

The Development of the Microblade Industry at the Richardson Island Site, Haida Gwaii,  
British Columbia

by

Nicholas Waber  
BA, University of British Columbia, 2006

A Thesis Submitted in Partial Fulfillment  
of the Requirements for the Degree of

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in the Department of Anthropology

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## **Supervisory Committee**

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**Supervisor**

April Nowell (Department of Anthropology)  
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## Abstract

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Microblades were a common feature of many lithic toolkits around the North Pacific during the late Pleistocene and early Holocene epochs. On Haida Gwaii, on British Columbia's North Coast, the earliest known microblades have been recovered from the Richardson Island site and date to approximately 8750 BP. Deep, well-defined stratigraphy at the site has provided a unique opportunity to observe a major technological shift as, between 8750 BP and 8500 BP, microblades gradually replaced the earlier bifacial toolkit and came to be a definitive aspect of the subsequent Moresby tradition technological suite. Several hypotheses have been presented, including microblades as a response to increasing raw material scarcity as a result of sea-level change, microblades as a technology imported by incoming Athapaskan speaking peoples, and microblades as an *in situ* design response to new subsistence practices brought about by ecological changes following the end of the last glaciation: a more durable, more deadly weapon well adapted to high-risk hunting activities.

In this thesis I examine the possible reasons behind that shift in lithic technology. My analysis employs multiple lines of evidence to consider the theories. I examine the microblade assemblage and consider aspects of tool manufacture, use, and discard to determine how the microblades may have been used, and how they may relate to other microblade traditions in the region; I consider the paleoecology of southern Haida Gwaii during the early Holocene; and I use a set of controlled experiments to compare bifaces and slotted points in terms of durability and wound channel creation.

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## **Dedication**

This thesis is dedicated to the memories of my grandfather, Hans Fograscher, and my grandmother, Doris Ottho, both of whom were integral in fuelling my interest in studying the past.

## Chapter 1: Introduction

Microblade technology represents a fundamental component of the lithic toolkit during the terminal Pleistocene (pre-10,000 BP) and early Holocene period (c.10,000 BP to 5,000 BP) on the Northwest Coast. A variety of microblade industries have been identified around the north Pacific rim. On Haida Gwaii (the Queen Charlotte Islands), the Moresby tradition is defined largely by the presence of microblades, in contrast to the preceding Kinggi phase, and the subsequent Graham tradition (Fedje and Christensen 1999:647-648; Fedje and Mackie 2005:158). Recent excavations at the Richardson Island site (1127T) in southern Haida Gwaii have revealed a transition from the bifacial technology common in Kinggi complex assemblages to the microblade-dominated Moresby tradition (Fedje and Mackie 2005:158). This transition, shown clearly over 5m of high resolution stratigraphy representing 1000 years of occupation between c.9400 BP and 8400 BP, is marked by a gradual adoption of microblades corresponding to the decline and disappearance of bifacial projectile points. Variation in raw material usage during the early microblade period has been interpreted as an experimental phase in microblade development (Smith 2004:170), which has been proposed as evidence of possible *in situ* development of microblade technology within Haida Gwaii (Magne 2004:115).

Various explanations have been presented for the origin and spread of microblade technology throughout the Northwest Coast and Haida Gwaii, including diffusion and development out of earlier Alaskan microblade industries (Lee 2007b), the importation of technology corresponding with early Holocene migrations of Athapaskan speakers (Yesner and Pearson 2002; Magne and Fedje 2007), or as an *in situ* response to raw

material scarcity as a result of sea level fluctuations (Magne 2004). This thesis proposes an alternative hypothesis: that microblade technology developed *in situ* on Haida Gwaii as a risk avoidance strategy to adapt to changing ecological conditions and pressures on the subsistence economy.

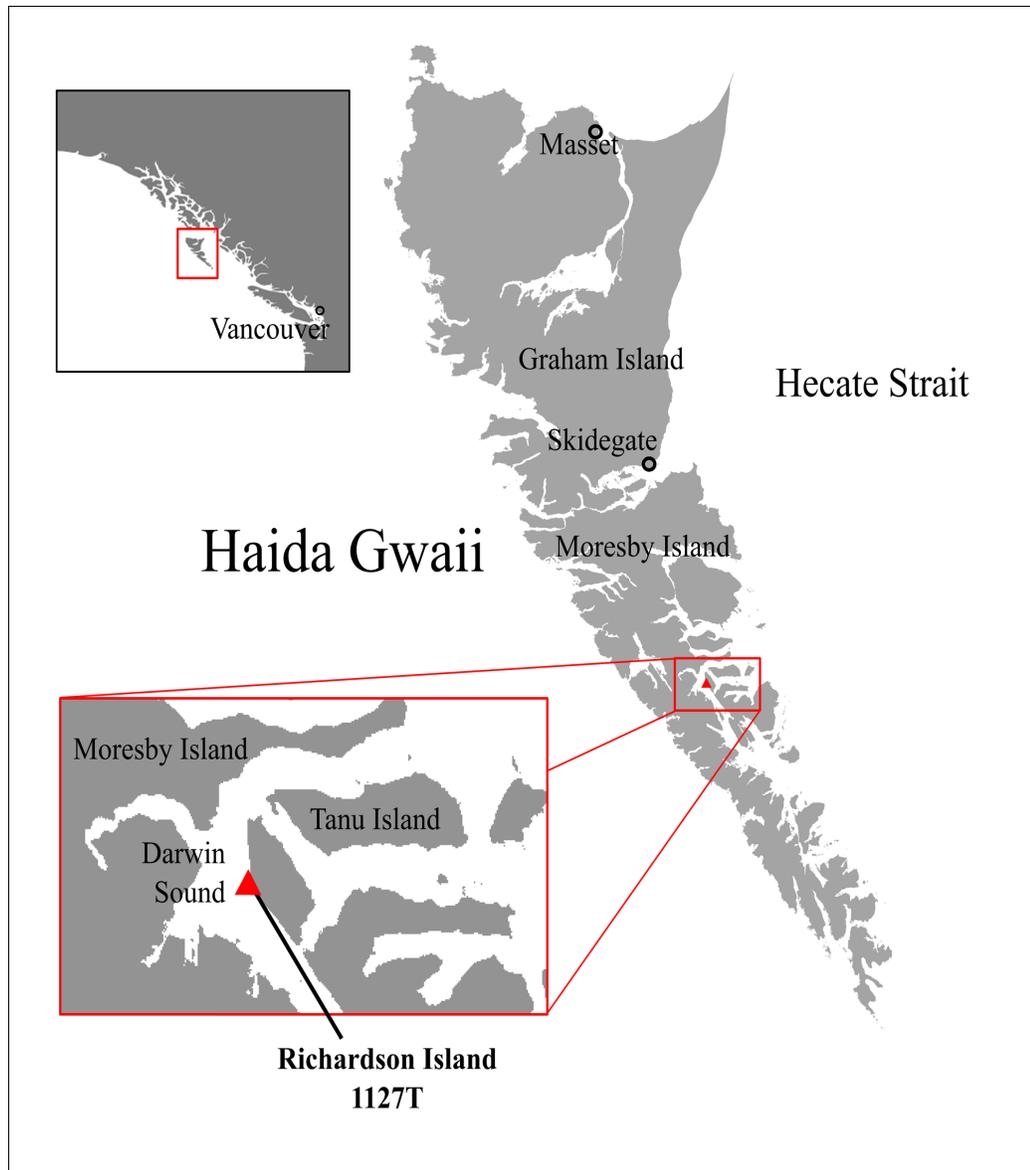
The risk avoidance model is based on the hypothesis that composite tools utilizing microblade insets, specifically slotted bone or antler points, offered distinct functional advantages over the Kinggi Phase bifaces. When used as a tip for a thrusting spear or killing lance the slotted point provided increased durability and greater lethality than its bifacial counterpart (Elston and Brantingham 2002:106). These are important considerations for hunters stalking large mammals, such as bear or sea lion.

This thesis examines the competing models for the development of microblade technology at Richardson Island (Figure 1). The research questions guiding this study are:

1. What were the local conditions that led to the introduction of microblade technology in southern Haida Gwaii at c.8750 BP?
2. How were the microblades recovered from excavations at the Richardson Island site originally used?
3. What is the validity of each of the previously proposed models for microblade introduction, adoption or development, relative to the specific situation of the Richardson Island site?
4. What are the merits of composite microblade tools relative to Kinggi phase bifaces?

5. Did microblades represent a design response to increasing risk in subsistence activities during the early Holocene in Haida Gwaii?

Several parallel approaches have been employed to address these questions. The Richardson Island microblade assemblage was analyzed in order to identify mode(s) of manufacture, use and discard. The paleoecology of the region was reconstructed on the basis of sea level curves, palynological data regarding the prevalence and distribution of plantlife, and paleontological and archaeological faunal remains. Archaeological faunal assemblages from Richardson Island, Kilgii Gwaay and Cohoe Creek were used to identify early Holocene hunting practices. Raw material availability was scrutinized, and other early Holocene microblade traditions were considered in regards to the potential driving motives behind the development of microblade technology. Also, experiments were conducted to assess the relative durability and deadliness of slotted points and bifacial projectile points.



**Figure 1: Area map. Red triangle indicates Richardson Island. Black circles indicate major current settlements.**

Based on the analysis of the Richardson Island microblades, it is most likely that they were used as lateral insets in slotted antler or bone points (Figure 2). The early Holocene sea level curve, combined with the raw material analysis of both microblade and non-microblade artifacts indicates that it was not a scarcity of tool stone that

prompted a shift from bifacial to microblade technology. A comparison of the *chaînes opératoires* between earlier Alaskan microblade industries and the Richardson Island microblade assemblage (and others around Haida Gwaii) suggests that although the initial concept of microblades may have come to Haida Gwaii through diffusion from the mainland, the industry developed domestically. Finally, the paleoecological models for the period in question show a changing landscape.



**Figure 2: Slotted point replica, design based on the slotted point artifact from Coho Creek, Haida Gwaii, as described in Christensen and Stafford 2005.**

After the end of the last glaciation, forests became more dense and ubiquitous, and the treeline crept higher, drastically reducing the open grassland and meadow areas. This resulted in a sharp decline in available habitat for meadow, prairie or tundra-adapted fauna such as caribou, and may have restricted their range to scattered subalpine meadows and triggered a decline in the species population (Wigen 2005:104, 111). With increasing variability among the available terrestrial prey animals making terrestrial prey exploitation more costly, the subsistence strategy of the early Holocene hunters changed accordingly. The hunting focus shifted away from the increasingly rare barren-ground

species to marine mammals and forest-dwelling prey, both of which required new hunting methods and posed new risks. In addition to the always-present risk of inadequate subsistence return from failed hunts, the sea lions and black bears that make up a large portion of the marine mammal and forest prey offer an additional risk: both are top tier predators and are thus dangerous prey. On this basis, I propose in this thesis that the slotted points with microblade insets, and thus the Richardson Island microblade industry, were developed as a risk-avoidance tool for high-risk hunting scenarios. The new technology made successful kills more likely, and reduced the chance of weapon failure through point breakage.

This theory was tested through archaeological experimentation. Replica slotted points and Kinggi phase *Xil* bifaces were compared through a pair of experimental tests examining wound channel creation, and durability against a direct bone strike. The former experiment involved direct observation of spear-mounted points being stabbed into blocks of ballistics gelatine. The gelatine provides a clear matrix that mimics the texture, density and structure of mammalian flesh and organs. This test showed that the slotted points produce a more traumatic wound than do the bifacial points, and would thus likely result in more efficient and sure kills. The latter test compared the two point types by counting how many direct strikes against a robust bone each point could withstand before breakage occurred. The slotted points were, once again, superior. The most durable bifacial point withstood barely half as many strikes as did the least durable slotted point. Thus, based on the experimental data, the slotted points provided a more durable, more deadly weapon for high risk hunting.

## **1.1 Summary of Chapters**

### **Chapter 2**

This chapter introduces the aspects of technological theory that were employed to analyze the Richardson Island microblade assemblage and guide the interpretation. Discussion includes the concepts of *chaîne opératoire*, design theory, reliable and maintainable technologies, and technological organization related to risk avoidance strategies.

### **Chapter 3**

Chapter 3 provides an in-depth discussion of microblade technology, including descriptions of microblade production techniques, methods of hafting and use. The chapter focuses on microblade technology from North America's Northwest Coast and the trans-Beringian region. Microblade technology and its relationship to design theory, reliable and maintainable models of technological strategy, and methods of risk management are also discussed.

### **Chapter 4**

This chapter examines microblade technology on the Northwest Coast. Select case studies of microblade sites from Siberia, southeast Alaska, British Columbia, and Washington are presented. These case studies each provide some insight into specific aspects of the Richardson Island microblade assemblage, and into the developmental trajectory of microblades on Haida Gwaii.

### **Chapter 5**

This chapter provides a description of the paleoecological conditions on early Holocene southern Haida Gwaii and a summary of the archaeological history of Haida Gwaii. Major topics include sea level change and the movement of paleoshorelines after the last major glaciation event, and climatic shifts and their effect on the flora and fauna of the

islands. The archaeological history presents brief summaries of the Kinggi Complex (c.10,600-8750 BP), the Moresby Tradition (c.8750-5000 BP), and the Graham Tradition (c.5000-250 BP).

### **Chapter 6**

Chapter 6 introduces the Richardson Island site and describes previous archaeological work carried out there. Topics include site location and formation processes, excavation chronology, stratigraphy, site features, faunal remains, and artifacts recovered from excavations.

### **Chapter 7**

Chapter 7 is a detailed description and analysis of the Richardson Island microblade assemblage. This includes analyses and interpretations of microblade production methods, techniques of hafting, and the nature of the development of microblade technology on Richardson Island and southern Haida Gwaii.

