DESIGN OF STONE TOOL TECHNOLOGY DURING THE
EARLY PERIOD (CA. 10,000-5,000 B.P.) AT NAMU,
CENTRAL COAST OF BRITISH COLUMBIA

by

FARID RAHEMTULLA
B.A., University of Alberta, 1985
M.A., University of Toronto, 1990
M.A., Simon Fraser University, 1995

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
in the Department
of
Archaeology

© Farid Rahemtulla
SIMON FRASER UNIVERSITY
Summer 2006

All rights reserved. This work may not be reproduced in whole or in part, by photocopy or by other means, without permission of the author.
APPROVAL

NAME: Farid Rahemtulla

DEGREE: Ph.D.

TITLE OF THESIS: Design of Stone Tool Technology During the Early Period (CA. 10,000 – 5,000 B.P.) at Namu, Central Coast of British Columbia

EXAMINING COMMITTEE:

Chair: George Nicholas, Professor

__________________________________
Roy Carlson, Professor Emeritus
Senior Supervisor

__________________________________
Philip Hobler, Professor Emeritus

__________________________________
Brian Hayden, Professor

__________________________________
Martin Magne, Parks Canada
Examiner

Date Approved: May 12, 2006
DECLARATION OF
PARTIAL COPYRIGHT LICENCE

The author, whose copyright is declared on the title page of this work, has granted to Simon Fraser University the right to lend this thesis, project or extended essay to users of the Simon Fraser University Library, and to make partial or single copies only for such users or in response to a request from the library of any other university, or other educational institution, on its own behalf or for one of its users.

The author has further granted permission to Simon Fraser University to keep or make a digital copy for use in its circulating collection, and, without changing the content, to translate the thesis/project or extended essays, if technically possible, to any medium or format for the purpose of preservation of the digital work.

The author has further agreed that permission for multiple copying of this work for scholarly purposes may be granted by either the author or the Dean of Graduate Studies.

It is understood that copying or publication of this work for financial gain shall not be allowed without the author’s written permission.

Permission for public performance, or limited permission for private scholarly use, of any multimedia materials forming part of this work, may have been granted by the author. This information may be found on the separately catalogued multimedia material and in the signed Partial Copyright Licence.

The original Partial Copyright Licence attesting to these terms, and signed by this author, may be found in the original bound copy of this work, retained in the Simon Fraser University Archive.

Simon Fraser University Library
Burnaby, BC, Canada
Abstract

This dissertation centers around an examination of a chipped stone tool component dating to the Early Period (10,000 – 5,000 \(^{14}\)C BP) at the site of Namu, located on the central coast of British Columbia. The site is important for a number of reasons, the most notable of which is the incredible time depth and the volume of archaeological materials dating to the early Holocene. Given that there are very few known and well-excavated sites of similar age on the Northwest Coast, Namu provides an opportunity to glimpse into a time period that is poorly understood from an archaeological perspective. Prior to this research, studies on Early Period lithic materials have focused on important chronological and preliminary culture-historical concerns, but we still know little about the people behind the stone tools.

Over the last four decades many researchers have been developing new theoretical and methodological perspectives for understanding stone tools. Most of this work has fallen under the approach termed Technological Organization. Under this conceptual umbrella there are a number of different approaches; one of the most useful is the study of stone tool design, subsumed under Design Theory. In general the goal is to try to understand the kinds of decisions made by ancient toolmakers in designing their stone technological systems, and the empirical effects of these decisions. Using this conceptual framework an analysis is performed on the stone tool assemblage from the Early Period at Namu. Unlike the Interior of British Columbia and many other parts of North America, the dominant raw materials used at Namu are unusually medium-grained igneous toolstones that are somewhat difficult to work with.
Based on the overall exercise, settlement, mobility, raw materials, tasks and learning are perceived as critical factors in the design of the stone technologies at Namu. The analysis supports the notion that Namu was a sedentary or semi-sedentary settlement very early in its history, and that the inhabitants must have used watercraft in order to underwrite the organization of their flaked stone tool technologies. These results have repercussions for our understanding of coastal hunter-fisher-gatherer groups, and for theoretical models that posit the long-term development of Northwest Coast societies.
Acknowledgements

The completion of this research is in part due to the support of many individuals. My supervising committee has been instrumental in providing guidance and support through the tenure of this project. As senior supervisor, Dr. Roy Carlson gave me the opportunity to examine the Namu materials, and to be part of the 1994 field research at the site. His role has been critical to this research. Over the years Professor Philip Hobler has provided support in so many ways, I am only one of very many students who have benefited greatly from his extensive field and lab experience, and from his friendship. Although his formal role in the committee was internal/external examiner, Dr. Brian Hayden has been inspirational in his wide-ranging work on lithics and on several other topics. Much of the conceptual basis of this dissertation is derived from his work. I also thank Dr. Martin Magne for serving as external examiner, and for forwarding pertinent publications through the years.

Department chairs and other faculty members provided financial and general support: Jack Nance, Jon Driver, Knut Fladmark, Cathy D’Andrea, George Nicholas and Eldon Yellowhorn. The staff at the Department of Archaeology has always been very adept and helpful. Ingrid Nystrom, Ann Sullivan, Robyn Banerjee and Linda Przbyla helped me to navigate through the inevitable bureaucracy at SFU, which would otherwise be far more frustrating. The lab staff has been instrumental in facilitating several aspects of the research. Andrew Barton provided much needed help with equipment and facilities, sometimes even before I asked for it. Shannon Wood has also been generous with her time.
The materials analyzed for this project were recovered under the auspices of field crews from the University of Colorado, and by students and staff of the Simon Fraser University 1977, 1978 and 1994 archaeology field schools. Without their efforts this research would not have been possible. The Heiltsuk People have also played a critical role in these projects; many community members provided expertise and/or were part of these field crews, including representation from the Heiltsuk Cultural Education Centre under the direction of Jennifer Carpenter. They include but are not limited to: Carl Humchitt, Julie Carpenter, Gary Housty, Beth Humchitt, and Jessica Schooner (Humchitt). I also thank Scott Williams for conducting the important stone tool replicative work, Jim Stafford for helping to sort through the debitage tailings and Kate Cooke for constructing the maps.

Over the years friendships were formed with several graduate and undergraduate students in the Department of Archaeology, there are too many to list here but during the course of this dissertation a few stood out in their willingness to always discuss various aspects of Northwest Coast archaeology or help out in other ways: Tom Arnold, Duncan McLaren, Rudy Reimer, Mike Richards, Cameron Smith, and Jim Stafford. Other individuals provided assistance in other ways such as providing opportunities for fieldwork or collaboration. These include: Aubrey Cannon, Gary Coupland, Colin Grier, Alan McMillan, Denis St. Claire and Elroy White.

Finally and most importantly I thank the Heiltsuk Peoples, on whose traditional territory this research is based. Many individuals from the community have been enormously helpful and supportive and I hope that this dissertation in some way contributes to a greater understanding and appreciation of Heiltsuk history.
# Table of Contents

Approval ................................................................. ii  
Abstract ........................................................................ iii  
Acknowledgements ......................................................... v  
Table of contents ............................................................ vii  
List of Tables ................................................................... x  
List of Figures ................................................................... xii  

Chapter One: Introduction ...................................................... 1  

Chapter Two: Hunter-Gatherers and Lithic Technology:  
Complex Decisions, Simple Tools .......................................... 9  
  Development of the study of Technological Organization .......... 12  
  The concept of Curation ............................................... 20  
  The growth of the Curation concept .................................. 23  
  Mobility and transport ............................................... 31  
  Raw material availability ............................................ 36  
  Processing requirements ............................................ 39  
  Stone tool design .................................................... 40  
  Reliability ................................................................ 42  
  Maintainability ....................................................... 44  
  Flexibility and versatility .......................................... 47  
  Social agency and lithic technology ............................... 49  
  Context specific studies on design ............................... 51  
  Summary .................................................................. 53  

Chapter Three: Background to Research ................................. 57  
  Geographic locus .................................................... 57  
  General palaeoenvironmental history ................................ 60  
  Relative sea levels .................................................. 62  
  Oral traditions ........................................................ 68  
  Palaeoenvironmental reconstruction and resource availability 69  
  Cultural background ................................................ 71  
  History of research and excavation ............................... 75  
  Culture history ...................................................... 89  
  The Pebble Tool Tradition ....................................... 92  
  The Northwest Coast Microblade Tradition ................. 96
List of Tables

Table 1: Namu chronology .......................................................... 86

Table 2: Raw material distribution of Early Period debitage ...................... 122

Table 3: Group 1 debitage tallies by period ........................................... 146

Table 4: Group 2 debitage tallies by period ........................................... 146

Table 5: Group 3 debitage tallies by period ........................................... 147

Table 6: Group 4 debitage tallies by period ........................................... 147

Table 7: Replicative experiments conducted to build reference sample .......... 153

Table 8: Debitage tallies by size grade for all experiments .......................... 155

Table 9: Mass analysis results for Group 1 materials ................................ 165

Table 10: Mass analysis results for Group 2 materials .............................. 166

Table 11: Mass analysis results for Group 3 materials .............................. 167

Table 12: Mass analysis results for Group 4 materials .............................. 168

Table 13: Results of culled experiments .............................................. 171

Table 14: Ratios of debitage recovery between Periods 1 and 2 for raw material Groups 1 – 4 ......................................................... 174

Table 15: G4:G3 debitage ratios for raw material Groups 1 – 4 ...................... 176

Table 16: MSRT data for experiments 1 – 6 ............................................ 177

Table 17: MSRT data for raw material Groups 1- 3 .................................. 180

Table 18: Flake type data for raw material Groups 1 – 3 ........................... 183

Table 19: Flake type data for experiments 1 - 6 ..................................... 184
Table 20: Dorsal scar count frequencies on Shatter and PRBs from Namu raw material Groups 1 and 2, and experiments
1 – 6 ............................................................................................................186

Table 21: Group 5 debitage tallies by period.................................................................................188

Table 22: Carlson's enumeration of Early Period tool types by time period..................................................193

Table 23: Technological classification of Namu artifacts ........................................................................195

Table 24: Distribution of Namu artifact types through time.................................................................306

Table 25: Potential tasks involving Namu stone tools........................................................................320
List of Figures

Figure 1: Location of Namu on central coast .................................................. 59

Figure 2: Namu excavation map .................................................................. 78

Figure 3: Stratigraphic profile, Rivermouth Trench ..................................... 81

Figure 4: Stratigraphic profile, Main Trench .............................................. 82

Figure 5: Sullivan and Rozen Flake Typology ............................................. 134

Figure 6: Total debitage frequency for all raw materials before and after addition of tailings .......................................................... 144

Figure 7: Total debitage weight by size grade for all raw materials before and after addition of tailings .................................................. 145

Figure 8: Replicated biface ..................................................................... 156

Figure 9: Exhausted multidirectional core (Experiment no. 5) ..................... 158

Figure 10: Line plot of weight percentage by size grade for experiments .......................................................... 159

Figure 11: Experimental mass analysis values, weight percentage by size grade .......................................................... 162

Figure 12: Weight by size grade distributions for the Namu materials and experimental samples .......................................................... 168

Figure 13. Selection of flakes culled from the experimental sample .......... 169

Figure 14: Comparison of weight by size grade of all culled experiments and Namu raw material Groups 1 - 3 ................................. 172

Figure 15: Comparison of MSRT values for Namu raw material Groups 1 - 3 and experiments 1 - 6 .......................................................... 180

Figure 16: Large flake blanks detached from unidirectional cores ................ 198

Figure 17: Large unidirectional core ......................................................... 199

Figure 18: Unidirectional core ................................................................. 199
Figure 88: Small thick biface ................................................................. 276
Figure 89: Small biface fragment .......................................................... 277
Figure 90: Small biface fragment .......................................................... 278
Figure 91: Biface Base ......................................................................... 280
Figure 92: Biface Base ......................................................................... 280
Figure 93: Biface Base ......................................................................... 281
Figure 94: Biface Tip ........................................................................... 282
Figure 95: Biface End Fragment ............................................................ 284
Figure 96: Biface End Fragment ............................................................ 285
Figure 97: Biface Medial ...................................................................... 286
Figure 98: Biface Edge Fragment .......................................................... 287
Figure 99: Projectile Point .................................................................. 288
Figure 100: Projectile Point ................................................................. 289
Figure 101: Projectile Point ................................................................. 290
Figure 102: Projectile Point ................................................................. 291
Figure 103: Projectile Point Base .......................................................... 292
Figure 104: Projectile Point Tip ............................................................ 293
Figure 105: Projectile Point Medial ...................................................... 294
Figure 106: Point Preform Base ......................................................... 295
Figure 107: Point Preform Tip ............................................................. 296
Figure 108: Point Preform Tip ............................................................. 297
Figure 109: Point Preform Medial ....................................................... 298
Figure 110: Effect of coarse raw material on biface thinning/shaping .......... 305

xvi
Figure 111. Namu core and non-debitage tool representation by period...307
Chapter 1: Introduction

Anthropologists have long recognized the unique nature of aboriginal socio-political organization, subsistence, settlement and art styles on the Northwest Coast of North America. This region has been the focus of numerous studies conducted by ethnographers and ethno-historians during the last two centuries, and early European explorers and travelers also recorded information on the lifeways that they witnessed. First Nations in the region today retain much information regarding the ecology of the land as well as the lifeways of their ancestors through knowledge in oral histories. This wealth of information has been used to varying degrees by archaeologists, as an analogical tool in reconstructing indigenous lifeways of the last few thousand years. The well-known ethnographies and ethnohistories have played a pivotal role in the interpretation of archaeological materials from the most recent several thousand years. Thus, our knowledge of the more recent history of Northwest Coast peoples is continually expanding, but relatively little is known about lifeways during the early to middle Holocene time period.

First Peoples are documented on the Northwest Coast by at least 10,000 $^{14}$C years ago and while there are some tantalizing oral histories that purportedly describe events as far back as the late Pleistocene (Harris 1997), such knowledge is not common within the academy. Moreover the ethnographic literature is less useful for constructing analogues for the early Holocene since dramatic environmental changes occurred throughout the Northwest Coast during the middle Holocene, which resulted in localized as well as widespread changes in lifeways (Fladmark 1975). For the most part flaked stone tools had been replaced by other technologies long before the first Europeans arrived on the
coast. Great caution is therefore necessary when evaluating early archaeological evidence in light of ethnographic data.

In the absence of historical documentation and historically contingent analogues, our archaeological interpretations on lifeways during this early time period rest on cultural material, palaeoecological evidence and where available, oral traditions. This situation is problematic in many ways as several agencies conspire to limit the kinds of empirical data available. One example is that locating and excavating archaeological sites from this time period is more difficult than for comparative sites of younger age. Our database of known early sites is quite small, whereas the number of excavated early sites is even smaller. Several factors are responsible for this situation.

Early Holocene site visibility is generally poor, and preservation is a major limiting factor in that organic materials do not survive in the acidic forest soils of the Northwest Coast. This limits the surviving archaeological material mainly to stone tools, although there are some organic cultural remains from this time period (Carlson 1996b; Fedje et al. 2001). Until the advent of shell middens though, organic preservation is poor in general. These temperate forests also tend to obscure older archaeological sites with heavy vegetation making their discovery more difficult.

A second hindering factor in our ability to locate early sites is the complex history of relative sea-level changes on the Northwest Coast. Post-glacial sea-level histories vary by specific locale along the coast, so that knowledge of such history is a requisite step in locating sites. In some instances these sites are well above the present day high tide line and in other instances, the sites are well under water (Fedje and Christensen 1999).
same complex hydrological processes are responsible for destroying many early sites mainly through weathering and erosion (Hobler 1978).

The third factor is that coastal survey and excavation in remote areas are both time-consuming and expensive. Outside the densely populated areas on the coast of British Columbia, the coastline is very rugged, remote, and difficult to access. Field research in such areas presents complex logistical challenges relating to transportation of crew and equipment as well as necessary supplies. Despite this situation there is a large inventory of known sites on the central coast of British Columbia, the result of decades of fieldwork by Simon Fraser University (S.F.U.) under the direction of Roy Carlson and Phil Hobler (Apland 1977; Carlson 1972, 1976, 1979; Hobler 1969, 1970, 1972, 1976; Pomeroy 1980 and others). For a summary of work in this area see Millennia Research 1997.

Once located, very few early sites are subject to large-scale excavation. More often than not, archaeological materials tend to be found several metres under the surface. This adds extra logistical costs in the recovery of such materials; even limited excavation requires extended amounts of time and finances. Although recently developed methods (Cannon 2000) allow for much quicker and more financially expedient sub-surface testing, the information recovered is quite limited, and large-scale survey is still constrained by the factors outlined above.

Needless to say archaeological sites dating to the early Holocene are sparsely known at present on the Northwest Coast, and very few of these contain a large volume of excavated materials. There are exceptions, however, and this dissertation revolves around one such exception. The site of Namu is located on the central coast of British
Columbia (Figure 1), at the confluence of Fithugh Sound and the Burke Channel, within the traditional territory claimed by the Heiltsuk First Nation. This site is spectacular in many ways, one of which is the enormous time span exhibited in its radiocarbon chronology. Namu has an occupational span that encompasses 10,000 $^{14}$C years and is further capped by a historic component (Carlson 1996b). This kind of record is paralleled by only a handful of sites around the globe. In essence the site dramatically captures and documents a number of major long-term events in the history of coastal-dwelling peoples on the Northwest Coast, ranging from the first post-glacial inhabitants to major changes in technology, subsistence and sociopolitical organization, and also life after contact with the Europeans. During this time span there are equally dramatic changes occurring in the hydrological (Andrews and Retherford 1978) and ecological (Hebda and Frederick 1990) spheres over most of the Northwest Coast.

This dissertation is more specifically concerned with the first five thousand or so year time frame (ca 10,000-5,000 $^{14}$C BP), henceforth known as the Early Period. Although designation of this time range may seem somewhat arbitrary, at Namu and elsewhere there are significant changes in stratigraphy, palaeoecology, material culture, subsistence and socio-political organization beginning roughly in the mid-Holocene. The cutoff at roughly 5,000 BP is therefore warranted (see Carlson 1979).

Despite the relatively voluminous amount of data recovered at Namu, archaeologically we still have little understanding of lifeways during the Early Period. Important preliminary works have been carried out in deciphering the chrono-stratigraphy (Carlson 1991) and culture history (Carlson 1996b) of this early time period, and Cannon (1991) has also described and discussed the importance of faunal economy for the last
1500 years of the Early Period. Nonetheless we have virtually no information on the non-
subsistence activities of the people that lived in this area during the first few thousand
years of the Holocene.

With this in mind a project was launched in 1992 to study the Early Period lithics
from Namu, with an overall goal of inferring the general activities of the inhabitants, as
reflected in the way in which they organized their lithic technologies. Over the course of
the last three decades, there has been a tremendous explosion of theoretical and
methodological works dealing with stone tools. Most of this research has fallen under the
rubric of "Technological Organization," however, other significant advances have been
made in technological design theory (Hayden et al. 1996). Using concepts borrowed
from Behavioral Ecology and Social and Design Theories, the focus on stone tools is now
what they can tell us about settlement patterns, land-use, social relations, and much more.
In light of these new ways of examining stone tools, the site of Namu presents an
excellent opportunity to investigate the 'people behind the technology' during the Early
Period. The study of technological organization has dramatically changed our way of
viewing stone tools, as well as enhanced our ability to deduce behavioural information
from this class of archaeological materials. This approach is anchored in the premise that
stone tool production cannot be divorced from hunter-gatherer settlement patterns and
socio-political strategies. As such, stone tools are representative of sometimes complex
decisions on the part of the toolmakers, who often had to deal with several variables
when designing their technologies.

This is a very dynamic view of stone technologies, one that recognizes the
importance of integrating tool manufacture, use and deposition, with hunter-gatherer
lifeways and use of landscape. Conversely, the approach has much potential for archaeology; we can begin to understand issues relating to land use, settlement and perhaps even socio-political issues in certain cases, by examining stone tools within this broad context. There has been a substantial revitalization in lithic archaeology since the development of the study of technological organization, and yet, this approach had never been applied to assemblages in the Northwest Coast, particularly for the Early Period.

Given the large amount of lithic material recovered at Namu, an approach focusing on technological organization and design theory could yield very beneficial results. The first step in the current project consisted of an analysis of just over 6,000 pieces of lithic debitage from the 1978 excavation, in order to work out a methodology for meaningful interpretation from this class of artifact (Rahemtulla 1995a). Three separate techniques were employed during the analytical phase; each one of these techniques emphasised a different suite of variables.

A number of inferences were generated as part of this study, all of which seemed to support the hypothesis that Namu was some form of sedentary settlement quite early in its history. There were a number of methodological problems in that initial study, however, all of them have been addressed in the present research programme. Because the initial study only examined a (unsystematically chosen) sample of the debitage, an inherent bias was built in that reduced the level of confidence in the inferences. Another problem in the initial study was the under-representation of small-size debitage; it was unclear as to whether the small debitage was present in the midden and not picked up by the screeners in 1978, or that the debitage was not present in large numbers to begin with. During the 1994 excavation the screening technique was modified to address this
problem. These and other problems reduced the efficacy of the interpretation, but the thesis still produced some groundbreaking results. The initial study was planned as a stepping-stone towards the present research, and so, this work is a report on the entire programme so far.

The present study focuses on the examination of all the chipped lithic material recovered from three seasons of excavation at the site with the exception of the obsidian tools and debitage, which were studied under a separate project (Hutchings 1996). Combined with the previous work, it is hoped that this research will contribute to the archaeological understanding of First Nations activities at Namu during the Early Period. As such, this chapter forms the introduction and general backdrop of the work that follows.

Chapter 2 is a theoretical treatise that outlines the conceptual underpinnings of this research and includes an in-depth critical discussion on the study of technological organization and design theory. This discussion includes a historical perspective on the development of the study of technological organization and concludes with some promising future directions. Chapter 3 provides a background to the context of the assemblage, including the physical setting of the site, previous research, chronology, and palaeoenvironmental issues. Namu’s importance in the pre-Contact history of the Northwest Coast is also highlighted, within a background of other known Early Period sites. The model for technological design and expectations is presented in Chapter 4. Chapter 5 describes the assemblage and methodology employed in the debitage analysis, and this includes both the archaeological and experimental samples. Chapter 6 focuses on the analysis of the core and non-debitage tool collection while Chapter 7 consists of
discussion of the results, including the relevance to our knowledge of pre-Contact lifeways on the Northwest Coast and general implications for theoretical models on the development of aboriginal cultures within the region.
Chapter 2: Hunter-Gatherers and Lithic Technology: Complex Decisions, Simple Tools

Introduction

In recent years the sub-discipline of lithic archaeology has undergone a small-scale paradigm shift of sorts, there has been a move in conceptual direction in which the interpretative armory is focused on discerning behavioural concerns. This newer approach has been termed the study of “Technological Organization,” and has its intellectual heritage in other disciplines, notably behavioural ecology. Over the last thirty years archaeologists have been attempting to adapt and mould notions borrowed from elsewhere into a general body of theory on the complex relationship between stone tool technology on the one hand, and human subsistence, settlement, and socio-economic strategies on the other. Implicit in the previous statement is the idea that any study of technology cannot be completely divorced from general behavioural and organizational concerns. Humans in pre-industrial societies must negotiate a barrage of environmental and socio-political constraints in order to make a living (Trigger 1991), and the design of their technologies should in some measure reflect respective solutions to their particular situations. Much of this new conceptual outlook is based on behavioural-ecological principles, particularly models of optimality. This has paralleled a growing trend towards evolutionary ecology in archaeology and some aspects of anthropology (Winterhalder and Smith 1981).

During the 1970s and 1980s, a number of researchers began promoting the utility of optimal foraging as an explanatory framework for ethnographic- and by extension, archaeological-hunter-gatherers (e.g. Jochim 1976; Winterhalder and Smith 1981; Speth
Various models were focused on; these were based largely on microeconomics and game theory (Foley 1985; Bousman 1993). A full discussion on this development within archaeology is beyond the scope of this thesis, suffice to say these models are under continual refinement and have been very useful in explaining hunter-gatherer decision making with regard to foraging, territoriality, sharing, and settlement patterns to name a few (Kelly 1995). The bulk of applications have been in the realm of subsistence, since as Bousman puts it: "...the food quest is the central drive mechanism for the calculation of risk" (1993:68). While it is undeniable that all things being equal, most human groups consider the procurement of nutrition to be the consummate daily challenge, it is also obvious that in general humans rely on technology to obtain their food more so than any other organism. Owing perhaps to the monumental variability involved even in hunter-gatherer decision-making in the food quest, most optimal foraging studies have focused on nutritional resources. As a result, rigorous incorporation of lithic technological subsystems into these schemas has been a slower process (Bousman 1993:61).

On the other side of the coin practitioners of the study of technological organization have embraced to varying degrees, the tenets of optimal foraging. While it is difficult to argue against the fact that there have been great conceptual advances in lithic theory in the last three decades, there is still a need to integrate such studies within the wider framework of optimal foraging (Jochim 1989). Perhaps, as stated above, the application of optimal theory to lithics is a fairly recent endeavour; as such a growth period would be expected in which determination of basic conceptual variables is necessary.
At the same time, aspects of human technology concerning the social context and milieu in which these technologies were produced have received far lesser treatment. An extraordinarily small number of researchers has attempted to apply such research angles to archaeological data. A large part of the reason for this must be the difficulty in accessing such issues from scant portions of the archaeological record (Rahemtulla n.d.). However there are increasing calls (Dobres and Hoffman 1994; Nelson 1996) to incorporate social theories into interpretive schemes that deal with constraints on human technologies in the past.

During the past two decades several different lines of thought have emerged on the interplay between stone tools and human behaviour, and most fall under the rubric of Technological Organization. Partially due to its young age this study is still fraught with problems, particularly in the realm of operationalizing conceptual advancements. Within the latter there are many issues for which there is no consensus, although there is a continuation in discourse (see papers in Odell 1996). Still, application of various tenets of technological organization has already bore fruitful results in research from many parts of the world (see papers in Carr 1994; Odell 1996; Torrence 1989). In some studies this approach has been applied in analyses of previously defined typological industries, of which the result has been a great augmentation to our understanding of the lifeways of the people (or previous hominids) responsible for manufacturing, transporting, and using the stone tools (e.g. Kuhn 1995). Most applications of technological organization have dealt with issues concerning settlement organization, used in the general sense. Regardless of the problems of operationalizing theoretical concerns, several substantive hypotheses have been generated and tested using this 'paradigm.' Historically,
technological organization has its roots in the now famous Bordes/Binford debate on Mousterian variability. In order to gain a full perspective on the current state of the study, a more complete historical development is presented below. This will serve to identify the underlying conceptual basis of the sub-discipline in more detail, and also point out problems and successes.

One of the pressing concerns in the current study of technological organization is the relevance of particular variables. This entails two general avenues of inquiry; determination of variables that contribute to decision making in the production and discard of stone tools, and the empirical effects of these decisions. These are certainly not trivial inquiries; their possible resolution requires much discourse within and between various conceptual realms, and judicious use of analogues from ethnographic and experimental works. Certain concepts, however, have gained great favour in the development of technological organization. These will be the focus of the following discussion, together with an assessment of their utility in the current state of the discipline.

Development of the study of Technological Organization

It is useful to examine the historical development of any scientific endeavour; this can lead to a more complete understanding of the current state of a particular discipline. Arguably the development of the study of technological organization has its roots far back, but the recent thrust has been due largely to the efforts of Lewis Binford.

The basic tenets of technological organization were implicitly realized as early as 1919 by William Henry Holmes in his studies on stone quarry sites in the eastern and
Holmes was particularly fascinated with these quarries and made some remarkably astute observations on lithic reduction strategies and their connection with factors of mobility. In his grand synthesis of 1919, Holmes cogently illustrated that in many cases the primary aim of lithic reduction at Mid-western quarries was production of bifaces. Moreover these bifaces would not necessarily be used at the quarry, but more likely transported to other locations where they could be finished into various forms and used for certain tasks. Holmes argued that reduction of parent material into bifaces at the quarry would make the implements easier to transport to further locations, and that a relatively minimal amount of resharpening would be needed to achieve final form. Concomitantly, bifaces chosen for transport would have to be of such quality that the flintknapper could be reasonably assured against failure further down in the reduction sequence. Holmes even went so far as to illustrate the kinds of failures that would have caused the ancient flintknappers to discard biface blanks at the quarry, such as too much center mass and lateral snaps. In a previous work Holmes (1890) discussed the importance of lithic debitage and suggested that much can be learned from this class of artifacts, particularly in the absence of tools.

Two very important issues emerge from Holmes' works; first that understanding of reduction strategies is paramount in deciphering lithic technology, and second, any foraging group's settlement and mobility patterns play a large role in the design and use of their stone tools. Yet the pertinence of Holmes' work was not to be realized for several decades. In the periods during and following the time of Holmes' research, the vast majority of archaeologists were using conceptual frameworks based on construction of formal typologies, the goal of which was to design culture-historical schemes (Trigger
1989, Willey and Phillips 1958). For lithic analysis it meant examination of attributes for similarities and differences mainly in tool categories, which were generally conceived as being the final form envisioned by the maker. The main factors that contributed to lithic design and change could only be relegated to diffusion and/or migration. While this was a necessary step in the intellectual development of the discipline, it also had the effect of suppressing innovative works like that of Holmes'.

More recently the development of technological organization was catalysed some 30 years ago in the 1960s when Lewis Binford and his then spouse Sally Binford began challenging the eminent prehistorian François Bordes' interpretations of French Middle Palaeolithic assemblages, leading to the celebrated 'Mousterian Debate.' In a seminal paper Binford and Binford (1966) questioned Bordes' interpretation and argued that stylistic or ethnic factors were not the primary and/or sole underlying cause of Mousterian variation. The Binfords suggested that activities carried out by makers of the Mousterian may have played a greater role in the design of the assemblages, and they espoused a "multivariate causation" approach which attempted to isolate several causal factors that might contribute to assemblage morphology. Broader causal variables could be "seasonally regulated phenomena, environmental conditions, ethnic composition of the group, size and structure of the group regardless of ethnic affiliation." Particular causal variables could be "situation of the group with respect to food, shelter, supply of tools on hand, etc." (p. 241). Moreover these variables were said to be interactive, resulting in far more complex underlying structure for stone tool design than had previously been thought.
This was a provocative proposition. Rather than view stone tool design as static and simplistic markers of ethnic/historic identity, the Binfords proclaimed that stone tool design was the result of a dynamic interplay between a suite of variables within both the social and physical (environmental) realms. Among the many implications for this reasoning, the most impressive was that stone tool production might be the result of relatively complex behaviours on the part of the makers, requiring mitigation of numerous variables. Conversely, archaeologists may be able to access and evaluate these behaviours by examining evidence for stone tool production in an appropriate context.

The Binfords then examined Mousterian assemblages from one French and two Middle Eastern sites that had been analysed according to Bordes' methodology. Reclassifying the artifacts on implied function based on morphology, Binford and Binford performed a factor analysis that resulted in five factors. These factors were argued to represent different activity tasks, two were "maintenance activities" relating to tool production and food processing, three were "extractive," two of these related to kill/butchery, and one possibly shredding and cutting of plant materials. Using this as a basis, each site was subsequently re-analysed for assemblage content.

This resulted in a number of reinterpretations in which the Binfords attempted to decipher specific activities and behaviours from the artifact groups. The categorization of "extractive" and "maintenance" behaviours foreshadows Lewis Binford's subsequent musings on cultural organization, as well as the concepts of curation/expediency. Importantly, the Binfords also acknowledged the roles of labour division, mobility, and distribution of raw materials in stone tool production. They went on to infer that Factor 4 may represent female use of localized raw materials to extract and process plant foods.
Bordes and Bordes (1970) responded to the Binfords' arguments in a systematic manner, faulting particular aspects of the latter work. The Bordes' claimed that the functional argument could not account for Mousterian variability when stratigraphic correlations between sites, and palaeoenvironmental data were factored in. They criticized the use of factor analysis on artifacts based on presumed function. Determination of anything but very gross functional categories based on morphology is indeed a dubious enterprise, and the Bordes' rightly suggested that only experimental programmes such as Semenov's (1964) seminal research on use-wear could determine artifact function. The Bordes' also castigated the use of Eskimo (Inuit) and other peoples as ethnographic analogues for European Paleolithic peoples due to the vastly different environmental contexts in which the peoples existed. While this argument may have been acceptable if left at that, the Bordes' criticism falls flat when they immediately thereafter suggest that the (highly maritime oriented and culturally complex) aboriginal peoples of the Pacific Northwest might be a more suitable analogue (1970:64).

The Bordes' maintained that Mousterian variability was due to different cultural groups, and not to differences in function or activity. While many points raised in the Bordes' argument have validity, they seemed to have downplayed the larger (and more intriguing) aspect of the Binfords' argument, that stone tool technologies are constrained by numerous factors of both social and environmental concern. The primary goal in the Binfords' study was to present an alternative methodology and framework for conceptualizing stone tools, and this is the spirit with which it should be read. By far the most intriguing aspects of the work are those that focus on specific cultural and physical variables that contribute to the design of stone tools. In a sense, the Binfords implied that
stone tools should be seen as hominid (human) responses to solving particular problems, a concept that would gain great utility in future studies. With this paper the Binfords essentially sowed the seed for the future flowering of the study of technological organization.

By way of addressing criticisms Binford (1973) took his functional argument several steps further. Responding to Mellars (1970) and Bordes (1970) among others, Binford suggested that taxonomies were measuring instruments, but more importantly one had to conceive and understand what it is that the instrument is measuring. In the case of Bordes and Mellars relative stylistic frequencies were assumed to reflect ethnic traditions. Binford reiterated that cultural organizational factors cannot be ignored but he conceded that style could indeed measure ethnic affiliations in the appropriate contexts, however, this needed demonstration and could not be simply assumed at the outset. He continued by asserting that stylistic and ethnic traditions were not yet developed during the Middle Paleolithic, but are apparent in the Upper Paleolithic, and this was founded on the following research.

Based on his studies on the Nunamiut, Binford (1977) discussed the concepts of "curation" and "expediency", as well as "tool design." Essentially his thesis was expedient tools tend to get left behind at use locations whereas curated items were kept and maintained for longer periods. Concomitantly, expedient tools were manufactured without much impartation of stylistic factors, whereas the opposite was true for curated items. This would have substantial consequences for the archaeological record. In general expedient items should be far more abundant than curated ones, and importantly, the expedient items could not necessarily be used as a basis for measuring ethnic tradition.
With this line of thinking Binford went on to suggest that Mousterian technology was largely if not entirely expedient, and therefore not amenable to study of style.

In the 1970s Binford became more concerned with how foraging groups culturally adapt to living on broader landscapes. He was particularly interested in the mechanics of settlement organization with respect to scheduling resource procurement across time and space (Binford 1980). After examining a database on hunter-gatherer organization in different parts of the world he came up with his now well-known division of "foragers" and "collectors." The former have high residential mobility and move consumers to food sources at different times of the year, the Kalahari !Kung are cited as an example. Collectors usually live in temperate climes where seasonality and patchy resources predicate greater complexity in scheduling and decision-making. Given this, collectors have base camps that are moved less frequently than those of foragers, and from these base camps collectors send out teams to procure resources that are then brought back to consumers at the base camp. In this manner collectors are able to cope with the logistical vagaries of surviving in such environments. The Nunamiut are the embodiment of this group. Binford realized that these examples were extremes within a continuum and stated as much (1978), however, there has been a propensity for other archaeologists to use these terms and concepts as though they are distinct categories (see Chatters 1987), a point which will be returned to shortly.

The extreme differentiation between two hunter-gatherer mobility/settlement types and two technological strategies inevitably led to an unofficial marriage of the two broad categories. Foragers were linked with expedient technologies while collectors essentially employed curational strategies. This is an unwarranted and overly simplistic
leap of logic; both concepts are heuristic devices. They are extreme cases that have been observed ethnographically. Despite Binford's note to this effect in his writings, in the decade after the original propositions were made other workers began using these concepts as though they were validated categories (Nelson 1991). This led to considerable confusion and multiple interpretations. The concepts of curation and expediency were even more ambiguous, and this too became the basis for some discord (Shott 1996b, see below). Rather than explore the variability and causality within and between the two broad continuums, there was a tendency to conform archaeological data into Binford's heuristic categories.

During the 1970s other ethnographic research projects focused on hunter-gatherer stone tool technology (e.g. Gould et al. 1971; Hayden 1977, 1979). The value of these works can be measured in many ways, but undoubtedly highly important was their illustration of the variability and complexity in the ties between mobility, economy and lithic technology. In the Western Desert of Australia for example Hayden (1977) describes a lithic technological system that has a near absence of “formed” tools. Realizing that normative approaches would be difficult to operationalize and more importantly, would negate the variability that conditions this technological system, Hayden cautions researchers to consider broader factors when interpreting archaeological materials. Such studies have far reaching consequences for the study of archaeological lithics; they reinforce the need for a more holistic view of stone technologies as dynamic entities.
The concept of curation

Curation has probably been the single most applied and yet misunderstood concept subsumed under the umbrella of technological organization. Most of the misunderstanding and ambiguity arise from the fact that there is no one precise definition for the term, and therefore it has been subject to various conceptual and methodological treatments that are sometimes diametrically opposed (Odell 1996, Shott 1996b). Binford himself was quite vague about what curation actually is, and used it to encapsulate a number of different ethnographic and archaeological behaviours (Odell 1996: 261). Yet, since its introduction into the anthropological literature, the term has arguably become one of the central tenets for discussions on technological organization.

Curation initially gained a platform in Binford's (1973) work not as a general theoretical principle, but as a part of a rebuttal in his on-going debates with François Bordes on Mousterian variation (Shott 1996b: 260). In this paper Binford argued that the main difference between Middle and Upper Paleolithic industries was that the latter were curated while the former were not. Variation in Mousterian and more recent industries was both the result of many factors, but Upper Paleolithic industries exhibited evidence for manufacture of tools "in anticipation of use" (1973). Due to differential environmental and resource distribution factors Upper Paleolithic toolmakers saw the need to manufacture their implements long before actual time of use, and these tools were then carried to the site of use. Moreover these implements could be maintained (through resharpening and recycling) and carried for repeated use episodes, which was described as an "efficient" strategy. So curation initially involved "anticipated use" of stone tools in which factors of mobility, transport and efficiency were invoked.
Middle Paleolithic industries by comparison did not display these features according to Binford. Makers of Mousterian tools used their implements at the time and place of manufacture, resulting in a very different type of toolkit that was termed "expedient." In this system hominids did not perceive a need for manufacturing and transporting finished or semi-finished tools from site to site. Dibble (1987) subsequently argued that Middle Paleolithic scrapers were in fact highly curated via resharpening and recycling, and this accounts for much of the contested Mousterian variation.

In Binford's early writings, expediency was posited as the inverse or opposite of curation. Even though he may have initially conceived expediency and curation as opposite ends within a continuum, the ambiguous nature of these terms and lack of precise definition eventually led to a bipolar scheme wherein technology could be described only as curational or expedient. More specifically anything that was not reflective of curation became expedient by default (Shott 1996b:266), and others later adapted this designation scheme wholesale.

In subsequent works Binford (1977, 1978, 1979) applied these terms in his discussion of Nunamiut technology and settlement organization. In observing several hunting episodes he recorded attributes such as gear use and discard, and also how its users perceived this gear. There was much seasonal variability in the way gear was used and stored and also importantly, the value placed on gear items and how these were maintained and/or discarded over the landscape. Most of what was discarded in the brief period observed was defined as "expedient" and easy to replace. On the contrary, highly valued and less easy to replace gear was maintained for prolonged use, either through repair or seasonal storage, or a combination of the two (Binford 1977).
Personal gear, caching of stone implements, and site furniture were all thought of as being curational strategies. An important realization at this stage was that personal gear is more likely to be highly valued and therefore conserved. With this, Binford also made the point that highly curated personal gear will only be found in certain contexts, at points of manufacture, maintenance, caching, possibly use and discard (presumably at the point where the item had exhausted its use life, or had suffered from irreparable damage). On the other hand the vast majority of the discards would be non-curated in nature. Even in this somewhat early work there is a hint of the dichotomous positioning of "curated" and "non-curated" items, which did not allow for complexity or variability in the scheme.

A major criticism of this study is that at the time it took place, the Nunamiut were using few or no stone tools, most of their "gear" consisted of mass produced consumer goods made of metal (see also Hayden 1976). While the primary import in Binford's study is the illustration of variability in how different implements are viewed, conserved and/or discarded, there is still the problem that the cycle of stone procurement, reduction and use operates under a different mechanical and social structure. Because lithic technology is reductive, the types of use, discard and particularly archaeological evidence are naturally expected to be somewhat different than what Binford observed.

Binford's observations here ironically cast a blow to his earlier theories on Mousterian variation. If Mousterian technology was largely "expedient" and discarded randomly over the landscape, then what exactly do agglomerations of Mousterian tools indicate? If these were indeed "activity areas" where certain endeavours repeatedly took place over long periods of time, surely this entails a depth of planning and "anticipated use" of the area that Mousterian toolmakers would have to transmit to future generations.
This is the type of archaeological patterning one would expect as the result of a collector strategy rather than a forager strategy, using Binford's own logic.

Hayden (1986) also realized this, noting that generalized foragers should be expected to have generalized toolkits. Based on ethnographic experience, Hayden claims that in Australia generalized hunter-gatherer resource extraction sites are rarely used more than once, and stone tools are rarely left behind in large numbers at these sites (1986:84). In general "foraging" groups display great similarity in stone tool assemblages between habitation sites, within particular ethnic traditions. Hayden also argues for a global generalized hunter-gatherer strategy until the later part of the Upper Paleolithic, where specialization begins to occur (see below).

The growth of the curation concept

During the 1980s other researchers were embracing and expanding upon Binford's initial ideas. Torrence (1983, 1989) argues from a conceptual viewpoint that curation is adaptive and relevant in situations of time stress, and is particularly important in managing risk and the consequences of failure to procure needed resources. In this scheme technological strategies function within a constrained overall temporal budget. Where there is time stress, Torrence argues that preparation or "gearing up" beforehand becomes a critical issue. Nash (1996) also raises an important criticism, that aside from the various ambiguities with regard to what curation is and how it is defined, there is also the vexing question of scale, "what exactly is curated: tools, assemblages, or technology?" (p. 82). This is also a source of some confusion, for example in earlier work (Binford and Binford 1966) the level of discussion was the assemblage, however in the
ethnographic-related writings the level of scale switched to tools (Binford 1977). The same confusion is transferred to other works, however most researchers seem to apply curation at the assemblage level. Shott (1996) declares that if curation is a valid concept, it should be applied at the level of tools, and not assemblages. Nelson (1991:62) sees curation and expediency as "plans" for human mitigation of the environment, they are variable both in their response to environmental conditions and in their implementation. Following this, stone tool design and assemblage diversity are "consequences" of curation and expediency (p. 62, emphasis original). Yet there are nebulous distinctions between curation and expediency that seem to defy any internal logic. Nelson (1991:63) states:

> Curation might include preparing and carrying either cores or tools to a workplace. In the first instance, potential sources of tools have been curated; in the second instance, finished products have been curated. Subsequent changes in the forms of these objects depend on whether they continue to be part of a curation strategy or are used expediently. For example, stockpiled or transported cores facilitate a strategy of making tools as they are needed, an expedient strategy.

The last statement is of particular interest since it negates core preparation and stockpiling as types of curation, unless they are transported to the workplace. Two issues can be identified; first, creation of a stockpile of cores or potential tools is intuitively a very curational strategy if we consider the "anticipation of use" clause. No one (hopefully) has ever been recorded hauling rocks for tens or hundreds of kilometres to create a pile for pure enjoyment. All things being equal, stockpiles are the ultimate expressions of "anticipation of use." Yet this has always been deemed an expedient strategy not so much in the obvious planning of the stockpile, but in the general lack of
conservative strategies in the reduction of stockpiled material (Parry and Kelly 1987; see also Hamilton 1994).

Secondly, the "workplace" may be 10km away or it may be 10m away from the stockpile, but this arbitrary distinction can mean an operational difference between curation and expediency according to Nelson. Such fuzzy categorization invokes a large measure of unnecessary subjectivity and plays a role in the current state of confusion regarding curation. To reiterate, there is much overlap between the various conceptualizations of curation and expediency, the categorical lines between these behaviours are very ambiguous and open to several different interpretations.

Sorting out of these conceptual problems is currently on going, however during the 1980s several workers began applying the curation-expedient scheme in their analyses (see Johnson and Morrow 1987, Torrence 1989), albeit employing the categories as mutually exclusive strategies. Operationally, this resulted in different approaches and ways to describe some type(s) of behaviour that reflected some measure of curation, or a lack thereof. These works highlighted different aspects of curation as had been variously stressed, particularly by Binford. Issues relating to site formation (Camilli 1989), raw material availability (Andrefsky 1994, Bamforth 1986, Jeske 1989), mobility (Goodyear 1989, Lurie 1989) and settlement organization (Parry and Kelly 1987) became important aspects of the curation-expediency continuum.

Bamforth (1986:39) states that Binford's usage of curation embodies a minimum of five separate aspects of stone tool production and use, these are "production of implements in advance of use, design of implements for multiple uses, transport of implements from location to location, maintenance, and recycling". Shott (1996:264) is
rightly uncomfortable with "anticipation of use" as a defining hallmark of curation. It is an ambiguous proposition if taken literally, since all tools are manufactured with some "anticipation of future use," whether ten seconds or ten months after manufacture. However the way in which the term has been used in the literature indicates an occasional subtle underlying meaning. Consider for example Nelson's (1991:62) emphasis on "preparation of raw materials in anticipation of inadequate conditions....at the time of place and use" as a discriminating feature between curation and expediency. This is a very specific use of the concept that centers around time stress formulated initially by Binford in his observations of Nunamiut caribou hunting, later conceptually expounded on by Torrence (1983). These situations are largely restricted to foragers in temperate zones (Kelly 1995), so this specific definition is not equally useful in all cases.

Odell (1996) examines Bamforth's five postulated categories and assesses the potential for operationalization for each one. He concludes that manufacture in anticipation of future use is not an easily identifiable feature in practice, but at the site level it can be distinguished at workshops and caches, which are relatively rare among known archaeological sites. By "workshops" it is assumed that Odell is referring to the presence of debitage, which is comparatively rare but not infrequent. At the individual artifact level, Odell argues that evidence for hafting could indicate curation. On this count he is right in noting the general dearth of such evidence in the material record, but fortunately there is some such evidence in his dataset from the Illinois Valley.

As for deciphering design of multiple use tools, Odell rightly points out a conceptual problem in discerning between the "act of designing" and "the fact of multiple use" (p. 57, emphasis original). The former could be linked to a curational strategy for
multiple use tools, while the same could not necessarily be argued for the latter. In this sense, the category is closely tied to the first one, production of implements in advance of use. However this is obviously a difficult issue to operationalize given the frailty of recognizing tools that have been purposely designed for multiple use, and Odell attempts to do it by using frequency of bifaces in his Illinois data set. Based on Kelly's (1988) work, Odell argues that bifaces in this region essentially serve as multifunctional tools.

For tool transport from location to location, Odell acknowledges the important role that mobility has been ascribed in discussions on curation, however he feels that the vagaries of lithic sourcing hamper efforts to deduce origins of particular stone materials. He argues that unless sources can be reliably pinpointed, a case for tool transport can be difficult to substantiate, a notion that Storck and von Bitter (1989) support. This is especially crucial in areas where there are widespread outcrops of particular sources that have homogeneous macroscopic characteristics. Equally critical, many researchers use overly simplistic reasoning in dealing with curation. Lothrop (1989) for example cites a general propensity on the part of some workers to expect that the amount of resharpening and recycling on tools will be positively correlated with the distance from raw material source. By focusing on one variable, distribution of raw material, all other factors are ignored.

However the situation may not be completely bleak; on a general level much can be said about transport of particular types of raw material (Goodyear 1989). In some cases, on a regional level flaking and discard patterns can be discerned (e.g. Bunn et al. 1980). Odell suggests that embedded procurement strategies can leave patterns that are difficult to decipher, although some researchers have claimed success in this regard.
(Morrow and Jeffries 1989). Shott (1996b:264) disputes any argument that favours transport as a defining hallmark of curation. He sees transport as a simple mechanism that may aid in curation of tools, but the act of transporting itself cannot be considered curation. This is basically a question of semantics; transportation of certain items to the exclusion of others over time could be considered curation in a general sense, but Shott's point is well taken.

In the category of tool recycling, Odell generally feels this is difficult to operationalize. This is an acceptable argument since stone tool making is a reductive process. All things being equal, recycling a broken tool into a new one obliterates much evidence of initial form. Furthermore, if we accept retouch as a type of evidence for recycling then it becomes imperative in practice to be able to distinguish between resharpenering and recycling, and so far this has proven elusive on most counts (Odell 1996:59).

Tool maintenance is the last aspect of curation noted by Bamforth, and Odell suggests that this feature can be operationalized via two methods that focus on formed tools. The first is using Shott's (1986:44, see below) index for measuring extent of retouch on hafted bifacial tools, which is the ratio of the total implement length to the haft length. This strategy makes the assumption of high standardization, wherein all hafted implements begin their use life at a predetermined size, so by measuring the ratio at a given point, one can measure the extent of resharpening.

There are two things wrong with the above assumption. First, the level of standardization ascribed to manufacturing points is unwarranted. It is not difficult to accept claims of standardization in haft size and form; the cost of procuring and
manufacturing hafting materials is considerable, in many cases more so than the stone implement (Keeley 1982). However it is less easy to accept claims for size standardization of entire bifacial, hafted elements, particularly if there is a strategy of repair in which the initial form of the biface is modified through resharpening. In other words, there is no benefit to making standardized points that will be subsequently modified. The exception to this would be if the actual resharpening method was controlled via imposed cultural standards (Flenniken 1985).

The second criticism of Shott's index is that resharpening of projectile points for instance, cannot be considered a constant linear process. As an extreme example, imagine two projectile points are manufactured, hafted, and first used at the same time. Point no. 1 suffers slight damage at the tip and right margin, while point no. 2 loses almost at the top half of its mass. The respective makers of the points both decide they are worth repairing. The implement morphologies resulting from these repair episodes will quite be different, we can expect point no. 2 to have a lower total length: haft length ratio, yet it will not have been maintained or for that matter curated more extensively than the first projectile point.

Odell's (1996:61) second indicator of tool sharpening in Midwestern sites is alternate beveling, however, little more is mentioned about this. On a curious note, it is surprising that Odell does not consider the significance of debitage assemblages in reconstructing reduction strategies over the landscape, or even at a single site. The potential for this endeavour is well recorded (Ahler 1989, Magne 1985, Rahemtulla 1995a).
Bamforth (1986) argues that maintenance and recycling are the only important aspects to be considered in curation, and that the primary constraining factor in technological organization is the availability of raw material. However when Bamforth attempts to operationalize this in one ethnographic and two archaeological instances, the results are less than favourable. In the ethnographic case, the !Kung are focused on, particularly their iron and other metal tools. For an argument based on availability and maintenance of raw material, it is difficult to see any benefit in using commercially produced and bought metal as an analogue for stone raw materials. Moreover Bamforth's archaeological analyses suffer from small sample size and weak methodology.

As it stands in the present, the concept of curation is still somewhat confusing and without precise definition (Hayden et al. 1996). Due to this nebulous nature, Nash (1996) and Odell (1996) suggest the term be abandoned or else if used, researchers should be specific in how they define it. On the contrary, Shott (1996b) argues the concept is still useful in some senses, and performs an “exegesis” in an attempt to salvage these useful qualities. Shott declares that curation can be seen as the degree of utilisation of a tool, which can be measured as a ratio of its initial potential maximum utility: actual realized utility before discard (p. 267). He realizes the daunting task of operationalizing this concept, but remains hopeful (p. 271).

Ultimately perhaps Odell's and Nash's assessments are valid, the concepts of curation and expediency have been useful in a heuristic sense but they have suffered far too much abuse as catch all explanations for all sorts of archaeological and behavioural variation. What was initially meant to be a conceptual tool went awry, resulting in a general complacency in which investigations of the underlying causality, complexity, and
variability of lithic technology are superseded by simplistic leaps in logic. It is time to move on to more productive grounds and examine in a more specific manner, the variables that contribute to the design and reduction strategies used for stone tools.

**Mobility and transport**

Human mobility is acknowledged as a critical aspect in foraging systematics (Kelly 1983) and in technological organization (Carr 1994b, Cowan 2000). One of the most important realizations in the development of the study was that stone raw materials found away from their sources could be indicative of settlement patterns (Goodyear 1979), that is they could have been discarded by mobile peoples who transported the material from another area as part of their foraging strategy. In previous conceptual frameworks, exotic materials in a given area were almost always automatically assumed and explained as evidence for trade or in extreme cases, migration. But it was not only exotics that could yield such information, Binford and Quimby (1963) argued for the importance of debitage in deciphering settlement patterns, since debitage is not normally a transported class of artifact. As such, mobility has played a large role in discussions and applications of technological organization.

Torrence (1983) for example was an early discussant of the relationship between settlement mobility and technological organization. She notes that because of the high mobility of most hunter-gatherer groups, there will be great constraints imposed in the form of carrying costs. Shott (1986:20) takes this argument further and suggests that higher residential mobility would encourage a more portable, multifunctional toolkit, assuming no aids are used in transport. He suggests that as mobility increases,
technological diversity and complexity should decrease, where diversity is reflected in the number of tool forms, and complexity is measured in the number of distinctive components that make up a tool (from Oswalt 1976). Shott compares toolkits from a number of low latitude ethnographic groups and finds this relationship to be significant. These results are deceptive, measuring for one clinal variable along latitude is questionable. Tool design is constrained by a number of factors but any one factor can look like it is patterned over a given area. Shott (1986:34) notes this himself when he states that such linear relationships should not be frequent, given the complexity of variables underlying technological organization.

One important point that Shott does raise regards the nature of episodes of mobility in that a distinction must be made between frequency of mobility and magnitude of mobility. He contends that technological diversity is strongly correlated with the former while tool complexity is weakly correlated with the latter. While generalizations between types of mobility and effects on technology can be accepted temporarily, it is obvious that archaeologists must pay more attention to different kinds of mobility (e.g. Kelly 1983, 1995) and their effects on technology. Simple correlations between mobility and technology are no longer warranted (Carr 1994b:36). Ingbar (1994) provides an interesting simulation model that underscores this point. Nonetheless Torrence (1989b:62) objects to Shott's interpretation, arguing instead that the tool assemblages observed are not determined by mobility per se, rather that both factors are determined by the same causal principles. For Torrence, mobility and technology are part of the adaptive package to a particular situation.
Working with Pleistocene/early Holocene quarries in the Great Basin Beck et al. (2002) demonstrate that distance to the residential site is correlated with the amount of reduction performed at the quarry. Because transport costs are heavy for lithic materials, toolmakers from distant residential sites reduced their bifaces to a greater stage than individuals and groups that resided closer to the quarry. Expounding on Holmes’ work a century before, the authors argue that transport cost and risk of failure are mitigating factors in exactly what toolmakers did at the quarries.

Not surprisingly, archaeologists have paid some attention to mobility in concern with foragers and collectors, notably the effects on technology at the two ends of the spectrum. Kelly (1988) makes an interesting argument that focuses on bifaces as a solution to instances where high mobility and scarce raw material availability are combined with the need for a multi-task toolkit. This could arise especially in instances where collectors must go on long logistical forays where there are no known raw material sources. In an archaeological case, Kelly ties curation and mobility with collector strategies at a particular locale in Nevada. Focusing specifically on bifaces, Kelly argues that at the time when collectors were using the site, well-made bifaces were a response to wide ranging mobility patterns where there are no suitable raw materials. In these instances bifaces serve as cores from which to remove expedient flakes for particular tasks, but also as tools in themselves. A well-made biface has the characteristic of being a potential core for several subsequent flake removals, without changing the edge angle of the biface to a degree that renders it inoperable as a future core or tool. The biface in this situation is an all-purpose implement that has several advantages, most notable of which is its portability.
On the other hand Parry and Kelly (1987) have argued that a reduction in residential mobility would favour a shift towards more expedient strategies. Examining a number of post mid-Holocene sedentary settlements in North America, they find there is an increasing trend towards generalized core reduction strategies as residential mobility decreases. Extensive raw material search and procurement time is too expensive for sedentary peoples, therefore it would be more economical to situate habitations close to raw material sources, or alternatively stockpile raw materials at the site. With a steady supply of raw materials at hand, there would be less pressure to conserve.

A problem with Parry and Kelly's hypothesis is that it negates the cost of building up a stockpile. If the cost of procurement is high, it would make more sense for toolmakers to be more conservative with raw material. Moreover Hayden (1981, 1986) has argued that on a world-wide basis, logistical settlement patterns seem to arise in concert with exploitation of \( r \)-selected species, and this had the effect of increasing tool specialization, which is the opposite pattern of what Parry and Kelly observe. This is an interesting situation, and there is a hint that an important factor has not been considered for the temporal focus of Parry and Kelly's study.

If we accept that stockpiles were indeed being created at these sedentary sites and that in some cases the raw material sources were several kilometers away, there is still a heavy cost in transporting the material, even if this were carried out in an "embedded" fashion (Binford 1979). This means that stockpiles are relatively expensive to maintain under normal circumstances, especially if the primary reductive strategies were non-conservative. However the "cost" of building and maintaining the stockpile would depend largely on the mode of transport.
One feature that perhaps deserves more attention in these studies is the presence of waterways in the vicinity of the site, and raw material source. Through readings for this research, it was noted that many of reported inland sedentary settlements occur near fairly large lakes, rivers and tributaries. It seems somewhat obvious that in many of these situations, some form of water transport could have been deployed. If so, the cost of transport decreases dramatically and the build up of stockpiles becomes far more economical (Rahemtulla 1996). There is a persistent tendency in North American studies to avoid serious consideration of the possibility that transport of raw and finished materials occurred via watercraft or by other methods such as sled dogs. This of course can be a large oversight in some cases, and has perhaps contributed to an erroneous larger picture of human settlement and technology (see also Engelbrecht and Seyfert 1994).

