in his scheme, Binford does not account for all possible site types. He omits places of ceremonial or religious activities (Magne 1985). Binford's work is significant as it suggests that differences in land-use activities should be visible in the archaeological record.

Two studies from the British Columbia Plateau have conducted analyses aimed at determining different land-use strategies as represented by surface scatters of lithic detritus (Pokotylo 1978, Magne 1985). Both Pokotylo and Magne attempted to define archaeological site types from lithic scatter composition in order to gain a better understanding of land-use patterns over particular or multiple landscapes. Both studies considered the value of linear models of lithic reduction strategies to gain insight into site use. The underlying goal of my analysis is drawn primarily from these two comprehensive studies.

Pokotylo's (1978) work compared 44 lithic scatters from the Upper Hat Creek Region of the Fraser Plateau using technological and typological variables. In using this methodology, Pokotylo was able to distinguish specific patterns of lithic assemblages and from this he was able to define different site types, primarily field camps and stations (residential, hunting, and general or root crop processing activity sites).

Magne's (1985) analysis was concerned primarily with understanding the lithic variables that are of particular importance for elucidating distinct site types. He used an experimental reference collection to evaluate the variables that best predicted intended reduction stages. Three variables in particular were found to be highly predictive in assessing manufacturing stage from debitage: dorsal scar count, platform scar count, and edge angle (Magne 1985: 113). Combining these with typological variables for tool classification, Magne was able to distinguish different site types although he does not attempt to ascribe particular behaviours to these site types.

Differences in quantity, tool types, and debitage types can all provide insights into specific activities that were undertaken. For example:

> Some studies that have linked stone tool technology to residential sedentism have, in general, associated formal tools with mobile hunter-gatherer populations and informal tools with more sedentary populations. The logic of this association is that mobile groups cannot risk being unprepared for a task while on the move. Unprepared in this sense means not having available tools to complete the tasks, and thus mobile groups diminish the risk by transporting tools with them. These tools have the characteristics of being multifunctional, readily modifiable, and

easily portable – the qualities of formal tools. Sedentary populations, on the other hand, do not have to expend extra effort in the production of flexible, transportable tools. The uncertainty of available resources for tool production is not as serious a problem. Relatively more sedentary groups do not need to consolidate tools into multifunctional, light weight configurations, but can safely manufacture, use, and discard tools according to the need of the moment when raw material are readily available [Andrefsky 1998].

Table 3. Land-Use and Settlement Patterns ascribed to Various Assemblage Structures.

Assemblage Structure	**Behavioural Pattern**
Curated tool, bifaces, standardized tool kit, standardized reduction strategy, maximization of raw materials	High degree of mobility
	Processing of large amounts of food in a short period of time
	Limited access to lithic raw materials
	Access to high quality raw materials
	Need for a reliable and maintainable toolkit
	Use of highly valued material
	Use of smaller tools
	Need for a small and easily portable tool kit and raw material.
	Tendency towards a foraging type land-use strategies
Expedient tools, high degree of waste, less reduction, inefficient material use	High degree of sedentism
	Few time constraints on food processing
	Access to low quality raw material
	Limited access to high quality raw materials
	Conditions favor the ability to risk using locally available materials at times of need.
	Material not valued.
	Use of larger tools
	Assisted mobility (e.g. water transport) to transport raw material
	Tendency towards a collecting-oriented type land-use strategies
Diversity of Tool Types	Base camp and resident camps
	Low mobility
Single Tool Type	Field camps
	Harvesting locations
	High mobility

Table 3 is a list of land-use and settlement patterns that archaeologists have ascribed to particular assemblage structures. Table 3 has been constructed from the following sources: Kooyman (2000), Andrefsky (1998), Tomka (2001), Parry and Kelly (1987) and Bleed (1986). This table provides a basis for comparing lithic assemblages from specific site location to possible past land-use patterns.

Clearly there are multiple explanations for particular patterns of lithic detritus. Some of these explanations are not mutually exclusive but may be indicative of related types of land-use strategies.

Traditional Land-Use of the Stave Watershed

Tony Dandurand et al. (1996) has produced an overview of traditional Kwantlen and Stó:lō land-use of the Stave Watershed region. This traditional land-use study documents several different resource gathering activities and locations in the Stave Watershed area. Most of the information in this study was related to the investigators by Kwantlen elder, Clarence Cheer. Background information on traditional use of the area, and similar areas was also gathered from Hill-Tout (1903), Duff (1952), Suttles (1955), Stevenson (1996), and Miller (1981).

A village site was located at the mouth of the Stave River, it is often refered to as *Skayuks*. The lower Stave Valley was an important salmon fishing place, especially in the area where the Canyon of the Stave River empties into the delta area. Stave Falls provided a barrier to migrating salmon, but kokanee and trout thrive above the falls. Seasonal fishing camps were established both above and below the falls. Hunting and trapping activities were undertaken throughout the area, and it is reasonable to assume that base camps were established for these activities. Resource gathering activities above the falls would have been facilitated by navigable waters. Large cedar trees from the Stave Lake region were valued as canoe trees. Plant foods were collected throughout the area. In particular, salmonberries and thimbleberries frequented the slopes of the river below the falls. The winter village of *Shxwowyeqws* was established close to the river's mouth. Clarence Cheer remembered many camping spots, pit houses, and shed-roof houses in the area (Dandurand et al. 1996). Several burial spots are also known (see McLaren et al. 1998). The watershed itself served as a travel corridor between the interior and coast: a trail from the south end of the Lillooet River leads to the Stave Watershed (Miller 1981).

From this summary of traditional land-use practice it is clear that different parts of the Stave watershed were used for many different land-use activities. In some cases different practices involved the use of different technologies. As such, one would expect that there would be different archaeological signatures left in places where different activities were undertaken. Such differences form the basis of the type of archaeological analysis undertaken in this chapter. Although the specific traditional land-use activity may not be discernable from this analysis, the different archaeological remains provide a means of tracing diversity of land-use and settlement and changing patterns of this diversity through time.

Methodology

Several methodological steps were undertaken as a part of the land-use analysis. Each surface collected artifact was classified. The number of each type of artifacts from each site was tabulated. A cluster analysis was undertaken to aid in determining relationships between sites based on their typological character. Clustered sites were analyzed as to their similarities and differences from other clusters. Residual sites (unclustered) were analyzed so as to uncover their unique character. Each clustered and unclustered site was mapped to enable a visual analysis of related site types. Finally, an analysis of land-use through time was undertaken by comparing the site clusters to the seriation results of the previous chapter. This methodology section describes the attributes used for the selection of types and the statistics employed to compare sites.

Typology

To address the question of whether different land-use and settlement patterns could be discerned from the materials collected, the typology draws on attributes of lithic manufacturing stage and of function. Where the type and stage of manufacture is classified, individual attributes of artifacts are drawn upon. Broad functional categories are suggests based on the frequency of formal tool types at different site locations.

Biface Reduction

Three indicators of bifacial reduction technology were used:

- formed biface (Biface),
- biface preform (Preform), and
- bifacial reduction flake (BRF).

Formed bifaces and biface preforms were classified separately for reasons of discerning different technological stages as well as highlighting the functional aspects of formed bifaces. Bifacial reduction flakes indicate the location where bifaces were manufactured or curated.

Formed bifaces were distinguished from bifacial preforms using the same criteria as outlined in the seriation typology, and follows the classification suggested by Johnson (1989:124). Formed bifaces lack cortex and have straightened lateral margins rather than wavy or irregular margins. All other bifaces were classified as biface performs.

Biface reduction flakes are flakes produced during the manufacture of bifaces. They are discernable from other types of flakes by their platform angle relative to the dorsal surface of the flake (Magne 1985; Andrefsky 2000). This attribute was not measured but was based on the observation of an obtuse platform angle, as the direct measurement of this type of attribute is problematic due to the often-rounded shape of the platform (Andrefsky 1998).

Cortex Bearing Debitage

Ten types of Cortex Bearing Tools and Debitage were classified:

- Cobble Cores (CobbCore),
- Bifacial Cobble Choppers (ChoppBi),
- Unifacial Cobble Choppers (ChoppUni),
- Scraper-Planers with Cortex (SP_WC),
- Retouched Flakes with Cortex (RTF_WC),
- Large Flake Tools with Cortex (LFT_WC),
- Shatter with Cortex (ShattWC),
- Spalls (Spall),

- Flakes with Dorsal Cortex (PNC_DC), and
- Flakes with Platform Cortex (PC_DNC).

The presence of cortex is a significant indicator of raw material availability and patterns of mobility (Andrefsky 1998). For this reason, sites with a high proportion of these types of tools may indicate a preference for locally available materials and/or an expedient approach to raw material use.

Cobble cores are cobbles that have flakes removed but cannot be classified as cobble choppers. Cobble cores may be split cobbles, cobbles from which flakes have been removed in one, two, or multiple directions, or may be circumferentially reduced from a single platform. Bifacial and Unifacial Cobble Choppers are cobble cores that have had flakes removed at one end of the cobble. Choppers are separated from cores, as there is an implication of function as a chopping tool as well as having the potential of being cores (Haley 1996). Scraper-Planers with Cortex are core tools with flat bottoms and flake removal or retouch along the basal edge to form a scraper-like cutting edge. Like Cobble Choppers, Scraper-Planers likely functioned as tools as well as cores. Both Cobble Choppers and Scraper-Planers are defined as expedient tool types.

Retouched Flakes with Cortex are cortex-bearing flakes that have been retouched laterally. Large Flake Tools with Cortex are large cortex bearing flakes that have been retouched or re-worked laterally. Retouched flakes and Large-Flake Tools can be used expediently or curated.

Spalls are characterized as having cortex both on the platform and dorsally. Spalls are the first flakes struck or split from cobbles. Materials were classified as spalls even if the amount of cortex was not continuous indicating secondary flake removal. Flakes with Platform Cortex were classified as such if they had cortex on the platform but lacked cortex dorsally. These types of flakes indicate the manufacturing and resharpening of Unifacial Cobble Tools or flake reduction from a cobble core. Flakes with Dorsal Cortex have cortex dorsally but lack cortex on the platform. These types of flakes indicate the beginnings of bifacial reduction or reduction of a split cobble using the ventral surface of the cobble as a platform. Shatter with Cortex includes flake fragments lacking platforms that have cortex. These flake fragments are indicators of the early stage of manufacturing strategies, but cannot be classified into any of the above-refined types.

Non-Cortex Bearing Tools and Debitage

There are nine Non-Cortex Tools and Debitage Types:

- Cores with No Cortex (CoreNC),
- Scraper-Planers with No Cortex (SP_NC),
- Small Simple Platform Flakes (Flake1sm),
- Large Simple Platform Flakes (Flake1lg),
- Middle Stage Platform Flakes (Flake2)
- Complex Platform Flakes (Flake3)
- Shatter with No Cortex (ShattWNC)
- Retouched Flakes (RTF)
- Large Flake Tools (LFT)

These materials have been reduced to the point that no cortex remains. This suggests greater curation of raw material or need to reuse materials. The lack of cortex is significant in terms of determining differences of mobility and land-use patterns.

Cores with No Cortex are cores of any type from which all cortex has been removed. Scraper-Planers with No Cortex are core tools with flat bottoms and flake removal or retouch along the basal edge to form a scraper like cutting edge. Scraper-Planers likely functioned as tools as well as cores and are expedient types of tools.

All platform-bearing flakes were analyzed in regards to platform type: simple, middle, and complex. Platform types were distinguished based on the number of facets on each platform following Magne (1985) and Andrefsky (1998). Simple platforms had no facets and were thus struck from cores with unscarred platforms such as single platform cores. Middle stage platforms contained two or three facets suggesting they were struck from cores with moderately scarred platforms. Complex platforms possessed more than three facets on the platform and are suggestive of being struck from cores that have been heavily worked or prepared for flake removal. There is an underlying assumption of a manufacturing sequence in the different stages of platform bearing flake types, with primary stage flakes being indicative of early stage reduction and complex of late stage. Large and Small Simple Platform Flakes were separated from one another as the larger flakes are more likely to indicate earlier reduction and the smaller flakes may indicate such things as scraper retouch as well as early reduction. Shatter with No Cortex includes all flake fragments with no platforms, thus preventing further classification.

Retouched Flakes with No Cortex are non-cortex bearing flakes that have been retouched. Large Flake Tools with No Cortex are large non-cortex bearing flakes that have been reworked so as to be formed into tools.

Blade Technology

Two types of blade technologies were recorded:

- Microblade Technology, and
- Blade Technology.

The incidence of blade technology indicates a highly curative oriented technology where the raw material is highly valued and a high degree of mobility may be inferred. Microblade Technology includes blade smaller than 2cm, microblade cores, and microblade core rejuvenation flakes. Blade technology includes flakes that are more than twice as long as they are wide, with distinct dorsal ridges and simple platforms and which are longer than 2cm. No (macro) blade cores were identified.

Quartz Crystal Technology

Quartz Crystal Technology includes formed tools and debitage. The debitage and tools were not found to be classifiable using the above system and are thus classified separately in the Quartz Crystal Technology type. This type traces the relative frequency of this technology at various site locations.

Ground Stone and Chipped Slate

Ground Stone Tools and Chipped Slate were found to be difficult to classify using the above system. They were thus recorded in two types:

- Ground Stone, and

- Chipped Slate.

Both ground stone technology and chipped slate are technologies associated with more recent time periods in the study area. As such, they were included in the land-use analysis with some hesitance as variation may be the result of temporality rather than differences in land-use. However, it was felt that these types may also contribute to different patterns of mobility and land-use and were thus, retained in this analysis.

Tabulation

Each artifact was analyzed and categorized into the most appropriate type. A database was constructed with different tables for each artifact type. This database was then imported into a statistical software program to undertake the cluster analysis. The cluster analysis was undertaken with the goal of finding relationships between sites based on the types of artifacts collected from those sites. The results of this analysis are tentative as non-systematic collection strategies were used.

Cluster Analysis

The WINbasp (Bonn Archaeological Statistic Package) was used to perform a cluster analysis of the different sites in the study area, and the manner in which they are related in regards to the mosaic of artifacts at each site.

Sites with fewer than five collected artifacts were excluded from the study as it was felt that the character of these sites may not be properly represented by the assemblage. It is likely that several of these sites are small scatters of detritus or isolated finds, while others may be of considerable size. Limiting the sites analyzed to those with five artifacts or more was undertaken arbitrarily and was not based upon statistical reasoning.

The first step of the cluster analysis is to measure the similarities and differences between collections. The Chi Square method of measuring distance was chosen as there is considerable variation in the number of artifacts analyzed from each site (from 5 to 556 objects). This method takes into account relative proportions of materials at each location rather than frequencies, thus accounting for difference in total quantity. For the frequency of each type from a given site, the deviations for the same type from other sites are calculated and tabulated. The tabulated deviations are then squared. The resulting squares are then divided by the frequency of the type from the given site. The results are summed to give a Chi Square distance for the type at the given site.

The clustering software then employs the Jarvis (1977) shared nearest neighbour algorithm to relate units spatially. Sites that share similarities in their lists of Chi Square distances are more closely related than others and are considered neighbours. The results are expressed hierarchically, using different thresholds of relatedness between sites, from larger to smaller, thus changing the number of neighbours for each site. The hierarchy is expressed as a spanning tree showing the spatial relationship of units when different numbers of near neighbours are considered.

Results

A total of 1902 artifacts from 48 different site locations in the study area were analyzed. From this analysis, the complement of artifacts from each site is presented in Appendix F. Appendix F includes sites with less than 5 artifacts collected.

Before running the cluster analysis, sites with less than five artifacts were removed from the tabulation of types from each site. Remaining after the removal of these sites were 1856 artifacts from 28 different sites. The cluster analysis revealed several distinct clusters when seven neighbours were considered. The results of the cluster analysis are presented in Figure 42.

Site Clusters

From the results of the Cluster Analysis, five distinct clusters are clearly delineated at the clustering level of 4 near neighbours. Eight sites remain unclustered in residue. Clusters derived from the Cluster Analysis are present in Table 4. The clustering level was chosen where the fewest residual sites and most clusters could be achieved.

It is hypothesized that each cluster has the possibility of representing different type of land-use pattern, based on the functional and technological attributes used. Each cluster and residual site is characterized in this section to investigate this possibility. The frequency and percentage of types in each cluster is presented in Appendix G. The characterization of each cluster and residual site was facilitated by referring to this chart.

Figure 42. Land-Use Cluster Analysis Results.

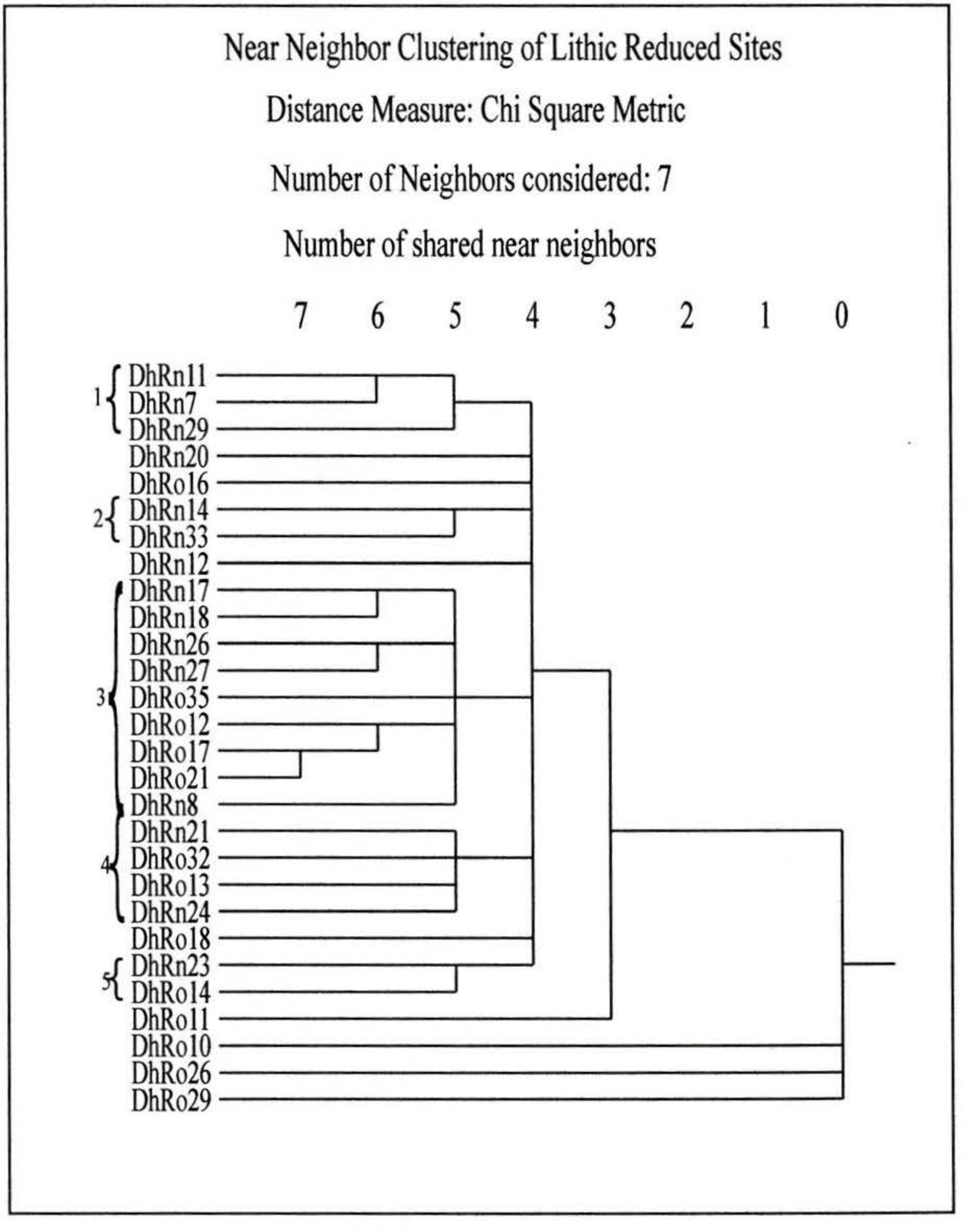


Table 4. Clusters Revealed in Cluster Analysis

3 Units in Cluster 1:
DhRn11
DhRn7
DhRn29
2 Units in Cluster 2:
DhRn14
DhRn33
9 Units in Cluster 3:
DhRn17
DhRn18
DhRn26
DhRn27
DhRo35
DhRo12
DhRo17
DhRo21
DhRn8
4 Units in Cluster 4:
DhRn21
DhRo32
DhRo13
DhRn24
2 Units in Cluster 5:
DhRn23
DhRo14
8 Units in Residue:
DhRn20
DhRo10
DhRo11
DhRo16
DhRo18
DhRo26
DhRn12
DhRo29

Cluster 1 – Curation Oriented Manufacturing

Three sites are included in Cluster 1: DhRn11, DhRn29, and DhRn7. All of these sites are located on raised terrace features in the south-eastern arm region of Stave Reservoir (Figure 43), at higher elevations, between 75-82m asl. The total frequency of artifacts at each of these sites varies with 213 artifacts from DhRn11, 52 from DhRn28, and 29 from DhRn7.

The sites in this cluster are characterized by a greater frequency of non-cortex bearing debitage, moderate percentages of expedient tools, and a lesser frequency of cortex bearing debitage and formal tools. Overall, this pattern demonstrates that the efficient use of raw materials was a relatively important aspect at these sites, although expedient tools were also produced and used. There is a high frequency of biface reduction flakes and biface preforms in particular at site DhRn11. Both cobble cores and cores with no cortex occur at low frequencies. Flake debitage is predominated by high frequencies of small simple platform flakes, complex platform flakes, shatter with no cortex, and biface reduction flakes. This is again suggestive of final stages of manufacture and tool re-sharpening activities. Finally, there is a percentage of quartz reduction technology. Overall there are lesser percentages of formal tools than at other site locations, suggesting the importance of curation over discard.

The pattern at these sites suggests access to both good and poor quality materials in the local area; the good quality material being used more efficiently than the poorer quality material. The high diversity of all types of lithics with the exception of chipped slate and ground stone indicates that these sites served as base-camp activity areas. All the sites may have served as staging areas into the Stave Region for people traveling by foot from Hatzic. The area in which these sites are situated is relatively devoid of raw materials, being primarily glacial outwash. Raw materials are readily available, however, at short distances in every direction from these sites.