### **Chapter 8**

Chapter 8 is the conclusion and summary. This chapter synthesizes the inferences made regarding the origin, development and use of microblades at Richardson Island during the early Holocene.

### **Appendices**

Appendix A provides a detailed description of the two experiments conducted to test how slotted points with side-hafted microblades compare with Kinggi phase bifacial projectile points in terms of deadliness and durability.

Appendix B describes the replication experiment used to examine whether semi-crested blades are viable diagnostic indicators of core preparation method when few cores have

been recovered from a microblade site. This study has also been published in more detail in Waber 2010.

## Chapter 2: Technological Theory

This chapter provides a background to the theoretical frameworks applied in analyzing the Richardson Island microblade assemblage. The primary bodies of theory used in this thesis are those of the *chaîne opératoire* and design theory. Both theories are predicated upon the agency and thoughtfulness of individual actors in the ancient past and both provide a robust groundwork for assessing how the decision-making process on early Holocene Richardson Island affected the technological organization and behaviour of the inhabitants.

*Chaîne opératoire*, roughly translated as “operational sequence”, is the product of the French school of social anthropology. Adopted as a means of describing the *gestalt* of technological behaviour, the concept of *chaîne opératoire* embraces every stage (both physical and cognitive) of a technological trajectory (Schlanger 1990:20). Indeed, it is the syncretism of the physical and cognitive aspects of an operational sequence that sets the *chaîne opératoire* apart from other methods of analysis. *Chaîne opératoire* lends itself to documenting and analyzing every step of tool production and use, from raw material acquisition and processing, through tool manufacture, use, curation and maintenance, to discard and (potentially) recycling (Edmonds 1990:57; Karlin and Julien 1994:154). Just as importantly, the *chaîne opératoire* simultaneously addresses each phase of cognitive engagement with the technology: identification of technological need, tool design, ideational modelling to guide manufacture, gestures of use, and integration into a technosocial environment (Sellet 1993:106). As such, *chaîne opératoire* is an optimal tool for examining the human factors behind the development of microblade technology in Haida Gwaii.

Similar to *chaîne opératoire*, design theory operates under a rubric that technologies are the result of a series of decisions made by tool makers and users. The technologies must not only perform a function as a response to an environmental challenge or means to achieving a physical or economic goal, but must do so within a set of constraints imposed by both the physical and social worlds within which the tool-making/using individuals dwell (Pellegrin 1990:117). Design theory has been constructed of several branches, including models of reliability and maintainability (Bleed 1986), expediency and versatility (Nelson 1991), and curation (Andrefsky 1994; Bamforth 1986; Bamforth and Bleed 1997; Torrence 1989). Each of these avenues contributes insight into the pressures and motivations guiding technological organization. From risk management to models of optimality, design theory provides a framework for examining tools from a socioenvironmental standpoint.

## **2.1 *Chaîne Opératoire* and Reduction Sequence**

In 2003 Michael Shott proposed that the two dominant theories of operational sequences, *chaîne opératoire* and reduction sequence, were “substantially the same thing” (Shott 2003:95). Both schools of thought address the processes involved in the production and use life of stone tools, providing the researcher with a conceptual framework applicable to typological categorization, cognitive analysis and insight into technological organization (Bar-Yosef and Van Peer 2009:105; Bleed 2001:114; Sellet 1993:106). However, *chaîne opératoire* and reduction sequence differ in how each method focuses the researcher’s attention: the former emphasizes the cognitive aspect of technique and gestures, suggesting a continuum of actions working toward a

predetermined ideal result, and the latter addresses models of actualized behaviour, analyzing ancient technologies based on a series of discrete decisions made by the tool maker (Bleed 2001:121; Sellet 1993:107).

This difference in theoretical emphasis may be interpreted as a result of how each method was brought into popular use. The concept of *chaîne opératoire* was originally introduced, from the field of French social anthropology, as a response to the overwhelming stylistic typological concentration of the Bordian school of typology (Shott 2003:100; Schlanger 1994:143). *Chaîne opératoire* removed lithic artifacts from their static positions as end-product stylistic cultural indicators and restored a degree of dynamism, temporally orienting them in sequential processes, complete with multi-stage use-lives and, most importantly, human agents controlling their production and implementation (Bar-Yosef et.al. 1992:511; Bleed 2001:106). Reduction sequence, while it had been first proposed much earlier, also developed a following from the processual response to Bordian tool typologies. American scholars following the empirical principals of the New Archaeology, drawing on the experimental replication movement spearheaded by Crabtree, Bradley and others, focused study on the stages of production, use, re-sharpening or repurposing and discard involved in achieving the artifact forms present in the archaeological record (Bleed 2001:108). However, rather than focusing on the ancient tool maker and his intent, primary attention was paid to the sequence of operations itself, determining stages of artifact production and the technical steps used to reach each stage (Bradley 1975:7; Collins 1975:16; Bleed 2001:108-109). This is not to say that the cognitive aspects of lithic analysis were absent from reduction sequence theory, but more

that the intent involved in lithic reduction is restricted to a stage-by-stage level of consciousness (Shott 2003:101).

André Leroi-Gourhan, a French anthropologist known for his multidisciplinary approach to the study of human diversity, introduced the *chaîne opératoire* to the anthropological community in the 1950's (Audouze 2002:281). Influenced by theorists such as Marcel Mauss who argued that all human actions are as much cultural as they are physical (1979:99), Leroi-Gourhan considered technology intrinsic to human existence and the ultimate preservable cultural act (Audouze 2002:282). He endeavoured to illustrate how techniques “form a gestural chain in which the tool is but in ‘instrument’”, that gesture creates and defines the tool, and that without the associated contextual gesture “the tool loses its technological significance” (Schlanger 1990:20). Furthermore, Leroi-Gourhan argued that technique was a traceable constant “present throughout human evolution” (Audouze 2002:282). To support this, he required a suitable theoretical framework that would allow him not only to compare technologies, but also to achieve a holistic view of individual technologies based on their constituent processes (Audouze 2002:282). *Chaîne opératoire* was ideal for this, as it provided a syntax within which relationships could be identified between stages of tool production and use (including material procurement and discard) as well as other determining factors, physical or social, all the while maintaining the preeminent concept of the entire process as a continuous entity (Audouze 1999:169, 2002: 287; Sellet 1993:107).

The reduction sequence, rather than being designed to consider technological processes holistically, was initially used to codify the multiple stages of tool production (Shott 1996:6; Bradley 1975:5, 7). In 1894 William Henry Holmes published a flow chart

illustrating the reduction sequence(s) involved in the production and transportation or abandonment of lithic artifacts recovered from sites along the United States' Eastern Seaboard (Shott 1996:6; 2003:96-97). This model has informed a great deal of the present understanding of lithic production processes, and, with few modifications, forms the basis for most lithic replication studies (Crabtree 1972:43; Callahan 2000:9; Andrefsky 2005:187-190; Whittaker 1994:199-203). It theoretically permits one to infer intent from unfinished tools in the archaeological record, based on their position in a culturally appropriate reduction sequence (Bradley 1975:13). However, because the archaeologist rather than the flintknapper defines the stages of the reduction sequence, an artificial typology may be created, reflecting modern sequential thinking rather than ancient sequential behaviour (Shott 1996:7; Bleed 2001:114; Collins 1975:16; Bar-Yosef and Van Peer 2009:114). This suggested bias is supported by a study that determined that distinct stages of biface reduction could not be identified in an experimental debitage assemblage (Shott 1996:21).

*Chaîne opératoire*, while frequently expressed with “[stratigraphic] vertical flow charts” similar to those of reduction sequence, and replete with stages of production, does address the process of tool manufacture as a continuum: a planned, coherent series of actions coordinated to transform raw material into an ideal finished technological product (Bleed 2001:119). By enabling the interpretation of the relationship between the archaeological assemblage and the would-be ideal final product, *chaîne opératoire* provides the archaeologist with insight into the cognitive intent of the knapper and the choices made during the process of tool manufacture (Edmonds 1990:57; Karlin and Julien 1994:154). The final tool, defined by the intended application, raw material and

cultural or symbolic requirements or constraints, is ultimately the product of (and is constrained by) the stoneworker's knowledge. Every action, from selecting the nodule and tools to work it with to the specific techniques applied, is carried out with the ideal template in mind, though contingent decisions made throughout the process, based on a "critical monitoring of the situation" may result in a slightly different form (Pelegrin 1990:117; Bleed 2001:121; Sellet 1993:107).

Alternatively, reduction sequence describes intent as guiding each action in order to bring the unfinished tool to the next stage of production (Bleed 2001:121). The entire process is a dialogue between the toolmaker and the material. The toolmaker applies his knowledge to each successive situation independently, basing his decisions on the specific constraints relevant to that step of production and to a significantly lesser extent on the desired final tool (Bleed 2001:121; Pelegrin 1990:122). Theoretically, a stage four biface blank could be finished into virtually any sort of biface, depending on the situational need, but until that specific need is identified, the artifact is a successfully knapped stage four blank (Callahan 2000:9; Pelegrin 1990:122).

One particularly interesting aspect of this division between the *chaîne opératoire's* teleological approach and reduction sequence's evolutionary one is that in the case of analyzing intent based on the desired final outcome rather than on the immediate material-based choices available, *chaîne opératoire* provides a more empathetic perspective, allowing the researcher to observe the stages of production independently and as a whole, carried out as part of a coherent strategy with a definite goal in mind (Bleed 2001:121; Tostevin n.d.:19). This cognitive approach to lithic analysis is perhaps *chaîne opératoire's* strongest feature. Whereas replication

experiments and the ordering of actions on a reduction sequence may provide an empirically determined model of ancient behaviour, *chaîne opératoire*'s attention to not only process of decision making but also mental modelling, provides insight into the thought behind those actions manifested in the archaeological record (Karlin and Julien 1994:154). *Chaîne opératoire* achieves this primarily through the analysis of technique, which may be considered the physical application of knowledge- a coordination of mental and bodily elements- in order to achieve a specific end (Schlanger 1990:18-19). The operational knowledge involved in the production of stone tools may be divided into two parts: conceptual knowledge and procedural knowledge (Karlin and Julien 1994:154). Conceptual knowledge, also referred to as ideational know-how, involves the operations based on mental models of the desired product: the evaluation of each stage and the decisions necessary to achieve the desired outcome (Pelegrin 1990:118; Karlin and Julien 1994:154). Procedural knowledge refers to the technical physical skill and understanding necessary to implement the tools and gestures appropriate to reducing the raw material in such a way that the resulting product will correspond to the ideational model (Pelegrin 1990:118). This form of knowledge encompasses everything from understanding the properties of the raw material and the knapping tools to having the muscle memory and coordination necessary to deliver an accurate blow with appropriate force (Pelegrin 1990:118).

Thus we see that *chaîne opératoire* and reduction sequence, while they share many features, are fundamentally different theoretical frameworks. Both analytical methods make use of seriated stages of reduction as models for artifact manufacture and use. Similarly, both models address issues of intent and decision making on the part of

the ancient knapper. *Chaîne opératoire*, however, carries this emphasis on the mental processes inherent to the physical acts much further than reduction sequence. Through application of the *chaîne opératoire*, the archaeologist may identify aspects of technological intent both in terms of the next production stage and the pre-patterned mental template of the ideal tool, as well as such long-term cognitive aspects of technological behaviour as knowledge of techniques and a history of apprenticeship. An emic perspective (as much as is possible in archaeology) is made available to the researcher. Conversely, reduction sequence, with its greater focus on individual decisions made on a step-by-step basis by the ancient flintknapper, and the model's strong ties to the American lithic replication movement, addresses the process(es) of stone tool production from a more empirical, etic standpoint.

## **2.2 Technological Strategies and Design Theory**

Technological strategies are cohesive cultural responses to conditions presented by the environment (Bamforth and Bleed 1997:109; Nelson 1991:57; Ugan et al. 2003:1315). These strategies provide a cognitive framework which guides a tool maker or user to structure their behaviour in order to affect an appropriate solution. Whether consciously or unconsciously, by working within a technological strategy, people know what kind of tool is expected of them, and how to use it (Nelson 1991:57-59). Constrained by logistical, economic, cultural and intellectual factors, a strategy must ultimately provide at least a minimally effective solution to a given problem (Nelson 1991:58; Bamforth and Bleed 1997:111; Bleed 1986:739).

### 2.2.1 Curation and Expediency

Nelson (1991:62) describes three categories of technological strategies:

expediency, opportunism and curation. Expedient strategies involve some foreknowledge of the availability of suitable material and conditions to make or customize tools at an activity site. Rather than carry already manufactured tools, an individual may gather raw material at the site and conveniently make whatever tool is optimal for the task at hand. This method is preferred in situations where material is known to be abundant and making the appropriate tool will not disrupt the primary activity (Bamforth 1986:38; Nelson 1991:64).

Like expedient technology, opportunistic technology involves the manufacture of necessary tools at the time and place of use. However, rather than anticipating the presence of materials at a processing site, or prey items at a site with suitable materials, opportunistic toolkits are made with whatever is at hand to react to an unforeseen circumstance (Nelson 1991:65). These reactions may be a response to a surprise opportunity for gain, or simply a stopgap measure when another piece of equipment has failed (Binford 1979:266; Nelson 1991:65).

Curation strategies involve the procurement, preparation, manufacture, maintenance and transport of tools or materials in anticipation of need. This may be considered a preparatory response to predictable use schedules or conditions. If an activity is expected to take place at a location that may have a shortage of raw material, or if the activity is time stressed and does not allow the tool user to make, customize or refurbish his tools during that time, a curative response is necessary (Nelson 1991:63; Bamforth 1986:38). Alternatively, one may consider curation as a time investment before an activity in order to maximize the results during the activity (Nelson 1991:63).