Moreover there is an assumption that sedentary peoples would have automatically had much smaller ranging patterns than more mobile groups (Odell 1994:72). While this may be true in the general sense, it would not necessarily preclude sedentary peoples from making long trips to procure resources. Binford (1979) argues that in such situations, the presence of exotic raw materials are due to "embedded" procurement, essentially raw material collection is built into subsistence/ranging activities. According to Binford this would make collection of such raw materials viable, the cost of sending out teams specifically for raw material being too costly. Speiss and Wilson (1989) produce an archaeological example from New England as a counter to this point. They argue that in this area, PaleoIndian peoples imported large quantities of exotic stone by sending out special logistical teams. Kelly (1992) documents studies where an increase in
Sedentism led to increased mobility. This suggests that mobility in and of itself is a complex phenomenon that cannot be simply categorized into basic types.

One of the most formidable problems in deciphering mobility in archaeological contexts has to do with scale of analysis, notably sampling for time and space. If we are interested in tracking mobility in archaeological groups, it goes without saying that an intensive regional sampling approach is almost necessary. Yet few archaeological programmes are conducted in this manner as there is still a preponderance on investigating the "big" sites (Tankersly 1989). Secondly, archaeologists must be able to deal with the problem of time averaging (Storck and von Bitter 1989). If we consider the landscape as a potential site, much of what we sample are repeat-use localities. Yet few archaeologists ever consider diachronic constituents even within a single site location, unless there is other evidence for temporal differentiation of material groupings. These problems are not inconsequential, however, they are partially a product of the manner in which realistic constraints act upon archaeological research.

**Raw material availability**

The distribution and availability of raw materials is a significant factor in determining technological organization (Torrence 1989a). Distribution here refers to the physical manifestation of raw material sources while availability deals with factors of accessibility, which are mitigated by social and physical variables. As a variable for technological organization raw material distribution has been inextricably linked more with mobility than any other variable, perhaps due to the ease with which simplistic arguments can be made about transport from sources. Bamforth (1986) and Andrefsky
(1994) are both proponents for raw material distribution as having a primary effect on overall technological organization. Bamforth essentially feels that where raw materials are in short supply, there will be a trend towards conservation of raw material via maintenance and recycling of tools, and this is a driving force for "curation."

Andrefsky's (1994) study centers on three western U.S. locales that were surveyed for archaeological and toolstone material. Andrefsky argues that raw material availability is the prime factor in strategies employed by the respective inhabitants. In particular he claims that the ubiquity and nature of the raw materials will condition the general technology, finer quality raw materials tend to be used for more "formal" tools while lesser quality materials are used for "informal" tools (1994). In the first surveyed area (Rochelle) raw materials are of a poor quality but are widely available, in the second (Pinyon Canyon) raw materials are of good quality and widely available, in the third area (Calispell Valley) there is a lack of raw materials. The respective archaeological observations are as follows; at Rochelle there is a preponderance of informal tools, the few formal tools are made on exotic materials. Both formal and informal tools characterize the Pinyon Canyon assemblages in roughly similar numbers, while the Calispell Valley material is largely formal and made from exotic materials. From this Andrefsky argues that where fine materials are widely available, they will be used for all tools, but where there is a constraint, these will be conserved. This argument essentially puts raw material availability above all other variables in technological organization, and also suggests that it is an independent variable. While this is certainly viable under certain circumstances, it is difficult to envision raw material alone as accounting for most of the variation in stone tool design in all instances (e.g. Dibble 1994). For instance
Freeman's (1994) findings contradict Andrefsky’s model, in analyses of Acheulean materials at Torralba for instance, where some 85% of toolstone weight has been imported from long distances. This occurs despite the fact that there are other lesser quality raw material sources much closer to the site. Marks et al. (1994) also find intriguing evidence in the Negev for highly conservative strategies, even in areas where abundant fine grained raw material sources are spaced as little as 1 km apart. Morrow and Jeffries (1989) tested whether exotic materials at a Late Archaic sedentary site were used any differently than local materials, they found this to be negative. Strategies used for local materials were duplicated with the exotic material; they argue this to be evidence for embedded procurement.

While there is little doubt that the role of raw material distribution and availability is paramount in technological organization, it is not independent of other considerations as implied by Bamforth and Andrefsky. Settlement organization including mobility, transport capacities, task requirements, and stress factors all need to be considered as well in the design of stone tools. One important point in this regard that is touched on by a small number of researchers (e.g. Hayden 1989; Jeske 1989) is the type of raw material. All too often, studies on technological organization have either assumed a uniform distribution and use of homogenous material, or they have not considered the implications of functional requirements. Clearly, certain activities benefit from properties of particular types of toolstone (Hayden et al. 1996), scrapers for instance function much better when made from harder, less brittle raw materials. This is probably more important where specialized tools are used, although it should not be automatically excluded in
generalized technologies. Needless to say like other variables, raw material distribution cannot necessarily account for a majority of variation in tool production.

**Processing requirements**

Hayden (1979, 1981, 1986, 1987, 1988, 1989) has championed the role of processing requirements in stone tool design and morphology. Starting from a broad context, he argues that observed general changes in technology are tied to changes in processing requirements and the availability of raw material. Beginning with the earliest stone tools, Hayden suggests that cutting and processing requirements changed through time and so to compensate for the increasing cost of raw material procurement, resharpening strategies changed. Resharpening strategies in general then became more material conservative over time. The culmination of this process occurred in the later part of the Upper Palaeolithic, when human groups began exploiting $r$-selected species. Processing requirements were greatly intensified at this time, leading to the development of specialized tools (Hayden and Gargett 1988).

Surprisingly, few other archaeologists have tackled the issue of task requirements in a formidable manner. It should be intuitively obvious that in designing their stone tools, the makers have some idea of how the tool is to function. However from one situation to the next, different designs can be used for similar functions (Hayden 1977). Tool design is also constrained by several other factors, and unless the archaeologist has some idea of the economy and tasks performed by the archaeological culture, processing requirements is a difficult issue to deal with. But it is not a variable that can be ignored in considerations of stone tool design. This underlines the importance of Hayden's work, but
it also leads to the realization that these issues need to be dealt with in more context specific studies (see below). Tomka (2001) has recently made a similar argument.

**Stone tool design**

One of the most promising directions in studies of technological organization concerns the application of design theory (Kleindienst 1975; Hayden et al. 1996). This field originally emerged as design analysis, developing within engineering and architecture, but has properties that are useful in lithic archaeology as well (Horsfall 1987:333). Its main feature is a focus on tools as solutions to specific problems. Problems in human behavioural ecology may be defined in a number of ways but are always context specific.

One of the most attractive features of design theory is its operational basis that argues that artifact form is constrained by various factors (Horsfall 1987:334). This line of thinking is also prevalent in behavioural ecology; hunter-gatherers are constrained by many factors in their technological and subsistence strategies (Kelly 1995). For lithic artifact design these constraints vary from one context to another, toolmakers may have to weigh several technological options as solutions to a particular problem, and this would require the simultaneous evaluation of costs and benefits in light of all the constraints. Solutions need not be "best" responses, given the conflict that may arise in the tension between competing constraints, however the artifact form will be a "satisfactory response to a total set of particular constraints, or to a specific context, and there is usually more than one possible satisfactory solution" (Horsfall 1987:334, emphasis original).
The most impressive aspect of this concept is that the constraints, (which are more or less those described in general studies of technological organization, i.e. raw material distribution, task requirements, mobility etc.) here are interactive and not independent variables. When considering design criteria, it is not feasible to focus solely on mobility, or solely on raw material distribution. Nor are these factors independent; mobility for example will constrain raw material access and transport. Social relations between groups can constrain one or more variables, and so on. These and other constraining factors must be considered simultaneously; in real life foragers (as opposed to academicians) rarely have the luxury of simple reductionist thinking. Decisions must be made while enumerating several variables simultaneously, and the solutions arrived at in a particular situation will not necessarily be the same in another situation where the contingencies are duplicated. This underscores the need to assess technological design criteria within context specific situations.

The second impressive aspect of design theory is its focus on specific contexts. One of the conceptual roadblocks faced by researchers in technological organization (and perhaps archaeology in general) is the propensity to derive universal codes of behaviour from a small number of examples. While this is understandable given the history of intellectual development in archaeology, the net effect has been a widespread inability to recognize the complexity in decision making with regard to stone tool design. Hopefully, this was evident in the discussion on curation. However this situation is changing in both studies of hunter-gatherer foraging (Kelly 1995) and technological (Hayden et al. 1996) strategies.
In the 1980s, a small number of archaeologists (Bleed 1986, Shott 1986) began contemplating various factors concerning the design of stone tools. Concepts were borrowed from other disciplines and introduced within archaeology, and soon these new terms were being cited in subsequent works. Bleed (1986) introduced the concepts of reliability and maintainability as specific design features of hunting weapons. These concepts were originally conceived for use in design of industrial systems, but are adapted for discussion on design of primitive weaponry. In this case, "both reliability and maintainability are strategies for making systems available when they are needed" (p. 739). Reliable systems are designed in such a way that whatever the circumstance of use, they can be relied upon to function. Maintainable systems, which are posited as distinctively different, can be easily repaired if broken, or if needed for a different task, can be "brought to a functional state."

**Reliability**

Bleed (1986:739) outlines some characteristics of reliable systems, these include: overdesign of components (stronger than they need to be), understressed (operates below full capacity), have parallel subsystems (redundant parts to ensure task is accomplished), good craftsmanship and carefully fitted parts, generalized repair kit, maintenance takes place at a time when not in use (presumably in advance), and finally they may be made and maintained by a specialist. This strategy obviously reflects a scheduled encounter strategy, such as that witnessed by Binford during the Nunamiut caribou hunts. The time and place in such hunting strategies are generally predictable but pursuit and capture time is tightly restricted (Bleed 1986:741).
Bleed then examines the Nunamiut as an ethnographic case study of use of reliable hunting systems. The hunting kit is examined, and Bleed feels satisfied that most of the design characteristics of reliable design are met by the Nunamiut technology. Preparation of weapons starts long before the hunt, these are of high quality and good craftsmanship and consist of numerous redundant subsystems. The problem here though is similar to that encountered in Binford's studies in that almost all the Nunamiut hunting gear consists of modern metal implements, "redundant subsystems" entails carrying 2-4 guns instead of one (Bleed 1986:743). While the time stress situation would be similar if stone tools replaced the modern implements, the difficulty lies in realizing the specificity with which these constraints would be dealt with and manifested in the lithic technology.

Nelson (1991:68) adopts Bleed's concepts and makes some very weak hypothetical arguments as examples of operationalizing these systems in lithic technology. Moreover there is some confusion over definition, Nelson feels that standardization should be a hallmark of reliable systems, but in Bleed's original concept, this could equally well reflect easily repaired implements, which signify maintainable systems. Hayden et al.'s (1996) summary of the concept of reliability is pertinent here; they conclude that while the concept of reliable systems may have some promise, it can be very difficult to operationalize. The category of "overdesigned components" for example would be difficult to apply in most archaeological contexts. Categorizing an implement as "overdesigned" implies qualitative assessment in which the researcher is confident of the variables being tracked. Use of this concept also assumes a very rare situation where the archaeologist already has complete knowledge of the range of variation in task use for a particular implement, and the subsequent alternative design
criteria that could be applied in the manufacture of the implement. This analytical strategy is somewhat reverse of a more productive strategy that would focus first on determination of context-specific implement task-use variation and design, and also factor in mobility, transport capacity and raw material availability. Once the archaeologist has a fair understanding of the variability in this system, an assessment can be made with regard to relative design features in a particular archaeological context. Hayden et al. (1996) also raise the very justified critique against Bleed's criteria for a generalized toolkit to repair reliable systems. If reliable systems require as much effort and scheduling as Bleed suggests, it is highly unlikely that they would be maintained with ordinary tools. A more plausible hypothesis would include the use of a specialized toolkit to manufacture and repair implements in such scenarios.

**Maintainability**

Bleed's (1986:739) characteristics for maintainable systems include; lightness and portability, subsystems arranged in series (different functions), specialized repair kit with extra ready to use components, modular design, design for partial function, repair and maintenance during use, user maintained, and overall easily repaired. Maintainable systems are thought to be optimal in situations of unpredictability, especially when combined with continuous need (p. 741). The !Kung and Yanomamo are offered as ethnographic examples in which maintainable systems are used.

There appearss to be a neat dichotomy and covariance of reliable systems with Binford's "collectors," and maintainable systems with "foragers." Like Binford's categories for settlement organization, Bleed's categories are far too general and
simplistic to be of any use when employed in their original forms. According to Bleed they work well with the seemingly obligatory ethnographic standards, the Nunamiut and !Kung, but this is more so because Bleed applied these design concepts with these two polarized contexts in mind. That these two ethnographic cases are not representative of all foragers should be stressed, but is instead overlooked which leads to the ambiguous conclusion that the reliable/maintainable technology scheme can be applied in similar fashion to all archaeological data. Once again, extreme cases are proposed as analogues to explain all archaeological variation. In this light the dichotomy proposed by Bleed seems highly artificial, and like the curation/expediency spectrum, it initially negates continuous variation in between these two types of design. As proposed by Bleed, the scheme also portends that there is an either/or choice in deciding whether an implement falls into reliable or maintainable categories. Far more serious though, is that Bleed only examines hunting arms within this scheme. Most foragers do not rely entirely on such equipment and so this concept has very limited applicability.

Meyers (1989) takes exception to this mutually exclusive argument and argues that reliable and maintainable aspects should co-occur in under certain circumstances. It is difficult to visualize a group of people relying exclusively on reliable or on maintainable systems at all times during the year. Meyers makes a good argument and states that even the "foragers" cited by Bleed do have some "reliable" weaponry which they carry with them in a disassembled fashion, but which require a minimum effort in time and energy to bring to operation. Instead Meyers feels that reliable and maintainable designs can be incorporated into the same tool, and it is the particular circumstance that will dictate these factors.
But far more serious, is the near impossibility of operationalizing these concepts. So far there has been no satisfactory application of reliable and maintainable systems in the archaeological literature. In the manner in which they have been used they are largely an extension of the curation/expediency concept, reliability is the design principle that any self-respecting collector must adhere to, while no forager would shun a maintainable design. This dichotomous positioning once again renders these concepts as inapplicable in a realistic sense. Bousman (1993) goes so far as to claim that the advent of reliable tool design during the Pleistocene may signal an increasing mental capacity in hominid evolution. However he gives no indication as to how we could ever hope to measure this. Meyers' (1989) realization that both reliability and maintainability can be incorporated in a single implement is logical, and an extension to this argument would see the breakdown of exclusive links between design concept and foraging strategy.

That being said, there is something useful in the categorization of "reliability" under certain circumstances. Where risk factors are high due to temporal stress in resource procurement such as in the case of the Nunamiut, it would make sense for their hunting technology to have some of the attributes described by Bleed as being reliable. However this does not negate the fact that when a !Kung marksman spots an antelope, he too must have a reliable weapon with which to dispatch the game. The difference may lie in the critical need for the resource, and factors of risk. For a !Kung, failure to capture an antelope may not be potentially as dire a situation as a Nunamiut who fails to capture a caribou during harvest season. In case of failure the !Kung individual is able to fall back on other resource patches while the Nunamiut individual may not have that particular option (Kelly 1995), although access to resources through social networks would be
available. From this we would expect Nunamiut hunting technology to incorporate a
greater number of design features that would protect against weapon failure. This
suggests that there is a factor of scale underlying the concept of reliability in weapon
design, and that factors of risk may play a large role in the degree of reliability needed in
a particular context.

Torrence (1989b) also argues along these lines in an expansion of her previous
(1983) work. In the earlier work she feels that there is a significant relationship between
resource stress which increases with latitude and number of tool types. More recently, she
argues that assemblage (weapons) structure is largely constrained by factors of risk. She
claims that short-term factors of risk are prime determinants in weapon composition,
diversity, and complexity. Furthermore that reliability and maintainability are important
design factors, but they should be viewed as variables rather than types (Torrence
1989b:63). This is a more sensible view of the concept than the original dichotomous
characterization, however, it still suffers from any applicability or operational relevance.
As mentioned previously assessing degree of reliability or maintainability is a qualitative
assessment, one that would be difficult unless applied in context specific situations where
a great deal in known about design requirements and possible solutions.

**Flexibility and versatility**

Shott (1986) discusses the concepts of flexibility and versatility based on a model
proposed by Ammerman and Feldman (1974). These are considered "variables (which)
can be employed to characterize forager technologies" (p. 19). Versatility essentially
describes the number of tasks an implement can be used for, and this can vary across tool
classes. Flexibility is defined largely by the range of task applications and also by the nature of the task applications. As an example, Shott cites two implements each designed for three task applications. One implement can only be used for three tasks related to tool maintenance while the other can accomplish three tasks ranging from tool maintenance to hunting. The latter is considered a more flexible tool (Shott 1989:19).

Nelson's (1991:71) definition for versatility is concurrent with Shott's, for her, versatile designs can be put to a variety of tasks without changing form, and offers the machete carried by the highland Maya as an example. So both Nelson and Shott see versatile forms as being generalized. Nelson views flexibility somewhat differently however, in her view flexible designs can be "changed in form to achieve multifunctional demands" (1991:70). She distinguishes between modular-flexible designs and sequential flexible design. The former might describe a hafted blade technology while the latter a bifacial reduction strategy.

These categories are even less useful than the reliable/maintainable scheme. They provide little conceptual aid to understanding technological organization, and also suffer from subjective applicability. Operationally it would be most difficult to determine the number of functions a tool was designed for, if wear marks are present what could potentially be noted is the number of functions the tool actually served. This is the troublesome aspect brought up by Odell (1996) previously in the discussion. From an archaeological point of view it would be difficult to discern between edge modifications implemented in the initial design versus those added at a later time. Similarly it would difficult to tell the kinds of functions (if any) an artifact served prior to its last
resharpening. Hayden et al. (1996) suggest that the older term "multifunctionality" is more suitable than versatility, since their premise is similar.

Social agency and lithic technology

In recent years, some researchers have increased their efforts in critiquing what they perceive to be overly functionalist frameworks for conceptualizing technology (Conkey 1991:79; Lechtman 1993). Instead, they argue human agency should be incorporated, if not given primacy in the interpretation of ancient material culture. The basic premises in this line of thinking are borrowed from Social Theory, whereby human agents consciously perceive and recreate their worlds through various means, one of which is the construction and manipulation of material culture. In essence material culture (including technology) becomes a metaphor in the negotiation of social relations between individuals and groups (Childe 1956; Dobres and Hoffman 1994:215).

Leaning heavily on the works of post-structuralists such as Giddens (1984) and Bourdieu (1977), this school "is concerned with social action and with the reproduction of society above the level of the individual actor" (Dobres and Hoffman 1994:222, emphasis original). The concept of structuration as promoted by Giddens (1984) figures heavily in these exercises, where societal reproduction and transformation are viewed within an active matrix of human intent. Individuals can, and do jockey for power or for other reasons in human societies and material culture plays an active role in such negotiating. Also, culture change need not be catalysed by external factors, nor do these changes necessarily begin at a grand scale, although they have the potential to become larger. These are extremely important points in that they expose the failure of
archaeologists to adequately consider the role of social agency in material culture. While culture historians privilege the role of historical antecedents in stone tool morphology for instance, most (but not all) of current approaches outlined in this chapter pay little attention to such factors. Agency based approaches on the other hand, have the potential to blend these important variables and potentially create a more sophisticated approach to understanding the design of material culture. But we are far from achieving that goal, especially when it comes to the vast portion of human history in which stone tools make up a majority of the preserved material cultural inventory.

Applications of such frameworks so far have been successful where particular technologies are focused upon, in particular plastic media such as pottery or architecture. Such technologies are vastly different from chipped stone technologies in many ways. Most importantly, they are additive and plastic meaning that a multitude of shapes and designs are available to the maker, and cultural rules for manufacture and design are easily encoded in such media. Chipped stone materials rarely allow for the same level of plasticity and also operate under a different suite of variables. Socially focused studies also tend to be far more successful in situations where there are several different lines of evidence are preserved, for example large habitation or urban sites. The greater the paucity of evidence, the more difficult it becomes to obtain social information from artifacts (Rahemtulla 1995), a principle that was realized as far back as 1954 by Christopher Hawkes (1954). Some researchers (e.g. Hood 1994) have attempted to apply this line of reasoning (social theory) to chipped stone systematics, but the results have been extremely unconvincing.
One major problem with regard to applications of such frameworks to lithics is that our entire volume of ethnographic and ethnoarchaeological studies on stone tools and hunter-gatherers is exceedingly small. Agency based approaches focusing on other types of technology such as pottery or iron working have the benefit of a larger body of analogues to draw from. Most specific studies on social agency and technology, however, are anchored on ethnoarchaeological and historical (e.g. Deetz 1977) works conducted in fairly recent times. None of these works has been conducted on mobile foragers using stone tools, and so any analogues drawn from modern sedentary villagers who use mass-produced implements must be used with extreme caution. Nonetheless, some projects have achieved reasonable success in constructing meaningful interpretations on agency. Each case must be evaluated in terms of available data and appropriate analogues, before attempting to infer any kind of behaviour for an archaeological circumstance.

**Context specific studies on design**

A most promising current direction in design theory is that taken by Hayden *et al.* (1996), where a specific context is evaluated in terms of perceived constraints, and possible design solutions. This approach comes closest to an attempt at understanding the decision-making process by modeling the constraints that would have been faced by tool-makers in a specific context. Several reduction strategies are considered in a winter housepit village situation located on the Plateau in British Columbia, and based on ethnographic information, various constraints are modeled. The authors then explore tool production via consideration of design criteria and how these are operationalized in the assemblage.
Constraints are broken down into five general categories of task constraints, material constraints, technological constraints, socioeconomic constraints and prestige and ideological constraints. Design considerations include size and weight, edge angle, hafting, use-life, reliability (overdesign), ease of repair and multifunctionality. This leads to the final category of production/reduction and resharpening strategies which include expedient block core, biface, flake/blade tools, bipolar, scavenging/recycling, groundstone and types of resharpening (Hayden et al. 1996:11). Each of the production strategies is thoroughly evaluated within the Keatley Creek assemblage in light of other considerations.

Using ethnographic data, Hayden et al. posit the types of requirements that would be ascribed to stone tools, based on the activities that would need to be performed. Using this as a basis, raw material availability as well as type are both factored in. Raw material availability and quality, transport capacities, task requirements and a number of other constraints are considered. All tool classes are evaluated within a program of constraints and design solutions. Since the setting is winter, extra forays for raw material procurement are assumed to be out of the question. The village residents therefore are shown to have recycled stone tools as a measure to conserve raw material.

The novelty of this study lies in its integration of factors of constraint on the one hand, and the operational application of these measures on the other. No one constraining factor is given precedence at the outset over another; all are considered and appropriately weighted. The traditional factors of mobility, raw material availability, processing requirements, plus some new categories are weighted against each other for each strategy. This leads to a potentially far better understanding of underlying structure than could be
gained with more traditional approaches that are currently in favour in the study of technological organization. As noted before, a major problem with other current approaches is that they tend to privilege one or two factors (i.e. raw material availability or mobility). On the other hand Hayden et al.’s modeling is potentially more realistic in emulating the hunter-gatherer decision-making process since it attempts to understand all the variables that need to be considered in designing stone tools within a specific context (in this case the Keatley Creek pithouse village).

The comprehensive nature of this study is illuminating and reassuring, in light of other developments in the study of technological organization. This approach is quite new and the authors caution its preliminary nature, but the results are encouraging. At hand is the nature of the complexity underlying stone tool production and this study is a rare work that attempts to grapple with several interactive variables in a context-specific situation.

Summary

The study of technological organization has been short but quite profitable. There are several general issues and criticisms that can be raised in the hopes that future studies can address them. Probably the primary conceptual weakness of the sub-discipline as it stands is the lack of any underlying unifying theoretical body. Most workers will acknowledge the roots of the study are in optimal theory but a brief review of the literature indicates that interpretations vary (Torrence 1994). Different conceptual aspects are emphasised in separate works resulting in a disparate set of theoretical notions.
If any progress is to be made in the coming years, we must realize the interactive nature of the variables that contribute to stone tool production. Arguably this can best be done in context specific situations rather than attempting to build universal models from one or two examples. This entails first trying to understand all the variables as much as possible in a given archaeological situation, and then simultaneously weighing these variables to find technological solutions that approximate optimality. Arbitrary evaluation of subjectively selected variables leads to circular reasoning, and has the potential of stalling any progress in the field. What this also entails is viewing stone tool manufacture within the larger socio-economic picture. Social factors such as learning and other intentional individual actions may be extremely important in some cases, in terms of understanding the variability in a given dataset.

Moreover there is a need to move away from dichotomous characterizations of varying principles such curation/expediency and reliability/maintainability. This process started with Binford's forager/collector spectrum, and even though this initial categorization was supposed to be a heuristic tool, most researchers have not used it in this manner. As a result most works dealing with any of the above characterizations tend to use them as preconceived categories in which to pigeonhole their data, rather than exploring alternative causal explanations.

The largest overall problem that has hindered studies though is applicability. While many of the advancements in the past two decades have been made in theoretical discourse, there has been a much slower trend towards operationalization of any principles. This is a formidable gap that needs work before further progress can be made. Interestingly, in Europe particularly France, there has been a trend in the last few decades
towards using the Chaîne Opératoire approach (Sellet 1993). While the focus in North America has been on theoretical concerns, in France the emphasis has been more on discerning variability from a practical and empirical point of view. Perhaps some communication and discourse between practitioners of these two approaches would be of benefit (although see Shott (2003) for critique on Chaîne Opératoire).

One other potentially useful approach is that employed by Kuhn (1992) where multiple lines of evidence are used. Kuhn examines technology from a couple of sites in Europe, and compares raw material availability, mobility, subsistence, and task requirements in assemblages assigned to modern humans as well as archaic humans (Mousterian). He finds that when seen within this broader picture, it is difficult to argue for much difference in the way technologies are organized within their specific contexts. In other words Kuhn believes that generalizations can only be made when a large body of context specific studies have been made. This is a far more sound approach than attempting to extract universal principles from a few studies where the variables are poorly known.

The study of technological organization has increased our understanding of the role of stone tools in past societies. The initial excitement in the 1960s and 70s was understandable; here was a more formidable way of looking at lithic technology, in comparison to the normative method. The most impressive aspect must have been that technological organization was willing to deal with a multitude of variables that culture history was not capable of. In the Binfords' paper of 1966, there was a hint of the notion of interactive variables that underlie the production of stone tools. Since then our ability to come to grips with the nature of this variability and its interactive behaviour has been a
slow process and we have reached a morass (Torrence 1994). However there are some bright prospects works such as that of Hayden et al.'s (1996) offer a promising vehicle out of this situation since they actually deal with the kind of complex variability and nature of interactions that the Binfords envisioned over thirty years ago. Based on the preliminary success of Hayden et al.'s work, a modified approach is used as the underlying conceptual theme of this dissertation (see Chapter 4).
Chapter 3: Background to Research

Geographic locus

The central coast of British Columbia has been defined by Hobler (1990:298) as the area bound by Douglas Channel in the north and Rivers Inlet in the south. This region features a rugged coastline with islands peppered along the outer portion of the coast and classic fjord lands leading to the inner parts of the coast and beyond. Three zones from west to east typically characterize the coast of British Columbia: the Outer Mountain Zone, the Coastal Trough, and the Coast Mountain Zone (Fladmark 1974). Beyond the outer mountains to the east lies the outer edge of continental shelf, a shallow drowned coastal plain that is rich in marine resources. Although exposed on other parts of the Northwest Coast, on the central coast of B.C. the continental shelf remains submerged at an approximate depth of 100m. The Coastal Trough Zone also forms part of this continental shelf, and includes the offshore islands that afford sheltered water ways suitable for maritime transport; the famed “inside passage.”

Andrews and Retherford (1978) provide a more specific physiographic description pertinent to the central coast of B.C., in which the area is crosscut into three broad zones with both elevation and topography intensifying from west to east. On the outer coast the outer most islands comprise the Milbanke Strandflat, where elevations are on the order of tens of meters. The central coast of B.C. is devoid of the outer coast mountains found on Haida Gwaii to the north and on Vancouver Island to the south. To the east of Millbanke Strandflat lies the Hecate Lowland (Holland 1964; c.f. Andrews and Retherford 1978:343), which includes the inner islands and the mainland foothills regions. Maximum elevations in this area top out at approximately 600m and are still
fairly rounded. Physiography in this zone is varied and ranges from gentle sandy to steep rocky beaches, as well as areas with no beach formation due to sharply rising landforms. Archaeologically this zone contains the highest number of sites and site types (Millennia Research 1997) on the central coast.

The third zone consists of the area in between the fjord heads and the outer mainland, and this area consists of deep cut fjords with mountain peak elevations up to 1800m. (Andrews and Retherford 1978:343). This is classic fjord land topography with waterways connecting the outer and inner coast area. These fjords played an important role in human history in the area, as transport and trade corridors, for example.

Namu (Fig. 1) is located in the middle or Hecate Lowland zone, immediately to the south of the confluence of Fitzhugh Sound and the Burke Channel, and within the traditional territory claimed by the Heiltsuk First Nation (see below). Also commonly known as the “Bella Bella” region, today this area falls within the Coastal Western Hemlock biogeoclimatic zone, characterized typically by mild winters and fairly cool summers, and by high amounts of rainfall (Meidinger and Pojar 1991). The site itself is located in a small and fairly shallow drainage bay for the Namu River. This location would have afforded shelter from prevailing winter winds, as well as defensive support. The Namu River is currently approximately 400m long with a bedrock substrate, and narrow gorges leading to small sections of rapids. The river is fed by Namu Lake, a 16km long water body that is in turn fed by runoff from the coastal mountains (Luebbers 1978). The lake is accessible via a short walk from the site proper.
Figure 1. Map showing location of Namu and surrounding region
Outwardly the location of Namu is significant from a resource point of view; the ocean would have provided near shore as well as pelagic resources, the river was a corridor for salmon traveling upstream, and the lake would have provided freshwater resources as well as hunting grounds for terrestrial animals seeking to quench their thirst and procure lakeside resources. The availability of these numerous and diverse resources must have contributed to the enormous longevity and success of site use.

The geographic location of Namu is also quite significant in that it is close to the entrance to the Burke Channel that eventually leads to present day Bella Coola. To the North lie Fisher and Dean Channels. In more recent times these were important transport corridors for goods and people moving in both directions. Moreover the heads of these fjords were important terminus points for trade routes into the Interior. Ethnographically the famed "grease trails" (McIlwraith 1992) were important in this region, whereby eulachon grease and other products from the coast were traded for products such as moose hides from the Interior. During the Early Period obsidian from the Rainbow Mountains is present at Namu (Carlson 1994), and it is likely that the volcanic material was transported by watercraft once it reached the heads of the inlets. Later in time, obsidian from sources to the north and south also reach Namu. It seems that Namu could have been perfectly poised as a central meeting point for trade routes extending from the north, south and east.

General palaeoenvironmental history

The debate on the timing and migration of first peoples into the Americas is well known (Carlson 1995; Dixon 1999) and publicized and will not be dwelt upon here,
except where it pertains to the focus of this thesis. Throughout Alaska and western Canada, use of marine and terrestrial landscapes and resources would have been highly constrained prior to the Holocene. During the late Pleistocene, the temporal and physical extent of glacial ice would have been the most important limiting factor for the first settlements in the region. The Cordilleran Glacier Complex that covered much of western Canada was prominently ensconced over the British Columbia coast up to the continental shelf during the Last Glacial Maximum (Jackson and Clague 1991), providing a formidable obstacle to human settlement. Deglaciation was under way by 13,000 $^{14}$C BP (Clague et al. 1982) and some areas on the coast were free of ice by c.a. 13,000 $^{14}$C BP (Blaise et al. 1990). Mann and Peteet (1994) suggest that with the exception of a 400km stretch of coastline in Southwestern British Columbia, the outer shores of the continental shelf between the Alaska Peninsula and Washington were ice-free by 16,000 BP (CAL).

More recently there has been increasing evidence (Heaton et al. 1996; Josenhans et al. 1997; Matthewes 1989) to support earlier proposals (Heusser 1960; Fladmark 1979) that many areas of the coast remained ice-free during the glacial maximum. As such, these areas would have provided potential refugia for many terrestrial organisms including humans. The most dramatic evidence consists of paleontological remains on Prince of Wales Island in Southeastern Alaska and on Haida Gwaii in northern British Columbia. Remains of brown and black bears in Southeast Alaska have been dated to before (34,000-47,000 BP) and immediately after (10,000-12,300 BP) the Late Glacial Maximum, suggesting that these animals may have survived through the Late Wisconsinan Glacial Maximum in these refugia (Heaton et al. 1996). Remains of black bear have also been discovered in a cave on Haida Gwaii and have been dated to
approximately 12,000 $^{14}$C BP (Fedje 2003:31), but could be as old as 14,500 $^{14}$C BP (Ramsey et al. 2004). Based on these and other late Pleistocene faunal remains within the region, McLaren et al. (2005) suggest that human hunters may have purposely targeted bears.

Isotopic studies on some of the bear remains have yielded very interesting results. A brown bear individual dated at 35,365 $^{14}$C BP at On Your Knees Cave shows a $\delta^{13}$C value of $-15.9\%_{\circ}$, indicating a diet high in marine protein. Similarly, a black bear at Enigma Cave on Dall Island has a $\delta^{13}$C signature of $-16.0\%_{\circ}$, while a number of bear specimens show values indicating a terrestrial or mixed diet (Heaton et al. 1996). These stable isotope values indicate that both marine and terrestrial subsistence sources were available during these times, providing support to the refugium hypothesis. Further support is seen in palynological remains that date to early post-glacial times (16,000 $^{14}$C BP and later) on Haida Gwaii (Mathewes 1989) and Kodiak Island (Mann and Hamilton 1995). If both the omnivorous black and brown bears could survive in these areas during the late Pleistocene, then clearly so could humans. These independent lines of evidence continue to provide support to the potential for a late Pleistocene human presence in the area.

**Relative sea levels**

Sea level histories have played crucial roles in the formation and decipherment of archaeological history of the Pacific Northwest Coast. Rising and lowering relative sea levels and associated lateral movements of shorelines would have constrained settlement patterns, resource availability and transportation, to list a few aspects of ancient lifeways. These moving shorelines have also played a large role in preservation and destruction of
archaeological sites over time, through water logging and wave erosion respectively. Following this, understanding relative sea level histories are necessary to understanding human use of landscapes through time in this area.

On the coast of British Columbia sea level histories are highly constrained by region (Clague et al. 1982), and this has resulted in an imbalance of knowledge; the sea level histories of some regions are much better understood than others. Unfortunately on the central coast of B.C. only preliminary work of this nature has been carried out. Much of the work done in this regard is tied to larger issues related to human migration into what is now known as the Americas. Sea level histories are highly varied and localized due to the complex interaction of tectonic, isostatic and eustatic processes (Clague et al. 1982). Differential effects of ice loading and unloading further compound this situation. A dramatic example of this is the maximum paleo-shoreline at the head of Kitimat Fjord located approximately 200m above present day sea level, while 200 km to the east at the edge of the continental shelf the contemporary paleoshoreline is drowned at 140m below present day sea level (Josenhans et al. 1997:71). General sea-level histories have been proposed for some regions of the British Columbia and Alaskan coasts (Clague et al. 1982; Mobley 1988; Jordan and Maschner 2000), and much of the data for these generalizations come from excavated and dated archaeological sites. Parts of the British Columbia coast have received intensive sea level survey, including location and analysis of ancient shorelines and deposits, both above and below modern shorelines. The west coast of Vancouver Island as well as the southern and northern mainland coasts of the province have received some attention in this regard (Clague et al. 1982, Howes 1983),
but the central coast is relatively unknown. The outer north coast in particular has been the focus of much recent research.

In the Queen Charlotte Sound to the west recent evidence indicates that parts of the continental shelf may have been sub-aerially exposed during the late Pleistocene. With sea levels generally 100m or more below present, the shallower portions of the shelf became terrestrial. Discovery of in situ rooted plant remains at 95m below present sea level at Cook Bank, off the north coast of Vancouver Island suggests that the area was sub-aerially exposed at 10,500BP (Luternauer et al. 1989). Similarly Goose Island Bank in the Queen Charlotte Sound, and Laskeek and Dogfish Banks in the Hecate Strait were sub-aerially exposed between 13,200 and 10,000 14C BP (Josenhans et al. 1995; Luternauer et al. 1989). Luternauer et al. (1989:357) suggest that other shallow areas of the continental shelf on the outer coast could have been sub-aerially exposed at this time, but this has yet to be tested. This has led to speculation on the existence of an exposed coastal plain between southern Haida Gwaii and northern Vancouver Island between 13,500 and 10,500 years ago. Such a plain would have allowed for terrestrial life (including perhaps large game animals) to traverse the area to the west of the ice sheets. More importantly it would have allowed for human groups to inhabit the area. Once again more work is needed both archaeological and geomorphological, before such notions can be tested.

Recent exceptional interdisciplinary effort in the western portion of the Hecate Strait has resulted in a localized sea level curve for the area adjacent to southern Haida Gwaii (Fedje and Josenhans 2000; Josenhans et al. 1997). The well constrained sea level histories there have an inverse relationship to those of the mainland coast: whereas
relative sea levels on the mainland tend to exhibit an overall post-glacial pattern of
regression, the western Hecate Strait pattern is reversed. Due to a postulated forebulge
process (Clague et al. 1982; Luternauer et al. 1989) the outer coast of northern British
Columbia saw a rapid post-glacial transgression of about 165m between 12.5 ka \(^{14}\)C BP
and 9 ka \(^{14}\)C BP, the latter reading being a high stand of some 15m above present day sea
level (Josenhans et al. 1997). This high-stand stabilized until 6,000 \(^{14}\)C BP and then
gradually declined to the present level. This has allowed for extraordinary mapping of
potential sub-aqueous (Fedje and Josenhans 2000) and terrestrial (Fedje and Christensen
1999) paleoshorelines on and near Gwaii Hanaas. Using this information, these
researchers have successfully applied principles of predictive modeling to locate ancient
archaeological sites based on the well-constrained sea level history. These
interdisciplinary efforts have only begun to illustrate the appeal and interpretive power of
sea level histories through combining geomorphic and archaeological evidence.

Retherford (1972) and Andrews and Retherford (1978) report on the last survey in
the central coast region, based on work conducted by Retherford as part of his M.S. thesis
research at the University of Colorado, over three decades ago. Since that time there has
been no concerted effort to decipher the sea level history of this part of the B.C. coast, a
situation in marked contrast to those of the north and south coasts. At Bella Coola the
marine limit during the late Pleistocene is a minimum of 160m above present day sea
level, while on the islands of the central coast the limit may have been 120m or more
above present day sea level (Andrews and Retherford 1978: 345, 347). To the northeast at
Kitimat, raised marine deposits dated at 10,500 \(^{14}\)C yr. B.P. are located 200m above
present day sea level (Clague 1985), while at the head of the Dean Channel raised marine
deposits are located some 230m above present day sea level (Retherford 1972:90). The lower marine limits observed by Andrews and Retherford in the fjord middle reaches may be the result of sampling bias, as access to sites of measurement were mostly locations of logging activities (Andrews and Retherford 1978:345, 346). This underscores the need for a more structured and intense effort in deciphering the region’s sea level histories. More recently Hall (2003) has provided an in-depth summary of sea-level research on the central coast as part of a focused look at the possible age of the Tsini Tsini site in the Bella Coola Valley.

On the central coast the high sea levels dropped with great speed as glacial retreat led to isostatic rebound in the later Pleistocene (Andrews and Retherford 1978; Clague et al. 1982). Initial deglaciation would have occurred in the western margins of the shelf, which in turn would have precipitated isostatic rebound in the area. By 10,500 BP this process would have been close to being complete. Based on a combination of geological and archaeological evidence, Andrews and Retherford (1978: 345, 347) suggest a preliminary sea level curve covering the last 10,200 years. By 10,200 ± 150 14C B.P. sea levels had dropped to a few meters above the 17m above present day high tide at Hvidsten Point, to the east of Namu. This corroborates well with the initial occupation date of 9,720 ± 140 14C B.P. at Namu, from a layer located about 4m above present day sea level (Carlson 1996:87). Andrews and Retherford (1978:348) suggest sea levels continued to fall so that by approximately 7,500 14C B.P., they fell to below present day levels. By roughly 14C 3,000 B.P., sea levels are estimated to have been some 3m below present day sea levels, based on basal dates from four intertidal sites (Luebbers 1978). Subsequent transgressions raised sea levels to their present levels, although the temporal
pace at which this has taken place may be quite variable (Andrews and Retherford 1978:348).

Clague et al. (1982:600) suggest that intertidal archaeological sites may be the result of cultural deposits accumulated at a time of lower than present sea levels, with subsequent transgressions resulting in wave erosion and exposure of the cultural materials (see also Apland 1977:29; Hobler 1978). An alternative explanation offered by Clague et al. (1982:600) is that the cultural material was originally cast into the intertidal zone adjacent supratidal living areas. In such a scenario, the rate of accumulation would be greater than the rate of wave erosion, until site abandonment, when erosion would accelerate and ultimately, the site would appear to be deposited at a time of lower sea levels.

Cannon’s (2000) recent coring programme on the central coast has yielded data that suggest a sea-level history contradictory to that set out by Andrews and Retherford (1978) and Clague et al. (1982). Cannon cored a number of archaeological sites in the region to their basal deposits while obtaining dates and elevations, and uses a sample of 12 sites in this study. There is a strong linear relationship between basal dates and elevation above present day sea level. Assuming the basal date in each case reflects establishment of the site in close position to the contemporary shoreline, Cannon argues that the overall pattern is strongly suggestive of a gradually declining shoreline, one that has never fallen significantly below the present day sea level. In this scenario, inhabitants of the region would continually position their sites on newly emergent terrestrial shoreline areas, following the relatively gentle pace of isostatic rebound.
This pattern contradicts the proposed sea level curve put forth by Andrews and Retherford, but it also does not follow the sea level curve for mid coast regions to the south of this area (Clague et al. 1982). Cannon’s data suggest that sea levels did not fall significantly below present levels for several millennia and then rise again to present levels. This has major implications for locating sites, and for our understanding of land use during the later Holocene on the central coast. Cannon’s argument is highly plausible but rests on the assumption that these sites were always located close to shoreline. While there is no reason to doubt this assumption, more substantive geomorphic evidence would greatly strengthen the interpretation. This would also require a re-evaluation of the causes of intertidal sites in the region, and Cannon (2000:74) suggests that the alternative scenario put forth by Clague et al. (1982:600) involving no sea level change may be more appropriate than the one involving lower than present sea levels. In any case, Cannon’s work only further reinforces the need to work out the sea level history of the central coast.

Oral traditions

Oral traditions describe a time of major floods where people had to relocate to higher ground. These stories are thought to be several thousand years old, and may date to the Late Pleistocene/Early Holocene epoch change (Millennia Research 1997). Farrand in Bella Bella recorded one of the most well-known and oft cited stories:

In the beginning there was nothing but water and a narrow strip of shoreline. (Farrand 1916:883).

Other flood stories (Boas 1973:2; McIlwraith 1948:504; Olson 1955: 340) identify place names, usually mountains or higher grounds where certain groups survived during the
time of high water levels. These stories provide a compelling line of evidence to the notion that settlement on the coast of B.C. occurred before complete deglaciation had taken place.

**Palaeoenvironmental reconstruction and resource availability**

In contrast to other parts of the B.C. coast, little palaeoenvironmental reconstruction has been conducted on the central coast. Pollen records have been studied in other areas (e.g. Mathewes 1989; Mann and Hamilton 1995) for some time now. Using a combination of sources based on studies in other areas (Hebda 1995; Mathewes 1989; Mann and Peteet 1994; Mann and Hamilton 1995; Mandryk et al. 2001), an extrapolated environmental history is presented for the central coast. Herb and shrub tundra dominated coastal environments until ca. 12,500 $^{14}$C BP when coniferous forests became reestablished, most likely a lodgepole pine paleobiome. A cooling period associated with the Younger Dryas age followed from about 11,000-10,000 $^{14}$C BP, and this in turn was followed by a warm and dry period between 10-9,000 $^{14}$C BP. Climatic conditions during the latter allowed for establishment of Sitka Spruce-Western Hemlock forests particularly on the northern and outer coasts. A shift to warmer and moister climate around 7,500 $^{14}$C BP exacerbated the spread of western hemlock. A cooling period follows between 5-4,000 $^{14}$C BP resulting in a climate similar to today, with the most significant trend being the expansion of cedar (Hebda and Mathewes 1984). This would eventually have a tremendous impact on Northwest Coast cultures (Ames and Maschner 1999). The last 4,000 years have seen the slow establishment of modern vegetation communities. A key
feature of the Early Period landscape then would have been a lack of cedar availability, and this has direct consequences for the archaeological record for that time.

The process of deglaciation would have had a tremendous impact both terrestrially and in the sea. On land all rivers and streams would have carried huge sediment and debris loads, changing gradients as sea levels changed. Once the inland ice had disappeared the landscape would have suffered catastrophic mass wasting, releasing coarser debris into streams and rivers (Clague et al. 1982). During deglaciation large volumes of marine clays and silts would have been deposited into the ocean, reducing light penetration and ultimately affecting the make up of near shore organic communities (Hebda and Frederick 1990:322). After 10,000 BP less sediment was deposited into the oceans, and water temperatures would have increased somewhat, particularly inshore. Edible molluscs such as butter clam (*Saxidomus vermicularis*) native littleneck (*Protothaca staminea*) and bay mussel (*Mytilus edulis*) occurred in abundance on parts of the coast as soon as the ice retreated (Hebda and Frederick 1990:327). Most of the major rivers would have been choked with sediment, preventing the establishment of salmonid populations until at least 10,000 BP. Smaller streams on the other hand, particularly on the drowned portions of the continental shelf could have allowed for smaller populations of salmon to survive immediately post glaciation or even during glaciation (Hebda and Frederick 1990:327), although these smaller streams would have been quickly inundated once sea levels began to rise.

Major riversheds would have taken longer to stabilize in terms of silt loading and aggregation, making it unsuitable for the large salmon runs seen in more recent times, until the middle of the Holocene (Fladmark 1975). This has been taken by some to
generalize that sedentary settlement and storage of salmon, increasing population density, and the incipient development of socio-cultural complexity did not occur on the coast until well after the establishment of major salmon runs in the larger rivers (Matson 1992; Matson and Coupland 1995).

On the other hand marine resources have been the mainstay of the Namu area economy for several millennia. Cannon’s work (below) on the central coast has demonstrated that capture, process and storage of salmon have occurred for at least seven thousand years on this part of the coast. Carlson (1998) also argues for a long history of maritime adaptation through much of the coast based on a number of lines of evidence, including stable isotope studies conducted on early human skeletal material. Evidence seems to be mounting that maritime adaptation occurred quite early in many places along the Pacific Coast of the Americas (Erlandson and Rick 2002; Erlandson et al. 2004; Sandweiss et al. 1998). That said we are still far from understanding the important contribution of plants to early subsistence economies in the Pacific Northwest (Lepofsky 2004).

**Cultural background**

The site of Namu lies within the traditional territory claimed by the Heiltsuk First Nation. Linguistically the Heiltsuk are part of the North Wakashan family of languages along with the Haisla, Oowekyala and Kwakwala (Millennia Research 1997; Thompson and Kinkade 1990). Ethnographic information at the Heiltsuk Cultural Education Centre suggests that Namu may be the locus for the aboriginal settlements Ma’was and Na’wamu (Carlson 1996b:83). Boas (1973) and Olson (1954) recorded ethnographies for
the area, from which much information has been derived (Pomeroy 1980). In 1833 European presence was established in the area when the Hudson’s Bay Company set up a post at Fort McLoughlin (Hobler 1983; Tolmie 1963). Historically a number of villages coalesced into a main settlement at Old Bella Bella in McLoughlin Bay at around A.D. 1870. The settlement was thereafter moved to its current location at Waglisla (Olson 1955:320), and the Heiltsuk are sometimes referred to as the Bella Bella. The definition of the term Bella Bella is ambiguous; Olson (1955:320) indicates that it is a corruption of pe’lbah, a place name that means “flat tapering point.” Swanton (1952:545-6) on the other hand suggests that the term is an aboriginal corruption of the word “Milbank”, further adopted back into English (c.f. Pomeroy 1980:2, 3). The Heiltsuk are comprised of five sub-groups (HCEC 1989):

- the ’Yísdtxv (Dean and Burke Channels)
- the ’Wuyalitxv (Fitzhugh Sound and islands to the west)
- the ’Qvuqva’yátxv (to the north of Waglisla, from Milbanke Sound up the Spiller Channel and Inlet
- ’Wuíltxv (Roscoe Inlet)
- ’Xixís (from Milbanke Sound up the channels, to Kynoche and Klekane Inlet

The number of tribal groupings prior to European Contact may have been far more extensive, with localized lineages spread throughout the territory (Millennia Research 1997). Like most other aboriginal groups in the Americas the Heiltsuk suffered great population decimation and severe disruption to their lifeways with the onset of smallpox.
epidemics during the 19th century (Boyd 1994), and due to other effects brought on by European Contact and colonization.

Namu is an important site to the Heiltsuk; it plays a fairly major role in their history (Pomeroy 1980). Elders note that until quite recently Namu had been used as a summer village while other informants indicate that there was one or more village(s) on the shores of Namu Lake behind the site proper. A quick reconnaissance in 2002 failed to locate any visible surface evidence for a village although the vegetation was very dense, resulting in poor visibility. The area around the lake has never been the subject of a full survey and this is likely something that should be done. It is entirely possible that the area may contain evidence for much earlier occupations as well.

At Namu itself a fish cannery was established prior to the turn of the century and like many other canneries on the coast of British Columbia, the Namu cannery was a fairly large operation by the 1930s to 1940s (Lyons 1969). By the 1940s Namu was a thriving town of around 5,000 people, complete with all the attendant facilities required by a settlement of that size. Also like other canneries on the coast, at Namu many different ethnic groups were employed including several Heiltsuk individuals. Many Heiltsuk elders shared vivid memories of their time as employees of the cannery but the picture is not completely rosy; institutionalized segregation meant that aboriginals and other minorities such as Japanese peoples had limited opportunities for advancement, and they had to live in a different part of the cannery under inferior conditions, relative to individuals of European descent.

The cannery was still in operation during the 1960s and 1970s when the first archaeological research projects began at Namu. Crews were able to use the facilities for
living and research purposes, and this was of great help to the research teams as it provided logistical support in this very remote part of the coast. By 1994 the cannery was no longer in operation, having been sold to a private company that was looking into the feasibility of turning Namu into an eco-tourism resort. A skeleton crew was hired to undertake basic caretaking duties and though the resort plans did not go ahead, the cannery is still in private ownership. At present the town is owned by Interpack, a forestry company that at Namu caters to a small number of eco-tourists that travel on the BC Ferries central coast route during the summer, as well as to a number of recreational boaters that pass through the area. In 2002 the author made a reconnaissance trip to Namu and noticed a great amount of deterioration has occurred since 1994. Several buildings and boardwalks have collapsed making pedestrian movement around the cannery a bit more challenging. Unless conservation efforts are made soon it is likely that this deterioration will continue at a rapid pace.

Given the amount and intensity of development and activities at Namu over the last century it is difficult to not dwell on the level of impact this has had on the archaeological record at the site. The known archaeological deposits at Namu are contained within a very small geographic area of the cannery, but it is very likely that the construction and concentrated human activity brought on by the cannery over a period of greater than one century has had a tremendous impact on the overall extent of archaeological deposits that once existed at Namu (Hester 1978a). As such the original extent of the deposits could have been substantially larger than they are at present. This however, will always remain a supposition that can probably never be tested.
History of Research and Excavation

Archaeological research on the Northwest Coast had a relatively late start considering the intense ethnographic research that was carried out in the late 19th and early 20th centuries (Boas 1966). Hester (1978a:1) laments that his early archaeological interest in the Northwest Coast led to frustration since it remained the most poorly known culture area in North America. The central and north coasts of British Columbia in particular remained largely unknown archaeologically until the last few decades, and current efforts continue to change that situation.

Harlan Smith (1909a, 1909b) conducted initial research on the central coast including the Bella Bella/Bella Coola regions during the early part of the 20th century. Although his main focus was on pictographs, he did note the shell midden deposits at Namu (unpublished notes) later officially recorded by Hobler in 1968 (Hobler 1992: pers. Comm.) Smith also commented on the chipped stone industries in the region, particularly the leaf shaped points. Arguing that these were products traded in from interior groups, Smith seemed rather convinced that this region was devoid of any such chipped stone manufacturing industries (1909a:359), a notion that would take hold for some time amongst academics. Moreover early ethnographic accounts (Boas 1966; McIlwraith 1992; Olsen 1954) also left an impression that chipped stone had a short antiquity in this region, or that it did not exist at all. The combined effects of these perceptions led to the belief that the central coast of British Columbia was only recently settled, and that other areas, particularly in the interior, had a much greater time depth.

Drucker and Beardsley conducted the first archaeological survey and excavation in the region during 1938 (Drucker 1943). Local informants advised Drucker as to the
location of some fifteen potential archaeological sites that he recorded, but visited only six. Three of these sites were tested; FbSx 6 in Roscoe Inlet known to be the location of an ethnographic winter village; FbTb 4 designated Kilkitei Village; and FbTb 5 on Campbell Island (c.f. Pomeroy 1980:15). Using the Direct Historic approach, Drucker and Beardsley attempted to work back in time although all the sites tested were of the late prehistoric, Contact or post-Contact period. As was common at the time before the invention of radiocarbon dating, stylistic traits formed the primary method for assigning chronology. In this very limited project none of the sites indicated any great antiquity to Drucker and Beardsley, reifying the common belief that the central coast was devoid of human settlement of any great antiquity. With the advent of World War II and the cessation of archaeological research on the coast, the notion of a coastline that was unsettled before the mid Holocene persisted for several decades (Carlson 1979:21).

Three decades after Drucker and Beardsley’s visit to the central coast archaeological work was reinitiated in the Bella Bella and Bella Coola areas (Carlson 1970, 1972, Hester 1978a; Hobler 1970). Jim Hester (1978a) headed a team from the University of Colorado while Roy Carlson and Phil Hobler of S.F.U. initiated what was to become long-term research in the region. As all of these projects were venturing into archaeologically uncharted territory, a primary aim constituted the establishment of regional chronologies. Armed with the ability to obtain absolute dates through radiocarbon dating, these research projects were freed from some of the dating hindrances faced by previous workers in the area. At the same time students associated with these projects also began their survey and other work that would later lead to the
first wave of graduate theses based on this region (Apland 1977; Conover 1972; Pomeroy 1980).

A team from the University of Colorado conducted the first season of excavation at Namu during 1968 under the direction of Jim Hester (1978a). These test excavations were exploratory in nature, the goal being to assess the stratigraphy and chronology of the shell midden. Excavations continued over the next two field seasons in 1969 and 1970 and two main trenches were opened, the Front and Rear/Main Trenches (Figure 2). In addition to the large number of artifacts recovered, a number of human burials were excavated at the site (Curtin 1984). Undoubtedly the most important information from this initial research project concerned dating of the site; a sample from the bottom of the Main Trench yielded a radiocarbon assay of 9,140 ± 200 14C BP (Hester 1978b). This early date confirmed that the central coast had been inhabited since at least the early Holocene, eradicating decades of speculation to the contrary. Subsequent dating of basal deposits corroborates this early date so that within a span of one decade, the scope of aboriginal history on the coast was extended by several millennia. These dates also confirmed Namu as one of the most significant archaeological sites in the Pacific Northwest, in view of the rarity of known coastal sites dating to that time period.

In total the Colorado excavations resulted in the recovery of 398 chipped and ground lithic artifacts from Namu and two other central coast sites (Luebbers 1978:36).
Figure 2. Namu Excavation Map (modified from Carlson 1996b)
In contrast to the SFU excavations the primary component in the Colorado derived assemblage consists of obsidian microblades. Bifacial projectile points, large cores and flakes, pebble choppers and a small amount of debitage characterize the rest of the chipped stone component (Luebbers 1978:62). Little attention seems to have been paid to the debitage, not an uncommon course of action at the time.

Subsequent to the Colorado work at Namu, Simon Fraser University conducted three seasons of excavations in 1977, 1978 and 1994, under the aegis of the archaeology field school directed by Roy Carlson (Carlson 1979, 1991 1994, 1996). Some of the materials from these excavations form the basis of this dissertation, which adds to the growing body of work on the site and surrounding region (Apland 1978; Cannon 1991; Carlson 1979, 1996; Curtin 1984; Hutchings 1996; Pomeroy 1980; Rahemtulla 1995a).

During the 1977 season the main trench backfill was removed and new excavation units were placed to the northwest, southwest and southeast of the Colorado excavations. Test pits and probing were also conducted in other areas to determine the extent of midden deposits (Carlson 1996:83). Despite the lack of shell midden deposits, all of the eastern test units in the forested areas were positive. Sterile till was encountered at a depth of less than 1m in all cases, and a basal date of $5700 \pm 360 \, ^{14}C \, B.P.$ was obtained from Test Pit 2 (Carlson 1996:87). These eastern test pits clearly indicate that: cultural material exists well outside the boundaries of the shell midden areas and; the site is the result of some complexity in terms of formation processes. Future research at the site will attempt to decipher the relationships between these areas.