Cluster 2, Generalized Reduction

Two sites are included in Cluster 2: DhRn14, DhRn33. DhRn14 is located at Rocky Point, the former mouth of Stave Lake and is a large site from which 103 artifacts have been collected. DhRn33 is located on a glacial outwash terrace near Cascade Creek. DhRn33 is a small site from which only 9 artifacts were collected.

The sites in Cluster 2 share the following common types: formed bifaces, preforms, cobble cores, shatter with cortex, middle stage flake reduction, shatter with no cortex, and a quartz reduction industry. This cluster is not well defined due in part to the lack of materials from DhRn33. In addition to the above types, DhRn14 has the following characteristics: a high percentage of cortex bearing debitage and primary stage reduction debitage with no cortex, a high number of retouched flakes, and the presence of blade and ground stone industries. Overall, Cluster 2 is fairly similar to Cluster 5 with exception that Cluster 2 sites have a higher frequency of cobble cores and a lesser frequency of shatter with no cortex, suggesting a slight emphasis on initial reduction strategies.

Although clustered together on the basis of technological stage and tool types, it is plausible that the two sites in Cluster 2 represent different land-use strategies. DhRn33 has a very low diversity of tool types and a low frequency of artifacts. It is more characteristic of a hunting station where reduction strategies undertaken were similar to those found at DhRo14. DhRo14 has a greater diversity of types and in particular formal tools such as bifaces and retouched flakes. DhRn14 has several distinct concentrations of artifacts within its boundaries and it may be an amalgamation of several smaller sites. The diversity of types and strategic location of this site at the mouth of Stave Lake suggests that it is may be better characterized as a base camp with similar reduction strategies as employed at DhRn33. Both sites share a quartz reduction industry.

Cluster 3, Generalized Use and Reduction, Middle Stage Reduction Emphasis

A total of nine sites are associated with Cluster 3: DhRn17, DhRn18, DhRn26, DhRn27, DhRn8, DhRo12, DhRo17, DhRo21, DhRo35. These sites are distributed throughout study area and are associated with a number of different geological landforms. With the exception of DhRn18 (87), all of the sites in this cluster have relatively low number of artifacts that were analyzed (between 12 and 18).

Cluster 3 site have an overall moderate distribution of both cortex and non-cortex bearing debitage and tools. Lower frequencies of cores with no cortex occur at these sites. There is a high frequency of formed bifaces and retouched flakes. Core tools are unevenly distributed in these sites but do occur, as do large flake tools. In regards to non-cortex flake types, Cluster 3 site have high relative percentages of large simple platform and middle platform flakes. There is a higher relative percentage of shatter with no cortex than shatter with cortex. Overall, this pattern suggests a generalized approach to lithic reduction with an emphasis on middle stage reduction strategies.

DhRn18 stands out in this cluster of sites as it has a much higher frequency of artifacts. This site may represent a scattering of small sites over a large landform, as there are several concentrations of material in the large site area included in DhRn18.

All sites in this cluster lack high frequencies of microblade, bipolar, and quartz reduction technologies and biface preforms and biface reduction flakes. This lack of diversity in industry points to the possibility that these sites are hunting and food processing locations and/or ephemerally used camps rather than main base camp type localities where tool production included moderately efficient use of some raw materials. With the exception of DhRo21, all of these sites would have been accessible from Stave Falls and Stave Lake by canoe. DhRo21 is located below Stave Falls and was likely better accessed by foot.

Cluster 4, Expedient Oriented Manufacturing and Tool Use and Bifacial Tools

Four sites are included in Cluster 4: DhRn21, DhRn24, DhRo13, and DhRo32. These sites have a moderate amount of artifacts from 17 to 42. DhRn21 is located on a bay mouth bar at the southern end of Stave Lake. DhRn24 is located on a remnant Bay Mouth Bar at the southern end of Stave Lake. DhRo13 is located on a transverse bar and terrace of Stave River, 750m north of Stave Falls. DhRo32 is located adjacent to Stave River, 1km north of Stave Falls.

Sites in Cluster 4 have high frequencies of cortex bearing debitage and tools. High percentages of cobble cores, cobble choppers, flakes with cortex, and large flake tools with cortex are associated with these sites. With the exception of cores with no cortex, there are relatively low frequencies of non-cortex bearing tools and debitage. There is a high frequency of formed bifaces and biface preforms although no biface reduction flakes were recorded. With the exception of the high frequency of bifaces, the distribution of types in this cluster suggests that there is an orientation towards the manufacturing and use of expedient tools at sites in this cluster.

Cluster 4 sites have a unique distribution of materials with the high percentage of primary stage reduction and expedient tools. There is also a high number of bifaces. Most categories of types are indicated in Cluster 4. The diversity of materials at these suggests that they are base camp-like. The reliance on expedient and primary stage reduction suggests that the occupants were able to risk using locally available materials at times of need.

Two of these camps are located on remnant bay mouth of Stave Lake: DhRn24 and DhRn21. These two sites are located at natural transition location from Stave Lake to the low-lying area to the south. The large number of expedient material and large sized waste may be a result of people trimming their excess after travelling by boat on the lake and transferring activities to land. Smaller, good quality materials, and formed artifacts would be the most likely types of materials to be retained. Trimmed excess could be cached for future use as the area lying to the south has a sparse distribution of raw material, being mostly glacial outwash.

DhRo32 and DhRo13 are sites located in the vicinity of Stave Falls were there is a high concentration of archaeological material and sites. Both of these sites are located just north of this very high activity area. DhRo32 and DhRo13 could be used without the need for a highly portable tool kit as they are located close to the Stave Falls habitation center and activities could risk using expedient tools as alternates and support was close by. The diversity of materials at these sites suggests that they are base camps, but secondary to the Stave Falls area.

Cluster 5, Generalized Use and Reduction, Expedient Emphasis

DhRn23 is located on a small remnant bay mouth bar at the southern end of Stave Lake. Twenty-five artifacts were analyzed from this site. DhRo14 is located just upstream of the former location of Stave Falls. A total of 100 artifacts from DhRo14 were analyzed.

Cluster 5 is similar to Cluster 3 in that it has moderate distributions of cortex bearing tools and debitage, non-cortex bearing tools and debitage. However, Cluster 5 Sites have a high percentage of shatter with cortex and spalls. Large, simple platform flakes and middle platform flakes are the common type of platform bearing debitage and there is a high relative percentage of shatter with no cortex. An emphasis on mid-stage reduction is derived from these statistics. Retouched flakes with no cortex and formed bifaces occur with frequency. Overall, there is a generalized pattern of tool use and lithic reduction found at sites in Cluster 5, which employs both curative and expedient strategies, although there is a greater emphasis on expedient strategies than is evident in Cluster 3.

DhRo14 is located on the east side of Stave River just North of Stave Falls. DhRo23 is located on a remnant bay mouth bar at the southern end of Stave Lake. DhRo14 has a much higher frequency and diversity of artifacts and is more like a base camp location with a similar pattern of reduction strategies to that found at DhRn23. DhRn23 lacks a high diversity of artifacts and is better classified as a resource acquisition and processing station and ephemeral-camp. It is located in proximity to the high concentration of material at DhRn18 and may be a satellite of this area.

Residual Sites

The following sites were found to lack of common elements with all other sites analyzed: DhRn12, DhRo18, DhRn20, DhRo10, DhRo11, DhRo16, DhRo26, and DhRo29. As these sites cannot be clustered they are characterized individually:

DhRo18

DhRo18 is located on the Shore of Stave River, 250m north of Stave Falls. DhRo18 is classed as residual partly because few artifacts have been collected from it and it does not share common distributions with other site types.

DhRo18 is a satellite of the large and diverse site at DhRo11, and suggest a distinct activity area. It is situated in a location of transportation transformation being adjacent to Stave Falls. Above the falls canoe travel is possible, below the fall, foot travel is necessary, as the Stave River Canyon makes boat travel difficult. As such, DhRo18 is best classified as a staging area characterized by many large tools.

DhRn12

DhRn12 is located at the northern end of the alluvial fan of Lost Creek where it empties into Stave Lake. DhRn12 is a relatively isolated site and lacks formal tools other than a retouched flake. On the basis of the data collected this site is difficult to classify and best included with the unknown site types category.

DhRn20

DhRn20 is located on two raised features in the low-lying wetlands area at the southern end of Stave Lake. DhRn20 lacks many types of artifacts making it difficult to classify with others. Overall it this site is characterized by a high percentage of mid and late stage reduction debitage, an overall lack of cores and core tools, and the presence of

Formed Bifaces, Preforms, and Retouched Flakes. This pattern is suggestive of curation-oriented reduction strategies and a resource gathering and processing location.

DhRo10

DhRo10 is located on a bar of the Stave River, 750m north of Stave Falls. It is a large site situated in a location of transition from navigable waters upstream to un-navigable water downstream. Relative to other sites, DhRo10 has very high frequencies of retouched flake tools, Biface Preforms, and Formed Bifaces. Most of the formed bifaces are complete. This distribution suggests that this site location was used as a base camp for hunting and processing. The relative abundance of discarded or lost tools suggests that the inhabitants using the site had an available abundance of these types of tools and had little recurring need to curate or reuse these types of tools. Additionally, this site may have served as a tool manufacturing and stockpiling location to outfit expeditions travelling upstream of Stave Falls. There is a high abundance of quartz, slate, and ground stone industries suggesting that multiple technologies were often being employed at this site.

DhRo11

DhRo11 has the highest amount of artifacts analyzed for this study totalling 556. This is a large site located 500m north of Stave Fall across the river from DhRo10 and is similar in being located at natural transition point from navigable waters upstream to the Stave Falls and Stave River Canyon downstream.

This site has a high diversity of artifact types and all types are represented with the exception of ground stone technology. There are higher proportions of cortex bearing tools and debitage at this site suggesting an emphasis on expedient technology. A lower frequency of bifacial tools compared to DhRo10 suggests that greater value was placed on these types of tools as they were not lost or left behind with as much frequency. Many of the bifacial tools from DhRo11 are fragmented. DhRo11 has a wide variety of artifact types suggesting a generalized approach with an emphasis on expedient reduction. It is likely that DhRo11 served as a base camp or village-like area and a staging point for expeditions upstream of the Stave Falls area. Raw material appears to have been relatively abundant and easy to find, resulting in the tendency towards expedient pattern of reduction and tools use. The deposition of large amounts of cores and slightly modified cobbles ensured that a steady supply of raw material was available to inhabitants using the site as a staging point.

DhRo16

DhRo16 is located on the Shore of Stave River at Devils Point. A total of 83 artifacts were analyzed from this site. Overall there is a low frequency of expedient tools and debitage from this site. There is an emphasis on non-cortex bearing flakes and biface reduction flakes. The assemblage is similar to sites in Cluster 1 with an emphasis on the curation of raw material but differs in that it lacks evidence of bipolar and blade reduction technologies.

DhRo26

DhRo26 is a large site located downstream of Stave Falls. Travel to this site would have been primarily by foot as navigation from upstream involves circumventing Stave Falls, and from downstream Stave Canyon. However, at certain times of the year Stave Canyon may have been navigable by canoe (Miller 1981). This site is below the salmon barrier of Stave Falls. DhRo26 has a general lack of a chipped stone industry in relation to other sites, although there is a high frequency of Formed Bifaces. Relative to other sites in the study area there is a high incidence of ground stone, quartz reduction, and chipped slate technologies at DhRo26. One radiocarbon date taken from subsurface deposits at DhRo26 places the site on either side of the Locarno/Marpole Transition at 2,500 B.P. (McLaren et al. 1997). The difference in technologies employed at this site reflects its later position in the relative temporality of sites evaluated. Objects found at DhRo26 during excavations include several nodules of ochre and it has been suggested that there is special ceremonial significance associated with this site (Maxwell 1998). The high diversity of materials and technologies and the structural remains found during excavations suggest that this site was at least a base camp and possibly a village site.

DhRo29

DhRo29 is located on an Island at the mouth of the Stave River Canyon. This place was known by local inhabitants as an aboriginal fishing location and encampment prior to the establishment of Ruskin Dam at the mouth of the canyon. This site is functionally different from others as it is associated with salmon fishing. The high frequency of ground stone implements suggests that it also dates to later time periods. Unlike DhRo26, there is a lack of Formed Biface and Biface Preforms indicating lesser emphasis on hunting and a greater emphasis on fishing at this site.

Land-Use and Settlement Patterns in the Stave Watershed Area

The results of the cluster analysis demonstrate different relative land use and site function in the study area. Table 5 lists the different types of sites identified and discussed in the last section presenting a synchronic perspective of land-use. Figure 43 is a map that characterizes the landscape of the study area based on the classification of site types and is also a synchronic diorama. Possible winter village site locations have been included as posited by ethnographic data (Duff 1958; Dandurand et al. 1996; McHalsie 2001). DgRn23 and DhRn6, located in the Hatzic Lake region have also been included. DgRn23 is a large village site (Mason 1994) also known as Xay:tem or the Hatzic Rock Site.

Table 5. Site Type Classifications

Site Association	**Technological Type**	**Functional Type**
Sites with less than 5 artifacts removed from Cluster Analysis + DhRn12	Unknown	Unknown or peripheral use
Cluster 4 (DhRn21 and DhRn24) + Residual site DhRo18	Expedient manufacturing	Staging area
Cluster 3 + Residual site DhRo29.	Generalized reduction. middle stage reduction emphasis.	Generalized use, resource acquisition or processing locations, ephemeral camps.
Cluster 1 + Residual site DhRo16	Curation oriented manufacturing.	Base camp
Residual site DhRn20	Curation oriented manufacturing	Resource acquisition or processing location, ephemeral camp.
Cluster 4 (DhRo32 and DhRo13)	Expedient manufacturing and expedient tools	Secondary camp
Residual sites DhRo14 and DhRo10	Generalized pattern of tools and debitage	Base Camp
DhRo11 and DhRo26	General pattern of tools with an emphasis on expedient manufacturing	Village site and staging area.
DgRn23 (Hatzic Rock Site)	Not analyzed	Winter village site Xay:tem known ethnographically and archaeologically.
Stave Delta	Not analyzed	Winter village site Skayuks known ethnographically

Figure 43 demonstrates three areas of concentrated land-use in the Stave Watershed Study area: close to mouth of Stave River, at Stave Falls, and at the Southern end of Stave Lake. In these areas of high site density residential base camps or villages are situated. Resource gathering and processing location tend to be located between and around these centers of density. The base camps situated in the area lying to the south of Stave Lake tend to be oriented towards the efficient use of raw materials. At Stave Falls there is a more generalized approach to tool use. Sites with expedient tool use are located in both of these areas. Few of the materials analyzed came from the mouth of the Stave River, and little is known about this region, at least from the analysis undertaken. Overall a pattern of diverse land-use is presented. Figure 43 does not take into account temporal differences and, thus, represents a long-term palimpsest of land-use.

Long-Term Patterns of Land-Use

Different strategies of land-use are implied by the different clusters produced. These clusters are hypothesized as representing different land and tool use strategies. Some of the variation in the tools and technologies analyzed may reflect different contemporaneous land-use strategies, or they may represent changing land-use strategies through time. It is also possible that sites with long periods of occupation, have changed function over time, and this change will not be discernable from surface collected material lacking stratigraphic division. In order to gain some perspective in regards to these problems, the sites analyzed in this section are compared to the temporal order of sites produced by the Seriation Analysis.

Figure 43. Map of Land-Use Strategies.

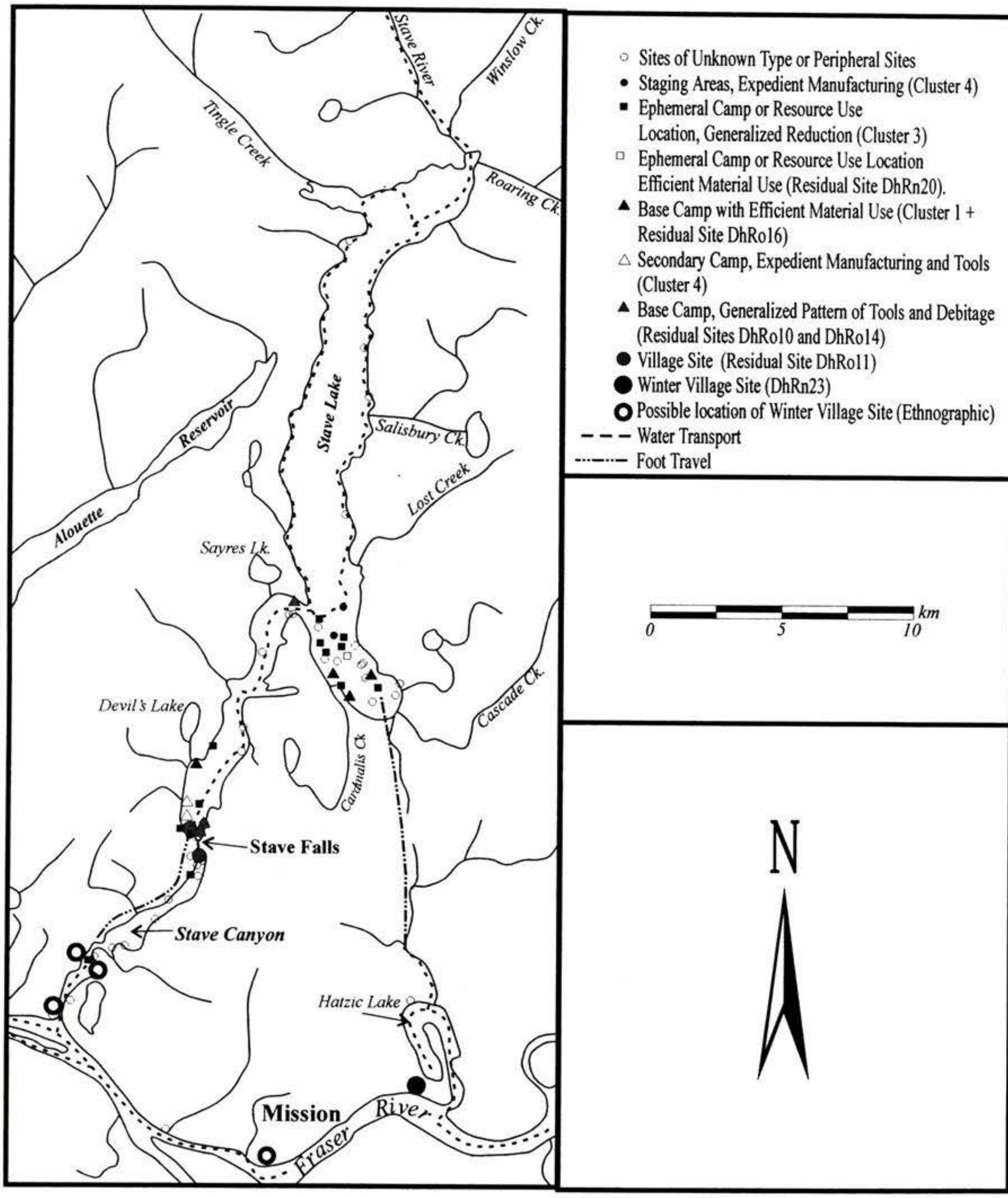


Table 6 lists all sites considered in the land-use analysis with formed bifaces. To create this table, each biface in the seriation analysis was given a number representing its rank order in the seriation results; the lower numbers being given to the earliest occurring objects and higher numbers to the latest occurring. This allows for the relative ordering of sites based on the rank order of bifaces from those sites. For sites with more than one biface, the mean rank order was taken and used as a temporal representation in the order the sites. The range of rank orders for sites with more than one biface is given to show the relative duration of occupation or reuse of sites.

Table 6 demonstrates that some of the land-use strategies employed co-existed but that there is a general trend from curative oriented strategies towards more expedient strategies. Clusters 1 and 2 are associated with point types found to be relatively early. Cluster 3 is found to occur throughout sequence. Clusters 4 and 5 appear to in the latter part of the sequence. Figure 44 presents a graphic illustration of the temporal relationship of Clusters.

Table 6 demonstrates that Cluster 3 sites tend to have brief use periods (with the exception of DhRn18 and DhRo17). This is significant as this cluster type has the longest duration in the sequence suggesting that land use activities associated with Cluster 3 sites were undertaken opportunistically in location, but repetitively as a land-use activity. This also supports the hypothesis that these sites are ephemeral camps or opportunistically used resource gathering/processing locations.

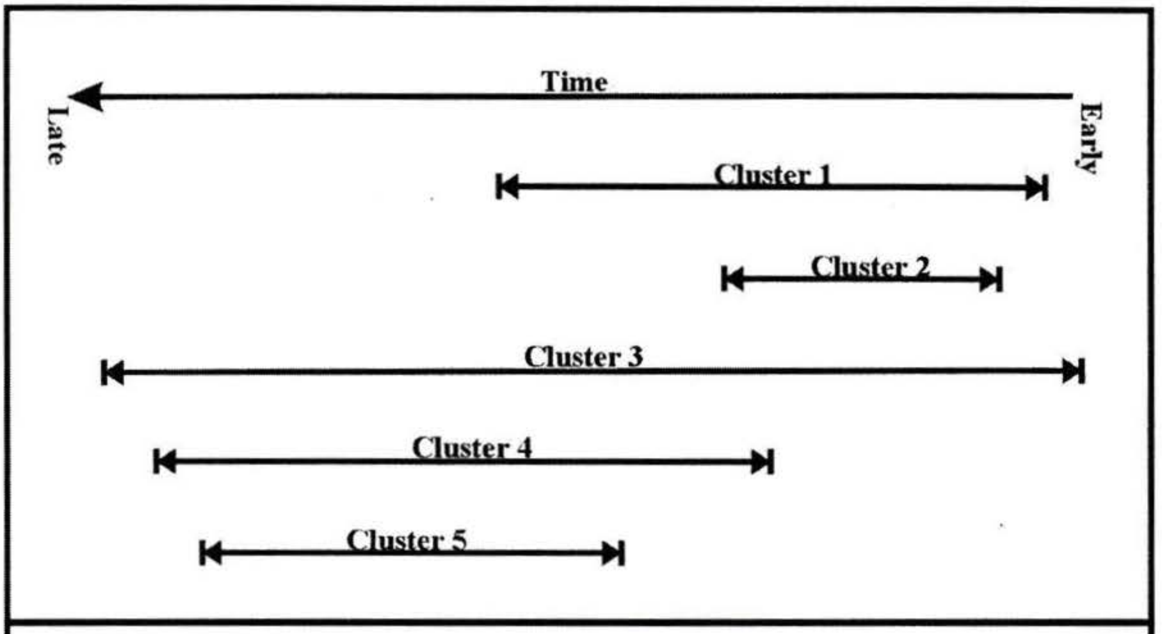
The temporality of sites left in residue is also worth some consideration. Four of the residual sites, DhRo11, DhRo16, DhRo10, and DhRo26 have considerable relative time spans as indicated by the range of rank ordered points in Table 6. It is plausible that these sites represent palimpsests of changing site function. For this reason it would difficult to classify these sites into distinct clusters as there are compiled element of different activities at these sites. Regardless, the complement of types found at these sites does characterize the sites with a distinctive signature. In contrast, there are several clustered sites that demonstrate considerable time spans of occupation as indicated by the range of rank ordered point: Cluster 1 (DhRn11, DhRn29), Cluster 2 (DhRn14), Cluster 3 (DhRn18, DhRo17). Cluster 4 (DhRo32, DhRo13) and Cluster 5 (DhRo14). These sites have been clustered and demonstrate the long-term maintenance of particular land-use strategies that cluster with sites that have been used for shorter terms.