Curation strategies are also valuable for mitigating risk. (Torrence 1989:60; Bamforth and Bleed 1997:124). By spending more time preparing high quality tools and materials for use beforehand, tool users may significantly lower the probability and/or consequences of failure (Bamforth and Bleed 1997:115; Torrence 1989:62). An example of this is provided by Binford (1979:263), in his statement that Nunamiut hunters “*never* went into the field with personal gear that was not in good condition and relatively new” (emphasis his). These arctic people live in an exceptionally hostile environment, where the consequences of tool failure are severe. They expected to encounter very harsh conditions, and thus heavily curated their toolkit, maximizing their chances of success (Binford 1979:263).

Caching tools, cores or other supplies at regularly used sites or central locations is a form of curation, as it predicts a future scarcity of naturally occurring raw material or time to make tools, and addresses it by providing a stockpile of usable material at or near a future activity site. However, caching may also be considered an enabler of expediency, as caches may be left somewhere “just in case” without a particular return date or specific activity in mind. Binford (1979:257, 258) describes Nunamiut hunters scattering caches of “insurance gear” (tools, firewood, spare parts and usable stone) across the landscape so that should a hunter find himself in an unforeseen situation, suitable equipment will be at hand (Binford 1979:257). Caches also allow heavy or bulky objects to be used in the field without the associated costs of transporting them there immediately before use (Nelson 1991:63; Binford 1979:256). Thus, rather than carry a kayak to and from a distant winter settlement, Nunamiut hunters cache their kayaks at the edge of lakes at freeze-up, and return to use them again after the Spring thaw (Binford 1979:256).

### 2.2.2 Reliable and Maintainable Technology

Design engineering is the process of finding a technological solution that is optimal for a specific problem, yet achievable within certain constraints (Bleed 1986:738). Bleed (1986:739) proposes a design continuum along which one may classify various technologies. At one end is reliable technology characterized by complex, durable, high quality, specialist made tools with a specific intended use. Reliable technology frequently utilizes modular, replaceable parts and is manufactured and maintained at periods distinct from times of use (Bleed 1986:740). Parallel, redundant and interchangeable components ensure that should any single part of a tool fail the tool will still perform adequately, as another part can either continue carrying out the required task, or the broken piece can be quickly and easily replaced with a ready-made spare. Total tool failure is rare in reliable systems, as tools are overdesigned and overconstructed; that is, the stress of the intended use of the technology is considerably below the actual failure threshold of the tool (Bleed 1986:740).

Reliable technology may be considered a response to unacceptable levels of risk. If the tool failure would be particularly costly, such as in the case of a hunter not successfully harvesting important prey that is only available at certain times or in certain places, a reliable weapon is likely to be selected (Bleed 1986:741, Bamforth and Bleed 1997:115, Torrence 1989:62). This risk mitigation value counteracts the increased costs of using premium materials and skilled labour to produce a reliable tool (Bleed 1986:741).

Maintainable technology occupies the opposite end of the design continuum. Rather than including durable, heavy-duty tools intended for a specific task, maintainable toolkits feature light weight tools that are easily repairable in the field and that may be

quickly adapted to a variety of different applications as the situation demands (Bleed 1986:741). Whereas reliable tools are appropriate for predictable situations where the consequences of failure may be severe, maintainable tools are most applicable for “generalized undertakings that have continuous need but unpredictable schedules and generally low failure costs” (Bleed 1986:741). A maintainable toolkit may not mitigate the potential risk of failure of any particular activity, but it may reduce the costs of that failure by allowing the user to carry out different activities as the opportunities present themselves (Nelson 1991:70; Torrence 1989:62).

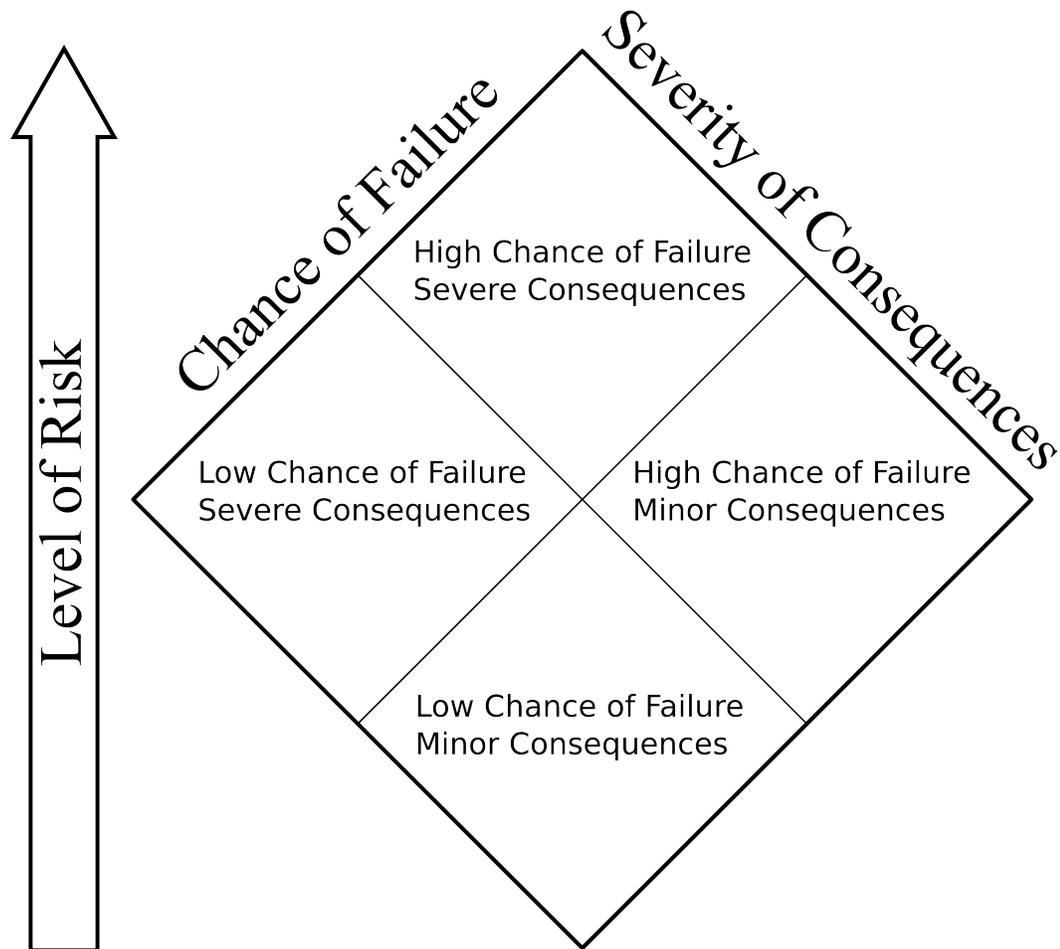
Nelson (1991) proposes two additional technological classifications that may be considered subcategories of maintainable toolkits: versatile and flexible tools. A versatile tool is one that may be used for a variety of functions without altering its form. This allows the user to spend less time making multiple tools and less energy carrying a large toolkit, though it may not be as efficient for a specific task as a specialized tool would be (Nelson 1991:73).

Flexible technology refers to tools that can easily change their form to adapt quickly to diverse tasks (Nelson 1991:70). Like versatile technology, fewer flexible tools need be carried than their specialized equivalents, though modular attachments and adaptors may be required. The Swiss Army Knife is an example of a flexible tool in modern Western civilization (Nelson 1991:70-71).

### **2.2.3 Cost and Optimality**

In addition to risk and function affecting design, economic costs can also dictate the technological strategy or toolkit design. These costs may be broken into two categories: raw material expense and opportunity costs. If there is a scarcity of suitable

raw material, the resulting design philosophy will take this into account and we may expect to see highly curated, reliable toolkits maximizing the resource potential of an area (Nelson 1991:77; Bamforth 1986:41; Andrefsky 1994:31; Bleed 2004:100). Alternatively, when raw material is abundant, people will be more likely to use expedient, maintainable tools (Bamforth 1986:40, 46-47; Bleed 2004:101). Basically, the easier it is to replace a broken tool, the less effort will be put into tool maintenance and curation (Bamforth 1986:46). Since raw material availability may vary within a cultural landscape, different tool designs may be evident even if the user group is the same. For example, tool makers in a settlement may have access to large caches of high quality raw material, and may therefore adopt an expedient, maintainable design strategy, while the same tool makers will carefully curate reliable tools at a hunting camp where there is little available stone (Bamforth 1986:46, Nelson 1991:78-79).



**Figure 3: Diagram of risk factors. As the chance of failure and/or the consequences of failure increase, so does the level of risk. Adapted from Waber and MacLean 2011.**

Opportunity costs also affect toolkit variability. With finite time to carry out one's tasks, decisions must be made between what is and is not a priority activity. Every hour spent procuring necessary material and manufacturing or maintaining a toolkit is an hour unavailable for another potentially beneficial task. Thus, necessary time investments in other activities will restrict time available to develop technology. Also, since significant developmental increases in technological complexity frequently require a (disproportionately) high dedication of time and resources, "optimal" technologies may

not be the most efficient for their intended task, but rather the most efficient for the amount of time invested (Ugan et al. 2003:1316). As a result of these costs, toolkits may be used as proxy indicators of risky behaviour. A common model is that the more important a task is, the more complex the tool may be (Torrence 1989:61). When expressed in terms of risk avoidance strategies this may be read as such: the more risky a situation is, the more complex or invested the risk-reducing tool will be (Figure 3) (Torrence 1989:61).

Finally, logistical considerations will significantly affect the design of a toolkit. If a tool is destined for use at a settlement, its size and weight may not be much of a factor in design decisions. Instead, the designer may focus on durability and efficiency as their primary goals, as the tool may be left as part of the stationary site furniture. Metates are an example of this, as generations of users may have ground their grains on a single metate without it ever having moved more than a few metres from where it was initially laid down (Nelson 1991:82). Conversely, tools designed with mobility in mind will tend to be as lightweight and compact as possible. Ideally, a transportable tool should not impede the user's movement (Nelson 1991:73, 75). These small, lightweight toolkits may be achieved through making miniature versions of full sized toolkits, utilizing versatile or flexible tools, or through using lightweight materials wherever possible (Nelson 1991:75).

## **2.3 Risk and Design**

### **2.3.1 Varieties of Risk**

There are multiple manifestations of risk. In archaeological literature, the most commonly discussed form of risk refers to the likelihood of subsistence failure, and measures taken to avoid that (Torrence 1989:59). Subsistence failure may be the result of

a group's failure to meet the necessary food quota either in the short term or the long term. Short term subsistence failures often take the form of individual instances of failure, when a hunt is unsuccessful or a harvest inadequate. Long term subsistence failure is the cumulative effect of multiple hunts, collecting or foraging forays, or harvests that together do not yield sufficient food to supply the group over the course of one or more seasons (Torrence 1989:59). Additional to these forms of risk, one must also consider the risk of the costs of hunting or foraging activities outweighing the benefits of the return. Following the patch/prey model discussed below, the levels of time, energy and material invested in an economic task increase the cost, and thus the consequences of failure (Bousman 1993:61). The returns from a costly event must be sufficiently high in order for it to be worthwhile. Inadequate returns from costly tasks may have long-reaching consequences, and thus high-investment endeavours may be categorized as long-term risks (Bousman 1993:61; Torrence 1989:60).

The ultimate in long-term subsistence failure (and high task investment) may be the physical danger encountered in many high-risk activities. Carrying out economic actions in unsafe environments places the very lives and wellbeing of both the participants and the group in a risky situation. Injuries may prevent a member of a community member from taking part in economic production (such as hunting or foraging), diminishing the potential return of activities in the immediate future without reducing the benchmark subsistence requirement. Similarly, the consequences of a hunter being killed by a dangerous prey animal reach beyond the immediate termination of his/her life: future hunts must be carried out without the late hunter's help, and the hunter's training and experience (time, energy and material costs unto themselves) are no

longer available to help develop younger replacements. Also, there may be social and material costs associated with death that the family and community must deal with. As a result, countermeasures designed to mitigate risk, while costly in isolation, may be beneficial when considered in relation to the potential consequences that could otherwise occur.

### **2.3.2 Foraging Theory and Tool Design**

As discussed in sections 2.2.1 and 2.2.2, a variety of technology may be employed to avoid or lower risk. Reliable tools with specific design purposes are often selected in order to address short-term risk where a predictable situation will be encountered, but failure may incur severe consequences in the long-term. Maintainable tools are preferred when the chances of failure are quite low, but the specific circumstances of the economic encounter (a hunting, foraging or harvesting event) are unknown (Bleed 1986:739; Torrence 1989:62). Furthermore, as risk increases, so does investment in risk avoidance technology. As such, the tools recovered from archaeological sites provide valuable insights into the risks encountered by the ancient site inhabitants.

Risk-mitigating technology may be adapted to reduce the likelihood of one or more specific failure subtypes. For example, an improved hunting weapon may reduce the likelihood of weapon failure, and thus help avoid losing prey that would otherwise have been taken (Torrence 1989:59). Alternatively, untended facilities such as traplines help control the temporal distribution of prey across the landscape (see below for a detailed description of patch and prey models of resource distribution). By holding the prey in place, the trap extends the amount of time that the resource may be found and collected from a predictable location (Torrence 1989:60).