During the 1978 season the testing programme continued and revealed a deeply stratified midden in the area close to the river mouth. Eventually three consecutive 2m X
2m units were opened, forming a trench of 2m X 6m, known as the “Rivermouth Trench.” This trench was excavated to sterile glacial till. Depth in this portion of the trench varies from 3.7m to 4.2m, and excavation was conducted in 10cm levels (Carlson 1996:85). A charcoal sample from the basal levels in the Rivermouth trench was submitted for radiocarbon assay and returned a date of 9,720 ± 140 14C B.P., both confirming and extending the long history of the site. In 1994 a second 2m X 6m trench was positioned and excavated to the north of the previously excavated portion of the Rivermouth Trench. As with the 1978 work, the 1994 excavation was carried out to sterile till deposits at approximately 4.2m.

Carlson (1991, 1996b:87-90) has interpreted the midden stratigraphy and chronology based on a number of variables including composition of layers, artifact types and radiocarbon dates. Overall the stratigraphy documents some 11,000 (CAL) years of site usage, clearly one of the most impressive chronologies in the Americas (Figures 3 and 4, Table 1), particularly for a coastal site. Seven Stratigraphic Units (SU) are recognized by Carlson and these make up some six cultural periods (Table 1). The basal level is characterized as SU 1, a yellow-brown glacial till composed mainly of sand that is culturally sterile along with a few boulders, and is found in both the Main Trench (Luebbers 1978) and Rivermouth Trench (Carlson 1979) areas. During the 1994 excavations artifacts were found within this stratum, but these were most likely the result of redeposition. At this depth much groundwater was encountered and the probability of artifacts falling from the walls onto the current excavated area without being noticed was quite high. What was clear, however, is that some of the early artifacts were resting on the surface of this SU.
Figure 3. Stratigraphic profile, Rivermouth Trench (modified from Carlson 1996b)
Figure 4. Stratigraphic profile, Main Trench (Modified from Carlson 1996b)
Stratigraphic Unit 2 overlies this basal layer, and it is the first layer bearing cultural materials. At the northwest corner of the Rivermouth Trench, Stratum 2 begins at a depth of 420cm (Carlson 1996b: 87). This corner is unusual in that during the 1994 excavation, there was a notable dip in the stratigraphic layers towards the north and west particularly in the lower depths of the midden. This unusual contortion of the stratigraphy could not be further investigated due to lack of time; it remains a topic for future investigation.

Stratigraphic Unit 2 contains chipped stone artifacts including various tools and debitage, fire-cracked rock and disintegrating sandstone slabs. Carlson divides this SU into two components, SU 2A and SU 2B. The primary matrix composition in both sub-units is a brown-black soil that is similar to that found in basal levels of other Northwest Coast shell middens. This soil is dark in colour and quite moist, making it nearly impossible to dry screen. The SU 2A matrix is quite dense and is often described as the “black matrix” (Carlson 1996b:87; Rahemtulla 1995a:17), and tends to have “greasy” quality when rubbed between one’s fingers. The chief characteristic that describes these sub-units is the inclusion of finely crushed lenses of shell and faunal material in SU 2B, whereas SU 2A is largely free of such materials. The genesis of such layers in middens has been the cause of some debate, with some arguing that the poor representation of faunal material in lower midden layers is the result of decay and organic leaching by movement of groundwater (Stein 1992). Carlson (1991:87) argues that a more likely explanation for the lack of fauna is the high natural soil acidity and the lack of enough acid neutralizing (through calcium carbonate content) mollusc shells. In this scenario, shellfish were probably consumed in lower quantities than in later periods, or else major deposition of shellfish took place elsewhere on the landscape. The result of this would be that the
acidic soil would quickly decay any organic materials within. In his MA thesis Sullivan (1993) attempted to deal with this issue by examining basal layers from two middens including Namu, but he was unable to put forth a conclusive argument. In any case, the earliest cultural materials from Namu occur in SU 2A in the form of chipped stone tools.

Culturally Carlson assigns Period 1 to correlate partially with SU 2A, so that Period 1 begins at 9,720 ± 140 14C B.P. and the most recent date is 6310 ± 80 14C B.P., also the transition date into Stratum 2B (or 10,676 B.P. – 7,210 B.P.). This SU varies in thickness from 20-60cm, with maximum thickness and age found in the southwest corner of the Rivermouth Trench (Carlson 1996b:87). In the Main Trench SU 2A is represented only in the eastern part of the excavated area and yielded dates of 9140 ± 100 14C B.P. and 7800 ± 200 14C B.P. (Carlson 1996b:87). In all there are some eight radiocarbon dates for this time period, with six of these derived from the Rivermouth Trench.

Based on stratigraphy, radiocarbon dates and artifact types, Carlson (1996b:87) has proposed a tripartite subdivision of Period 1 (14C years): Period 1A, 10,000-9,000 B.P; Period 1B 9,000-8,000 B.P; Period 1C 8,000-6,000 B.P. Period 2 summarily dates from 6,000-5,000 B.P. Together, Periods 1 and 2 are referred to as the “Early Period” (see below). Periods 1A and 1B derive wholly from SU 2A, while Period 1C derives from the top of SU 2A and lower part of SU 2B.

With the exception of Period 1C, Stratigraphic Unit 2B is correlated with Period 2, with seven dates ranging from 6,060 ± 100 14C B.P. to 5,170 ± 90 14C B.P. Five of these dates are derived from the Main Trench while only two stem from the Rivermouth Trench area, one of these being a Test Pit excavation. There does not appear to be a disconformity between SU 2A and SU 2B, there is great similarity in composition and
texture, with the exception of the faunal material in SU 2B. Maximum thickness is 40 cm in the Rivermouth Trench and 70 cm in the Main Trench. The earliest faunal material is found in the Rivermouth Trench in SU 2B, and is associated with a date of 6,310 ± 80 14C B.P., which marks the transition between SU 2A and SU 2B. The appearance of faunal material is a significant marker in the Namu stratigraphy; this class of material intensifies dramatically in shell midden build up in Period 3 and continues to be deposited at the site until European Contact and beyond (Cannon 1991). It also signals the initial appearance of the bone and antler industry at the site, although this is likely due to preservation factors. Intuitively it seems that bone and antler would have been important raw materials, especially before the wide availability of cedar several millennia later.

Whereas in the Rivermouth Trench there is a greater number of artifacts recovered from Period I deposits, the vast majority of artifacts recovered in the 1969-70 University of Colorado Main Trench excavations were found in SU 2B (Hester and Nelson 1978; Carlson 1996b), or Period 2. This suggests that there is some variability in location of discard of artifactual material over time; Period 1 deposits are much thicker in the Rivermouth Trench while Period 2 deposits seem to be relatively better represented in the Main Trench. In the Main Trench two fragmentary burials (1.11B.1 and 1.13D.1) are associated with SU 2B (Hester and Nelson 1978). Both seem to be adults with no grave goods, and no clear orientation (Curtin 1984, cf. Carlson 1996B:90). Burial 1.11B.1 has an associated date of 5,590 ± 100 14C (SFU 344).

Period 3 marks the initiation of massive shell midden build-ups that continue for several millennia afterward. Carlson (1991:91) gives an age range of 5,000-4,500 14C B.P. for this period, where all four radiocarbon dates were obtained from the Main
<table>
<thead>
<tr>
<th>Period</th>
<th>Location</th>
<th>Stratum</th>
<th>Sample No.</th>
<th>Material</th>
<th>¹⁴C years B.P.</th>
<th>Calendar years B.P.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact</td>
<td>F</td>
<td>Gak 3121</td>
<td>Charcoal</td>
<td></td>
<td>480±80</td>
<td>521</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>Gak 3122</td>
<td>Charcoal</td>
<td></td>
<td>680±90</td>
<td>668</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>Gak 3123</td>
<td>Charcoal</td>
<td></td>
<td>980±100</td>
<td>927</td>
</tr>
<tr>
<td></td>
<td>M 7</td>
<td>WSU 1942</td>
<td>Charcoal</td>
<td></td>
<td>1405±120</td>
<td>1308</td>
</tr>
<tr>
<td></td>
<td>M 6</td>
<td>Gak 3125</td>
<td>Charcoal</td>
<td></td>
<td>1470±80</td>
<td>1361</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>Gak 3124</td>
<td>Charcoal</td>
<td></td>
<td>1840±80</td>
<td>1769</td>
</tr>
<tr>
<td>2000 (2000 CAL) B.P.</td>
<td>M 8</td>
<td>Gak 3118a</td>
<td>Shell</td>
<td></td>
<td>1880±90</td>
<td>1850**</td>
</tr>
<tr>
<td></td>
<td>M 6</td>
<td>WSU 1939</td>
<td>Charcoal</td>
<td></td>
<td>2185±85</td>
<td>2226</td>
</tr>
<tr>
<td></td>
<td>M 6</td>
<td>Gak 3119</td>
<td>Charcoal</td>
<td></td>
<td>2440±100</td>
<td>2527</td>
</tr>
<tr>
<td></td>
<td>M B78-1</td>
<td>SFU 341</td>
<td>Bone</td>
<td></td>
<td>2530±160</td>
<td>2650</td>
</tr>
<tr>
<td></td>
<td>RM 5d</td>
<td>WSU 1938</td>
<td>Charcoal</td>
<td></td>
<td>2540±80</td>
<td>2672</td>
</tr>
<tr>
<td></td>
<td>RM 4b</td>
<td>SFU 10</td>
<td>Charcoal</td>
<td></td>
<td>2720±80</td>
<td>2818</td>
</tr>
<tr>
<td></td>
<td>M 5</td>
<td>Gak 2714</td>
<td>Charcoal</td>
<td></td>
<td>2810±100</td>
<td>2922</td>
</tr>
<tr>
<td>4</td>
<td>M 6a</td>
<td>Gak 2713</td>
<td>Charcoal</td>
<td></td>
<td>2880±100</td>
<td>3013</td>
</tr>
<tr>
<td></td>
<td>RM 3d</td>
<td>SFU 17</td>
<td>Charcoal</td>
<td></td>
<td>3280±100</td>
<td>3516</td>
</tr>
<tr>
<td></td>
<td>M 5c</td>
<td>WSU 1944</td>
<td>Charcoal</td>
<td></td>
<td>3330±90</td>
<td>3608</td>
</tr>
<tr>
<td></td>
<td>M 5b</td>
<td>Gak 2715</td>
<td>Charcoal</td>
<td></td>
<td>3400±100</td>
<td>3660</td>
</tr>
<tr>
<td>3500 (4000 CAL) B.P.</td>
<td>RM 4a</td>
<td>SFU 19</td>
<td>Charcoal</td>
<td></td>
<td>3500±100</td>
<td>3774</td>
</tr>
<tr>
<td></td>
<td>RM 3a</td>
<td>SFU 1</td>
<td>Charcoal</td>
<td></td>
<td>3825±105</td>
<td>4218</td>
</tr>
<tr>
<td></td>
<td>M 4b</td>
<td>Gak 2717</td>
<td>Charcoal</td>
<td></td>
<td>4290±125</td>
<td>4862</td>
</tr>
<tr>
<td></td>
<td>M 212E1</td>
<td>S2327</td>
<td>Bone</td>
<td></td>
<td>4300±125</td>
<td>4864</td>
</tr>
<tr>
<td>4500 (5000 CAL) B.P.</td>
<td>M B 4J1</td>
<td>SFU 343</td>
<td>Bone</td>
<td></td>
<td>4390±160</td>
<td>4928</td>
</tr>
<tr>
<td></td>
<td>M 4a</td>
<td>Gak 2716</td>
<td>Charcoal</td>
<td></td>
<td>4540±140</td>
<td>5200</td>
</tr>
<tr>
<td></td>
<td>M 4G2B1</td>
<td>SFU 342</td>
<td>Bone</td>
<td></td>
<td>4680±160</td>
<td>5381</td>
</tr>
<tr>
<td></td>
<td>M 4G8</td>
<td>S2328</td>
<td>Bone</td>
<td></td>
<td>4700±125</td>
<td>5380</td>
</tr>
<tr>
<td></td>
<td>M B 77-2</td>
<td>S2326</td>
<td>Bone</td>
<td></td>
<td>4775±130</td>
<td>5525</td>
</tr>
<tr>
<td>5000 (6000 CAL) B.P.</td>
<td>RM 2b</td>
<td>WAT 451</td>
<td>Charcoal</td>
<td></td>
<td>5170±90</td>
<td>5940</td>
</tr>
<tr>
<td></td>
<td>M 2b</td>
<td>WSU 1943</td>
<td>Charcoal</td>
<td></td>
<td>5240±90</td>
<td>5969</td>
</tr>
<tr>
<td></td>
<td>M 2b</td>
<td>WSU 1947</td>
<td>Charcoal</td>
<td></td>
<td>5590±90</td>
<td>6375</td>
</tr>
<tr>
<td></td>
<td>M 1.11B1</td>
<td>SFU 344</td>
<td>Bone</td>
<td></td>
<td>5590±100</td>
<td>6375</td>
</tr>
<tr>
<td></td>
<td>TP2 2b</td>
<td>WAT 456</td>
<td>Charcoal</td>
<td></td>
<td>5700±360</td>
<td>6480</td>
</tr>
<tr>
<td></td>
<td>M 2b</td>
<td>WSU 1940</td>
<td>Charcoal</td>
<td></td>
<td>5740±100</td>
<td>6506</td>
</tr>
<tr>
<td>6000 (7000 CAL) B.P.</td>
<td>M 2b</td>
<td>WSU 1941</td>
<td>Charcoal</td>
<td></td>
<td>6060±100</td>
<td>6921</td>
</tr>
<tr>
<td></td>
<td>RM 2a</td>
<td>Beta 75340</td>
<td>Charcoal</td>
<td></td>
<td>6310±80</td>
<td>7210</td>
</tr>
<tr>
<td></td>
<td>RM 2a</td>
<td>WAT 517</td>
<td>Charcoal</td>
<td></td>
<td>6550±90</td>
<td>7431</td>
</tr>
<tr>
<td></td>
<td>RM 2a</td>
<td>Beta 75341</td>
<td>Charcoal</td>
<td></td>
<td>7620±80</td>
<td>8502</td>
</tr>
<tr>
<td></td>
<td>1 M 2a</td>
<td>Gak 3120</td>
<td>Charcoal</td>
<td></td>
<td>7800±200</td>
<td>8660</td>
</tr>
<tr>
<td></td>
<td>RM 2a</td>
<td>WAT 516</td>
<td>Charcoal</td>
<td></td>
<td>8570±90</td>
<td>9468</td>
</tr>
<tr>
<td>10000 (11000 CAL) B.P.</td>
<td>RM 2a</td>
<td>WAT 519</td>
<td>Charcoal</td>
<td></td>
<td>9000±140</td>
<td>9920</td>
</tr>
<tr>
<td></td>
<td>M 2a</td>
<td>Gak 3244</td>
<td>Charcoal</td>
<td></td>
<td>9140±200</td>
<td>10067</td>
</tr>
<tr>
<td></td>
<td>CAL) B.P.</td>
<td>2a</td>
<td>WAT 452</td>
<td>Charcoal</td>
<td></td>
<td>9720±140</td>
</tr>
</tbody>
</table>

**Location:** F=Front Trench  M=Main Trench  RM=Rivermouth Trench  TP2=Test Pit 2

**Sample no. (Lab):** Gak= Gakushina  WSU=Washington State University  SFU= Simon Fraser University  S= University of Saskatchewan  WAT= University of Waterloo  Beta= Beta Analytic

*Calibrated dates were obtained using software provided by the Quaternary Isotope Laboratory at the University of Washington (Stuiver and Reimer 1987). An average is provided where multiple calibrated dates resulted from a single ¹⁴C date. Six sample dates (Beta 75341, GAK 3120, WAT 516, WAT 519, Gak 3244, and WAT 452) extend beyond the maximum capacity of the calibration software. In these cases, calibrations were obtained using the formula:

\[ \text{Calendar years B.P.} = \left( \frac{\text{¹⁴C years B.P.}}{1.05} \right) \times 470 \] (Stuiver et al. 1986: 969-979). When calibrated with uranium-thorium series tables (Bard et al. 1990: Table 1) the basal date (9720 ± 140) from the Rivermouth Trench calibrated to 11,090 years B.P. (c.f. Carlson 1991:85; 1996b: 84).

**Shell date is not corrected for marine reservoir effect (Southon and Fedje 1998).**

Table 1. Namu chronology (modified from Carlson 1996b:84)
Trench. Consisting largely of fragmented mollusc shells, particularly mussels and clams, remains of this period are again much better represented in the Main Trench relative to the Rivermouth Trench, where it tends to range between 10-20cm in thickness. In general this period is not well represented at the site, and Carlson (1991) suggests that greater extents of these deposits existed before the truncating construction of the bunkhouse to the west. In the Main Trench there are at least three multiple burials with associated grave goods: Burial SFU 77-2 associated with a date of 4775 ± 130 \( ^{14} \text{C} \) B.P; Burial 4G8 associated with a date of 4700 ± 125 \( ^{14} \text{C} \) B.P; and Burial 4G2 associated with a date of 4680 ± 160 \( ^{14} \text{C} \) B.P. Although not the earliest burials in the general region, the pattern of multiple burials with grave goods is not common at this time period. Clearly something unique was occurring in this area at this time, and Carlson (1991:91) suggests that this was a burial area and possibly a burial house.

Period 4 deposits are most well represented in the Rivermouth Trench, where they make up close to half of the cultural layers (Carlson 1991:91). In general the Period dates from 4,500-3,500 \( ^{14} \text{C} \) B.P. from a total of four dates, although one date is omitted from the chronology since it presents a reversal. A sample obtained from the base of Period 4 deposits in Rivermouth Trench in 1994 yielded a date of 2,940 ± 160 (Beta 75339), clearly too late in time. Carlson (1996b:85) argues this is an erroneous date that is likely the result of a small (<1gm of carbon after pretreatment) sample size. Three of the dates from this period derive from the Main Trench, and again, two of these are associated with burials in the western portion, 4,390 ± 160 \( ^{14} \text{C} \) B.P. and 4,300 ± 125 \( ^{14} \text{C} \) B.P. These dates indicate that this area continued to be used for burials for a period of at least 500 years. In the Rivermouth Trench deposits of this period consist of fragmented shell with
humus and fire cracked rock, and reach a maximum thickness of 140cm (Carlson 1991:93).

Period 5 dates from 3,500 to 2,000 14C B.P. based on 11 radiocarbon assays, 7 from the Main Trench and 4 from the Rivermouth Trench. In the Rivermouth Trench deposits containing whole shell with lenses of humus and fragmented shell represent this period. Period 6 dates from 2,000 14C B.P. to European contact and is represented only by dates from the Front Trench (Hester and Nelson 1978) and Main Trench areas.

The focus of this dissertation is on chipped stone materials from Periods 1 and 2, or the Early Period (Carlson 1979). The complexity of Northwest Coast shell middens is well known (Ames and Maschner 1999; Stein 1992) and Carlson (1991:95) acknowledges this in his characterization of the Namu stratigraphy and chronology. This presents a problem in that fine-grained separation of stratigraphy and chronology is extremely difficult and fraught with all kinds of challenges. Because of this, control of time and stratigraphy is left at a coarse grain level in this study. That is, the only temporal control used in this dissertation is the distinction between Periods 1 and 2, representing four millennia and one millennium respectively. The only possible conceptual approach in this situation is to consider these deposits as massive palimpsests that represent a coalescence of activities through time, as reflected in the material culture. This is problematic in many respects, for one it does not allow the kind of interpretive focus that would allow differentiation of individual or specific activities and their archaeological consequences. There is little or no fine grained patterning in artifact distribution that would allow for detailed interpretations (see Rahemtulla 1995a:21). It is possible, however, to make observations on artifact patterning in a very general sense. Using a
design theory approach, it is possible to try to untangle some of the general classes of activities that took place at the site and whether or not there were any major changes in these activities through time. The utility of such an approach has been demonstrated for a site in the Interior Plateau (Hayden et al. 1996) but has never been applied to an early Northwest Coast chipped stone assemblage. Previous work has focused more on concerns relating to technological organization in general (Hall 1998; Rahemtulla 1995a). Magne (1985) cautions against application of experimental data sets based on one site to other sites on a regional level. The reasoning is that with highly mobile people different activities were likely taking place at different locations on the landscape, so modeling the entire technological repertoire based on one site can lead to erroneous interpretations. This is a reasonable expectation where such regional level data are available; unfortunately for the central coast Namu is the only site with an adequate-sized, well-dated sample from the Early Period.

**Culture History**

Kroeber (1939) proposed an influential model that saw early New World inhabitants as interior hunters, much like the dominant paradigm followed for decades by North American archaeologists. In explaining Northwest Coast maritime adaptations, however, Kroeber’s model proposed that interior hunters arrived on the coast through the river valleys, and through a gradual process, adopted a maritime life-way. Matson and Coupland (1995) have most recently carried this torch in arguing that the peoples of the Northwest Coast have their ancestry in the Clovis Culture (see Carlson (1995) for critique).
Rather than seeing similarities with fluted point traditions, Carlson (1998:30) argues that typologically the earliest coastal lithic industries are more similar to those of interior Alaska, specifically foliate bifaces and microblades, than to the fluted and stemmed points of interior areas adjacent to the British Columbia coast. The Nenana Complex (West 1996) slightly pre-dates both the Clovis and known coastal traditions, and Carlson (1998: Fig. 1) suggests that it may be the antecedent for both of these traditions. In Carlson’s view the ancestors of initial settlers on the Northwest Coast likely originated in central Alaska and at some time became maritime adapted before moving down the coast. These groups were responsible for the initial appearance of the Pebble Tool Tradition at sites such as Namu (Carlson 1996). At Namu the earliest cultural material has been assigned to this tradition and there is an absence of microblades. Based on similarities in tool types and reconstructed paleoeconomies, Carlson (1990) suggests that the origins of the Pebble Tool tradition might be found in the Kamchatka Region in Northeast Asia. From there initial populations would have brought the technological tradition with them as they settled on the Northwest Coast.

Apland (1977, 1980) examined chipped stone assemblages from 38 sites surveyed on the central coast between 1970 and 1974. The sample includes collections from Quatsino Sound to the south of Namu and Kwatna. Four different site types were classified; middens, beach sites, fish traps and undecided. The vast majority of sites are middens followed by beach (intertidal) sites. One of Apland’s goals was to gain an understanding of the time frame within which chipped stone was a prominent technology within this region. The University of Colorado excavations at Namu had already shown that chipped stone technologies had an antiquity of at least 9,000 $^{14}$C BP on the central
coast. Through examination and comparison of artifacts from dated sequences, Apland (1982:27) proposes that chipped stone ceased to be a primary method of tool manufacture on the central coast at approximately 1,000 B.C. Subsequent to that date most stone technologies are based on grinding and polishing techniques. This trend occurs over large areas of the Northwest Coast (Matson and Coupland 1995).

Apland examined some 550 tool-specimens, the vast majority of which are classified as being of basalt-andesite origin. He (Apland 1982:29) argues that these raw materials would have been widely available in cobble form on nearby beaches. An informal survey conducted by the author in 1994 suggests that Apland may be partially correct (see Chapter 4). Six major classes of tools were proposed: bifaces, unifaces, notches, spurs, microblades and edge modified tools (Apland 1982:30). Some of these categories are further subdivided.

Apland concluded that there are two distinct technological traditions represented in the sample, and that these traditions are also geographically exclusive. A pebble spall tradition was inferred from the Quatsino Sound collections, and this features “crude percussion flaked pebble and spall tools and medium to large sized leaf shaped points” (Apland 1982:61). Based on similarities with other southern traditions, Apland estimates that this tradition has an antiquity of at least 5,000 years and possibly more (1982:61). The second tradition is centered further to the north on the central coast, and is a “prepared core-flake tradition characterized by a wide variety of specialized cutting and scraping implements and well developed cores and flakes” (1982:61). Apland sees two phases to this tradition, the earlier Namu phase dates to 9,000 BP and includes
microblades in addition to the above described tool types, and the later Cathedral Phase that lacks microblades but has a higher preponderance of bifacially flaked points.

As this work was done previous to the SFU excavations at Namu, some of Apland’s results have been superceded by new data. Without the benefit of radiocarbon dates or excavated assemblages from stratified sites, Apland did an admirable job of trying to understand the nature of these central coast assemblages. Based on excavations on the central coast and elsewhere conducted since Apland’s work, most researchers now believe that technological traditions that have bifacial points pre-date those with microblades.

Carlson (1979, 1983, 1990, 1995, 1996a) has developed a model for Early Period technological traditions and their cultural-historical affiliations in British Columbia and associated regions. Five basal traditions are identified: the Fluted Point Tradition, the Intermontane Stemmed Point Tradition, the Plano Tradition, the Pebble Tool Tradition and the Microblade Tradition. Two of these are of concern to the central coast: the Pebble Tool Tradition and the Microblade Tradition. Carlson argues that based on the sequences at Namu and other sites on the Northwest Coast, that the Pebble Tool Tradition seems to have a greater antiquity in the region.

The Pebble Tool Tradition

Unifacially chipped cobbles, leaf shaped bifaces and flake-based tools are the hallmarks of the Pebble Tool Tradition (Carlson 1983; 1990; 1996b). As a construct the Pebble Tool tradition has been in use for some time, although under variant nomenclatures such as the “Old Cordilleran” (Butler 1961; Matson 1976) culture, the
Milliken Component (Mitchell and Pokotylo 1996) or the “Proto-Western” (Borden 1975) traditions. The tradition is widespread throughout the Northwest Coast, although it seems to have a greater distribution in regions to the south of Namu (Borden 1975; Carlson 1990; Haley 1987) and appears as far south as the mouth of the Columbia River (Minor 1984) and upstream at Five Mile Rapids (Cressman 1960).

Partially due to the emphasis on unifacial flaking and seemingly simplistic manufacturing techniques, pebble tools were thought to be temporally restricted to a very early time period. A large collection of pebble tools were recovered at the Yale site in the Fraser Canyon near Hope, British Columbia, and Borden (1968b) noted that in the lower deposits these tools were not associated with any bifacial tools. Placing them within the “Pasika Complex” Borden (1968a, 1968b) argued that they date from a time before bifacial flaking was widespread in the Americas and therefore could function as “fossil indexes” similar to Pleistocene technologies elsewhere. In fact Borden (1968b:12) suggested a cultural link with the old chopper/chopping tool industries associated with Homo erectus in eastern Asia (Movius 1949). Doubt was cast on this hypothesis and many suspected early on that pebble tools in and of themselves, were not a suitable time marker (e.g. Grabert 1979). Haley’s (1987) dissertation indeed showed that pebble tools do occur over a wide range of time periods and appear in contexts that are quite recent. Reexamination of the Yale deposits and radiocarbon dating revealed that the pebble tools are much younger than Borden had suspected (Haley 1996). When pebble tools from other sites were also factored in, Haley (1987) concluded that there was no “pre-biface” Pebble Tool Tradition on the coast.
Haley's (1987, 1996) innovative work also examined the technological basis for the Pebble Tool Industry. He argues that the Pasika Complex is not a discrete cultural complex but rather a technological process related to adaptive processes. Borden's (1968a) morphological typology of the Yale pebble tools is rejected in favour of a more complex strategy of reduction focusing on initial form and material, resharpening and rejuvenation and flake tool production. The morphology of pebble tools then is related more to an adaptive and expedient strategy to deal with situational circumstance (or technological organization), as discussed in Chapter 2 of this dissertation (see also Rahemtulla 1995b). This is in keeping with studies elsewhere that were beginning to show that cobble core-tool morphologies were not simply final products of some "mental template" but rather the result of a number of strategies on the parts of the makers and users. For example Toth (1985) demonstrated that many of the Oldowan tool forms classified as distinct implements by Leakey (1971) were actually part of a continuum in the reduction of cobble cores in which the flakes were the desired products. Likewise Dibble (1987) argued that the contentious Levallois morphology was a result of resharpening strategies.

There is a strong correlation between sites containing Pebble Tool Tradition components and proximity to water. The vast majority of these sites is in, or would have been, in close proximity to marine and/or riparian environments (Carlson 1983; Haley 1987), some of which may have been favourable to salmonids and other aquatic resources. Given these settings it is highly likely that people at these sites manufactured and used watercraft (Carlson 1983, 1990; Rahemtulla 1995b).
Experiments conducted on processing salmon with flakes recovered from pebble tool production have shown the efficacy of these unretouched flakes in that task (Rahemtulla 1995b). The unique form of these unifacial flakes is ideal as knives for processing salmon in small numbers. The experimental programme illustrated that the flakes are easier to grasp when processing fatty fish such as salmon, and that the flakes could be readily produced from any fine-grained cobbles of volcanic origin. Although the cutting efficiency varies by raw material, a skilled fish processor could easily find a suitable cobble along a beach or riverbank.

Carlson (1996a:4) demonstrates that as a group Pebble Tool Tradition components are indicative of early maritime adapted peoples at a number of sites including Namu IA (Carlson 1998), the Upper Terrace Component at Tsini Tsini (Hobler 1996), the early non-microblade sites in the Queen Charlottes known as the “Kinggi Complex” (Fedje 1996; Fedje and Christensen 1999), Bear Cove I (C. Carlson 1979), Glenrose I (Matson 1996) and the Milliken Phase Component at the Milliken Site (Mitchell and Pokotylo 1996). This counters alternative proposals that see the development of the Pebble Tool Tradition as developing inland first and spreading to the coast later (Butler 1961; Matson 1996), and is supported by site dates, which are earlier on the coast (Carlson 1995). Moreover Carlson (1983; 1990) has suggested that there may be cultural continuity between the makers of the Pebble Tool Tradition and ethnographic Wakashan and Salish speakers.
The Northwest Coast Microblade Tradition

Microblade technology initially appears at Namu during Period 1b (9,800 \(^{14}\)C BP) in addition to tools classified to the Pebble Tool Tradition, which continues on from Period 1a (Carlson 1996b: Table 2). At roughly 8,500 BP microblades become more common in the assemblage at Namu, and Carlson classifies them as part of a second and more recently introduced technological tradition, the Microblade Tradition. The tradition is seen as potentially being the result of a second wave of migration from Northeast Asia and arriving into British Columbia via the Alaska Panhandle (Carlson 1990:67; but see also Borden 1969). A time gradient seems evident whereby the age of microblade-bearing sites becomes younger towards the south, with the earliest sites occurring in Alaska at Ground Hog Bay 2 dated 9,200-4,200 \(^{14}\)C BP (Ackerman et al. 1979), Hidden Falls on Baranoff Island dated to 9,500 \(^{14}\)C BP (Davis 1989), and Chuck Lake on Hecata island with a date of 8,200 \(^{14}\)C BP (Ackerman et al. 1985). Carlson (1979) initially suggested that Namu is an interface between the Microblade Tradition to the north and the Pebble Tool Tradition to the south, but later (Carlson 1996b) concluded that they both came from the north.

On Haida Gwaii microblades have been recovered from a number of sites dating from approximately 9,000 BP. Based on materials found at Cohoe Creek, Lawn Point, Kasta, and a number of intertidal sites, Fladmark (1975, 1979, 1982, 1986) proposed the Moresby Tradition, a local variant of the North Coast Microblade Tradition. Initially thought to date from 7,400-5,500 \(^{14}\)C BP, the hallmarks of this tradition were thought to be microblade cores made on split argillite pebbles and trapezoidal flakes, pebble tools and unifacially retouched flakes. A key characteristic of this tradition was the lack of
bifaces (Magne 2004). More recent research has greatly expanded the Early Period inventory of sites and artifacts particularly on Gwaii Haanas. An early tool complex containing bifaces dating to 9,500\textsuperscript{14}C BP has been recovered and these do not seem to co-occur with microblades (Fedje \textit{et al.} 2001), following the pattern at Namu. As a result Fedje and Christensen (1999) propose the Kinggi Complex that includes bifaces, scraper planes and flake tools but lacks microblades, and predates the Moresby Tradition. Interestingly, cobble choppers are “rare” within the Kinggi Complex (Fedje and Christensen 1999:647).

Armed with the new findings, Fedje and Christensen (1999) redefine the Moresby Tradition to include a transitional phase that extends the antiquity of the tradition to 8,900 \textsuperscript{14}C BP. Lasting approximately 500 years, the Transitional Phase essentially sees the introduction of microblade technology alongside biface technology. Biface technology seems to disappear after 8,000 \textsuperscript{14}C BP, leading to the classic Moresby Tradition (Fedje and Christensen 1999). Morphologically the microblade cores from Haida Gwaii resemble others found in coastal contexts in British Columbia and Alaska as well as the Interior Plateau of British Columbia (Carlson 1983:93; Magne 2004:93) with possible facet-face core rejuvenations as opposed to platform tablet rejuvenation, width-wise they are fairly wide and range in shape from “boat-shaped” to “conical” and “bullet-shaped” (Magne 2004:93). That said, they are dissimilar to the “Campus” wedge-shaped types from central Alaska, which tend to be narrower and also show core rejuvenation through platform removal. The parent material form also appears to be different; in interior Alaska raw materials seem to be originally in tabular form as opposed to the split cobble or trapezoidal flakes used on coastal British Columbia and S.E. Alaska (Magne 2004).
What these differences in technological structure mean is unclear at present especially when set within the context of the Nenana/Denali debate, although most explanations center on either “ethnicity” and/or “function” (Magne 2004:94; see also Chapter 2).

In order to determine whether microblade technologies spread through diffusion into the Americas or were developed in situ, Andrefsky (1987) examines the microblade technologies from central Alaska and from Hokkaido, which display great similarities. Andrefsky concludes that since the palaeoenvironmental contexts are quite different in the two regions, adaptive responses are unlikely to have caused the technological similarities, and with some caution, he concludes that diffusion is the more likely explanation.

Magne and Fedje (2003) postulate that the spread of microblade technology in western North America is strongly correlated with movements of Athapaskan speakers, although use of the technology is not restricted to members of that linguistic group. In some instances the microblades are associated with northern Kavik style points. This proposed migration involves an initial southward movement from what are now Alaska and the Yukon down into coastal and interior British Columbia. A much later movement occurs eastward and south into what is the United States. The nature and spread of microblade technologies into the Americas is still somewhat contentious, although the temporal gradients are compelling.

Blade technologies and particularly microblade technologies have long been thought of as strategies to maximize raw material in terms of cutting edge (Magne 2004; Rasic and Andrefsky 2001), and this would play into technological organization in a given circumstance. Magne (2004) examines the artifacts from the fine relatively fine-
grained sequence at Richardson Island as well as other sites on Gwaii Haanas and concludes that the development and adoption of microblade technology may have been an *in situ* development. Looking at the frequencies of tool types and debitage over time, Magne finds that as bifaces and scraper planes begin to wane, microblade technology becomes more prevalent. The correlations are quite strong and interestingly, neither the waning of bifaces nor the advent of microblade technology is sudden; both trends occur gradually.

Turning to raw materials, Magne classifies eight general categories of raw materials, with three being more common than the next five (Magne 2004:106-108). Bifaces and scraper planes are most strongly correlated with a banded metamorphic material, whilst the microblade industry is made almost entirely of argillite. Statistically there is strong pattern that demonstrates a shift in raw material usage over time, corresponding to the changes in artifact frequencies. The temporal trend towards use of microblades and argillite is also apparent at the later sites of Arrow Creek I and Lyell Bay. Magne also suggests that the scraper planes and denticulate scraper planes bear good resemblance to the later microblade core performs. When considered in light of rapidly changing sea levels, Magne postulates that raw material sources such as the banded metamorphic may have been drowned as a result of rising sea-levels. As a result the inhabitants may have resorted to other materials such as argillite and at the same time, adopted raw material conservative strategies such as microblades. The development of microblades in this region then would be an *in situ* adaptive response to changing access to raw materials on the one hand, but also the extension of previously practiced technology. This is one of the few works that attempts to examine the development of microblade technology from a
perspective of technological organization, although Magne does not refer to the study as such.

The overall distribution of these early lithic materials is interesting and open to alternative interpretations, although it is important to keep in mind that very few sites have been excavated, and the total excavated area within all of these sites is also very low. Sampling is therefore an issue, making it difficult to fully understand the variables that contributed to the patterning observed. Whether the pattern is the result of; separate migrations (Carlson 1996a), or technological adaptations to specific contingencies (Magne 2004), or a combination of both remains to be seen. New discoveries such as the early biface and scraper plane industry on Haida Gwaii are raising more questions than providing answers.

Subsistence studies

A number of analyses have been conducted on fauna from Early Period sites in British Columbia. On the south coast is the notable site of Glenrose Cannery in Vancouver with a basal date of 8150 ± 250 14C BP (Gak 4650), and cultural deposits extending to 5.5m below surface (Matson 1976). Early Period artifacts are classified to the Old Cordilleran Component, with cobble tools, scraper planes, a small number of leaf-shaped points and other bifaces, and a few antler artifacts (Matson 1976). Imamoto’s (1976) analysis of the fauna showed a numerical dominance of terrestrial mammals, particularly elk, followed by deer, and harbour seal. A spring/summer occupation is indicated through the presence of juvenile elk and deer. A number of fish species were also identified, but these occur in smaller numbers (Casteel 1976). Unfortunately none of
the faunal material was subject to dating, but Matson and Coupland (1995) suggest that the fauna date from between 6-5000 BP. Matson (1996) has interpreted these fauna as a mainly terrestrial mammal adaptation as part of a seasonal round.

The Bear Cove site on northern Vancouver Island has yielded a similar artifact inventory and basal date of 8020 ± 110 \(^{14}\)C BP (WSU 2141) as the Glenrose Cannery site (C. Carlson 1979; 2003). Cobble tools form the majority of the early assemblage along with lesser numbers of bifacial tools and projectile points, the latter being mainly leaf-shaped. The bottom of a later component is dated to roughly 4500 \(^{14}\)C BP and Catherine Carlson (2003) notes that there are interesting trends in the fauna throughout the site occupation; notably the relative representation of sea-mammals decreases over time while the relative importance of fish and land mammals increases. Deer are the most significant land mammals while Rockfish dominate the fish remains. In contrast to the early assemblage at Glenrose, at Bear Cove there is an early dominance of large sea mammals over land mammals and a Winter-Spring occupation is inferred. Moreover procurement of these sea mammals and some open water fish would require watercraft and a fairly sophisticated capture technology (C. Carlson 1979; 2003). Matson and Coupland (1995:77) suggest that early Bear Cove could also represent a seasonal variant within the Old Cordilleran Culture whereby some groups were subsisting on sea mammals for part of the year. This is in keeping with their overall theoretical approach in which early populations emerged from the interior and slowly developed maritime lifeways. The Glenrose Cannery seemingly fits into this scheme with its high representation of land mammal remains. It is important to remember, however, that terrestrial mammals were much more than nutritional resources; they were also valued for the raw materials they
provided, and some of these raw materials such as bone and antler were used as components in technologies to capture marine resources (Hodgetts and Rahemtulla 2001; Rahemtulla 2003). As such coastal sites with a representation of large land mammals need to be interpreted with some caution.

Recent work at the Kilgii Gwaay site on Gwaii Haanas (Fedje et al. 2001) has revealed a site with a basal date of 9460 ± 50 14C BP. In addition to chipped stone tools, which the authors indicate look very much like the pre-microblade industries at the Richardson Island site and at Namu, faunal remains are also present in the lower levels at Kilgii Gwaay, making it the earliest known preserved midden on the coast of British Columbia and Alaska. Numerically fish, especially Rockfish dominate the assemblage followed by mammals, along with some bird and shellfish remains. The authors remark on the low visibility of salmon, arguing that perhaps the salmon runs had not yet been established at this early time period (Fedje et al. 2001:112). Black bear (*Ursus americanus*) is the most common mammal and it is possible that this animal was purposely hunted and/or trapped (Mclaren et al. 2005). Sea-mammal remains are present as well, in particular harbour seals and otters. California mussel dominates the shellfish. Fedje et al. (2001) remark that the marine constituent of the faunal assemblage looks remarkably contemporary, but the terrestrial comparison to modern faunal communities is less clear from this sample. What is clear, however, is that at Kilgii Gwaay the inhabitants must have had access to watercraft and were well versed in obtaining maritime resources (Fedje et al. 2001:119).

An issue of great gravity is when sedentary settlement and storage of salmon based on mass capture began on the Northwest Coast. These characteristics are seen as essential to
the development of the classic ethnographic pattern of more recent times, featuring large sedentary settlements, highly complex social organization, dense populations, warfare, large trade networks and highly developed rituals and material arts (Ames 1994; Matson 1992; Matson and Coupland 1995). Most researchers subscribe to the notion that all of these characteristics emerged fairly recently in Northwest Coast history, having developed over the last three millennia. For the rest of Northwest Coast pre-Contact history it is thought that most groups were “generalized” egalitarian hunter-gatherers. This notion is now being challenged (Cannon 1998; Carlson and Hobler 1993; Rahemtulla 2005; Rahemtulla and Cannon 2001) as some researchers question whether all of the above noted characteristics of the Northwest Coast ethnographic pattern developed roughly simultaneously and/or only recently in long-term history. Evidence is beginning to point to an early development of storage and sedentism without attendant evidence for high-density populations, nor highly stratified societies, at least on some parts of the coast.

Cannon for instance (1991, 2002, 2006) has long argued that the earliest faunal material at Namu indicates salmon storage. Together with the inferred seasonality from the fauna, Cannon has suggested that Namu was the location of a winter village by at least 7,000 thousand years ago. Salmon and herring are the dominant species for approximately seven millennia (Cannon 2000). Others (Ames and Maschner 1999:139) have suggested that this pattern could also be due to seasonal agglomerations of smaller mobile hunter-gatherer groups, and that large numbers of salmon do not necessarily imply storage. New evidence, however, may shed additional light on the storage hypothesis. Studies on ancient DNA from the Namu salmon remains (Yang et al. 2004)
have shown a preponderance of species with lower fat content such as pink and chum in the early part of the record. Although other more fatty species are present in lower numbers, Cannon and Yang (2006) argue that the pink and chum were likely chosen for processing for storage due to their lower fat content, while the other species may have been consumed upon procurement. Based on this Cannon has reiterated his position that Namu was an early sedentary settlement.

Rahemtulla’s (1995a – see also below) initial assessment of the Early Period debitage from Namu provides some support to Cannon’s contention that Namu was a sedentary settlement very early in its history. A number of lines of evidence were marshaled as support, these are: impressive continuity in raw materials and reduction strategies throughout the Early Period; the assemblage consists largely of regionally local coarse grained materials, with the exception of imported obsidian; there is some evidence for stockpiling of raw materials; the establishment of a lithic dump area is evident (probably away from the living area); some degree of trampling is evident (Rahemtulla 1995a:103-107). Taken together, these inferences are best interpreted as a very intensively used site, such as a sedentary or semi-sedentary settlement. Such a pattern would not be expected in a special activity site that is seasonally occupied. This research formed the basis of the current project, and all of the various inferences are reexamined in light of new data.

Cannon’s work also illustrates a decline of salmon at Namu at approximately 4,000 BP, and this may be due to silting of the lower reaches of the Namu River, which would have greatly impacted the fishery (1991:31). Use of marginal resources at Namu seems to increase at this time (Cannon 1995; Cannon et al. 1999; Zita 1997). Roughly at the same time new settlements and villages appear to be established in the region at that
time, and Cannon (2002) has argued that this may be a consequence of the collapse of the salmon fishery at Namu. More recently Cannon (2002) has suggested that the long continuity at Namu and the establishment of these new settlements at 4,000 BP may also have a social explanation.

There was an extensive obsidian trade network established early in SE Alaska as well as on coastal and interior British Columbia. Obsidian from sources in SE Alaska and NE British Columbia show up in early sites such as Ground Hog Bay 2 and Hidden Falls (Ackerman et al. 1985). By 9700 BP obsidian sourced to the Rainbow Mountains on the edge of the Plateau is present at Namu (Carlson 1994:313). Later in time obsidian from Mt. Edziza to the north and as far south as Oregon is found in the Namu deposits (Carlson 1994). Although the nature of these networks remains unknown, clearly obsidian is moving over very long distances with the earliest known settlements on the coast. This brings up some interesting questions on mode and frequency of contact between coastal and interior populations, mode of trade, mode of transport and the nature of other goods traded. Perhaps of greatest interest is the question of how these networks operated on a social level.

**Early Period summary**

Although we still have far to go in the quest toward understanding the nature of Early Period life-ways on the central coast and adjacent areas, field and lab research conducted over the last few decades has dramatically changed the perception of a coastline that was barren until the last few millennia. Combined with new data from northern British Columbia and southeastern Alaska, we now know that aboriginal
ancestors were present on the coast by at least 10,000-11,000 $^{14}$C BP and probably earlier. While the debate continues over the timing and route of the first peoples to settle the Americas, the evidence from the earliest known coastal sites in British Columbia and southeast Alaska point to a maritime adaptation. This raises some interesting questions with regard to the relationship between this type of adaptation and chipped stone technology. There are virtually no substantial ethnographies on stone tool-using maritime hunter-gatherers, and so the archaeological record as incomplete and ambiguous as it is forms our main source for exploring this relationship. The site of Namu is particularly well suited to this given the large volume of chipped stone material from the Early Period, as well as the mounting evidence (e.g. Cannon and Yang 2006) that the site was a sedentary winter village early in its history. This assemblage provides a unique window of opportunity to try and understand the people behind the stone tools, and at the same time, provide a glimpse into a way of life that seems absent from the corridors of anthropological theory.

Given that most of the central coast was virtually unknown archaeologically until a few decades ago, there has been much energy devoted to a basic understanding of chronology, paleoenvironment and culture history (Carlson 1979; Hobler 1982). Along with this variations in tool types over time and space have been explained as being the result of movements (or lack thereof) of groups bearing specific tool traditions. While the evidence for this is certainly compelling, given recent developments in our theoretical understanding of hunter-gatherer use of stone tools (see Chapter 2), the present research aims to expand the analysis of Early Period chipped stone tools from Namu by placing them within a wider framework of design theory (after Hayden et al. 1996). Doing so will
lead to a better understanding of the decision process that the Namu toolmakers faced when designing their technologies. This certainly does not negate the notion that social and cultural factors played a strong role in the design of these technologies, but at the same time if we want to fully understand Early Period technologies we need to approach them within a broader perspective.
Chapter 4: Model for technological design and expectations

Given the physical setting of Namu, it is very likely that the use of watercraft had a substantial impact on the way in which the inhabitants designed their technologies, in comparison to groups who did not have transport aids and moved about largely on foot. Using the same logic inversely we can examine the lithic artifacts and attempt to deduce the contribution of human mobility via water transport. Moreover, if there is evidence for some type of sedentary settlement at the site of Namu dating back to the Early Holocene, this would challenge current notions that posit early Northwest Coast peoples as strictly mobile foragers. The following are summary results from the first round of the analysis (Rahemtulla 1995a).

1) There is a very impressive continuity at the site in terms of raw materials used and reduction strategies employed, this continuity lasts over four and half thousand years.

2) The assemblage is dominated by "medium quality" igneous toolstones, such as andesite, basalt and trachyte. There is some measure of variation in quality between individual specimens but on the whole, these raw materials are relatively difficult to work with. There is also a relatively small amount of obsidian present in the assemblage, however this material was being imported from some distance and was used quite differently.

3) The chief toolstones, andesite and basalt, are reduced in a number of ways, but most techniques seem outwardly expedient in design. There is some degree of raw material conservation exhibited in terms of resharpening and expended cores, but this occurs with low frequency.

4) The andesite and basalt are being brought into the site as large cores and/or flakes, with much of the initial flaking and testing occurring at the raw material source. This is borne out by the cortex frequency patterning in the mass analysis.
In addition, a large number of these were discarded while still in reducible size and form. It would seem that the Namu inhabitants were not overly concerned with discarding these items before modification and/or use. Combined with other lines of evidence, this has been argued to represent raw material stockpiling at the site.

5) The trachyte is local and in the initial form of rolled cobbles. Interestingly, this material seems to be used chiefly for unifacial reduction, leading to what have been termed Pebble Tools.

6) A lithic dump area was established very early in the site history and displays remarkable continuity. This inference is supported by a couple of lines of evidence that need further testing (see Chapter 4). Moreover, starting at roughly 6,500 years ago shell midden buildup is apparent at the site, and this midden buildup occurs directly over the lithic dump area.

7) There is some evidence of trampling on lithics at site.

Taken together these preliminary inferences suggest that Namu was more than just a camp location during the first half of the Holocene. Cannon's (1991) analysis of the patterning in fauna from the midden led him to believe that Namu was a winter village almost as soon as the faunal record begins at sometime after 7,000 BP. The debitage analysis supported this notion, but also suggested this settlement pattern goes back another 3,000 years. The hypothesis of Namu as an Early Holocene winter village challenges conventional archaeological wisdom, whereby the winter village settlement system did not emerge on the Northwest Coast until after 5,000 years ago (Fladmark 1975; Matson and Coupland 1995). From a technological point of view the Namu village hypothesis is most interesting since it posits a semi-sedentary settlement pattern in which chipped stone forms the major technological component. This leads to the question of
how a maritime oriented semi-sedentary settlement pattern would affect the organization and design of the lithic technology?

In order to pursue this line of thinking a model has been constructed as a heuristic device to try and understand the reduction strategies employed at Namu. This model utilizes the tenets of design theory, which postulates that there will be several constraints on the design of any technology (Hayden et al. 1996). The goal in the present case is to predict what the ancient technological system at Namu should look like by factoring in known and hypothetical constraints on the design of this lithic technology. Although there are many uncontrolled variables in this exercise, such studies are useful in elucidating the relationship between technological design and human use of the landscape.

Four general categories of constraints are outlined here. These are not in any particular order of importance nor are they mutually exclusive. Moreover there is a fair amount of overlap and linkage between and within categories. The categories are: general and residential mobility; raw material availability and transport capacity (grouped together); task requirements; and a miscellaneous category entitled “other factors”. For each of these categories, a number of constraints are considered and following this, expectations are outlined. These expectations are then compared with archaeological data.

**General and Residential Mobility**

A major question on Early Period lifeways on the Northwest Coast concerns the nature of settlement and land use. There has been a persistent notion that peoples in this
part of the world were highly mobile during this time period, with low population densities and ephemeral settlements (Ames and Maschner 1999; Matson and Coupland 1995). Partially this is based on the low number of sites known from this time period, but given the complexity of sea-level histories on the coast, the visibility of such sites may be obscured. Combined with the perception that sedentism, storage and a constellation of other developments in Northwest Coast lifeways occurred only after major environmental changes during the mid-Holocene (Fladmark 1975), the Early Period is believed to reflect a sparse landscape with highly mobile and small groups of foragers barely eking out a living. Arguably, this model is based on analogues drawn for terrestrial hunter-gatherers in very different ecological and physiographic situations and has never been challenged nor tested. As a result the idea that early Northwest Coast peoples were “generalized” hunter-gatherers has taken hold (Rahemtulla 2005), and the image of highly mobile foragers who lacked permanent settlements is seen as validated amongst many workers.

Alternatively Cannon (1991, 2003) has strongly argued that Namu was a winter village by at least 6,500 BP, the chipped lithic assemblage provides another line of evidence that can support or refute this theory. If Namu was a seasonal sedentary settlement there is considerably reduced residential mobility during some part of the year. However this does not preclude logistical expeditions to procure resources during this time. The assumption is that the people who lived at Namu were fully adept at maritime transport. If this is an intensive habitation site we should expect that a wide range of general activities to be undertaken, and this should be reflected in the lithic technology. We should expect to see a diversity of reduction strategies and morphological tool forms. The debitage should not reflect a narrow range of reduction operations, i.e. focusing
solely on core reduction or on tool production but likely some combination. Parry and Kelly (1987) argue that as people become more sedentary, there should be a shift in technology from curated strategies such as bifaces and prepared cores to expedient flake-based technologies. In such a case lack of nearby raw material sources can be compensated by the buildup of stockpiles. If this was the case at Namu there may be a greater focus on generalized core reduction strategies.

A related possibility is that Namu was a short-term, seasonally occupied base camp at which general activities took place. In this scenario, there should be some technological diversity exhibited in tool morphology and in reduction patterns. Logistical trips would be made to obtain resources including lithic raw materials.

On the other hand if Namu was a special activity site, this too should also be reflected in the lithic technology. Only certain parts of reduction spectrums should be present, since this would only be a part of the use of landscape by a highly mobile people. Debitage patterns may be expected to reflect constrained reductive operations. At the same time the expectation is for low tool diversity, reflecting a select number of tasks.

**Raw Material Availability and Transport Capacity**

Raw material availability can be affected both by the presence and absence of materials on the landscape, as well as access to the materials, either due to physical or social circumstance. The central coast of British Columbia is generally devoid of any superior raw materials for flaking, with the exception of highly localized obsidian sources and a few unknown sources of other rock types. The primary raw materials used for lithic technology at Namu are andesite, dacite, basalt, rhyolite and a number of other igneous
and metamorphic materials that are not available in the immediate locale around Namu, but they can be found on adjacent islands and possibly in the Kwatna Inlet, which is approximately 15km away. These materials would have been transported into Namu and worked at the site. Given the volume of lithic materials at Namu, either these raw materials were simply transported to Namu, worked and then removed, or there was a regular supply of toolstone available at the site, in the form of a stockpile. Parry and Kelly (1987) argue that stockpiling can be highly advantageous in sedentary situations as it reduces the need for extensive travel and search time for raw materials. According to their argument, this may lead to a greater adoption of generalized core and flake technologies.

If watercraft were used to transport people and goods, it would make sense for the Namu inhabitants to stockpile workable andesite and basalt at the site, if it was a village. This would ensure a continual supply of raw materials for various tasks, and would also reduce the need for scavenging of lithic materials. If the materials are being brought in on foot, there is a tremendous cost of transport given the extremely rugged terrain in this area. As such the expectation is for strategies that are highly conservative of raw material. This could be manifested in a number of ways, the primary of which is size. If there was any pressure to conserve raw materials at Namu we should expect to see a trend towards smaller sized lithic implements. This would be the result of successive resharpening episodes and more intensive recycling of lithic materials.

Two related considerations are the constraints on reduction inherent in the raw materials, and performance of the raw materials with regard to reduction and use. These coarse-grained raw materials are not what one would qualitatively classify as fine
Knapping materials, they are fine to medium grained, physically very hard, and tend to have inherent fault planes. As such, they impose limits on the kinds of reduction strategies that can be performed. Breakage and step fractures are common in the assemblage, and fine pressure flaking is rare. The result is often implements that look "crude" and less refined than tools made on softer materials. On the other hand the physical structure of these materials would allow the implement to hold its edge for much longer than more brittle materials such as obsidian. Activities requiring greater force and longer working periods such as chopping and scraping would therefore benefit from such materials.

The assemblage at Namu also contains a fair amount of imported obsidian. This raw material had to be transported from sources several hundred kilometers away. From this we should expect that the obsidian will be curated to a much higher degree than the more locally available andesite and basalt. Second, the physical structure of obsidian is quite different from the andesite and basalt, and may allow for different reduction strategies.

Task Requirements

The primary requirement of any technology is that it must be able to perform a certain task, or a number of tasks. For example, tools with high edge angles would be used for different purposes than tools with low edge angles. The general morphology of tool forms can also affect performance, for example chopping implements should have a different design compared to fish knives. As argued previously, if Namu is a sedentary occupation, then we should expect a multitude of task requirements that in turn would
reflect a diversity of activities. These tasks would entail cutting, chopping, scraping, sawing, piercing and many others. Depending on the task, size of tool and intensity of use, some forms may be hafted, while others will function as hand held implements. Despite the absence of cedar at this time (Hebda and Mathewes 1984), wood-working was likely a very important activity in constructing and/or maintaining watercraft, shelter, firewood, tools and weapons, animal traps and snares, fish weirs, and decorative items. Use of chipped stone tools would be very important in carrying out these tasks, as were ground stone tools later in time. Bone and antler work was also likely important. The bone and antler industry begins to develop in Period 2 at Namu, but the absence of such items in Period 1 is due to either sampling and/or preservation. Hide working should be of great importance at this time given the absence of cedar. In more recent times this remarkable raw material was used to manufacture clothing, but during the Early Period animal hides and furs were likely the primary materials for clothing.

A further consideration would also be the subsistence economy. Although there is some evidence for intensive salmon exploitation at Namu as early as 7,000 BP, the magnitude of the harvest was far less than in more recent times (Cannon 1991). We should therefore not expect technological specialization with regard to subsistence, such as the highly curated ground slate knives of more recent periods (Stewart 1977). On the other hand there should be evidence for some type of technology capable of handling such tasks. Hunting and fishing implements should also be present, as well as implements that reflect the capacity for defense against other groups.

Archaeologically we should expect all of this to be manifest again in the variety of tool forms, in terms of size and weight, morphology and edge angle. We should expect
a lithic assemblage capable of performing a spectrum of tasks on a variety of materials ranging from stone, to wood and other organic materials. On the other hand if only a limited range of these activities were taking place at Namu, there will be a smaller range of variation.

Based on various sources a potential list of tasks in which stone tools would be used is listed below. These tasks are based on various ethnographies of hunter-gatherers living in various parts of the world, as well as on intuitive reasoning (see Hayden et al. 1996). Since there have been major changes in the physical and social landscapes since the Early Period, ethnographic works on more recent Northwest Coast societies should be used with caution as there may be great differences in social organization, mobility, task requirements and volume of processing, raw materials and other aspects. The list presented below is by no means exhaustive, and there could be many more unknown tasks that would require the use of stone implements.