Figure 45, Figure 46, and Figure 47 have been devised by dividing the temporal sequence revealed in the last chapter in to three phases, Early, Middle, and Late and then mapping the site types associated with these phases to gain further insight into changing land-use patterns through time.

Table 6. Clusters Associated with Sites Ordered by the Seriation Analysis.

Site	***Number of Formed Bifaces from Each Site***	***Rank order or mean of rank order of Formed Bifaces***	***Lowest rank order***	***Highest rank order***	***Range of rank order***	***Cluster***
DhRn8	1	12				3
DhRn11	8	22.375	4	59	55	1
DhRn33	1	24				2
DhRo17	3	24.6	3	60	57	3
DhRn15	1	30				
DhRn20	2	30.5	23	38	15	Residue
DhRo12	1	32				3
DhRn25	1	33				
DhRo11	11	35.27	8	102	94	Residue
DhRo13	3	36.3	19	69	50	4
DhRn14	7	39.71	16	74	58	2
DhRn17	1	42				3
DhRo16	4	42.75	2	114	112	Residue
DhRo35	1	43				3
DhRo14	4	52.25	7	77	70	5
DhRn27	1	58				3
DhRn21	1	62				4
DhRn29	3	64.6	18	90	72	1
DhRn26	1	68				3
DhRn18	5	68.6	5	92	87	3
DhRo1	1	71				
DhRo32	5	72.2	9	99	90	4
DhRo36	2	72.5	66	79	13	
DiRn2	1	73				
DhRo10	31	76.74	31	113	82	Residue
DhRo26	8	78.75	36	106	70	Residue
DhRn23	2	90	87	93	6	5
DhRn24	1	94				4
DhRn18	1	104				Residue
DhRo21	2	111	107	115	8	3
DhRo28	1	116				

Figure 44. Comparison of Cluster Temporalities.



Cluster 1 - Curation Oriented Manufacturing
Cluster 2 - Generalized Reduction
Cluster 3 - Generalized Use and Reduction, Middle Stage Reduction Emphasis
Cluster 4 - Expedient Oriented Manufacturing and Tool Use, and Bifacial Tools
Cluster 5 - Generalized Use and Reduction, Expedient Emphsis

Figure 45. Early Sequence Land-Use and Settlement Patterns.

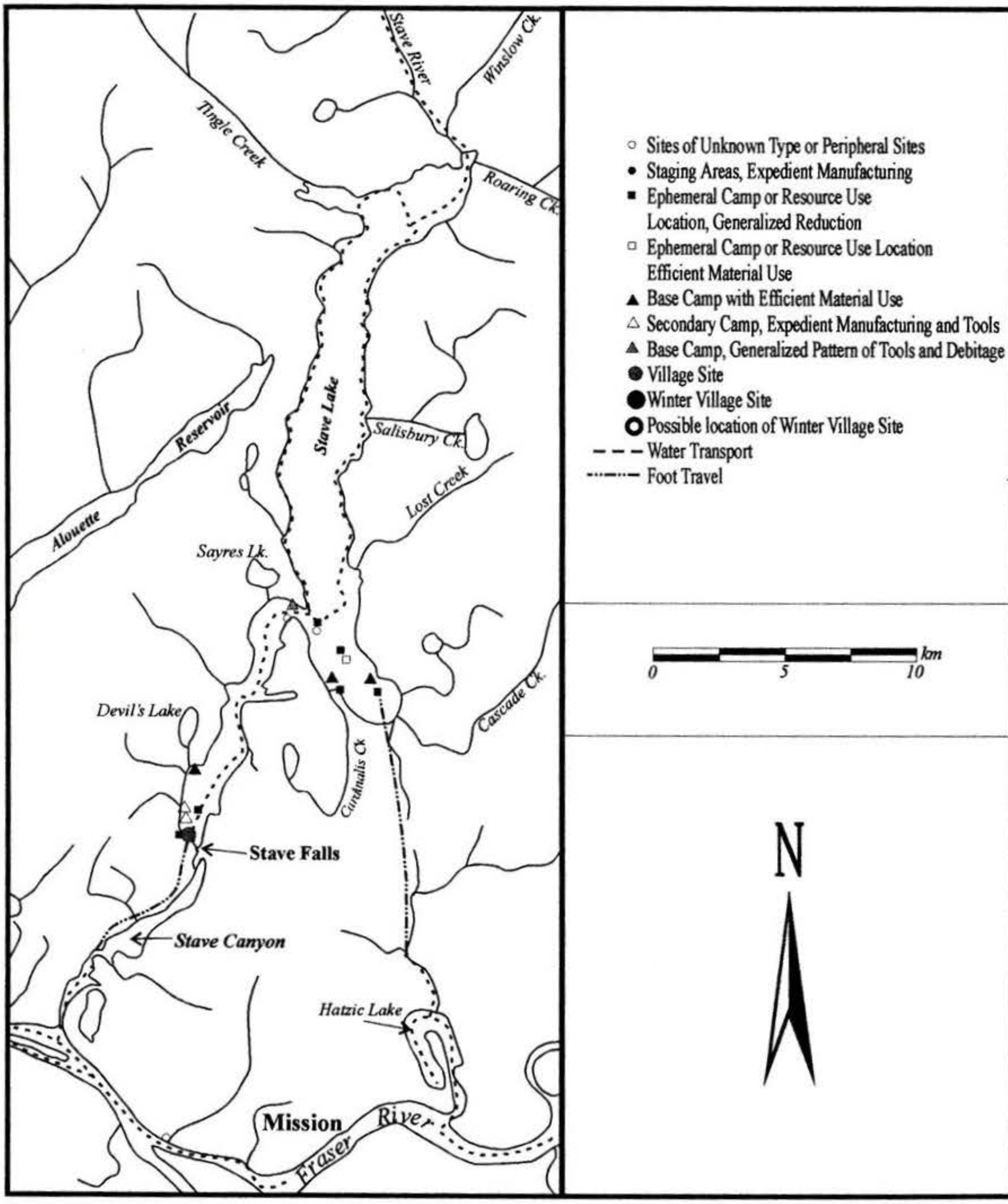


Figure 45. Early Sequence Land-Use and Settlement Patterns.

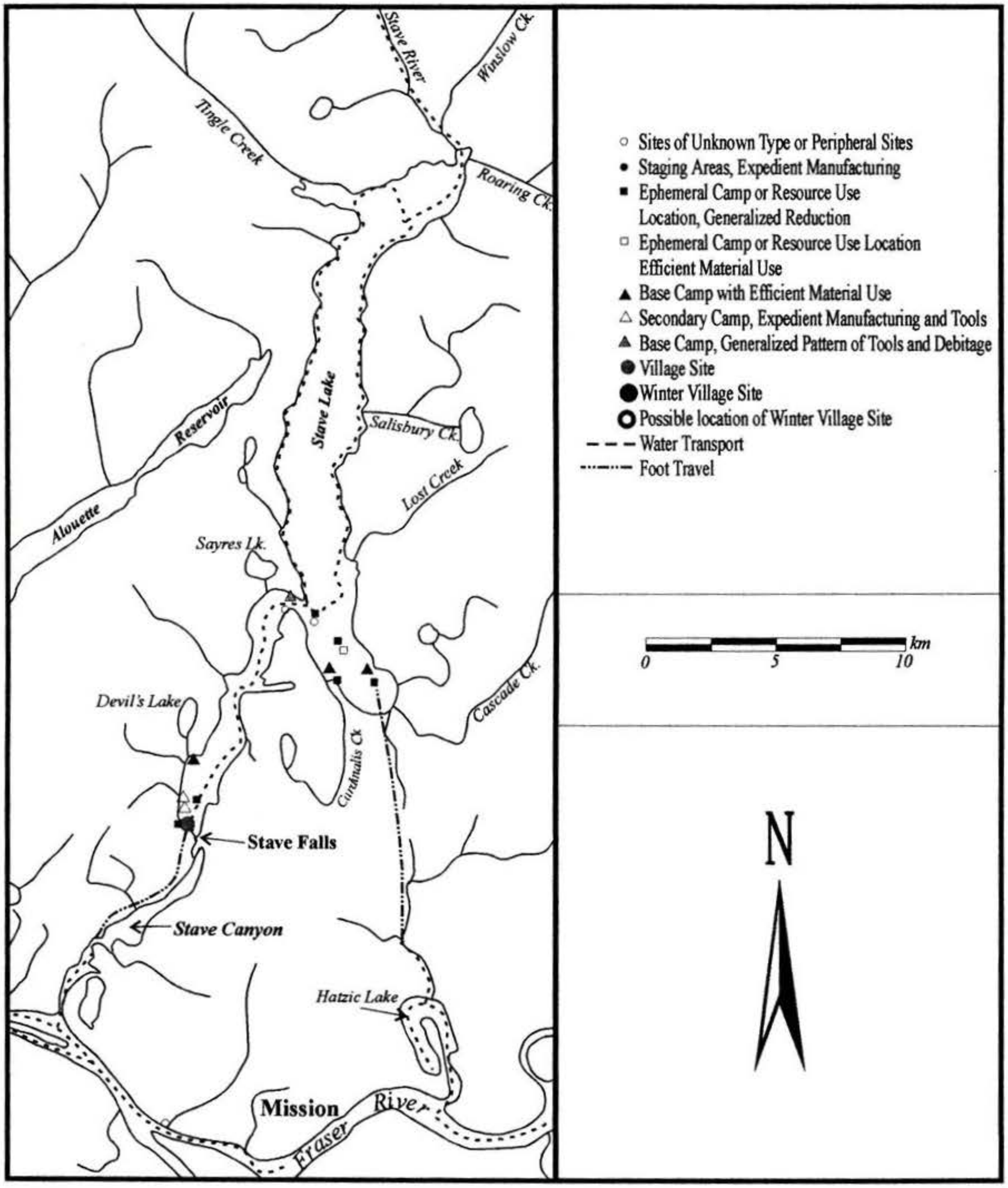


Figure 46. Middle Sequence Land-Use and Settlement Patterns.

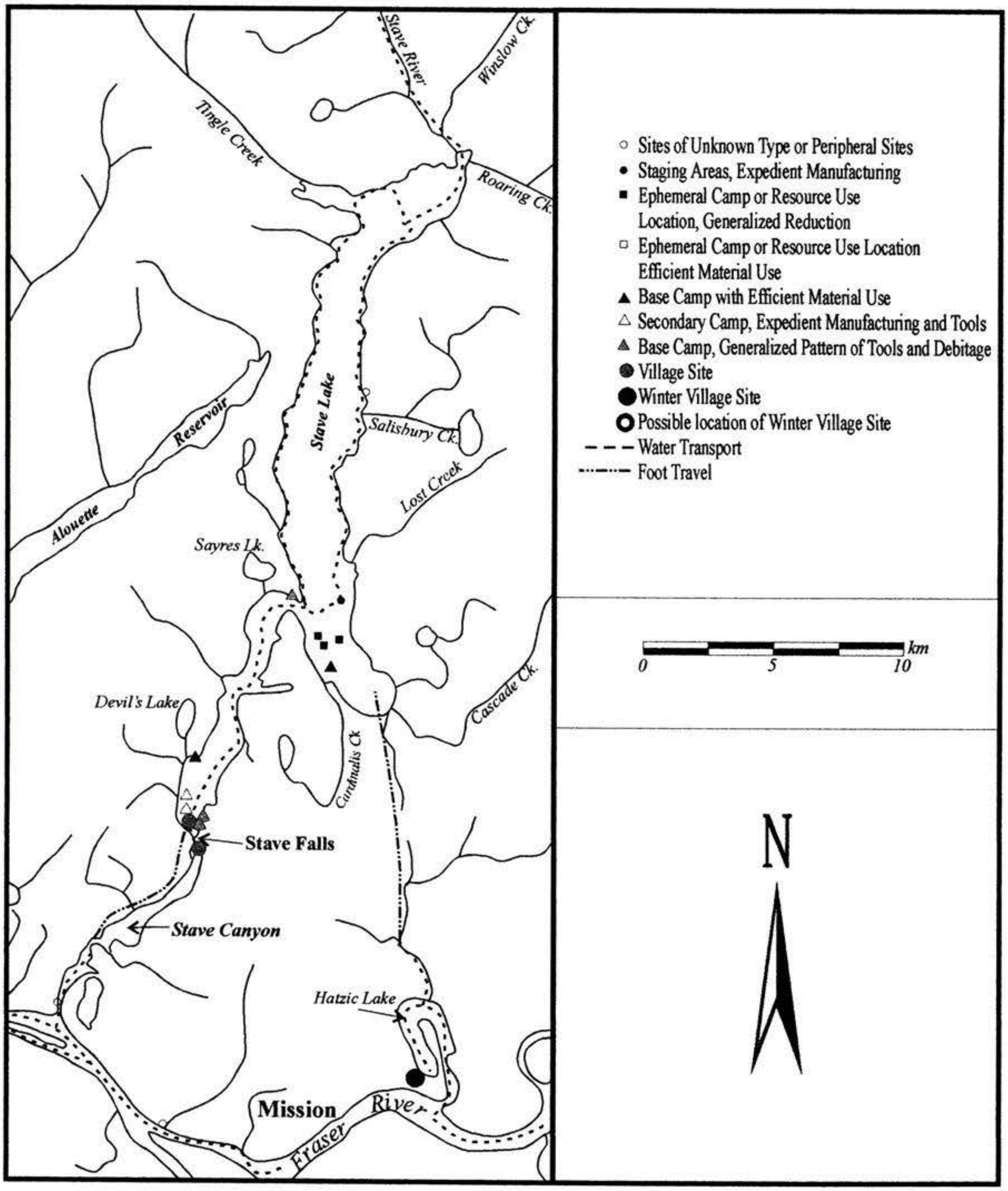


Figure 47. Late Sequence Land-Use and Settlement Patterns.

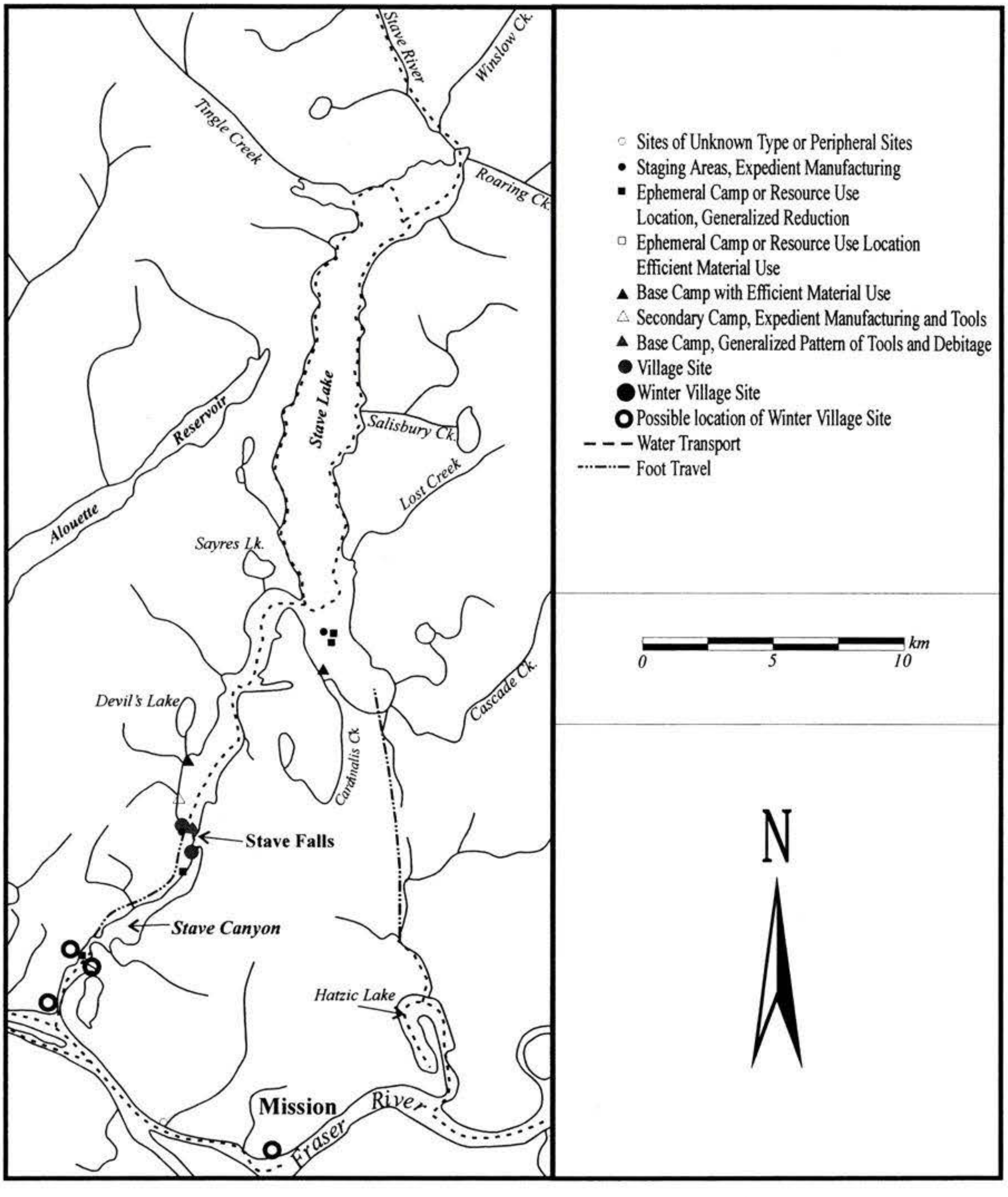


Figure 45 reveals the earliest site locations to be found in the study area. Site densities begin with concentrations in the Stave Falls and South End of Stave Lake areas. There is greater density of use of the south end of the lake in this period than in any other. Conversely, the Stave Falls area seems to increase in usage in the middle period (Figure 46). Many of the base camp location remain the same throughout the sequence. Ephemeral camps, resource gathering/processing locations seem to change locations from one period to another. The south end of Stave Lake has a concentration of ephemeral camp, resource acquisition/processing locations throughout the middle and late periods (Figure 46, Figure 47), whereas in the Stave Falls region they are fewer, perhaps being amalgamated into camps or being misclassified as camps.

Importantly, and in contrast to these patterns of changing land-use, there is also evidence on these maps of continuity in the use of location through time. The areas in which human occupation first appear continue to be used throughout the sequence. There is an increased tendency in this pattern through time. In the early period, site types include base camps with efficient material use, sites of unknown type, secondary camps, resource acquisition/processing locations (ephemeral camps) with emphasis on middle stage reduction, and the palimpsest DhRo11, which is synchronically classified as a village site. Overall this pattern suggests land-use strategies are associated with a higher relative degree of mobility due to the efficiency of material use. Later periods include the presence of a number of base camps, village locations, and staging areas, and lesser occurrence of ephemeral camps or resource acquisition and processing locations than found previously. There is a shift in this period with the greater presence of base campsites with generalized patterns of tool manufacture. The relative lack of ephemeral camps suggests that land-use is becoming less opportunistic and more regularized in site location choice. This pattern seems to continue into the latter period, although land-use strategies appear to become even more restricted relying on traditional base camp locations.

With the exception of the southern end of Stave Lake, there are few sites that have been located along the shores of the lake. Much of the region is extremely steep and inhospitable, and much of the resource use undertaken on the lake may have been done from watercraft. Furthermore, this area is difficult to access and inventory work has not been as extensive.

Conclusions

This chapter presents the methodology and results of an archaeological land-use analysis of the Stave Watershed Study Area. It has demonstrated that there are different land use activities that were undertaken in the region. There have been some changes in the overall distribution of types and land-use practices and the locations preferred for undertaking these activities through time. It has also been demonstrated that some areas have continued to be used in general throughout the entire human occupation of the region.

There is a general shift in land-use patterns revealed in this analysis from curation oriented manufacturing strategies to more expedient oriented strategies. In earlier times the reliability and maintainability of the tool kit use is of importance due to relatively high mobility, the need to acquire and process food at a moments notice, and possibly, limited access to high quality materials. In later periods, there is an emphasis on expedient oriented strategies, use of locally available and poorer quality materials, and lesser relative mobility. In earlier periods land-use appears to be more opportunistic in terms of location chosen for activities. In later periods, sites appear to be chosen on the basis of tradition of use.

CHAPTER SEVEN - DISCUSSION AND CONCLUSIONS

Introduction

There are many ways in which long-term periods of history can be described and understood. This thesis has explored multiple long-term histories of the study area and surrounding region. These histories are broad in scope and provide sequences of events. In some instances, striking similarities can be found between one historical sequence of events and another. Threads of similarity amongst other sequences are less prominent. These histories suggest multiplicity in experience and understanding over long-term periods of time.