As mentioned above, risk mitigation is often a significant factor in guiding technological design. Prey and patch models of resource risk (Bousman 1993:61) fit well with the other aspects of design theory. Prey and patch models provide a framework for understanding resource distribution throughout an ecology in terms of both time and space, and the costs associated with collecting those resources. The prey model is in effect when resources are distributed throughout much of a region, but they are either not plentiful or have temporally limited availability. The temporal limitations may be considered on an individual scale, where a prey animal may or may not be present at a particular place at any given time (unpredictable; temporally unrestricted), or on a more universal scale, where a prey animal (or a large herd of them) will certainly be at a particular place, but only for a limited time each season (predictable; temporally restricted) (Bousman 1993:65). An example of the prey model may be a deer. Deer are widely distributed throughout the forest, but as mobile creatures with independent agency, their precise location at any given time is difficult to predict. The patch model is based on resources being plentiful in some areas, but not being universally distributed. Seasonality may also affect this, but often to a lesser extent than the temporal restrictions on prey models (Bousman 1993:65). An example of the patch model is a berry bush. The bush is in a known location, and the fruit is harvestable at a predictable time, but the location is fixed and not necessarily conveniently close to a community settlement. The next bush may also be some ways away.

Increasing patchiness (generally manifested by increasing space between resource clusters, and increasing remoteness from settlements) requires a greater investment in time, energy and material for people to capitalize on the available resources. As a result

of the greater investment, the risk of an inadequate resource return has more severe consequences as the patchiness increases. Based on an equivalent input of time, the likelihood of an inadequate return also increases. Therefore, in response to increasing patchiness, it has been shown that hunter-gatherer groups will invest in a more intensive engagement with each individual patch (Bousman 1993:62). This intensification generally takes the form of spending more time at fewer patches.

Prey models also manifest risk in particular ways. However, instead of requiring greater investment in order to try to maximize return to avoid resource shortfall, prey models require an investment in order to avoid failure and thereby maximize return. Because of the temporally heterogeneous nature of prey-model resources, a missed collection opportunity may have long-reaching consequences. Bousman (1993), Torrence (1989) and Bleed (1986) describe how increased investment in technological strategies may be used to offset high risk hunting tasks where the costs of failure may be particularly high. All three authors use high arctic hunters as an example. Tundra caribou are highly migratory, and may only be available in any particular location for a very brief (but predictable) time. The meat, hide, antlers and bones of the caribou form an integral part of the subsistence base and material culture of many high latitude peoples. As such, success in the annual caribou hunt is vital to the wellbeing of the community. In order to ensure success (or rather minimize the chances of failure), high arctic caribou hunters invest a great deal of time, energy and material into their hunting equipment. The equipment is very complex, well made, and well maintained, conforming to the definitions of reliable technology. As such, the likelihood of equipment failure compromising hunting success is minimal; the weapons will function when called upon

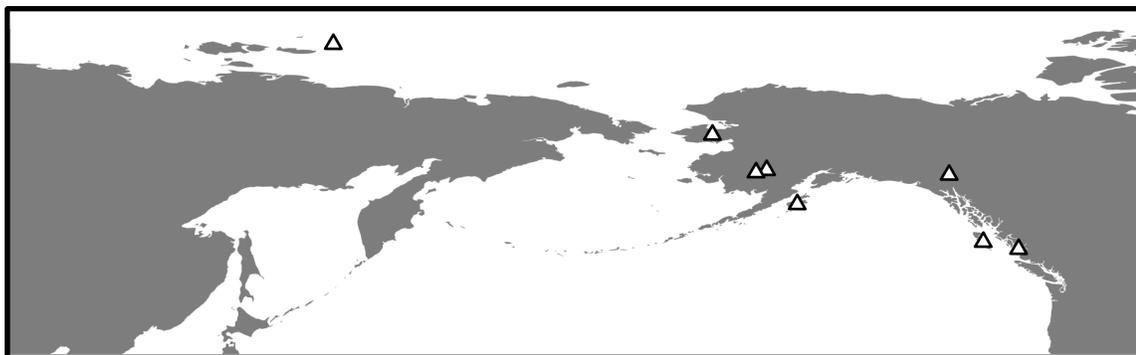
(Bleed 1986:743; Bousman 1993:64; Torrence 1989:64). Similar to high latitude hunters, an increase in toolkit and weapon complexity and reliability has been observed for maritime-adapted cultures (Bleed 1986; Oswalt 1976:96; Torrence 1989:61). As reliance increases on maritime resource, such as fish or (especially) sea mammals, the complexity of the toolkit also increases (Oswalt 1976:96).

One important aspect of the relationship between resource availability and toolkit reliability and complexity is the correlation between resource distribution and latitude. Several authors (ie. Torrence 1983; Oswalt 1976) have observed that equatorial hunter-gatherers are more wont to employ a versatile, maintainable toolkit. Resource distribution may be patchy throughout their foraging territory, but temporal availability is often unrestricted, and a wide array of resources are available. Thus, though clusters of any individual resource may be remote from one another, the intervals may yield many other resources, and collectors will do well to be prepared for a variety of foraging opportunities (Torrence 1989:60-61). As one considers groups further from the equator, the temporal availability of resources becomes increasingly restricted as seasonal variation increases. High latitude hunter-gatherers will likely rely more heavily on fewer resources, and thus organize their technology in such a way as to optimally exploit those resources when they become available. As mentioned above, high arctic caribou hunters are an example of people reliant on predictable but temporally highly restricted prey. As a result, the toolkit taken on caribou hunting excursions is highly reliable and designed specifically for that task (Bleed 1986:743; Torrence 1989:64). Following this model, combined with the positive relationship between maritime adaptation and complex

technological strategy, one may expect an even greater increase in toolkit investment among high latitude coastal hunter-gatherers (Oswalt 1976:182; Torrence 1989:61).

### 2.3.3 North Pacific Slotted Points and Risk

The northern slotted point tradition (discussed in more detail in Chapter 4) is an example of the intensification of technology among high latitude coastal foragers. Intact (or partially intact) slotted points have been recovered from a variety of sites around the North Pacific Rim (Figure 4). As discussed in Chapter 3, slotted points with microblade insets represent a very durable, reliable hunting weapon. The bone or antler component, making up the large structural section of the point, is a hard, slightly elastic material, unlikely to break during use (Elston and Brantingham 2002:106; Knecht 1997:206; Pétilion et al. 2011:1279) (See also Chapter 7.5; Appendix A.2). The microblade insets are removable and replaceable if damaged or lost, and the high number of microblades that may be hafted in each slot meant that the loss of a few microblades would not significantly compromise the functionality of the weapon. However, the process of making each slotted point is quite costly in terms of material, time and labour, and microblade production requires a specialized skillset and knowledge base, so quite an investment is necessary to maintain such an industry.



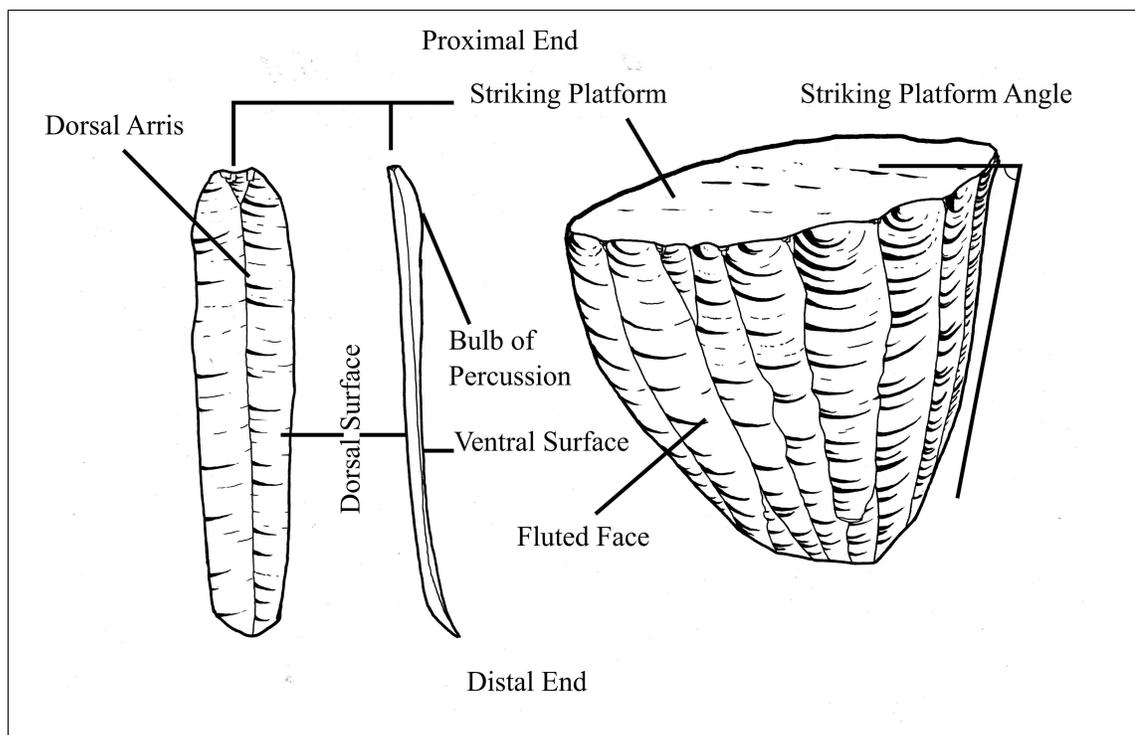
**Figure 4: Preserved slotted point sites around the North Pacific region.**

The Zhokov Island site off the coast of Northern Siberia (see chapter 4.1 for a more detailed description) provides good evidence of slotted point weaponry being used for high risk hunting. In addition to a rich assemblage of preserved slotted points, many with intact microblades, the Zhokov Island faunal collection included the bones of polar bears, caribou and various sea mammals (Giria and Pitul'ko 1994:32). As discussed above, the temporally constrained availability of caribou reflects a relatively high-risk hunting endeavour. Similarly, hunting polar bears is very high risk, though less because of the risk of missing the opportunity to collect resources than because of the risk of facing a very large, fierce, top level predator. Seaborne hunting in high latitudes is also a risky undertaking, as sea mammals may be large and fierce, and the vagaries of the northern oceans pose a significant threat to small watercraft. Clearly, the ancient hunters of Zhokov Island were accustomed to high-risk hunting activities, and selected slotted point weapons as technological solutions to some of the problems they faced.

## Chapter 3: On Microblades

### 3.1 Microblades: A Definition

Microblades have been variously defined throughout the archaeological literature (Andrefsky 2005:207; Bar-Yosef and Kuhn 1999:323; Crabtree 1972:76; Elston 2002:2; Odell 2003:96; Whittaker 1994:232). For the purposes of this thesis, microblades will be defined roughly following Lee (2008:82), as stone flakes manufactured from a prepared core. The unmodified complete flake is at least 2.5 times as long as it is wide, with roughly parallel lateral edges. The dorsal surface of a microblade should display one or more arrises (ridges) running parallel to the long axis of the microblade (Figure 5). The dorsal flake scars should be parallel, and should indicate that prior bladelet removals occurred following the same axis, originating from the proximal end of the microblade. Microblades are considered distinct from generalized blades based on their size: the term “microblade” is generally accepted to be restricted to artifacts that meet the above criteria and are less than 11mm wide at the widest point. That being said, microblades are still considered blades, though not all blades are microblades. Throughout this thesis, microblades may also be referred to as “bladelets”, though this term will generally be reserved for microblade-like flakes or other very small flakes with parallel lateral edges and a high length:width ratio.



**Figure 5: Microblade and core anatomy**

### 3.1.2 Blade-like Flakes and Microliths

One important aspect of microblades is that the blade form is achieved through deliberate action in core preparation, rather than as a coincidental byproduct of stone flaking. Accidentally produced bladelets may display many characteristics associated with microblades (especially parallel lateral margins and the 2.5:1 length:width ratio), but are termed “blade-like flakes” (BLF henceforth) if they cannot be associated with deliberate microblade production (Flenniken 1980:297; Croes 1995:180; Lee 2007b:83). Since intentionality does not preserve archaeologically, a common method of determining whether an artifact is a BLF or a microblade is through contextual association within the assemblage. If a bladelet is recovered alone, with no microblades or microblade cores,

and the morphology is not unequivocally microblade-like, it is likely to be defined as a BLF. However, if recovered in association with other aspects of microblade technology, it is more likely to be identified as a microblade. The method is clearly imperfect, but is the best technique currently available.

Unlike BLFs, microliths do not necessarily share many morphological features with microblades, apart from their size. Microliths are very small flaked stone tools with potentially variable edge profiles and dorsal scar patterns (Andrefsky 2005:33; Lee 2007b:84). The dorsal flake scars are a primary distinguishing feature between microblades and microliths (Lee 2007b:84, 85). Also, microlith manufacture frequently does not generally require a specially prepared core and may be achieved through direct bipolar percussion flaking (a method not often associated with microblade production) (Lee 2007b:85, Whittaker 1994:115).

### **3.2 Microblade Manufacture**

A variety of manufacture techniques may be employed to produce microblades. While the final product -the microblade- may appear uniform, there is wide variation in methods of core preparation and rejuvenation; core support; and application of force. This section will describe a selection of these methods with special emphasis on those relevant to Haida Gwaii and Northwest Coast microblade traditions and to those employed during experimental microblade production.

### 3.2.1 Core Preparation

Microblade manufacture is based on the principles of prepared core reduction sequences. That is, the knapper dictates the form of the flakes through the careful preparatory shaping of the core's surfaces (Andrefsky 2005:144; Odell 2003:95; Whittaker 1994:221). Ideally, each flake will contribute to the optimal core shape, enabling the efficient removal of subsequent flakes (Flenniken 1987:121; Whittaker 1994:221). The goals of prepared core reduction are thus twofold: (1) to remove flakes of a desired and predetermined shape from a core and (2) to maintain that core shape to facilitate and optimize the removal of more ideal flakes. This is in marked contrast to biface reduction sequences, where the form of the objective piece is the primary concern and the flakes removed are largely byproduct debitage, and to generalized core reduction where the overarching goal is to remove usable flakes, without significant regard to minimizing variance in progressive core shape (Odell 2003:63). Obviously, many bifacial reduction flakes may be very useful cutting tools, and a good knapper will reduce a core in such a way as to maintain usable platform angles and avenues of flake removal, but these goals are secondary to the driving desire for an ideal bifacial tool form or a useful flake.