Potential tasks involving use of chipped stone

Woodworking (chopping, bark removal, scraping, shaving, planing, cutting, sawing, drilling, shaping)
- Procurement of fibrous raw materials (trees, branches etc.)
- Construction and maintenance of watercraft and accessories (e.g. paddles)
- Construction and maintenance of facilities for shelter, storage and defense
- Construction and maintenance of facilities for hunting, trapping, gathering and fishing
- Construction of hunting, gathering, fishing, defense and general use implements, including fiber cordage for rope, basketry, netting and other uses
- Construction of fire-starting utensils (drills and boards)
- Procurement of firewood (kindling and larger pieces)
- Carving of masks, totems or ceremonial items

Bone and antler modification (crushing, scraping, scoring, cutting, sawing, planing, drilling)
- Manufacture of fishhooks and harpoons for harvesting land and sea resources
Manufacture of ceremonial, decorative and other items (e. g. beads, combs, musical instruments, gaming pieces)
Manufacture of wedges for woodworking and other purposes
Breaking and cracking bone for nutrition (marrow) and raw material

*Soft organic material modification* (scraping, cutting, perforating, crushing, pounding)
Hide scraping and working for clothing, containers and other uses
Removal and/or modification of other soft tissue such as internal organs to use as containers, binding, ceremonial gear and other uses
Harvesting, butchering and processing of animals, plants and fish for nutritional, medicinal, ceremonial or other purposes
Removal of shellfish adhering to rocks
Scarring human bodies for decorative/ceremonial purposes
Crushing/processing of paints and/or ochres

*Manufacture/modification of lithic materials*
Hard hammer percussion, core reduction, flake and tool production, abrasion
Learning and practice in making various tools
Manufacture and maintenance of hunting, gathering and fishing implements
Manufacture and maintenance of weapons for use during hostilities

*Prestige Technologies* (see Hayden 1998)
Pieces that may not be used for any overt functional tasks, but may have high aesthetic and social value

*Other Factors*

In the category of other factors, several types of analyses were carried out on the debitage. The mass analysis from the first round of research indicates that the main excavation area at Namu is not where the primary flintknapping operations took place. In other words, the analysis suggests that there was a designated lithic waste dump area at Namu, which also later served as a midden for organic refuse such as shellfish. This inference will be tested during the current research. At any rate the presence of a substantial midden supports the contention that Namu was a sedentary settlement.
Model summary

These kinds of exercises can be very useful if used in moderation, when trying to understand the variability inherent in traditional technological systems. What is missing in this model and is acknowledged as a weakness, is the role of stylistic variables in the design of these technologies. In other words, this model admittedly swings towards optimal behaviour as its basis, and softens the role of cultural factors in the design of these technologies. That said aspects of settlement and mobility in particular may be discernable from the overall design of the technologies at Namu.

Moreover, if one examines the technologies of the Early Period on the Northwest coast, it is apparent that they are very generalized and spread over very large areas. Diagnostics tend to be very general and based on technological rather than stylistic attributes. For example the presence or absence of microblades, bifaces, or cobble choppers is used to determine culture historical affinities. Moreover when viewed in a regional context, with a few exceptions these artifact categories do not display any large amount of internal variability in morphology or design, except where different raw materials are used. These factors suggest that the design of Early Period technologies on the Northwest Coast were influenced somewhat by the variables described above. The next two chapters involve a detailed look at the design and reduction strategies as reflected in the Early Period chipped lithic technologies at Namu.
Chapter 5: Debitage Analysis

General introduction

This is an analysis of all chipped stone material from the Early Period at Namu, with the exception of obsidian. The present chapter focuses mainly on the debitage analysis, while the non-debitage tools are presented in the following chapter. Although it is common to include cores in the debitage analysis, they are included in the following chapter here because many of the cores were also used as tools themselves. The overall sample is derived from the Main and Rivermouth Trenches, although the debitage derives largely from the latter. The three S.F.U. expeditions to Namu undertaken during 1977, 1978 and 1994 employed an excavation strategy that followed natural layers as well as arbitrary 10cm levels. All materials were water screened through 1/8” mesh.

During the first round of research some 6,288 pieces of Early Period debitage were analyzed, these were recovered during the S.F.U. 1978 excavations of the Rivermouth Trench (Rahemtulla 1995). The first goal of this first stage of the research program was to develop a strategy for debitage analysis of the Namu material, based on techniques developed by other researchers. A second goal was to use this information to understand the way in which the Namu inhabitants organized their chipped stone technologies. The results were mixed; lack of a comparative experimental sample for the Namu material was a major shortcoming. Despite some of the noted analytical weaknesses in the first round of research various lines of evidence emerged and were used to formulate a hypothesis that Namu was the location of a sedentary settlement very early in its history. This independently supported Cannon’s (1991) similar conclusion.
arrived at through examination of the faunal material, although that record begins approximately four thousand years after the initial appearance of chipped stone.

Although the basic tenets of technological organization had long been applied in adjacent areas (Brisland 1992; Hamilton 1994; Hayden et al. 1996; Magne 1985), the 1995 research on the Namu lithic debitage is the first known study to apply the principles of technological organization to an Early Period assemblage from the central and northern Northwest Coast (Rahemtulla 1997). Subsequently Metz (1996) and Hall (1998) and have used similar approaches to research on potentially Early Period materials from the Tsini Tsini site in the Bella Coola Valley. Breffitt (1993) touched upon some of the tenets of technological organization in his analysis of the Skoglund’s Landing assemblage from Haida Gwaii, but did not conceptually link his study to the approach.

The current research report is in many ways an expanded continuation of the first leg of the project. Debitage from the 1994 excavations were analyzed as well as the tools. Raw material categories were maintained by characteristics, but changed in nomenclature, and the analytical techniques used in the 1995 report are applied in the debitage analysis here. The debitage analysis was initially designed so that the data collected in the first round could be combined with the debitage data from the current round. Unfortunately processing and enumerating the tailings from the 1994 excavations at Namu took much greater time and energy than predicted, and the results changed the size grade composition of the debitage assemblage, making the collections from 1978 and 1994 incompatible (see below). In essence, the debitage reported in this research are solely from the 1994 excavations.
Raw materials

For this research, all of the available chipped stone from the Early Period at Namu was analyzed with the exception of obsidian, which was the subject of a separate study (Hutchings 1996). The Namu Early Period collection consists mainly of chipped stone made on igneous rock types, with a smaller number of sedimentary and metamorphic raw materials. Within each of these major classifications there is a large variety of materials represented, indicating that the Namu inhabitants utilized a wide range of raw materials for their flintknapping. In general these materials can be characterized as being coarse-grained and physically very hard, with the exception of the obsidian. Qualitatively the vast majority would be classified as less than desirable to most modern flintknappers. They require greater force to detach flakes from cores and because of the hardness of the materials and incipient fracture planes, flakes often end with multiple step and hinge terminations. Many of the tools, cores and flakes display various amounts of stepping reflecting the frustration that must have been felt by the knappers. Pressure flaking most of these materials would be extremely challenging as noted in the experiments below, and this is also supported by the lack of evidence for pressure flaking in any of the tools in the collection. Yet these stones were obtained, worked into various forms and used as the primary lithic materials for well over five millennia.

During the first stage of the current research project, Professor Colin Crampton at the Department of Geography at S.F.U. aided raw material identification; Crampton had previously advised Brian Apland (1977) as he was conducting research for his Masters degree. Three major raw materials were identified in the sample prepared for Prof. Crampton, Andesite, Basalt and Trachyte, along with much smaller numbers of other
materials such as quartzite, microgranite, sandstone and others. Based on this four general raw material categories were created: Andesite, Basalt, Trachyte and Miscellaneous (Rahemtulla 1995a). The last category comprised of materials that were not present in enough numbers to warrant a separate category. All the debitage were separated as such through basic macroscopic observations such as colour and texture. There was some overlap between the Andesite and Basalt categories making identification difficult, although the former generally tends to be lighter in colour and slightly softer in hardness (Cox et al. 1973). The basalt is characteristic in that it has a slight purple tinge and is sometimes laminar, giving it a slate-like appearance. Likewise, trachyte overlaps in characteristics with andesite. The former is the dominant raw material in the production of pebble tools. The trachyte category is thought to comprise largely of rolled cobbles as the starting point.

As the next round of research progressed, it became apparent that the three main raw material categories were not homogenous. A larger raw material sample was submitted for analysis to Robbie Dunlop of the Earth Sciences Department at S.F.U. As suspected, all three categories contain other raw materials that are qualitatively similar in terms of fracture morphology. As a result of this, the raw material groups were renamed while retaining membership criteria from the first round of research. In total some 43,608 pieces of debitage were analyzed for the current research, and these were classified into five raw material groups. Group 1 is dominated by basalt and dacite, and consists of the hardest materials within the three main groups (Table 2). The materials in this group are generally the darkest in colour although there is some variability, and they comprise the second highest group in terms of frequency at 11.1% (with the exception of Group 4,
the Miscellaneous group). Group 2 is dominated by andesite but also contains much smaller amounts of altered rhyolite and micrdiorite. Andesites are common in areas where mountainous areas are adjacent to oceanic plates; they are generally softer than basalts on the Mohs scale and also generally lighter in colour (Cox et al. 1973). At 62.9%, group 2 is by far the dominant raw material of all the groups within the collection. Group 3 is dominated by trachyte but also includes smaller numbers of microgranodiorite and other materials that seem to occur largely in pebble/cobble form, as they are the primary types of raw materials used for pebble tools and other core tools. This group consists of 8.1% of the collection. Group 4 is the Miscellaneous category with a large number of rock types in smaller frequencies. The variation in raw material quality within this group ranges from extremely coarse to fairly fine-grained. Indeed, that some of these materials were worked at all was very surprising given their coarse texture. Sorting this group into more distinct categories would have taken an enormous amount of time and energy, so it was left as a general category and represents 13.0% of the debitage collection. Group 5 consists of milky quartz, although the sample is quite small at 4.7%.

<table>
<thead>
<tr>
<th>Raw material group</th>
<th>1 Basalt, dacite</th>
<th>2 Andesite, etc.</th>
<th>3 Trachyte, etc.</th>
<th>4 Miscellaneous</th>
<th>5 Quartz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debitage frequency (%)</td>
<td>11.3</td>
<td>62.9</td>
<td>8.1</td>
<td>13.0</td>
<td>4.7</td>
</tr>
<tr>
<td>N = 43608</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Raw material distribution of Early Period debitage

It should be noted that given the difficulty in sorting out these raw materials, there is likely a substantial overlap between categories. Some of the pieces that are classified as
andesite may actually be basalt, and vice-versa. Distinguishing between these raw materials is difficult at the best of times, as revealed in the number of pieces identified by Dunlop as andesite/basalt. This is not entirely problematic as these two raw materials were used in fairly similar ways; they were separated mainly due to slight differences in flaking quality due to differences in hardness. That said there is great variability in quality within categories. Some of the finest flaking occurs on basalt, such as the bifaces recovered in the burials in Period 3 (Museum of Archaeology and Ethnology, S.F.U.). Clearly, the inhabitants of Namu did periodically have access to higher quality flaking materials (other than obsidian), although it is not known how or from where they were obtained.

In terms of raw material procurement, with the exception of obsidian, there has been very little work on sourcing the materials at Namu. Igneous rocks comprise a large portion of the lithology on this part of the coast (Baer 1968, 1973), and so large-scale maps available through the Geological Survey of Canada are of little use in this regard. Apland (1977, 1982) noted that the raw materials used for chipped stone on the central coast area are available on the beaches on islands and on the mainland throughout the region. While this may be true in a general sense, brief reconnaissance trips conducted to bays and beaches adjacent to Namu failed to reveal such raw materials with the exception of rolled cobbles. There are no known sources within the immediate vicinity of Namu, so it is apparent that the raw materials were transported in from elsewhere. The Kwatna area, located some 12-15km from Namu may be one of the source areas (see experimental sample below). Materials collected here for the experimental sample are very similar in macroscopic and flaking characteristics to those used at Namu, and a
number of the large nodules at Kwatna had been tested at some point in time. There may also be other source areas.

Locating the origin of raw materials is important in deciphering technological organization, but the vast majority of studies have been conducted under the assumption that people moved raw materials around the landscape on foot (Chapter 2). Not knowing the exact locations of raw material procurement may not be a detrimental issue at Namu since the inhabitants seem to have had steady access to the sources, and they transported the materials in large quantities to the site, likely with the use of watercraft. The raw material for the experimental collection was obtained from a single location at Kwatna and contains both basalt/dacite and andesite cores. This indicates that the raw materials do occur in the same vicinity at least in Kwatna and would not have been subject to different procurement strategies. Once located, they are easily transported by watercraft to Namu and elsewhere. During the next round of research, investigation will focus on the possibility of using archaeometric techniques to clarify the relationship between the Kwatna and Namu raw materials.

History of debitage analysis

For a long time the value of debitage analysis was unrealized and so most research projects spent little energy on this aspect (Magne 1989:15). During the last two decades the interpretive value of lithic debitage has risen astronomically due to advances in both conceptual approaches and in techniques of analysis. This is reflected in the tremendous growth in the academic literature focused on lithic debitage, and there are now even edited volumes on the topic (e.g. Andrefsky 2001; Hall and Larson 2004). During the first reporting of the current project, lithic debitage studies were still relegated
to a specialty study and were not a major subject of study. Suffice it to say, debitage analysis is no longer an optional sub-specialty under general lithic analysis. It is a necessary task if one truly wants to understand the people behind the stone tools.

The history of interest in debitage can probably be traced back to early pioneers such as William Henry Holmes (1890; see Chapter 2), but following this there was a period of several decades in which debitage was routinely overlooked as a source of relevant information. In part this was due to the cultural-historical paradigm that dominated much of Americanist archaeology during the first half of the 20th century. Under this approach most stone tools were envisioned as the final result of the “mental template” in the mind of the maker. As such they could be analyzed within a comparative framework to assess spatial and chronological relationships between sites and regions. A problem with this conception, however, is that individual artifacts can pass through several stages through their “lifetimes” (Dibble 1987; Flenniken 1985), and can therefore have undergone one or more changes in morphology, also informally known as the “Frison Effect” (Dibble 1987:36). Sometimes the final form of the tool may not coincide with the initial form designed by the toolmaker, but was later redesigned due to changing circumstances (see Chapter 2). Scavenging of previously made artifacts due to low seasonal availability can also result in individual artifacts being reduced into different forms. In these cases, it would be very difficult to realize that artifacts may have undergone these cycles by examining the tool itself. Moreover similarities in tool morphology do not necessarily mean similarity in manufacturing technique, and in some cases only studies of debitage can reveal this information (Ritchie and Gould 1985:35). Nonetheless, for a long time debitage was routinely ignored during the analysis phase and
in many cases, it was not even collected. This is reflected in the category “waste” that was often used to classify unretouched, unused flaked material (Larson 2004:3).

One of the most important characteristics of debitage is that under normal circumstances the manufacturers do not transport them (Magne 1989:15; Odell 1989:163). Tools such as projectile points on the other hand, were transported since the place of use may be different than the place of manufacture. Debitage can be assumed to be in the original location of discard and therefore can be used as indicators of land use or settlement patterns (Binford and Quimby 1963; Magne 1985). Microdebitage can even allude to smaller activity areas within larger sites (Fladmark 1982c). By examining the reduction strategies at a particular locale on a landscape, it may be possible to understand what people were doing at that location, particularly if there are other lines of evidence. This in turn may give us a glimpse at how they organized their technology. Debitage analysis can potentially tell us the nature of reductive operations at a site, even if the final tool forms are not present. Such was the case at the Tsini Tsini site near the Bella Coola Valley, where Hall (1998) found that the voluminous debitage at the site reflected largely a mid stage bifacial reduction strategy. Initial shaping was taking place elsewhere, and final tool forms appear to have been removed from the site by the makers and/or users.

A further reason for the slow development of debitage studies was the lack of appropriate techniques and methods for analyzing this type of material culture. During the 1960’s and 1970’s several flintknappers such as Don Crabtree, François Bordes, and Mark Newcomer amongst others rose to prominence on both sides of the Atlantic. Although not all were academically trained, they were greatly influential and precipitated a strong interest in learning and understanding flintknapping and reduction strategies.
amongst both academic and avocational archaeologists. Influential works by Collins (1975) and Newcomer (1971) focused on the idea and importance of lithic reduction sequences in the manufacture of stone tools, reflecting Holmes' work of nearly a century previous. As these pursuits gained popularity, so did the awareness of debitage. At the same time ethnoarchaeological studies conducted on stone tool using peoples began illustrating that unretouched flakes are often used as implements (Hayden 1977), and are even at times the primary reason for flintknapping. These endeavours worked together to slowly dispel the idea that debitage could contribute nothing significant to archaeological research.

The 1970's and 1980's brought on a number of experimental studies aimed at understanding the variability in lithic reduction strategies and the resulting debitage produced (Collins 1974; Magne and Pkotylo 1981; Magne 1985), as well as fracture mechanics in general (Cotterell and Kamminga 1987). One of the earliest typologies developed is still in wide use today, and it is based on the amount of cortical cover present on a flake (Francis 1983; Stafford and Stafford 1979). Based on the assumption that cores are usually nodular rolled cobbles or other size of clast, flakes removed in sequence from such a core will have differential amounts of cortex particularly on the dorsal surface, but also on the striking platform. Flakes from the initial reduction are Primary flakes and have the most cortex, Secondary flakes have a lesser amount of cortex and Tertiary flakes have no cortex and are thus assumed to be derived from a later stage of core reduction.

Problems with this typology include the fact that not all cores have cortex to begin with. Large blanks obtained from a quarry for instance, may not exhibit any cortex at all
(Dibble 1985; Odell 1989). Flakes reduced from such a core may be mistaken for tertiary flakes. In order to use this typology, it is important to have an idea of the initial core form. Ahler (1989) and others note that cortex can be present even during late stage reduction, so that different reductive strategies may result in different cortex profiles. This typology is overly simplistic and should not be used as a sole method of understanding reduction profiles. Use of cortical cover alone may be useful only in identifying early stage reduction flakes (1989). That said Toth (1985) effectively used a six-stage flake sequence for reduction of cobbles in order to identify how early hominids were using raw materials over the landscape. The reduction sequences in that case were simple and predictable.

A problem in debitage studies, one that plagues many other areas of archaeology as well, entails differences in typology and nomenclature. Various researchers that have employed different approaches have tended to create their own typologies for debitage classes, and this can seriously hamper comparison with other research programs (Morrison 1994:21). Similarly in aggregate analyses individual research programs have focused on different size grade progressions, making cross comparison with other datasets difficult if not impossible.

In order to construct a more comprehensive and systemic understanding of tool making, Collins (1975) and Newcomer (1971) began to view lithic reduction in flow streams, beginning with raw material procurement, reduction sequence, use and discard. Initial stages and shaping are conducted with hard hammers, after which soft hammers are used for thinning and further shaping and if applicable, pressure flaking is conducted
in the final shaping towards the end. Callahan (1979) constructed an influential flow
system to model biface production in eastern North America.

Since that time many different approaches to debitage analysis have been devised
and tested (Ahler 1989b; Amick and Mauldin 1989; Andrefsky 2001; Bradbury and Carr
1999; Magne 1985; Prentiss 1993, 1998; Stahl and Dunn 1982; Sullivan and Rozen
1985). In general most approaches can be classified under two general categories;
Individual Flake Analysis (IFA) and aggregate analysis. In IFA, each piece of debitage is
examined for one or more attributes and classified accordingly. With large collections,
such analyses can consume a fair amount of time. Aggregate analysis involves
examination of debitage collections en masse, and usually involves size sorting and
collection of a small number of attributes by size grade. The focus of analysis is at an
assemblage level, rather than at the individual flake level. A common characteristic
shared by almost all techniques is the desire to distinguish patterns resulting from
different types of reduction strategies, usually core reduction and tool production. The
latter involves biface manufacture but can also involve other forms.

Individual flake analysis

During the 1970’s a flurry of experiments were designed to bring some
applicability to debitage analysis. Much energy was focused on what attributes were
relevant in debitage analysis and secondly, how to measure them. In some cases long lists
were proposed such as Phagan’s (1976) list of 28 variables. Magne (1985:108) points out
two problems with these early works, the first being that experimental replication is
necessary in order to understand the archaeological applicability of any set of attributes.
Many of the early lists were designed without the benefit of replicative studies. The second and potentially more hindering problem is redundancy in that many attributes do not appreciably add more information to the analysis, and therefore the enormous time and energy needed to collect many attributes on each specimen would be wasted, or at least unnecessary. In view of this Magne and Pokotylo (1981) and Magne (1985) conducted a series of programs designed to reduce the list of attributes to a more manageable size, through replicative experiments. In the first study a list of eight non-redundant attributes was proposed while in the second, Magne was able to bring this down to six attributes that are used in the present study.

Magne’s (1985) work focused on lithic material from 38 sites located in a number of regions in the southern Interior Plateau of British Columbia. Through a combination of experimentation and analysis of archaeological materials, he aimed to model the reduction trajectories discerned archaeologically. By doing so, it would be possible to understand site functions and therefore land use patterns.

Magne’s (1985) classification involves two main types of debitage, PRB (Platform Remnant Bearing) and Shatter (no remnant platform). Each type has a specialized type within; BRFs (Bifacial Reduction Flake) are late stage PRBs and occur during biface reduction. General characteristics include an acute angle between the platform and ventral face and multifaceted platforms. BIP (Bipolar) flakes are classified as a special type of shatter, produced through bipolar percussion. Recognition of these specialized flakes is not unproblematic as there is some amount of subjectivity. Almost any percussive strategy can produce what look like biface reduction flakes and/or bipolar flakes, while biface reduction and bipolar bashing can both yield “normal” flakes (Ahler
1989b:211; Sollberger and Patterson 1978:103). Recognizing this, Magne (1985:127) accedes that the experience level of the analyst plays a role in identification of these special flakes.

Initially Magne (1985:113) chose six attributes as a means to understand reduction sequence through debitage; weight, dorsal scar count, dorsal scar complexity, platform scar count, platform angle, and cortex cover. Magne argues that the list can be narrowed further, in that for PRBs and BRFs platform scar count is the single most important variable. For shatter, dorsal scar count is the most relevant attribute. That said, in applying this technique Rahemtulla (1995a) noted that for the coarse-grained raw materials from Namu platform scar counts are extremely difficult to see on PRBs, and so dorsal scar counts were used instead. This raises a rather thorny issue that describes many aspects of archaeological analysis; subjectivity in recognizing and measuring attributes. Odell (1989) for instance notes that even the seemingly simplest operations such as counting flakes scars can yield different results based on the individual. This is a sobering study and serves as a reminder that archaeology can never be a completely objective endeavour. While it is impossible to completely eradicate such subjectivity, a background in flintknapping and reduction strategies combined with a familiarity of the raw material would probably ameliorate the situation to a degree (Rahemtulla 1995a:41).

The main objective in Magne’s research was to delineate block core reduction from tool production based on what he observed in the artifact assemblages from the region. A tripartite classification for debitage was used based on sequence of flake removal from the core consisting of early, middle and late stages. Early PRBs and Shatter have 0 or 1 platform and dorsal scar respectively, middle PRBs and Shatter have 2
platform and dorsal scars respectively and late PRBs and Shatter have 3 or more of the respective scars. BRFs are logically expected to fall into the late portion of the spectrum.

Like all other methods of debitage analysis, the goal is to note general trends in the patterning based on the analyses of individual flakes. An assemblage with a preponderance of early flakes indicates reduction strategies dominated by core reduction, the middle stages involve primary trimming, marginal retouch, and the initial stages of reduction in unifacial and bifacial tools. Late stage is primarily tool-making, specifically the "latter half of all the reduction events of unifacial and bifacial implements" (Magne 1985:107). The middle category is ambiguous and may signal a mixed assemblage where there is more than one reduction strategy represented. This is a difficult situation to resolve with any method of debitage analysis.

Magne (1985) had great success with this method in his research program but others (Ingbar et al. 1989; Morrison 1994) argue that when tested through experimentation the method does not always live up to its claims. Ingbar et al. (1989) applied the method to primarily bifacial assemblages and found that the method lacks validity, while Mauldin and Amick (1989) suggest that dorsal scar counts are not useful in delineating reduction stages. Morrison (1994) found that coarse-grained materials such as quartzite do not behave as expected under the model. After performing a number of experimental reduction operations with core reduction and tool production, Morrison found that "early" stage flakes tend to dominate the assemblages regardless of reductive operation. She also found that quartzite produces 50% more platform flakes than does obsidian during soft hammer biface reduction (Morrison 1994:100). Moreover specialized flakes such as BRFs and Bipolar flakes were not easy to identify, and did not
occur in the numbers predicted by Magne, as per reduction strategy. Raw material variation then can cause significant differences in patterning, and may affect the validity of the method.

The Sullivan and Rozen Flake Completeness Typology

In order to reduce subjectivity and ambiguity in classification of debitage, Sullivan and Rozen (1985 – also Sullivan 1987) published what is now a classic paper on debitage analysis. Arguably this study was the prime catalyst in moving lithic debitage into the forefront of mainstream disciplinary consciousness. Sullivan and Rozen had a number of goals, one of which was to reduce the amount of time required for debitage analysis. One of the most serious constraints to recording attributes on individual flakes is the amount of time required. As debitage typically tends to occur in fairly large numbers, this can greatly extend the analysis time of a research program. For instance Magne (1985:111) reports that it took six weeks of continuous work to measure six attributes on a sample of just fewer than 2,700 experimental flakes. Magne estimates that the addition of two more variables such as length and width would double the time to measure the attributes in the same sample. Clearly for large samples, this type of analysis is too costly in terms of time and energy. Sullivan and Rozen (1985) therefore presented a new flake typology based on flake completeness that could considerably reduce the time required for analysis, as well as remove the ambiguity and subjectivity that is inherent in attribute based flake typologies. Like most approaches to debitage, Sullivan and Rozen aim to differentiate core reduction and tool (bifacial) production.
In this hierarchical classification (Figure 5) scheme the primary criterion is the single interior (ventral) surface with characteristics such as a bulb of percussion, ripple marks, fissure cracks etc. Specimens that lack an interior surface are classified as debris, while those with a surface are examined at the next level. Presence of a point of applied force (striking platform or fragment thereof) is sought and if one exists, the flake proceeds to the next level, while if such a point does not exist the flake is classified as a flake fragment. The next level involves the presence or absence of intact margins, those with margins are complete flakes and those without are broken flakes. Margins are considered intact if the distal end has a feathered or hinge termination. Due to the ambiguity of step terminations (that can also be caused by post-depositional processes), flakes with these types of terminations are not considered to be intact (Sullivan and Rozen 1985:758).

![Debitage Diagram](image)

**Figure 5. Sullivan and Rozen Typology (SRT)**
Sullivan and Rozen (1985: 762, 769) expected core reduction should be dominated by high numbers of complete flakes and debris. Core reduction typically results in platforms with greater surface area, in turn resulting in thicker flakes. Conversely, biface reduction would be dominated by high numbers of broken flakes and flake fragments caused by the breakage of thinner billet flakes.

Within a few years of publication there were a number of critiques with the flake completeness approach (Amick 1989; Baumler and Downum 1989; Ingbar et al. 1989; Magne 2001; Morrison 1994; Prentiss 1993, 1998; Prentiss and Romanski 1989). A major problem revolved around the lack of experimental testing of the method; Sullivan and Rozen had developed the method using archaeological data and tested against the same. To many this argument was too circular and a number of experimental programs were initiated to test the method in various ways.

Prentiss and Romanski’s (1989) experimental results contrast with some of the expectations of Sullivan and Rozen’s model, but support others. For instance they found that biface production produces higher numbers of complete flakes than does the moderate number produced during core reduction, contradicting Sullivan and Rozen. They did find that core reduction produced a higher amount of debris and moderate numbers of broken flakes and flake fragments. Split flakes occurred in low numbers regardless of reduction strategy. Bradbury and Carr (1995) note that in their experiments, the relative number of complete flakes and flake fragments were similar in both core reduction and tool production, again contradicting Sullivan and Rozen’s expectations. A common theme that emerged from these experimental programs is that variation introduced by raw material differences, knapper skill level, and other unknown factors.
caused different experimental results. Nonetheless, Prentiss and Romanski (1989) claim that overall the Sullivan and Rozen technique does seem to work in certain instances, although not for the reasons claimed by the latter.

Based on their experimental work, Prentiss and Romanski (1989) employ five categories: complete flakes, proximal flakes (equivalent to Sullivan and Rozen's "broken flakes"), medial distal flakes (equivalent to Sullivan and Rozen's "flake fragments"), non-orientable fragments (equivalent to Sullivan and Rozen's "debris"), and split-flakes. The last category comprises flakes that are split longitudinally but still have a remnant platform (Fig. 5).

More recently Prentiss (1998) conducted experimental tests on the reliability and validity of the flake completeness approach. Reliability focuses on consistency in measurements in a technique, while validity measures the fit between theoretical expectations and the actual outcome (Nance 1987). After constructing an experimental sample of various reduction strategies with obsidian, Prentiss conducts a number of multivariate studies to examine the method. He concludes that the method is fairly reliable when used with highly vitreous raw materials, but it does not display significant construct validity when used on these materials. Validity does improve, however, when the method is combined with a size grade technique. Prentiss is keenly aware that raw materials with other properties may provide different results, so that more experimentation is necessary. Because of the small experimental sample in the present research, such tests are not possible.

Morrison (1994:117) found that for quartzite, the SRT could not differentiate between core reduction and tool production. Instead, the coarse grained material seemed to
produce a "generalized pattern" across reduction strategies. In addition obsidian was also subject to the same analytical treatment and produced very different results, highlighting the unknown variability introduced by raw material properties. She (Morrison 1994:126-7) argues that the relatively poorer flaking quality of the quartzite for instance has a direct role in causing breakage patterns that are different than those for softer materials. Experiments with obsidian produced two to three times as many complete flakes than quartz when both materials were subject to similar reductive operations. She also suggests that poor quality materials will produce higher numbers of non-orientable fragments as suggested by Baumler and Downum (1989:107) and others. Due to energy needed to detach flakes from harder raw materials, heavier hammerstones are required along with greater force of impact. This certainly would have been the case with the coarse-grained materials at Namu.

**Aggregate (Mass) analysis**

During the 1970's and 1980's groups of researchers began experimenting and developing techniques for aggregate analysis of debitage (Ahler 1989a, 1989b; Henry et al. 1976; Patterson 1982; Stahl and Dunn 1982). In contrast to examining each flake individually, these methods seek to collect data on aggregate masses of debitage in order to deduce general patterns of reduction. A key feature of aggregate approaches is the size sorting of debitage into various classes depending on the individual program. This can be done either manually or with various mechanical aides. The most common method involves size sorting through commercially available sets of mesh screen.
Of all the advocates for aggregate analysis, perhaps Ahler (1989a, 1989b) has emerged as the most well known proponent with an approach known as “mass analysis.” After years of experimentation and application to Midwestern data sets, Ahler and his associates have demonstrated the utility of this method. Based upon the premise that different reduction strategies will show distinct patterns when sorted by size grade, mass analysis seeks to identify these patterns through experimental analyses. Dimensions such as weight and to a lesser extent cortex are particularly important. For example, basic core reduction strategies will likely result weight profiles skew towards larger flake size grades, whereas late stage tool production will show a profile generally skew towards smaller flake sizes. Through comparison with experimentally produced reference samples it is possible to deduce reduction strategies. Ahler (1989b) and associates have built up a formidable experimental database for comparative purposes, however, these are based on a limited number of fine-grained materials such as Knife River Flint and Crescent Chert.

Based on decades of experimentation Ahler (1989b:100) determined four size grades that are optimum for most archaeological situations. These include: 1”, 1/2”, 1/4” and 1/8” screen mesh sizes, labeled as G1, G2, G3, and G4 respectively. Debitage smaller than what would be caught in a 1/8” screen apparently contribute little non-redundant information, resulting in the minimal cutoff. In order to employ the mass analysis technique, it is important for research projects to minimally screen and collect materials within a 1/8” screen, although Ahler (1989b) suggests that some useful information may be obtainable from materials screened through 1/4” mesh as the cutoff. Once the debitage are sorted by size, flakes are enumerated, weighed and examined for specimens with cortex, for each size grade.
Once quantified these data are compared with experimental reference samples. Advantages of mass analysis include the fact that results are replicable, unlike most of the IFA approaches, and therefore less subjective. Moreover the relatively short amount of time needed to measure and collect the data is especially useful when examining large datasets. Although anyone can be trained to collect the data, their interpretation does require some experience (Ahler 1989b; see also Carr and Bradbury 2004).

One of the most formidable problems with mass analysis is its ability to deal with technologically mixed samples. In many cases more than one reduction strategy has contributed to the assemblage and this can confound the analysis. Although this weakness characterizes almost all forms of debitage analysis, it is particularly salient in mass analysis due to the focus at the assemblage level (Larson 2004:12). Although Ahler (1989b) has had some success in using multivariate methods to distinguish different strategies within technologically mixed sample, these experiments were conducted with fine-grained materials. Ahler (1989b:110-111) also applied the technique to a mixed archaeological assemblage from a sedentary site and got variable results. From this, he suggests that archaeologically the method works best when dealing with samples from well defined constricted areas such as features, as opposed to general midden deposits such as the one at Namu.

Morrison (1994) found that when using quartzite as a raw material, mass analysis had partial success in delineating different reduction strategies, although the patterning is not as strong as most of Ahler’s examples. She also found that obsidian produced very different profiles from the quartz when reduced in the same manner, thereby validating Stahl and Dunn’s (1982:98) suspicion that raw material may affect size grade profiles.
She also found that for quartzite flake frequency and cortex profiles were not useful and did not contribute to the overall analysis.

All three of these methods were problematic when applied to coarse-grained materials such as quartzite (Morrison 1994). Perhaps due to the nature of the raw material, flake breakage patterns did not seem to match expectations nor did they match published results from experiments. Moreover, attributes such as platform and dorsal scars, and flake types such as biface reduction flakes were very difficult to discern with quartzite. As such Morrison questions the validity of comparison between raw materials when used with any of the techniques. This re-emphasizes the need for experimentation with raw materials other than the fine-grained materials traditionally employed by knapping programs. During the first round of research in the current program the shortcomings in using these techniques with the coarse-grained materials from Namu was recognized (Rahemtulla 1995a), especially since no comparative database was available. For this reason, three separate methods were chosen to examine the Namu debitage, Magne’s Flake Type Method, the Sullivan and Rozen Typology and Mass Analysis. At the time, it was thought that using three distinct approaches would result in greater robusticity in results (Rahemtulla 1995a:47). Since that time the use of multiple methods in debitage analysis has become de rigueur (Bradbury 1998; Bradbury and Carr 1995; Larson 2004; Odell 2000:291).

The vast majority of experiments in stone tool manufacture have been conducted on physically softer materials in which the fracture patterns can be better controlled. Obsidian and chert seem by far to be the materials of choice even in areas where archaeological sites display different and sometimes more coarse materials. Runnels
(1985) notes that lithic analysts are so blinded by the ease of use in obsidian and chert that these materials have exclusively become the definition of lithic analysis. This is problematic in that these materials are far from exclusive in the archaeological record. By focusing on a narrow range of toolstones we ignore the variability introduced by other types of raw materials, in terms of fracture patterns and in terms of land use. Crabtree (1975:108) and others noted this some time ago but few seem to have taken heed.

Morrison (1994) discovered a similar situation in her examination of quartzite artifacts from Wyoming. Despite the use of this material since the dawn of stone tool manufacture (Crabtree 1967; Leakey 1971) very little replicative experimental work has been conducted using quartzite. A similar point can be made for the coarse-grained andesites, basalts and other volcanics that were used for thousands of years on the coast of British Columbia.

**Tailings analysis**

During the first round of research there was an anomalously low number of small size debitage, notably in the G4 categories. Frequencies for G4 size debitage range from 0-5.8% depending on raw material category. This is unusually low, as most knapping operations will yield a high number of G4 size debitage; so much so that this size class dominates frequency plots in experimental assemblages (Patterson 1982). This lack of small debitage was somewhat confounding and a number of hypotheses were put forth to explain the patterning. After rejecting post-depositional processes as a causal effect two other hypotheses remained.
The first was an argument developed following the work of Behm (1983) in which the lack of small sized debitage was the result of flintknappers ‘sweeping up’ the work area and removing the detritus to a designated dump area. This in turn was stimulated by Gallagher’s (1977) observations amongst stone tool using, village-dwelling peoples in Ethiopia. Gallagher observed that flintknappers in these villages frequently conducted knapping within the normal activity areas, but in order to avoid injury the detritus was subsequently swept and deposited in a designated dump area. Behm’s (1983) experimental recreation of these activities showed that a substantial number of the small debitage do not get picked up in sweeping operations, and they are therefore under-represented in the swept materials. Based on this work plus other lines of evidence (Rahemtulla 1995a:103-104), a hypothesis was formulated that the Rivermouth Trench was a dump area, so that actual flint knapping operations took place elsewhere on site. The very low frequencies of G4 debitage in the assemblage were the result of cleaning operations and use of a dump area for several millennia. Together with the other lines of evidence, a working hypothesis was formulated that Namu was an intensively occupied site, on the order of a sedentary or semi-sedentary village almost immediately with initial occupation. Cannon (1991) independently arrived at the same explanation for the faunal material, which starts somewhat later in the Namu record.

The third hypothesis on the lack of small debitage centered on collection strategies. It was suggested (Carlson 1994: pers. comm.) that the screeners during the 1977 and 1978 field seasons did not pick up the small debitage during the wet screening process. Despite the use of water screening through 1/8” mesh, the screeners may not have noticed the smaller cultural material that was obscured in the muddy screens. If this
were so, then a large amount of debitage had been lost during the previous excavations. In order to test this hypothesis a new collection strategy was implemented during the 1994 excavations.

During the 1994 field season a recovery strategy was used whereby the screened and still moist tailings were removed, tagged and taken back to the field lab with adjoining kitchen. Here they were spread onto a baking dish and put into a diesel stove in order to desiccate the matrix for further examination. Once the tailings were dry, they were re-examined for artifactual material. When the surrounding matrix is dry, stone, bone and other artifacts become much more visible due to changes in colour, texture as well as gloss and sheen. Due to the amount of labour involved in such an operation, only a limited number of level materials were sorted in the field. Tailings, from all Early Period levels, however, were baked in the stove and then bagged and shipped to Vancouver. Once in the lab at SFU, in addition to the author, a student was hired under a B.C. Work Study to sort out artifacts from the surrounding matrix. As can be expected, this operation took an extraordinary amount of time and energy to complete, but the results justify the effort.

The added cultural material recovery from the tailings is nothing short of dramatic. There are indeed a large number of small size flakes that would not have been picked up by the screeners, but also a number of larger sized flakes and artifacts (including a microblade core!) in the tailings. Total debitage count in the four main raw material categories increased by some 180% after the addition of tailings. Faunal material, obsidian and quartz pieces were also recovered in the tailings. Amazingly all this would have all been discarded as backdirt (as in previous seasons) had the extra step
in the recovery process not been implemented. This serves as a caution in excavating and water screening middens containing the thick, dark matrix. Without use of water, it is extremely difficult to screen this type of matrix, and yet, the viscous mud created by water screening acts as a detriment to observation of small artifact and faunal material in the screens. It is easy for even experienced screeners to miss large numbers of artifacts under these conditions. The use of the extra step to examine tailings is strongly recommended in such situations.

In general all raw material categories saw dramatic increases in G4 debitage, but there are also substantial increases in the G3 category (Figure 6). A number of G2 debitage was also recovered in the tailings. After the addition of the tailings, the G4 category dominates in frequency across all raw materials, with the G3 group forming the second most prevalent category. This patterning is to be expected in most flint knapping operations, but the numbers for the small size debitage are still somewhat low (see

![Figure 6. Total debitage frequency for raw material Groups 1 to 4, before (N=14,822) and after (N=41,578) addition of tailings.](image-url)
below).

The plot for the total debitage weight by size grade (Fig. 7) shows increases in the G3 and G4 categories at the expense of the G1 and G2 categories, but these changes are not as dramatic as those for the frequency plots. Nonetheless, the difference is significant. As expected, the heavier G1 and G2 flakes still dominate by weight across all raw materials. Implications for interpretations on knapping strategies are discussed further below, suffice it to say that the unusually low occurrence of small sized debitage noted in the earlier round of research (Rahemtulla 1995a) was due more to lack of recovery in the screening process than to any other factor.

Breakdown of debitage by period is displayed in Tables 3-6. In the Group 1 category (Table 3) there are increases of 57.6% and 1,539.6% in debitage in the G3 and G4 categories respectively after the addition of tailings. The total debitage count went from 1,741 to 4,925. Similar increases are seen in Group 2 where total initial count of

![Figure 7. Total debitage weight by size grade for raw material Groups 1 to 4, before (N= 39,436.5g) and after (N= 45,432.4g) addition of tailings.](image-url)
9,744 increases to 27,455 after tailings, Group 3, which increases from 1,250 to 3,523, and Group 4 where the total count goes from 2,087 to 5,675. Weight profiles by size grade are also redistributed although the vast majority of new flakes from the tailings are smaller flakes, the G1 and G2 categories are less dramatically affected by the addition.

<table>
<thead>
<tr>
<th>Period</th>
<th>Size</th>
<th>Before tailings</th>
<th>After tailings</th>
<th>Ave. Wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td># flakes</td>
<td>Wt (g)</td>
<td># flakes</td>
</tr>
<tr>
<td>1</td>
<td>G1</td>
<td>33</td>
<td>1202.1</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>374</td>
<td>2009</td>
<td>378</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>1008</td>
<td>879.7</td>
<td>1647</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>136</td>
<td>21.6</td>
<td>2603</td>
</tr>
<tr>
<td>2</td>
<td>G1</td>
<td>1</td>
<td>19.9</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>33</td>
<td>130.5</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>128</td>
<td>109.8</td>
<td>144</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>28</td>
<td>4.6</td>
<td>86</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>34</td>
<td>1,222</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>407</td>
<td>2,139.5</td>
<td>411</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>1,136</td>
<td>989.5</td>
<td>1,791</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>164</td>
<td>26.2</td>
<td>2,689</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1,741</td>
<td>4,377.2</td>
<td>4,925</td>
</tr>
</tbody>
</table>

Table 3. Group 1debitage tallies by Period, before and after inclusion of tailings.

<table>
<thead>
<tr>
<th>Period</th>
<th>Size</th>
<th>Before tailings</th>
<th>After tailings</th>
<th>Ave. Wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td># flakes</td>
<td>Wt (g)</td>
<td># flakes</td>
</tr>
<tr>
<td>1</td>
<td>G1</td>
<td>129</td>
<td>4641.8</td>
<td>129</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>1746</td>
<td>8368.6</td>
<td>1774</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>5070</td>
<td>3868.3</td>
<td>8553</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>1791</td>
<td>237.7</td>
<td>15370</td>
</tr>
<tr>
<td>2</td>
<td>G1</td>
<td>6</td>
<td>111.9</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>171</td>
<td>799.4</td>
<td>171</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>667</td>
<td>495.8</td>
<td>781</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>274</td>
<td>36.9</td>
<td>671</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>135</td>
<td>4,753.7</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>1917</td>
<td>9,168.0</td>
<td>1945</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>5737</td>
<td>4,364.1</td>
<td>9334</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>2065</td>
<td>274.6</td>
<td>16,041</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>9,744</td>
<td>18,560.4</td>
<td>27,455</td>
</tr>
</tbody>
</table>

Table 4. Group 2 debitage tallies by Period, before and after inclusion of tailings.
### Table 5. Group 3 debitage tallies by Period, before and after inclusion of tailings.

<table>
<thead>
<tr>
<th>Period</th>
<th>Size</th>
<th># flakes Before tailings</th>
<th>Wt (g)</th>
<th># flakes After tailings</th>
<th>Wt (g)</th>
<th>Ave. Wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G1</td>
<td>41</td>
<td>1,582.1</td>
<td>41</td>
<td>1,582.1</td>
<td>38.6</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>463</td>
<td>2,179.9</td>
<td>472</td>
<td>2,212.9</td>
<td>4.7</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>578</td>
<td>605.9</td>
<td>1003</td>
<td>1,056.1</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>64</td>
<td>12.0</td>
<td>1859</td>
<td>277.4</td>
<td>0.1</td>
</tr>
<tr>
<td>2</td>
<td>G1</td>
<td>2</td>
<td>42.7</td>
<td>2</td>
<td>42.7</td>
<td>21.4</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>36</td>
<td>200.3</td>
<td>36</td>
<td>200.3</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>62</td>
<td>65.2</td>
<td>62</td>
<td>65.2</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>4</td>
<td>0.7</td>
<td>48</td>
<td>7.9</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>G1</td>
<td>43</td>
<td>1,624.8</td>
<td>43</td>
<td>1,624.8</td>
<td>15.5</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>499</td>
<td>2,380.2</td>
<td>508</td>
<td>2,413.2</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>640</td>
<td>671.1</td>
<td>1065</td>
<td>1,121.3</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>68</td>
<td>12.7</td>
<td>1907</td>
<td>285.3</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,250</td>
<td>4,688.8</td>
<td>3,523</td>
<td>5,444.6</td>
<td></td>
</tr>
</tbody>
</table>

Table 6. Group 4 debitage tallies by level, before and after inclusion of tailings.

<table>
<thead>
<tr>
<th>Period</th>
<th>Size</th>
<th># flakes Before tailings</th>
<th>Wt (g)</th>
<th># flakes After tailings</th>
<th>Wt (g)</th>
<th>Ave. Wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G1</td>
<td>71</td>
<td>5988.4</td>
<td>71</td>
<td>5988.4</td>
<td>84.3</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>641</td>
<td>3720</td>
<td>718</td>
<td>4044.7</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>927</td>
<td>875.2</td>
<td>1623</td>
<td>1680.7</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>119</td>
<td>15.3</td>
<td>2770</td>
<td>675.1</td>
<td>0.2</td>
</tr>
<tr>
<td>2</td>
<td>G1</td>
<td>15</td>
<td>656.5</td>
<td>15</td>
<td>656.5</td>
<td>43.8</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>62</td>
<td>333.4</td>
<td>67</td>
<td>349.6</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>219</td>
<td>216.7</td>
<td>259</td>
<td>252.5</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>33</td>
<td>4.6</td>
<td>152</td>
<td>29.9</td>
<td>0.2</td>
</tr>
<tr>
<td>Total</td>
<td>G1</td>
<td>86</td>
<td>6,644.9</td>
<td>86</td>
<td>6,644.9</td>
<td>77.3</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>703</td>
<td>4,053.4</td>
<td>785</td>
<td>4,394.3</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>1,146</td>
<td>1,091.9</td>
<td>1,882</td>
<td>1,933.2</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>152</td>
<td>19.9</td>
<td>2,922</td>
<td>705</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2087</td>
<td>11,810.1</td>
<td>5675</td>
<td>13,677.4</td>
<td></td>
</tr>
</tbody>
</table>
The Experimental Sample

Early in the research design for this project, a key goal was to construct a comparative experimental sample made on similar, if not the exact same raw materials as the Namu assemblage. This is especially important given the nature of these raw materials and the lack of comparative experimental collections elsewhere. The vast majority of experimental reference samples are made on finer-grained materials that are much easier to work with (see Ahler 1989b; Morrison 1993), although Magne (1985) did some work with coarser materials. Lack of an appropriate comparative experimental collection was seen as a major shortfall in the first stage of research (Rahemtulla 1995a).

The first step in the construction of an experimental collection is to obtain the appropriate raw material. Phil Hobler indicated that the Kwatna Inlet, some 15km to the east of Namu, had some large boulders of raw material similar to those at Namu. During the excavation at FaSu-19 in 1969 (Hobler 1971), he had noted the large boulders, many of which had been worked and used to manufacture tools. Hobler speculated that the source for these boulders was located above the site, up the fairly steep slope. During the summer of 1997 Hobler and the author took a 14ft riverboat powered by a 25hp engine from the Bella Coola dock to the Kwatna Inlet, a trip of some 4-5 hours each way. Upon reaching the inlet a number of bays and streams were checked for the presence of appropriate raw materials, but success was not achieved. On the second day of the trip, we managed to locate a number of angular boulders of dacite and andesite on a talus slope above FaSu-19. Visual examination and further testing confirmed that these materials were very similar to those in the Namu assemblage. These materials were not found at the primary source but likely traveled down the talus slope from that location at
higher elevations. Lack of time prevented further investigation of the source, but this will be conducted at a later date. A number of the tabular and boulder-size fragments were collected and eventually brought down to the shoreline and loaded onto the boat. Some weathering is apparent on the outer surface of the pieces, but not at a stage to be classified as 'cortex'.

Once the material was transported to Vancouver a second problem arose with regard to creating the experimental sample: very few flintknappers have the ability to work with this physically extremely hard material. Since most knappers train and work with softer materials such as obsidian, chert and dacite from the Interior of B.C., few have the ability to work with much harder materials that have different fracture properties. The transition to working with these types of raw materials requires a great deal of practice, raw material stockpiles and perhaps most importantly, the simple desire to work with such materials.

After unsuccessfully trying to persuade a number of colleagues in Oregon who are well known for their flintknapping abilities to take on the challenge, Scott Williams agreed to lend his skills to the research. Williams has several years of experience working with tough basalts in Hawaii and had recently moved to Oregon. After lengthy conversations about the Namu project and the desire for an experimental sample, he agreed to come up to Vancouver to try and work the Kwatna material. Unfortunately time constraints only allowed him to make this a short trip, with two days devoted to flintknapping. The sample was therefore limited to six experiments, but given the complete non-existence of comparable reference material, it is used here with the acknowledgement that it is a small sample.
The first course of action was to familiarize Williams with the Namu assemblage. A sample of cores, flakes, bifaces, other tools and debitage was laid out in the lab, where he spent some time examining the material. After this, we began the knapping experiments in the Department of Archaeology's designated flintknapping area. Since collection of all debitage was a prime goal in these experiments, a large tarp was laid over the sand at the bottom of the flintknapping pit to allow for sweeping. Initially Williams chose a small angular fragment to remove a few flakes and become familiar with the raw material. Once the experiments began, several methods were used to record the activities. Subsequent to each blow, G1 to G3 size debitage were numbered according to their sequence of removal. After each experiment was over the entire work area was swept and the debitage collected and bagged. Notes were recorded for each experiment, including decisions and actions verbalized by Williams and at various times photographs were taken using colour slide film. In addition Jim Stafford recorded the whole process with a digital video camera, resulting in several hours of tape.

In total some six experiments were performed as shown in Table 7. The experiments were designed to model the kinds of reduction strategies seen with Group 1 and Group 2 raw materials (Magne 1985). Group 3 and other materials were not tested, as they were reduced in different way (see below). All of the experiments with the exception of Experiment 3 focused on opportunistic flake removal from cores, as this is the main mode of reduction at Namu. Both single platform and multidirectional knapping were conducted depending on the size and shape of the core. Most cores were reduced to exhaustion. Experiment 3 consists of a biface reduction in order to replicate a leaf-shaped point. No experiments were conducted on prepared cores (sensu the Levallois Technique).
since we were operating under restricted time limits, and this type does not occur frequently in the Namu collection.

Experiment 1 is a single platform core reduction on a basalt/dacite block core. Because this material is so physically hard it is often necessary to place the core on an anvil (a small boulder in this case) in order to strike a blow with enough force to remove a large flake. Note that this is not the same as bipolar percussion; here the core is rested in a manner so that some part of it is supported by the anvil, but not necessarily the area of impact. Although the core sustains some damage from the impact force returning from the anvil, the flake exhibits no sign of the use of an anvil during percussion. In order to balance the core on the anvil, Williams often used a large piece of hide in between the two rocks; cradling the hide around the core and resting the whole apparatus on the surface of the anvil achieved a more stable striking surface. During the course of the experiments, the anvil and hide were used when necessary. The use of an anvil in this manner is not reported frequently either in the ethnographic nor the experimental literature. In the case of the latter, it is probably due to the fact that most knappers work with softer materials that do not require such aids.

Williams used a dense granite hammerstone for most of experiment 1. Edge preparation was achieved through tapping of the core edge surface and where needed, grinding of the surface with the hammerstone to remove small overhangs and excess material. The knapper’s experience and familiarity with tougher raw materials was immediately apparent as he began to detach flakes with relative ease. It was also apparent that much more force was required to detach flakes with this material in comparison to more brittle materials like obsidian and chert. Williams remarked several times that a
particular blow would have removed a flake from an obsidian core, whereas with this material several blows were required.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Raw Material</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basalt/Dacite</td>
<td>Single platform core, anvil and freehand percussion</td>
</tr>
<tr>
<td>2</td>
<td>Basalt/Dacite</td>
<td>Multidirectional core</td>
</tr>
<tr>
<td>3 (Part I)</td>
<td>Basalt/Dacite</td>
<td>Early stage (2) biface</td>
</tr>
<tr>
<td>3 (Part II)</td>
<td>Basalt/Dacite</td>
<td>Later stage (3) biface point</td>
</tr>
<tr>
<td>4</td>
<td>Andesite</td>
<td>Single platform, then multidirectional core</td>
</tr>
<tr>
<td>5</td>
<td>Basalt/Dacite</td>
<td>Single platform and multidirectional core to exhaustion.</td>
</tr>
<tr>
<td>6</td>
<td>Andesite</td>
<td>Large single platform core</td>
</tr>
</tbody>
</table>

Table 7. Reduction experiments conducted to build up the reference sample

Some six different core reductions were performed in the experimental set, and the main goal was to produce usable flakes. Due to the small experimental set, cores of different size were chosen for the various reduction strategies in order to maximize variation. Raw material package size is an important source of variation in archaeological lithic assemblages, and can especially hamper results of mass analyses (Bradbury and Franklin 2000). To partially control for the effects of initial core size, at least one large basalt/dacite core (Exp. 1) and two medium-sized cores (Exp. 2 and 5), and one large andesite (Exp. 6) and one medium-sized (Exp. 4) core were selected for the experiments.
Experiment 1 began with a large tabular core that was deemed suitable for single platform flaking. This material is a darker basalt/dacite and even though coarse-grained, the knapper commented that it responded quite well, especially in comparison to the core in Experiment 5. The large flat surface and adjacent angles provided numerous opportunities to create striking platforms, although the stone anvil was used in almost all flake removals in this experiment. A number of large flakes were taken off in this manner and after a while when all the possible single platform space was exhausted, the knapper switched to a multi-platform strategy (Experiment 2). This was necessary as there were several other platform opportunities remaining on the core. Undoubtedly this is the kind of decision that ancient toolmakers would have faced, and if maximization of flake removal was a goal, then they would have followed the same path. The vast majority of the 506 flakes removed belong to the G4 category, however, some 9.6% are in the G1 and G2 categories. These larger size class flakes would have been optimal for use as tools. Debitage frequencies and weights by size grade are illustrated in Table 8.

Experiment 2 began with the same core as in experiment 1, but at this stage the knapper decided that based on its morphology, he was going to switch to multidirectional strategy. This decision was based on the shape and size of the core; at this point it was much smaller than when Experiment 1 began. Edge fragments were periodically removed to rejuvenate the core. A total of 410 flakes were removed, with 11.7% falling into the G1 and G2 categories, but the vast majority was in the G3 and G4 categories. As the core was reduced in size, Williams held it in the palm of his hand to cushion the core and to direct the force of impact imparted by the hammerstone in his other hand. When this method was used, the incidence of split flakes increased dramatically. Alternatively
when the core was used with the anvil immediately thereafter, almost no split flakes were produced. It is not known exactly why this occurred, but it obviously has to do with the

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Size</th>
<th>#</th>
<th># (%)</th>
<th>Wt (g)</th>
<th>Wt (%)</th>
<th>Ave. Wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G1</td>
<td>15</td>
<td>3.0</td>
<td>1038.3</td>
<td>72.7</td>
<td>69.2</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>34</td>
<td>6.7</td>
<td>282.9</td>
<td>19.8</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>120</td>
<td>25.7</td>
<td>80.2</td>
<td>5.6</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>337</td>
<td>66.6</td>
<td>27.2</td>
<td>1.9</td>
<td>0.1</td>
</tr>
<tr>
<td>N=506</td>
<td>1428.6g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>G1</td>
<td>12</td>
<td>2.9</td>
<td>405.8</td>
<td>52.1</td>
<td>33.8</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>36</td>
<td>8.8</td>
<td>282.9</td>
<td>36.3</td>
<td>7.9</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>101</td>
<td>24.6</td>
<td>68.0</td>
<td>8.7</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>261</td>
<td>63.7</td>
<td>22.4</td>
<td>2.9</td>
<td>0.1</td>
</tr>
<tr>
<td>N=410</td>
<td>779.1g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 (I)</td>
<td>G1</td>
<td>2</td>
<td>0.8</td>
<td>22.9</td>
<td>13.3</td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>19</td>
<td>7.6</td>
<td>94.0</td>
<td>54.6</td>
<td>4.9</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>58</td>
<td>23.1</td>
<td>43.3</td>
<td>25.1</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>172</td>
<td>68.5</td>
<td>12.1</td>
<td>7.0</td>
<td>0.1</td>
</tr>
<tr>
<td>N=251</td>
<td>172.3g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 (II)</td>
<td>G1</td>
<td>1</td>
<td>0.3</td>
<td>32.0</td>
<td>25.9</td>
<td>32.0</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>17</td>
<td>5.7</td>
<td>44.3</td>
<td>35.8</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>80</td>
<td>26.9</td>
<td>35.2</td>
<td>28.5</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>199</td>
<td>67.0</td>
<td>12.1</td>
<td>9.8</td>
<td>0.1</td>
</tr>
<tr>
<td>N=297</td>
<td>123.6g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>G1</td>
<td>21</td>
<td>3.0</td>
<td>651.1</td>
<td>53.3</td>
<td>31.0</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>61</td>
<td>8.8</td>
<td>420</td>
<td>34.4</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>174</td>
<td>25.0</td>
<td>112</td>
<td>9.2</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>441</td>
<td>63.3</td>
<td>37.6</td>
<td>3.1</td>
<td>0.1</td>
</tr>
<tr>
<td>N=697</td>
<td>1220.7g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>G1</td>
<td>12</td>
<td>3.0</td>
<td>372.4</td>
<td>60.3</td>
<td>31.0</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>26</td>
<td>6.4</td>
<td>167.8</td>
<td>27.2</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>93</td>
<td>23.0</td>
<td>56.0</td>
<td>9.1</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>274</td>
<td>67.7</td>
<td>21.7</td>
<td>3.5</td>
<td>0.1</td>
</tr>
<tr>
<td>N=405</td>
<td>617.9g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>G1</td>
<td>18</td>
<td>2.3</td>
<td>1197.0</td>
<td>77.7</td>
<td>66.5</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>51</td>
<td>6.5</td>
<td>211.2</td>
<td>13.7</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>215</td>
<td>27.6</td>
<td>99.2</td>
<td>6.4</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>496</td>
<td>63.6</td>
<td>33.7</td>
<td>2.2</td>
<td>0.1</td>
</tr>
<tr>
<td>N=780</td>
<td>1541.1g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>G1</td>
<td>81</td>
<td>2.4</td>
<td>3757.1</td>
<td>63.4</td>
<td>46.4</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>244</td>
<td>7.3</td>
<td>1503.1</td>
<td>25.4</td>
<td>6.2</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>841</td>
<td>25.1</td>
<td>493.9</td>
<td>8.3</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>2180</td>
<td>65.1</td>
<td>166.8</td>
<td>2.8</td>
<td>0.1</td>
</tr>
<tr>
<td>N=3346</td>
<td>5921.5g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8. Debitage tallies by size grade for all experiments

the way in which the force of impact is transmitted through the core when held in this manner. This has implications for flake completeness techniques proposed by Sullivan and Rozen (1985) and Prentiss and Romanski (1989) (see below).
Experiment 3 consisted of a two-part reduction to produce a biface. The goal of this experiment was to produce a leaf-shaped point similar to those in the Namu collection. Williams began with a fairly large flake obtained during the reductions in Experiment 1. At this point we had a discussion on whether the biface stage classification (Andrefsky 1999; Callahan 1979) used by others for softer materials could be applied to these coarse-grained ones. The concept of reduction stages, particularly in biface manufacture is a controversial issue (Bleed 2002; Bradbury and Carr 1999; Morrison 1994) as there is some debate on whether or not knappers in the past saw biface reduction as a stage process or a continuum. Since the shaping and thinning procedure slightly different for this material, we decided on a three-stage sequence. Stage 1 involves acquisition of the material which in this case is a flake reduced from a large tabular core.