This discussion attempts to draw upon the similarities and differences of the historical sequences explored. As such, a broad and inclusive perspective of the known human past of the study area is attempted. In tracking similarities and differences, particular attention is paid to the relationships between narrative themes and stylistic expression, rather than more archaeologically sanctioned devices such as absolute dates. In undertaking this type of synthesis, similarity in narrative theme or stylistic expression may indicate similarities in chronology although it is possible that similar narrative or stylistic events occurred at different times. Similarly, differences in narrative sequences may indicate differences in chronology, but different events can co-occur.

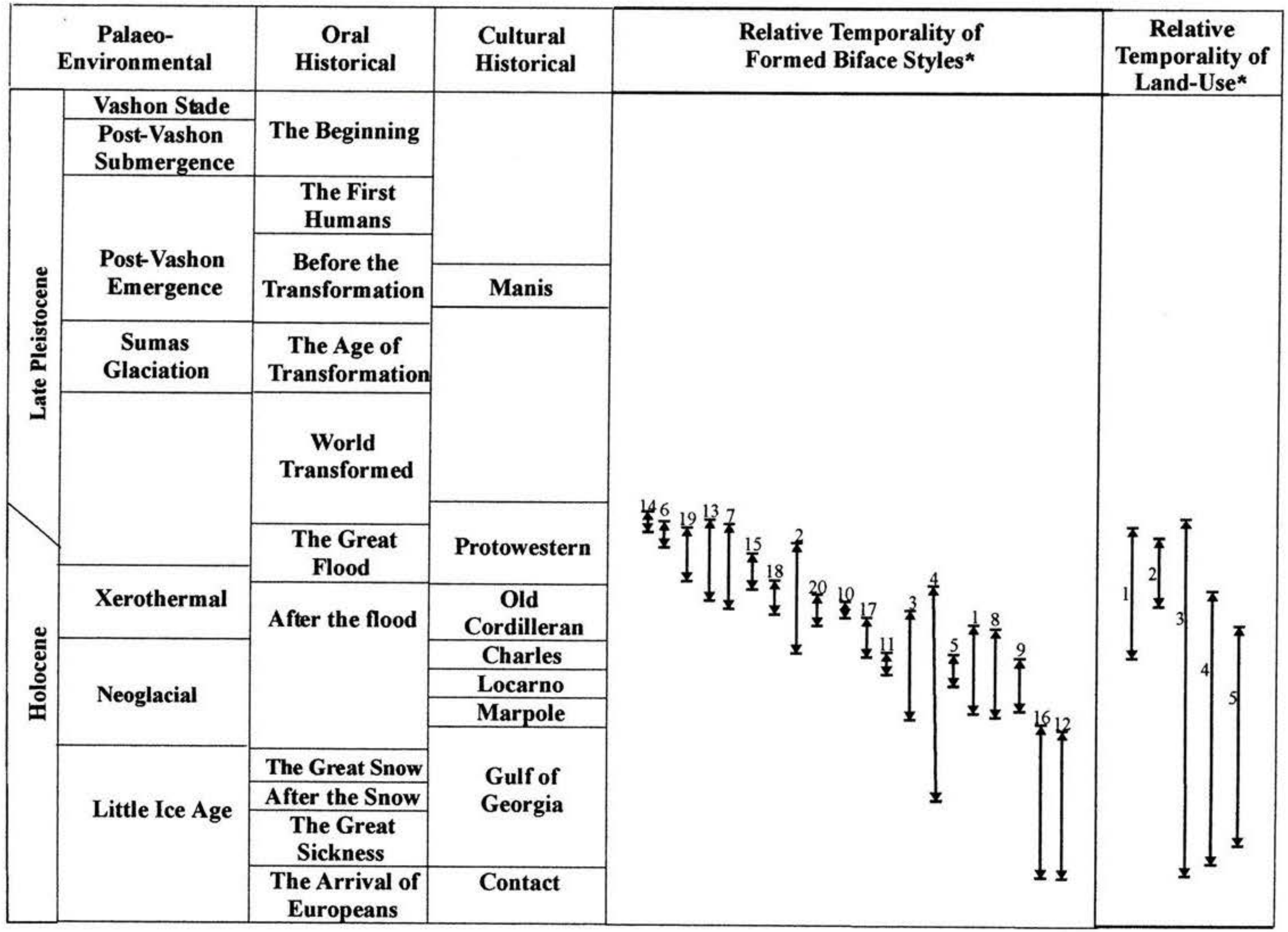
Figure 48 presents a chart demonstrating the relatedness of sequences drawing from narrative event and stylistic cross-references. It forms the backbone of the relationship between sequences discussed in this chapter. All sequences are ordered from older to newer events and cross-referenced by similarities of narrative theme or stylistic expression, with the exception of the palaeo-environmental and archaeological sequences that have been cross-referenced on the basis of absolute dates.

Sequences Produced through Analysis

The results of the seriation and land-use analyses reveal sequences that occurred in the Stave Watershed over long-term periods of time. These sequences are readily comparable to the known archaeological sequence of the region as all are constructed from archaeological materials.

Drawing on comparative material from the Glenrose Cannery Site, formed bifaces from the seriation were shown to have links with the known archaeological sequence. The Stave material was also clustered into several classes to provide a comparative basis. Materials associated with the Protowestern tool tradition occur earliest in the sequence and have affinities with other early tool traditions in Western North America including the Intermontane Stemmed Point Tradition and the Plano complex, referred to collectively as the Stemmed Point Tradition (Bryan 1980). The Protowestern material has not been previously recognized in the archaeological sequence of the lower Fraser Valley or Strait of Georgia region, with the possible exception of the Manis Mastodon site that may in fact predate the Protowestern period (Gustafson and Manis 1984). This seriation analysis has extended the known sequence of human occupation in the region to the late Pleistocene/Holocene transition and linked this occupation to descendent traditions.

Figure 48. Mosaic of Long-Term Sequences.



*For Descriptions see Chapter 5 for Formed Bifaces and Chapter 6 for Land-Use.

Sites in the study area were categorized based on the assemblage of artifacts collected. A cluster analysis revealed five distinct clusters of site types and several residual types. These types vary in reduction strategies and frequencies of formal tools. When placed in temporal order using the results of the seriation analysis, it was found that sites from the early part the sequence had greater tendencies towards curative manufacturing strategies. Sites associated with later time periods displayed tendencies towards expedient manufacturing strategies. These patterns suggest that land-use strategies in the earlier part of the sequence involved greater mobility reflected in efficiency in the use of raw material and curation of artifacts to ensure that tools were available when needed. Later time periods involved lesser mobility and allowed for greater risks in the use of flake stone technology.

The shift from curative to expedient strategies occurs approximately at the same time as a major shift in projectile point styles. Formed bifaces with collateral and oblique flake scar orientations, parallel and lamellar flake scar outlines, and finishing thinning flakes removed to the central median of each tool, are replaced by the less finely crafted materials of later periods with random and sub-radial flake scar orientations, variable flake scar orientation, and lacking finishing thinning flakes to the medial axis of each tool. Prior to this shift, the projectile points in the area have greater affinities with those from other regions, many far reaching such the Plains, Great Basin, Northwest Coast, and Northern Cordillera. Following the shift, most of the types are restricted to a more regional tradition, particularly, in the contracting stem point tradition. Similar trends in craftsmanship and towards developing regional traditions occur in other localities in the Americas and are often used to characterize the threshold between palaeo-Indian and

Archaic Traditions (Hayden 1981). Significantly, changes in patterns of mobility and group interaction have been associated with this period of transition. It is argued that Palaeo-Indian groups maintained wide interaction networks due to the unreliability of resources (Hayden 1981). Wide interaction networks increased cultural homogeneity over vast regions. With changing environments and the adoption of new technologies:

> it was no longer necessary to maintain as frequent or widespread reciprocal relations with other bands ... Because of this more reliable and abundant resource base, many groups became much more independent economically; economic alliances were greatly reduced in importance; and means formerly used to insure maintenance of distant interaction and reciprocal responsibilities between groups were greatly relaxed and abandoned. Specifically, this resulted in cessation of widespread trade in aesthetic, exotic raw material and highly-crafted items, and it increased regionalization of cultural systems in most areas (Hayden 1981:119).

If the adoption of expedient technology is taken to indicate lesser relative mobility, then it lends support to the decrease in interaction as an explanation of change in projectile point styles in the Stave Watershed area. Curiously, however, this shift seems to occur around the end of the Old Cordilleran Tradition, long after reliable resources, including salmon, became available in the region (Matson 1992 contra Fladmark 1975). Significantly, a major change in the environment of the region does occur at approximately the same time: the establishment of cedar forests. Indeed, the broad technological spectrum and plasticity of cedar utilization (Hebda and Mathewes 1984) may have effected regionalization rather than food resource stabilization, a proposition that runs counter to the oft-cited importance of salmon storage to the development of regional traditions (Schalk 1977; Matson 1992; Mason 1994). Despite changes of mobility, interaction, and style, there are many aspects of the technological and stylistic complements from the study area that suggest continuity of the tradition in tool making and land-use suggesting changes were conventionalized into existing ways of life.

A Context of Historical Sequences

The environmental, archaeological, and oral historical sequences for the study area provide insight into the human history of the region. At the narrative level, and as expressed in Figure 48, the oral historical and environmental sequences seem to have much more in common with one another than with the archaeological sequence. Whereas the phases of the archaeological sequence are based primarily on frequencies of artifact types and ascribed radiocarbon dates, the temporal markers of the oral historical and environmental sequences are based on large-scale change as a result of environmental shifts.

Two different perspectives of the past are presented when one considers the archaeological narrative in association with the oral historical and palaeo-environmental narratives. The known archaeological sequence is characterized by relatively gradual change (Fladmark 1982; Matson and Coupland 1995). Environmental upheavals rarely figure into the sequence. There are exceptions including the shift from the Milliken to Mazama Phases in the Fraser Canyon that are separated with 6,600 year old Mazama ash (Mitchell and Pokotylo 1996). Subtle environmental change does occur at similar times to changes in the archaeological sequence including a slight regional cooling episode, known as the Tiedemann advance (Ryder 1989), associated with the change from Locarno Beach to Marpole culture types (Mitchell 1971), and a perceived 'stabilization' in salmon stocks around 5,000 B.P. and the associated 'development of' storage (Fladmark 1975; but see Matson 1992). Significantly, in comparison to the events of the late Pleistocene described in the palaeo-environmental sequence and the large-scale upheavals of the oral historical sequence, few catastrophes or environmental factors are given for changes in the archaeological sequence. Although the reasons for change from one phase to another, in particular the change from Locarno Beach to Marpole (e.g. Borden 1951), have not always been presented in models that stress the idea of continuity, the long-term sequence of tool types (Mitchell 1971; Fladmark 1982) suggests overwhelming continuity and gradualism. Indeed, many archaeological interpretations have adopted this concept of continuity and gradualism as a given in their models of the emergence of cultural complexity or of the development of the northwest coast ethnographic pattern (Mitchell 1971; Schalk 1977; Matson 1992; Matson and Coupland 1995; Carlson 1996).

Unlike the archaeological sequence, the oral historical and environmental sequences are concerned with profound environmental change. Periods in the palaeo-environmental sequence are separated by large-scale environmental change: glaciation, dropping sea levels, isostatic rebound, a catastrophic flood, and climatic shifts. In similar ways, the oral history is organized sequentially by large-scale environmental upheavals such as related in the Transformation, the Great Flood and the Long Snow (Hill-Tout 1897; Hill-Tout 1903; Street 1974; Stern 1934, Jenness 1955). Significantly, these are the types of events that make stories interesting and thus, repeatable and memorable. Whereas the archaeological sequence of the study area is concerned with the gradual, the oral historical sequence focuses on the punctuation of catastrophe and upheaval.

As the oral historical sequence includes many references to environmental upheavals it can be compared on a relative scale to the palaeo-environmental narrative that also includes episode of regional upheaval. The relative sequence of themes associated with environmental change is key to this comparison.

The oral historical sequence provides a relative temporal framework for the study area that suggests when the first ancestors arrived or appeared that the land was unoccupied (Hill-Tout 1897; Street 1974). Similarily, the palaeo-environmental model for the study area suggests that the area was likely uninhabitable before 13,000 years B.P. as a result of the large-scale glaciation of the region and submergence (Armstrong 1981:12; Mathewes 1973; Clague 1982).

After the arrival of the first human, the local and presently identifiable fauna of the area became established as is related by the oral historical sequence (Hill-Tout 1897; Jenness 1955). At first it is related that there are only mussels and clams to eat (Jenness 1955). Following deglaciation the palaeo-environmental sequence reveals that edible mollusks such as butter clam, native little-neck clam, and bay mussel, "that served as important food resources to prehistoric peoples and today, occurred abundantly as ice left the area" (Hebda and Frederick 1990). In some instances, the oral histories are very detailed about the sequence by which species are established in the area (Jenness 1955).

The coming of *Xals* brings about great transformation in terms of the landscape, people, and ecology (Stern 1934; Hill-Tout 1903; Jenness 1955; Street 1974). Similarly, the events that occur around the deglaciation of the area bring about tectonic, eustatic, and isostatic dynamics (Armstrong 1981).

The great flood brings about yet another catastrophe in the sequence of the oral histories. Similarly, the environmental history relates a story of a catastrophic flood event that occurred between 9,800-9,160 radiocarbon years B.P. (Conway et al. 2001).

Following the flood, according to the oral-historical sequence, is a period of relative stability during which the people recover, salmon are reestablished, and people thrive. Concerning the establishment of salmon, Hebda and Fredrick (1990) suggest

> At first there could have been no salmonids, or spawning areas in any of the main river systems. Most of these were likely choked by ice until about 13,000 years ago and many until 10,000 to 11,000 years ago.

In the oral-historical sequence salmon are established before the flood, and are once again established after the flood. (Jenness 1995; Street 1974).

There are a great many similarities in the relative sequence of events between the early part of the oral-historical narrative and the late Pleistocene as characterized by the palaeo-environmental sequence. Both draw upon environmental change as benchmarks and climaxes.

Compared to the events of the late Pleistocene, climatic conditions during the Holocene are relatively stable. Few large-scale catastrophic events appear to occur during this period as related by the palaeo-ecological, oral historical, and archaeological data. The long-term stability of this period provides little upheaval for oral historical temporal references. Conversely, the stability of this period provides accumulations and centralization of human activity making highly visible and accessible concentrations of archaeological material of the type that archaeologists like to take advantage of (Clague et al. 1982: 603).

Subtle environmental change does occur during the Holocene. This includes the gradual rise of sea levels and the complementary growth of the Fraser Delta (Williams and Hebda 1991). This event is also referred to in the oral historical sequence where Tsawwassen is said to have been an island before it became connected to the mainland

(Appleby 1961). Conditions in the latter part of the Holocene are thought to have been periodically cooler and wetter than the early Holocene. Three glacial advances occur between 6,000-5,000 B.P., 2,300-1,900, and 900-100 B.P. (Ryder 1989). The late neoglacial advance, known as the 'Little Ice Age' was the most pronounced. The oral historical sequence refers to the period of the Great Snow that follows the stability that occurred after the Great Flood. The shifts from the Old Cordilleran to Charles phases, Locarno to Marpole culture types (Mitchell 1971) and technological changes in the complement of artifacts in the late Gulf of Georgia culture type (Carlson 1970) all occur at periods of Neoglacial re-advances. Although these periods are found in evidence of glacial advances, there seems to have been little effect on the vegetation communities of the area, although the onset of this cooler period is associated with the establishment of cedar in the region (Anderson et al. 1989).

The oral-historical and environmental sequences have many similarities in the long-term sequence of events that have occurred since the last glaciation/beginning of the oral historical sequence. The archaeological sequence does not seem to refer to events as antiquated as the oral historical and palaeo-environmental narratives. Periods of general environmental stability during the Holocene provide a means for the accumulation and development of archaeological materials, but less fodder for dynamic oral-historical or palaeo-environmental narratives. Subtle changes in Holocene environments as recorded in the palaeo-environemntal and oral-historical sequences may have been associated with shifts in late Holocene culture types.

Understanding the Processes of Tradition

Human actors are intricately involved in the mosaic of long-term stabilities and changes as traced through the multiple histories explored in this thesis. Significantly, social memory ties the actors involved in these sequences together, and consequently the processes of social memory provide a means of understanding the action of people over extremely long periods of time.

Memories are representations of the past, as Fentress and Wickham (1992:6) note "what makes memory usable at all is that we can articulate it". The act of remembering is the articulation of memories through embodied acts (utterance, action, thought, and emotion). Memories must become "sedimented" if they are to be remembered and recognized as entities of tradition (Berger and Luckman 1966). There are (at least) two manners in which societies sediment memories. These are: incorporation and inscription (Connerton 1989). Incorporation refers to the personal storage of knowledge in an individual person's memory. The process of storage is not necessarily intentional or conscious and may occur as a matter of habit. Inscription refers to the process of storing knowledge in a form external to a body or being, as in a book or text. With incorporation, traditions are passed from one individual knower to another. Inscriptions provided the means of storing knowledge away from actors, but which may (or may not) be accessed by the actors at a later date – the knowledge is essentially forgotten by the actors. It is the vessel of the memory that is of significance to the distinction, but both forms are important in the preservation of tradition.

In the process of incorporation, a story knower does not necessarily memorize a story word for word; rather, as a listener, and through repeated performance of a particular story, it becomes incorporated into the memory of the individual. This type of remembering can be distinguished from memorization, as it is habitually remembered, and it is the stimulus of performance that brings certain phrases to an orator's narrative, rather than it being prepared before hand (Lord 1981). Sensory organs incorporate memories. In the case of oral poetry, several mnemonic devices are used to remember memories:

> songs many thousands of lines long could be composed without writing, by the singer's drawing on a store of formulae and formulaic expressions with no need to prepare a text beforehand: composition and performance were not separate stages but facets of the same act. Some formulae were short phrases fitting a given metrical position, but longer formulaic expressions included runs of several lines, themes topics, and narrative plots. There was no fixed or 'correct' text, as in written literature, for each performance was different and equally authentic [Finnegan 1992:41].

An oral narrative itself may be considered to be "a sort of natural container for memory; a way of sequencing a set of images, through local and semantic connections, into a shape which is itself, easy to retain in memory" (Fentress and Wickham 1992:50).

An archaeological sequence is, in part, an aggregate of incorporated representations through time. A sequence of tool styles is in essence a reflection of the consecutive rememberings of a sequence of actors. The manufacturer may draw upon habitual memories such as learned reduction techniques and is guided by inscribed templates or incorporated ideals as to the desired outcome. Similarly, an oral narrator may make reference to various mnemonic devices (for example as inscribed in geographic reference points) or listen to complementary performances by other bards.

By understanding the manufacture of tools, the use of the landscape, and the narrating of stories in the context of social memory, a means of understanding both the perseverance of tradition and simultaneous change in tradition can be understood. As such, tradition cannot be envisioned as static or wholly dynamic. Rather, it is in essence emergence of the past shaped by the present.

If an archaeologist is to uncover the processes of remembering in the past, then it is necessary to view these memories in terms of mnemonic devices employed. To understand the long-term social processes of incorporated memory in the past, certain aural/oral qualities used in oral historical performance can be drawn from to provide guidance through analogy. For example, there are several means by which oral narratives are remembered: repeated exposure, narrative structure, external reference, and rhyme and rhythm.

A reproduction created by a rememberer, whether a story, tool, or inhabitation begins with the desire to create a particular thing. The shape of the end product is generally known to the beginning of the production; it can be something that is drawn from an inscribed physical example (template) or an incorporated memory (ideal). The influence of the mental template has long been considered in the theorizing of tool manufacture amongst archaeologists (Rouse 1964).

Deviations from templates or ideals can occur as a result of the performance, because of outside influences such as the diffusion or ideas, ideals, or templates, or because of individual innovation. In the case of the oral performance, many factors may influence the production during the course of performance. For example, the favourable or not so favourable responses of the audience may result in elaboration or summarization, forgotten passages, or events may require innovative thinking to rework narrative flows. The listeners to the narrative may remember aspects resulting from the context of one poor performance rather than a good and elaborated performance.

Similarly, performing the task of manufacturing and using a tool to the specifications of a given tradition will produce variation as a result of many manufacturing related factors: the quality of the material being used, the blank or broken object being operated upon, the rigidity of the society about the perpetuation of a given tradition, mistakes made, and forgotten stages or elements of manufacture.

Actors react in different ways when change and stability occur in concert. Sir Frederic Bartlett (1964) was particularly intrigued by the manners in which change and stability interacted in oral history and in graphic representations of non-literate societies. Bartlett devised some tests to see if there were any patterns in the transformations that oral narrative might undergo when introduced into a foreign cultural milieu. The subjects of these experiments were asked to memorize a folk-tale from a different cultural group, and then after a rest period of fifteen to thirty minutes the subjects were asked to write a version of the story from memory. The story that was produced by this subject was then taken and given to the next subject who repeated the experiment, except that the text that had been produced in the previous situation served as the text that was being read and remembered by this subject. After the story had been passed through a string of people it was noted that it had story changed in various ways. Bartlett referred to these changes as the conventionalization of cultural material foreign to the test subjects. In essence, these stories were changed to reflect the convention of the people adopting them. This process of conventionalization was found to occur in a historical analysis of pictographic symbols as well (Bartlett 1964: 178-185). Bartlett's process of conventionalization can be characterized by four interrelated processes: 1) the representation becomes absorbed as an aspect of the habitual memory of the group; 2) the representation may be simplified or elaborated; 3) it may retain seemingly unimportant foreign elements; 4) and, it may work with other influences to construct a characteristic form of social trend.

Similar ideas have been considered in archaeological thought regarding social time. In particular, Gosden (1994) writes eloquently about the time of habit, and considers it as being long in duration. Gosden also develops the concept of 'public time', which is generally of shorter duration, and is the manner in which social groups negotiate habit within their particular context. The processes of conventionalization are evident in the manner in which Gosden (1994:189) characterizes the structuring of public time by habitual time:

> Public time arises as a coping mechanism for the problems of habit, and over time shades off into habitual action, forming a temporal cycle of thought and unthought patterns of life ... Public time must resonate with habit in order that it be accepted, so that habitual action sets the limits to the manipulation of public time.