Microblade core reduction is particularly interesting in terms of this *schema opératoire*, as the cores are frequently very small and a hallmark of the technology is the ability to achieve maximal cutting edge with minimal raw material expenditure (Sheets and Muto 1972:632; Whittaker 1994:221). Thus, intermediate core maintenance (between blade removals) must by necessity not remove large masses of material from the core, lest the core be reduced to an unusably small size. Considered in contrast to other prepared core traditions, such as Levallois flaking where a series of preparatory flake removals are

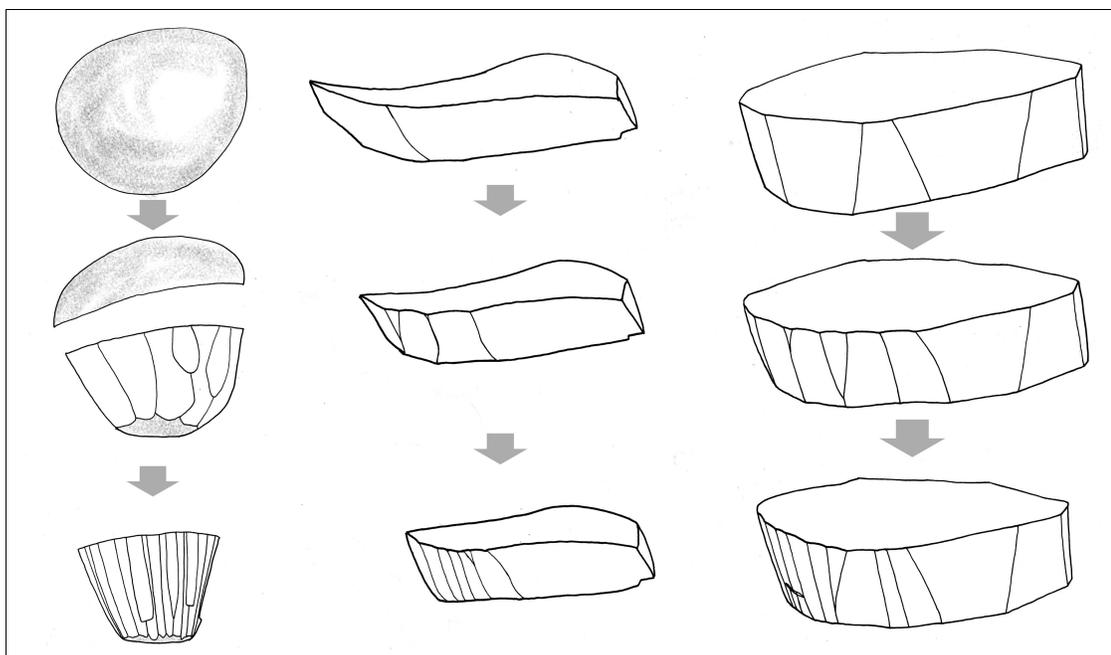
necessary between the removal of each Levallois flake (Odell 2003:90; Whittaker 1994:121), virtually every microblade flake removal action following the initial core preparation must result in a both a formed microblade as well as an optimized core form for the next microblade.

### **3.2.1.1 Microblade Core Preparation Methods**

There are two primary methods of microblade core preparation: unidirectional core preparation and bifacial core preparation. These methods have been identified in many regions and have been identified using various terms -both descriptive and cultural/geographic- often applied equally to the core preparation method as well as core forms. These terms may be problematic, as they may not necessarily reflect the varying *chaînes opératoires* of the core preparation strategies (not all unidirectional or bifacial cores are produced following the same sequence) (Odell 2003), may be region-specific (ie. Northwest Coast Variant; Yubetsu; Denali; etc.) (Ackerman 2007; Bamforth and Bleed 1997; Magne and Fedje 2007), or may not take into consideration variability in raw material form or variation and/or overlap in stages in the reduction sequence (ie. Conical, boat-shaped, wedge-shaped, bullet-shaped, etc.) (Andrefsky 2005; Crabtree 1972; Odell 2003; Elston and Brantingham 2002). For the purposes of this thesis, core preparation techniques will be generalized either as “unidirectional” or “bifacial” techniques, but will be considered distinct from morphological core descriptions.

### 3.2.1.2 Unidirectional Core Preparation

The unidirectional core preparation reduction sequence (Figure 6) may be summarized as a series of flake removals (generally using direct hard-hammer percussion), each originating from a single striking platform, running parallel towards the distal end of core. The flake scars create a lateral core surface at an acute angle to the striking platform and may also be used to establish longitudinal guiding ridges or corners along which incipient microblades may be removed. Hard-hammer percussion often leaves deep negative bulbs of percussion in the flake scars, which result in overhanging striking platform edges (the most proximal portion of the core's lateral surfaces may be slightly concave), and necessitate some additional light trimming to enable microblade production.



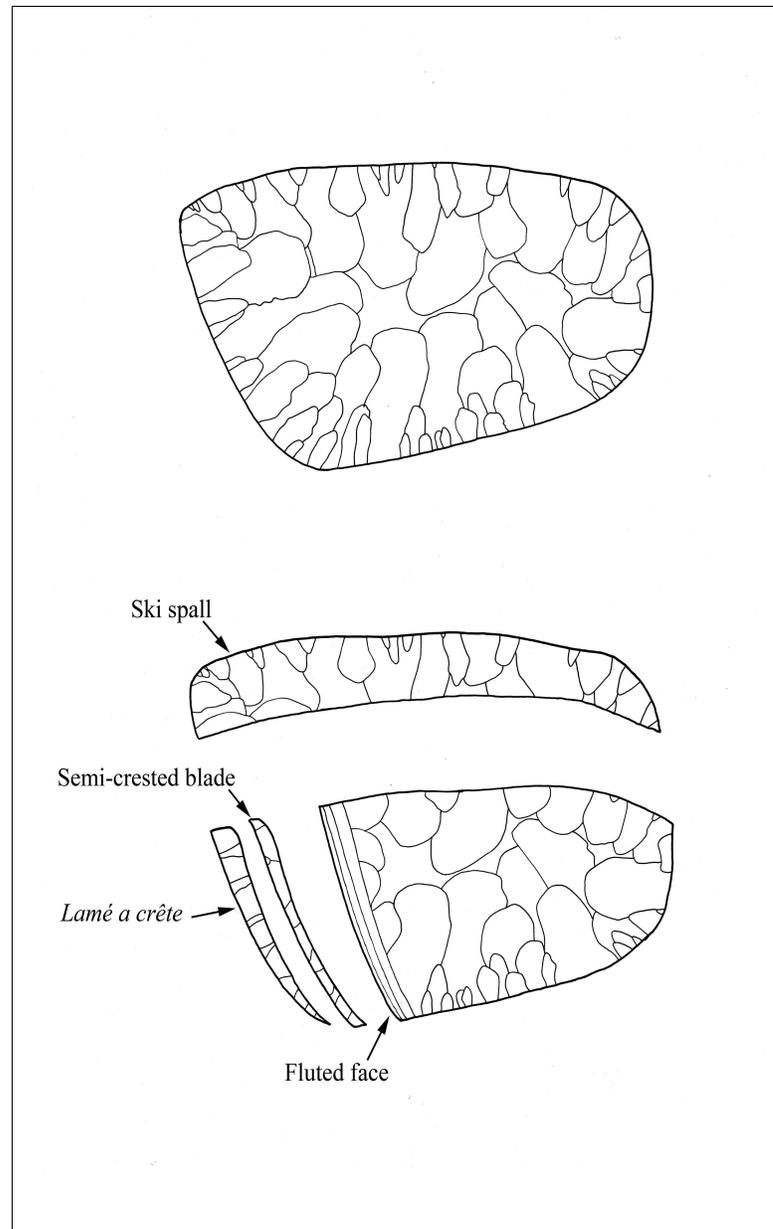
**Figure 6: Unidirectional core types and core preparation sequences. Left-to-right: cobble core, flake core, tabular core. All three types may ultimately be reduced to a conical, boat-shaped or bullet-shaped core.**

A suitable striking platform is a prerequisite for the unidirectional core preparation process (Whittaker 1994:221). To establish a striking platform the knapper must either select raw material that already exhibits a suitably flat surface, or must create such a surface. Three primary strategies were employed (Figure 6). First, tool makers might select material with a somewhat planar structure, as long as that structure was one of thick planes with non-planar, conchoidally fracturing stone between them. This would provide ready-made natural platforms; often perfectly flat. The second strategy involves splitting a cobble or pebble (either by bipolar percussion or throwing the nodule violently against an anvil stone), and using the resulting interior plane as the surface. These surfaces may exhibit slight undulation, and can require some platform flaking (flake removals along the plane of the platform- not strictly unidirectional) to remove convex sections. Third, cores were frequently made on thick flakes. The ventral surface of the flake would function as the striking platform and after any particularly acute edges were trimmed off, microblades could be removed around the flake's periphery. At some stages of this process the microblade core may appear very similar to a unifacial endscraper.

### **3.2.1.3 Bifacial Core Preparation**

Bifacial microblade core preparation involves shaping the core in a multi-stage process during which a thick bifacially flaked blank is spalled to establish an optimally formed core (Figure 7) (Flenniken 1987:120; Rasic and Andrefsky 2001:63). First, a thick flake must be removed from a large core. This flake is then shaped through bifacial flaking to a desired blank form: generally an ovoid or rounded trapezoidal profile. Exhausted or battered bifacial tools may also be converted into microblade core preforms. The biface is then struck to remove one or several long spall-like flakes along

one of the margins (generally the longest edge). This process is very similar to flaking a burin both in the gestures as well as in that the desired outcome is a flake scar with squared edges at the sides of the bifacial preform. The long, thick flake, often with a triangular cross-section and flake scars on both dorsal surfaces indicating the bifacial core preparation is called a “ski spall” (Flenniken 1987:121; Whittaker 1994:221). Ski spalls may be considered crested flakes, reflecting the presence of the lateral flake scar remnants, or cresting, on both dorsal surfaces. Several ski spalls (subsequent ones have the flake scar of previous ski spalls on their dorsal surface rather than the crested ridge) may be removed in order to achieve an optimal striking platform surface on the core. Following the removal of the ski spall(s) an inaugural flake is removed from what will become the core's fluted surface. Like the ski spall, this long, parallel sided flake follows the relatively straight ridge created by the bifacial shaping, and will exhibit the flake scars along its dorsal surface. This artifact is termed a crested blade or *lame à crête*. Since the ski spall may also be considered a crested blade, the term *lame à crête* will be used henceforth to distinguish between the two flake types. Both ski spalls and *lames à crêtes* may be considered to be diagnostic artifacts for identifying the bifacial microblade core preparation method, even if no cores were recovered from a site (Odell 2003:121). The lateral ridges of the flake scar left by the *lame à crête* serve to guide subsequent removal of the inaugural microblades (Crabtree 1968:455; Odell 2003:95). These blades will exhibit cresting on the dorsal surface to one side of the central arris, but only a single longitudinal flake scar to the other. As the fluted face is expanded and the core is reduced, microblades from the lateral margins of the fluted face will exhibit this unimarginal cresting and are thus termed “semi-crested blades” (Waber 2010:56).

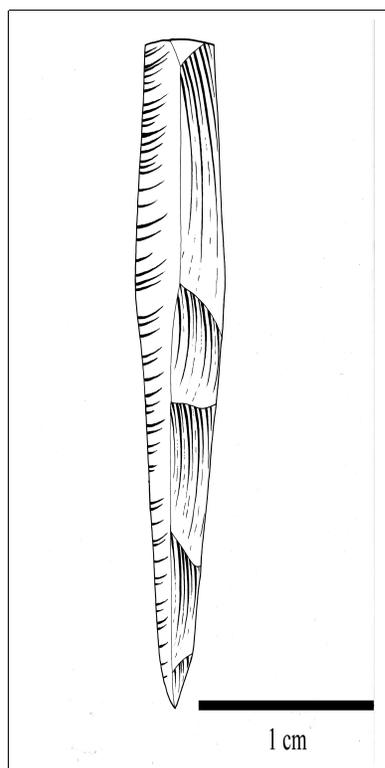


**Figure 7: Bifacially prepared core with ski spall, lame à crête, and semi-crested blade. From Waber 2010.**

#### 3.2.1.4 Semi-crested blades

Semi-crested blades are a common feature of bifacial core preparation. During microblade production it is necessary to maintain the curvature of a microblade core's

fluted surface in order to regularize the thickness of each microblade and also to maintain the presence of the longitudinal ridges that guide each microblade's path of fracture (and become the bladelet's dorsal arris(es)). If the fluted surface becomes too flat, the microblade scars and ridges can no longer function to restrict the lateral extents of each microblade and the flakes will become wider with more erratic margins (Flenniken 1987:122). Thus, as microblade removal progresses, microblades must be taken from the extreme lateral margins of the fluted face, thereby extending the curvature of the core and drawing the core's chord further back along the striking platform. The microblades removed from the margins of the fluted face of a bifacially prepared core will exhibit a unique dorsal flake scar pattern: the dorsal surface to the side of the arris adjoining the fluted face will be as sharp and regular as any other microblade, but the other surface will display portions of any lateral flake scars that were present on the core's lateral surfaces (Figure 8). If microblades are removed sequentially, following a lamellar flaking pattern, there should be at least two semi-crested blades produced from each row of blade removals.