Experiment 3 Part I consists of Stage 2 of biface manufacture. At this point Williams mentioned that platform edges need to be extra well prepared due to the precision and force needed to detach flakes, and so he began using a synthetic industrial abrasive material for this purpose. The goal for this experiment was simply to achieve a bifacial edge around the perimeter of the flake. In comparison to other raw materials, thinning and shaping were secondary goals during this stage. Minimal thinning and shaping did take place as the edge was normalized, but at a much slower rate when compared to softer raw materials. One reason for this is the force needed to remove flakes and create a bifacial edge. Forces of impact travel slowly through this material, resulting in greater impact force required on the one hand, and a shorter distance of travel on the other. It is difficult to detach flakes that travel over a large portion of the face.
Once a bifacial edge was created around the perimeter, Williams began to perform thinning and shaping operations (Experiment 3, Part II). As the biface began to take shape and was reduced in size, relative mass began to “accumulate” in the center, causing a distinctive shape in cross section. It was very difficult to remove this mass as the flakes became less invasive as edge angles increased. Accordingly, as the biface became narrower in width, it increased in relative thickness. At this stage many of the flakes show step terminations, particularly as the knapper attempted to remove the excess mass in the center of the biface. Also as the biface became smaller, Williams had trouble holding it in his hand as he struck it with the other. The heavy force of impact caused the hand holding the biface to absorb the impact by moving down in order to avoid injury. At this point Williams went back to using the anvil and hide to creatively balance the biface as he struck it. Finally when no more flakes could be taken off, the experiment was ended (Figure 8).

Figure 8. Replicated biface

Many of the bifaces at Namu display the characteristics described for the experimental biface (see below); they tend to be relatively thick with much center mass,
and they tend to have numerous flake scars indicating step terminations. From our experiment, it was clear that this patterning is due to the vagaries of the raw material, and not to any intentional design. The experimental biface was declared a “reject” since despite having a sharp tip and fairly sharp edges, there was still quite a bit of mass that may have affected hafting onto a spear or dart. On the other hand it could certainly be used as a knife.

Williams felt strongly that these materials were too tough to work with most conventional soft hammers, unless they were themselves very hard wood, bone, antler, etc. After appraising the collection and examining the bifaces, Williams felt that all of the necessary flaking can be done with a hard hammer on these raw materials. This again contradicts conventional thinking based on obsidian and chert, in that thinning and finishing stages in manufacture require soft hammer percussion (Callahan 1979).

Experiment 4 was conducted on a medium-sized andesite core. This core was reduced through a combination of single platform and multidirectional flaking. The raw material itself is fairly hard and contains macroscopic phenocrysts that give it a distinctive look. The Namu collection is replete with this raw material. Once again the detachment of flakes occurred in a fairly opportunistic manner.

Experiment 5 was mainly a multidirectional flake removal from a basalt core. This raw material is physically the toughest of all the raw materials in the sample and as such, it was the most difficult to work with. Detaching flakes from this core required considerably greater amounts of force and concentration. Nonetheless Williams was able to knap this core to exhaustion (Fig. 9). Upon completion, it was noted that this core bears a striking resemblance to a core in the Namu collection.
Experiment 6 (Table 8) was a large tabular core much like the first one. The vast majority of flaking was single platform. Unfortunately this core could not be flaked to exhaustion as a massive internal flaw caused the piece to implode partway through the process. Regardless, a number of flakes were removed before the core had to be abandoned.

One characteristic that became very apparent with this raw material is that not only does it require much more force to detach flakes than would be required for less tougher materials, but also that more time is required in tool production mode. The extra edge preparation on the one hand, and the relatively short flakes removed in thinning operations combine to add to the time needed to manufacture a biface, for instance. We estimated that it would temporally take it least four times longer to manufacture a biface from these materials in comparison to materials such as obsidian. All of these factors
point to a likely greater training period when working these materials. The inhabitants of Namu probably began working and practicing with these raw materials at a fairly young age, and some or many of the lithics in the Namu collection may be due to their handiwork.

Figure 10 shows a line plot for weight distribution by size grade for all of the experiments. The first apparent distinction is that both stages of the biface reduction have a very different distribution pattern than those of the core reductions. Both biface patterns exhibit relatively low values in the G1 size grade as can be expected, followed by an increase in the G2 category and the dropping off into the G3 and G4 categories. In contrast all of the core reductions have G1 values in excess of 50%, followed by

![Figure 10. Line plot of weight percentage by size grade for experiments](image)

**Figure 10. Line plot of weight percentage by size grade for experiments**
continuing drop-offs into the smaller size grades. At first glance it seems that under ideal conditions, mass analysis does track the differences between core reduction and tool production as predicted by Ahler (1989b). Morrison (1994) found that reduction of quartzite resulted in generalized profiles in weight distribution. Clearly this is not the case here, however, large flakes have not been removed for tool use as suggested by Ahler (1989b:99), Magne (1985:100) and others (see below).

The second interesting pattern in the graph is the similarity in the curves for Experiments 1 and 6 on the one hand, and Experiments 2 and 4 on the other. The former were largely single platform reductions on large tabular cores, while the latter were flaked in a multidirectional fashion. In the first and last experiments, there is a very high preponderance of weight in the G1 category. This should be expected, as the first flakes removed from these large tabular cores will be quite large, and much of the core mass is removed at this stage. Flakes can be expected to have fairly thick platforms and widely expanding margins. A dramatic drop follows into the G2 class followed by slower drop-offs into the G3 and G4 categories. In Experiments 2 and 4, G1 values are still high at just above 50%, followed by more gradual drops into the smaller categories. The similarities are quite striking especially between Experiments 2 and 4, where the raw materials are different. This suggests that there may not be much difference in flaking patterns between Group 1 and Group 2 raw materials, although the sample size here is quite small. Alternatively, these similarities may have more to do with initial core size than with flaking strategy; at the start of the experiments the cores in the first and last experiments were of the same size, while the cores in Experiments 2 and 4 were roughly the same size. This supports the contention (Stahl and Dunn 1982; Bradbury and Franklin
that raw material package size may be an important factor in size grade distributions. A larger sample with more experiments is needed to further test this hypothesis on these raw materials.

Interestingly, Experiment 5 produced a curve that is in between those of Experiments 1 & 6, and Experiments 2 & 4. Values in the G1 category are just above 60% followed by a large drop in the G2 category, after which the curve is virtually similar to Experiments 2 and 4. The starting size of this core was not quite as large as 1 and 6, but it was notably more difficult to work with due to its physical hardness, which exceeded all of the others. It also suggests that there may be more internal variability in quality and hardness within the raw material categories than is initially obvious.

In comparison with Ahler’s (1989b) published experimental data, Experiments 1 and 6 closely match his profile for hard hammer flake production on Crescent Chert (p. 107), but they do not accord with his values for hard hammer freehand random flake production on Knife River Flint (p. 92) (Figure 11). As can be seen in the graph, this is a very strong correlation. The profile for experiment 3-1 is quite close to Ahler’s (1989b:92) hard hammer stage 2 biface edging. Ahler’s values for G2 flakes is slightly lower but the G3 quotient is higher. Nonetheless the overall patterning is very similar. Not surprisingly none of the results in the present experiment match Ahler’s values for anything beyond stage 3 of biface manufacture. As expected, biface manufacture with coarse-grained materials such as these does not follow the same trajectory as bifaces made on softer materials. Once initial edging has been achieved, thinning operations on these materials involves removal of thicker and less invasive flakes, and so after this stage, comparison with other materials is likely to reveal different patterns.
Still, the relatively close fit between the Experiment 1, 3-I, and 6 patterns and Ahler’s is reassuring, it was not something that was expected given Morrison’s (1994) problems in comparing quartzite to finer-grained materials. On the other hand, the multidirectional core Experiments 2 and 4 did not match any of Ahler’s published values, although it should be noted that he has only provided a sample of all the experimental data. Ahler (1989b) indicates that he is willing to make the complete set of data available, but several attempts to communicate with him were unsuccessful.

Use of multivariate methods has been deemed as useful if not critical in studies on experimental debitage (Johnson 2001, Magne 2001; Prentiss 1998, 2001). In most cases

![Figure 11. Experimental mass analysis values, weight percentage by size grade](image)
the reduction of random error is a prime directive, and this is done mainly in two ways (Magne 1985). The first is to create a significant sample size by conducting repeated experiments for each technique. For example, several biface reduction episodes will be conducted along with several core reduction sequences, or any other strategy that the experiment is designed to track. The second method to is to have a number of flintknappers with different skill levels contribute to the assemblage. Because archaeological assemblages are the results of more than the contribution of one individual, this is seen as an important contribution. Unfortunately the replications conducted in the present research do not lend themselves to such analyses, since the sample is very small, and produced by a single individual.

The Namu mass analysis results

Mass analysis data for Group 1 materials are illustrated in Table 9. There is a notable difference in frequency across size grades between periods 1 and 2. The largest differences are in the G3 and G4 categories where the former occurs in higher frequency in Period 2 while the latter has a greater presence during Period 1. The same pattern is evident across all raw material groups. Group 2 materials (Table 10) also show differences that are most pronounced in the two smallest categories, with the G3 category increasing in number between Periods 1 and 2 and G4 debitage greatly decreasing in Period 2. The same pattern can be seen in the data for raw material Groups 3 (Table 11) and 4 (Table 12). This is a curious pattern and it may have something to do with location of knapping versus location of discard (see below).
For Group 1 there is general concordance in the weight distribution profiles between Periods (Table 9), with the exception of the G1 and G3 categories. There is a dramatic drop in relative G1 weight during Period 2, along with a jump in G3 weight. Sample size is an issue here, with only one piece of G1 debitage recovered during Period 2. For mass analysis, weight distribution by size grade is a critical measure, as different reduction strategies are expected to have different profiles. As expected, in Period 1 the largest two size categories dominate the weight profile. In Period 2, the G2 and G3 categories have the greatest amount of weight. This again could be due to sample size.

Group 2 distribution of size by both frequency and weight (Table 10) also shows some differences between periods. As with Group 1, there is a dramatic drop in both frequency

<table>
<thead>
<tr>
<th>Size grade</th>
<th>#</th>
<th># (%)</th>
<th>Weight (g)</th>
<th>Wt. (%)</th>
<th>Av. Wt. (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>33</td>
<td>0.7</td>
<td>1202.1</td>
<td>25.5</td>
<td>36.4</td>
</tr>
<tr>
<td>G2</td>
<td>378</td>
<td>8.1</td>
<td>2022.9</td>
<td>43.0</td>
<td>5.4</td>
</tr>
<tr>
<td>G3</td>
<td>1647</td>
<td>35.3</td>
<td>1199.3</td>
<td>25.5</td>
<td>0.7</td>
</tr>
<tr>
<td>G4</td>
<td>2603</td>
<td>55.8</td>
<td>283.1</td>
<td>6.0</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Period 1 N = 4661 Total weight: 4707.1g

| G1   | 1  | 0.4 | 19.9 | 7.2 | 19.9 |
| G2   | 33 | 12.5 | 130.5 | 47.4 | 4.0 |
| G3   | 144| 54.5 | 117.1 | 42.1 | 0.8 |
| G4   | 86 | 32.6 | 10.8 | 3.9 | 0.1 |

Period 2 N = 264 Total weight: 278.3g

| G1   | 34 | 0.7 | 1222.0 | 24.5 | 35.2 |
| G2   | 411| 8.4 | 2153.4 | 43.2 | 4.8 |
| G3   | 1791| 36.4 | 1316.4 | 26.4 | 0.6 |
| G4   | 2689| 54.6 | 293.9 | 5.9 | 0.1 |

Early Period Total N = 4925 Total weight: 4985.7g

Table 9. Mass analysis results for Group 1 materials
and weight between periods. The G1 category in particular sees a substantial reduction in relative weight in Period 2, along with an increase in G2 and G3 weight. The G4 category shows a decline in relative weight. For Period 1 both raw material Groups 1 and 2 show great similarity in percentage profiles for number of flakes and weight.

<table>
<thead>
<tr>
<th>Size grade</th>
<th>#</th>
<th># (%)</th>
<th>Weight (g)</th>
<th>Wt. (%)</th>
<th>Av. Wt. (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>129</td>
<td>0.5</td>
<td>4641.8</td>
<td>23.5</td>
<td>36.0</td>
</tr>
<tr>
<td>G2</td>
<td>1774</td>
<td>6.9</td>
<td>8628.8</td>
<td>43.6</td>
<td>4.9</td>
</tr>
<tr>
<td>G3</td>
<td>8553</td>
<td>33.1</td>
<td>5264.4</td>
<td>26.6</td>
<td>0.6</td>
</tr>
<tr>
<td>G4</td>
<td>15370</td>
<td>59.5</td>
<td>1259.2</td>
<td>6.4</td>
<td>0.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Period 1 N = 25826</th>
<th>Total weight: 19794.2g</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>6</td>
<td>111.9</td>
</tr>
<tr>
<td>G2</td>
<td>171</td>
<td>799.4</td>
</tr>
<tr>
<td>G3</td>
<td>781</td>
<td>540.2</td>
</tr>
<tr>
<td>G4</td>
<td>671</td>
<td>72.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Period 2 N = 1629</th>
<th>Total weight: 1524.2g</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>135</td>
<td>4753.7</td>
</tr>
<tr>
<td>G2</td>
<td>1946</td>
<td>9370.1</td>
</tr>
<tr>
<td>G3</td>
<td>9327</td>
<td>5806.9</td>
</tr>
<tr>
<td>G4</td>
<td>15948</td>
<td>1402.3</td>
</tr>
</tbody>
</table>

Early Period Total N = 27455 Total weight: 21318.4g

Table 10. Mass analysis results for Group 2 materials

Table 11 illustrates mass analysis data for raw material Group 3. During the first round of research, the G1 size grade in this raw material category comprised over 70% of the weight in both periods (Rahemtulla 1995a:63). In the present research the corresponding G1 values are substantially lower, although the G1 and G2 weight combined is well over 70% across both periods. The present G2 values are much higher than before, in 1995 they were 32 and 22 percent for Periods 1 and 2 respectively; here
they range from 43% to 63%. In the first round of research the G3 flakes comprised less than 5 percent of the sample weight, whereas here they comprise just over 20 percent. These differences are significant, although it should be pointed out that in 1995 the entire Group 3 sample consisted of only 416 pieces across both periods. This class of raw materials is used largely in the pebble and other tools, and so the heavy emphasis on removal of large and/or thick flakes is not surprising. This would account for the very high relative flake weights in the two largest flake size grades.

<table>
<thead>
<tr>
<th>Size grade</th>
<th>#</th>
<th># (%)</th>
<th>Weight (g)</th>
<th>Wt. (%)</th>
<th>Av. Wt. (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>41</td>
<td>1.2</td>
<td>1582.1</td>
<td>30.8</td>
<td>38.6</td>
</tr>
<tr>
<td>G2</td>
<td>472</td>
<td>14.0</td>
<td>2212.9</td>
<td>43.1</td>
<td>4.7</td>
</tr>
<tr>
<td>G3</td>
<td>1003</td>
<td>29.7</td>
<td>1056.1</td>
<td>20.6</td>
<td>1.0</td>
</tr>
<tr>
<td>G4</td>
<td>1859</td>
<td>55.1</td>
<td>277.4</td>
<td>5.4</td>
<td>0.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Period 1</th>
<th>N = 3375</th>
<th>Total weight: 5128.5g</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>2</td>
<td>1.4</td>
</tr>
<tr>
<td>G2</td>
<td>36</td>
<td>24.3</td>
</tr>
<tr>
<td>G3</td>
<td>62</td>
<td>41.9</td>
</tr>
<tr>
<td>G4</td>
<td>48</td>
<td>32.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Period 2</th>
<th>N = 148</th>
<th>Total weight: 316.1g</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>43</td>
<td>1.2</td>
</tr>
<tr>
<td>G2</td>
<td>508</td>
<td>14.4</td>
</tr>
<tr>
<td>G3</td>
<td>1065</td>
<td>30.2</td>
</tr>
<tr>
<td>G4</td>
<td>1907</td>
<td>54.1</td>
</tr>
</tbody>
</table>

| Early Period Total | N = 3523 | Total weight: 5444.6g |

Table 11. Mass analysis results for Group 3 materials

Group 4 materials (Table 12) also show a significant drop in total numbers and weight across periods. Like the Group 3 material though, this group also shows a fairly similar weight distribution across periods, despite differences in frequency profiles across time. Like the other categories, the major changes in frequency occur in the two smallest
size groups. It is difficult to say much else about this category since it is made up of a
great diversity of raw materials.

<table>
<thead>
<tr>
<th>Size grade</th>
<th>#</th>
<th># (%)</th>
<th>Weight (g)</th>
<th>Wt. (%)</th>
<th>Av. Wt. (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>71</td>
<td>1.4</td>
<td>5988.4</td>
<td>48.3</td>
<td>84.3</td>
</tr>
<tr>
<td>G2</td>
<td>718</td>
<td>13.9</td>
<td>4044.7</td>
<td>32.6</td>
<td>5.6</td>
</tr>
<tr>
<td>G3</td>
<td>1623</td>
<td>28.6</td>
<td>1680.7</td>
<td>13.6</td>
<td>1.0</td>
</tr>
<tr>
<td>G4</td>
<td>2770</td>
<td>53.5</td>
<td>675.1</td>
<td>5.4</td>
<td>0.2</td>
</tr>
</tbody>
</table>

|               |     |       |            |         |             |
| Period 1      | N = 5182 | Total weight: 12388.9g |
| G1            | 15  | 3.0   | 656.5      | 51.0    | 43.8        |
| G2            | 67  | 13.6  | 349.6      | 27.1    | 5.2         |
| G3            | 259 | 52.5  | 252.5      | 19.6    | 1.0         |
| G4            | 152 | 30.8  | 29.9       | 2.3     | 0.2         |

|               |     |       |            |         |             |
| Period 2      | N = 493 | Total weight: 1288.5g |
| G1            | 70  | 1.2   | 6120.5     | 44.7    | 77.3        |
| G2            | 757 | 13.3  | 4403.5     | 32.2    | 5.6         |
| G3            | 1885| 33.2  | 1864.4     | 13.6    | 1.0         |
| G4            | 3705| 65.3  | 705.5      | 5.2     | 0.2         |

|               |     |       |            |         |             |
| Early Period Total | N = 5675 | Total weight: 13677.4g |

Table 12. Mass analysis results for Group 4 materials.

Comparison of the Namu mass analysis profiles with the experimental samples from Kwatna and Ahler reveals interesting results (Figure 12). Because they are very similar and for the sake of clarity Experimental Groups 1 and 6 have been collapsed into a single curve, as have Groups 2 and 4. For the same reason, each of the Namu raw material curves has been collapsed into a single curve for both periods. It is immediately apparent that the Namu materials do not match any of the experimental curves. Raw material Groups 1 and 2 have very similar profiles to each other, and as a group they most closely match the curve for Experiment 3-II, the later stage biface reduction. The
next closest curve is Ahler’s biface Stage 2 curve. This is somewhat unexpected, as there is no evidence for a major emphasis on biface production at Namu. One problem may be that the Namu assemblage is a mixture of reduction strategies as indicated previously. It is not known specifically how this would affect the mass analysis profiles. But there is another confounding variable.

![Figure 12. Weight by size grade distributions for the Namu materials and experimental samples](image)

A problem with modeling lithic assemblages is that they produce ideal profiles. Archaeologically, we cannot expect to find all the products of flaking that are recorded experimentally. Stone tool users in the past would have used or retouched certain flakes for use elsewhere, or perhaps used the flakes and/or cores as blanks for other tools and even trampled over piles of debitage (Prentiss 1993, 1998; Prentiss and Romanski 1989).
In view of this both Ahler (1989b:99) and Magne (1985:100) advocate the removal of flakes that can be used as tools or as blanks, from the experimental sample. This is a very subjective procedure as acknowledged by both authors, but it is a somewhat necessary step in order to model strategies pursued by the original toolmakers, and to render the experimental samples comparable to the archaeological materials.

A culling operation (Ahler 1989; Prentiss 1993) was performed on the experimental samples to ascertain the effects of flake removal on the profiles. For all experiments flakes with certain attributes were removed from the samples, as they would have been by stone tool-users. Large flakes that could serve as blanks for further tool production, or large flakes that have either robust, sharp edges or edges that are amenable to resharpening were immediately removed. In general complete flakes with a platform and robust margins were culled, as were any flake fragments with such margins and enough area to grip onto in order to use as a tool (Gould et al. 1971; Hayden 1979). Most flakes that were removed would make excellent cutting implements for hard and soft materials (Fig. 13) when hand-held, although some could be modified for hafting. Many

Figure 13. Selection of flakes culled from the experimental sample
could be resharpened into various forms with a range of edge angles. The vast majority of culled flakes are in the G1 size category but smaller sized flakes could certainly be useful for a number of tasks such as bone and antler modification (Deal and Hayden 1987).

Table 13 displays results of the remaining flakes in the experimental samples after the culling. As can be expected, there is a significant decrease in G1 flakes and a smaller

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Size</th>
<th>#</th>
<th># (%)</th>
<th>Wt (g)</th>
<th>Wt (%)</th>
<th>Ave. Wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 N=491</td>
<td>G1</td>
<td>6</td>
<td>1.2</td>
<td>448</td>
<td>53.4</td>
<td>74.7</td>
</tr>
<tr>
<td>838.3g</td>
<td>G2</td>
<td>28</td>
<td>5.7</td>
<td>282.9</td>
<td>33.7</td>
<td>10.1</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>120</td>
<td>23.7</td>
<td>80.2</td>
<td>9.6</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>337</td>
<td>69.0</td>
<td>27.2</td>
<td>3.2</td>
<td>0.1</td>
</tr>
<tr>
<td>2</td>
<td>G1</td>
<td>0</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>22</td>
<td>5.7</td>
<td>97.0</td>
<td>51.8</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>101</td>
<td>26.3</td>
<td>68.0</td>
<td>36.3</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>261</td>
<td>68.0</td>
<td>22.4</td>
<td>1.5</td>
<td>0.1</td>
</tr>
<tr>
<td>3 (I) N=244</td>
<td>G1</td>
<td>0</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>105.4g</td>
<td>G2</td>
<td>14</td>
<td>5.7</td>
<td>50.0</td>
<td>47.4</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>58</td>
<td>23.8</td>
<td>43.3</td>
<td>23.8</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>172</td>
<td>70.5</td>
<td>12.1</td>
<td>11.5</td>
<td>0.1</td>
</tr>
<tr>
<td>3 (II) N=293</td>
<td>G1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75.3g</td>
<td>G2</td>
<td>14</td>
<td>4.8</td>
<td>28.0</td>
<td>37.2</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>80</td>
<td>27.3</td>
<td>35.2</td>
<td>46.7</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>199</td>
<td>67.9</td>
<td>12.1</td>
<td>16.1</td>
<td>0.1</td>
</tr>
<tr>
<td>4</td>
<td>G1</td>
<td>7</td>
<td>1.0</td>
<td>159</td>
<td>26.3</td>
<td>69.9</td>
</tr>
<tr>
<td>603.6g</td>
<td>G2</td>
<td>50</td>
<td>7.4</td>
<td>295</td>
<td>48.9</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>174</td>
<td>25.9</td>
<td>112</td>
<td>18.6</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>441</td>
<td>65.6</td>
<td>37.6</td>
<td>6.2</td>
<td>0.1</td>
</tr>
<tr>
<td>5</td>
<td>G1</td>
<td>2</td>
<td>0.5</td>
<td>56.5</td>
<td>23.4</td>
<td>28.3</td>
</tr>
<tr>
<td>241.7g</td>
<td>G2</td>
<td>21</td>
<td>0.5</td>
<td>107.5</td>
<td>44.5</td>
<td>5.1</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>93</td>
<td>23.8</td>
<td>56.0</td>
<td>23.2</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>274</td>
<td>70.3</td>
<td>21.7</td>
<td>9.0</td>
<td>0.1</td>
</tr>
<tr>
<td>6</td>
<td>G1</td>
<td>2</td>
<td>0.3</td>
<td>124.5</td>
<td>30.7</td>
<td>62.3</td>
</tr>
<tr>
<td>405.4g</td>
<td>G2</td>
<td>45</td>
<td>5.9</td>
<td>148.0</td>
<td>36.5</td>
<td>32.9</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>215</td>
<td>28.4</td>
<td>99.2</td>
<td>24.5</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>496</td>
<td>65.4</td>
<td>33.7</td>
<td>8.3</td>
<td>0.1</td>
</tr>
<tr>
<td>Total N=3232</td>
<td>G1</td>
<td>17</td>
<td>2.4</td>
<td>788.0</td>
<td>32.0</td>
<td>46.4</td>
</tr>
<tr>
<td>2457.1g</td>
<td>G2</td>
<td>194</td>
<td>7.3</td>
<td>1008.4</td>
<td>41.0</td>
<td>5.2</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>841</td>
<td>25.1</td>
<td>493.9</td>
<td>20.1</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>2180</td>
<td>65.1</td>
<td>166.8</td>
<td>6.8</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Table 13. Results of culled experiments
decrease in G2 flakes. In some cases all G1 flakes were removed from the experimental sample. A primary goal of this exercise was to try and model the curves for raw material groups 1 and 2 at Namu. In addition to the flake culling exercise, all of the experiments were collapsed into a summary through averaging (bottom section in Table 13). This is done to simulate a technologically mixed assemblage, with the caution that the experimental sample is very small. These values were plotted with the Namu values for raw material Groups 1-3 (Figure 14). The experimental curve is now much closer to the profiles for raw material groups 1 and 2 but not Group 3, as expected. There are some differences in the proportions of G1 and G3 weighting but otherwise the curves are remarkably similar. A chi-square test was performed on a comparison between the collapsed experimental results and raw material Groups 1 ($\chi^2 = 92.9233$, df=3, $p<.001$) and 2 ($\chi^2 = 137.2023$, df=3, $p<.001$), the results are highly significant in both cases, suggesting that the experimental group is quite different to the archaeological groups. It is important to remember, however, that these tests are performed on the weight in each size grade. The removal of only on or two flakes could change the entire weight percentage profile in each case. Combined with the subjectivity in the culling exercise, the significance tests are not very useful. The visual patterning in Figure 14 clearly shows a trend towards matching the debitage patterns at Namu. Ahler (1989b) suggests that simple visual tools such as graphs can be of great aid in deciphering the complex patterns that underlie debitage.

This pattern demonstrates that the Namu assemblage is indeed a technologically mixed sample, as is also reflected in the tool collection. Discriminating the actual proportions of reduction strategies in the archaeological sample is extremely difficult,
although Ahler (1989b) has had minimal success in this regard. In this case the culling procedure combined with the conflation of two experimental biface and five core reduction strategies has produced a curve similar to those for the main raw materials at 

![Graph](image)

**Figure 14.** Comparison of weight by size grade of all experiments culled and collapsed, and Namu raw materials Groups 1-3.

Namu. This does not obviate other strategies such as prepared core reduction happening at a lower frequency at Namu, the effects of such strategies were not tested here; nonetheless the dominant core reduction (culled) strategy seems to have the strongest effect on the pattern. As suspected during the first round of research, this is a technologically mixed sample. The main form of reduction at Namu appears to be core
reduction for the purpose of obtaining flakes, while biface reduction took place at a lower frequency.

Debitage patterns between periods

An interesting pattern in the debitage recovery is the ratio of material between Periods 1 and 2 (Table 14). There is a substantial decline in the amount and weight of debitage between the two periods for all raw materials. Part of this may be due to differences in temporal span; Period 1 is roughly four times as long as Period 2. That said there still seems to be a smaller representative sample in Period 2. If lithic materials were being discarded also in other parts of the site, then different use of space may explain the decline. Hester (1978) and Carlson (1991) both note that Period 2 deposits are much more substantial within the Main Trench than in the Rivermouth Trench, indicating that

<table>
<thead>
<tr>
<th>Raw material group</th>
<th>Period 1:2 ratio (# flakes)</th>
<th>Period 1:2 ratio (weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17.8:1</td>
<td>17.2:1</td>
</tr>
<tr>
<td>2</td>
<td>16.0:1</td>
<td>12.3:1</td>
</tr>
<tr>
<td>3</td>
<td>21.8:1</td>
<td>15.1:1</td>
</tr>
<tr>
<td>4</td>
<td>11.5:1</td>
<td>9.04:1</td>
</tr>
</tbody>
</table>

Table 14. Ratios of debitage recovery between Periods 1 and 2 for raw material groups 1-4.

there may have been a shift in areas where disposal and other activities were taking place. Detailed examination of the debitage frequency profiles may lend support this notion.

In all raw material classes, there is a substantial drop in relative G4 debitage in Period 2. This has led to an over-representation of G3 and to a lesser extent, G2 debitage.
Period 1 results in all cases accord fairly well with the experimental group when averaged out while Period 2 debitage frequencies show a moderate to significant difference than the experimental pattern. This suggests that for most of Period 1, a substantial portion of the flintknapping was taking place at the midden location. On the other hand, the location of flintknapping may have shifted during Period 2.

During the 1995 research there was a dramatic lack of G4 debitage as mentioned, and a possible explanation for this pattern focused on functional areas within the site. Post-depositional site alteration was ruled out as an explanation in favour of a cultural one (Rahemtulla 1995a:101-102). Ethnoarchaeological studies conducted by Gallagher (1977) documented the Gurage, Arussi-Galla and Sudama in Ethiopia, who were village-dwelling stone tool-using peoples. Gallagher noted that in order to reduce the chance of injury to pedestrians, individuals within these communities flaked obsidian into a container or they resharpened their scrapers in an area away from foot traffic. If used, lithic waste containers were subsequently discarded at designated dump areas.

Based on this Behm (1983) conducted a number of simulations in order to investigate debitage patterning when the area of flaking was subsequently cleaned and the materials discarded elsewhere. Behm used a number of methods to clean up simulated “living areas” including sweeping and hand picking the debitage. The cleaned materials were then processed using mass analysis, and Behm discovered an interesting pattern. The G4 debitage frequencies were anomalously low, since even after clean up, many of these pieces are left behind at the place of knapping (1983:13). This was used as an analogue to explain the low G4 frequencies at Namu; the Rivermouth Trench was a lithic dump area, and the G4 debitage remained behind at the place of knapping. That organic
materials were dumped at the same location sometime later was used as support for this hypothesis.

<table>
<thead>
<tr>
<th>Raw Material</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period 1</td>
<td>1.7:1</td>
<td>1.8:1</td>
<td>1.9:1</td>
<td>2.2:1</td>
</tr>
<tr>
<td>Period 2</td>
<td>0.6:1</td>
<td>0.8:1</td>
<td>0.7:1</td>
<td>0.6:1</td>
</tr>
</tbody>
</table>

**Table 15. G4:G3 debitage ratios for raw material Groups 1-4**

With the new data from the tailings and the experiments, it is apparent that the Period 1 debitage frequencies are within the expected results of a technologically mixed assemblage. In other words, there is no significant deflation of G4 materials in Period 1, if we allow for some loss in the archaeological sample due to loss of sample bags in the lab, counting error, etc. On the other hand, there is a significant drop in G4 debitage during Period 2, indicating that the location of flintknapping may have shifted sometime before or during this time. Behm (1983) suggested that primary flaking deposits should have a G4:G3 ratio of 2:1. In the experiments conducted here, the average G4:G3 ratio is 2.6:1. Table 15 illustrates the G4:G3 ratios for the four major classes of raw material across both Periods. The dramatic change in ratios between periods and across all raw material categories is clear. Moreover the Period 2 ratios are far below those obtained in the experimental samples. With collection of tailings no longer an issue, the best explanation for this change is a shift in functional areas; during most of Period 1 the knapping and discard of lithic materials took place in the same location. During Period 2 the location(s) of knapping shifted, and the Rivermouth Trench area functioned more as a
dump. This is roughly when organic (faunal) material appears in significant density within the deposit (Cannon 1991; Carlson 1991).

Results of the SRT analysis

The experimental sample was analyzed using the Sullivan and Rozen Typology; results are presented in Table 16. Originally Sullivan and Rozen argued that core reduction should yield a high amount of complete flakes while tool production should produce a high number of proximal flakes. Based on experimental assessments both Prentiss and Romanski (1989) and Baumler and Downum (1989) show that tool production actually produces a higher number of complete flakes than does core reduction. This is certainly the case in the present experimental sample where the highest number of complete flakes is seen in the later stage biface reduction. In the above-cited works, experiments with softer materials show combined values of complete flakes in core reduction ranging from 7.4–25.4% and from 30.4–88.0% in tool production. The experimental values below fit in with these ranges, although Experiments 2 and 6 show a slightly higher number of complete flakes for core reduction. Prentiss and Romanski

<table>
<thead>
<tr>
<th>SRT Fl. Type</th>
<th>Exp. 1 N = 167 (%)</th>
<th>Exp. 2 N = 147 (%)</th>
<th>Exp. 3-I N = 79 (%)</th>
<th>Exp. 3-2 N = 98 (%)</th>
<th>Exp. 4 N = 253 (%)</th>
<th>Exp. 5 N = 140 (%)</th>
<th>Exp. 6 N = 287 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete</td>
<td>20.4</td>
<td>29.9</td>
<td>24.1</td>
<td>43.9</td>
<td>22.5</td>
<td>26.4</td>
<td>29.6</td>
</tr>
<tr>
<td>Proximal</td>
<td>16.8</td>
<td>15.6</td>
<td>5.1</td>
<td>20.4</td>
<td>21.7</td>
<td>20</td>
<td>21.3</td>
</tr>
<tr>
<td>Medial/distal</td>
<td>37.1</td>
<td>35.4</td>
<td>44.3</td>
<td>28.6</td>
<td>34.4</td>
<td>32.1</td>
<td>35.2</td>
</tr>
<tr>
<td>Split</td>
<td>22.2</td>
<td>16.3</td>
<td>22.8</td>
<td>6.1</td>
<td>13.0</td>
<td>20.7</td>
<td>11.5</td>
</tr>
<tr>
<td>Non-orientable</td>
<td>3.6</td>
<td>2.7</td>
<td>3.8</td>
<td>1.0</td>
<td>8.3</td>
<td>0.7</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Table 16. SRT data for Experiments 1-6
(1989) also argue that proximal flakes should occur in equal numbers in both core reduction and tool production. In the present experimental sample values for proximal flake types are relatively consistent, including in the later stage biface reduction, validating Prentiss and Romanski’s assertion. Experiment 3-I, however, shows an anomalously low frequency of proximal flakes along with a high number of medial/distal flakes. This is a curious pattern and one that is not expected. It is difficult to know why this pattern deviates so much from the others, but perhaps the higher incidence of split flakes comes at the expense of proximal flakes in this experiment. During the reductions, we noted a higher number of split flakes were produced when the knapper held the core in his hand, while fewer split flakes occurred when the biface was rested on the anvil during reduction. During Experiment 3-I many of the flakes were removed with the core held in hand, but for experiment 3-II the anvil was used far more frequently.

In core reduction Prentiss and Romanski’s (1989) experimental values for medial/distal flakes range from 22.2 – 25.6% and in tool production, from 35 – 35.7%. In the current sample the pattern is reversed to an extent where in general core reduction values for medial/distal flakes are slightly higher than the later stage biface reduction. On the other hand, the biface edging experiment 3-I shows the highest number of medial/distal flakes. Split flakes occur in roughly equal numbers in core reduction and tool production in Prentiss and Romanski’s experiments, and all values are under 10%. For the Kwatna sample values for split flakes are quite variable across experiments, with some showing slightly higher than 20% of the total sample. Interestingly, the later stage biface reduction shows the lowest number of split flakes at 6.1%. The high number of split flakes here is related to the nature of the raw material. Greater physical force
combined with hammerstones of greater density result in a much higher force of impact when working with coarse raw materials. In turn this produces a higher number of split flakes. Amick and Mauldin (1997) and Morrison (1994) also found that quartzite displayed similar patterns for split flakes.

Prentiss and Romanski (1989) found that experimental core reduction resulted in non-orientable fragments ranging from 31.7 – 32.6% while Baumler and Downum (1989) discovered 29.1 – 37% for the same. In tool production the former found values of 4 – 10% while the latter 1.3 – 10.8%. All of the experiments on the Kwatna materials show non-orientable fragment values of less then 10%, and all but one experiment show values of less than 5%. In general the later stage biface experiment does show a slightly lower value for this category than all of the core reductions with the exception of Experiment 5, the very hard material. These results are significantly different than the ones in Prentiss and Romanski’s and in Baumler and Downum’s. It seems once again that these differences are caused by the raw material properties. The very low number of non-orientable fragments in Experiment 5 is most interesting, in that this material requires the highest force of impact to detach flakes. As such, we would expect the frequency of non-orientable fragments to be high. A larger experimental sample size is needed in order to explore this relationship further.

Table 17 reveals results of the SRT analysis on Namu material Groups 1-3. In general there is consistency in the frequency of flake completeness in all three raw material categories, although Group 1 displays a low number of complete flakes and a slightly elevated frequency of medial/distal flakes. Group 3 has a significantly higher
Table 17. SRT data for raw material Groups 1-3

<table>
<thead>
<tr>
<th>SRT Flake Type</th>
<th>Raw material group 1</th>
<th></th>
<th>Period 2</th>
<th>Early Period Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Period 1 (N = 1449)</td>
<td></td>
<td>N = 153</td>
<td>N = 1602</td>
</tr>
<tr>
<td>Complete</td>
<td>8.0 (14.4%)</td>
<td></td>
<td>5.4 (12.8%)</td>
<td>7.8 (12.6%)</td>
</tr>
<tr>
<td>Proximal</td>
<td>20.0 (20.0%)</td>
<td></td>
<td>19.8 (20.0%)</td>
<td>20.2 (20.2%)</td>
</tr>
<tr>
<td>Medial/distal</td>
<td>51.0 (51.0%)</td>
<td></td>
<td>56.3 (56.3%)</td>
<td>52.1 (52.1%)</td>
</tr>
<tr>
<td>Split</td>
<td>12.9 (12.9%)</td>
<td></td>
<td>4.8 (4.8%)</td>
<td>12.2 (12.2%)</td>
</tr>
<tr>
<td>Non-orientable</td>
<td>7.9 (7.9%)</td>
<td></td>
<td>15.0 (15.0%)</td>
<td>8.6 (8.6%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Raw material group 2</th>
<th></th>
<th>Period 2</th>
<th>Early Period Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Period 1 (N = 6984)</td>
<td></td>
<td>N = 870</td>
<td>N = 7854</td>
</tr>
<tr>
<td>Complete</td>
<td>14.6 (14.6%)</td>
<td></td>
<td>11.6 (11.6%)</td>
<td>14.2 (14.2%)</td>
</tr>
<tr>
<td>Proximal</td>
<td>18.9 (18.9%)</td>
<td></td>
<td>17.5 (17.5%)</td>
<td>18.7 (18.7%)</td>
</tr>
<tr>
<td>Medial/distal</td>
<td>44.9 (44.9%)</td>
<td></td>
<td>44.4 (44.4%)</td>
<td>44.9 (44.9%)</td>
</tr>
<tr>
<td>Split</td>
<td>15.0 (15.0%)</td>
<td></td>
<td>15.7 (15.7%)</td>
<td>15.1 (15.1%)</td>
</tr>
<tr>
<td>Non-orientable</td>
<td>6.5 (6.5%)</td>
<td></td>
<td>10.8 (10.8%)</td>
<td>7.0 (7.0%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Raw material group 3</th>
<th></th>
<th>Period 2</th>
<th>Early Period Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Period 1 (N = 1081)</td>
<td></td>
<td>N = 103</td>
<td>N = 1184</td>
</tr>
<tr>
<td>Complete</td>
<td>15.2 (15.2%)</td>
<td></td>
<td>11.6 (11.6%)</td>
<td>15.0 (15.0%)</td>
</tr>
<tr>
<td>Proximal</td>
<td>13.9 (13.9%)</td>
<td></td>
<td>11.6 (11.6%)</td>
<td>13.7 (13.7%)</td>
</tr>
<tr>
<td>Medial/distal</td>
<td>41.9 (41.9%)</td>
<td></td>
<td>44.7 (44.7%)</td>
<td>42.1 (42.1%)</td>
</tr>
<tr>
<td>Split</td>
<td>23.6 (23.6%)</td>
<td></td>
<td>24.3 (24.3%)</td>
<td>23.6 (23.6%)</td>
</tr>
<tr>
<td>Non-orientable</td>
<td>5.5 (5.5%)</td>
<td></td>
<td>7.8 (7.8%)</td>
<td>5.7 (5.7%)</td>
</tr>
</tbody>
</table>

number of split flakes, and all categories reveal a non-orientable fragment quotient of less than 10%, which fits well with the experimental sample. In general the archaeological samples fit in well within the range of the experimental samples, however, there are some interesting differences. Complete flakes are somewhat lower in the archaeological samples, particularly in Group 1. This may be due to culling operations; the experimental results here are before culling was performed. Complete flakes tend to be removed at a much higher frequency in culling operations than any other type of flake, which could be reflected in the deflation seen in the archaeological samples. Medial/distal fragments seem slightly higher in the archaeological sample, and this could be due to the effects of trampling. A critique raised by Prentiss and Romanski (1989) in their evaluation of the
Sullivan and Rozen typology is that the technique does not account for trampling of assemblages. They argue that trampling can potentially significantly alter the flake completeness composition of an assemblage. Experiments conducted in this vein by Prentiss and Romanksi demonstrate that this is the case.

Because the raw materials in the present research are so different than those used by other researchers, comparison to experimentally trampled assemblages may not be valid. Fracture patterns in the coarser raw materials due to trampling are expected to differ significantly from softer materials. Unfortunately trampling experiments were not conducted with these coarse materials during this round of research, although such experiments are planned for the future.

Figure 15. Comparison of SRT values for Namu raw material Groups 1-3 and experiments 1-6.
The SRT technique as applied to these coarse materials reveals mixed results. The experimental sample size needs to be expanded, but there are some similarities as well as significant differences with experimental samples performed on softer materials. Overall the general frequency of flake completeness types in the archaeological sample is within the ranges seen in the experimental sample for core reduction (Fig. 15), however, the pattern does also seem to suggest a myriad of reduction strategies is represented at Namu. Separation of core reduction from tool production is difficult in technologically mixed samples, as seen in the mass analysis. A larger experimental sample combined with trampling experiments would greatly enhance our understanding of differences in pattern due to coarse-grained materials.

Results of the Flake Type Method

Magne’s (1985) flake type method was devised to distinguish core reduction from stages of tool production at 38 sites in the southern Interior of British Columbia. When this method was applied in the Namu debitage in the 1995 research, it yielded the most ambiguous results of the three techniques, mainly due to the coarseness of the raw material. As a test, it was included again in the present research to ascertain not only how well the experiments support the theory behind the technique, but also to see if there is any fit between the experimental and archaeological samples. Table 18 illustrates the breakdown of flake type by raw material and period. Consistency across periods is generally good with the exception of raw material Group 1 where there is an increase in shatter and a decrease in PRBs between Periods 1 and 2. The sample size in Period 2, however, is very small. Shatter and PRBs are represented in roughly equal amounts for
raw material Groups 2 and 3, with a slight preponderance of Shatter in the former and a slight preponderance of PRBs in the latter. This is likely due to the emphasis on the reduction of river rolled cobbles for Group 3. Group 1 materials show a significant dominance of Shatter over PRBs, and initially it was thought that this may be due to the

<table>
<thead>
<tr>
<th>Raw material Group 1 Flake Type</th>
<th>Period 1 N = 1450 (%)</th>
<th>Period 2 N = 168 (%)</th>
<th>Early Period Total N = 1618 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shatter</td>
<td>59.2</td>
<td>70.2</td>
<td>60.4</td>
</tr>
<tr>
<td>BRF</td>
<td>2.4</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Bipolar</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PRB</td>
<td>38.3</td>
<td>27.4</td>
<td>37.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Raw material Group 2 Flake Type</th>
<th>Period 1 N = 6982 (%)</th>
<th>Period 2 N = 869 (%)</th>
<th>Early Period Total N = 7851 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shatter</td>
<td>51.5</td>
<td>55.2</td>
<td>51.9</td>
</tr>
<tr>
<td>BRF</td>
<td>1.3</td>
<td>0.7</td>
<td>1.2</td>
</tr>
<tr>
<td>Bipolar</td>
<td>0</td>
<td>2.8</td>
<td>0.3</td>
</tr>
<tr>
<td>PRB</td>
<td>47.1</td>
<td>41.3</td>
<td>46.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Raw material Group 3 Flake Type</th>
<th>Period 1 N = 1081 (%)</th>
<th>Period 2 N = 104 (%)</th>
<th>Early Period Total N = 1185 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shatter</td>
<td>47.4</td>
<td>51.9</td>
<td>47.8</td>
</tr>
<tr>
<td>BRF</td>
<td>0</td>
<td>1.9</td>
<td>0.2</td>
</tr>
<tr>
<td>Bipolar</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PRB</td>
<td>52.6</td>
<td>46.2</td>
<td>52.1</td>
</tr>
</tbody>
</table>

### Table 18. Flake type data for raw material Groups 1-3

physical hardness of this group in general, but the experiments show otherwise (below).

In comparison, the experimental sample (Table 19) shows a greater and significant preponderance of PRBs across all categories. Note that the highest proportion of PRBs occurs in Experiment 5, which was the hardest material used in all of the experiments. With this exception, the ratio of Shatter to PRBs is similar for all the core reduction exercises. As expected, the biface reduction shows a different pattern particularly in Experiment 3-II, with a significant drop in Shatter and an increase in BRFs.
and PRB's. No Bipolar debitage were produced in the experiments, and this class is also not well represented in the archaeological sample.

One of Magne's goals was to reduce the number of attributes that need to be measured in individual flake analysis, and he constructed a list of six. The most important attributes are flake scar counts, on platforms on BRFs and PRBs and on the dorsal faces of shatter. The basic premise is that as a core is subject to greater reduction, it will be subject to a greater number of flake detachment scars. Logically, this will also extend to the debitage removed at any time during the sequence. Magne's experiments showed that early stage reduction produces a prominence of PRBs and Shatter with 0-1 scars, while middle stage reduction centres on 2 scars and late stage reduction is reflected in 3 or more scars.

When this technique was applied in the first round of the current research, the results indicated a heavy concentration of 1-2 scar debitage. This was taken to indicate a technologically mixed assemblage with a focus on early to middle stage reduction, but scar visibility was also a problem. Due to the coarse grained nature of the material, it was not possible to accurately count platform scars on many of the debitage. The flake scars that would be highly visible in other raw materials are difficult if not impossible to detect.

<table>
<thead>
<tr>
<th>Fl. Type</th>
<th>Exp. 1 N = 166 (%)</th>
<th>Exp. 2 N = 147 (%)</th>
<th>Exp. 3-I N = 79 (%)</th>
<th>Exp. 3-2 N = 98 (%)</th>
<th>Exp. 4 N = 254 (%)</th>
<th>Exp. 5 N = 130 (%)</th>
<th>Exp. 6 N = 286 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shatter</td>
<td>41.6</td>
<td>39.5</td>
<td>46.8</td>
<td>29.6</td>
<td>42.7</td>
<td>28.5</td>
<td>37.8</td>
</tr>
<tr>
<td>BRF</td>
<td>0</td>
<td>0</td>
<td>2.5</td>
<td>6.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bipolar</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PRB</td>
<td>58.4</td>
<td>60.5</td>
<td>50.6</td>
<td>64.3</td>
<td>57.7</td>
<td>71.5</td>
<td>62.2</td>
</tr>
</tbody>
</table>

Table 19. Flake type data for Experiments 1-6
in some cases. As a result, dorsal scar counts were used to investigate all the debitage, including PRBs and BRFs.

The BRFs were classified (see also Rahemtulla 1995a:79) based on a number of attributes such as a platform to interior surface angle of less than 35°, relatively narrow platforms, and dorsal perimeter scarring. In the biface reduction experiment a relatively higher proportion of BRFs is expected, especially during the later stage of reduction. For experiment 3-II, the BRF class comprises only 6.1% out of the sample of 98 flakes. This is a very low frequency and counters the tenets of the technique. Once again, this is related to the raw material itself rather than a shortcoming in technique. Bifaces produced with these materials are different in morphology than bifaces produced with softer materials, and the texture and flaking patterns restrict the number of “classic” BRFs.

Table 20 illustrates the dorsal scar counts for Shatter and PRBs for Namu Groups 1 and 2 materials as well as all of the Experiments. As can be seen, the archaeological materials are fairly consistent within each flake category despite raw material differences. For the Shatter type, all of the categories show highest frequencies in 1 dorsal scar with the exception of experiment 3-II, the later stage biface reduction. The core reductions range from 57% to 87%. This is quite a range of variability but this pattern is expected in a situation where core reduction is by far the dominant strategy. Experiment 3-II shows a slightly higher number of shatter with 2 scars, again following the predictions set out by Magne. This pattern is even more apparent in the PRB dorsal scars for Experiment 3-2. In producing bifaces on these raw materials, it is doubtful that the resulting debitage would reveal a preponderance of debitage with 3 or more flake scars.
Table 20. Dorsal scar count frequencies on Shatter (top row) and PRBs (bottom row) from Namu Groups 1 and 2 raw materials, and Experiments 1-6.

<table>
<thead>
<tr>
<th>Dorsal scar count SH</th>
<th>Grp. 1 (%)</th>
<th>Grp. 2 (%)</th>
<th>Exp. 1 (%)</th>
<th>Exp. 2 (%)</th>
<th>Exp. 3-1 (%)</th>
<th>Exp. 3-2 (%)</th>
<th>Exp. 4 (%)</th>
<th>Exp. 5 (%)</th>
<th>Exp. 6 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.3</td>
<td>0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>63</td>
<td>63</td>
<td>65.2</td>
<td>57.1</td>
<td>73.3</td>
<td>45</td>
<td>81.6</td>
<td>87</td>
<td>77</td>
</tr>
<tr>
<td>2</td>
<td>35.3</td>
<td>31.3</td>
<td>34.8</td>
<td>42.9</td>
<td>26.7</td>
<td>50</td>
<td>18.4</td>
<td>13</td>
<td>23</td>
</tr>
<tr>
<td>≥ 3</td>
<td>1.3</td>
<td>0.9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dorsal scar count PRB</th>
<th>Grp. 1 (%)</th>
<th>Grp. 2 (%)</th>
<th>Exp. 1 (%)</th>
<th>Exp. 2 (%)</th>
<th>Exp. 3-1 (%)</th>
<th>Exp. 3-2 (%)</th>
<th>Exp. 4 (%)</th>
<th>Exp. 5 (%)</th>
<th>Exp. 6 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.8</td>
<td>0.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3.6</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>49.7</td>
<td>52.5</td>
<td>66.2</td>
<td>45.9</td>
<td>44.8</td>
<td>32.1</td>
<td>58.7</td>
<td>65.1</td>
<td>79.5</td>
</tr>
<tr>
<td>2</td>
<td>47.1</td>
<td>45.8</td>
<td>32.5</td>
<td>52.7</td>
<td>55.2</td>
<td>64.3</td>
<td>40.5</td>
<td>31.3</td>
<td>20.5</td>
</tr>
<tr>
<td>≥ 3</td>
<td>2.4</td>
<td>1.6</td>
<td>1.3</td>
<td>1.4</td>
<td>0</td>
<td>3.6</td>
<td>0.8</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The PRB profiles again reveal ambiguous results that seem incompatible with the dorsal scar counts. Only Experiments 1 and 6 show consistency across both flake types; all other categories show small to significant differences in scar counts across the two flake types. The two archaeological samples show great similarity to Experiment 1 in the shatter type category but not in the PRB category. This may be a result of the difficulty of counting these flake scars.

Morrison (1994) found this technique to be the least reliable and to have the least validity of the three techniques. She encountered problems similar to those detailed here when she attempted to examine quartzitedebitage using this technique. Essentially the nature of the raw material obscures the important visual criteria needed to evaluate attributes. The arises and valleys that normally define flake scars can be extremely difficult if not impossible to detect in some cases. Morrison also found that identification of types such as BRFs is difficult and very subjective, particularly with coarse-grained materials. That this method worked successfully for Magne is unquestionable, but he was working with fine-grained trachydacites from the southern Interior of British Columbia. It
is apparent that the method is much less successful with these coarser materials, mainly
due to problems of visibility and classification.

The quartz industry

Mass analysis data for raw material Group 5 is illustrated in Table 21. These
debitage were not analysed through the individual flake analysis, since their technological
origin seems fairly certain. The class consists largely milky or veined-quartz, a difficult
material to knap. Upon examination of the sample in general, the collection exhibits
classic signatures of bipolar flaking, lending support to Carlson’s speculation (1996:93)
on this point. Many of the specimens exhibit fracture planes that are consistent with the
bipolar reduction of small quartz nodules or pebbles. Bipolar reduction has also been
argued as an efficient strategy to maximize the utility of a raw material (Shott 1989), but
here it seems that initial core size is the principle factor in the application of this
technique to this raw material type.

The mass analysis reveals that as expected, the G4 category has the highest
number of flakes but surprisingly, this category also accounts for the highest amount of
weight. This is very unusual, but would be expected in bipolar reduction of small quartz
cobbles or pebbles. Due to the fracture mechanics of quartz, much shatter should be
expected, and if the core size is small, the majority of the shatter will be small. Initial
core size is indicated by the rarity of the two larger size grades, the entire Early Period is
represented by 3 G1 size pieces and 47 G2 size pieces. As with all the other raw
materials, there is a significant decline in quartzdebitage during Period 2. Flenniken
(1981) reports the recovery of a hafted quartz flake in cedar slats at the Hoko River Site in Washington. Manufactured through the bipolar bashing of small quartz nodules, the blade-like flakes were used to process salmon. It is difficult to say if the similarly

<table>
<thead>
<tr>
<th>Period</th>
<th>Size</th>
<th># flakes</th>
<th>Wt (g)</th>
<th>Ave. Wt (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G1</td>
<td>3</td>
<td>113.3</td>
<td>37.8</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>42</td>
<td>262.6</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>316</td>
<td>279</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>1548</td>
<td>371.7</td>
<td>0.2</td>
</tr>
<tr>
<td>2</td>
<td>G1</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>5</td>
<td>49.4</td>
<td>9.9</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>45</td>
<td>40.8</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>61</td>
<td>16.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Total</td>
<td>G1</td>
<td>3</td>
<td>113.3</td>
<td>37.8</td>
</tr>
<tr>
<td></td>
<td>G2</td>
<td>47</td>
<td>312</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>G3</td>
<td>361</td>
<td>319.8</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>G4</td>
<td>1619</td>
<td>388</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2030</td>
<td>113.3</td>
<td></td>
</tr>
</tbody>
</table>

Table 21. Group 5 debitage tallies by period (after addition of tailings)

produced quartz products were used for similar tasks at Namu, suffice it to say that the quartz was used to a lesser extent than the main classes of raw materials during the Early Period.

Debitage analysis summary

The debitage analysis has been fruitful in a number of ways, but much more works needs to be done. In comparison with the previous round of research two new aspects were added and they greatly enhanced the analysis. The first was the implementation of the tailings analysis. The new information that resulted from this operation changed the scope of the analysis but also illustrates the amount of data that can be lost in the excavation and recovery of material from deep coastal middens. This

188
serves as a great caution for collection strategies in such sites. The second aspect was the construction of the experimental reference sample. Even though the sample is very small, interpreting the Namu patterning without it would have been difficult. But far more than that, the experimental reductions illustrated that working with such raw materials requires slightly different knapping strategies in comparison to working with softer materials. It is little wonder that it was so difficult to find a modern knapper with experience in working such materials.