Human actors are intricately involved in the mosaic of long-term stabilities and changes as traced through the multiple histories explored in this thesis. In the oral historical sequence, themes, mnemonic devices, and the relative temporality of events were passed from one generation to another through teaching, repetition, and remembering. It is certain that such aspects as outside influences, forgetting, and performative elaboration may have changed or altered aspects of the manner in which the a particular narrative was remembered. These changes likely occurred many times in the past. However, various aspects of these narratives remained constant regardless of these changes, much as the primary mnemonic devices for these stories, geographical reference points, remained relatively unchanged since their creation or uncovering (Mohs 1987). The relative chronology identified in this thesis suggests that the temporality of events in the past was an important aspect of the stories as remembered by their narrators. The corroboration of the sequence of events between orators lends credence to these processes. Social memory is key to the continuation of these oral traditions and, as suggested by this thesis, has been for an extremely long time.

A number of conventions are apparent in the sequential patterns in the oral narratives. In particular, the stories of Simon Pierre (Jenness 1955) and Chief Sepass (Street 1974) contain references that seem to drawn on biblical images or language (Suttles 1987; Beirwert 1999). Sepass's narratives contain references to 'writing' as being employed long ago by the sun. These aspects have been incorporated into the narratives as a process of understanding the traditional stories in a contemporary or cross-cultural (ethnographic) context. It is likely that similar changes occurred with relative frequency throughout the life history of these stories. Stability in these traditions is displayed by an overall consistency in theme, geographical reference, and relative temporality, shared by different storyteller and keepers of social memories. Indeed, only changes acceptable to the particular time would have been allowed.

The seriation sequence constructed for the study area presents a long-term history in which social memory is key. The continuity of stylistic attributes of formed bifaces necessitates that the manufacturing sequence and stages are remembered so as to reproduce similar biface types generation after generation. Certainly change occurs due to many possible factors: adaptation to different mobility patterns, outside influence, raw material, individual innovation, and performative context. However, many attributes remain constant for very long periods of time and in some cases one period may not be distinguishable from others based on the style of projectile points (for instance the considerable overlap of St. Mungo and Marpole period materials in the seriation analysis). Significantly, tradition is adhered to through social memory, the processes of which are exemplified by long-term stability. Changes in style also occur through conventionalization, where aspects of the new or foreign ideal are absorbed into the existing manufacturing sequence, or aspects of the old or traditional method of manufacturing are retained when a new style is adopted. This is evident in the manifestation of projectile point attributes through time. The sequence shows that three attributes: Excurvate Blade, Alternating Order of Flake Scar Removal, and a Lenticular Cross-section form the backbone of tradition throughout the sequence of point manufacturing. Some attributes are absorbed into the existing range of styles when they appear such as the different basal forms or relative amount of bifacial working (Scar#/Length). Other attributes eventually become the normative means of expression such as the adoption of variable patterns of flake scar outlines and the disappearance of lamellar and parallel flake scar outlines, collateral flaking, and the practice of removing finishing flake scars to the center of the artifact. Adherence to tradition in the context of subsequent presents requires that tradition be continually modified.

The long-term patterns of land-use in the study area also involve social memory. That people continue to return to the same place generation after generation may be the results of incorporated habitual memory, or inscribed evidence of that use, rather than for reasons associated with ideas such as optimal foraging or other ecologically reductionist reasons. Indeed, if salmon procurement and storage allows for affluence and excess to the economy of the region (e.g. Schalk 1977), why would people continue to use a non-salmon bearing region? Certainly variety of sustenance was likely important, but one must not discount the tradition of land-use or tradition of particular resource usage. The social memory of land-use creates a long-term pattern where sites and localities are continuously used despite changes in human economies. Consequently, long-term inhabitation of the study area demonstrates increased continuity in repetitive site use, yet relative change in land-use patterns.

The practice of tradition involves patterns of stability and change. Archaeological inquiry into long-term history most often explains change, but rarely is concerned with understanding stability. Evaluations of oral history have often been devoid of acknowledgements of stability. It has been demonstrated that long-term practices of tool manufacturing, land-use, and story telling involve aspects of social memory, and as such, demonstrate the repetition and reinvention of tradition in subsequent presents.

The results of this thesis demonstrate the importance of change and continuity when considering very long-term periods of history. This consideration differs from the archaeology generally practiced in the region where change is privileged both in the construction of culture-histories, or by the ahistorical and ecologically centerred explanations used by processual archaeologists (Mackie 2001). This thesis has attempted to provide multiple understandings of the long-term histories and the enactment of tradition throughout those histories.

Conclusion

This thesis has presented three long-term sequences from the lower-Fraser River drainage region and through analysis has constructed two additional sequences from archaeological materials collected in the Stave River Watershed. The long-term histories have been considered in concert to develop a tapestry of interwoven histories. Similarities and differences in the sequence of events are illustrated and compared and all contribute to the understanding of the long-term history of the region. Of primary importance is the concept of tradition that is continually being repeated by the rememberings of generation of human actors in different contexts throughout the temporality of the sequence. As such, tradition permeates throughout the sequences investigated as represented by simultaneous and consecutive patterns of continuity and change.

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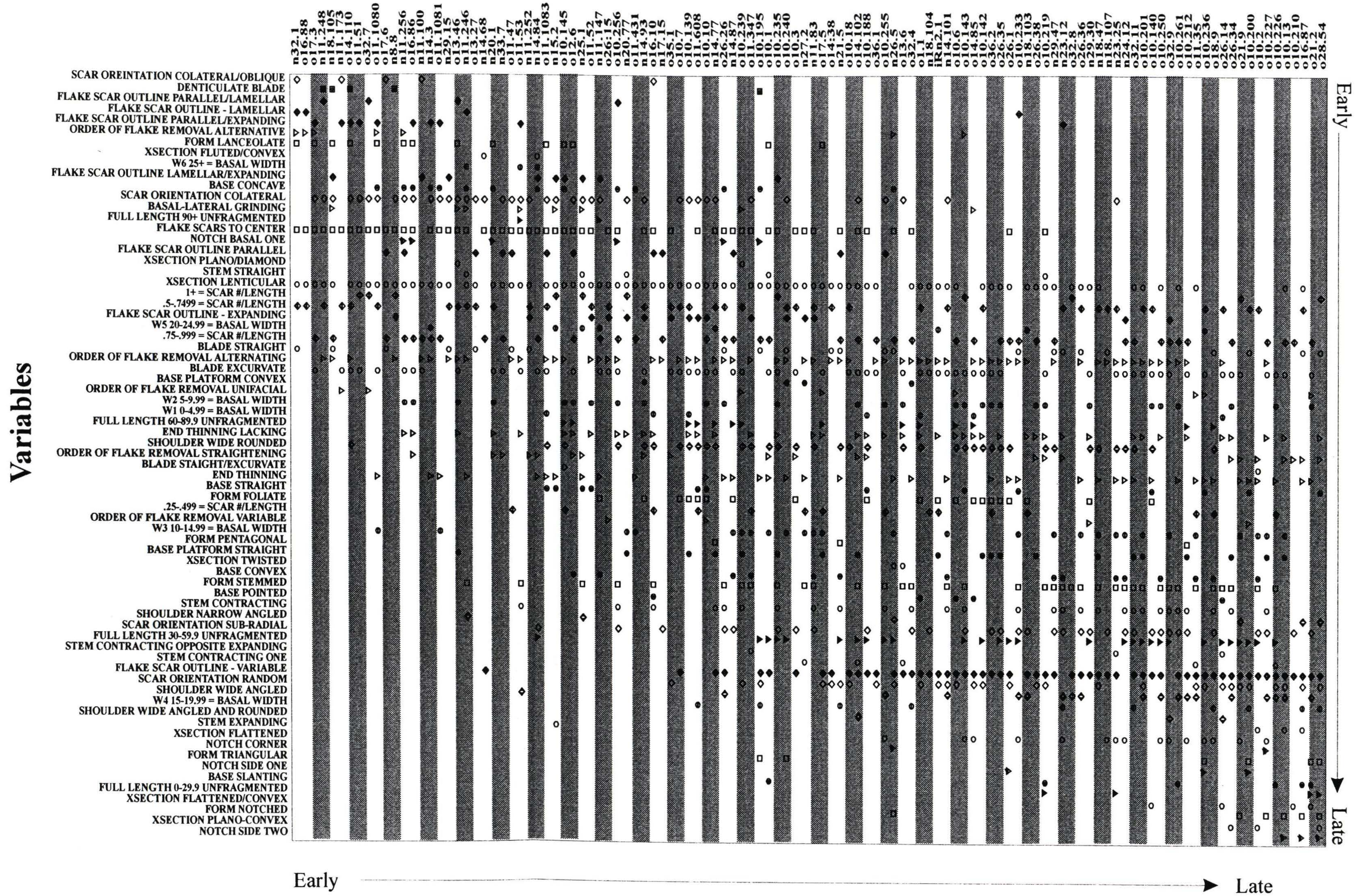
Appendix A. Enlargement of Figure 17, Results of Seriation Analysis.

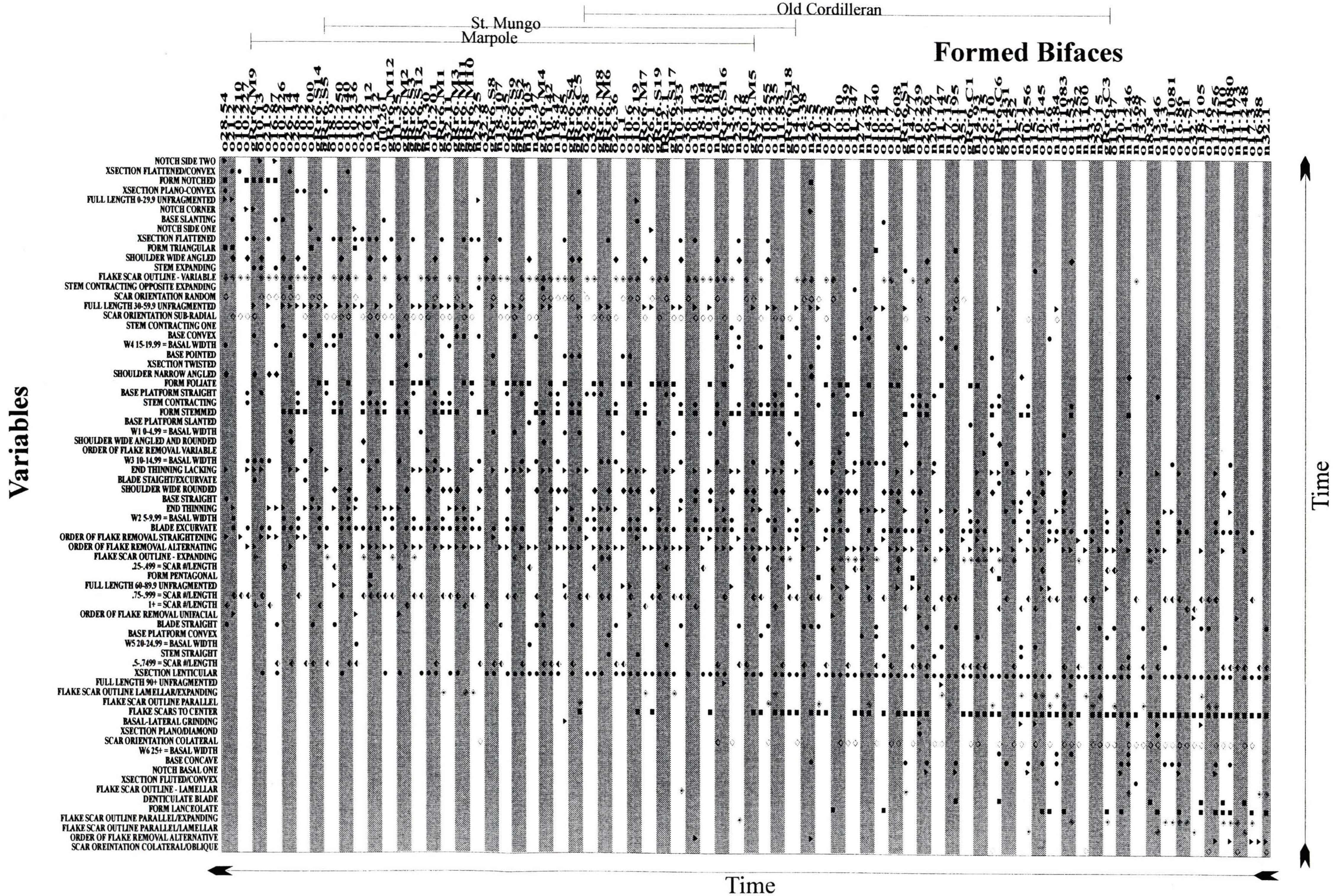
Appendix A. Results of Seriation Analysis (Enlargement of Figure 17).

Formed Bifaces



Appendix B. Enlargement of Figure 36, Seriation Results with Formed Bifaces from the Glenrose Cannery Site.

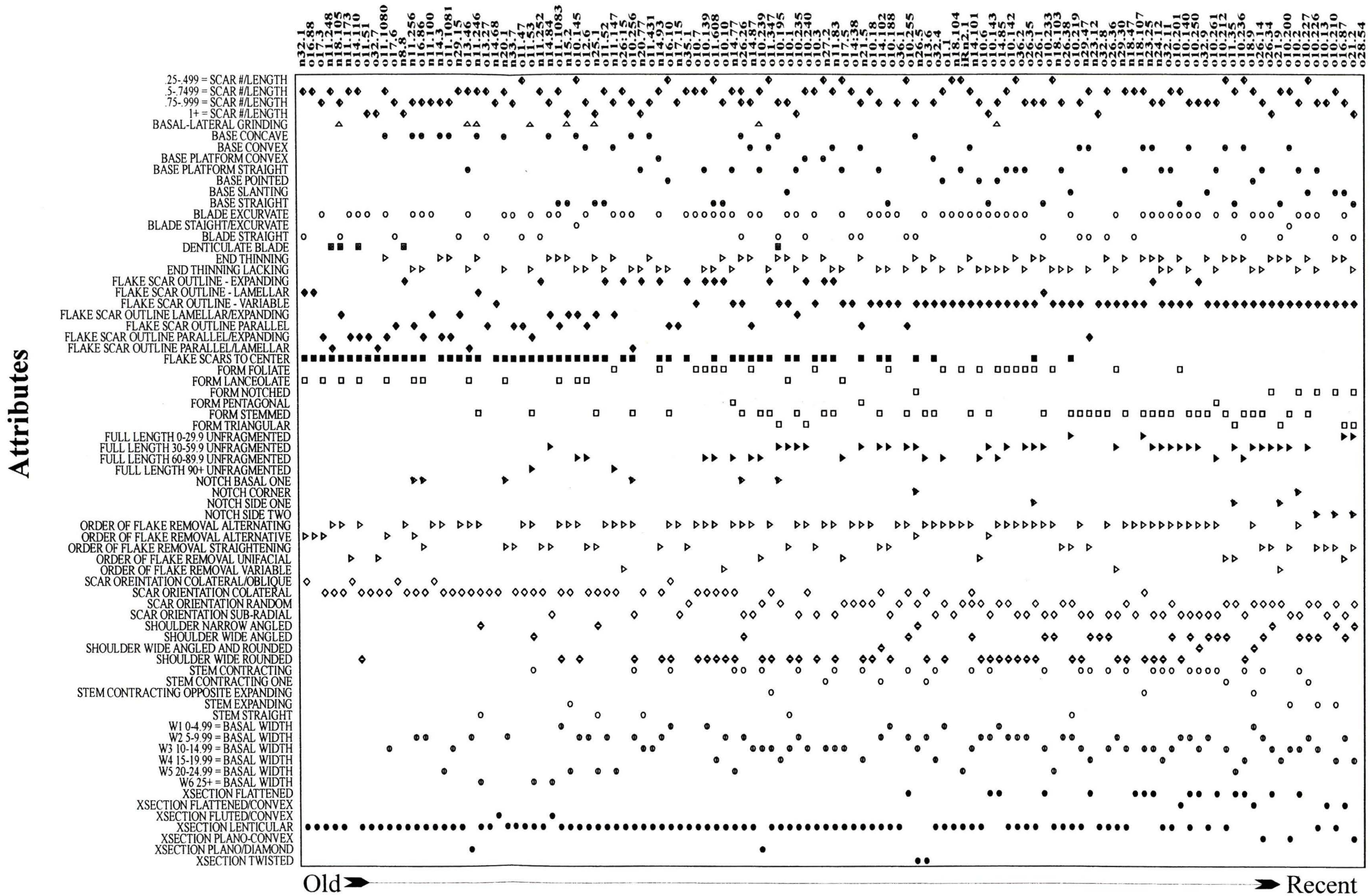
Appendix B. Seriation Results with Formed Bifaces from the Glenrose Cannery Site (Enlargement of Fig. 36).



Appendix C. Enlargement of Figure 38, Temporality of Formed Biface Attributes.

Appendix C. Temporality of Formed Biface Attributes (Enlargement of Fig. 38).

Points



Appendix D. List of Formed Bifaces and Attributes.

File: FINAL.ENT

Data: points

116 Units 74 Types

1218 Incidences

List of Units with Types Sorted by Name

Unit: iRn2.1

Variables:

BASEP BASEW5 BLADEE ENDTHINN FORMF OFSRAG ORIENTR OUTLINV S/L2 XSECTL

Unit: n11.100

Variables:

BLADEE OFSRAG ORIENTCO OUTLINLE S/L4 XSECTL

Unit: n11.147

Variables:

BASECX BASEW5 BLADEE ENDTHINY FORMF Leng4 OFSRAG ORIENTC OUTLINLE S/L4 XSECTL

Unit: n11.173

Variables:

BLADEE CENTER_Y OFSRU ORIENTCO OUTLINPE S/L3

Unit: n11.246

Variables:

BASECV BASEW6 CENTER_Y ENDTHINY FORMS GRINDB/L OFSRAG ORIENTC OUTLINL S/L3 SHLDNA STEMS XSECTL

Unit: n11.248

Variables:

CENTER_Y DENTICU OFSRAG ORIENTC OUTLINPL S/L3 XSECTL

Unit: n11.252

Variables:

BLADES CENTER_Y OFSRS ORIENTC OUTLINE S/L3 XSECTL

Unit: n11.256

Variables:

BASECV BASEW2 BLADEE CENTER_Y ENDTHINN FORML NOTCHBO OFSRAV ORIENTC OUTLINP S/L4 XSECTL

Unit: n11.83

Variables:

BASECX BASEW3 CENTER_Y ENDTHINN FORMS OFSRAG ORIENTS OUTLINE S/L3 SHLDWR STEMC XSECTL

Unit: n14.101

Variables:

BASECX BASEW3 BLADEE ENDTHINY FORMS OFSRAG ORIENTC ORIENTR OUTLINV S/L3 SHLDWA STEMC XSECTL

Unit: n14.3

Variables:

BASECV BASEW5 CENTER_Y ENDTHINY OFSRAG ORIENTC OUTLINPE S/L4 XSECTL

Unit: n14.68

Variables:

CENTER_Y ORIENTC OUTLINV S/L4 XSECTFC

Unit: n14.77

Variables:

BASEP BASEW5 BLADEE CENTER_Y ENDTHINN FORMP Leng3 OFSRAG ORIENTC OUTLINV S/L3 SHLDWR STEMC XSECTL

Unit: n14.84

Variables:

BASECV BASEW6 BLADEE CENTER_Y ENDTHINY Leng2 OFSRS ORIENTS OUTLINLE S/L4 XSECTFC

Unit: n14.87

Variables:

BASECX BASEW3 BLADEE CENTER_Y ENDTHINY FORMF Leng3 OFSRAG ORIENTS OUTLINP S/L4 XSECTL

Unit: n14.93

Variables:

BASEPCX BASEW2 BLADEE CENTER_Y ENDTHINN FORMF OFSRS ORIENTC OUTLINE S/L3 SHLDWR XSECTL

Unit: n15.2

Variables:

BASES BASEW5 CENTER_Y ENDTHINY GRINDB/L OFSRAG ORIENTC OUTLINLE S/L5 STEME XSECTL

Unit: n17.15

Variables:

OFSRAG ORIENTS OUTLINP S/L4 XSECTL

Unit: n18.103

Variables:

BASEPS BASEW5 ENDTHINN FORMF OFSRAG ORIENTS OUTLINV S/L2 SHLDWA XSECTL

Unit: n18.104

Variables:

BLADEE OFSRAG ORIENTS OUTLINV S/L2 XSECTL

Unit: n18.105

Variables:

BLADES CENTER_Y DENTICU FORML GRINDB/L OFSRAG ORIENTC OUTLINLE S/L4 XSECTL

Unit: n18.107

Variables:

BLADES OFSRAG ORIENTS OUTLINV S/L3 XSECTFL

Unit: n18.47

Variables:

BASEP BASEW3 ENDTHINY FORMS OFSRAG ORIENTR OUTLINV S/L3 SHLDWR STEMC XSECTL

Unit: n20.1

Variables:

BASECV BASEW2 BLADEE CENTER_Y ENDTHINN FORML NOTCHBO OFSRS S/L3 XSECTL

Unit: n20.77

Variables:

BASEP BASEW3 ENDTHINN ORIENTC OUTLINE S/L5 STEMS XSECTL

Unit: n21.5

Variables:

BASECX BASEW4 BLADES CENTER_Y ENDTHINY FORMP Leng2 OFSRAG ORIENTR OUTLINP S/L4 SHLDWR STEMC XSECTL

Unit: n23.12

Variables:

BASECX BASEW4 BLADES ENDTHINN FORMS OFSRS ORIENTS OUTLINPE S/L3 SHLDWA STEMC XSECTFL

Unit: n23.25

Variables:

BASECX BASEW3 BLADEE ENDTHINY FORMS Leng1 OFSRAG ORIENTC OUTLINV S/L3 SHLDWR STEMCOEX XSECTFL

Unit: n24.12

Variables:

BASECX BASEW3 BLADEE ENDTHINY FORMS Leng2 OFSRAG ORIENTS OUTLINE S/L4 SHLDWR STEMC XSECTFL

Unit: n25.1

Variables:

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Unit: n26.5

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Unit: n27.2

Variables:

BASEPCX BASEW3 CENTER_Y ENDTHINY FORMS OFSRAG OUTLINE S/L2 STEMO XSECTL

Unit: n29.15

Variables:

BLADES CENTER_Y OFSRAG ORIENTC OUTLINLE S/L3 XSECTL

Unit: n29.30

Variables:

BASEW2 BLADEE ENDTHINN FORMF Leng2 OFSRV ORIENTS OUTLINV SHLDWR XSECTL

Unit: n29.47

Variables:

BASECX BASEW3 BLADES FORMS OFSRAG ORIENTS OUTLINV S/L4 SHLDWR STEMC XSECTL

Unit: n32.1

Variables:

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Unit: n33.7

Variables:

BLADEE CENTER_Y OFSRS ORIENTC OUTLINP S/L4 XSECTL

Unit: n8.8

Variables:

CENTER_Y DENTICU OFSRAG ORIENTC OUTLINE S/L5 XSECTL

Unit: o1.1

Variables:

BASEPT BASEW1 BLADEE ENDTHINN FORMF Leng3 OFSRAG ORIENTR OUTLINV S/L3 SHLDWR XSECTL

Unit: o10.1

Variables:

BASESL BASEW3 BLADEE CENTER_Y ENDTHINY FORML Leng2 OFSRS OUTLINV S/L4 SHLDWR STEMS XSECTL

Unit: o10.10

Variables:

BASES BASEW2 BLADEE ENDTHINY FORMF OFSRV ORIENTC OUTLINE S/L4 SHLDWR XSECTL

Unit: o10.13

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BASEP BASEW3 BLADEE ENDTHINN FORMN NOTCHST OFSRS ORIENTR OUTLINV S/L4 SHLDWA STEME XSECTL

Unit: o10.139

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BASEP BASEW1 BLADEE ENDTHINN FORMF Leng3 OFSRAG ORIENTC OUTLINE S/L3 SHLDWR XSECTL

Unit: o10.140

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Unit: o10.142

Variables:

BASEP BASEW2 BLADEE ENDTHINN FORMF Leng2 OFSRAG ORIENTR OUTLINV S/L3 SHLDWR XSECTL

Unit: o10.143

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Unit: o10.145

Variables:

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Unit: o10.18

Variables:

BLADEE OFSRAG ORIENTR OUTLINV S/L3 SHLDWR XSECTL

Unit: o10.188

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Unit: o10.195

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Unit: o10.200

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Unit: o10.201

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Unit: o10.210

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Unit: o10.212

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Unit: o10.219

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Unit: o10.226

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Unit: o10.227

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Unit: o10.233

Variables:

BASES BASEW3 BLADES ENDTHINY FORMS Leng2 OFSRAG ORIENTS OUTLINL S/L4 SHLDWA STEMC XSECTFL

Unit: o10.235

Variables:

BASEP BASEW2 BLADEE CENTER_Y ENDTHINN FORMS Leng2 OFSRAG ORIENTS OUTLINLE S/L5 SHLDWR STEMC XSECTL

Unit: o10.236

Variables:

BASES BASEW5 BLADEE ENDTHINY FORMT Leng2 NOTCHSO OFSRU ORIENTR OUTLINV S/L3 XSECTFL

Unit: o10.239

Variables:

BASEP BASEW3 BLADEE CENTER_Y FORMS GRINDB/L Leng3 OFSRU ORIENTR S/L3 SHLDWR STEMC XSECTPD

Unit: o10.240

Variables:

BASEPCX BASEW3 BLADES ENDTHINY FORMT Leng2 OFSRAG ORIENTC OUTLINE S/L3 XSECTL

Unit: o10.250

Variables:

BASECX BASEW2 BLADEE ENDTHINN FORMS Leng2 OFSRAG ORIENTS OUTLINV S/L4 SHLDWA STEMC XSECTFL XSECTL

Unit: o10.255

Variables:

BASEW2 BLADES ENDTHINN FORMS Leng2 OFSRAG ORIENTC OUTLINP S/L2 SHLDWA STEMC XSECTFL

Unit: o10.256

Variables:

BASECV BASEW2 BLADEE CENTER_Y ENDTHINN FORMS NOTCHBO OFSRAG ORIENTS OUTLINPL S/L4 SHLDWR STEMC XSECTL

Unit: o10.261

Variables:

BASESL BASEW2 ENDTHINY FORMS OFSRAG ORIENTS OUTLINV S/L4 SHLDWA STEMC XSECTL

Unit: o10.3

Variables:

BLADEE CENTER_Y FORMF OFSRS ORIENTS OUTLINV S/L3 SHLDWR XSECTL

Unit: o10.6

Variables:

BASEPT BASEW2 BLADEE ENDTHINN FORMF Leng3 OFSRU ORIENTR OUTLINV S/L4 SHLDWR XSECTL

Unit: o10.7

Variables:

BLADEE FORMF OFSRAG ORIENTC OUTLINV S/L3 SHLDWR XSECTL

Unit: o11.1080

Variables:

BASECV BASEW3 BLADEE CENTER_Y ENDTHINY FORML OFSRAV ORIENTC OUTLINPE S/L3 XSECTL

Unit: o11.1081

Variables:

BASECV BASEW3 CENTER_Y ENDTHINY ORIENTC OUTLINPE S/L4 XSECTL

Unit: o11.1083

Variables:

BASES BASEW1 BLADEE CENTER_Y ENDTHINY FORML OFSRAG ORIENTC OUTLINP S/L3 SHLDWR XSECTL

Unit: o11.347

Variables:

BASECX BASEW3 CENTER_Y ENDTHINN FORMS OFSRAG ORIENTC OUTLINE S/L2 SHLDWR STEMCOEX XSECTL

Unit: o11.35

Variables:

BASECX BASEW3 ENDTHINY FORMS OFSRU ORIENTR OUTLINV
S/L2 SHLDWA STEMO XSECTL

Unit: o11.431

Variables:

BASECV BASEW3 ENDTHINY S/L4 XSECTL

Unit: o11.47

Variables:

BLADES CENTER_Y OFSRAG ORIENTC OUTLINP S/L2 XSECTL

Unit: o11.51

Variables:

BLADEE CENTER_Y ORIENTC OUTLINPE S/L5 XSECTL

Unit: o11.52

Variables:

BASES BASEW2 CENTER_Y ENDTHINN OFSRAG ORIENTC OUTLINE
S/L3 XSECTL

Unit: o11.53

Variables:

BASEW6 BLADEE CENTER_Y ENDTHINN FORMS GRINDB/L Leng4
OFSRAG ORIENTC OUTLINPE SHLDWA STEMC XSECTL

Unit: o11.608

Variables:

BASES BASEW4 BLADEE CENTER_Y ENDTHINN FORMF Leng3
OFSRAG ORIENTC OUTLINE S/L2 SHLDWR XSECTL

Unit: o12.6

Variables:

BASECX BASEW2 BLADEE CENTER_Y ENDTHINN FORML Leng3
OFSRS ORIENTC OUTLINP S/L4 XSECTL

Unit: o13.27

Variables:

BLADES ORIENTC OUTLINP S/L3 XSECTL

Unit: o13.46

Variables:

BASEP BASEW2 BLADEE CENTER_Y ENDTHINN FORML GRINDB/L OFSRAG ORIENTC OUTLINPL S/L3 XSECTPD

Unit: o13.6

Variables:

BASEPP BASEW2 BLADEE ENDTHINN FORMS Leng3 OFSRAG ORIENTC OUTLINV SHLDWR STEMO XSECTT

Unit: o14.102

Variables:

BASEP BASEW2 BLADEE CENTER_Y ENDTHINN FORMS Leng2 OFSRS ORIENTC OUTLINV S/L4 SHLDWA_R STEMO XSECTL

Unit: o14.110

Variables:

BLADEE CENTER_Y DENTICU FORML OFSRAG ORIENTC OUTLINPE S/L3 SHLDWR XSECTL

Unit: o14.85

Variables:

BASEPT BASEW1 BLADEE ENDTHINN FORMF GRINDB/L Leng3 OFSRAG ORIENTR OUTLINV S/L4 SHLDWR XSECTFL

Unit: o14:38

Variables:

BLADES OFSRAG ORIENTR OUTLINV S/L3 XSECTL

Unit: o16.10

Variables:

BASEPT BASEW1 CENTER_Y ENDTHINN FORMS OFSRAG ORIENTCO OUTLINP S/L2 SHLDWR STEMC XSECTL

Unit: o16.86

Variables:

BASECV BASEW2 BLADEE CENTER_Y ENDTHINN FORML NOTCHBO OFSRS ORIENTC OUTLINPE S/L4 XSECTL

Unit: o16.87

Variables:

BASESL BASEW4 BLADES ENDTHINY FORMN NOTCHST OFSRS ORIENTR OUTLINV S/L3 SHLDNA STEME XSECTL

Unit: o16.88

Variables:

CENTER_Y OFSRAV OUTLINL S/L3 XSECTL

Unit: o17.3

Variables:

BLADEE CENTER_Y FORML OFSRAV ORIENTC OUTLINPE S/L4 XSECTL

Unit: o17.5

Variables:

BASEP BASEW3 BLADEE ENDTHINN FORML Leng3 OFSRU ORIENTR OUTLINV S/L2 XSECTL

Unit: o17.6

Variables:

BLADES CENTER_Y ORIENTCO OUTLINP S/L4 XSECTL

Unit: o18.9

Variables:

BASECX BASEW4 BLADES ENDTHINY FORMS Leng3 ORIENTS OUTLINV S/L2 SHLDWR STEMC XSECTFL

Unit: o21.2

Variables:

BASESL BASEW2 BLADEE ENDTHINY FORMT Leng1 OFSRU ORIENTS OUTLINV S/L4 SHLDWA XSECTFLC

Unit: o21.9

Variables:

BASEW3 BLADEE ENDTHINY FORMN Leng2 OFSRS ORIENTR OUTLINV S/L5 SHLDNA XSECTFL

Unit: o26.1

Variables:

CENTER_Y ENDTHINY FORMF Leng2 NOTCHSO OFSRAG ORIENTR OUTLINV S/L4 SHLDWR XSECTL

Unit: o26.14

Variables:

BASEPT BASEW1 BLADEE ENDTHINN FORMS Leng2 OFSRAG ORIENTR OUTLINV S/L3 SHLDWA_R STEMCOEX XSECTFLC

Unit: o26.26

Variables:

BASECV BASEW2 BLADES CENTER_Y ENDTHINY FORMS NOTCHBO OFSRAG ORIENTS OUTLINV S/L3 S/L4 SHLDWA STEMC XSECTL

Unit: o26.34

Variables:

BASEP BASEW2 BLADEE ENDTHINN FORMS Leng2 OFSRS ORIENTR OUTLINV S/L4 SHLDWA STEMC XSECTPC

Unit: o26.35

Variables:

BASEP BASEW2 BLADEE ENDTHINN FORMF Leng2 OFSRAG ORIENTS OUTLINV S/L4 SHLDWR XSECTL

Unit: o26.36

Variables:

BASEW3 BLADES ENDTHINY FORMS OFSRAG ORIENTS OUTLINV S/L3 SHLDWA STEMC XSECTL

Unit: o26.38

Variables:

BASEP BASEW2 ENDTHINN OFSRS ORIENTR OUTLINV S/L4 XSECTL

Unit: o26:15

Variables:

BLADEE CENTER_Y OFSRAG OFSRV OUTLINE S/L3 XSECTL

Unit: o28.54

Variables:

BASES BASEW4 BLADES ENDTHINN FORMN FORMT Leng1 NOTCHST OFSRS ORIENTR OUTLINV S/L5 SHLDNA XSECTPC

Unit: o32.11

Variables:

BASEP BASEW4 BLADEE ENDTHINN ENDTHINY FORMS Leng2 OFSRAG ORIENTS OUTLINV S/L4 SHLDWR STEMC XSECTL

Unit: o32.4

Variables:

BASEPCX BASEW4 CENTER_Y ENDTHINY FORMS OFSRAG ORIENTS OUTLINV S/L4 STEMC XSECTL

Unit: o32.7

Weight: 1.0000

CENTER_Y OFSRU ORIENTC OUTLINPL S/L5 XSECTL

Unit: o32.8

Variables:

FORMS OUTLINV S/L5 SHLDWA XSECTL

Unit: o32.9

Variables:

BASEW3 BLADEE FORMS Leng2 OFSRAG ORIENTS OUTLINE S/L4 SHLDWA_R STEMC XSECTFL

Unit: o35.1

Variables:

BLADEE CENTER_Y OFSRS ORIENTR OUTLINE S/L3 XSECTL

Unit: o36.1

Variables:

BLADEE OFSRAG ORIENTR OUTLINV S/L4 XSECTL

Unit: o36.2

Variables:

BASEP BASEW2 BLADEE ENDTHINY FORMF OFSRAG ORIENTS OUTLINV S/L2 SHLDWR XSECTL

Appendix E. Formed Biface Cluster Statistics.

Similarity Coefficient: Jaccard
Min. # of common neighbours within cluster: 2 of 4 examined neighbours
Minimum number of elements per cluster: 2

6 Units in Cluster 1:
o36.2
o10.3
n29.30
o10.188
o26.35
o10.140

6 Units in Cluster 2:
o10.18
o36.1
n17.15
n11.100
o10.7
o14:38

3 Units in Cluster 3:
o26.26
o32.4
o10.261

11 Units in Cluster 4:
o26.38
o32.11
o10.250
o10.227
o10.212
o10.143
o10.235
o14.102
o10.256
o10.13
o26.34

3 Units in Cluster 5:
iRn2.1
n18.104
n18.103

4 Units in Cluster 6:
o32.7
n8.8
o11.51
n11.248

6 Units in Cluster 7:
o13.27
n11.252
n29.15
n18.105
o11.47
o35.1

5 Units in Cluster 8:
n29.47
n11.83
o10.233
o32.9
n24.12

5 Units in Cluster 9:
o10.201
n18.47
o26.36
n23.25
n14.101

2 Units in Cluster 10:
o10.139
n14.77

3 Units in Cluster 11:
o10.6
o14.85
o1.1

2 Units in Cluster 12:
o10.226
o21.2

10 Units in Cluster 13:
n33.7
o11.1081
o11.1080
n14.3
o17.3
o12.6
n20.1
n11.256
o16.86
o11.431

2 Units in Cluster 14:
o16.88
n32.1

3 Units in Cluster 15:
n15.2
n25.1
n11.246

3 Units in Cluster 16:
o16.87
o10.200
o28.54

2 Units in Cluster 17:
n26.5
o10.195

3 Units in Cluster 18:
n14.93
o11.52
o11.608

2 Units in Cluster 19:
o14.110
o11.1083

2 Units in Cluster 20:
o16.10
o11.347

33 Units in Residue:
o11.35
o18.9
n14.87
n20.77
o10.240
n27.2
n11.147
o11.53
o10.210
o32.8
o10.142
o26.1
o10.10
o13.6
n23.12
n18.107

o10.255
o10.219
o10.1
n21.5
o17.6
n11.173
o17.5
n14.68
n14.84
o10.239
o13.46
o21.9
o10.236
o10.2
o10.145
o26:15
o26.14

21 Types and 66 Objects in Cluster No. 1:

BLADEE	6	(64)■■■■■■
FORMF	6	(20)■■■■■■
OUTLINV	6	(58)■■■■■■
ORIENTS	6	(33)■■■■■■
SHLDWR	6	(38)■■■■■■
XSECTL	5	(86)■■■■■
Leng2	4	(29)■■■■
BASEW2	4	(29)■■■■
OFSRAG	3	(64)■■■
ENDTHINN	3	(44)■■■
ENDTHINY	2	(40)■■
OFSRS	2	(23)■■
S/L3	2	(42)■■
BASEP	2	(20)■■
CENTER_Y	2	(55)■■
BASES	2	(13)■■
OFSRV	1	(4)■
BASEW1	1	(7)■
XSECTFLC	1	(4)■
S/L2	1	(15)■
S/L4	1	(44)■

15 Types and 38 Objects in Cluster No. 2:

OFSRAG	6	(64)■■■■■■
XSECTL	6	(86)■■■■■■
OUTLINV	4	(58)■■■■
BLADEE	4	(64)■■■■
S/L3	3	(42)■■■
S/L4	3	(44)■■■
ORIENTR	3	(30)■■■
SHLDWR	2	(38)■■
OUTLINLE	1	(9)■
FORMF	1	(20)■
OUTLINP	1	(12)■
BLADES	1	(23)■
ORIENTC	1	(41)■
ORIENTS	1	(33)■
ORIENTCO	1	(5)■

18 Types and 37 Objects in Cluster No. 3:

OFSRAG	3	(64)■■■
ORIENTS	3	(33)■■■
STEMC	3	(28)■■■
XSECTL	3	(86)■■■
S/L4	3	(44)■■■
ENDTHINY	3	(40)■■■
FORMS	3	(37)■■■
OUTLINV	3	(58)■■■
BASEW2	2	(29)■■
CENTER_Y	2	(55)■■
SHLDWA	2	(19)■■
BLADES	1	(23)■
NOTCHBO	1	(6)■
BASECV	1	(14)■
BASEW4	1	(10)■
BASESL	1	(6)■
S/L3	1	(42)■
BASEPCX	1	(4)■

39 Types and 142 Objects in Cluster No. 4:

ENDTHINN	11	(44)■■■■■■■■■■■
BLADEE	10	(64)■■■■■■■■■■
S/L4	9	(44)■■■■■■■■■
OUTLINV	9	(58)■■■■■■■■■
BASEP	8	(20)■■■■■■■■
STEMC	8	(28)■■■■■■■■
XSECTL	7	(86)■■■■■■■
FORMS	7	(37)■■■■■■■
ORIENTS	7	(33)■■■■■■■
BASEW2	7	(29)■■■■■■■
Leng2	6	(29)■■■■■■
OFSRAG	6	(64)■■■■■■
SHLDWA	5	(19)■■■■■

OFSRS	4	(23)	■■■■
XSECTFL	4	(15)	■■■■
SHLDWR	4	(38)	■■■■
CENTER_Y	3	(55)	■■■
ORIENTR	3	(30)	■■■
BASEW3	2	(27)	■■
S/L5	2	(11)	■■
FORMN	2	(6)	■■
SHLDWA_R	1	(3)	■
BASEW4	1	(10)	■
STEMO	1	(5)	■
OUTLINLE	1	(9)	■
BASES	1	(13)	■
BASECX	1	(15)	■
FORMP	1	(3)	■
XSECTPC	1	(3)	■
BASECV	1	(14)	■
STEME	1	(4)	■
ENDTHINY	1	(40)	■
NOTCHBO	1	(6)	■
Leng3	1	(14)	■
NOTCHST	1	(3)	■
OFSRAV	1	(7)	■
ORIENTC	1	(41)	■
NOTCHC	1	(2)	■
OUTLINPL	1	(4)	■

13 Types and 26 Objects in Cluster No. 5:

XSECTL	3	(86)	■■■
OUTLINV	3	(58)	■■■
OFSRAG	3	(64)	■■■
S/L2	3	(15)	■■■
ORIENTS	2	(33)	■■
FORMF	2	(20)	■■
BLADEE	2	(64)	■■
ENDTHINN	2	(44)	■■
BASEW5	2	(8)	■■
ORIENTR	1	(30)	■
SHLDWA	1	(19)	■
BASEP	1	(20)	■
BASEPS	1	(1)	■

12 Types and 26 Objects in Cluster No. 6:

CENTER_Y	4	(55)	■■■■
XSECTL	4	(86)	■■■■
ORIENTC	4	(41)	■■■■
S/L5	3	(11)	■■■
OFSRAG	2	(64)	■■
OUTLINPL	2	(4)	■■
DENTICU	2	(5)	■■
OUTLINE	1	(16)	■
OUTLINPE	1	(10)	■
S/L3	1	(42)	■
BLADEE	1	(64)	■
OFSRU	1	(8)	■

17 Types and 43 Objects in Cluster No. 7:

XSECTL	6	(86)	■■■■■■
BLADES	5	(23)	■■■■■
CENTER_Y	5	(55)	■■■■■
ORIENTC	5	(41)	■■■■■
S/L3	4	(42)	■■■■
OFSRAG	3	(64)	■■■
OUTLINLE	2	(9)	■■
OFSRS	2	(23)	■■
OUTLINE	2	(16)	■■
OUTLINP	2	(12)	■■
BLADEE	1	(64)	■
S/L4	1	(44)	■
ORIENTR	1	(30)	■
FORML	1	(14)	■
S/L2	1	(15)	■
GRINDB/L	1	(8)	■
DENTICU	1	(5)	■

23 Types and 60 Objects in Cluster No. 8:

BASEW3	5	(27)	■■■■■
FORMS	5	(37)	■■■■■
OFSRAG	5	(64)	■■■■■
STEMC	5	(28)	■■■■■
ORIENTS	5	(33)	■■■■■
S/L4	4	(44)	■■■■
Leng2	3	(29)	■■■
XSECTFL	3	(15)	■■■
BASECX	3	(15)	■■■
OUTLINE	3	(16)	■■■
SHLDWR	3	(38)	■■■
BLADEE	2	(64)	■■
BLADES	2	(23)	■■
XSECTL	2	(86)	■■
ENDTHINY	2	(40)	■■
S/L3	1	(42)	■
SHLDWA_R	1	(3)	■
ENDTHINN	1	(44)	■
OUTLINV	1	(58)	■
OUTLINL	1	(4)	■
BASES	1	(13)	■
SHLDWA	1	(19)	■
CENTER_Y	1	(55)	■

22 Types and 61 Objects in Cluster No. 9:

OUTLINV	5	(58)	■■■■■
OFSRAG	5	(64)	■■■■■
S/L3	5	(42)	■■■■■
FORMS	5	(37)	■■■■■
BASEW3	5	(27)	■■■■■
XSECTL	4	(86)	■■■■
ENDTHINY	4	(40)	■■■■
STEMC	4	(28)	■■■■
BLADEE	3	(64)	■■■
SHLDWA	3	(19)	■■■
ORIENTR	3	(30)	■■■
SHLDWR	2	(38)	■■
BASEP	2	(20)	■■
BASECX	2	(15)	■■
ORIENTC	2	(41)	■■
ORIENTS	1	(33)	■
BLADES	1	(23)	■
Leng1	1	(4)	■
XSECTFL	1	(15)	■
ENDTHINN	1	(44)	■
Leng2	1	(29)	■
STEMCOEX	1	(3)	■