**Figure 8: Semi-crested blade.**

**From Waber 2010.**

Semi-crested blades may function as indicators of microblade core preparation method in sites with few or no diagnostic cores or flakes. As mentioned above, ski spalls and *lames à crêtes* may be used as diagnostic indicators for the presence of the bifacial microblade core preparation strategy, and may thus be useful for identifying possible cultural site affiliation based on technological traditions. However, since neither ski spalls nor *lames à crêtes* are generally very sharp, they are unusable as tools and experience curation and disposal practices different from regular microblades (Odell 2003:95; Waber 2010:56). The crested blades are most likely to be discarded at the microblade core production locus, rather than to be curated and carried to other activity sites, such as hunting camps or butchering locales. Semi-crested blades, because one lateral margin is

comparable to any other microblade, would be usable as cutting tools, and would therefore likely be included in a selection of utilitarian microblades. The use-life trajectory would be the same, as would the circumstances of disposal. Therefore, the presence of a high proportion of semi-crested blades in a microblade assemblage should be indicative of bifacial microblade core preparation.

Semi-crested blades are not exclusive to bifacially prepared microblade cores; they also occur in microblade assemblages produced from unidirectionally prepared cores as artifacts of the vagaries of core preparation flake scar morphology. However, there is a significant difference in occurrence frequency between bifacially prepared core (BPMC) and unidirectionally prepared core (UPMC) microblade assemblages. An experimental study performed by the author (Waber 2010) revealed that semi-crested blades are present in more BPMC core-blade assemblages (collections of microblades removed from a single core), and to a far greater extent in those positive (semi-crested blade-bearing) assemblages than in UPMC assemblages. 100% of BPMC core-blade assemblages included semi-crested blades, while 45% of UPMC core-blade assemblages did. Within the assemblages, a mean of 34% of BPMC and 6% (positive) or 2.75% (all) UPMC microblades were semi-crested blades. See appendix B for a detailed description of the experiment and results.

### **3.2.2 Core Rejuvenation**

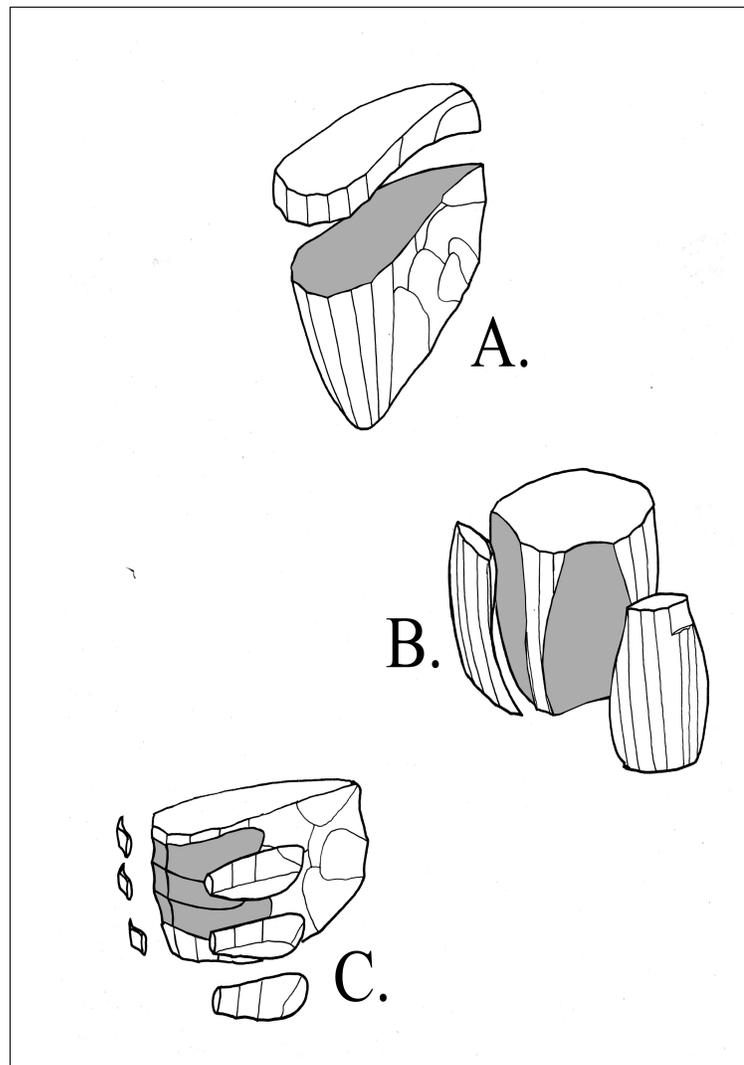
Clearly, the optimality of a microblade core's form will diminish as microblade removal progresses, eventually leading to the necessity to rejuvenate the core. This rejuvenation may depend largely on the initial core preparation method (see above), but

takes two primary forms: (1) tabular striking platform flake removal and (2) fluted face rejuvenation. In the case of the former, the microblade core is struck in such a way as to remove a tabular spall that includes much of the striking platform and often the extreme proximal portion of the fluted face (Figure 9). This serves to re-establish a usable striking platform angle as well as to remove residual overhanging material or remnant step fractures and ground corners from the edges of the striking platform. This method does, however, come at a cost to the tool producer. By reducing the core's fluted face length through this tabular flake removal, subsequent microblades will be shorter than could otherwise be achieved.

The second method involves striking the microblade core slightly behind the edge of the striking platform in order to remove a relatively wide, thick flake from the fluted face (Figure 9). The flake will remove overhanging material at the striking platform edge as well as bulging, rounded or stepped sections of fluted face. The resulting flake scar provides a fresh striking platform angle and may also establish a new ridge to guide bladelet removals. This method may be slightly advantageous over the platform spall removal technique as it does not compromise core height (and thus microblade length) and the flakes may remove step fractures and other masses from further down the fluted face. However, removing material from the fluted surface does reduce the overall number of potential microblades that a core may produce.

My own experimental knapping exercises have revealed a third potential core rejuvenation method, in which a series of flakes may be removed laterally from the fluted face of a core, gradually restoring the striking platform angle (Figure 9). This method is somewhat similar to the bifacial core preparation technique discussed above, but does not

necessarily require flakes to be removed from more than one core surface. Contrary to the other two core rejuvenation techniques, this lateral flaking very rarely results in any immediately identifiable debitage. Unless the removed flakes transgress significant portions of the core's fluted face, the debitage is largely indistinguishable from any other small flake.



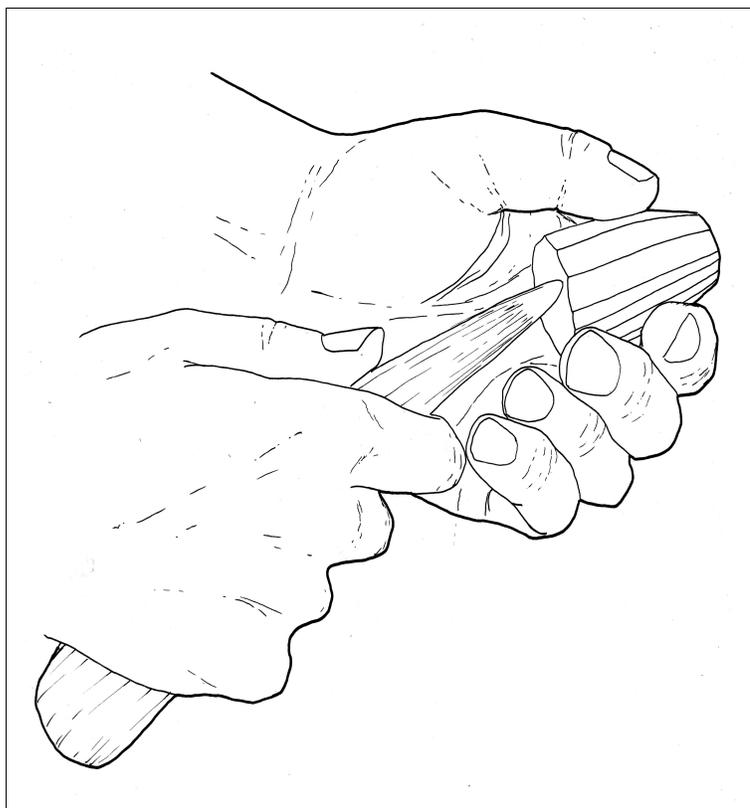
**Figure 9: Core rejuvenation techniques. A: Platform spall technique. B: Fluted face flake technique. C: Lateral surface flake technique. The grey shaded areas indicate the flake scars left by the rejuvenation flake removals.**

### **3.2.3 Core Support and Application of Force**

One significant challenge in microblade production is holding the microblade core in a suitably firm, immobile grip without causing the microblades to break during flaking. Very few definitive ethnohistoric or ethnographic sources exist that document microblade core support methods in active use. As a result, a variety of support techniques have been employed by different experimental flintknappers and archaeologists. These include various hand-held and vised positions, each of which has benefits and drawbacks.

#### **3.2.3.1 Handheld Cores**

Handholding microblade cores is a challenging method as it requires a very high degree of physical strength in the knapper's non-dominant hand and arm (Figure 10). Following Flenniken's illustrated method of Mesoamerican blade production (Flenniken and Hirth 2003:101), the core is generally held tight between the forefingers and the thumb of the non-dominant hand. The hand is positioned with the palm upward and the back of the hand braced against the inside thigh of the same leg. The core is held with the fluted surface facing upward and running parallel to the thigh and the striking platform facing the knapper. Microblades are taken off the top surface of the fluted face using a pressure flaking technique similar to Crabtree's method (Crabtree 1972:15; Patten 1999:71; Whittaker 1994:135). The knapper's thumb must be positioned parallel to the longitudinal axis of the core's fluted surface. If the thumb lies across the fluted surface the pressure will affect blade removal; blades are likely to snap on removal and step fractures may occur.

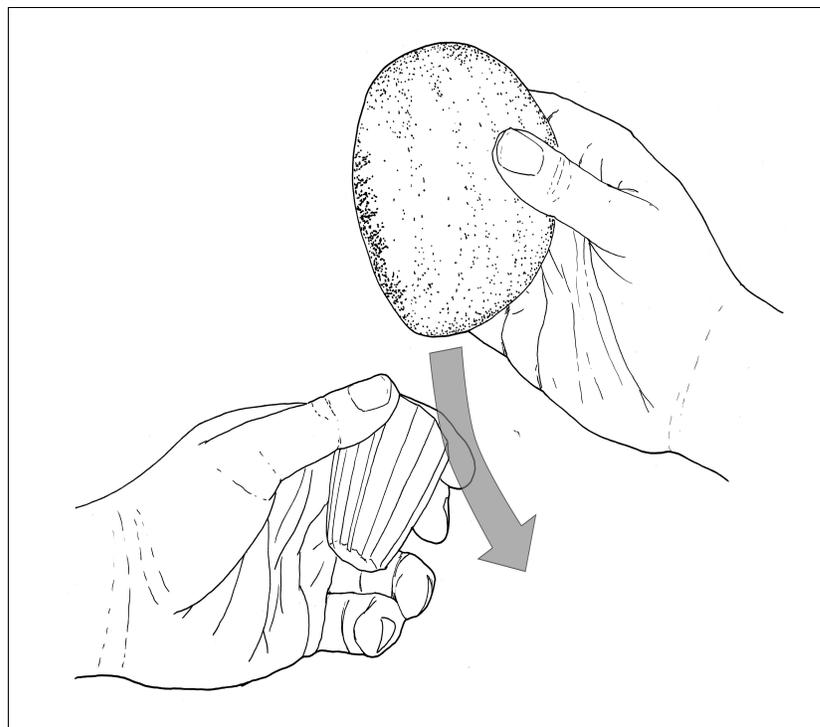


**Figure 10: Handheld pressure microblade removal. After Flenniken and Hirth 2003.**

Alternatively, the core may also be held in the palm, pinned by the fingers (similar to common biface pressure flaking position (Whittaker 1994:135)). However, contrary to the biface, the core's striking platform will face the side of the hand near the base of the little finger rather than the wrist. The active fluted face will generally be positioned in the space between the fingertips and the palm, though some knappers employ a leather handpad with a channeled recess and thereby press blades downward off the core.

Microblade cores may also be handheld for direct or indirect percussion flaking. Crabtree and Swanson (1968) describe a method of blade production whereby the knapper holds the blade core vertically (striking platform upward) and strikes blades off using the long edge of a discoid or angular cobble and a somewhat glancing blow (Figure

11). The core is held between the fingers and thumb and the hammerstone is swung past gently on a relatively straight trajectory, just catching the edge of the blade core. The hammerstone, generally a softer stone such as limestone, sandstone or gabbro, does not impact the core directly on the striking platform as is usual in direct hard-hammer percussion, but rather clips the edge of the striking platform, “dragging” blades off (Crabtree and Swanson 1968:52). This method is effective for blade removal, but based on the author's knapping exercises the blades produced are rarely small enough to be considered “true” microblades, and the dimensions and form of the lateral margins will be far more variable than pressure-flaked blades.



**Figure 11: Handheld direct percussion microblade removal. After Crabtree and Swanson 1968.**

Indirect percussion may be achieved by holding the core vertically between the second, third and fourth fingers and the palm of the non-dominant hand while the forefinger and thumb hold the punch in position. The punch, generally a short section of antler or bone, is held just behind the edge of the core's striking platform, angled nearly parallel to the fluted surface. This is struck with a hammer (either an antler, bone or wooden billet or a hammerstone) held in the dominant hand. The core may either be held in the palm or have its base supported against an anvil (a hard, unyielding surface), though this is difficult to achieve with smaller cores.