The mass analysis was particularly instructive in this regard, as the culling exercise and mixture of technological strategies resulted in a pattern that closely matches that of the archaeological material. It seems fair to say that the Namu debitage, at least for raw material Groups 1 and 2, can be interpreted as the result of reduction strategies that focus primarily on core reduction for the production of flakes and secondarily, the manufacture of various tool forms including bifaces. Many of the cores as well as the flake blanks were used as tools, or they were further modified into a number of tool forms that are the subject of the next chapter. Flake size ranges indicate that large cores were brought to the site and that the entire sequence from initial core reduction to tool production was taking place on site.

On the other hand the individual flake analyses were less useful due to a number of factors. The nature of the raw materials here clearly has a major effect on debitage patterns, which are quite different than experimental and archaeological values for debitage made on softer materials. The coarser structure and greater percussive forces required to detach flakes combine to produce different patterns of flake completeness and flake types when compared to chert, obsidian and trachydacite. A larger experimental
sample would definitely be of great benefit when applied to the Modified Sullivan and Rozen Typology, but less useful for the flake type method outlined by Magne (1985). Major problems with the latter method as applied to these raw materials include the difficulty in quantifying flake scars and the difficulty in recognizing specific flake types such as BRFs (biface reduction flakes – see Chapter 5). While use of multiple techniques for debitage analysis is becoming the standard, these results indicate that more experiments with coarser raw materials are needed, and that the nature of the raw materials should be considered when choosing the actual analytical technique(s).

While the debitage analysis here has provided some interesting results, more work needs to be done. The major factor in this regard is the expansion of the experimental collection. Given that many archaeological sites in British Columbia and elsewhere contain lithic materials made on coarser-grained material, it is imperative to understand the contribution of these materials towards the overall organization and design of stone technologies at the respective sites. Only a small number of experiments were conducted as part of this research, but for the next stage manufacture of a wider number of tool forms would be beneficial. In addition, a greater number of knappers at diverse skill levels would also be useful, as this too would contribute to the overall variation.

The results of the Namu debitage analysis suggests that this is a technologically mixed sample. Although flake removal from multidirectional cores consists the primary mode of reduction, tool production in the form of bifaces, points, various flake tools and microblade cores were also undertaken. This is not generally indicative of a special activity site, in that a wider range of tasks are implied in the reduction strategies here. Based on this it more likely that Namu was either a seasonal base camp or a more
intensive habitation, such as a sedentary or semi-sedentary settlement. The next chapter looks at the non-debitage lithic assemblage, and the final chapter evaluates all results in light of the modeling exercise in Chapter 4.
Chapter 6: Analysis of Cores and Non-Debitage Tools

This chapter presents the findings of the non-debitage quotient of the Namu assemblage not including the obsidian, which was analyzed as a separate project (Hutchings 1996). Carlson (1996b) has presented a preliminary culture-historical classification of these materials (Table 22). In the present research a combined technological/typological analysis is presented; the goal is to try and understand the variation and nature of the reduction strategies reflected in the Namu assemblage from a design viewpoint as described in Chapter 4. In order to understand the decision making process in, and constraints on, stone tool production it is necessary to have some understanding of the technological steps that resulted from this whole process.

That being said there is much overlap between this classification scheme and Carlson's. Some of the pieces shown in Carlson's paper could not be found during the time of this research, as such this sample is missing a few items but that number is quite small. On the other hand, a number of previously unanalyzed artifacts were recovered in the level bags from the 1994 excavation, and they are included here. These were collected as debitage in the field and separated once the actual analysis began at the lab in Vancouver.

Each piece was examined under an incandescent lamp to highlight the shadows and therefore, the topography on the specimen. Before the data were entered into a database, a pencil sketch was made of every piece and any relevant information was recorded, so that the author could refer back to these notes if necessary. A 20X hand lens was used to examine any smaller features and when higher magnification was necessary,
### Table 22. Carlson’s (1996b: Table 2) enumeration of the Namu Early Period tool types by time period. Period 1A: 10,000-9,000 BP. Period 1B: 9,000-8,000 BP. Period 1C: 8,000-6,000 BP. Period 2: 6,000-5,000 BP.
a 30X dissecting microscope was employed. A pair of digital calipers was used to record relevant dimensions (see Appendix A) and a triple beam balance scale was used to weigh the pieces.

The analysis here follows an intuitive process first described by Collins (1975) and others. The initial step is raw material acquisition, specifically the initial raw material forms brought into Namu. The possibilities range from boulders to pebbles, and from partially to fully decorticated cores in various shapes and sizes, to flake blanks with various amounts of modification. From here the goal is to document the general kinds of reduction patterns visible on these initial forms, and ideally, to decipher the various reduction trajectories. In order to do this a general technological classification scheme was set up (Table 23). Detailed attributes and data collection methods for each category are presented in Appendix A.

The first general categories are Cores and Core Tools, followed by Flake Based Tools. This is the intuitive starting point for all pieces in the collection; the assumption is that every piece started out as a core or product thereof. The main core reduction types are standard: unidirectional, multidirectional, and bipolar. Pebble tools are included as a special type of core tool, acknowledging that their initial form is rounded or tabular-shaped cobbles. The microblade reduction spectrum is included as a subset in the core and core tool classification since this is above all, a specialized core reduction strategy.

Flakes and flake-based tools consist of unifacial and unimarginally retouched pieces, but not bifaces. A number of forms are represented here, including a variety of scraper types. The majority of these flake tools were produced through a minimum amount of modification on the flake blank.
<table>
<thead>
<tr>
<th>Cores</th>
<th>No.</th>
<th>Biface tools</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 – Unidirectional core</td>
<td>24</td>
<td>BI-Biface</td>
<td>10</td>
</tr>
<tr>
<td>C2 – Multidirectional core</td>
<td>53</td>
<td>LAB-Large Asymmetrical Biface</td>
<td>12</td>
</tr>
<tr>
<td>C3 – Bipolar core</td>
<td>5</td>
<td>STB-Small Thick Biface</td>
<td>15</td>
</tr>
<tr>
<td>Microblade Core</td>
<td>9</td>
<td>SBF-Small Biface Fragment</td>
<td>5</td>
</tr>
<tr>
<td>Microblade Core Preform</td>
<td>15</td>
<td>BP1 - Biface base</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BP2 – Biface tip</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BP3 – Biface end fragment</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BP4 – Biface medial</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Biface Edge Fragment</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total cores</strong></td>
<td>106</td>
<td><strong>Total biface tools</strong></td>
<td>137</td>
</tr>
<tr>
<td>Core tools</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core tool</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core scraper</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pebble Tool</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total core tools</strong></td>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flake-based tools (non-biface)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block Core Flake</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uniface</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uniface fragment</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unimarginal tool</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unimarginal Tool Fragment</td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bimarginal tool</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bimarginal Tool Fragment</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notch</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wedge</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drill</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudo-burin</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perforator</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spall Tool</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilized Flake</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1- Endscraper</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2- Sidescraper</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3- Indeterminate</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4- Scraper plane</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5- Oblique</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6- Denticulate</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8- Converging</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9- Denticulate scraper pl.</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10- Circular</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventrally Retouched Scraper Plane</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total flake based tools</strong></td>
<td>164</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total core and flake tools</strong></td>
<td>210</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 23. Technological classification of Namu Early Period non-debitage artifacts**
Biface reduction strategies form the final category, and a number of sub-types are proposed within this classification; although some of these may relate to various stages of production others are clearly different. Still, manufacturing of bifacial points was of some concern to the Namu inhabitants. Moreover, it seems that production of bifaces (or knowledge thereof) was a relatively important endeavour at Namu, and there may be evidence here for “learners” reflected in some of the pieces.

In each category, possible tool tasks are discussed within the scope of technological design. Deciphering tool function can only be done reliably through use-wear studies and there is great ambiguity when morphology is used in a simplistic manner to determine function (Odell 1996b; Semenov 1957). With most of the coarse-grained raw materials used at Namu, however, use-wear is not possible. These hard materials do not wear easily and even after extensive use, they may show no evidence of the type that shows up on softer materials (Keeley 1980). An attempt was made to try and decipher use wear on a number of tools and flakes in the Namu collection, both with a 20X hand lens and under a 60X microscope. This study failed to note any type of use wear on the pieces and a second attempt was made where a number of pieces were submitted to Cameron Smith for assessment. Smith’s (2004) dissertation research included a use-wear analysis on stone tools made on softer materials from late Prehistoric contexts on the Columbia River in Oregon. His expertise in use-wear has been built over a number of years and his success is demonstrated in his thesis work. Smith’s assessment on the Namu material was similar to the author’s initial attempts; the hardness and coarse-grained nature of the materials greatly increase the difficulty in finding traces of
wear. Only one sample yielded any results, a small biface made on black chert (described below).

With this in mind general functional tasks are suggested here very cautiously, based on overall morphology and edge angle(s). Acute angles are useful in cutting, chopping, adzing and sawing tasks, while higher edge angles are good for scraping and associated tasks. Crabtree (1977) also argues that obtuse edge angles are very useful for certain tasks, but that this type of edge angle is often ignored or dismissed as being useless by archaeologists. The suggestions in this thesis are by no means inferring any actual function(s), they are simply a way to try and understand the variation in design.

Core and Core Tool Strategies

C1 – Unidirectional Core

No: 24

Raw material groups: 1 (8.3%); 2 (54.2%); 3 (4.2%); 4 (33.3%)

Period: 1A (4.2%); 1B (45.8%); 1C (12.5%); 2 (37.5%)

Average weight: 350.1g Average length: 64mm Average thickness: 33mm

Some 24 pieces are identified as unidirectional cores and fragments thereof. There is significant variation in size, with the smallest at 11mm in length and weighing 1.4g while the largest measures 203mm in length and weighs 4329g. These pieces represent various stages of core life from initial flaking to expended core stage. With the exception of the blade core, there is little evidence for preparation for the removal of standardized or particular types of flakes; rather, flaking is done in an expedient fashion. In some cases
large flake blanks were unidirectionally detached from presumably very large cores, and some of these flakes were recovered in an unretouched condition (Fig. 16).

Figure 16. Large Flake Blanks Detached from Unidirectional Cores. (EISx-1:381A, left, EISx-1:225, right)

No. 2055 (Fig. 17) is a very large tabular core weighing over 4kg. It displays six large flake scars, all the result of detachments from the same platform. In addition there are smaller flake scars around the perimeter, they represent unsuccessful attempts at flake removal. There is a significant amount of raw material left in this core and it is curious that it was not further reduced. The platform angle has reached a stage where it would be difficult to remove more flakes, but this could easily be overcome by various means of platform rejuvenation. The fact that such a large core was brought into the site but not further reduced suggests that transport aids such as watercraft were used, and that the Namu toolmakers were not overly concerned with raw material conservation.
Artifact no. 1978 (fig. 18) is a core of basalt and it is relatively fine-grained. It appears to be a very large and thick flake that has been turned into a core. This core exhibits much platform preparation and platform isolation, in order to remove flakes. The platform surface is relatively flat, and it is entirely possible that this was used as a tool of some sort. Once again there is plenty usable of raw material left in this core, and the fact that this was not taken advantage of reflects a situation in which conservation of raw material is not a major concern.
Some of these unidirectional cores are tabular pieces (Fig. 19), displaying more than one flat surface. They also show some short flake removals on the flat basal portion of the core, the result of impact forces while resting the core on an anvil, as was done in the experimental part of this research. Application of heavy impact via percussion on these cores while held in the hand would be a dangerous operation and would more than likely lead to injury.

Figure 19. Unidirectional Core (EISx-1:3664, left; EISx-1:3570, right)

No. 2189 is a unidirectional core that appears to have been either intentionally or unintentionally prepared for blade removal. As the only core of this type, it is certainly unique within the assemblage. The core has a triangular wedge-shaped side profile but more oblong from above. There is flake removal around most of the perimeter. The flake scars on one face of the core are quite wide at the point of initiation and become narrower towards the base, so they are not blades in the classic sense. It would be very difficult to standardize a core on this coarse material, and this is reflected in the fact that the core seems to have been abandoned at a fairly early stage. At least two flake/blade removal attempts ended in large, thick step fractures (Fig. 20). Some cortex is visible towards the
base of the core. The reasoning behind this strategy is puzzling; there is no other evidence for blade production in the rest of the assemblage. That said there is plenty of raw material had a knapper chosen to pursue a different strategy at this point. Blades and blade cores are not ubiquitous in the Pacific Northwest, but they have been recovered in numerous coastal and interior contexts (Sanger 1968).

Figure 20. Unidirectional Blade Core (ElSx-1:2189)

C2 – Multidirectional Core

No: 53

Raw material groups: 1 (6.2%); 2 (44.6%); 3 (7.7%); 4 (40.0%)  
Period: 1A (3.8%); 1B (66.0%); 1C (11.3%); 2 (18.9%)

Average weight: 411.0g  Average length: 76mm  Average thickness: 21mm

Multidirectional cores and core fragments comprise the largest portion of the core sample in both numbers and in weight (Figs. 21 and 22). An additional twelve multidirectional cores are listed under the core tool categories. These cores exhibit a
minimum of two platforms from which flakes were detached. A wide variety of forms and sizes and present, and most are the result of opportunistic flaking. Some cores are still quite large and can be reduced further, but many are expended and resemble similar products from the experimental reductions.

During the experiments a chief goal was to model the Namu assemblage, and in doing so it became apparent that the vast majority of flakes were reduced during multidirectional flaking of cores. In the experiments opportunistic flaking was used as the main reduction strategy, where large tabular cores were first reduced via single platform flaking to take advantage of the core shape so that large flake blanks could be produced. Once the cores reached a certain size and when edge angles prevented the continuation of single platform reduction, a multidirectional strategy was then pursued. The Namu
toolmakers apparently pursued a similar strategy as is reflected in the high number of multidirectional cores.

Apland (1977:97) reported that there were a number of “well prepared” multidirectional cores in the sample that he analyzed. This classification is suggested as a subset of the general category of multidirectional cores. It is unclear as to what this distinction entails, but the implication is that there is some sort of “prepared core” industry that is somehow different from the regular multidirectional core strategy. Core preparation is an essential part of flake reduction, especially with these coarse raw materials. During the experimental reductions for this project the main goal was an opportunistic reduction of flakes from a multidirectional core. In order to do this the knapper had to constantly prepare the core after each flake detachment. As the core becomes progressively smaller, the flakes detached in this manner exhibit dorsal scars emanating from more than one direction, as will the platform. This is a natural

Figure 22. Multidirectional Core (ElSx-1:1255, top left, ElSx-1:2217, top right, ElSx-1:1318, bottom)
progression in core reduction and not the result of any larger core preparation strategy as implied by Apland.

C3 – Bipolar Core

No: 5

Raw material groups: 1 (27.3%); 2 (36.4%); 4 (36.4%)

Period: 1B (60.0%); 1C (20.0%); 2 (20.0%)

Average weight: 31.8g  Average length: 49mm  Average thickness: 19mm

Figure 23. Bipolar Core (Left to right: ElSx-1:3701h, ElSx-1:1141, ElSx-1:3163)

Five bipolar cores are represented in the Early Period (Fig. 23), which suggests that the Namu toolmakers did not widely pursue this strategy on these raw materials. There are a number of forms represented but all range in size from 30 to 50mm. All show signs of impact and battering from opposing directions. No. 1141 has a classic piece
esquille morphology, while no. 3163 has a flat break giving it a sharp angular burin-
point. There is no evidence to show that this was done intentionally; it is more likely a
break that occurred during the flaking process. It is difficult to tell whether the bipolar
flaking occurred before or after the piece snapped.

CT – Core Tool

No: 8

Raw material groups: 2 (25.0%); 3 (25.0%); 4 (50.0%)
Period: 1A (25.0%); 1B (25.0%); 1C (25.0%); 2 (25.0%)
Average weight: 462.7g    Average length: 102mm    Average thickness: 28mm

There are 33 pieces in the Core Tool category, although twenty-five of these are
described under the sub-category of Core Scraper. Average edge angle is 81°. These
artifacts are classed within this category since they exhibit flaking to achieve a working
tool edge, but that the overall morphology would not function as a scraper. In general
they appear to be more geared towards chopping tasks based on their weight, overall
morphology and edge angles. In most cases the grasping area of the tool is situated on the
margin opposite to the working edge, and this area seems to have been either unretouched
or retouched in manner so to allow the user a comfortable grip. Artifact No. 1408 (Fig.
24) is made on a large tabular core and has the morphology of a discoidal chopper. It has
fairly sharp edge achieved through high angle unifacial flaking, while the platform on the
butt end is unretouched, allowing the user to gain a grip in this area. Flake scars from this
process are quite small, indicating that they were not the focus in this strategy. Moreover
this raw material is very coarse-grained and hard, lending further support to the possibility that this functioned at least as a chopping implement.

Figure 24. Core Tool (ElSx-1:1408)

Other artifacts in this category exhibit some similar attributes. Artifact nos. 2042 and 1260 (Fig. 25), are made on thick flakes reduced from cobbles; both have dorsal cortex and both have modified edges that are quite sharp and well suited for chopping. Like the previously described artifact, these two also have unmodified platform areas that are opposite to the assumed working edge, again to facilitate grasp during use.

Figure 25. Core Tool (ElSx-1:2042, left, ElSx-1:1260, right, both profiles)
Likewise, artifact nos. 3769b and 414 (Fig. 26) both display an adze-like morphology in which the assumed working edge is quite sharp, while the opposite grasping end has scars from what appear to be convenience flakes (see below) detached from the dorsal face.

Figure 26. Core Tool (ElSx-1:3769b, left, ElSx-1:414, right)

CS –Core Scraper

No: 25

Raw material groups: 2 (28.0%); 3 (16.0%); 4 (56.0%)

Period: 1A (4.0%); 1B (68.0%); 1C (16.0%); 2 (12.0%)

Average weight: 422.0g  Average length: 90mm  Average thickness: 44mm

Artifacts that share a number of attributes are classified within this category. All are cores made on either flake blanks or split cobbles (Figs. 27 and 28). All have steep edge retouch adjacent to a flat or slightly convex surface that would be ideal for a scraping/planing motion. This steep edge retouch is intentional as evidenced by the short, shallow flakes that sometimes occur on core faces from which larger flakes were
previously removed. Average edge angle for this class is 74° and although there is some variation, none of these artifacts exhibits edge angles of less than 65°. Some of these artifacts look similar to scraper planes, except that they are much larger and weigh substantially more. Weights range from 153g to 1269g with an average of 422g, which together with their overall size, suggest that these tools were likely used for more heavy-duty tasks. One piece (no. 2185) displays striae and polish that is consistent with heavy use, located on the surface that would have come into contact with the worked material. This is a fairly large piece with two possible working edges.

Figure 27. Core Scraper (ElSx-1:3019, left, ElSx-1:3550, right, both profiles)

In some cases the toolmakers have taken advantage of the smooth, cortical dorsal surface when the core fragment has been reduced from a rolled cobble (artifact nos. 3688 and 3788, Fig. 28). This design allows for reduced friction during a scraping motion since the smooth cortical face of the tool would glide with greater ease on the surface of the worked material, than would a tool with any unsmooth areas on its contact surface.
In one case a bipolar core appears to have been turned into a scraper of sorts (Fig. 29). This piece displays signs of ‘bipolar’ impact whereby there is evidence for battering on the edge opposite to where the hammer struck the core. Subsequently one edge seems to have been retouched to an angle of 72° and form a convex scraping edge.
Period: 1A (7.7%); 1B (38.5%); 1C (23.1%); 2 (30.8%)

Ave. weight: 479.1g  Ave. length: 92mm  Ave. width: 79mm  Ave. thickness: 46mm

Thirteen pieces are identified as Pebble Tools and it should be noted that some of the pieces classified by Carlson (1996:Table 2) as Pebble Tools may be classified separately under core tools or core scrapers in the present work, especially if the form of the original parent material is unclear. Only tools that are clearly derived from an initial cobbles form are classified as Pebble Tools (see also Apland 1977:68). These enigmatic tools are mostly unifacially flaked (with one exception) and have a widespread occurrence in the Americas (Grabert 1979; Haley 1987; Krieger 1964; Teltser 1991) and yet their real function(s) remains speculative. They have long been suspected as being designed for woodworking and related activities, a logical assumption given their form. They are well suited to chopping and adzing functions for which their weight is an advantage, and the rounded cortical covering provides a natural backing that provides a comfortable grip while dissipating the force of impact in the user's hands. Edge angles are also well suited to such tasks; the average edge angle in the Namu collection is 80°, which matches exactly what Apland (1977:84) recorded for a sample of 63 similar pieces from five central coast sites (Figs. 30 and 31). Even though there is some variation in edge angle, the tendency towards the low 80s suggests that some measure of standardization was applied in the manufacture of these tools. This standardization is likely due to functional requirements such as chopping, adzing and scraping related to woodwork, as has been suggested (Apland 1977; Carlson 1979). Luebbers (1978:44) suggests that they could have also been used to crush bone.
Some pebble tools exhibit wear signs due to impact, which suggests that they were used in situations that required heavy force. Many exhibit evidence for successive resharpening, visible in the manner and angles in which the flake scars are related. In general the various shapes conform to Haley’s (1987) reduction sequences for pebble tools from sites further to the south. They are general sequences aimed at resharpening

![Figure 30. Pebble Tool (ElSx-1:250, left, ElSx-1:3568, right)](image)

![Figure 31. Pebble Tool (a. front, b. profile ElSx-1:3036, top, ElSx-1:3671, bottom left, ElSx-1:2139, bottom right)](image)
the tools or extending their use life as cores. Other pieces (e. g. no. 1307) exhibit staining and pot-lid fractures that are likely the result of excessive heat.

One pebble tool edge fragment was recovered (Fig. 32), and this is likely a platform rejuvenation flake. Haley (1996:62) illustrates this technique as part of the overall pebble tool reduction strategy. Rejuvenation flakes such as this would allow for further removal of material from the parent piece, extending its life as a core and/or tool. Haley (1987) argues that pebble tools also served as cores from which to produce usable flakes, but this idea has not gained much prominence. Elsewhere (Rahemtulla 1995b) I have suggested that some flakes removed during pebble tool reduction have an ideal shape for cutting fish, and this has been supported through experimental evaluation.

Figure 32. Pebble Tool Edge Fragment. (EISx-1:1998)

Microblade Core and Preform

No: 24

Raw material groups: 1 (8.3%); 2 (37.5%); 4 (54.2%)

Period: 1B (45.8%); 1C (45.8%); 2 (18.2%)

Ave. weight: 24.9g Ave. length: 39mm Ave. width: 27mm Ave. thickness: 18mm
Twenty-four pieces are classified as Microblade Cores or preforms. For the purposes of this research project the definition of microblade cores is broadened to include the entire sequence of core preparation and reduction. In order to be classified as a microblade core here, the piece has to show evidence that the toolmaker attempted to make microblades based on the design of the core and more importantly, the presence of “punch” marks is necessary. The size of these cores necessitates the use of an indirect percussive method with the use of a punch likely made of antler, and this process leaves a distinctive morphology when the core platforms are viewed from above. As such the intent of the toolmaker and process of reduction are of great import in this way of thinking, as these variables are reflected in the design of the stone tools. Finished and or “classic“ microblade cores are therefore only part of the entire sequence of reduction since the toolmakers had to first accomplish forming and preparation prior to the removal of microblades. Cores that evidence such preparation and also show scars from partially successful attempts at microblade removals are classified as microblade cores, while cores that show preparation in this direction with no microblade removals are classified as microblade core preforms. The latter, however, may exhibit attempts to “punch” out initial microblades. No actual microblades were noted during the present research although Carlson (1996b) reports the presence of a small number of these.

Microblade Core

No: 9

Raw material groups: 1 (14.3%); 2 (28.6%); 4 (57.1%)

Period: 1B (33.3%); 1C (66.6%)
In general the microblade cores are similar to those found in other sites on the Northwest Coast; they are tabular to conical, although the shape of the core depends largely on the stage of reduction (Magne 2000). All are made on split cobbles or more likely, on thick flake blanks. Like the cores from Haida Gwaii and the interior of British Columbia, none of these cores show platform rejuvenation through tablet removals, as seen in the “Campus Core” type (Mobley 1991). On the other hand they do show possible rejuvenation attempts on the fluted and lateral surfaces (Sanger 1968). Platform preparation is rare although core edge preparation is the norm rather than the exception. Once again, it is due to the hardness of the raw materials that extra preparation was necessary.

Sanger (1968:104) remarks that core edge preparation on quartz crystal microblade cores from San Juan Island is not as extensive as that seen on Plateau microblade cores. The latter are made mostly on basalt (or dacite?), a tougher material that does require more edge preparation as seen in the experiments for this project. Twelve “crude basalt and argillite” microblades were recovered at the Milliken site by Borden, and Sanger comments that these are “wide, thick and generally do not show the precision of many Plateau specimens” (1968:106). Clearly raw material affects the overall production and morphology of microblades as well as microblade cores.

Core no. 3565 (Figs. 33 and 34) is tabular in form and has at least 3-4 blade scars on the fluted surface. Overall shaping of the core was achieved through the removal of a large amount of mass attached to the right lateral surface. Visibility and hence
quantification and description of the number of blade scars is compounded by the nature of the material, and by what appears to be an overlap in these scars. There also appears to have been an attempt to rejuvenate the core by removing a large diagonal flake across the fluting surface. This attempt failed, as the flake was not large enough to successfully carry out this operation. Either subsequently or some time before, unsuccessful attempts were made to removed microblades from the back of the core. This is evident in blade scars that travel over a very short distance from the platform. The core was recovered in Period 1B sediments.

Figure 33. Microblade Core (ElSx-1:3813, top left, ElSx-1:3565, top right, ElSx-1:3761, bottom left, ElSx-1:3812, bottom right)
Core no. 3761 (Figs. 33 and 34) dates to Period 1B and has also been shaped to achieve a triangular form in platform view; both lateral surfaces have been broken, although it is difficult to tell if this was intentional. This core exhibits at least seven blade scars that are punched, and evenly spaced. Unfortunately they are truncated by an unintentional break emanating from the right lateral surface. As a result, none of the blade scars is complete, however, the presence of punch marks as well the clear attempt at spacing the blades indicate that this was a microblade core.

Core no. 3812 is made on a relatively finer-grained material, making the attributes somewhat easier to note. This piece was recovered in Period 1C deposits. Intentional flaking of the left and right lateral surfaces was conducted in order to shape this piece, which in this group least resembles a scraper plane. Flake scars involved in this shaping emanate from the platform area as well as from the bottom. The platform

Figure 34. Microblade Core, platform view, core edge facing down (EISx-1:3813, top left, EISx-1:3565, top right, EISx-1:3761, bottom left, EISx-1:3812, bottom right)
length and width are relatively small compared with the core height, giving it an appearance similar to some cores from Gwaii Haanas (Fedje 1996: Fig. 11a, 11b). The fluting surface seems to have been prepared through the removal of a large flake, leaving a flat surface. It is from this surface that the microblades were removed. This core exhibits four microblade removals although none travel further than one third of the length of the core. Judging by the core preparation, the goal or intention was obviously to remove blades that traveled along a substantial portion of the core. It seems that after several attempts at such microblade removal, the toolmaker gave up when he/she realized that it is not possible to get longer blades from this core.

Figure 35. Microblade Core (ElSx-1:3701d, top left; ElSx-1: 3701m, top right; ElSx-1:3701p, bottom)
Core no. 3701d is of great interest since it is made on quartzite (Fig. 35). This cube shaped core was recovered from Period 1C deposits, and it displays some successful microblade removals. Unfortunately the most recent attempts at blade removals from the fluted surface resulted in much stepping and buildup of mass on the core edge. This has obscured most of the previous history of blade scars on this surface. What is clear, however, is that at least some microblades were successfully removed from this core prior to the problem that developed on the core edge. Perhaps it goes without saying that the sustained manufacture of microblades on quartzite (or any of these materials, for that matter) would be exceedingly difficult and probably very frustrating. That the toolmakers at Namu were even trying to do this suggests that at times they had the desire to make microblades, but not the right raw materials.

Artifact no. 3701m also dates to Period 1C and has peculiar attributes. The platform is elongated and narrow, unlike the other cores noted in the collection. This core appears to be made on a split flake. Moreover the microblade removals occur on the side of the piece (Fig. 35), as opposed to the front as seen in the other specimens. Two short blade scars are apparent, but they have been truncated by a later break in the core bottom. Both blade removals are initiated with the use of a punch.

Core no. 3701p is a fairly small core that shows three or more blade scars on the fluted surface. The core dates to Period 1C and exhibits clear signs of initiation through the use of a punch. This can even be seen in the outline of the core edge when viewed from the platform (Fig. 36). The “denticulate” appearance is caused in this case through the successive use of indirect percussion through the use of a punch. The blade scars in
this case are all very short; none traverse the height of the core that is also relatively small at 13mm.

Core nos. 3816 and 3698 (Fig. 37) are interesting in that they both display more than one platform that shows punch marks. No. 3816 has been shaped into a small core, after which punch marks are evident on a number of edges. All attempts were unsuccessful. Similarly, core no. 3698 shows at least three platforms exhibiting
microblade removal attempts. The punch initiations are clearly visible in Fig. 38.

Figure 38. Microblade Core, multi-platform. (ElSx-1:3816, left, ElSx-1:3698, right)

Microblade Core Preform

No: 15

Raw material groups: 1 (6.7%); 2 (40.0%); 4 (53.3%)

Period: 1B (53.3%); 1C (33.3%); 2 (13.3%)

Ave. weight: 34.68g  Ave. length: 44mm  Ave. width: 26mm  Ave. thickness: 19mm

Microblade core preforms are made on split cobbles or on flake fragments. These preforms are sometimes referred to as "microflake cores", although from a design perspective it is difficult to understand the logic of preparing cores from which such tiny flakes would be removed. This is particularly remarkable if such flakes are envisioned as a goal with these coarse raw materials. On the other hand, the morphology of these cores is exactly what one would expect in the production sequence for microblade cores. Initial shaping is done through various means, most commonly flaking of the lateral edges.
Edge angles are intentionally flaked quite high, as would be needed for eventually removing microblades. Often the distal margin is isolated by forming a convex edge, which is ideal for initiating microblades. Luebbers (1978) apparently picked up on this but only vaguely, when describing such cores made on obsidian recovered during the University of Colorado excavations at Namu. He writes: "...this evidence suggests that both flakes and blades were struck from similar if not the same core" (Luebbers 1978:42). In general platforms tend towards an initial rectangular or triangular shape that would change with further modification. The initial shape of these cores would change dramatically if a number of successive microblades were to be removed; they could eventually attain the conical shapes seen in the Namu obsidian cores (Hutchings 1996) and in Gwaii Haanas (Magne 2000, 2004).

In the literature archaeological descriptions of microblade core preforms on the Northwest Coast are almost non-existent; most microblade cores are identified only when fully formed. Yet we know that the toolmakers had to proceed through several steps before microblades could be successfully removed; indeed the process by which microblade cores are manufactured has been known and debated for some time now (e.g. Kobayashi 1970; Mobley 1984). Like bifaces and other implements, microblade cores require some preparation prior to the removal of microblades, so archaeologically there should be evidence for this. If the entire preparation process took place at a particular location, conceptually this can be likened to the process of biface manufacture that has been described as taking place in stages (e.g. Callahan 1979). The recovery of the microblade cores described above affirmed that the Namu toolmakers were at least attempting to make microblades on the harder raw materials. Consequently an effort was
made in trying to recognize whether or not microblade core preforms are present in the Namu collection. Magne (2004) also characterizes a group of artifacts as “microblade core preforms.”

Some of the preform cores bear great resemblance to scraper planes; there is a distinct morphological relationship between these categories and a great amount of overlap between the two. In this research the difference is in size; scraper planes are much larger and heavier. An arbitrary cut off was set at 60mm length and 25mm thickness; all pieces with those minimum dimensions are classified as scraper planes, as they are too large for microblade production. All microblade core preforms have a flat platform surface with signs of platform preparation. This takes the form of small scale chipping to stabilize the edge and create an appropriate angle from which to detach microblades. Average edge angle for microblade core preforms is 74° while for microblade cores the average is 81°. Some of the core preforms exhibit punch marks though and clearly, a punch would not otherwise be used on a scraper plane.

Magne (2000) also notes the close morphological relationship between scraper planes and microblade cores and suggests that the emergence of microblade technology on Gwaii Haanas may be an independent outgrowth of scraper plane technology. In particular, Magne notes quantitative changes where bifaces and denticulate scraper planes are slowly overshadowed by the increasing presence microblade technology over a period of one and a half millennia. Magne suggests that changes in resource availability and/or access to raw materials caused by sea level changes may have pressured the toolmakers into using more raw material conservative strategies such as microblade technology, at least at some part of their movements over the landscape. In this scenario the production
of microblade cores is a continuation in the sequence in manufacturing scraper planes. After the core has been prepared for microblade removal, continuation of this process would lead to the conical shapes found in the Gwaii Haanas sites.

This is an interesting argument in which Magne suggests that the development of microblade technology in Gwaii Haanas at that time may have been partially or wholly the result of circumstance, and not due to the introduction of a new tool making tradition from elsewhere. An implication from this argument is that for some time the inhabitants of the area were manufacturing scraper planes but did not take the extra steps of making microblades until the situation forced them to do so. The logic in producing microblade cores from scraper plane designs is understandable, but it is difficult to understand why people who make scraper planes would not be capable of making microblades. It is likely that they knew how to make microblades and either did not feel compelled to do so, or that they manufactured them in small numbers that are invisible archaeologically.

Figure 39. Microblade Core Preform (ElSx-1:2000, left, ElSx-1:3751a, right)
Artifact no. 2000 (Figs. 39 and 40) is also made on a thick flake although the bottom is rounded instead of flat. The core has been prepared through incidental flaking around its perimeter, and then on the distal margin there are at least two “punch” marks, one of which is initiated on the arris of a previous flake scar. None of the marks seems to have been successful in removing microblades. Artifact no. 3751a (Figs. 39 and 40) is interesting in that it is one of the few cores that exhibit platform flaking. The toolmaker attempted to flatten the convoluted ventral surface of this split pebble flake, but was only partially successful. The distal margin shows a flaking pattern similar to those of other microblade core performs; steep edged and shaping of the margin into a convex form.

Figure 40. Microblade Core Preform, platform view. (EISx-1:2000, left, EISx-1:3751a, right)

Core no. 3579 (Figs. 41 and 42) has been shaped to have a round platform when viewed from above. This involved considerable flaking around the perimeter, after which
approximately seven to eight attempts were made at using a punch to create the arrises that could be used to remove microblades. Clearly this core was in preparation for microblade removal.

Figure 41. Microblade Core Preform (ElSx-1:3579)

Figure 42. Microblade Core Preform, platform view. (ElSx-1:3579)

Core no. 2093 (Figs. 43 and 44) is a round shape with flaking around the perimeter, except around the back. There are definite punch marks present particularly on the core
edge. It appears to have been abandoned after the punch attempts resulted in much stepping. The resulting edge from this process is quite fragile and would probably crumble if put to use in any scraping or cutting motion. Artifact no. 2094 (Figs. 43 and 44) is a core fragment with punch marks in what would have been the core edge. It is difficult to tell if the break on the left lateral edge was intentional or not.

Figure 43. Microblade Core Preform (ElSx-1:2093, left, ElSx-1:2094, centre, ElSx-1:2059, right)

Core no. 2059 (Figs. 43 and 44) is split in half. The piece exhibits large flake removals around the perimeter to achieve initial shaping and create a steep platform. There is no sign of any attempts to use a punch on this core.
Figure 44. Microblade Core Preform, platform view. (EISx-1:2093, left, EISx-1:2094, centre, EISx-1:2059, right)

Of great interest is that the Namu toolmakers were making some effort towards producing microblades on these coarse grained materials, a daunting task indeed. Clearly the failures speak to the difficulty of this endeavour but on the other hand it is difficult to know the success rate since the successful cores would have presumably been used elsewhere. Of equal interest is that microblade cores made on these materials appear to intensify in Period 1C, about the same time that the obsidian microblade industry begins to gain greater prominence. Unlike the obsidian microblade industry, however, the coarser counterparts decline during Period 2.

The establishment of a regular supply of obsidian seems to have mitigated the Namu toolmakers' need to manufacture microblade cores on the local coarse-grained materials. Based on the volume of obsidian recovered during the 1994 excavation at Namu, it seems obvious that there was a steady supply indeed. During the tailings analysis some 139g of obsidian was recovered, and this was in addition to microblades and other tools already accounted for. Given that this material is coming from some
distance, this is a significant amount from a 6m x 2m excavation area. Carlson (1994) indicates that the earliest obsidian at Namu is from the Rainbow Mountains on the plateau to the east of the Bella Coola Valley. It seems fair to speculate that locating the various obsidian sources and subsequent establishment of trade networks took some time on the Northwest Coast, and everywhere else. The microblade industry at Namu seems to intensify with the availability of obsidian, not an unexpected pattern.

Large Block Core Flake

No: 13

Raw material groups: 2 (66.7%); 3 (25.0%); 4 (8.3%)

Period: 1A (7.7%); 1B (84.7%); 2 (7.7%)

Ave. weight: 79.2g Ave. length: 62mm Ave. width: 55mm Ave. thickness: 20mm

Average edge angle: 60°

There are thirteen large block core flakes in total, and these are generally large, thick flakes detached either from unidirectional or multidirectional cores. Baumler (1988) devised a technique to differentiate flake blanks produced through single platform detachment from multidirectional flaking. By imposing four quadrants over the dorsal face of the flake, it is possible to determine the type of flaking. Essentially flakes produced through single platform techniques exhibit dorsal scars emanating from one direction whereas flakes from multidirectional cores will exhibit dorsal flake scars emanating from more than one quadrant direction. When these dorsal scars emanate from several directions, the flake has a resemblance to those produced through prepared core
techniques. At Namu, however, there is little evidence to suggest the sustained use of a prepared core reduction strategy such as the Levallois Technique (van Peer 1994). These flakes are more likely the products of intense opportunistic multidirectional flake removal. During the multidirectional core flaking in the experimental reductions, at least two such flakes resulted as a consequence of this opportunistic strategy. As such, Carlson (1996b:90) is correct in suggesting that the presence of “prepared” cores and flakes at Namu is due to a general sequence of reduction, and not due to any connection to Levallois Industries in the Old World.

At Namu six of these are unretouched (Figs. 16 and 45), and seven display retouch (Fig. 46). The unretouched flakes are derived from single platform reduction as reflected in the single direction of dorsal flake scars. All of these flakes show battered and stepped platforms, particularly on the dorsal faces, this reflects several repeated attempts to detach the flake. Due to the tremendous force of impact required to detach thick flakes on this raw material, often several attempts are required, as was noted in the

Figure 45. Large Block Core Flake, Unretouched. (EISx-1:1802b, top left, EISx-1:1308, top right, EISx-1:1375c, bottom left, EISx-1:1860a, bottom right)

229
experiments. Edge angles vary on these flakes and although they do not show any sign of retouch, they could have been used for certain tasks. In the debitage analysis they would be classed as G1 size flakes in the mass analysis.

The retouched flakes are also generally large and thick, although there is more variation in this group. Artifact no. 2125 (Fig. 46) is a multidirectional flake that has been retouched, and classified under Ventrally Retouched Scraper Planes. No. 2143 is a unidirectional flake with retouch on the adjacent left margin, while no. 1798 is a unidirectional flake, on which the toolmaker apparently tried to initiate a bifacial edge on the distal portion. During the process the flake truncated giving it the appearance of a point; there is no evidence that it was used in any manner. Artifact no. 3106 is an interesting multidirectional flake that appears to have been retouched some time after it was initially detached from its parent core. The piece accumulated a peculiar brown-coloured precipitate coating as a consequence of weathering. The flake scars comprising the retouched area, however, are less weathered than the rest of the surface of the tool. The most likely explanation for this is that the flake was “scavenged” long after it was initially detached. Artifact no. 2140 shows acute retouch on the left margin; this would make a good cutting tool. No. 1860b is a very thick flake whose morphology is similar to that of a scraper plane; it is a multidirectional flake with a flat ventral face. Retouch on this piece consists of a single flake detachment on the dorsal face.

Given that core reduction is the dominant strategy at Namu as reflected in the debitage, one may expect to find a greater number of large block core flakes in the assemblage. It is important to remember, however, that these large flakes were also
blanks for various other tool types. Because of their size, they were also likely used for a variety of tasks elsewhere on the site, and off site. The debitage analysis shows that these larger flakes were purposely culled and therefore their limited representation in the midden is not surprising.

**UN – Uniface**

No: 4

Raw material groups: 1 (20%); 2 (40%); 3 (20%); 4 (20%)

Period: 1B (75.0%); 2 (25.0%)

Average weight: 74.8g Average length: 83mm Average thickness: 21mm

Nine tools in total are unifacially modified (Figs. 47 and 48); one is described separately as a wedge, one a perforator, and 2 as notches, while five are included in this
section. No. 3738b is a large flake that is triangular in cross-section and made on a very 
coarse-grained volcanic material. It has been unifacially flaked along one entire edge on 
the dorsal face at an angle of 68°. The overall shape and material of this piece suggests a 
scraping/planing function. No. 1324c is a flake exhibiting unifacial retouch around one 
edge. It seems that the knapper was trying to establish a centred edge platform from 
which to remove flakes in a bifacial manner, but gave up in the process.

Figure 47. Uniface (ElSx-1:3738b, top left; ElSx-1:1324c, top right; ElSx-1:1402, 
bottom)

No. 1402 (not Early Period) is unifacially retouched on both faces (different locations),
and it has a denticulate appearance. It has a fairly steep edge angle of 49°. Specimen no. 
3685d is a thick broken flake with unifacial retouch on the distal margin. The edge also
has a denticulate appearance and has an angle that varies between 62-72°. Piece no. 3682
is a thick flake that has been unifacially retouched on both faces. The flake scars are of
varying sizes so there is no uniformity in edge modification. It is unclear as to why the
knapper did this; perhaps it was simply to practice.
UF – Uniface Fragment

No: 21

Raw material groups: 1 (4.5%); 2 (59.1%); 3 (9.1%); 4 (27.3%)
Period: 1B (47.6%); 1C (14.3%); 2 (38.1%)
Average weight: 46.0g Average length: 52mm Average thickness: 10mm

Twenty-two pieces are uniface tool fragments (Figs. 49 to 51), of which a number are described in other sections. No. 3676g is a thin flake fragment with fairly invasive retouch as is no. 3638. The latter has cutting edge that could function as a knife. No. 1392 seems to be a preform for a biface, as the knapper tried to stabilize the edge for bifacial flaking. The same applies to no. 2091, a flake that has been unifacially shaped and has a denticulate appearance, although this flake is still quite thick in cross-section. It could have also functioned as a perforator. No. 2045 is a thick tabular flake fragment with
retouch on one margin, subsequent to the break, while unifacial flaking has obliterated the original platform on no. 3091. No. 3765 is an interesting piece as it has a very small notch on the unifacially modified margin; it is difficult to tell whether or not this was intentional. It is triangular in cross-section and has been unifacially flaked around the entire perimeter. Fine-grained material and a thin flake characterize no. 1131, this tool

Figure 50. Uniface fragment (Top left to right: EISx-1:1131, EISx-1:3185, bottom left to right: EISx-1:1703, EISx-1:3597h)
has a good sharp edge. No. 3185 is a piece of quartz crystal that has been unifacially
modified, however, it dates to a much more recent time. No. 1703 is a simple flake
fragment that has unifacial retouch at 40°, a sharp edge, and no. 3597h is a very small
fragment of a shaped unifacial tool with very steep edges. Too little of the original piece
is present to deduce any function.

Figure 51. Uniface fragment (EISx-1:3820a, right; EISx-1: EISx-1:3820f, top right;
EISx-1:3769a, bottom right)

No. 3820a is a large flake with unifacial modification giving it an adze like edge. It
weighs almost 360g, which suggests a heavy-duty function. On the other hand no. 3820f
is quite fragile by comparison, a flake that has been modified both unifacially and
unimarginally around its perimeter. This may have been a perforator, where the tip has
broken off. The fragility of this piece suggests a lack of force, and perhaps used on a soft
material. Piece no. 3769a is a small fragment with steep retouch, indicating that it might
be a scraper fragment.

235
UM – Unimarginal Tool

No: 11

Raw material groups: 1 (15.4%); 2 (53.8%); 4 (30.8%)

Period: 1A (7.7%); 1B (51.5%); 1C (15.4%); 2 (15.4%)

Average weight: 27.4g  Average length: 54mm  Average thickness: 12mm

Thirteen pieces are unimarginally-retouched flakes (Figs. 52 and 53), one of which is described in the Wedge category (no. 3604c). In general they are varied in size, although the longest dimension for most is at least 50mm. Elongated flakes feature unimarginal retouch on either the left or right margin, on the dorsal face, while expanding flakes exhibit retouch on the distal margin. Curiously, there are a number of thick, split flakes in this category. These tools seem suitable for either cutting/sawing or scraping tasks. Edge angles overall range from 38-70° with an average of 58°.

Figure 52. Unimarginal Tool (Top left to right: EISx-1:3676b, EISx-1:3597b; bottom left to right: EISx-1:1332, EISx-1:3604a)
Specimen no. 3576 (Fig. 53) has a denticulate appearance on its margins due to the retouch. The edges are quite acute at 50°, suggesting a cutting function. No. 2291 is also interesting in that although it displays unimarginal retouch, it also has a notch that has not received any retouch. In other words, the notch was formed when the original flake was detached. This certainly could have been used as a notch, although there is no overt evidence for this.

UMT – Unimarginal Tool Fragment

No: 27

Raw material groups: 1 (13.8%); 2 (51.7%); 3 (%); 4 (34.5%)
Period: 1B (48.1%); 1C (25.9%); 2 (25.9%)
Average weight: 13.1g
Average length: 37.0mm
Average thickness: 8.0mm
There are twenty-seven unimarginal tool fragments (Fig. 54). As a group they consist of a variety of forms, edge angles and raw materials. The edge angles vary from very acute at 22° up to 82°, implying a variety of tasks. Some of these pieces are very thin in cross-section and they have denticulated, acute margins. They were most likely used in tasks related to cutting, much like serrated knives, as opposed to scraping.

**BT – Bimarginal Tool**

No: 1

Raw material groups: 2 (100%)

Period: 1B (100%)

Average weight: 1.3g  
Average length: 30mm  
Average thickness: 3.0mm
One specimen is classed as a bimarginal tool, no. 3701w (Fig. 55). This is a small piece exhibiting bimarginal flaking around the entire perimeter save for one quadrant where there is a truncation. The piece was flaked after the truncation episode as is reflected by the unimarginal flaking that occurs on the truncation scar. Overall this specimen has the appearance of a point; it is very thin and the edges are relatively sharp. That said, it does not show the fine flaking exhibited by other pieces, so a learner may have made it.

Figure 55. Bimarginal Tool (EISx-1:3701w)

**BMT – Bimarginal Tool Fragment**

No: 3

Raw material groups: 1 (33%); 2 (66%)

Period: 1B (66.6%); 2 (33.3%)

Average weight: 4.9g  Average length: 42.3mm  Average thickness: 4.7mm
Specimen 3710l (Fig. 56 left) is a broken flake fragment that has been bimarginally retouched. It is difficult to differentiate the dorsal from the ventral face on this piece, as both are fairly flat. The bimarginal edge itself is quite sinuous. The overall appearance of this flake suggests a cutting and/or scraping function, the flat broken edge provides a safe user surface. Specimen 3597d (Fig. 58, centre) appears to be a fragment of a larger tool. The dorsal surface of the original flake is apparent, and there is non-

Figure 56. Bimarginal Tool Fragment (Left to right: ElSx-1:37011, ElSx-1:3597d, ElSx-1:1030).

continuous marginal retouch along both faces. Overall the piece is flat and thin, with an edge angle of 53°. Specimen no. 1030 is a secondary multiple flake that is made on a fine-grained variety of basalt/dacite. It is thin and small, and bimarginally retouched in the distal portion. The concavity created by the secondary multiple flake allows the user to gain good purchase, despite the overall small size. The tool is 2mm thick and weighs only 0.6g.
NO – Notch

No: 3

Raw material groups: 1 (33.3%); 2 (33.3%); 4 (33.3%)

Period: IB (100%)

Average weight: 47.8g   Average length: 55mm   Average thickness: 17mm

Three notches date to the Early Period (Fig. 57). All are made on flakes and have been deliberately retouched to produce a notch on either the left or right margin. On artifact no. 1581 the notch has been produced through unimarginal flaking on the ventral surface of the flake. This piece was also used for pounding, as evidenced by a battered area on the opposite margin. Notably at 110 grams, this artifact weighs considerably more than the other two. No. 3685 actually has two notched areas on a broken flake. Both notches were created by the removal of a single flake. Widths of the notches are 5mm and 7mm. No. 3765 is described under Uniface Fragments; it is unclear as to whether or not the small notch was intentionally created on this flake. At any rate it could have functioned as a notch had the user desired so.

Figure 57. Notch (Top row left to right: EISx-1:1581, EISx-1:3685f, bottom row left to right: EISx-1:3765, EISx-1:3346 – not Early Period)
WE – Wedge

No: 2

Raw material groups: 1 (50%); 2 (50%)

Period: 1B (50.0%); 2 (50.0%)

Average weight: 140g  Average length: 35mm  Average thickness: 9mm

Two pieces are classified as wedges (Fig. 58), based on a number of attributes. Both are flakes that have an ideal morphology for use as wedges. Both exhibit force applied in the platform area and crushing on the opposite margin. No. 3604c does have some unimarginal flaking on the right margin, but is otherwise unretouched. The feathered termination has an angle of 54° but also displays micro scarring and edge damage as the result of crushing. The platform does show some evidence for battering but this could be from the original flake removal. Evidence for heavy impact from use as a tool, however, is evident in the flake scars on the ventral face adjacent to the platform. No. 3729a exhibits virtually the same attributes, except that it has unifacial flaking on the right margin. The distal margin is heavily battered in this case and like the previous piece, there are large flake scars on the ventral face adjacent to the platform.

This combination of characteristics strongly suggests that these pieces were used as wedges, fitting in well with the notion that woodworking was an important activity at this time. In more recent times peoples on the Northwest Coast shaped organic materials such as antler from terrestrial mammals, or hard woods, into wedges to work cedar and other types of wood. Given the low number of lithic items classified as wedges
in this sample, it is highly possible that organic wedges were also prominently used
during the Early Period, but have not survived due to lack of preservation. The recent
discovery of such an item from a wet site on Gwaii Haanas dating to the Early Period
supports this notion (Mackie 2003).

**DR – Drill**

No: 2

Raw material groups: 2 (100%)

Period: 1A (50.0%); 1C (50.0%)

Average weight: 3.8g  Average length: 32mm  Average thickness: 6.5mm

During this analysis only two drills were located out of the four that Carlson
(1996:90) describes. Both drills are bifacially worked. Specimen no. 3513 (Fig. 59) is
incomplete, with the tip of the bit broken off. It is bifacially flaked and unlike the bit,
there is much centre mass and stepped flaking along the body of the tool, creating a high edge angle. The exception is at the rounded base, which is thinned enough for hafting. This was very likely a tool that was resharpened to exhaustion, as reflected in the overall size of 40mm, with the bit taking up 17mm. With softer materials such as obsidian it may be possible to apply one or two more resharpening episodes on a drill this size, but with this material, the force needed to resharpen the bit (2.7mm thick at broken end of bit) would obliterate the entire tool. That the toolmakers were even able to resharpen the material to this stage is remarkable.

Specimen 2077 consists of the bit portion of a drill that apparently snapped in a lateral manner from its parent piece. It has a slightly trapezoidal cross section, and the edges are fairly sinuous. There is a fair amount of centre mass, and this together with the sinuous edges suggests that this may be part of a preform. Alternatively, such morphology might work well for drilling through dense fibrous material such as wood. The relatively thick cross section would provide the tensile strength necessary to

Figure 59. Drill (Left ElSx-1:3513, Right ElSx-1:2077)
penetrate through denser materials while the sinuous edge would provide a strong but not necessarily sharp cutting edge. Average edge angle on this piece is 63°.

**PB – Pseudo-Burin.**

No: 1

Raw material groups: 4 (100%)

Period: 2 (100%)

Average weight: 13.6g  Average length: 57.0mm  Average thickness: 8.0mm

Piece no. 3523 (Fig. 60) appears to be a flake that has a burinated tip, although not in the “classic” manner (Tixier 1974:10). In this case a tabular flake has been bifacially retouched to strengthen the edge; it is too thick and blunt to be used for any purpose. The flake has then been split in half by directing a blow to the dorsal face at mid-point, resulting in a flat break with a visible remnant of the conchoidal fracture at the point of impact. Subsequently the upper margin of the bifacially worked edge has been further thinned, giving the appearance of a burinated point. It seems that the knapper put some effort into achieving this form, so it is obviously intentional. Regardless of the technique of manufacture this tool could certainly be used as a burin, as suggested by the morphological resemblance to burins from other areas.

245
The lack of burins in Northwest Coast assemblages has always been somewhat puzzling, given the resplendent bone and antler industry that was used in a very wide variety of manners for several millennia. Beginning in Period 2 the Namu assemblage has a substantial worked bone and antler component (Carlson 1996b) and so any suggestion that organic materials were not prominent until more recent times is not supported by the data. Moreover, the lack of burins persists well into time periods where there is ample evidence for complex and intricate working of bone and antler (see for example Carlson and Hobler 1993; MacMillan and St. Claire 2005; Matson and Coupland 1995). If "classic" burins were never popular then what were people at Namu using to fashion bone and antler?

In both the archaeological and experimental assemblages, a wide variety of flake morphologies are represented. Many of the broken flakes exhibit edges that could easily be used in a burin-like manner without any modification. And due to the physical hardness of these materials there would be little evidence for such use. As a nice illustration of expediency, it would be easy to retrieve an appropriate flake from the
midden in order to engage in bone/antler work (or any other task). This would not require any special flaking or preparation; the only training an individual would need is to select the right flake with the correct edge. This is obviously purely speculation but intuitively it makes sense. Whether or not such use would be reflected on the flake is unknown, given the coarseness of the raw material.

Crabtree (1977) makes a similar argument in suggesting that flakes with obtuse angle edges may have been purposely manufactured and/or selected to function as burins. Using a combination of use-wear and experimentation, Crabtree convincingly argues that flakes with such angles were used for such a task in many parts of the Americas where burins are notably absent, and even into Palaeolithic times. The obtuse angle, argues Crabtree, outlasts smaller angles when force is applied in working materials such as bone and antler, for example. Coming from another angle Barton (1996) convincingly argues that burins were used in more tasks than simply engraving. Based on analyses of burins from multiple sites he argues that archaeologists may be underestimating the multifunctional use of these pieces, and that this has major repercussions for our understanding of prehistory in areas where burins are common. Together, these works suggest that any stone tool has the potential to be used in more than one manner, and that our classifications can sometimes blind us to understanding the full scope of tasks undertaken with lithics. Such a sentiment is in keeping with the overall approach in this thesis.
PE – Perforator

No: 4

Raw material groups: 2 (50%); 2 (50%)

Period: 1B (25.0%); 1C (25.0%); 2 (50.0%)

Average weight: 41.5g  Average length: 59mm  Average thickness: 14.0mm

Four pieces are classified as perforators. All show intentional modification that results in converging edges that end in a pronounced tip. This class subsumes categories such as spurs and gravers used by others (Apland 1977; Carlson 1996b). Artifact no. 1704 (Fig. 63, left) is a thin flake that has been mostly unimarginally modified on the dorsal face, coupled with a small area of bimarginal flaking to produce the perforator tip. It has a diagonal snap that could have occurred either during manufacture or during use. With only 1.7mm thickness at the tip and 5mm overall, this perforator was likely used in a drill-like motion on soft materials. Specimen no. 3820d (Fig 61, centre) is quite thick in comparison. This is either a cortical flake or remnant of a split cobble that has been unifacially flaked in an expedient manner to produce a very sharp tip. There are only three large flakes removed with no sign of core preparation, and the edge angles along the margin are quite high at 75° and so this item could have also functioned as a scraper. Even larger at 84mm in length and weighing 120g is no. 1266, a large flake with the flat ventral surface still intact. Like the previous piece, the flaking here has resulted in a very steep angle. No. 2083a is a large thick flake that has received very little modification around the tip. Evidence of use is displayed in the breakage and smoothing of the tip. It
would seem that the user opportunistically took advantage of the natural shape of the flake and put it to some use.

Figure 61. Perforator (Left to right: EISx-1:1704, EISx-1:3820d, EISx-1:1266, EISx-1:2083a)

It is difficult to discern how these tools were used, but the larger ones seem to show few signs of preparation, and were probably produced very quickly once the flake blank had been obtained. The high edge angles on the larger pieces suggest that they may have had some sort of scraping function in addition to the ability to pierce. Most still have a very sharp point, so either they were used on soft materials that caused little or no damage to the tip, or they were not used after the last resharpening episode.

ST – Spall Tool

No: 5

Raw material groups: 2 (20%); 3 (60%); 4 (20%)
Period: 1B (40.0%); 1C (60.0%)

Average weight: 146.0g  Average length: 73mm  Average thickness: 21mm

A total of five spall tools were recovered. All have the classic cortical cover indicating detachment from a rolled cobble. Specimen 3817d (Fig. 62) consists of a thin spall which has been flaked mainly in the proximal area of the dorsal face, with some a lesser amount of retouch on the distal/ventral. In both cases the retouch forms an edge with an angle of 52°. No retouch appears on no. 3676h (Fig. 62) although there are signs of use as evidenced in the microflaking visible on the dorsal face. Spall tool no. 3011 on the other hand exhibits very steep retouch and breakage on one edge, possibly from use. The unbroken edge otherwise has a particularly sharp unmodified edge with an angle of 22° that would be ideal for use as a knife.