17 Types and 26 Objects in Cluster No. 10:

Leng3	2	(14)	■■
BLADEE	2	(64)	■■
ENDTHINN	2	(44)	■■
ORIENTC	2	(41)	■■
SHLDWR	2	(38)	■■
XSECTL	2	(86)	■■
S/L3	2	(42)	■■
OFSRAG	2	(64)	■■
BASEP	2	(20)	■■
FORMF	1	(20)	■
OUTLINV	1	(58)	■
OUTLINE	1	(16)	■
BASEW1	1	(7)	■
FORMP	1	(3)	■
STEMC	1	(28)	■
BASEW5	1	(8)	■
CENTER_Y	1	(55)	■

17 Types and 37 Objects in Cluster No. 11:

OUTLINV	3	(58)	■■■
BASEPT	3	(5)	■■■
ENDTHINN	3	(44)	■■■
Leng3	3	(14)	■■■

BLADEE	3 (64)	■■■
ORIENTR	3 (30)	■■■
SHLDWR	3 (38)	■■■
FORMF	3 (20)	■■■
OFSRAG	2 (64)	■■
S/L4	2 (44)	■■
XSECTL	2 (86)	■■
BASEW1	2 (7)	■■
GRINDB/L	1 (8)	■
OFSRU	1 (8)	■
BASEW2	1 (29)	■
XSECTFL	1 (15)	■
S/L3	1 (42)	■

17 Types and 23 Objects in Cluster No. 12:

BLADEE	2 (64)	■■
SHLDWA	2 (19)	■■
OUTLINV	2 (58)	■■
BASEW2	2 (29)	■■
BASESL	2 (6)	■■
ENDTHINY	2 (40)	■■
Leng2	1 (29)	■
Leng1	1 (4)	■
STEMO	1 (5)	■
FORMS	1 (37)	■
S/L2	1 (15)	■
S/L4	1 (44)	■
ORIENTR	1 (30)	■
FORMT	1 (6)	■
ORIENTS	1 (33)	■
XSECTFLC	1 (4)	■
OFSRU	1 (8)	■

21 Types and 94 Objects in Cluster No. 13:

XSECTL	10 (86)	■■■■■■■■■■
CENTER_Y	9 (55)	■■■■■■■■■
S/L4	8 (44)	■■■■■■■■
ORIENTC	8 (41)	■■■■■■■■
BLADEE	7 (64)	■■■■■■■
BASECV	7 (14)	■■■■■■■
FORML	6 (14)	■■■■■■
OUTLINPE	5 (10)	■■■■■
ENDTHINY	4 (40)	■■■■
OFSRS	4 (23)	■■■■
ENDTHINN	4 (44)	■■■■
BASEW2	4 (29)	■■■■
OFSRAV	3 (7)	■■■
NOTCHBO	3 (6)	■■■
BASEW3	3 (27)	■■■
OUTLINP	3 (12)	■■■
S/L3	2 (42)	■■
Leng3	1 (14)	■
BASECX	1 (15)	■
BASEW5	1 (8)	■
OFSRAG	1 (64)	■

8 Types and 13 Objects in Cluster No. 14:

OUTLINL	2 (4)	■■
CENTER_Y	2 (55)	■■
S/L3	2 (42)	■■
XSECTL	2 (86)	■■
OFSRAV	2 (7)	■■
ORIENTCO	1 (5)	■
BLADES	1 (23)	■
FORML	1 (14)	■

19 Types and 37 Objects in Cluster No. 15:

XSECTL	3 (86)	■■■
GRINDB/L	3 (8)	■■■
CENTER_Y	3 (55)	■■■
ENDTHINY	3 (40)	■■■
ORIENTC	3 (41)	■■■
BASES	2 (13)	■■
BASEW5	2 (8)	■■

S/L5	2	(11)■■
SHLDNA	2	(6)■■
FORMS	2	(37)■■
OFSRAG	2	(64)■■
OUTLINLE	2	(9)■■
STEMS	2	(5)■■
BASEW6	1	(3)■
STEME	1	(4)■
BASECV	1	(14)■
S/L3	1	(42)■
OUTLINL	1	(4)■
OFSRS	1	(23)■

22 Types and 38 Objects in Cluster No. 16:

OUTLINV	3	(58)■■■
BASEW4	3	(10)■■■
BLADES	3	(23)■■■
ORIENTR	3	(30)■■■
OFSRS	2	(23)■■
FORMT	2	(6)■■
SHLDNA	2	(6)■■
FORMN	2	(6)■■
BASES	2	(13)■■
S/L3	2	(42)■■
NOTCHST	2	(3)■■
ENDTHINY	2	(40)■■
XSECTPC	1	(3)■
XSECTL	1	(86)■
Leng1	1	(4)■
BASESL	1	(6)■
Leng2	1	(29)■
ENDTHINN	1	(44)■
OFSRV	1	(4)■
NOTCHSO	1	(3)■
S/L5	1	(11)■
STEME	1	(4)■

19 Types and 26 Objects in Cluster No. 17:

BASECV	2	(14)■■
BLADES	2	(23)■■
S/L4	2	(44)■■
OUTLINV	2	(58)■■
ORIENTR	2	(30)■■
Leng2	2	(29)■■
ENDTHINY	2	(40)■■
CENTER_Y	1	(55)■
FORMT	1	(6)■
XSECTL	1	(86)■
XSECTT	1	(2)■
OFSRAV	1	(7)■
FORMN	1	(6)■
BASEW3	1	(27)■
BASEW4	1	(10)■
NOTCHC	1	(2)■
SHLDNA	1	(6)■
DENTICU	1	(5)■
NOTCHBO	1	(6)■

17 Types and 34 Objects in Cluster No. 18:

OUTLINE	3	(16)■■■
ENDTHINN	3	(44)■■■
ORIENTC	3	(41)■■■
XSECTL	3	(86)■■■
CENTER_Y	3	(55)■■■
BASES	2	(13)■■
OFSRAG	2	(64)■■
BASEW2	2	(29)■■
SHLDWR	2	(38)■■
BLADEE	2	(64)■■
S/L3	2	(42)■■
FORMF	2	(20)■■
OFSRS	1	(23)■
S/L2	1	(15)■
BASEW4	1	(10)■

BASEPCX	1 (4)	■
Leng3	1 (14)	■

14 Types and 22 Objects in Cluster No. 19:

ORIENTC	2 (41)	■■
BLADEE	2 (64)	■■
SHLDWR	2 (38)	■■
CENTER_Y	2 (55)	■■
OFSRAG	2 (64)	■■
S/L3	2 (42)	■■
XSECTL	2 (86)	■■
FORML	2 (14)	■■
DENTICU	1 (5)	■
ENDTHINY	1 (40)	■
OUTLINP	1 (12)	■
BASES	1 (13)	■
BASEW1	1 (7)	■
OUTLINPE	1 (10)	■

17 Types and 24 Objects in Cluster No. 20:

ENDTHINN	2 (44)	■■
XSECTL	2 (86)	■■
OFSRAG	2 (64)	■■
FORMS	2 (37)	■■
S/L2	2 (15)	■■
SHLDWR	2 (38)	■■
CENTER_Y	2 (55)	■■
STEMC	1 (28)	■
OUTLINP	1 (12)	■
BASEPT	1 (5)	■
STEMCOEX	1 (3)	■
OUTLINE	1 (16)	■
BASEW3	1 (27)	■
BASECX	1 (15)	■
ORIENTC	1 (41)	■
ORIENTCO	1 (5)	■
BASEW1	1 (7)	■

66 Types and 345 Objects in Residue:

XSECTL	18 (86)	■■■■■■■■■■■■■■■■■■
BLADEE	17 (64)	■■■■■■■■■■■■■■■■■
OUTLINV	16 (58)	■■■■■■■■■■■■■■■■
OFSRAG	15 (64)	■■■■■■■■■■■■■■■
CENTER_Y	15 (55)	■■■■■■■■■■■■■■■
ENDTHINY	14 (40)	■■■■■■■■■■■■■■
FORMS	12 (37)	■■■■■■■■■■■■
ENDTHINN	11 (44)	■■■■■■■■■■■
S/L3	11 (42)	■■■■■■■■■■■
Leng2	11 (29)	■■■■■■■■■■■
SHLDWR	10 (38)	■■■■■■■■■■
BASEW3	10 (27)	■■■■■■■■■■
ORIENTR	10 (30)	■■■■■■■■■■
S/L4	10 (44)	■■■■■■■■■■
ORIENTC	9 (41)	■■■■■■■■■
BASEW2	7 (29)	■■■■■■■
OFSRS	7 (23)	■■■■■■■
BASECX	7 (15)	■■■■■■■
BLADES	7 (23)	■■■■■■■
ORIENTS	7 (33)	■■■■■■■
XSECTFL	6 (15)	■■■■■■
STEMC	6 (28)	■■■■■■
Leng3	6 (14)	■■■■■■
S/L2	6 (15)	■■■■■■
OUTLINE	5 (16)	■■■■■
FORMF	5 (20)	■■■■■
OFSRU	5 (8)	■■■■■
SHLDWA	5 (19)	■■■■■
BASEP	5 (20)	■■■■■
FORML	4 (14)	■■■■
OUTLINP	4 (12)	■■■■
S/L5	3 (11)	■■■
STEMO	3 (5)	■■■
STEMS	3 (5)	■■■
OUTLINPE	3 (10)	■■■

OUTLINLE	3	(9)	■■■
GRINDB/L	3	(8)	■■■
BASEW4	3	(10)	■■■
Leng4	2	(2)	■■
BASECV	2	(14)	■■
XSECTFC	2	(2)	■■
OFSRV	2	(4)	■■
BASEPCX	2	(4)	■■
XSECTFLC	2	(4)	■■
BASESL	2	(6)	■■
BASES	2	(13)	■■
XSECTPD	2	(2)	■■
BASEW5	2	(8)	■■
BASEW6	2	(3)	■■
ORIENTCO	2	(5)	■■
BLADESE	2	(2)	■■
NOTCHSO	2	(3)	■■
FORMT	2	(6)	■■
FORMN	1	(6)	■
FORMP	1	(3)	■
STEMCOEX	1	(3)	■
STEME	1	(4)	■
SHLDNA	1	(6)	■
XSECTPC	1	(3)	■
SHLDWA_R	1	(3)	■
OUTLINPL	1	(4)	■
Leng1	1	(4)	■
BASEPP	1	(1)	■
BASEPT	1	(5)	■
XSECTT	1	(2)	■
BASEW1	1	(7)	■

Appendix F. Frequency of Artifact and Debitage Types at Site Location in the Study Area.

Unit: DhRn10

Weight: 1.0000 Variance: 0.0000 Mean: 1.0000

Id: 34 Attribute: Dark Blue

Containing Types:

1 Flake1lg	1 Preform

Unit: DhRn11

Weight: 1.0000 Variance: 13513.8145 Mean: 7.8967

Id: 1 Attribute: Dark Blue

Containing Types:

12 Biface	2 Bipolar	2 Blade	18 BRF
1 ChoppBi	3 ChoppUni	3 CobbCore	2 CoreNC
19 Flake1lg	9 Flake1sm	20 Flake2	6 Flake3
2 LFT	1 MicroB	2 PC_DNC	5 PNC_DC
12 Preform	6 Quartz	9 RTF	1 RWF
1 ScraperP	2 ShattBL	4 ShattWC	67 ShattWNC
2 Spall			

Unit: DhRn12

Weight: 1.0000 Variance: 12.8000 Mean: 1.2000

Id: 35 Attribute: Dark Blue

Containing Types:

1 Bipolar	2 CobbCore	2 Flake1lg	1 ShattWC
2 ShattWNC			

Unit: DhRn13

Weight: 1.0000 Variance: 3.0000 Mean: 0.5000

Id: 36 Attribute: Dark Blue

Containing Types:

1 Flake3 1 ShattWNC

Unit: DhRn14

Weight: 1.0000 Variance: 2559.7180 Mean: 3.0606

Id: 2 Attribute: Dark Blue

Containing Types:

8 Biface	1 Bipolar	2 Blade	1 BRF
1 ChoppUni	8 CobbCore	2 CoreNC	12 Flake1lg
1 Flake1sm	7 Flake2	1 Flake3	3 GroundS
1 MicroB	3 PC_DNC	2 PNC_DC	1 Preform
3 Quartz	7 RTF	1 RWF	1 ScraperP
8 ShattWC	28 ShattWNC	1 Spall	

Unit: DhRn15

Weight: 1.0000 Variance: 4.8333 Mean: 0.8333

Id: 46 Attribute: Dark Blue

Containing Types:

1 Biface	1 Flake1lg	1 PC_DNC	2 PNC_DC

Unit: DhRn16

Weight: 1.0000 Variance: 0.0000 Mean: 1.0000

Id: 37 Attribute: Dark Blue

Containing Types:

1 CoreNC	1 Flake3	1 RTF

Unit: DhRn17

Weight: 1.0000 Variance: 72.8163 Mean: 1.0476

Id: 4 Attribute: Dark Blue

Containing Types:

1 Biface	1 ChoppBi	1 CobbCore	1 Flake1lg
2 Flake2	1 RTF	5 ShattWNC	

Unit: DhRn18

Weight: 1.0000 Variance: 1261.3876 Mean: 5.4765

Id: 5 Attribute: Dark Blue

Containing Types:

5 Biface	1 BRF	1 ChoppBi	1 ChoppUni
8 CobbCore	5 CoreNC	11 Flake1lg	1 Flake1sm
7 Flake2	4 LFT	1 PC_DNC	3 PNC_DC
7 Preform	1 Quartz	8 RTF	2 ScraperP
2 ShattWC	17 ShattWNC	1 Spall	

Unit: DhRn19

Weight: 1.0000 Variance: 10.7917 Mean: 0.8333

Id: 38 Attribute: Dark Blue

Containing Types:

1 Flake2	1 RTF	2 ShattWNC

Unit: DhRn20

Weight: 1.0000 Variance: 188.5262 Mean: 2.3485

Id: 6 Attribute: Dark Blue

Containing Types:

2 Biface	1 BRF	4 Flake1lg	2 Flake1sm
5 Flake2	2 Flake3	1 PC_DNC	1 PNC_DC
2 Preform	3 RTF	1 ScraperP	8 ShattWNC

Unit: DhRn21

Weight: 1.0000 Variance: 31.5913 Mean: 1.6095

Id: 7 Attribute: Dark Blue

Containing Types:

1 Biface	1 Bipolar	2 ChoppUni	5 CobbCore
3 CoreNC	3 Flake1lg	1 Flake2	1 LFT

1 MicroB 2 PC_DNC 1 PNC_DC 1 Preform
2 ShattWNC

Unit: DhRn22
Weight: 1.0000 Variance: 0.0000 Mean: 1.0000
Id: 39 Attribute: Dark Blue
Containing Types:
1 Flake2 1 RTF

Unit: DhRn23
Weight: 1.0000 Variance: 140.8970 Mean: 1.9421
Id: 8 Attribute: Dark Blue
Containing Types:
2 Biface 3 Flake1lg 2 Flake1sm 1 Flake3
1 PC_DNC 1 RTF 1 ScraperP 1 ShattBL
4 ShattWC 7 ShattWNC 2 Spall

Unit: DhRn24
Weight: 1.0000 Variance: 12.9286 Mean: 1.0714
Id: 10 Attribute: Dark Blue
Containing Types:
1 Biface 1 ChoppUni 1 CobbCore 1 Flake1lg
2 Flake2 1 Flake3 1 GroundS 1 PC_DNC
1 Preform 1 Quartz 1 RTF 1 ShattWC
2 ShattWNC 2 Spall

Unit: DhRn25
Weight: 1.0000 Variance: 3.2000 Mean: 0.6000
Id: 11 Attribute: Dark Blue
Containing Types:
1 Biface 1 Preform 1 ShattWNC

Unit: DhRn26

Weight: 1.0000 Variance: 95.9598 Mean: 1.9643

Id: 12 Attribute: Dark Blue

Containing Types:

1 Biface	1 Bipolar	2 BRF	1 Flake1lg
1 Preform	7 RTF	5 ShattWNC	

Unit: DhRn27

Weight: 1.0000 Variance: 73.2420 Mean: 1.8776

Id: 13 Attribute: Dark Blue

Containing Types:

1 Biface	1 Blade	2 Flake1lg	4 Flake2
1 LFT	2 RTF	5 ShattWNC	

Unit: DhRn28

Weight: 1.0000 Variance: 0.0000 Mean: 1.0000

Id: 14 Attribute: Dark Blue

Containing Types:

1 Biface

Unit: DhRn29

Weight: 1.0000 Variance: 303.0955 Mean: 2.5029

Id: 15 Attribute: Dark Blue

Containing Types:

4 Biface	2 Bipolar	1 BRF	1 ChoppBi
2 ChoppUni	1 CobbCore	1 CoreNC	5 Flake1lg
4 Flake1sm	3 Flake2	2 Flake3	3 PNC_DC
2 Preform	3 Quartz	5 RTF	1 RWF
1 ShattWC	10 ShattWNC	1 Spall	

Unit: DhRn31

Weight: 1.0000 Variance: 0.0000 Mean: 1.0000

Id: 41 Attribute: Dark Blue

Containing Types:

1 Flake1lg 1 RTF

Unit: DhRn32

Weight: 1.0000 Variance: 0.0000 Mean: 1.0000

Id: 42 Attribute: Dark Blue

Containing Types:

1 RWF

Unit: DhRn33

Weight: 1.0000 Variance: 24.0000 Mean: 1.0000

Id: 16 Attribute: Dark Blue

Containing Types:

1 Biface 1 CobbCore 1 Flake2 1 Preform

1 Quartz 1 ShattWC 3 ShattWNC

Unit: DhRn7

Weight: 1.0000 Variance: 339.9900 Mean: 1.6750

Id: 48 Attribute: Dark Blue

Containing Types:

1 Blade 1 BRF 1 ChoppUni 1 CobbCore

1 CoreNC 2 Flake1lg 2 Flake1sm 2 Flake2

1 LFT 1 PNC_DC 1 Preform 2 Quartz

1 RWF 1 ScraperP 1 ShattWC 11 ShattWNC

Unit: DhRn8

Weight: 1.0000 Variance: 0.8333 Mean: 1.1667

Id: 17 Attribute: Dark Blue

Containing Types:

1 Biface 1 Flake1sm 1 Flake2 1 Flake3

2 PC_DNC 1 PNC_DC

Unit: DhRn9

Weight: 1.0000 Variance: 0.0000 Mean: 1.0000

Id: 51 Attribute: Dark Blue

Containing Types:

1 PNC_DC

Unit: DhRo1

Weight: 1.0000 Variance: 0.0000 Mean: 1.0000

Id: 18 Attribute: Dark Blue

Containing Types:

1 Biface 1 ChoppUni 1 ShattWC

Unit: DhRo10

Weight: 1.0000 Variance: 5683.8252 Mean: 7.0870

Id: 19 Attribute: Dark Blue

Containing Types:

31 Biface 2 Bipolar 1 Blade 2 BRF

3 ChoppUni 4 CobbCore 14 Flake1lg 3 Flake1sm

6 Flake2 2 Flake3 7 GroundS 4 LFT

1 MicroB 8 PC_DNC 6 PNC_DC 11 Preform

17 Quartz 18 RTF 2 RWF 1 ScraperP

4 ShattWC 46 ShattWNC 11 Slate

Unit: DhRo11

Weight: 1.0000 Variance: 17994.1563 Mean: 21.3846

Id: 20 Attribute: Dark Blue

Containing Types:

11 Biface 13 Bipolar 5 Blade 3 BRF
7 ChoppBi 8 ChoppUni 46 CobbCore 19 CoreNC
84 Flake1lg 10 Flake1sm 37 Flake2 10 Flake3
11 LFT 7 MicroB 37 PC_DNC 26 PNC_DC
5 Preform 10 Quartz 13 RTF 2 RWF
10 ScraperP 13 ShattBL 36 ShattWC 119 ShattWNC
5 Slate 9 Spall

Unit: DhRo12
Weight: 1.0000 Variance: 1.5000 Mean: 1.2500
Id: 21 Attribute: Dark Blue
Containing Types:
1 Biface 1 Bipolar 2 Flake1lg 2 Flake2
1 LFT 1 ScraperP 1 ShattWNC 1 Spall

Unit: DhRo13
Weight: 1.0000 Variance: 37.6111 Mean: 2.2778
Id: 22 Attribute: Dark Blue
Containing Types:
3 Biface 1 Blade 1 ChoppBi 4 ChoppUni
4 CobbCore 1 CoreNC 3 Flake1lg 2 Flake2
1 Flake3 2 GroundS 6 LFT 1 PC_DNC
1 PNC_DC 3 Preform 1 Quartz 1 ScraperP
2 ShattWC 4 ShattWNC

Unit: DhRo14
Weight: 1.0000 Variance: 513.4546 Mean: 4.4545
Id: 23 Attribute: Dark Blue
Containing Types:
5 Biface 2 Bipolar 1 Blade 3 ChoppUni
6 CobbCore 3 CoreNC 7 Flake1lg 2 Flake1sm

10 Flake2 2 Flake3 2 LFT 3 PC_DNC
1 PNC_DC 5 Preform 2 Quartz 6 RTF
2 ScraperP 2 ShattBL 6 ShattWC 24 ShattWNC
1 Slate 3 Spall

Unit: DhRo15
Weight: 1.0000 Variance: 0.0000 Mean: 1.0000
Id: 24 Attribute: Dark Blue
Containing Types:
1 CoreNC 1 Flake2 1 PNC_DC

Unit: DhRo16
Weight: 1.0000 Variance: 512.2778 Mean: 4.6111
Id: 25 Attribute: Dark Blue
Containing Types:
5 Biface 12 BRF 4 CobbCore 1 CoreNC
10 Flake1lg 3 Flake1sm 4 Flake2 1 Flake3
2 LFT 3 PNC_DC 1 Preform 3 Quartz
2 RTF 1 RWF 1 ShattBL 4 ShattWC
23 ShattWNC 3 Spall