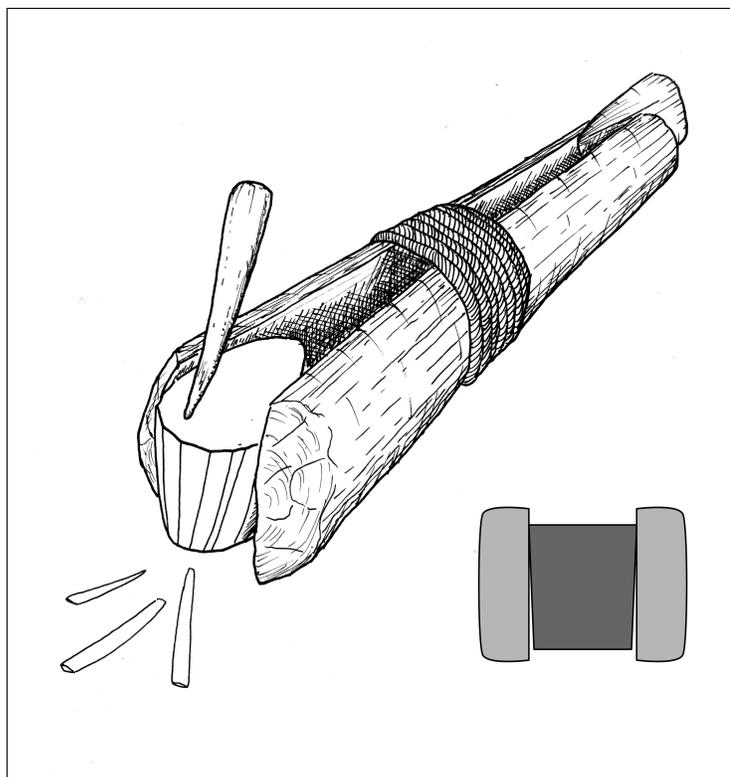
The primary challenge with any handheld core technique is preventing core rotation at the instant of impact (Whittaker 1994:225). It is imperative that the core's rotational position must be maintained throughout the application of force in order that the blade's lateral extent will be restricted to the desired dimensions. Variation from the ideal position will often result in the crushing or stepping of the striking platform edge, or at best the removal of a much shorter than desired flake with significantly subparallel margins. Either result compromises the optimality of the form of the fluted surface and/or the striking platform angle and will generally necessitate some core rejuvenation actions to be performed. Since each rejuvenation event reduces the size of the core, thereby compromising either the size or the number of subsequent potential microblades, it is desirable to minimize the frequency of core rejuvenation.

### **3.2.3.2 Device-held Cores**

Because of the high amounts of pressure exerted during the applications of force required for blade removal, several flintknappers have developed a variety of devices

designed to hold cores stationary. These range from various simple vises to complex leverage machines. The author is unaware of any archaeological examples of any of these devices, though issues of preservation (most are made primarily of wood and fibre) or identification may affect their non-presence in the archaeological record.

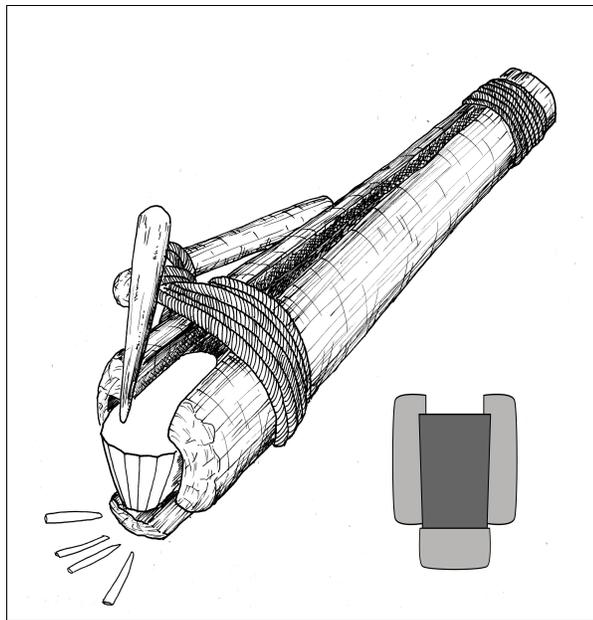
The most commonly known method of vise-held core microblade production is Crabtree's vise and chest-crutch technique (Figure 12) (Crabtree 1968:453; Whittaker 1994:222). This method involves the use of a two-jaw vise holding a polyhedral core vertically to allow the knapper to stand above it and remove blades using a chest-crutch pressure flaker. The vise is made of two long wooden boards, bound together near the middle, and a wedge that is driven between the boards at the end opposite the core. The force of the wedge pushing the ends of the vise apart at one end causes the vise to pinch the core firmly at the other (Crabtree 1972:453; Sollberger and Patterson 1976:524; Whittaker 1994:222). This model has since been applied at a smaller scale in descriptions of blade production methods elsewhere in the world, including the Northwest Coast (Fladmark 1986a:35).



**Figure 12: Two-jawed vise. After Crabtree 1968.**

While Crabtree's vise is quite effective for blade production on the long, cylindrical Mesoamerican blade cores, it does not function as well when applied to conical or wedge-shaped microblade cores. Because the smaller cores tend to taper towards the distal end, the two-jaw vise only grips the lateral surfaces nearest the striking platform. This, especially in the case of conical cores, results in a core that is likely to rotate under pressure. As a result, various knappers (cf. Callahan, Tabarev) have developed a three-jawed microblade vise (Figure 13). In addition to the two lateral clamping jaws, a third platform jaw is added to support the distal end of the core and prevent rotation. Rather than drive a wedge into the distal end of the vise to tighten the jaws at the proximal end, the vise is bound tight at the distal end, the core inserted at the

opposite end, and then bound again at or near the core. The author's preference is to use a stout band of nylon or leather and an antler handle to create a tourniquet to facilitate fast and easy repositioning and removal of the core. Callahan's illustrated three-jawed vise is approximately 30cm long. A vise of this length allows a fair degree of variation in the size of the core used. Tabarev (1997) describes use of a "pocket" vise; essentially a miniature version of Callahan's three-jawed vise. Tabarev's vise is more portable than Callahan's, but restricts the maximum size of core that may be braced in it. Both vises are ideal for microblade production by pressure flaking, and are quite effective for indirect percussion flaking as well, as the vise may be placed on the ground and held under the knapper's foot to free the non-dominant hand for easier manipulation and positioning of the punch.

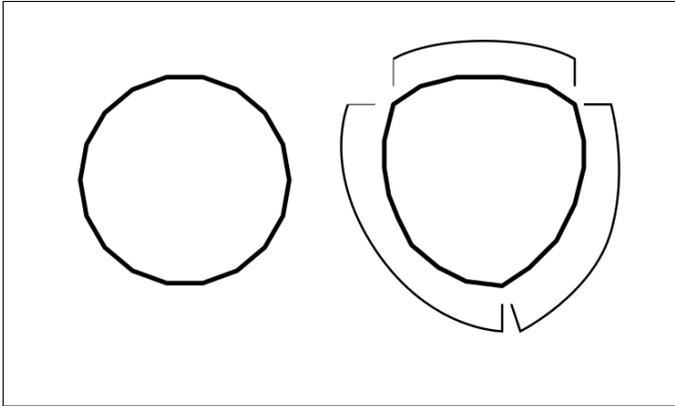


**Figure 13: Three-jawed vise. After Callahan 1985 and Tabarev 1997. The stick shown on the far side of the vise is used to tighten the tourniquet in order to clamp the core in place.**

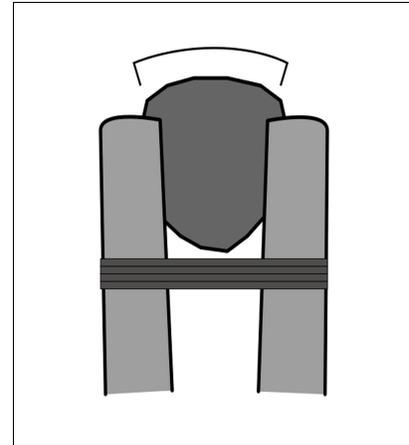
One important consideration in regards to microblade core support by hand or by vise is that of core repositioning. As microblades are removed from a core, the core becomes smaller, the fluted surface often becomes flatter, and therefore the core must be repositioned occasionally to facilitate further blade removals. This is easily done when using handheld support techniques as the core is free in the knapper's hand. It may be rotated at will to find the optimal flaking platform and position. However, when the core is supported in a vise, the vise must be loosened and retightened every time the core is repositioned, slowing the blade production procedure and disrupting the flow of work. Callahan's vise illustration shows that a bifacially prepared core may be positioned in the vise in such a way as to allow a significant segment of the core to protrude from the end of the vise. In such a situation, between a quarter and a third of potential microblades may be removed from the core before it is necessary to reposition it.

Interestingly, as such a core is reduced and the striking platform reaches a stage that will not permit further blade removals without rejuvenation, the core may be reversed in the vise and blades may be removed from the opposite end of the platform. This procedure may be repeated for either lateral side of the platform when the core reaches a stage that it can be rotated 90° in the vise. The positioning of a core within a vise leaves some evidence in the form of the core. Since the vise restricts the amount of fluted face that a knapper may work, it effectively divides the core into active surfaces. Each surface will be reduced as a unit, generally maintaining an internally consistent level of curvature. The other active faces on the core will generally display a similar degree of curvature. As a result, a core may be fluted on all lateral surfaces (360°), but should not be considered conical. A top-down view will reveal a polyhedral silhouette

rather than a round one (Figure 14). Girea and Pitul'ko (1994:38-39) identify this sectional segmentation of “rounded” cores as a deliberate strategy for maintaining microblade consistency independent of support method. They argue that if microblades are removed from a core in continuous circumferential circuits (effectively a spiral), the core's diameter will shrink to such an extent that the width, thickness and length of the microblades will become inconsistent with earlier products and will thus be unusable in situations demanding uniform morphology such as inset points. Thus, the lateral surfaces of the microblade core are cognitively segmented and reduced individually to maintain a constant virtual core diameter even while the actual core shrinks (Girea and Pitul'ko 1994:39). While this principle holds true for maximizing consistent microblade production, the same effect may be produced by the surface-use constraints imposed by a microblade vise. A spiralling microblade removal pattern would require far more frequent vise releases and re-tightenings than is necessary for blade removal, so each surface is flaked consistently following a pattern suitable for the continued removal of microblades. The result is essentially the same slightly polyhedral (non-round or pseudo-round) core as that illustrated by Girea and Pitul'ko (Figure 15).



**Figure 14: Round and polyhedral core forms as viewed from above the striking platform. The brackets surrounding the polyhedral core indicate the extents of each individual contiguous fluted face.**



**Figure 15: Top-down view of a core in a vise. The bracket indicates the available flaking surface (without repositioning the core), which may lead to the creation of the polyhedral vertical core profile.**

Sollberger and Patterson (1983; 1976) have proposed two alternative methods of pressure microblade production. The first involves the use of a two-pronged fork apparatus to hold the core stationary as a pressure tool levers blades off between the tines (1976:524). This method facilitates the fast and easy repositioning of a core, much like handheld techniques. The use of the crotch of the fork as a fulcrum enables very high amounts of pressure to be exerted, potentially making this a useful technique for flaking harder materials or producing longer blades (Sollberger and Patterson 1976:524). The second method requires the use of a double-levered pressure flaking device. The core is held in position in a vise, with the jaws of the vise applied to the core's striking platform

and distal end rather than the lateral surfaces. A lever device is positioned to apply pressure simultaneously to the edge of the core's striking platform and to the lower jaw of the vise, squeezing the core to remove each blade (Sollberger and Patterson 1983:26). Sollberger and Patterson describe the working process as very precise, fast and efficient, with force “applied at a slow, uniform rate” (Sollberger and Patterson 1983:26). While this may be true, the device appears to be quite complex and unwieldy, and thus may be useful for the fast production of microblades, but less so as an analogy for ancient blade-making practices.

### **3.3 Microblade Hafting**

Microblade technology, generally acknowledged as an exceedingly efficient and effective technological strategy, owes a great deal of its efficiency to the hafting methods employed to produce composite tools. A single microblade offers very little cutting edge, and is difficult to hold, but when hafted either as part of a knife or a projectile point, lends a very sharp edge to a durable organic handle. These hafts therefore compose a very important aspect of the microblade toolkit, yet, due to poor preservation, they are rarely recovered from archaeological sites and are therefore frequently overlooked in discussions of specific technological behaviour.

Two primary approaches to microblade hafting may be identified in the archaeological record: edging composite projectile points and edging knives (Figure 16). In both cases, the microblade is attached to an organic structural component that provides the leverage, control and rigidity to apply the microblades' sharp cutting edge to the maximum effect. However, the specific suite of actions associated with each of these tool

variations is significantly different, as the microblade-edged points are designed to puncture and lacerate prey as part of a stabbing motion, while the knives are meant to bring the microblade edge into use in controlled cutting operations. As such, each mode of hafting indicates a different design intention for the microblade portion of the toolkit, and may likewise represent different economic strategies and subsistence activities taking place at microblade-bearing sites (Bleed 1986:738). Whereas slotted points may perform double-duty and function as cutting tools as well as spear tips or arrowheads, end-hafted or side-hafted microblades mounted in smaller blunt-ended handles clearly serve a more restricted purpose as knives or scrapers alone.