Figure 62. Spall Tool (ESx-1:3817d, top left; ESx-1:3676h, top right, ESx-1:3011, bottom)

Spall tool no. 2181 (Fig 63) has a distinctive morphology; the dorsal face exhibits large scars from previous flake removals leaving a thin strip of cortex on the butt end.
The opposite edge has been unifacially retouched, but also battered to an angle of 88°, indicating that it was used with some force. The design of this tool is such that it allows the user to impart much more force than if the cortical segment was not present. This is analogous to a natural form of backing. No. 2194 (Fig. 63) is a thick spall that has been unifacially retouched giving it the appearance of a pebble tool. The unifacial retouch has given it a classic “stepped” (in cross section) edge that is also denticulate. As a group these tools tend towards edges with medium to steep angles, indicating a scraping/chopping function.

Figure 63. Spall Tool (ElSx-1:2181, left; ElSx-1:2194, right)

UTF – Utilized Flake

No: 12

Raw material groups: 1 (23.1%); 2 (46.2%); 4 (30.8%)

Period: IB (50.0%); 1C (25.0%); 2 (25.0%)

Average weight: 11.7g Average length: 39mm Average thickness: 8mm
Some 12 flakes are classified as utilized. Although it is difficult to decipher use on these raw materials, these particular flakes indicate micro scarring on one or more margins that can only be the result of use. In other words, the size of the micro scars are too small to be the result of retouch, and moreover they occur on margins that intuitively could have been used. None of these flakes show signs of retouch on the worked edge; they were used as detached from their cores. Since these pieces show definite signs of use, they were obviously used with some intensity and likely on hard materials. Most indicate edge damage on one face, but a few have edge wear on both faces, indicating a sawing motion. On some pieces (e.g., nos. 3667 and 3086) there is considerable edge damage indicated, where small sections of the margins have snapped off forming a micro denticulate pattern. Luebbers (1978:44) classifies flakes as being utilized where there is "abrasion". A number of overall shapes and edge shapes are represented, from straight to concave and concave used margins. Average edge angle on the group as a whole is

![Figure 64: Utilized flake (Top row left to right: EISx-1:1927, EISx-1:3820e, EISx-1:3090, EISx-1:1332b, EISx-1:2083a, bottom row left to right: EISx-1:3563c, EISx-1:3667, EISx-1:2064, EISx-1:913)](image-url)
approximately 43°, although the range is from 18-65°. A variety of tasks were probably performed with these items. A selection of utilized flakes is presented in Fig. 64.

Scrapers

SC1 – Endscraper

No: 5

Raw material groups: 2 (40%); 4 (60%)

Period: 1B (40.0%); 1C (20.0%); 2 (40.0%)

Average weight: 18.4g Average length: 45mm Average thickness: 9mm

There are five endscrapers (Fig. 65) in the collection. All feature distal margin retouch, by definition. No. 3750 is a robust flake with retouch forming an edge angle of 80°. The ventral face is unretouched and smooth. Possible convenience flaking (see Ventrally Retouched Scraper Planes – below) adjacent to the platform has considerably thinned the grasping area of this tool and made it very comfortable to hold. Artifact no. 3105 is made on a broken flake, and the angle of retouch is 85°. Slight microfractures are present on the ventral face obverse to the area of retouch; these are likely the result of use. No. 2063 is made on a square, chunky quartzite flake that has a good edge angle for scraping. Specimen no. 2288 is a thin flake with distal retouch, but it has also been modified on its left and right margins by what appears to be edge grinding. No. 3478 is a fine-grained dacite flake shaped like a “thumbnail” scraper, although it dates from Period 4, which post-dates the Early Period. As a group these
scrapers are not very large, and with a couple of exceptions they are made on harder raw materials.

SC2 – Sidescraper

No: 3

Raw material groups: 2 (100%)

Period: 1A (33.3%); 1B (33.3%); 2 (33.3%)

Average weight: 48.5g  Average length: 33mm  Average thickness: 18mm

Figure 66. Sidescraper (Left to right: ElSx-1:3027, ElSx-1:1374, ElSx-1:1799)
There are three sidescrapers in the assemblage (Fig. 66). Artifact no. 3027 displays alternate retouch on the right margin, while no. 1374 is an elongated flake that has a triangular cross-section with a convex retouched margin forming an edge angle of 70°. It has a similar morphology to artifacts that have been classed as microblade core preforms, but this piece shows less preparation in that direction. No. 1799 is a thick flake with retouch on both the left and right margins, forming an average edge angle of 74°.

SC3 – Scraper indeterminate

No: 19
Raw material groups: 1 (15.8%); 2 (36.8%); 3 (10.5%); 4 (31.6%)
Period: 1B (52.6%); 1C (26.3%); 2 (21.1%)
Average weight: 51.1g  Average length: 57mm  Average thickness: 16mm

Nineteen artifacts are classified as scraper indeterminate (Fig. 67). These are flake fragments in which the striking platform is missing, and it is difficult to decipher the direction of the impact force. They are a varied group in terms of size and morphology, ranging from 29 cm to 127 cm for maximum dimension, and weighing from 5.6 g to 119.7 g. Average edge angle for the entire group is 65°.

255
SC4 – Scraper Plane

No: 5  
Raw material groups: 2 (80%); 4 (20%)  
Period: 1B (80.0%); 1C (20.0%)  
Average weight: 65.2g  Average length: 62mm  Average thickness: 27mm

Five pieces are identified as scraper planes (Fig. 68), these are made either on split cobbles or thick flakes. All have a single flat platform and exhibit steep angle retouch resulting in small flake removal; obviously the flakes were not the objective in this strategy. That said there does seem to be some platform preparation as well. As a group they show remarkable standardization in overall size, ranging from 56-66mm in length. Average edge angle is 77°.
SC5 – Oblique Scraper

No: 1

Raw material groups: 4 (100%)

Period: 1C (100.00%)

Average weight: 44g  Average length: 51mm  Average thickness: 16mm

There is one oblique scraper in the assemblage (Fig. 69). This is a thick flake with retouch on some of the distal portion. The flaking is minimal and gives the impression that it was made in a very expedient manner. It also exhibits some micro-scarring that may be the result of use.
Figure 69. Oblique Scraper (EISx-1: 1991b)

SC6 – Denticulate Scraper
No: 11
Raw material groups: 2 (41.7%); 3 (33.3%); 4 (33.3%)
Period: 1A (18.2%); 1B (54.5%); 2 (27.3%)
Average weight: 65.3g Average length: 53mm Average thickness: 15mm

The Denticulate Scraper Category is made up of eleven artifacts (Fig. 70). There is some variation in size, form and thickness in this category and a variety of raw materials are represented. With the exception of one cobble fragment, they are made on flakes of various sizes. Most of these raw materials seem more coarse-grained than what is represented in the overall assemblage. Some pieces show additional retouch to facilitate a comfortable grasp; no. 3415 has a backed margin formed through bimarginal flaking, while no. 370 has what may be a “convenience flake” removal on the ventral surface. In the latter case the flake removal is in the area where the tool would have been held during use.
SC8 – Converging Scraper

No: 1

Raw material groups: 4 (100%)

Period: 1C (100%)

Average weight: 13.3g Average length: 36mm Average thickness: 10mm

Artifact no. 3826 is the lone converging scraper in the assemblage (Fig. 71). This appears to be a fragment of what was once a larger piece; it exhibits breaks on three margins. The working edge is convex in shape and has unifacial retouch creating an edge angle of 58°.
SC9 – Denticulate Scraper Plane

No: 1

Raw material groups: 2 (100%)

Period: 2 (100%)

Average weight: 79.4g  Average length: 56mm  Average thickness: 30mm

Fig. 72. Denticulate Scraper Plane (ElSx-1:2190, Left, basal view, right, side view)

There is one denticulate scraper plane (Fig. 72); it is made on a split cobble. It
has a flat platform surface from which flakes of various sizes have been removed, but the overall edge angles are high, ranging from 78-86°. The flaked scars indicate a high incidence of stepping, produced during manufacture.

**SC10 – Circular Scraper**

No: 1  
Raw material groups: 4 (100%)  
Period: 1B (100%)  
Average weight: 84.7g  
Average length: 60mm  
Average thickness: 22mm

Artifact no. 1802d is a circular scraper made on a large thick flake (Fig. 73). It is made on a coarse-grained igneous raw material. The flake has been retouched almost around the entire perimeter, with the exception of the platform area. Edge angles range from 70-82°.

![Figure 73. Circular Scraper (ElSs-1:1802d)](image)

Figure 73. Circular Scraper (ElSs-1:1802d)
VRS – Ventrally Retouched Scraper Plane

No: 8

Raw material groups: 1 (25%); 2 (62.5%); 4 (12.5%)

Period: 1A (37.5%); 1B (50.0%); 2 (12.5%)

Average weight: 86.5g  Average length: 70.3mm  Average thickness: 24mm

This class of artifacts is previously undescribed (Figs. 74 – 76). It is admittedly a somewhat ambiguous classification, but one that does have some merit based on the attributes observed on these pieces. Most of these artifacts do not resemble the classic scraper planes described above, and are therefore described separately. Some have initial bifacial flaking on parts of their margins and could be remnants of what the manufacturers intended to be bifaces. In general they are fairly large pieces that exhibit steep angle retouch on at least one margin. In all cases the area of steep retouch has meets a flat surface resulting in a morphology that is useful for scraping/planing tasks. Of interest though is that all have one or more flakes removed from the ventral surface, at a location other than the assumed scraping edge. When each one of these items was held by the author in the assumed position of use, it became apparent that the remnant scars from these “convenience flakes” greatly increased the comfort of the grip by allowing the thumb or another finger to gain better purchase on the implement (Figs. 75 and 77). This would be particularly advantageous where great force needs to be placed on the tool. The position of these flake scars could be surreptitious, however, given all the attributes combined it seems that their placement was planned and intentional.
Figure 74. Ventrally Retouched Scraper Plane, dorsal aspect. (ElSx-1:1290, top left, ElSx-1:2125, top right, ElSx-1:3659, bottom left, ElSx-1:3701s, bottom right)

Figure 75. Ventrally Retouched Scraper Plane, ventral aspect. (ElSx-1:1290, top left, ElSx-1:2125, top right, ElSx-1:3659, bottom left, ElSx-1:3701s, bottom right)
These convenience flake scars are isolated and occur as single scars or double scars on the margin opposite to the assumed working edge. They allow the user to hold the tool at an angle that would be conducive to scraping and planing motions. In cases of
working with tight angles on wood for example, this simple design feature would increase the advantage of the tool.

**HS – Hammerstone**

No: 5

Raw material groups: 4 (100%)

Period: 1B (60.0%); 1C (20.0%); 2 (20.0%)

Average weight: 279.1g  Average length: 84mm  Average thickness: 41mm

Five hammerstones date to the Early Period assemblage (Figs 78 and 79). As expected, they are very hard cobbles of granite, diorite and other materials. All exhibit pitting/battering on one end, the result of heavy impact on other objects. The pattern of pitting on no. 1749 is interesting as it indicates that the hammerstone was used to impart force from a vertical direction as well as from an angle. No. 2131 has a small area exhibiting pitting due to impact force, but this is not as defined as it is in other hammerstones, so it may not have been used for repeated episodes. In some cases the hammerstones appear to be used as abraders as well. This is not uncommon in flintknapping, where core edge preparation often requires grinding prior to flake removal.
Figure 78. Hammerstone (EISx-1:566, left; EISx-1:1749, right)

Figure 79. Hammerstone (EISx-1:2131, left; EISx-1:3633, right)

266
Pecked/Grooved Pebble

No: 2

Raw material groups: 4 (100%)

Period: 1A (50.0%); 1B (50.0%)

Average weight: 188.4g  Average length: 67mm  Average thickness: 35mm

Artifact no. 1825 is a pebble that has a groove running parallel to its longest dimension (Fig. 80). The groove is somewhat centred on the pebble and is likely for wrapping cordage. Carlson (1996b) has interpreted this as a bolas stone or net sinker, the latter seems more logical as it resembles similar objects recovered in wet site contexts with the netting still wrapped around the pebble. No. 2175 (Fig. 81) is more ambiguous; the combination of raw material deterioration and weathering make it difficult decipher. The pebble has been pecked perpendicular to its longest dimension, there does seem to be indications of an incipient groove caused by pecking.

Figure 80. Grooved Pebble (ElSx-1:1825)
BI - Biface (Complete)

No: 10

Raw material groups: 1 (40.0%); 2 (30.0%); 3 (10.0%); 4 (20.0%)
Period: 1B (60.0%); 1C (20.0%); 2 (20.0%)

Ave. weight: 34.9g  Ave. length: 76mm  Ave. width: 28mm  Ave. thickness: 12mm
Ave. width/thickness ratio: 3.1:1  Average edge angle: 54°

Ten pieces are classified as complete bifaces (Figs. 82 – 86). These are in varying stages of production ranging from early to mid-late. Margins and edge angles also vary, although the average edge angle is somewhat high at 54°. No. 3811 (Fig. 82) is a split flake that the toolmaker bifacially retouched around some, but not all of the perimeter. The biface was not completed, although it could have functioned as a knife or saw. Artifact no. 3650 (Fig. 82) has an asymmetrical shape, but fairly thin edges. While much
Effort has been made in creating good sharp edges, relatively little effort has been put into thinning either end. Taken together, these characteristics suggest that either this was meant to be a knife, or it could be a “practice” piece.

Figure 82. Biface (EISx-1:3811, left, EISx-1:3650, right)

Biface no. 3774 (Fig. 83) is a very interesting piece in that it appears to have been heat-treated. The piece is made on basalt/dacite and displays irregular dark staining that results from heat treatment, along with other characteristics. It seems that the biface was initially formed into a leaf shape and then either purposely or unintentionally exposed to a heat source. Flake scars from removals after the heat treatment display a very different (coarser) interior texture that appears to have made it very difficult to control the flaking. Large irregular breaks occur instead of the conchoidal fracture seen previous to the heat treatment. In this case the heat treatment (if intentional) seems to have backfired and caused the material to become more difficult to work with, instead of easier. Bakewell (1996) has argued that heat-treated dacite does appear archaeologically in other areas of the Northwest Coast.
No. 3530 (Fig. 83) has very sinuous edges and is likely at an early stage of manufacture. It may have been discarded after the tip broke off, taking a significant mass of material off one face. Artifact no. 3597\textsuperscript{n} (Fig. 83) is also an interesting piece that is made on a unique banded, fine-grained raw material. It is a curiously small biface (relative to others in this collection) that has a general point-like morphology; it is very thin in cross-section but does not have a very pointed tip. In fact there is very little flaking in the area of the tip. In general the flaking over the piece is bifacial but does not reach the centre. The point seems too small and thin to sharpen much further without the risk of breakage, and yet it is difficult to see how this piece could function as a point with such a rounded tip. Upon first glance, the combination of characteristics is reminiscent of a child’s toy: the unique coloured raw material, the relatively small size, and the fact that little effort has been made into sharpening the point. Such items have also been reported in the Arctic (Park 1998), but in this case it would be difficult to test such a proposition here.

Figure 83. Biface (Left to right: ElSx-1:3774, ElSx-1:3530, ElSx-1:3597\textsuperscript{n})
Biface no. 1849 (Fig. 84) is somewhat enigmatic in that it has the appearance of a small Acheulean handaxe. It is unique in its size at 85mm long, 19mm thick and 98g in weight. In other words, this is a very thick and heavy biface for its size. Given this thickness it could not function as a point in its present form, and it is unlikely that the biface could be reduced into any type of point. The form, however, suggests that the toolmaker may have initially wanted to manufacture a point, but realized at some time that there was too much mass to remove given the size. The bifacial edges have been formed through the removal of large flakes, so that only the initial edging has taken place. Edge angles range from 70-81° on this piece. It certainly could have been used for some other task, or it may have been manufactured for aesthetic reasons.

Figure 84. Biface (EISx-1:1849)

Two sets of pieces were refitted to form complete bifaces (Fig. 85; Carlson 1996b), both display a lateral snap suggesting that they were broken during manufacture. The extreme tip on no. 1865 is missing; this is a fairly thin piece exhibiting straight sharp edges and flaking to the centre. The matching basal segment no. 1262 also exhibits
flaking to centre but still has some centre mass. It also has a round base that has been thinned. Artifact no. 1841 (incorrect number) has fairly sharp straight edges and forms the tip of the biface. The extreme tip of this piece is slightly rounded, so it is likely that the knapper was still working on it. The basal half of this biface is still fairly thick and exhibits a substantial amount of centre mass. The knapper apparently tried to remove this mass but was unsuccessful, resulting in a number of large step fractures that would be difficult to deal with.

Figure 85. Biface (EISx-1: 1865/1262, left, EISx-1:1841/1789, right)

One piece (no. 3051 – Fig. 86) is a backed biface. This appears to be a biface base segment with a convex butt and displays a lateral snap. One margin of the biface has a sinuous edge that is not very sharp, while the other margin has been deliberately blunted.
through high angle impact. The backed edge exhibits a large quantity of step fractures that have been caused by the high angle flaking. This is a curious piece in that it was obviously backed, but the opposite (working) edge is not particularly sharp. Apland (1977) reports three backed bifaces from FaSu-21 and Pbsu-1, but in these cases backing was achieved through longitudinal splitting of the biface. Interestingly, Apland (1977:52) notes that two of the three specimens exhibit “crude” flaking, implying that the working edges are not very sharp. He suggests that backed bifaces may have been used either for sawing or heavy cutting tasks.

Figure 86. Backed Biface (EISx-1:3051)

LAB – Large Asymmetrical Biface

No: 12

Raw material groups: 1 (69.2%); 2 (7.7%); 4 (23.1%)

Period: 1A (8.33%); 1B (66.7%); 1C (25.0%)

Ave. weight: 29.8g  Ave. length: 52mm  Ave. width: 44mm  Ave. thickness: 12mm

Ave. width/thickness ratio: 3.9:1  Average edge angle: 48°
This category of biface fragments consists of pieces that are fairly large relative to other bifaces in the assemblage, but they are also quite wide relative to their thickness (Fig. 87). Almost all are broken and display breakage failures that are common during manufacture. In general they appear to be early to mid stage bifaces with varying edge stabilization. Some have straighter bifacial edges while in others the edges are still somewhat sinuous. None of these tools displays particularly sharp edges although edge angles do approach a fairly acute angle in some cases. While these bifaces could have served as knives, their lack of sharp edges would have limited their capacity in this function.

On the other hand, their peculiar asymmetrical shape is probably derived from the manufacturing process. During the experimental manufacture of the biface it was noted that at one stage, the biface had a similar asymmetrical form. Through further reduction the biface became more symmetrical. In the case of these bifaces from Namu, breakage
during manufacture may have led to their discard in their present forms. Curiously, some of these bifaces are quite thin and given the amount of mass, they could not have been reduced much further than their current width without risk of edge failure. In other words, it seems that some of these bifaces were intentionally designed to be large and thin. If so, they could have been used as hand held knives but if they were hafted onto spears, they would have been far too large to throw, and could only be used in thrusting/stabbing motions.

Apland (1977:55-57) describes a similar group of artifacts that he classified as “Large Crude Bifaces”. He further suggests that they are likely blanks for the manufacture of points or backed bifaces. Of interest here is that Apland only provides measurements for length dimension for one out of the nine bifaces, but the average width tabulated from seven pieces is 44mm, exactly the same average for the bifaces in the Namu collection. Average thickness in the present collection however is 12mm, compared with 16mm in the collection that Apland analyzed.

**STB – Small Thick Biface**

No: 15

Raw material groups: 1 (33.3%); 2 (33.3%); 4 (33.3%)

Period: 1B (53.3%); 1C (20.0%); 2 (26.7%)

Ave. weight: 14.8g  Ave. length: 45mm  Ave. width: 28mm  Ave. thickness: 12mm

Ave. width/thickness ratio: 2.4:1  Average edge angle: 59°

In contrast to the large asymmetrical bifaces, the fifteen small thick bifaces were intentionally designed to be small (Fig. 88). In the vast majority of cases, these bifaces
appear to have been discarded after they had reached a critical stage at which more flaking would be difficult. These bifaces exhibit a high amount of centre mass relative to their size, and they generally also have high edge angles not associated with later stage bifaces. Perhaps the toolmakers envisioned making small bifacial implements but gave up after realizing that it would be impossible to remove the centre mass since the biface had already become quite small. Some specimens (e.g. 619) exhibit only a few flake scars, indicating that they were still in a relatively early stage of manufacture. Another possibility is that they were the result of individuals simply practicing their knapping skills.

Figure 88. Small Thick Biface (Top left to right: E1Sx-1:3564, E1Sx-1:619, E1Sx-1:3701u, bottom left to right: E1Sx-1:3591, E1Sx-1:3567, E1Sx-1:3197)

SBF – Small Biface Fragments

No: 5

Raw material groups: 1 (33.3%); 2 (50.0%); 4 (16.7%)

Period: 1B (60.0%); 1C (40.0%)

276
Ave. weight: 7.1g Ave. length: 42mm Ave. width: 24mm Ave. thickness: 8mm Ave. width/thickness ratio: 2.6:1 Average edge angle: 54°

Six pieces are classified as Small Biface Fragments (Fig. 89). Like the Small Thick Bifaces, most of these exhibit a relatively early stage of flaking and are either broken via transverse snaps, or they are at a critical point at which no more mass can be removed without further compromising the piece. Overall they have less mass than items in the previous classification, but they display uneven mass distribution, once again illustrating the difficulty of working with these materials. No. 3409 (not Early Period) is a

Figure 89. Small Biface Fragment (Top left to right: ESx-1:3409, EISx-1:1989, EISx-1:1257, bottom left to right: EISx-1:1338, EISx-1:3173)

piece with very early stage reduction, with only a few large scars. The edges do not appear functional and it is curious that anyone would start a biface on something this small. Straight edges characterize artifact no. 1989, however, this piece exhibits a large amount of mass at one end that would be extremely difficult to remove. Artifact no. 1257
is heavily weathered making it difficult to distinguish its characteristics in any detail, but its sinuous edges are apparent. No. 1338 is a flake that has been worked bifacially and displays a transverse snap, likely a manufacturing failure. No. 3173 displays partial bifacial retouch around its perimeter, although also has an odd break that seems to have removed much of its center mass. This seems to have occurred through end shock, where the toolmaker imparted a large force that removed a large portion of one face.

Perhaps the most interesting piece in this category is No. 1841 (Fig. 90), which is made on black chert. This is a rare material in the collection and its origin is unknown. The artifact is an odd-shaped piece that has been bifacially retouched around its perimeter, but the overall shape is almost circular, resembling a thumbnail scraper. The edge around most of the perimeter is very sinuous and would not be appropriate for cutting nor for scraping. As this material appears somewhat softer than the majority of materials in the collection, it was submitted to Cameron Smith for use-wear analysis. Smith (2003) was able to find use-wear on one small part of the artifact, the only margin

Figure 90. Small Biface Fragment (ElSx-1:1841)
that exhibits moderately high edge angle. Smith concluded that the edge was used to work a material softer than bone/antler but harder than soft plant fibers. He suggests that the artifact was used in a unidirectional scraping motion and that the most likely worked material was wood.

**BP-1 Biface Base**

No: 18

Raw material groups: 1 (50.0%); 2 (27.8%); 4 (22.2%)

Period: 1B (61.1%); 1C (27.8%); 2 (11.1%)

Ave. weight: 10.9g Ave. length: 35mm Ave. width: 30mm Ave. thickness: 9mm

Ave. width/thickness ratio: 3.3:1 Average edge angle: 46°

Eighteen pieces are classified as biface basal segments (Figs. 91 to 93). In general they vary in terms of edge sharpness, ranging from thick and sinuous to fairly straight and sharp. These are quite large and when completed, they would have made formidable points. Cross sections vary from plano-convex to bi-convex to rhomboid, and this characteristic would be determined by the nature of the raw material and the actions of the knapper. Some 90% of these pieces display lateral snaps, and many also display an attempt to thin the base in preparation for hafting. In some cases this has been successful but in others, the thinning attempts have led to step and hinge fractures, which would have made removal of the mass in this area even more difficult. Most of these pieces exhibit straight margins although there is some variation in basal form.
The vast majority of these basal segments have wide or narrow convex bases that are characteristic of foliate points, but two have stemmed bases. Artifact no. 1864 (Fig. 91) displays a stem that terminates in a convex base, and this piece also shows signs of thinning at the base. No. 1705 (Fig. 91), also shows an attempt at creating a stem.
piece has a straight base, and it is still relatively thick at 8mm. Flaking is non-invasive and indicative only of edging to attain a form, so it appears that this piece would have remained quite thick if completed.

Artifact no. 1787 (Fig. 93) bears a similar resemblance to no. 3600, described under Complete Points (see p. 286). Both of these pieces exhibit some similarities to the Chindadn Points found much further north. This piece is also heavily weathered, however, and detailed flaking features are obscured. It may therefore be part of a more finished point, but this is too difficult to ascertain. No. 2086 (Fig. 92) has a spur-like projection that is an accidental result of the flaking process; there are no signs to suggest that it was intentionally formed. That said it certainly could have been used in that manner, once manufactured.

Figure 93. Biface Base. (Top row left to right: ElSx-1:3604b, ElSx-1:3685, ElSx-1:3599, bottom row left to right: ElSx-1:3810, ElSx-1:3596, ElSx-1:1787)
BP2 – Biface Tip

No: 11

Raw material groups: 1 (75.0%); 2 (9.1%); 4 (18.2%)

Period: 1B (63.6%); 2 (27.3%)

Ave. weight: 12.8g  Ave. length: 45mm  Ave. width: 27.7mm  Ave. thickness: 10mm

Ave. width/thickness ratio: 2.8:1  Average edge angle: 52°

This category is admittedly ambiguous as some of these pieces could be either tips or bases (fig. 94). The twelve pieces classified within this category display a tendency for sharply converging margins that are typical in point tip segments. Still, they are in a stage where it is difficult to be sure. Their early to mid stage is indicated by their general form and high edge angles, but also that with a couple of exceptions almost all have edges that are still quite sinuous, they have a great amount of mass on the edges and

Figure 94. Biface Tip. (Top row left to right: EISx-1:2289, EISx-1:1324b, EISx-1:2117, bottom left to right: EISx-1:1248, EISx-1:1867).
on their centres, and some 85% of these pieces exhibit lateral snaps. In general they conform to the foliate form and it seems obvious that they are designed to eventually function as points, used in the general sense.

**BP3 – Biface End Fragment**

No: 48

Raw material groups: 1 (41.1%); 2 (39.2%); 4 (19.6%)

Period: IA (2.1%); 1B (54.2%); 1C (20.8%); 2 (22.9%)

Ave. weight: 24.4g  Ave. length: 44mm  Ave. width: 33mm  Ave. thickness: 12mm

Ave. width/thickness ratio: 3.1:1  Average edge angle: 55°

This category consists of biface fragments that are either too incomplete, or they are not developed to a stage where they can be reliably classified as a base or a tip (Figs. 95 and 96). Forty-nine pieces make up this category, making it the largest in the assemblage. In general they are in the early stage of manufacture although some may be in the mid stage. Lateral snaps are very common in this group, with some 70% exhibiting this type of breakage. In most cases these biface fragments display much centre mass and sinuous bifacial edges, reflecting their early stage. In general they also tend to have high edge angles with an average of 55°.

Within this category there may be evidence for variable technological skill levels, as exhibited by some of the more poorly made pieces. Even after taking into account the nature of the raw material, there seems to be a very wide variation in flaking quality. In comparison with other bifaces in the collection, some pieces here are qualitatively
Figure 95. Biface End Fragment. (Top row left to right: ELsSx-1:3790, ELsSx-1:3685a, ELsSx-1:3604g, bottom left to right: ELsSx-1:3163, ELsSx-1:3554, ELsSx-1:3661)

“poorly” made, where edge angles are very high, rendering the biface almost unworkable. While this may be the result of occasional mistakes made by skilled toolmakers, it could also be the result of learners. If individuals (for instance children) were being taught to make stone tools at Namu there should be some evidence for this. The idea of training and education related to stone tool making seems to have completely escaped the archaeological mainstream (Finlay 1997). In all cases where people made stone tools, they learned how to make them through some process of training, and much of the archaeological record is evidence of this. That said it is not easy to try and distinguish the products of learners versus those of more practiced toolmakers, especially when the main raw materials are very difficult to work with.
Figure 96. Biface End Fragment. (Top row left to right: ElSx-1:2007, ElSx-1:2184, ElSx-1:1274, bottom left to right: ElSx-1:3672, ElSx-1:3775, ElSx-1:2090)

BP4 – Biface Medial

No: 14

Raw material groups: 1 (62.5%); 2 (31.3%); 4 (6.3%)
Period: 1B (71.4%); 1C (14.3%); 2 (14.3%)

Ave. weight: 13.4g Ave. length: 39mm Ave. width: 26mm Ave. thickness: 10mm
Ave. width/thickness ratio: 3.1:1 Average edge angle: 46°

These fragments are remnants of the blade portion of bifaces; they have no ends, bases, nor tips (Fig. 97). In most cases they display two transverse fractures resulting in straight or angled breaks. Cross section profiles vary depending on the amount of centre mass remaining. Most have fairly straight margins and although all show stabilized bifacial edges, none of the edges are particularly sharp. Step fractures are common on many of the pieces.
Figure 97. Biface Medial. (Top row left to right: ElSx-1: 3024, ElSx-1:3701j, ElSx-1:35971, EEx-1:3540a, bottom left to right: ElSx-1:126, EExx-1:1622)

Biface Edge Fragment

No: 4

Raw material groups: 1 (20%), 2 (60%); 4 (20%)
Period: 1A (20.0%); 1B (20.0%); 1C (20.0%); 2 (20.0%)
Ave. weight: 12.0g  Ave. length: 46mm  Ave. width: 15mm  Ave. thickness: 9mm
Average edge angle: 57°

Five biface edge fragments are present in the assemblage (one is not Early Period), and while four are approximately in the same size range, one (no. 2168) is notably larger (Fig. 98). These are pieces that were inadvertently detached from the biface core during the manufacturing stage, when impact from the hammer caused the entire edge to collapse. Given the impact forces required to work with this material, it is somewhat surprising that there are not more edge fragments in the collection.
Figure 98. Biface Edge Fragments. (EISx-1:2168 far left, EISx-1:3563d, top centre, EISx-1:3068, top right, EISx-1:3830, bottom centre, EISx-1:1949, bottom right)

PP – Projectile Point (Complete)

No: 9

Raw material groups: 1 (11.1%); 2 (11.1%); 4 (77.8%)

Period: 1A (11.1%) 1B (44.4%); 1C (33.3%); 2 (11.1%)

Ave. weight: 10.7g Ave. length: 55mm Ave. width: 19mm Ave. thickness: 6mm Ave. width/thickness ratio: 3.5:1 Average edge angle: 45°

Nine pieces are classified as complete projectile points (Figs. 99 to 101); all have thin sharp cutting edges and points that are capable of penetration given enough applied force. Artifact no. 3590 (Fig. 99) displays some fine flaking and although it still has some centre mass, the combination of sharp edges and a point make this a formidable tool. There seems to be an incipient stem created through pressure flaking, giving the base a
great similarity to no. 3722, classified under projectile point base segments (Fig. 103). Point no. 3600 (Fig. 99) is a very interesting piece made on a different raw material, possibly rhyolite. Overall it has an appearance that bears some similarity to the Chindadn points found to the north. Of great interest is that this artifact was recovered in two pieces that apparently broke in antiquity and was refitted in present times. As is visible in the photograph, however, the two segments have weathered differently causing the top half to appear darker in colour than the lower half. This is a thin flake that was formed into a point through some invasive flaking but largely through bimarginal flaking. The point likely broke during shaping, as reflected in a small edge fragment removal at the terminus of the transverse fracture. No. 3803 (Fig. 99) may also be made on rhyolite or volcanic tuff, it is complete except for the extreme tip. The edges are very sharp and the base is thinned for hafting.

Figure 99. Projectile Point. (Left to right: ElSx-1:3590, ElSx-1:3600, ElSx-1:3803)
Point no. FS9.3.1 (Fig. 100) is made on a fine-grained trachydacite similar to that found in the central and southern Interior of British Columbia. It is a foliate shaped point with sharp edges and a thinned base and is more recent than the Early Period (Luebbers 1978:51). No. 2076 (Fig. 100) is made on what also may be trachydacite, it is plano-convex in cross section and also displays basal thinning. As there are no known sources for this material on the central coast, it may have been obtained through trade. Point no. 1780 (Fig. 100) is a flake that has been formed into a point through bimarginal flaking. There are appears to a slight stem at the base, although this may be unintentional as there is much stepping in this area. Artifact no. 1247 (Fig. 100) is an almost complete projectile point, with part of the base missing. It is thin and very sharp around most of its perimeter, with the exception of one small area adjacent to the snapped base that exhibits a large amount of stepping.

Figure 100. Projectile Point (Left to right: FS9.3.1 (not Early Period), EISx-1:2076, EISx-1:1780, EISx-1:1247)
Artifact no. FS512.2 (Fig. 101) is a thick biface although it has the form of a point. Due to its thickness the tip has no power to penetrate unless it was used in a stabbing motion at close range. The edges are somewhat sharp although some dulling may have occurred through weathering on this piece. Luebbers (1978:50) claims there is minimal abrasion on the shoulders on this piece. No. 1709 (Fig. 101) is interesting in that it is made on a multi-coloured cryptocrystalline material, most likely chalcedony. It is one of the very few pieces in the entire collection made on this material, the source of which is unknown. It displays some fine collateral flaking, which was probably a pleasure for the Namu toolmakers after working with their regular coarser materials. Even so, the piece does exhibit some stepping on one face and although the edges are fairly straight, there is a 

Figure 101. Projectile Point (FS5.12.2, left, ElSw-1:1709, right)

slightly sinuous quality to them. In profile there is more mass at the base than on the rest of the artifact and given the overall size, this may have been a function of hafting. Given the rarity of this material in the collection it seems odd that it was discarded in the midden.
Artifact no. 2096 (Fig. 102) is the largest of the three and it is made on quartzite. This piece is quite thin and has sharp edges but neither end has a sharpened tip, although this may have broken off at some point. The edges are sharp enough to perform cutting operations and the piece is thin enough to haft, but it would require slight modification to sharpen the tip into a usable point, if that was the intention. Given the raw material this piece displays superb workmanship.

Figure 102. Projectile Point (ElSx-1:2096)

PP1 – Projectile Point Base

No: 4

Raw material groups: 1 (25.0%); 2 (50.0%); 4 (25.0%)

Period: 1B (25.0%); 1C (75.0%)

Ave. weight: 1.6g  Ave. length: 16mm  Ave. width: 18mm  Ave. thickness: 6mm

Ave. width/thickness ratio: 3.0:1  Average edge angle: 45°
Four pieces are characterized as projectile point base segments (Fig. 103). All have straight margins and are quite thin, so hafting would not be a problem. Point no. 3722 displays a slight stem that has been thinned for hafting, while the base has a gently concave form. Overall the basal segment bears remarkable similarity to artifact no. 3590, described under projectile points. Nos. 3548 and 3817e also have thinned bases, display a contracting form that is characteristic of foliate points, while no. 3540b has more gently converging margins and a straight base.

Figure 103. Projectile Point Base. (left to right: ElSx-1:3722, ElSx-1:3548, ElSx-1:3540b, ElSx-1:3817e).

PP2 – Projectile Point Tip

No: 3

Raw material groups: 1 (33.3%); 2 (33.3%); 4 (33.3%)

Period: 1B (33.3%); 1C (66.7%)

Ave. weight: 1.8g Ave. length: 21mm Ave. width: 17mm Ave. thickness: 6mm
Ave. width/thickness ratio: 2.8:1 Average edge angle: 45°
All three projectile point tips have sharp points and edges (Fig. 104). They are all also relatively thin at the tip and two of the three display lateral snaps. Artifact no. 3804 is made on a cryptocrystalline material and has a break that is more reminiscent of a bending fracture (Cotterell and Kamminga 1987). No. 3806 is a fairly narrow point with collateral flaking that is slightly off centre.

Figure 104. Projectile Point Tip. (ElSx-1:1814, left, ElSx-1:3804, centre, ElSx-1:3806, right)

**PP3 – Projectile Point Medial**

No: 2

Raw material groups: 2 (50.0%); 4 (50.0%)

Period: 1B (50.0%); 1C (50.0)

Ave. weight: 5.5g Ave. length: 32mm Ave. width: 19mm Ave. thickness: 8mm

Ave. width/thickness ratio: 2.5:1 Average edge angle: 50°

Of the two projectile point medial segments, no. 1273 (Fig. 105) is the smaller at 26mm in length. Despite some centre mass, it displays straight margins and very sharp
bifacial edges that would make this a formidable cutting instrument. Artifact no. FS9.10.19 also displays very sharp edges, but is much more narrow in width. It could have also function as a drill or perforator if complete. It seems that both of these pieces were discarded at a fairly late stage of manufacture.

![Figure 105. Projectile Point Medial. ElSx-1:1273](image)

**PP5 – Point Preform Base**

No: 6

Raw material groups: 1 (16.7%); 2 (83.3%)

Period: 1B (50.0%); 2 (50.0%)

Ave. weight: 2.5g  Ave. length: 21nm  Ave. width: 19mm  Ave. thickness: 6mm

Ave. width/thickness ratio: 3.1:1  Average edge angle: 43°

Of the six pieces classified as projectile point preform bases (Fig. 106), at least three show some attempt at thinning, perhaps for the purpose of hafting. This is done through the removal of small thinning flakes, although on one piece (3655b) thinning on one face was achieved through the removal of one large flake. No. 3720 is mostly
unifacially flaked, with one particular flake removal giving the piece a “stemmed” form. It is unclear as to whether or not this was intentional. The rest seem to have a shape that is best classified as foliate. All but one of these pieces exhibit lateral snaps.

Figure 106. Point Preform Base (Top left to right: ElSx-1:1684, ElSx-1:1866, ElSx-1:3720, bottom left to right: ElSx-1:3655b, ElSx-1:1391, ElSx-1:3794a)

PP6 – Point Preform Tip

No: 14

Raw material groups: 1 (18.8%); 2 (43.8%); (37.5%)

Period: 1B (66.7%); 1C (20.0%); 2 (6.7%)

Ave. weight: 3.5g Ave. length: 28mm Ave. width: 19mm Ave. thickness: 7mm

Ave. width/thickness ratio: 2.8:1 Average edge angle: 57°

There are fourteen projectile point preform tips in the collection (Figs. 107 and 108). In general they are identifiable as the tip segments of points, although most are not sharp enough to penetrate through any mammal hide, for instance. Their preform stage is
also indicated by their average edge angle of 57°, which is generally too dull to perform the cutting action required of a projectile point. All but one display lateral snaps, and almost all have a foliate shape. Artifact no. 3602 (Fig. 107) is made on what appears to be quartzite. Although it has very straight edges, there is still significant centre mass giving it a thick cross-section profile. Artifact no. 1853 (Fig. 107) is a fairly thick piece and displays a shape that is between a foliate point and a Chindadn Point. No. 3224 has one a fairly straight bifacial edge on one margin, but the other seems to have been heavily battered.

Artifact nos. 3724 and 3760 (Fig. 108) are both interesting in that they both display a very sharp and pointed tip, but neither one shows any bifacial flaking. Both pieces show breakage via a lateral snap, although part of the bulb of percussion is still visible in no. 3724. The latter artifact is made on a cryptocrystalline raw material and is unimarginally flaked for the most part, although there does appear to be one larger flake.
scar on the dorsal face, created prior to forming the edges. Although the tip and edges are fairly sharp, the basal portion is still thick at 5mm (compared with less than 2mm at the tip). No. 3760 exhibits unifacial flaking on the dorsal face only, followed by shaping through bimarginal flaking. Like the previous artifact, this piece also has a very sharp tip and sharp margins, and it could easily have functioned as a perforator when complete.

Figure 108. Point Preform Tip (ElSx-1:3724, left, ElSx-1:3760, right)

PP7 – Point Preform Medial

No: 1

Raw material groups: 2 (100.0%)

Period: 1C (100.0%)

Ave. weight: 11.3g Ave. length: 39mm Ave. width: 23mm Ave. thickness: 10mm

Ave. width/thickness ratio: 2.3:1 Average edge angle: 53°

Two pieces are identified as medial segments from projectile point preforms.

There is a significant difference in size and weight between these two artifacts. No. 3675
(Fig. 109) is the larger of the two at 39mm in length, it displays lateral snaps at both ends. The quality of flaking is very good considering the raw material, although there is some stepping exhibited on both faces. From the overall morphology it seems that the toolmaker was creating a stem (or at least incipient) towards the basal portion of the point, as exhibited by the excursive shape. Artifact no. 3528 is much smaller at 19mm in length, and post-dates the Early Period. One edge on this piece is still somewhat sinuous and also exhibits signs of battering. The basal portion of this point ends with a lateral snap, however the tip portion has a peculiar circular fracture. This could have occurred during manufacture, but it is difficult to be sure.

Figure 109. Point Preform Medial (ElSx-1:3675, left, ElSx-1:3528, right – not Early Period).

Discussion

It is apparent that the Early Period assemblage is quite diverse given the nature of the raw materials used. Both the debitage analysis and the tools suggest that multidirectional flaking of cores consisted the primary reduction strategy, followed by a

298
number of retouch and biface reduction strategies. Larger core tools are also important for tasks requiring greater impact forces. Although the actual number of expended multidirectional cores is smaller than the number of bifacial tools, the vast majority of the latter are rejects, as exhibited in predominance of manufacturing failures such as transverse snaps, multiple hinge and step fractures and the inability to remove excess mass of materials. Given the coarseness of the raw materials it is likely that the rate of manufacturing failures is significantly higher than for softer raw materials. The biface representation in this collection may therefore be exaggerated. The cores on the other hand are the end products of a process in which several flakes have been removed, for use with or without further modification. In the experimental portion of this research it became clear that when starting with a larger core, a unidirectional strategy works best to remove large flakes but at some point a multidirectional strategy is necessary in order to remove as much mass as possible from the core. This combination of strategies maximizes the potential number of flake blanks that can be removed from a core.

Some if not most of the flakes were undoubtedly used to form various unimarginal, unifacial, bimarginal and bifacial implements. Very few unmodified large flakes were recovered in the archaeological assemblage, which reflects the fact that they were selected for modification and/or used elsewhere. At the same time the number of overall flake-based tools (n=164) is smaller than expected, particularly since they are outnumbered by bifacial tools (n=176). Once again, this reflects the fact that the bifaces are likely discarded rejects and the vast majority of flake tools were used/deposited elsewhere. The debitage analysis shows that during Period 1, the Rivermouth Trench area served as a locus for both flintknapping and discard of lithic materials. All types of
reduction strategies were performed, but successful bifaces and other tools were not always discarded here. Broken bifaces and expended cores on the other hand, were discarded here. Core tools on the other hand occur in fair number and are quite diverse in morphology and weight. Overall the diversity of tool forms and the volume of materials strongly suggests that a variety of tasks were performed at Namu, and that some of the tools were prepared at the site for use elsewhere. This conforms generally to Binford’s (1980) “logistical collector” pattern of settlement, although “forager” base camps can exhibit similar patterns.

This variety of tools includes pieces with acute, moderate, and high edge angles. Some of the flake tools and bifaces do have acute edges that are capable of cutting and piercing. Many are modified into scrapers or implements with high edge angles that are useful in scraping and woodworking. Ethnographic studies (Gould et al. 1971; Hayden 1979; Miller 1979; White and Thomas 1972) show that edge angle and the amount of edge on a tool are of great significance in how people choose the appropriate flakes. Acute angles are chosen for cutting related tasks while scrapers and woodworking implements tend to display higher edge angles. In Australia Ferguson (1980) reported that flake knives tend to have edge angles ranging from 21°-48° with a mean of 35°, while Gould et al. (1971) reported a wider range of approximately 20° to under 60°.

Also in Australia Hayden (1979) found that most chopping implements tend to have edge angles ranging from 60° to 90°, peaking at 75°. He also found that an important criterion for chopping tools is mass; most weigh from 0.25 kg to 3.0 kg. In the Namu collection some pebble tools and core tools may have been used in this way, with average edge angles of 80° and 81° respectively, and in both cases the average weight is
over 0.4kg. These forms attest to the fact that woodworking and other tasks requiring heavy chopping were of some importance at Namu. It is likely that much of the material culture at the time was based on wooden raw materials, as was the case in more recent times.

A point of interest with the Namu materials is that the inhabitants were using a combination of strategies that would be characterized by others as being both “curational” and “expedient”. Bifaces and microblades are both considered strategies that maximize curation, while the dominant core/flake reduction of stockpiled materials is considered an expedient strategy. Parry and Kelly (1987) observe that in a number of sedentary situations, as people begin to rely on stockpiled materials the need for more curational strategies tends to decline. For instance as the number of expedient tools increases, the number of bifaces declines. The logic in this argument rests on the premise that bifaces will be increasingly used as cores and as multifunctional tools in areas where toolstones are in short supply (Kelly 1983). Seddon (1992) describes such a change in his examination of debitage from three sites in the Lower Illinois Valley. The model intuitively works for terrestrial foragers moving about on foot with no transport aids.

Yet the interesting shift towards increasing use of expedient tools at the expense of bifacial ones may also have other contributing factors. In most cases sedentary settlement is accompanied by a shift in economy involving the intensification of food resources, and this in turn would have an impact on tool design. Consider for instance that if a group of people began to rely more on cultivated plant foods and less on hunted and gathered foods, we would expect changes in the types and frequencies of tools used. A reduction of bifaces in this case may also have to do with functional requirements;
people were making fewer bifaces because they did not need as many as they did previously (see also Tomka 2001). Parry and Kelly’s study is certainly intriguing but from a design perspective it privileges the role of mobility and settlement while downplaying the role of other considerations such as task requirements, transport capacity, nature of raw material and others.

The Namu assemblage is dominated by expedient core reduction, but there are also significant numbers of bifaces and microblade cores, both curational strategies. A key factor in this process, however, is the nature of the raw materials used at the site. Coarse-grained materials were the primary toolstones and they played a large role in the types of strategies pursued by the Namu toolmakers. Intuitively one would expect a high amount of expedient reduction with such materials, and this is indeed the case. This supports Andrefsky’s (1994:30) contention that multidirectional flaking of cores is used in situations where toolstone availability is dominated by poor-quality materials, but contradicts his argument that bifaces will be made primarily in situations where high-quality raw materials are available in low quantities. Some of the bifaces are indeed made on qualitatively slightly “better” grades of basalt or andesite, but the vast majority is made on the same coarse-grained raw material as the other cores. Like the Parry and Kelly (1987) study, Andrefsky’s modeling seems situated for terrestrial foragers moving about on foot. At Namu similar raw materials are used in both multidirectional core reduction and in the production of bifaces. It seems that the bifaces here were not necessarily produced as part of a strategy to conserve raw material, as is the implication in the above models.
Luebbers (1978) describes a number of bifacial points but only a few date to the Early Period and interestingly he comments (1978:46) based on the small sample that the raw materials seem more “variable” than those used in more recent periods, as is reflected in his general characterization of the earlier points as “Crude Bifacial Projectile Points”. In general the very small sample of post Early Period bifaces and points examined in the present study seem to support Luebbers’ contention. They are more fine-grained, which allows for greater precision in flaking. The spectacular points recovered in the burials are a case in point (see Luebbers 1978: Figs. 32 and 40). These are long, lanceolate points that exhibit fine, detailed flaking and seem to be made of qualitatively different raw materials than what is seen in the general assemblage. Without more information it is difficult to explain the greater presence of the finer-grained raw materials in more recent times, however, it is likely that use of watercraft was crucial in obtaining such materials either through trade or direct procurement.

The presence of the bifaces raises questions on the range of tasks they may have been used in. Given that these raw materials preclude the use of these bifaces as cores, their primary functions would include their use as knives and saws, and in the arming of spears and darts. Well-made smaller points could be used in hunting of land and sea mammals as either spear points, harpoon points or atlatl dart points. Leblanc (2000) for instance documents the archaeological use of chipped stone harpoon points (“end blades”) for the purpose of hunting seals in Labrador. The larger bifaces and points at Namu could also have been used in close range on spears and harpoons for stabbing and short distance throwing, but they were not likely used in arming long distance weapons due to their weight. These larger implements could also have been used for defensive
purposes. Whatever the case, bifacial tools were important components of the tool complement during the Early Period, although more so during the first half.

One thing that is very apparent from the experiments and from the debitage and tool analyses is that the coarse-grained raw materials used at Namu play a significant role in the reduction strategies used and in the resultant debitage patterns and tool morphologies. These raw materials provide serious constraints on reduction strategies, limiting the directions that the toolmakers could take at any given stage during the manufacturing process. Unlike less tougher materials such as chert and obsidian, the Namu materials are much less forgiving and require a greater amount of skill and force to master. This is evident in the high percentage of step and hinge fractures as well as other types of breaks noted. Nowhere is this more apparent than in the bifacial tools. As opposed to biface manufacture with finer-grained raw materials, the coarser toolstones at Namu limit the number of thin shaping flakes that are often removed with billets in other materials. There is very little sign of any use of soft hammers in the Namu assemblage, and during the experimental portion of the research the knapper had serious doubts as to the efficacy of such percussors on these materials. On the other hand if soft hammers were used at Namu their effects would be difficult to recognize.

With coarse-grained raw materials biface manufacture takes a slightly different path than what has been documented for other materials. Callahan’s (1979) stage reduction sequence for biface manufacture is perhaps the most well known, but like other schemes that followed it is based on reduction of materials such as chert, flint and obsidian. This is best seen in cross section in Fig. 110, which provides an idealized comparison between biface shaping in coarse- versus fine-grained materials. In the
coarser material (Fig. 110a), the physical toughness of the material makes it extremely difficult to remove long thin flakes that extend approximately to the midline of the biface (Fig. 110b) for the purpose of shaping. As a result there is a tendency for relative mass to build up in the center of the biface, giving it a characteristic morphology. With finer-grained materials, such mass accumulations can be removed through one or more long flakes aimed at removing the excess. Coarser materials require much more force to remove such mass, but hitting a biface with too much force at this stage can snap the artifact into two pieces. Most of the bifaces at Namu display such lateral snaps, and a large number of them display a cross sectional profile with excess center mass, indicating that regardless of the skill of the toolmaker the raw materials provide some very difficult challenges. Learning to make bifaces with such materials would require considerable practice and a steady supply of raw materials. It is very likely that a significant number of the Namu bifaces are the products of individuals with different skill levels, including learners.

The temporal distribution of artifacts at Namu is similar to what Carlson (1996b: Tables 2 and 3) describes. Overall Period 1 artifacts vastly outnumber the artifacts from

![Figure 110. Effects of raw materials on biface thinning. Coarse material (a) and fine-grained material (b)]
Period 2 (Table 24) as noted in the debitage analysis, but there are other interesting trends. There appears to be a greater amount of overall deposition during Period 1B than at any other time. More than half of the non-obsidian tool inventory dates to this one thousand year time span. Period 1A yields a minor amount of remains while Period 1C, a span of some two millennia is represented by approximately 20% of the assemblage, as is Period 2. This pattern does not necessarily mean that Namu was most intensively used during Period 1B and less intensively during following periods, it is more likely a reflection of shifting areas of use and deposition within the site. It is difficult for example to see a real drop in the core and flake industries since these multipurpose tools were likely used on a daily basis.

Non-obsidian microblade cores appear in Period 1B and intensify in 1C, dropping off substantially in Period 2. Interestingly obsidian microblades first appear at Namu

<table>
<thead>
<tr>
<th></th>
<th>Cores and core tools</th>
<th>Microblade cores</th>
<th>Flake-based tools</th>
<th>Biface tools/points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Period 1A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-9,000 ¹⁴C BP</td>
<td>(7) 5.5%</td>
<td>0</td>
<td>(9) 5.5%</td>
<td>(5) 2.8%</td>
</tr>
<tr>
<td><strong>Period 1B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-8,000 ¹⁴C BP</td>
<td>(73) 57.0%</td>
<td>(11) 45.8%</td>
<td>(89) 54.3%</td>
<td>(99) 56.3%</td>
</tr>
<tr>
<td><strong>Period 1C</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8-6,000 ¹⁴C BP</td>
<td>(19) 14.8%</td>
<td>(11) 45.8%</td>
<td>(30) 18.3%</td>
<td>(43) 24.4%</td>
</tr>
<tr>
<td><strong>Period 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-5,000 ¹⁴C BP</td>
<td>(29) 22.7%</td>
<td>(2) 8.3%</td>
<td>(36) 21.4%</td>
<td>(29) 16.5%</td>
</tr>
<tr>
<td><strong>All tools total</strong></td>
<td><strong>n=492</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(128) 26.0%</td>
<td>(24) 4.9%</td>
<td>(164) 33.3%</td>
<td>(176) 35.8%</td>
</tr>
</tbody>
</table>

*Table 24. Distribution of Namu artifacts through time*
during Period 1B and peak during Period 2 (Hutchings 1996). The toolmakers were initially trying to make microblades on a variety of materials but as obsidian became more available, they seem to have used the coarser materials less commonly. It is entirely possible that some of the non-obsidian (and maybe some of the obsidian) microblade attempts are the result of learners. This technology requires some skill and practice to perfect. Use of non-obsidian raw materials would enhance a learner’s capability in this regard without using too much of the valuable obsidian.

![Figure 111. Namu core and non-debitage tool representation by period](chart)

Bifacial implements seem most well represented during Period 1B; indeed almost 60% of all the bifacial tools in the assemblage were recovered from deposits dating to
this period. After this, bifaces do not appear in such high numbers again during the Early Period (see also Carlson 1996b: Table 2; Luebbers 1978). This pattern could be the result of sampling error due to shifting activity areas within the site, but if the drop in relative biface representation from Period 1B to Periods 1C and 2 is real, one possible explanation may be the intensification in use of organic raw materials. Beginning in Period 2 bone and antler tools appear in the shell midden, and these are modified into various gathering and hunting implements (Carlson 1996b; Luebbers 1978). Although such implements were very likely used throughout Period 1, they have not survived the vagaries of preservation. Nonetheless intensification in the use of these raw materials after Period 1B could partially explain the reduction in biface manufacture. Bone and antler harpoons and fishing implements are extremely effective, as exhibited by their prominence in more recent sites along the Northwest Coast. As such they may have supplanted some of the tasks previously conducted with bifacially worked tools. This shift would ameliorate the need to procure and work the typical coarse-grained stone materials, but it would also involve an increased need to take terrestrial mammals for raw materials (Rahemtulla 2003). The increase in obsidian at this time may also be related to an increase in the use of bone and antler implements. Carlson (1990) for instance has argued that used as inset armatures, microblades would greatly enhance the efficiency of harpoons made on bone and antler. But the increase in obsidian after Period 1B at Namu also raises other important questions.

Hayden (1996) describes a class of material culture called “prestige technologies”, generally tools and/or other artifacts that require a substantial amount of labour to produce or are made on rare materials. These artifacts are thought to confer
prestige to their owner/user. At Namu there is no overt evidence for such technologies during the Early Period, however, well made knives and points could have carried some degree of prestige. Given the difficulty of working with the raw materials, success rates must have been relatively lower than compared with finer-grained toolstones, and a skillfully made implement would have been relished. This is evident in the burials following the Early Period, where there are extremely well made bifacial points included as grave goods (Luebbers 1978). In the midden, on the other hand, the vast majority of bifaces are rejects from the manufacturing process.

When seen in this light, the increasing presence of obsidian at Namu and elsewhere raises intriguing questions on distribution and consumption. There seems to be a relatively substantial amount of obsidian flowing into Namu from some distance. In itself, this raises a number of issues on how this obsidian was moving over the landscape in such amounts through such broad areas. The social nature of the trade networks remains unknown but it is apparent that they were fairly well organized. Secondly, questions arise as to how the obsidian was distributed and consumed at Namu itself. Given the rarity of the raw material it is interesting to ponder whether or not everyone had equal access to it. Intuitively it seems reasonable to suggest that not everyone would have knapped and/or used the obsidian, in which case it may have carried some degree of prestige at various times. This in turn leads to questions on the nature of the social structure(s) through time at the site. If early Namu was a sedentary settlement at which some storage of marine products was practiced (Cannon and Yang 2006) and a fair amount of trade goods was imported (and presumably exported), could there have been a form of social organization in which power and authority were practiced to varying
degrees but not formalized? Unfortunately our present body of ethnographic analogues on such societies is very limited, and so this remains an untested hypothesis. Ultimately a significantly greater amount of data is needed to resolve such issues.
Chapter 7: Synthesis and conclusion

The analysis of Early Period stone tools and debitage from Namu reveals that there is considerably more going on than initially meets the eye. What some characterize as a "crude" and "simple" technology is actually part of a sophisticated response to contingencies present during that time period. In designing and organizing their chipped stone tool technologies the Namu inhabitants had to evaluate several variables so that even though the implements themselves may look simple, they are products of a larger process of conscientious decision-making related to short and long term survival.

Although stone was only one raw material in a suite of many, it was generally the hardest raw material available and thus conferred advantages in many ways, as it had done for several millennia around the world. In the region around Namu the main stone raw materials are not qualitatively desirable but they appear to have been fairly accessible through time, and the inhabitants used them in a number of strategies to produce a surprisingly diverse range of tools and implements.