Unit: DhRo17
Weight: 1.0000 Variance: 3.0000 Mean: 1.5000
Id: 26 Attribute: Dark Blue
Containing Types:
3 Biface 1 BRF 1 Flake2 1 LFT

Unit: DhRo18
Weight: 1.0000 Variance: 8.5455 Mean: 1.6364
Id: 27 Attribute: Dark Blue
Containing Types:

4 CobbCore 2 CoreNC 2 Flake1lg 1 Flake2
1 GroundS 2 LFT 1 MicroB 1 PNC_DC
2 RTF 1 ScraperP 1 ShattWNC

Unit: DhRo19
Weight: 1.0000 Variance: 0.0000 Mean: 1.0000
Id: 28 Attribute: Dark Blue
Containing Types:
1 Biface

Unit: DhRo20
Weight: 1.0000 Variance: 0.7500 Mean: 1.2500
Id: 49 Attribute: Dark Blue
Containing Types:
2 CobbCore 1 Flake1sm 1 Flake3 1 ShattWNC

Unit: DhRo21
Weight: 1.0000 Variance: 1.5000 Mean: 1.5000
Id: 29 Attribute: Dark Blue
Containing Types:
2 Biface 1 Bipolar 1 Flake1lg 2 Flake1sm
2 GroundS 1 PNC_DC

Unit: DhRo24
Weight: 1.0000 Variance: 0.5000 Mean: -0.5000
Id: 52 Attribute: Dark Blue
Containing Types:
1 ChoppUni

Unit: DhRo26
Weight: 1.0000 Variance: 251.6923 Mean: 4.8462

Id: 30 Attribute: Dark Blue

Containing Types:

11 Biface	5 CobbCore	1 CoreNC	1 Flake3
4 GroundS	1 LFT	3 MicroB	2 Preform
11 Quartz	2 RTF	2 ShattWC	5 ShattWNC
15 Slate			

Unit: DhRo27

Weight: 1.0000 Variance: 0.0000 Mean: 1.0000

Id: 53 Attribute: Dark Blue

Containing Types:

1 ChoppUni

Unit: DhRo28

Weight: 1.0000 Variance: 0.0000 Mean: 1.0000

Id: 31 Attribute: Dark Blue

Containing Types:

1 Biface

Unit: DhRo29

Weight: 1.0000 Variance: 269.8560 Mean: 2.9600

Id: 44 Attribute: Dark Blue

Containing Types:

3 BRF	2 CobbCore	3 Flake1lg	2 Flake1sm
1 Flake2	3 Flake3	7 GroundS	6 PC_DNC
3 PNC_DC	1 Quartz	1 ShattBL	3 ShattWC
17 ShattWNC	1 Slate	1 Spall	

Unit: DhRo31

Weight: 1.0000 Variance: 0.0000 Mean: 1.0000

Id: 50 Attribute: Dark Blue

Containing Types:

1 ShattWNC

Unit: DhRo32

Weight: 1.0000 Variance: 46.3732 Mean: 2.1834

Id: 47 Attribute: Dark Blue

Containing Types:

6 Biface	1 Bipolar	2 ChoppUni	5 CobbCore
2 CoreNC	2 Flake1lg	1 Flake2	2 PC_DNC
3 PNC_DC	2 Preform	5 RTF	1 RWF
1 ShattWNC			

Unit: DhRo35

Weight: 1.0000 Variance: 4.8750 Mean: 0.8750

Id: 32 Attribute: Dark Blue

Containing Types:

1 Biface	1 ChoppBi	2 Flake1lg	1 Flake1sm
1 Quartz	2 RTF	1 ShattWNC	

Unit: DhRo36

Weight: 1.0000 Variance: 0.0000 Mean: 2.0000

Id: 33 Attribute: Dark Blue

Containing Types:

2 Biface

Unit: DhRo37

Weight: 1.0000 Variance: 0.0000 Mean: 1.0000

Id: 43 Attribute: Dark Blue

Containing Types:

1 Blade 1 GroundS

Appendix G. Frequency and Percentage of Types in Each Site and Cluster.

Cluster	UNITNAME	Biface		Preform		BRF		CobbCore		ChoppBi		ChoppUni	
1	DhRn11	12	5.64%	12	5.64%	18	8.46%	3	1.41%	1	0.47%	3	1.41%
1	DhRn29	4	7.72%	2	3.86%	1	1.93%	1	1.93%	1	1.93%	2	3.86%
1	DhRn7	0	0.00%	1	3.39%	1	3.39%	1	3.39%	0	0.00%	1	3.39%
	Total	16	5.44%	15	5.10%	20	6.80%	5	1.70%	2	0.68%	6	2.04%
2	DhRn14	8	7.75%	1	0.97%	1	0.97%	8	7.75%	0	0.00%	1	0.97%
2	DhRn33	1	11.02%	1	11.02%	0	0.00%	1	11.02%	0	0.00%	0	0.00%
	Total	9	8.02%	2	1.78%	1	0.89%	9	8.02%	0	0.00%	1	0.89%
3	DhRn17	1	8.24%	0	0.00%	0	0.00%	1	8.24%	1	8.24%	0	0.00%
3	DhRn18	5	5.73%	7	8.02%	1	1.15%	8	9.17%	1	1.15%	1	1.15%
3	DhRn26	1	5.49%	1	5.49%	2	10.98%	0	0.00%	0	0.00%	0	0.00%
3	DhRn27	1	6.18%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
3	DhRn8	1	14.07%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
3	DhRo12	1	9.72%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
3	DhRo17	3	48.98%	0	0.00%	1	16.33%	0	0.00%	0	0.00%	0	0.00%
3	DhRo21	2	21.81%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
3	DhRo35	1	10.92%	0	0.00%	0	0.00%	0	0.00%	1	10.92%	0	0.00%
	Total	16	9.11%	8	4.55%	4	2.28%	9	5.12%	3	1.71%	1	0.57%
4	DhRn21	1	4.09%	1	4.09%	0	0.00%	5	20.44%	0	0.00%	2	8.18%
4	DhRn24	1	5.80%	1	5.80%	0	0.00%	1	5.80%	0	0.00%	1	5.80%
4	DhRo13	3	7.16%	3	7.16%	0	0.00%	4	9.55%	1	2.39%	4	9.55%
4	DhRo32	6	17.80%	2	5.93%	0	0.00%	5	14.83%	0	0.00%	2	5.93%
	Total	11	9.38%	7	5.97%	0	0.00%	15	12.79%	1	0.85%	9	7.67%
5	DhRn23	2	7.87%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
5	DhRo14	5	5.02%	5	5.02%	0	0.00%	6	6.03%	0	0.00%	3	3.01%
	Total	7	5.60%	5	4.00%	0	0.00%	6	4.80%	0	0.00%	3	2.40%
Residue	DhRn12	0	0.00%	0	0.00%	0	0.00%	2	24.68%	0	0.00%	0	0.00%
Residue	DhRo18	0	0.00%	0	0.00%	0	0.00%	4	21.76%	0	0.00%	0	0.00%
Residue	DhRn20	2	6.18%	2	6.18%	1	3.09%	0	0.00%	0	0.00%	0	0.00%
Residue	DhRo10	31	15.06%	11	5.35%	2	0.97%	4	1.94%	0	0.00%	3	1.46%
Residue	DhRo11	11	1.94%	5	0.88%	3	0.53%	46	8.13%	7	1.24%	8	1.41%
Residue	DhRo16	5	6.02%	1	1.20%	12	14.45%	4	4.82%	0	0.00%	0	0.00%
Residue	DhRo26	11	17.15%	2	3.12%	0	0.00%	5	7.80%	0	0.00%	0	0.00%
Residue	DhRo29	0	0.00%	0	0.00%	3	5.50%	2	3.66%	0	0.00%	0	0.00%

Cluster	UNITNAME	ShattWC		Spall		PNC_DC		PC_DNC		Bipolar_WC		LFT_WC	
1	DhRn11	4	1.88%	2	0.94%	5	2.35%	2	0.94%	2	0.94%	1	0.47%
1	DhRn29	1	1.93%	1	1.93%	3	5.79%	0	0.00%	1	1.93%	0	0.00%
1	DhRn7	1	3.39%	0	0.00%	1	3.39%	0	0.00%	0	0.00%	0	0.00%
	Total	6	2.04%	3	1.02%	9	3.06%	2	0.68%	3	1.02%	1	0.34%
2	DhRn14	8	7.75%	1	0.97%	2	1.94%	3	2.91%	1	0.97%	0	0.00%
2	DhRn33	1	11.02%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
	Total	9	8.02%	1	0.89%	2	1.78%	3	2.67%	1	0.89%	0	0.00%
3	DhRn17	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
3	DhRn18	2	2.29%	1	1.15%	3	3.44%	1	1.15%	0	0.00%	1	1.15%
3	DhRn26	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	5.49%	0	0.00%
3	DhRn27	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	6.18%
3	DhRn8	0	0.00%	0	0.00%	1	14.07%	2	28.14%	0	0.00%	0	0.00%
3	DhRo12	0	0.00%	1	9.72%	0	0.00%	0	0.00%	0	0.00%	1	9.72%
3	DhRo17	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
3	DhRo21	0	0.00%	0	0.00%	1	10.90%	0	0.00%	0	0.00%	0	0.00%
3	DhRo35	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
	Total	2	1.14%	2	1.14%	5	2.85%	3	1.71%	1	0.57%	3	1.71%
4	DhRn21	0	0.00%	0	0.00%	1	4.09%	2	8.18%	1	4.09%	0	0.00%
4	DhRn24	1	5.80%	2	11.60%	0	0.00%	1	5.80%	0	0.00%	0	0.00%
4	DhRo13	2	4.78%	0	0.00%	1	2.39%	1	2.39%	0	0.00%	5	11.94%
4	DhRo32	0	0.00%	0	0.00%	3	8.90%	2	5.93%	0	0.00%	0	0.00%
	Total	3	2.56%	2	1.71%	5	4.26%	6	5.12%	1	0.85%	5	4.26%
5	DhRn23	4	15.74%	2	7.87%	0	0.00%	1	3.93%	0	0.00%	0	0.00%
5	DhRo14	6	6.03%	3	3.01%	1	1.00%	3	3.01%	2	2.01%	2	2.01%
	Total	10	8.00%	5	4.00%	1	0.80%	4	3.20%	2	1.60%	2	1.60%
Residue	DhRn12	1	12.34%	0	0.00%	0	0.00%	0	0.00%	1	12.34%	0	0.00%
Residue	DhRo18	0	0.00%	0	0.00%	1	5.44%	0	0.00%	0	0.00%	2	10.88%
Residue	DhRn20	0	0.00%	0	0.00%	1	3.09%	1	3.09%	0	0.00%	0	0.00%
Residue	DhRo10	4	1.94%	0	0.00%	6	2.92%	8	3.89%	2	0.97%	2	0.97%
Residue	DhRo11	36	6.36%	9	1.59%	26	4.59%	37	6.54%	6	1.06%	8	1.41%
Residue	DhRo16	4	4.82%	3	3.61%	3	3.61%	0	0.00%	0	0.00%	1	1.20%
Residue	DhRo26	2	3.12%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	1.56%
Residue	DhRo29	3	5.50%	1	1.83%	3	5.50%	6	10.99%	0	0.00%	0	0.00%

Cluster	UNITNAME	RTF_WC		SP_WC		CoreNC		SP_WNC		Flake1sm		Flake1lg	
1	DhRn11	0	0.00%	1	0.47%	2	0.94%	0	0.00%	9	4.23%	19	8.93%
1	DhRn29	0	0.00%	0	0.00%	1	1.93%	0	0.00%	4	7.72%	5	9.65%
1	DhRn7	0	0.00%	1	3.39%	1	3.39%	0	0.00%	2	6.79%	2	6.79%
	Total	0	0.00%	2	0.68%	4	1.36%	0	0.00%	15	5.10%	26	8.84%
2	DhRn14	0	0.00%	0	0.00%	2	1.94%	1	0.97%	1	0.97%	12	11.63%
2	DhRn33	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
	Total	0	0.00%	0	0.00%	2	1.78%	1	0.89%	1	0.89%	12	10.69%
3	DhRn17	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	8.24%
3	DhRn18	0	0.00%	2	2.29%	5	5.73%	0	0.00%	1	1.15%	11	12.60%
3	DhRn26	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	5.49%
3	DhRn27	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	2	12.35%
3	DhRn8	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	14.07%	0	0.00%
3	DhRo12	0	0.00%	1	9.72%	0	0.00%	0	0.00%	0	0.00%	2	19.45%
3	DhRo17	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
3	DhRo21	0	0.00%	0	0.00%	0	0.00%	0	0.00%	2	21.81%	1	10.90%
3	DhRo35	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	10.92%	2	21.85%
	Total	0	0.00%	3	1.71%	5	2.85%	0	0.00%	5	2.85%	20	11.39%
4	DhRn21	0	0.00%	0	0.00%	3	12.26%	0	0.00%	0	0.00%	3	12.26%
4	DhRn24	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	5.80%
4	DhRo13	0	0.00%	1	2.39%	1	2.39%	0	0.00%	0	0.00%	3	7.16%
4	DhRo32	1	2.97%	0	0.00%	2	5.93%	0	0.00%	0	0.00%	2	5.93%
	Total	1	0.85%	1	0.85%	6	5.12%	0	0.00%	0	0.00%	9	7.67%
5	DhRn23	0	0.00%	0	0.00%	0	0.00%	1	3.93%	2	7.87%	3	11.80%
5	DhRo14	0	0.00%	1	1.00%	3	3.01%	1	1.00%	2	2.01%	7	7.03%
	Total	0	0.00%	1	0.80%	3	2.40%	2	1.60%	4	3.20%	10	8.00%
Residue	DhRn12	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	2	24.68%
Residue	DhRo18	0	0.00%	0	0.00%	2	10.88%	1	5.44%	0	0.00%	2	10.88%
Residue	DhRn20	0	0.00%	1	3.09%	0	0.00%	0	0.00%	2	6.18%	4	12.35%
Residue	DhRo10	1	0.49%	1	0.49%	0	0.00%	0	0.00%	3	1.46%	14	6.80%
Residue	DhRo11	2	0.35%	4	0.71%	19	3.36%	6	1.06%	10	1.77%	84	14.84%
Residue	DhRo16	0	0.00%	0	0.00%	1	1.20%	0	0.00%	3	3.61%	10	12.04%
Residue	DhRo26	0	0.00%	0	0.00%	1	1.56%	0	0.00%	0	0.00%	0	0.00%
Residue	DhRo29	0	0.00%	0	0.00%	0	0.00%	0	0.00%	2	3.66%	3	5.50%

Cluster	UNITNAME	Flake2		Flake3		ShattWNC		ShattBL		RTF_WNC		LFT_WNC	
1	DhRn11	20	9.40%	6	2.82%	67	31.50%	2	0.94%	9	4.23%	1	0.47%
1	DhRn29	3	5.79%	2	3.86%	10	19.30%	0	0.00%	5	9.65%	0	0.00%
1	DhRn7	2	6.79%	0	0.00%	11	37.33%	0	0.00%	0	0.00%	1	3.39%
	Total	25	8.50%	8	2.72%	88	29.93%	2	0.68%	14	4.76%	2	0.68%
2	DhRn14	7	6.79%	1	0.97%	28	27.14%	0	0.00%	7	6.79%	0	0.00%
2	DhRn33	1	11.02%	0	0.00%	3	33.05%	0	0.00%	0	0.00%	0	0.00%
	Total	8	7.13%	1	0.89%	31	27.62%	0	0.00%	7	6.24%	0	0.00%
3	DhRn17	2	16.48%	0	0.00%	5	41.20%	0	0.00%	1	8.24%	0	0.00%
3	DhRn18	7	8.02%	0	0.00%	17	19.48%	0	0.00%	8	9.17%	3	3.44%
3	DhRn26	0	0.00%	0	0.00%	5	27.45%	0	0.00%	7	38.43%	0	0.00%
3	DhRn27	4	24.71%	0	0.00%	5	30.88%	0	0.00%	2	12.35%	0	0.00%
3	DhRn8	1	14.07%	1	14.07%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
3	DhRo12	2	19.45%	0	0.00%	1	9.72%	0	0.00%	0	0.00%	0	0.00%
3	DhRo17	1	16.33%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	16.33%
3	DhRo21	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%
3	DhRo35	0	0.00%	0	0.00%	1	10.92%	0	0.00%	2	21.85%	0	0.00%
	Total	17	9.68%	1	0.57%	34	19.36%	0	0.00%	20	11.39%	4	2.28%
4	DhRn21	1	4.09%	0	0.00%	2	8.18%	0	0.00%	0	0.00%	1	4.09%
4	DhRn24	2	11.60%	1	5.80%	2	11.60%	0	0.00%	1	5.80%	0	0.00%
4	DhRo13	2	4.78%	1	2.39%	4	9.55%	0	0.00%	0	0.00%	1	2.39%
4	DhRo32	1	2.97%	0	0.00%	1	2.97%	0	0.00%	5	14.83%	0	0.00%
	Total	6	5.12%	2	1.71%	9	7.67%	0	0.00%	6	5.12%	2	1.71%
5	DhRn23	0	0.00%	1	3.93%	7	27.54%	1	3.93%	1	3.93%	0	0.00%
5	DhRo14	10	10.05%	2	2.01%	24	24.12%	2	2.01%	6	6.03%	0	0.00%
	Total	10	8.00%	3	2.40%	31	24.81%	3	2.40%	7	5.60%	0	0.00%
Residue	DhRn12	0	0.00%	0	0.00%	2	24.68%	0	0.00%	0	0.00%	0	0.00%
Residue	DhRo18	1	5.44%	0	0.00%	1	5.44%	0	0.00%	2	10.88%	0	0.00%
Residue	DhRn20	5	15.44%	2	6.18%	8	24.70%	0	0.00%	3	9.26%	0	0.00%
Residue	DhRo10	6	2.92%	2	0.97%	46	22.35%	0	0.00%	18	8.75%	2	0.97%
Residue	DhRo11	37	6.54%	10	1.77%	119	21.03%	13	2.30%	13	2.30%	3	0.53%
Residue	DhRo16	4	4.82%	1	1.20%	23	27.70%	1	1.20%	2	2.41%	1	1.20%
Residue	DhRo26	0	0.00%	1	1.56%	5	7.80%	0	0.00%	2	3.12%	0	0.00%
Residue	DhRo29	1	1.83%	3	5.50%	17	31.15%	1	1.83%	0	0.00%	0	0.00%

Cluster	UNITNAME	Bipolar		MicroB		Blade		Quartz		Slate		GroundS		Total
1	DhRn11	0	0.00%	1	0.47%	2	0.94%	6	2.82%	0	0.00%	0	0.00%	213
1	DhRn29	1	1.93%	0	0.00%	0	0.00%	3	5.79%	0	0.00%	0	0.00%	52
1	DhRn7	0	0.00%	0	0.00%	1	3.39%	2	6.79%	0	0.00%	0	0.00%	29
	Total	1	0.34%	1	0.34%	3	1.02%	11	3.74%	0	0.00%	0	0.00%	294
2	DhRn14	0	0.00%	1	0.97%	2	1.94%	3	2.91%	0	0.00%	3	2.91%	103
2	DhRn33	0	0.00%	0	0.00%	0	0.00%	1	11.02%	0	0.00%	0	0.00%	9
	Total	0	0.00%	1	0.89%	2	1.78%	4	3.56%	0	0.00%	3	2.67%	112
3	DhRn17	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	12
3	DhRn18	0	0.00%	0	0.00%	0	0.00%	1	1.15%	0	0.00%	0	0.00%	87
3	DhRn26	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	18
3	DhRn27	0	0.00%	0	0.00%	1	6.18%	0	0.00%	0	0.00%	0	0.00%	16
3	DhRn8	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	7
3	DhRo12	1	9.72%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	10
3	DhRo17	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	6
3	DhRo21	1	10.90%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	2	21.81%	9
3	DhRo35	0	0.00%	0	0.00%	0	0.00%	1	10.92%	0	0.00%	0	0.00%	9
	Total	2	1.14%	0	0.00%	1	0.57%	2	1.14%	0	0.00%	2	1.14%	176
4	DhRn21	0	0.00%	1	4.09%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	24
4	DhRn24	0	0.00%	0	0.00%	0	0.00%	1	5.80%	0	0.00%	1	5.80%	17
4	DhRo13	0	0.00%	0	0.00%	1	2.39%	1	2.39%	0	0.00%	2	4.78%	42
4	DhRo32	1	2.97%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	34
	Total	1	0.85%	1	0.85%	1	0.85%	2	1.71%	0	0.00%	3	2.56%	117
5	DhRn23	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	25
5	DhRo14	0	0.00%	0	0.00%	1	1.00%	2	2.01%	1	1.00%	0	0.00%	100
	Total	0	0.00%	0	0.00%	1	0.80%	2	1.60%	1	0.80%	0	0.00%	125
Residue	DhRn12	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	8
Residue	DhRo18	0	0.00%	1	5.44%	0	0.00%	0	0.00%	0	0.00%	1	5.44%	18
Residue	DhRn20	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	32
Residue	DhRo10	0	0.00%	1	0.49%	1	0.49%	17	8.26%	11	5.35%	7	3.40%	206
Residue	DhRo11	7	1.24%	7	1.24%	5	0.88%	10	1.77%	5	0.88%	0	0.00%	566
Residue	DhRo16	0	0.00%	0	0.00%	0	0.00%	3	3.61%	0	0.00%	0	0.00%	83
Residue	DhRo26	0	0.00%	3	4.68%	0	0.00%	11	17.15%	15	23.39%	4	6.24%	64
Residue	DhRo29	0	0.00%	0	0.00%	0	0.00%	1	1.83%	1	1.83%	7	12.83%	55

VITA

Surname: McLaren Given Names: Duncan Stewart

Place of Birth: Saskatoon, Saskatchewan, Canada

Educational Institutions Attended:

University of Victoria	1999-2003
Simon Fraser University	1991-1996

Degrees Awarded:

B.A.	Simon Fraser University	1996

Honours and Awards

British Columbia Heritage Trust Scholarship	2001-2002

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Auth[redacted]

Duncan McLaren
February 14, 2003