Modeling Exercise Evaluation

General and Residential Mobility

In Chapter 4 the modeling exercise revolves around a number of categories to evaluate the design variables underlying the Namu assemblage. Although the categories are treated equally, three major variables emerge as being critical to the Early Period stone tool design: raw materials, transport capacity and settlement, as reflected in task diversity. Results of the analysis suggest that Namu was a sedentary settlement, and that
the inhabitants must have had access to watercraft. The modeling exercise posited that if Namu were a sedentary or semi-sedentary settlement, there should be a wide range of tool types and morphologies, capable of performing a multitude of tasks. The archaeological assemblage from Namu contains a variety of tool types categorized under the general strategies: core and core tools, flake based tools and bifacial tools. Specifically they range from block cores, core and pebble tools, bifaces, scrapers of various forms, microblades, unmodified and modified flakes, and other forms. These also vary greatly in size, weight and edge angle. With the physical toughness and coarse-grained structure of the raw materials, these tool forms would have been adequate to handle many of the potential tasks outlined in the modeling exercise in Chapter 3. In addition, the entire gamut of reduction stages is represented from initial core reduction to various stages of biface and microblade production, although there is an emphasis on core reduction. This extensive representation of reduction strategies at the same location would be highly unusual at a special activity site, unless it was a quarry.

The majority of this technology is based on core reduction for the purpose of producing flake blanks. These were used unmodified, or they were modified by various means ranging from expedient retouch to the production of bifaces. Parry and Kelly (1987) suggest that stone tool assemblages in sedentary villages should be dominated by simple, expedient reduction strategies based on block core flakes. At Namu in spite of the wide range of morphological tool forms, minimally retouched or unretouched flakes numerically dominate the assemblage, along with cores and core tools. Most of these expedient tools would have been used on site. Hayden et al. (1996) found that at the winter pithouse village at Keatley Creek in the southern interior of British Columbia,
expedient block core strategies provided the bulk of lithic tool forms. Like the Keatley assemblage at Namu the vast majority of flakes greater than 2cm were culled for use elsewhere at the site or modified through some type of retouch.

The hardness of the raw materials is such that any tools made on them would have been quite durable. Even unretouched flakes make formidable implements when the overall morphology, edge angle and weight are appropriate to the task. This could also explain the relatively lower numbers of flake-based tools in comparison to bifaces. With these raw materials it can be difficult to recognize evidence for use on unretouched flakes. Unretouched flakes may have been used on a daily basis for a wide range of functions, as has been noted in ethnoarchaeological works (Hayden 1979, Gould et al. 1971). It seems likely that most individuals would be capable of detaching flakes for use in this manner.

At the same time there was a need to produce more specialized technologies such as bifaces and microblades. The majority of the bifacially worked tools at Namu display breaks that occur commonly during manufacturing and so they are likely rejects. This does not preclude the pieces from being used for other purposes before being discarded, but it is likely that they did not reach the final forms intended. On the other hand, the low number of completed points for instance, suggests that successfully made pieces were used and perhaps discarded off site. Microblades are even more specialized, and the majority of these are made on imported obsidian. These too were reduced on site although it is unclear as to where they were used (Hutchings 1996). They were certainly discarded within the midden area after use. For Namu as a sedentary settlement the expectation is met in that the technology at Namu reflects a multitude of tasks and
activities, and there is a diversity of reduction strategies. Combined with the volume of materials and the depth of time during which the site is used, this is far more reflective of a logistical-collector (seasonally?) settlement than a short-term camp or special activity site.

Raw material availability and transport capacity

At Namu the availability of raw materials must play a factor in this scenario. Because of the constant availability of these raw materials, the Early Period inhabitants were not overly concerned with conservation of raw materials, with the exception of imported fine-grained raw materials. The use of watercraft would have allowed year-round access to raw material sources, and also transport of large quantities of raw and worked materials over the landscape. By cutting the time and energy required for raw material procurement and transport the use of watercraft would in effect expand the potential search area used by foragers. More importantly the quick access time and transportability of raw materials would have alleviated factors related to risk management. That the Namu inhabitants were exploiting a large geographic area is reflected in the stunning diversity of raw material types in the collection. With this background generalized technologies without a heavy curational component make sense, especially in areas where available raw materials are not always fine-grained.

Alternatively if the inhabitants of this area moved exclusively on foot over land, the design requirements for the technology would drastically change, resulting in a very different type of stone tool assemblage. There would likely be a greater need for
conservation of all raw materials, which of course would be reflected in the formed tools and debitage.

There is a sizeable amount of large, still reducible material that has been discarded at Namu, strongly suggesting that the inhabitants were not overly concerned with conservation of these raw materials. These discarded materials occur in the form of large unmodified and retouched flakes, cores, pebble tools and bifaces. Many of these could be retouched several times if there was any pressure to conserve raw materials. Moreover many of the cores still have a large amount of mass, including one that weighs over four kilograms. The fact that these cores and tools were discarded in a usable state is highly suggestive of a raw material stockpiling strategy, which would be easily facilitated with the use of watercraft. Stockpiling toolstone would reduce the pressure to conserve the raw material while providing a steady supply. Since there is no source for the primary raw materials within the immediate locale at Namu, they had to be transported in from beaches and streambeds within the region, and possibly from Kwatna some 15km away. It is difficult to explain the density of lithic material at this site without invoking stockpiling, especially since the entire spectrum of reduction is taking place at Namu. Given the large number of secondary raw materials classified here as “Miscellaneous,” it is likely that they too were stockpiled. Creating and maintaining these stockpiles could not have been accomplished without the use of watercraft given the rugged terrain and extremely steep slopes that characterize this area. If the majority of raw materials were brought in on foot there would likely be a much greater effort in conservation due to the very high cost of transport. On the other hand with the use of watercraft collection of materials for the creation of stockpiles could be easily embedded into other activities.
But why stockpile raw materials in the first place? Such a strategy would not be expected at a special use campsite, unless it was used for a substantial part of the year. Parry and Kelly's (1987) classic paper argues that stockpiling of lithic raw materials is a common pattern at post mid-Holocene sedentary sites across North America, and it is assumed that the collection of stockpiled materials was embedded in other activities around the landscape. With the build up of stockpiles, there is also a shift from raw material conservative strategies such as biface and microblade manufacture to expedient core and flake-based industries. Hamilton (1994) found exactly this situation in his examination of the lithic materials at Meier, a late pre-Contact site in the Lower Columbia River Valley in Oregon.

For maritime hunter-gatherers employing watercraft, stockpiling raw materials would be relatively easy since they could load their vehicles (depending on size and carrying capacity) with suitable raw materials as encountered, or make special trips to known sources with much greater speed than their terrestrial counterparts. Creation of stockpiles would facilitate a constant supply of raw materials at a specific location where they could be modified for use as needed. At Namu the dominant strategy was an expedient core and flake based industry, followed by a biface industry. This conforms to Parry and Kelly's (1987) expectations for a sedentary site. Taken together with the inference of a wide range of activities this is reflective of an intense occupation resembling a sedentary (for at least part of the year) settlement. It is interesting to contemplate the stockpiling of lithic raw materials as analogous to storage of food products.
If Namu was indeed some type of “village” during the Early Period, stockpiling would have another crucial function: to provide raw materials for learning skills. Too often archaeologists assume that people in the past were born flintknappers, resulting in little to no consideration given to the role of training (Finlay 1997; Shelly 1990). These raw materials are qualitatively difficult to work with, they are generally physically very hard igneous rocks that require much practice to master. Modern day flintknappers with expertise in other materials such as obsidian and chert find it difficult to work with these coastal materials. In the experimental project to replicate the Namu material, only one flintknapper experienced with tough coastal basalts was located after a search of several weeks. In antiquity people likely started training on these materials at a young age, and having a constant supply of raw materials at a sedentary site would facilitate such a process. This may explain why some of the discarded pieces in the Namu midden look like learners modified them, even after taking the coarse-grained nature of the material into account. For example, some of the discarded bifaces exhibit very thin edges compared to their overall mass, in such cases it would be impossible to continue to work the piece into a functioning point or knife. An experienced knapper would have either corrected for this at an earlier stage or discarded the piece. On the other hand it is the type of “mistake” that one would expect from a learner. Secondly, it is obvious that most of the obsidian reduction at Namu centered around microblades. This technique requires training and practice and presumably the expensive obsidian would not be used for this purpose (at least on a large scale). The presence of both microblade cores and core preforms made on more local materials suggests that these were more likely used for learning and/or practicing.
Task requirements

Overall the lithic assemblage during the Early Period at Namu is reflective of a generalized technology, with some exceptions. Flakes and cores are the mainstays of the system and due to the physical toughness of the raw material, many of these items could have been used unretouched. It is always important to bear in mind, however, that organic materials were the primary raw materials and since there is little preservation of these in Period 1, the sample is highly biased towards lithics. Croes (1997) reports that at more recent and well-preserved wet sites such as Ozette, stone constitutes a paltry 5% of the raw materials used. Even if we accord a greater role to lithic raw materials during the Early Period, it is likely that bone, antler, shell and above all else wood were the primary raw materials for daily life. That said, all these raw materials do potentially need occasional modification with harder materials such as stone, and so chipped stone was probably much more important during the Early Period than in more recent times when the popularity of ground stone increased, especially for woodworking.

In order to evaluate task requirements as set out in the model in light of the Namu assemblage, a list is presented below in which the tasks are matched with potential tool types (see also Table 25). It is immediately apparent that many of the tool types in the Namu collection could be used in a number of tasks, again reflecting their generalized design.

Woodworking (chopping, bark removal, scraping, shaving, planing, cutting, sawing, drilling, shaping)

Procurement of fibrous raw materials (trees, branches etc.)
Construction and maintenance of watercraft and accessories (e. g. paddles)
Construction and maintenance of facilities for shelter, storage and defense
Construction and maintenance of facilities for hunting, trapping, gathering and fishing

318
Fabrication of hunting, gathering, fishing, defense and general use implements, including digging sticks, fiber cordage for rope, basketry, netting and others.
Construction of fire-starting utensils (drills and boards).
Procurement of firewood (kindling and larger pieces).
Carving of masks, totems or ceremonial items.

**Potential stone tools:** Core tools, core scrapers, pebble tools, unimarginal and bimarginal tools, unifacial tools, notches, wedges, drills, scrapers, scraper planes, ventrally retouched scraper planes, bifaces, unretouched flakes, hammerstones.

*Bone and antler modification (crushing, scraping, scoring, cutting, sawing, planing, drilling)*

- Manufacture of fishhooks and harpoons for harvesting land and sea resources.
- Manufacture of ceremonial, decorative and other items (e.g. beads, combs, musical instruments, gaming pieces).
- Manufacture of wedges for woodworking and other purposes.
- Breaking and cracking bone for nutrition (marrow) and raw material.

**Potential stone tools:** Core tools, pebble tools, unimarginal and bimarginal tools, unifacial tools, wedges, drills, scrapers, scraper planes, ventrally retouched scraper planes, pseudo-burins, backed bifaces, unretouched flakes, hammerstones.

*Soft organic material modification (scraping, cutting, perforating, crushing, pounding)*

- Hide scraping and working for clothing, containers and other uses.
- Removal and/or modification of other soft tissue such as internal organs to use as containers, binding, ceremonial gear and other uses.
- Harvesting, butchering and processing of animals, plants and fish for nutritional, medicinal, ceremonial or other purposes.
- Removal of shellfish adhering to rocks.
- Scarring human bodies for decorative/ceremonial purposes.
- Crushing/processing of paints and/or ochres.

**Potential stone tools:** Core scrapers, unimarginal and bimarginal tools, unifacial tools, scrapers, scraper planes, ventrally retouched scraper planes, perforators, bifaces, unretouched flakes, microblades, hammerstones.

319
Manufacture/ modification of lithic materials

Hard hammer percussion, core reduction, flake and tool production, abrasion
Learning and practice in making various tools
Manufacture and maintenance of hunting and gathering implements
Manufacture and maintenance of weapons for use during hostilities

Potential stone tools: Cores, core tools, core scrapers, pebble tools, unretouched flakes, bifaces, retouched flakes, hammerstones.

Prestige technologies
Microblades (obsidian?), some bifaces, rare raw materials.

<table>
<thead>
<tr>
<th></th>
<th>Woodworking</th>
<th>Bone and antler work</th>
<th>Soft organic work</th>
<th>Stone tool work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core tool</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Core scraper</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pebble Tool</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uniface</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Unimarginal tool</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Bimarginal tool</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Notch</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wedge</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drill</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudo-burin</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Perforator</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Spall Tool</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Scraper</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Scraper plane</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Ventrally Retouched Scraper Plane</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Biface</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Projectile Point</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Unretouched flake</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 25. Potential tasks involving Namu stone tools

As noted previously, Parry and Kelly (1987) argue that the trend towards greater sedentism should be accompanied by a decrease in specialized tools and an increase in generalized technologies. While true to some degree this expectation may not be
completely realistic. For example Sievert and Wise (2001) suggest that an increase in sedentary use of the Kilometer 4 site in Peru led to a greater range of activities represented in the diversity of tool forms. Despite the perceived specialization towards maritime resources during the Late Archaic, use of generalized technologies remains constant. So as the site becomes more the locus of a sedentary settlement, generalized core and flake technologies continue to dominate but specialized technologies continue to be used for certain tasks. Tomka (2001) suggests that a reduction in residential mobility should not automatically mean a shift towards generalized technologies, rather that task requirements remain a major consideration in technological design. The Namu assemblage echoes some of these findings in that generalized technologies dominate, but specialized technologies also continue to be manufactured and used.

At Namu there are some types of specialized technology, in particular the microblade industry and to a lesser extent, the biface industry. The vast majority of obsidian at Namu is used for microblade technology and in subsequent bipolar reduction. These two strategies are highly raw material conservative when used in sequence as at Namu. This material seems to have been brought into Namu in the form of microblade cores, and once these cores were expended, they were further reduced in a bipolar fashion (Hutchings 1996). In this manner, the obsidian was reduced to its maximum potential. Hutchings notes that the obsidian microblades display wear reflecting a number of uses, including as armatures for bone and antler composite harpoons. Some of these could also have been used as fish knives similar to those found at the Hoko River Site (Flenniken 1981).
There is one other aspect of the technology that could have served as fish processing implements. Elsewhere (Rahemtulla 1995b), I have suggested that debitage from unifacial reduction of river rolled cobbles make ideal expedient fish processing knives. This is a very simple and expedient technology that has been experimentally tested. This type of debitage is present throughout the Early Period sequence at Namu and many other NW coast sites. The cores are typologically classified as part of the Pebble Tool Tradition or Pasika Complex.

We should also expect some of the technology to be carried off site to be used elsewhere. For example, some bifaces may have served as projectile points during hunting expeditions. Almost all of the bifaces and projectile points in the Namu assemblage show breaks that are common during manufacturing, failures such as lateral snaps. These were the rejects; in other words the successful bifaces and points were probably carried off for use elsewhere. Theoretically the Namu assemblage is somewhat different to Parry and Kelly’s (1987) expectations, in that both the biface and microblade industries continue alongside the expedient coreflake technology. It is obvious that many successfully made bifaces and points were either carried off site or used somewhere else within the site.

We can speculate on the kinds of off site activities these implements may have been used for, but they likely involved a wide range of tasks ranging from hunting land and sea creatures, to cutting and sawing and for possibly for defensive purposes. The latter aspect is virtually ignored in discussions on the Early Period despite mounting evidence from early skeletal remains throughout the Americas exhibiting physical signs of violence. Later burials at Namu are associated with many grave goods including well
made lanceolate stone points as well as bone points, and an adult male skeleton has a bone point lodged in between two of his vertebrae (Luebbers 1978:32). Conflicts and hostilities must have occurred from time to time during the five millennia, and it is likely that some of the stone implements were used in this regard. Because of the constraints inherent in the coarse raw materials, it is unlikely that these bifaces were used as cores in the manner suggested for other areas (Bamforth 1991; Kelly 1988; Kelly and Todd 1988; Nelson 1991)

**Early Namu as a Sedentary Settlement: Multiple Lines of Evidence**

Examination of the Early Period lithics here adds to the growing body of evidence from Namu (Cannon 1991; Cannon and Yang 2006; Carlson 1979, 1994, 1996b). In evaluating the results of the present research, it is exceedingly important to do so in light of other work. The use of multiple lines of evidence is a powerful way in which to assess competing interpretations (Wylie 1985). The following is a description of the various lines of evidence from the Early Period noted in this research and other works. There is some overlap in these categories but they have been separated for the sake of clarity.

1) There is a high density of chipped stone raw materials recovered from the very small part of the site has been sampled. A diversity of stone tool types were manufactured at Namu, reflecting a diversity of tasks performed. These range from large and heavy core and pebble tools to delicate flake-based tools. A number of these are related to woodworking, scraping and possibly bone/antler modification.

2) The raw materials are transported into the site in large volumes and stockpiled. Most raw materials are medium-grained and qualitatively hard to work with. The entire reduction spectrum is represented at the site, from large core reduction to biface production. The exception to this is the obsidian industry. This material is imported from much further distance, and it is used primarily in the manufacture of microblades. Watercraft would be absolutely necessary to facilitate the stockpiling of more local materials, and trade of materials from distant sources.
3) During the first three millennia stone tools, cores and debitage are discarded continuously in the area of the Rivermouth Trench, and to a lesser degree at the Main Trench. It seems that most of the flintknapping is occurring at that location as well. After the first three millennia organic materials (fauna) are also discarded at the same locations. For the Early Period alone, this represents a midden accumulation of some five thousand years. The site is in use for another five thousand years.

4) The faunal evidence reflects a winter village settlement pattern beginning at least seven thousand (uncalibrated) years ago (Cannon 1991, 2000, 2003; Cannon and Yang 2006). A diversity of fauna is indicated, but marine products dominate. There is considerable evidence for storage of processed salmon.

5) Namu’s geographic location may be important. Situated on the confluence of Fitzhugh Sound and the Burke and Dean Channels, Namu could have played an important role in any trade networks that existed in the region. Obsidian trade networks were established relatively early (Carlson 1994). In terms of resources the Namu inhabitants would have benefited from their proximity to the ocean, river and a freshwater lake. This would have provided access to a diversity of plants and animals.

When all these lines of evidence are evaluated together, the most plausible explanation is that Namu was indeed some type of sedentary or semi-sedentary settlement during the Early Period. Even though faunal material is not present in the levels that document the first few millennia, the overall strategies for lithic raw material selection, transport, reduction and discard strongly suggest that this was no ephemeral campsite. Rather, this was the location at which populations used in an intensive manner, over some part or all of the year. It is far more difficult to explain this pattern as a seasonal campsite or special activity site. Use of the site certainly could have changed from time to time but the overall patterning is strongly indicative of a sedentary or semi-sedentary settlement. The notion of semi-sedentary settlements existing at this time counters common beliefs held by some archaeologists, beliefs that are built on theoretical premises and faulty analogies that now must be questioned.
Early Namu as a Sedentary Settlement: Implications for Theoretical Models

For some time now there has been a perception that all early populations on the Northwest Coast were “generalized” hunter-gatherers, and even though the specific terminology may not be invoked, it is implied in discussions (Butler and Campbell 2004; Matson 1992; Matson and Coupland 1995). This concept was developed for classic ethnographic terrestrial foragers who tend to have a high rate of residential mobility and an emphasis on hunting and gathering terrestrial products (Lee and DeVore 1968). But in a coastal temperate zone, the concept does not necessarily translate well. Among the many key differences from terrestrial hunter-gatherers, coastal peoples who have access to watercraft are able to develop fundamentally different settlement patterns, trade networks and subsistence strategies, even if they are “generalized” in terms of dietary breadth. The use of watercraft is an important issue that has not received enough treatment in studies on coastal hunter-gatherers (Ames 2002), and this is tied to the lack of ethnographic works on coastal hunter-gatherers in general.

Several lines of evidence now suggest that during the first half of the Holocene Namu was a sedentary settlement where people most likely practiced winter storage of salmon (following Cannon 1991). On a more general level this means that at least on some parts of the coast, there existed populations that were unlike any known terrestrial hunter-gatherers, nor were they analogous to their well-known “socially-complex” descendants that populated the coast in more recent times (Ames 1994). And yet they share many characteristics with both groups. Some have opted to use the term “maritime hunter-gatherer” to differentiate from classic terrestrial hunter-gatherers, but there are problems in defining exactly what the term maritime hunter-gatherer means, as coastal
environments are complex and peoples in such areas use the various resources differentially (Yesner 1980; Ames 2002).

Many archaeologists tend to correlate increasing sedentism and use of storage with increasing population density and socio-political complexity, which is problematic. Using a range of ethnographic data Binford (1990) demonstrates that there is no necessary correlation between sedentism and storage on the one hand, and social complexity on the other. On the Northwest Coast the prevailing thought until recently favoured a late co-development of storage, sedentism and social complexity (Matson 1992; Matson and Coupland 1995). Others have begun to question this linear developmental scheme (Cannon 2006; Moss and Erlandson 1995:34) and Maschner (1999) argues strongly against this idea in his long-range study of settlement on the Alaska Peninsula.

If Namu was not a sedentary settlement during the Early Period, then the incredible longevity, extent of deposits and variety of cultural material become more difficult to explain. Other factors need to be considered though; the site has a number of features that would be desirable to early settlers but Cannon (2002) has recently argued that environmental/physical factors alone cannot explain the continual occupation of Namu particularly during the early part of the Holocene. Instead he argues that social constraints may have played a role in Namu's virtually continuous occupation during the Early Period, and the lack of other settlements in the area until much later.

This interesting argument is thought provoking and adds a needed humanist balance to the evolutionary/ecologically-derived interpretations that dominate the discussion. There are other physical factors, however, that may come into play in the
deliberation of Namu’s longevity as a sedentary settlement. The first is the presence of a large freshwater lake immediately behind the site (Fig. 1). This water body forms part of the Namu River drainage, and it most likely provided additional resources as it did in more recent times (Pomeroy 1980). Deer and other terrestrial mammals come down from the adjacent areas to drink the water, and so many of the lakeshore areas would be ideal hunting and/or trapping grounds. Heiltsuk informants note that in more recent times several villages were located around the lake. It is difficult to imagine that this body of water did not play a major role in human lives throughout Namu’s existence, given its proximity to the site.

An additional factor is Namu’s physical location immediately south of the confluence of Fitzhugh Sound and the Burke Channel. Obsidian (and presumably other materials) was widely traded throughout this entire region beginning in the early Holocene (Carlson 1994), and Namu is in an ideal geographic position to take advantage of trade networks extending to the north, east and south. Given the meager evidence it is difficult to try and decipher the mechanisms of these very large trade networks, but the sheer volume of imported obsidian at Namu indicates that this was more than down the line trading. Almost 140g of obsidian shatter (does not include microblades and cores) were recovered from a 6m X 2m X 1m area during the 1994 excavation. This may not seem like much, but it is important to keep in mind that this obsidian originates from sources that are several hundreds of kilometers in distance. It would be surprising if the obsidian were not obtained in some organized manner, particularly given the low population densities at this time (Ames and Maschner 1999; Cannon 2006). Although highly speculative, the Namu inhabitants could have played a role in the trade for
obsidian and other products originating from the Rainbow Mountains on the Plateau to the east, as well as sources to the north and south. In such a scenario, Namu would have been much more important than a simple village perpetuated by generations of related lineages; it would have been an important trade centre for people in neighbouring regions as well. As such, extensive longevity in site use would not be surprising. Perhaps it is the combination of some or all of these factors that contributed to the Namu phenomenon.

A key argument against permanent settlements during this time is the lack of any unambiguous living and/or storage structures (Ames and Maschner 1999:262). This lack of evidence is problematic, but part of the problem may be that we do not know exactly what we are looking for. Archaeologists commonly look for evidence of post-holes, hearths and "floors" within midden profiles, but these tend to occur after the midden has been well established at a site. Moreover such features characterize more recent cedar house forms that were essentially built directly on the ground. Housing and storage structures, however, may have taken an entirely different form during the first half of the Holocene. The earliest cultural material at Namu rests on a sterile sand layer that has been interpreted as glacial till (Carlson 1991, 1996b), or may be a beach deposit. At any rate, such a substrate would likely discourage construction of on-ground or even semi-subterranean structures, as would the extensive bedrock outcrops in the local area. Alternatively, ethnographic peoples in similar foreshore microenvironments often build structures on stilts. This affords protection from ground moisture as well as from non-human scavengers (Rahemtulla and Cannon 2001).

The ethnographic Kamchadal for instance on the Far East coast of Russia built log structures on stilts in foreshore environments for both living and storage (Jochelson
Such structures functionally make sense given the available raw materials and the wet and sandy environment in which the sites are located. Elsewhere Captain Cook’s party (Beaglehole 1988) also recorded log house structures on stilts in coastal Alaska, and houses on stilts continued to be used into the historic period on the central coast (McIlwraith 1992). These structures can be built from any type of timber, and the stone tool technology at Namu is adequate enough to facilitate their construction. If the early inhabitants at Namu and other sites on the coast were using these kinds of structures the evidence would be very difficult to locate given the spatially limited excavations that are dictated with deep middens. That said, negative evidence is of course extremely weak at best, but if storage and sedentism are indicated in other lines of evidence then the lack of structural remains needs some thought. The classic cedar plank structures of more recent periods on the coast are obviously a poor analogue to any possible structures built before the availability of cedar in the latter half of the Holocene (Hebda and Mathewes 1984), and so when looking for Early Period structures we may need to explore a wider range of possibilities.

That coastal hunter-gatherers are unique has been argued for some time now (e.g. Yesner 1980), but the idea of early generalized coastal hunter-gatherers continues to linger. The notion of generalized hunter-gatherers carries certain implications, notably a high rate of residential mobility and an emphasis on terrestrial hunting. While it may be true that many early populations on the Northwest Coast were generalized in terms of subsistence breadth, it is difficult to envision them within the same environmental and social parameters as classic ethnographic generalized hunter-gatherers (Lee and DeVore1968). The analogy is even weaker when watercraft are put into the mix. The use
of watercraft by hunter-gatherers particularly in coastal environments would have a tremendous effect in all aspects of daily social life, ranging from subsistence, trade, warfare and uses of the landscape to name a few. This presents a problem in that there are comparatively very few ethnographic studies on coastal hunter-gatherers, and so the effects of use of watercraft on human short and long-term settlement, subsistence, and sociality are poorly understood. It may be fair to say that we are only beginning to understand that foragers in boats may be very different than the vast majority of ethnographic terrestrial foragers that have been used to build up our theoretical models and assumptions. The recent flurry of publications on indigenous North American watercraft is confirmation of this (see for example Cassidy 2004; Des Laurier 2005). Moreover there is now a growing body of archaeological literature on Early Holocene coastal hunter-fisher-gatherers particularly in the Americas (Erlandson 1994; Erlandson et al. 2004; Sandweiss et al. 1998).

The use of watercraft is critical to our understanding of Early Period lifeways, as this factor has a tremendous impact on the development of logistical organization, subsistence, trade and other aspects. It would seem that the relatively small number of ethnographic studies on coastal peoples with access to watercraft tends to act as a constraint on our archaeological interpretations. Simply put, it is difficult to envision chipped stone using coastal hunter-gatherers in sedentary situations because we have no ethnographic models for this. Moreover the archaeological evidence is spotty, partially due to the complex history of sea levels on the coast that has resulted in the drowning of a large portion of the Early Period landscape (Clague et al. 1982). The antiquity of aquatic adaptations is in itself problematic due to a similar lack of evidence in other parts of the
world, but Erlandson (2001) has made a compelling argument in support of a greater
temporal depth of aquatic adaptations in human history.

While it is important to acknowledge that the Namu data are still meager and open
to alternative interpretations, the chipped stone tools in combination with other lines of
evidence suggest that logistical organization and some form of sedentary settlement were
in place by the early Holocene. This in turn questions the long-standing assumption that
storage, sedentism, population growth and increased social complexity developed at a
much later time on the coast. Whatever the case, it seems clear that we have no
ethnographic analogues for what was happening during the Early Period on the central
coast of British Columbia, and we must therefore approach the archaeological record
with creative caution.

In conclusion, stone tools can be the result of complex negotiations on the part of
their makers. Local and long-term histories, individual skills and ambitions,
physiography and terrain, mobility and transport modes, land-use and settlement, raw
material types and accessibility, and task requirements are some of the variables that need
to be considered in the design of chipped stone technologies. At Namu these factors
contribute to what outwardly looks like a simple technology. Morphologically it may
look simple, but the design and organization of this technology is part of a larger and
sophisticated response to physical and social contingencies that operated at different
scales for several millennia. The proof for the success of these strategies is the
remarkable longevity in the use of this site. Something very unique was going on at
Namu during the first (and last) half of the Holocene. Or was it really that unique at all?
References Cited

Ackerman, R. E.

Ackerman, R. E., T. D. Hamilton, and R. Stuckenrath

Ackerman, R. E., K. C. Reid, J. D. Gallison, and M. E. Roe

Ahler, S. A.

Ammerman, A. J. and M. W. Feldman,

Ames, K. M.

Ames, K. M. and H. G. D. Maschner

Amick, D. S. and R. P. Mauldin
Amick, D. S. and R. P. Mauldin (eds.)

Andrefsky, W. A.

Andrefsky, W. A. (ed.)

Andrews, J. T. and R. M. Retherford

Apland, B.
1982 Chipped stone assemblages from beach sites on the central coast. In *Papers on Central Coast Archaeology*, edited by P.M. Hobler, pp. 13-64. Simon Fraser University, Department of Archaeology, Publication No. 10, Burnaby.

Baer, A. J.

Bamforth, D. B.

Bard, E., B. Mamelin, R. G. Fairbanks and A. Zindler

Barton, C. M.
Baumler, M. F.

Baumler, M. F. and C. E. Downum


Behm, J. A.

Bever, M. R.

Binford, L. R.


Binford, L. R. and G. I. Quimby

Binford, L. R. and S. Binford
Blaise, B., J. J. Clague, and R. W. Mathewes

Bleed, P.,
2001 Trees or branches, links or chain: archaeological models for the consideration of stone tool production and other sequential activities. *Journal of Archaeological Method and Theory* 8:101-127.

Borden, C. E.

Bordes, F. and D. Soneville-Bordes

Bousman, C. B.

Boyd, R. T.

Bradbury, A. P.

Bradbury, A. P. and P. J. Carr


Bradbury, A. P. and J. D. Franklin


Breffitt, J. R.


Brisland, R. T. W.


Bunn, H. T., J. W. K. Harris, Z. Kafulu, E. Kroll, K. Schick, N. Toth, and A. K. Behrensmeyer,


Butler, R. B.


Butler, V. L. and S. K. Campbell


Cahen, D., L. Keeley and F. L. van Hoten


Callahan, E. C.


Camilli, E.

Cannon, A.

Cannon, A., H. P. Schwarcz and M. Knyf

Cannon, A. and D. Yang

Carlson, C. C.

Carlson, R. L.

Carlson, R. L. and P. M. Hobler

Carr, P. J.
1994b Technological organization and prehistoric hunter-gatherer mobility: Examination of the Hayes Site. In The Organization of North American Prehistoric

Chatters, J. C.,

Clague, J. J.

Clague, J. J., J. R. Harper, R. J. Hebda and D. E. Howes

Collins, M. B.

Conover, K. J.

Cotterrell, B. and J. Kamminga

Coupland, G.

Cowan, F. L.

Crabtree, D. E.
Croes, D. R.

Curtin, A. J.

Deal, M. and B. Hayden

Dibble, H. L.

Dibble, H. L. and A. Pelcin

Dibble, H. L. and J. C. Whittaker

Dixon, E. J.

Drucker, P.

Ellis, C. J. and J. C. Lothrop (eds.)
Engelbrecht, W. E. and C. K. Seyfert

Ensor, H. B. and E. R. Roemer, Jr.

Erlandson, J. M.

Erlandson, J. M. and T. C. Rick

Erlandson, J. M., T. C. Rick and M. R. Batterson

Farrand, L.

Fedje, D. W.

Fedje, D.W. and T. Christensen

Fedje, D. W. and H. Josenhans

Fedje, D. W., R. Wigen, Q. Mackie, C. Lake and I. Sumpter
Ferguson, W. C.

Fladmark, K. R.
1979b The early prehistory of the Queen Charlotte Islands. *Archaeology* 32:38-45.
1982b *Fire and Ice: the Archaeology of Mt. Edziza*. Department of Archaeology, Simon Fraser University Publication No. 14, Burnaby, B.C.

Flenniken J. J.

Foley, R.

Francis, J.

Freeman, L. G.
Frison, G. C. and L. C. Todd

Gallagher, J. P.

Goodyear, A. C.


Gould, R. A. and S. Saggars

Grabert, G. F.
1979 Pebble tools and time factoring. Canadian Journal of Archaeology 3:165-175.

Grier, C.

Haley, S. D.
1987 The Pasika Complex Cobble Reduction Strategies on the Northwest Coast. Unpublished Ph.D. Dissertation, Department of Archaeology, Simon Fraser University, Burnaby, B.C.

Hall, C. T. and M. L. Larson (eds.)

Hall, D. R.
1998 Tsini Tsini: A Technological Analysis of a Biface Production Centre in the Talchako River Valley, B.C. Unpublished M.A. Thesis, Department of Archaeology, Simon Fraser University, Burnaby, British Columbia.
2003 Paleoenvironments, the Tsini Tsini Site, and Nuxalk oral histories. In Archaeology of Coastal British Columbia: Essays in Honour of Professor Philip M.

Hamilton, S. C.
1994 Technological Organization and Sedentism: Expedient Core Reduction, Stockpiling and Tool Curation at the Meier Site (35CO5). Unpublished M.A. Thesis, Department of Anthropology, Portland State University.

Harris, H.

Hayden, B.
1986 Resource models of inter-assemblage variability. Lithic Technology 15:82-89.

Hayden, B. and R. Gargett,

Hayden, B. and W. K. Hutchings

Hayden, B., N. Franco and J. Spafford,

HCEC (Heiltsuk Cultural Education Centre)
1989 Information Package on the Bella Bella Heiltsuk. Heiltsuk Cultural Education Centre, Waglisla, B.C.

344
Healan, D. M.

Heaton, T. H., S. L. Talbot and G. F. Shields

Hebda, R. and R. W. Matthewes

Hebda, R. and S. G. Frederick

Henry, D. O. and G. H. Odell (eds.)
1989 *Alternative Approaches to Lithic Analysis*. Archaeological Papers of the American Anthropological Association, No. 1

Hester, J. J.

Heusser, C. J.

Hilton, S. F.

Hobler, P. M.


Hodgetts, L. and F. Rahemtulla

Holmes, W. H.

Hood, B. C.

Horsfall, G.,

Hutchings, W. K.
Ingbar, E.

Ingbar, E. E., M. Larson and B. A. Bradley

Jelinek, A. J., B. Bradley and B. Huckell

Jeske, R.,

Jochelson, W.

Jochim, M. A.

Johnson, J. K.

Johnson, J. K. and C. A. Morrow (eds.)
1987 The Organization of Core Technology. Westview Press, Boulder, CO.

Jordan, J. W. and H. D. G. Maschner
Josenhans, H., D. W. Fedje, K. W. Conway and J. V. Barrie


Keeley, L.,

Kelly, R. L.,

Kelly, R. L. and L. C. Todd

Kleindienst, M.,

Kuhn, S. L.,

Larson, M. L.

Leblanc, R. and J. W. Ives
Leblanc, S.

Lepofsky, D.

Luebbers, R.

Lothrop, J.C.,

Lurie, R.,

1989 Late Pleistocene terrestrial deposits on the continental shelf of Western Canada: evidence for rapid sea-level change at the end of the last glaciation. *Geology* 17:357-360.

Lyons, C.

McAnany, P. A.

MacIlwraith, T. F.

McLaren, D., R. J. Wigen, Q. Mackie, and D. W. Fedje

349
McMillan, A. D. and D. E. St. Claire
2005 *Ts’ishaa: Archaeology and Ethnography of a Nuu-chah-nulth Origin Site in Barkley Sound.* Archaeology Press, Department of Archaeology, Simon Fraser University, Burnaby.

Magne, M. P.

Magne, M. P. and D. Fedje

Magne, M. P. and D. L. Pokotylo

Mann, D. H. and D. M. Peteet

Marks, A. E., J. Shokler, and J. Zilhao,

Maschner, H.G.D.
Matson, R. G.


Matson, R. G. and G. Coupland

Matthewes, R. W.

Mellars, P.,

Metz, D.

Meyers, A.,

Millennia Research Ltd.

Miller, T. O.

Mitchell, D. H.
Mitchell, D. and D. L. Pokotylo

Mobley, C. M.

Monks, G. G.

Montet-White, A. and S. Holen (eds.),

Morrison, D. M.

Morrow, T. A.

Morrow, C.A. and R.W. Jeffries,

Moss, M. L. and J. M. Erlandson

Movius, H. L.

Muto, G. R.

Nance, J. D.

Nash, S. E.,


Nelson, M.,

Newcomer, M. H.

Odell, G. H.,
Odell, G. H. (ed),

Olson, R. L.

Oswalt, W. H.,

Park, R. W.

Parry, W. J. and R. L. Kelly,

Patterson, L. W. and J. B. Sollberger

Pecora, A. M.

Pelcin, A. W.

Pokotylo, D. L.
1978 Lithic Technology and Settlement Patterns in the Upper Hat Creek Valley, B.C. Unpublished Ph.D. Dissertation, Department of Anthropology and Sociology, University of British Columbia, Vancouver.
Pomeroy, J. A.

Prentiss, W. C.

Prentiss, W. C. and E. J. Romanski

Rahemtulla, F.
1995b Yet another reconsideration of the Northwest Coast Pebble Tool Tradition. Paper presented at the Northwest Anthropology Conference, Portland, OR.

Rahemtulla, F. and A. Cannon
2001 Early baseline adaptations on the central coast of British Columbia. Paper presented at the meetings of the Canadian Archaeological Association, Banff, AB.

Ramsey, C. J., P. A. Griffiths, D. W. Fedje, R. J. Wigen, and Q. Mackie
2004 Preliminary investigation of a late Wisconsinan fauna from K1 cave, Queen Charlotte Islands (Haida Gwaii), Canada. Quaternary Research 62:105-109.
Rasic, J. and W. Andrefsky

Reimer, R.

Retherford, R.

Rick, T. C., J. M. Erlandson and R. Vellanoweth

Rule, P. and J. Evans

Runnels, C.


Seddon, M. T.

Sellet, F.

Semenov, S. A.
Shelley, P. H.

Shott, M. J.

Sievert, A. K. and K. Wise

Smith, C.
2003 Use-wear study on ElSx-1:1841. Manuscript on file at the Archaeology Laboratory, University of Northern British Columbia.
2004 The social organization of production in three protohistoric Lower-Columbia River plank houses. Unpublished PhD dissertation, Department of Archaeology, Simon Fraser University, Burnaby, B.C.

Smith, H. I.

Southon, J. and D. W. Fedje
1998 A 12,000 year record of $^{14}$C reservoir ages for the British Columbia coast. Paper presented at the 31st annual meetings of the Canadian Archaeological Association, Victoria, B.C.

Stafford, C. R. and B. D. Stafford

Stahle, D. W. and J. E. Dunn
Stein, J. K.

Storck, P. L. and P. H. von Bitter

Stuiver, M. and P. J. Reimer
1987 User’s Guide to the Programs CALIB and DISPLAY 2.1. Quaternary Isotope Laboratory, Quaternary Research Center, AK-60. University of Washington, Seattle, WA.

Stuiver, M., B. Kromer, B. Becker and C. W. Ferguson

Sullivan, A. P. III

Sullivan, A. P. III and K. C. Rozen

Sullivan, G. M.

Tankersley, K. B.

Teltscher, P. A.

Thompson, L. C. and M. D. Kinkade
Tixier, J.
1974 Glossary for the description of stone tools. With special reference to the
Epipalaeolithic of the Maghreb. Translated by M. H. Newcomer. Newsletter of Lithic
Technology: Special Publication Number 1.

Tomka, S. A.
1989 Differentiating lithic reduction techniques: an experimental approach. In
Experiments in Lithic Technology, edited by D. S. Amick and R. P. Mauldin, pp. 137-
162. BAR International Series No. 528, Oxford.
2001 The effect of processing requirements on reduction strategies and tool form: a
new perspective. In Lithic Debitage: Context, Form, Meaning, edited by W.

Torrence, R.
1983 Time budgeting and hunter-gatherer technology. In Hunter-Gatherer Economy in
Cambridge University Press.
1989b Re-tooling: Towards a behavioural theory of stone tools. In Time, Energy and
Stone Tools, edited by R. Torrence, pp. 57-66. Cambridge University Press,
Cambridge.
1994 Strategies for moving on in lithic studies. In The Organization of North American
International Monographs in Prehistory, Archaeological Series 7, Ann Arbor, MI.

Torrence, R. (ed.)

Toth, N.

Trigger, B. G.

White, J. P. and D. H. Thomas
1972 What mean these stones? Ethno-taxonomic models and archaeological
interpretations in the New Guinea Highlands. In Models in Archaeology, edited by D.

Wiley, G. and P. Phillips
1958 Method and Theory in American Archaeology. University of Chicago Press,
Chicago.

Wilmsen, E. N.
Winterhalder, B. and E. A. Smith (eds.)

Yang, D., A. Cannon and S. R. Saunders

Zita, P.
Appendix A

Key and description of database categories

(CAT) Catalogue number
All catalogue numbers of artifacts recovered during SFU excavations are preceded by the Borden designation for Namu, ElSx-1. The University of Colorado excavations used a different numbering system (see Luebbers 1978). During the analysis a number of inconsistencies were noted in that many of the catalogue numbers on the artifacts did not match up with those in the actual catalogue. As a result, a number of artifacts are incorrectly labeled, so that two or more pieces share the same catalogue number.

Unit
For ease of data collection the excavation units at the Rivermouth Trench were numbered. The six 2m X 2m excavation units start (as measured from site datum) from W4 – 6, S 66 – 68 (Unit 1) to W8 – 10, S 64 – 66 (Unit 6). Units 1, 2, and 3 were excavated by SFU during the 1994 season while units labeled 4, 5, and 6 were excavated in 1978.

(Lv) Level and Period Correlation
During the 1994 excavations in the Rivermouth Trench debitage were collected in level bags and with the exception of the basal level, all are 10cm in depth. Basal level measurements recorded during the 1978 excavations are slightly different, but the debitage recovered during those excavations are not included in the present study. Based
on Carlson’s (1995) study of the stratigraphy and chronology a rough correlation with periodization was used to separate debitage from Periods 1 and 2. In some cases very little or no debitage was recovered in certain level bags dated to Period 2 (see Chapter 4).

This scheme does not apply to tools from the Rivermouth or Main Trenches, which are reported by period based on the layer in which they were recovered.

<table>
<thead>
<tr>
<th>Depth Below Surface</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>390 – 420</td>
<td>1</td>
</tr>
<tr>
<td>380 – 390</td>
<td>2</td>
</tr>
<tr>
<td>370 – 380</td>
<td>3</td>
</tr>
<tr>
<td>360 – 370</td>
<td>4</td>
</tr>
<tr>
<td>350 – 360</td>
<td>5</td>
</tr>
<tr>
<td>340 – 350</td>
<td>6</td>
</tr>
<tr>
<td>330 – 340</td>
<td>7</td>
</tr>
<tr>
<td>320 – 330</td>
<td>8</td>
</tr>
<tr>
<td>310 – 320</td>
<td>9</td>
</tr>
<tr>
<td>300 – 310</td>
<td>10</td>
</tr>
<tr>
<td>290 – 300</td>
<td>11</td>
</tr>
<tr>
<td>280 – 290</td>
<td>12</td>
</tr>
</tbody>
</table>

**Unit 1**
270/280 – 310/320 cm DBS: SU2B, Period 2
320 – 340 cm DBS: SU 2B, Period 1C
340 – 370 cm DBS: SU 2A, Period 1B
370 – 390 cm DBS: SU 2A, Period 1A

**Unit 2**
290/320 – 350/360 cm DBS: SU 2B, Period 2 (with some intrusions from above)
350/360 – 400 cm DBS: SU 2 (with some intrusions from above)
   360 – 380 cm DBS: SU 2B, Period 1C
   380 – 400 cm DBS: SU 2A, Period 1A/1B

**Unit 3**
330 – 360/390 cm DBS: SU 2B, Period 2
390 – 400 cm DBS: SU 2B, Period 1C
400 – 420 cm DBS: SU 2B, Period 1C

Based on changes in stratigraphy, dating and artifact content Carlson (1996b; Table 2) divides Period 1 into three components:

- Period 1A: 10,000 – 9,000 $^{14}$C BP
Period 1B: 9,000 – 8,000 $^{14}$C BP  
Period 1C: 8,000 – 6,000 $^{14}$C BP  
Period 2: 6,000 – 5,000 $^{14}$C BP

(RM) Raw Material Classification  
Five primary raw material categories were employed in characterizing the Namu raw materials. There is a very diverse range of materials represented and there is likely much overlap between the first four groups (see Chapter 4).

1) Basalt/Dacite Group  
2) Andesite/Dacite Group  
3) Trachyte Group  
4) Miscellaneous Group  
5) Quartz

(SZ) Size category  
Debitage were size sorted according to the mass analysis technique outlined by Ahler (1989a). Following Ahler, a setup consisting of four nested screens was set up. Debitage were put through this setup as the whole apparatus was gently moved back and forth to facilitate the sorting process. The size grades refer to the mesh size of the hardware cloth used in the screens.

1) G1 1”  
2) G2 1/2”  
3) G3 1/4”  
4) G4 1/8”

(#) Number of Pieces  
This count was designed for level bags, the vast majority of which contained more than one piece. In cases where tool forms were recovered in artifact bags, they were either given new numbers or received a letter designation after the number (e.g. ElSx-1: 3597a). In some cases many tools were recovered from level bags and tailings bags, requiring the use of many letters in conjunction with a single artifact number.

(Wgt) Weight  
Weight measured in grams. Most weights were measured using a triple beam balance, although an electronic balance was used in some cases. Tools were weighed individually but debitage collected in level bags were size sorted and weighed en masse.

(AW) Average Flake Weight  
Debitage were subject to mass analysis and so this is the average flake weight in grams for each size category. For example a collection of 24 G3 flakes weighs 24g, so the average flake weight for the size class is 1g.
(CR) Pieces with cortex
The Mass Analysis technique requires quantification of number of flakes with cortex within each size grade (Ahler 1989a). Actual amount of cortical cover on each piece is unimportant in this technique.

(FC) Flake completeness
During the individual flake analysis a modified version of the Sullivan and Rozen (1985) scheme was used, as modified by Prentiss and Romanski (1989). Flake categories:

1) complete
2) proximal (intact margins)
3) medial/distal
4) split flake
5) non orientable (shatter)

(FT) Flake type
This classification refers to flake types as set out in Magne (1985). This was used to classify the following flake types.

1) Shatter
2) BRF (Biface Reduction Flake)
3) Bipolar flake
4) PRB (Platform Remnant Bearing flake)

(SF) Special Flakes
During the previous round of research the number of Secondary Multiple Flakes and Unifacial Core reduction flakes was quantified to assess the contribution of flakes derived from river rolled cobbles. Although these data were also collected in present research the results are not used, as they do not contribute to the current argument.

1) SMF (Secondary Multiple Flake)
2) Unifacial core reduction flake

(Pp) Platform prep.
Ode11 (1989) argues that the preponderance of dorsal perimeter scarring is indicative of late stage reduction, specifically biface manufacture. This platform preparation is necessary to stabilize the biface edge prior to flake removal. In the present research, however, this attribute is not altogether useful since the raw materials are so physically hard that almost all reduction, whether early or late stage, requires intense platform preparation. While it is true that biface reduction with these raw materials requires a higher intensity of platform preparation as noted in the experimental portion of the
research, distinguishing between different levels of intensity would require too much energy, and the results would likely not be compelling.

0) Absent 
1) Present

(PC) Platform Cortex
Magne's (1985) debitage analysis requires the simple quantification of platform cortex to determine potential place in the reduction sequence.

0) none
1) 0-30%
2) 30-60%
3) 60-100%

(PS) Platform scars
Platform scar quantification is important in the flake analysis proposed by Magne (1985), although this technique was very difficult to apply on these coarse raw materials (see text). An incandescent lamp was used as well as a 20X hand lens but these did not alleviate the problem.

1) 0-1
2) 2
3) 3
4) >3

(PA) Platform Angle
Platform angle on flakes was measured with the aid of a goniometer. This measurement is the angle that forms between the horizontal plane extending from the platform, and the interior surface of the flake.

\[
\text{XX}^\circ
\]
**DC) Dorsal Cortex**
The amount of dorsal cortex on a flake can lead to understanding where it fits into a reduction sequence (Magne 1985). Four categories were used to classify flakes according to amount of cortex.

0) none  
1) 1-30%  
2) 30-60%  
3) 60-100%

**DS) Dorsal Scars (>2mm):**
The number of dorsal scars on a flake is important in determining reduction strategy (Magne 1985). In some cases quantification of scars was very difficult due to the nature of the raw materials.

1) 0-1  
2) 2  
3) >3

**L) Lipping**
The presence of lipping on the inner edge of the striking platform has been argued as potentially indicative of soft-hammer production (Hayden and Hutchings 1989), and as part of the constellation of attributes that characterize bifacial reduction flakes. Unfortunately for the purposes of this research, this category was not very useful, likely due to the nature of the raw material.

0) Absent 1) Present

**CR) Core Type**
Cores were classified in terms of type of flaking exhibited in scars. Unidirectional cores exhibit one platform from which all flakes are removed; multidirectional cores display two or more separate platforms from which flakes were struck. Bipolar cores exhibit force of impact from two directions, while blade cores display the purposeful removal of blades. Only one piece in the entire collection is classified as a blade core, and it is subsumed under unidirectional cores.

1) Unidirectional  
2) Multidirectional  
3) Bipolar  
4) Blade
(CC) Cortex on Core
The amount of cortical cover on the core surface was estimated through the use of four categories.

0) none  
1) 1-30%  
2) 30-60%  
3) 60-100%

(MC) Microblade Core
Artifacts classified as Microblade Cores were further classified as being unidirectional (single platform) or multidirectional (two or more platforms). Microblade core preforms consist of various morphologies based on split cobbles or thick flakes. The intentional shaping of the core is obvious, as is the platform preparation. While some workers call these pieces “scraper planes”, it is suggested that in this collection, scraper planes are larger in size. These artifacts are in the correct size range for microblade production.

1) Unidirectional  
2) Multidirectional  
3) Preform

(BS) No. of blade scars
The number of blade scars on microblade cores was quantified into three categories to decipher the stage of development in the core’s use life.

1) 1-3  
2) 4-10  
3) >10

(MB) Microblade or Microblade fragment
Items classified as microblades or microblade fragments received an affirmative in this category. This was a difficult procedure as flakes that look like microblades were produced throughout the reduction sequence in the experiments.

(BI) Biface
Artifacts that are bifacially flaked but too general to classify otherwise were assigned to this category. Pieces in this category have a morphology that could ultimately be used as a knife, point, scraper or for some other function. In other words their morphology is such that they could not be definitively classified as points, and they are quite large in general. They are much larger and heavier than pieces classified as Projectile Points and Point Preforms, and as such, if hafted and employed as points they were more likely used in
close contact rather than thrown from a distance. They are quite large in cross section (average thickness: 12mm) and have higher edge angles (average edge angle 54°).

(BP1) Biface base
Basal portion of bifacial tool with a generalized point/knife morphology.

(BP2) Biface tip
Tip portion of bifacial tool with a generalized point/knife morphology.

(BP3) Biface end
End segment of bifacial tool with a generalized point/knife morphology. These end segments are not worked to a degree in which they can be classified as tips or bases.

(BP4) Biface medial
Medial segment of bifacial tool with a general point/knife morphology. Tip and base are missing.

(BB) Backed Biface
Backed bifaces exhibit at least one margin with bifacial flaking while another margin (usually opposite) is backed via intentional breaking of the piece. Apland (1974) discovered a number of these in his examination of collections from the central coast.

(LAB) Large Asymmetrical Biface
Large asymmetrical bifaces are bigger than most bifaces and points in the general collection. They are also asymmetrical in that they exhibit more mass on one side of the biface than the other. During the experimental replication we noted that this was a common morphology for many of the bifaces in mid production. The nature of the raw material is such that often one entire margin of the biface is reduced to a particular stage before moving to the other margin. Moreover most of these exhibit lateral snaps of the kind that occur during manufacture. That said, some of these bifaces are very thin for their overall size and given the nature of the material, it seems that an experienced knapper would have realized the difficulty in creating a straight sharp edge with such forms. A number of these pieces may be the result of learning and/or practice.

(STB) Small Thick Biface
This is a curious category in that these pieces are fairly small and yet they retain a significant amount of mass. Many of them are in a very early stage of production and with this raw material it is extremely difficult to envision anyone completing a point from these pieces. High edge angles are common as would be expected.
(SBF) Small Biface Fragment
This is a general category in which bifacially worked pieces were assigned. They are different from general bifaces in their smaller size, which warrants a separate classification.

(UN) Uniface and (UNF) Uniface Fragment
Unifacial tools display retouch or flaking where the flake scars are greater than 5mm from the edge of the piece (Magne 1984).

(UM) Unimarginal Tool and (UMT) Unimarginal Tool Fragment
Unimarginal tools exhibit retouch that ranges from 2 – 5mm from the edge (Magne 1984). A unimarginal tool can display multiple edges that have been modified in this manner.

(BT) Bimarginal Tool and (BMT) Bimarginal Tool Fragment
These are pieces that exhibit unimarginal retouch on two adjoining faces. The extent of retouch varies from small segments to the entire perimeter.

(PP) Projectile Point
Complete projectile points exhibit a number of features that reflect their ability to penetrate, cut, and be hafted and thrown with or without the aid of an atl atl. In general they are significantly smaller and lighter than pieces identified as Bifaces or Point Preforms. They are thin in cross section (average thickness: 6mm) have sharp margins (average edge angle: 45°) capable of cutting and sharp tips that could potentially penetrate a target when imbued with enough force. Lastly, they display bases that have been thinned to a stage where they could be hafted. There is much overlap between this category and Projectile Point Preform category. In essence they should be seen as a continuum rather than as discrete categories.

(PP1) Projectile Point base
Basal segment of projectile point.

(PP2) Projectile Point tip
Tip segment of projectile point.

(PP3) Projectile Point medial
Medial segment of projectile point. Tip and base are missing.
**(PP4) Projectile Point preform**
Pieces classified as Projectile Point Preform exhibit a suite of characteristics that suggest their final form as Projectile Points. They are slightly larger and thicker than projectile points (average thickness: 9mm) and have margins that are not quite sharp enough to function as efficient cutting edges (average edge angle: 55°). They also have tips that are not quite sharp enough to penetrate a target if used as a projectile, and they may have bases that are not yet suitable for hafting. That said their morphology indicates that they could be a stage in the manufacture of projectile points. They are also smaller and lighter than pieces classified as Bifaces.

**(PP5) Projectile Point Preform base**
Basal segment of projectile point preform

**(PP6) Projectile Point Preform tip**
Tip segment of projectile point preform

**(PP7) Projectile Point Preform medial**
Medial segment of projectile point preform

**(BRF) Bifacially Retouched Flake**
Flakes that exhibit some bifacial retouch

**SC Scraper**
Scraper are flakes that have been modified to have a high angle of retouch on one or more margins. Nine sub-categories were identified based on the location of the scraping edge. The significance of these differences in margin of retouch has more to do with the initial form of the flake rather than to any cultural preferences.

- SC1 – Endscraper
- SC2 – Sidescraper
- SC3 – Scraper Indeterminate
- SC4 – Scraper Plane
- SC5 – Oblique Scraper
- SC6 – Denticulate Scraper
- SC8 – Convergent Scraper
- SC9 – Denticulate Scraper Plane
- SC10 – Circular Scraper
(VRS) Ventrally retouched scraper plane
Ventrally retouched scraper planes consist a previously unidentified class of artifacts. They are of various shapes, but they all display one or more edges that would be suitable for chopping/planing. Most of these pieces also display areas of retouch termed “convenience flakes”, whose function is assumed to have been to provide the user with a comfortable grip. From a design point of view their placement intuitively makes sense. Whether or not they were actually used in this manner is difficult to test, given the coarse-grained nature of these raw materials.

(DR) Drill
Items classified as drills have a morphology that is suited to the task, although they could be used for other tasks (Andrefsky 1998).

(PE) Perforator
This general class of artifact displays intentional modification to create a pronounced tip. This designation subsumes artifacts classified elsewhere as gravers and spurs.

(PB) Pseudo burin
This artifact (n=1) exhibits a morphology that is similar to burins found elsewhere but the manufacturing process is different here (see Chapter 5)

(WE) Wedge
Wedges consist of thick flakes with feathered terminations and exhibit battering on the platform combined with crushing in the distal margin. Their overall morphology is also consistent with other artifacts identified as wedges elsewhere.

(NO) Notch
These are flakes that have been intentionally retouched to produce one or more notches on either margin.

(CT) Core tool
Core tools display intentional modification to cores for the purpose of creating working edges. As a subset to this category, Core Scrapers (CS) display edge angles that would be suitable for scraping actions. In general these tools encompass a wide variety of sizes and shapes. Pebble Tools display an initial cobble form, represented by a remainder of cortical covering on some part of the artifact.
(SP) Spall
Spalls are early stage flakes detached from river rolled cobbles. As such their dorsal faces tend to have a high percentage of cortical cover. In many cases spalls can be used without further modification, as they exhibit morphologies and margins capable of performing a variety of tasks from cutting to scraping.

(ST) Spall tool
Spall tools are spalls that have been modified in some way after detachment from the core.

(UF) Utilized flake
This class of artifact was difficult to identify since the coarse-grained raw materials used at Namu do not exhibit much sign of wear. A small group of flakes, however, exhibit micro-scarring and edge abrasion that is consistent of wear.

(EA) Edge angle
Angle measured on core platform or biface edge.

(HS) Hammerstone
A small number of hammerstones was identified during the analysis. In general they are rounded river cobbles of various raw material, and almost all exhibit signs of use via battering on one or more surfaces.

(Lat snap) Lateral snap
0) Absent 1) Present

(DIM) Dimensions
Measurement of dimensions is dependent on the type of artifact and overall morphology. For irregular shapes such as multidirectional cores the maximum dimension of the piece was treated as the length.
Comments
Various notes recorded for each artifact.