**Figure 16: Replicated slotted point and microblade knives. The slotted point is modelled after the specimen recovered from Cohoe Creek, BC, and the cedar-handled knives are modelled after artifacts from the Hoko River wet site, Washington.**

These two methods of hafting microblades are quite interesting in the context of Northwest Coast archaeology, as both methods are visible in the archaeological record,

though they do not appear to overlap geographically. Slotted points, generally made from bone or antler, are prevalent throughout Siberia and Alaska, and appear occasionally in central and northern areas of the Northwest Coast (Lee 2007a:122, Lee 2007b; Gira and Pitul'ko 1994; West 1994). Wooden handles from knife-hafted microblades (and microliths) have been recovered from sites on Avayalik Island, northern Labrador, as well as the Hoko River wet site in northwestern Washington (Croes 1995:180-182; Flenniken 1981:71; Jordan 1980:623). Some unilaterally slotted bone or antler tools have been identified in Alaskan and Siberian microblade sites, but it is unclear whether they represent antler microblade knives or unilaterally inset slotted points.

Both technologies are found largely in sites from cultures with maritime-adapted economies, but they represent markedly different attitudes towards technological strategies. Both hafting methods capitalize on the modular, replaceable microblades, but whereas the slotted bone and antler points from the Northwest Coast and Alaskan sites indicate a significant investment of labour in shaping and scoring the hafts, the wooden knife handles are much more easily constructed and (at least in the case of the Hoko River assemblage) appear to be very expediently formed, unfinished, and possibly considered as disposable as the microblades themselves (Croes 1980:181; Flenniken 1981:72). These various hafting methods may therefore indicate respectively reliable and maintainable technological systems employed in the various regions.

### **3.3.1 Slotted Points**

Several slotted points have been recovered from microblade sites in Siberia, Alaska, the Yukon Territory and British Columbia. These points, ranging from 12 cm to

28 cm long, are characterized by a pair of long, straight grooves running parallel to the point's long axis, incised into the "short" end of the points' oval cross section (Lee 2007a:123, Lee 2007b; Gira and Pitul'ko 1994; West 1994). Microblades would have been inserted into the grooves, parallel to the point in such a way that the succession of aligned blade edges would create long, continuous, very sharp edges on either side of the point. In this way, ancient hunters would have durable points, unlikely to shatter or snap either on impact with bone in the prey or in case of a miss, yet would still have the sharp-edged cutting benefits of lithic point technology. Presumably the increased laceration caused by the microblade edges would result in more bleeding in the prey, facilitating easier tracking (in the case of terrestrial game), and inducing death, exhaustion or shock earlier (Coles 1973:126; Elston and Brantingham 2002:106).

### 3.3.1.1 Geographic Distribution in the Northeast Pacific



**Figure 17: Slotted point sites around the North Pacific.**

Three main Alaskan sites have yielded slotted points: Trail Creek Caves on the Seward Peninsula, Lime Hills Caves in Southwestern Alaska, and Rice Ridge on Kodiak Island (Ackerman 1996:471; Larsen 1968:53; Lee 2007a:123-124; Steffian 2001:109; Steffian et al. 2002:11; West 1996:484). In all three cases, the points are made from sea

mammal bone or antler and were found in association with microblades, but without any blades hafted (*ibid.*). The Trail Creek Caves were first excavated by Helge Larsen in 1948, and represent the first slotted bone points to be recovered in North America (Larsen 1968:54; Lee 2007a:123; West 483; Steffian et al. 2002:11). Seven specimens were recovered from Trail Creek Caves, including one nearly complete point, “three basal segments, two point segments, and one medial segment” (West 1996:483). The most complete specimen is 12.1 cm long by 0.8 cm wide by 0.6 cm thick (West 1996:483; Larsen 1968:54). All of the segments displayed the deep slots (3mm deep by 1.5-2mm wide) indicative of microblade hafting. Radiocarbon dates from associated faunal material dates to 9070 +/- 150 BP, making this site contemporaneous with the Denali microblade complex elsewhere in Alaska (Dixon 2001:285; Larsen 1968:55).

The 12 slotted point fragments recovered from Ride Ridge are similar to the Trail Creek points in that they display the same bilateral grooves for microblades, and are of comparable width (6.5-11.9 mm) and thickness (3.7-8.3 mm) (Steffian et al. 2002:21). Additionally, two unslotted preforms were recovered, one of which was intact and was 18.5 cm long (*ibid.*). Several of the broken point segments were refitted, and the resulting point was over 28cm long (Steffian et al. 2002:11). Steffian et al. identified a correlation between the average slot width and average microblade width below the bulb of percussion, indicating that a complete microblade may not fit into the grooves, but one with the proximal end snapped off should set firmly in place. This is supported by 83% of the microblade assemblage being composed of incomplete microblades, especially proximal segments which would have been discarded during tool manufacture (Steffian et al. 21-22). Radiocarbon dates from wood charcoal found in basal layers at the Rice Ridge

yielded a date of 7589-6319 BP, and the site has been attributed to the Ocean Bay I tradition (7500-5700 BP); an early Holocene horizon characterized by microblade technology and flaked stone tools associated with hunting activities (Steffian et al. 2002:3, 5).

The Lime Hills Cave site produced only a single slotted “arrowhead”, with the distal end broken off, 10.7cm long by 0.71cm wide by .59 cm thick (Ackerman 1996:471). This point, like those from Trail Creek and Rice Ridge, exhibits bilateral slots for microblades and a tapering proximal end for attachment to a spear, dart or arrow. Interestingly, however, the grooves in the Lime Hills point are incised in a different manner than those from the previous two sites. Whereas the Trail Creek and Rice Ridge slotted points were grooved in such a way that a narrow section of bone was left between the deepest points of the slots (an elongated I cross-section, somewhat similar to a steel girder), the slots on the Lime Hills point are positioned so the nadir of the slots nearly overlap, creating more of a Z-shaped cross section (Ackerman 1996:472; Steffian et al. 2002:11). This may have been a design element incorporated to take into account the shallow triangular cross section of the microblades, and thereby reduce the offset of the blade edge.

The Northwest Coast has yielded three slotted point sites, also dating to the Early Holocene: On-Your-Knees Cave, Cohoe Creek, and Namu. While the latter two sites both produced slotted points, On-Your-Knees Cave exhibited a cluster of microblades, arranged in such a way as to indicate the one-time presence of a now disintegrated organic haft (Lee 2007a:124). The Cohoe Creek site yielded several segments of a broken slotted bone point similar to the Alaskan examples in most respects, though somewhat

wider (nearly 2 cm) than its Northern counterparts (Christensen and Stafford 2005:266). Refitted (though still incomplete), the Cohoe Creek point is over 20 cm long, indicating that it was part of a relatively robust spear, rather than an arrowhead. A short (approximately 7cm) segment of a slotted bone point was also recovered from Namu (Carlson 1996:95-96). This artifact, broken just above the start of the bilateral grooves, is of comparable width to the Cohoe Creek specimen. Based on cursory photographic comparison with complete specimens from the Alaskan sites, the Cohoe Creek and Namu point segments appear to be proximal end fragments (or in the case of the Cohoe Creek point, missing the distal segment).

One slotted antler point has been recovered from the Gladstone Ice-patch in the Yukon. This point, dated to 7310 +/-40 BP, is 24cm long by 1 cm wide and exhibits the same bilateral grooves (1-1.5mm wide and 2-4 mm deep) as the other points (Hare et al. 2004:267; Helwig et al. 2008:280-281). Interestingly, since this point was frozen in the ice-patch, some of the spruce-resin mastic used to fix the microblades in the slots has preserved, providing insight into the hafting practices associated with slotted points (Helwig et al. 2008:282). Also, a broken lithic fragment was found stuck in some of the resin (Helwig et al. 2008:282.).

An significant slotted point assemblage was recovered from Zhokov Island in the Siberian High Arctic. The tools include 12 bilaterally slotted and 13 unilaterally slotted points (as identified by the authors). The collection was excavated from a permafrost context with remarkable levels of preservation: in addition to the slotted points (with many inset microblades intact), a large number of wooden artifacts were recovered. The slotted points were made entirely of antler, bone, fossil mammoth ivory or walrus ivory

(Giria and Pitul'ko 1994:33). The largest fragments measure 17.4 and 17.5 mm long, respectively, and are predicted to have been as long as 24-35cm when complete (Giria and Pitul'ko 1994:32, 34). Giria and Pitul'ko tentatively suggest that some of the smaller, unilaterally slotted artifacts may have been knives, but do not discuss this possibility in any detail (1994:33). The presence or absence of any hafting adhesives is also not specified.

### **3.3.2 Knives**

Microblade knife hafts have been recovered from two primary locations: Hoko River on the Northwest Coast, and Avayalik Island, off the Northern tip of Labrador. Both sites have yielded wooden handles slotted for use with microblades, and in the case of Hoko River, with quartz microliths and a quartz crystal microblade intact. The Hoko River wet site in northwestern Washington State yielded twelve side-hafted and three end-hafted knives (and three handles without blades), made from split cedar handles and bound with cedar bark, spruce root or cherry bark (Croes 1995:180). The cutting component of the knives is almost universally vein quartz microliths produced through bipolar percussion, except in the case of the end-hafted quartz crystal microblade (Croes 1995:180, 182; Flenniken 1981:108). The handles are removed from cedar plank “cores” using small stone hand-wedges, and then split to accommodate the blades (Croes 1995:161, 180). The bindings appear to be the only means employed in fixing the microliths and microblade in the cedar handles; no adhesive was detected (Croes 1995:180).

The Avayalik Island microblade handle, like those recovered from Hoko River, is made of wood and exhibits a lateral slot at the distal end to accommodate the microblade (Jordan 1980:623). Several other wooden artifacts have also been described as “presumably microblade handles”, but this inference is based more on their fragility disqualifying them as foreshafts than any actual indicators of microblade hafting (Jordan 1980:623). No bindings or adhesives were recovered in direct association with the microblade hafts, but knotted baleen strips and braided musk-ox wool cordage was found, and either might serve adequately to fix the microblades (Jordan 1980:623).

### **3.4 Microblade Tools: Reliable and Maintainable Design**

One particularly interesting aspect of microblade hafts, whether slotted bone/antler points or wooden knives, is that they may indicate markedly different design standpoints in terms of reliable and maintainable technology. Based on Bleed’s criteria, the slotted osseous points are relatively definitive items of reliable technology: they are overconstructed, unlikely to fail, carefully and painstakingly crafted and have replaceable, modular, redundant components (Bleed 1986:739). The bone or antler structure is hard yet flexible, and unlikely to break, while the microblades may be quickly and easily replaced if any are dulled, damaged or lost during use. However, this reliability comes at a cost, as the process of shaping the bone or antler to a symmetrical point and incising the straight longitudinal slots is relatively time consuming, and also consumes long pieces of good bone or antler tool material.

The Hoko River knives, however, exhibit the hallmarks of maintainable technology. While similarly modular, any aspect of the Hoko River knife might fail (not

just the stone blade) and be replaced quickly and easily. The handles do not exhibit any finishing beyond being sectioned to length and split to accommodate the microliths. This may indicate that the handles were designed to be as disposable as the blades. This would make sense, considering that Croes (1995:182-183) and Flenniken (1981:77) both attribute the function of the microlith knives to fish processing, and it would likely be considerably easier to switch from one pre-made knife to the next as each was successively dulled, rather than replace and rebind successive microliths with one's hands slippery with fish guts. These inferences are consistent with Bleed's model that reliable tools are used in high-risk situations, while maintainable tools are used when failure does not involve significant loss, but the resource must be processed within a constrained time window (Bleed 1986:739). Based on these interpretations, the Avayalik Island knife handle would appear to be part of a reliable tool system, as it is much more carefully crafted than its Northwest Coast counterparts, and Avayalik Island is over 400 km north of the arctic treeline (the island is nearly devoid of vegetation), so wood would be a relatively scarce material (Jordan 1980:620). That said, since bone, antler or ivory were likely as difficult to acquire and process in the arctic as anywhere else, the wooden hafts may also have been a material-costly maintainable response to low-risk design needs, and the increased craftsmanship was simply a function of the workability of arctic driftwood as compared to fresh cedar.

One universal property of the microblade hafting systems is the ease with which one may replace broken or dulled microblades. None of the slotted points or knives indicate the use of sinew, hide glue, pitch, tar or any other binding agent or material that requires boiling, steaming, soaking or heating. The microliths in the Hoko River knives

are held in place by the fibrous bindings wrapping the flexible cedar tight around them, while the slotted points (based on the Yukon example) are set tightly into the grooves, which have been filled with unheated spruce resin (Croes 1995:180; Helwig et al. 2008:286). Thus, blades could be instantly replaced, restoring the tools to their fully functioning states without the need to stop mid-task and make a fire and/or boil water. This would be an important consideration for ancient tool users, especially in the context of the Northwest Coast where one might be hunting or working on a boat or in an environment similarly ill-suited for fire making (not to mention the time cost involved in bringing water to boil using the technology of the period).

### **3.5 Microblades and Risk**

As mentioned above, microblade technology, specifically slotted osseous points, are highly reliable tools appropriate for use in high-risk situations where tool failure could have catastrophic consequences. The extremely robust material of the point body combines with the very sharp cutting edges of the inset microblades to create a durable yet lethal hunting weapon, unlikely to break at an inopportune moment (Elston and Brantingham 2002:109; Knecht 1997:203). This model is supported by the presence of polar bear and walrus bones among the faunal remains at Zhokov Island (Giria and Pitul'ko 1994:32), as either of these animals would be extremely dangerous, especially if wounded. Knecht (1997:203) reports that experiments studying variation in durability between lithic and osseous points indicate that the slightly elastic bone and antler weapons are far less likely to break than their completely rigid stone counterparts. Not only do bone and antler points survive better than stone points when impacted against

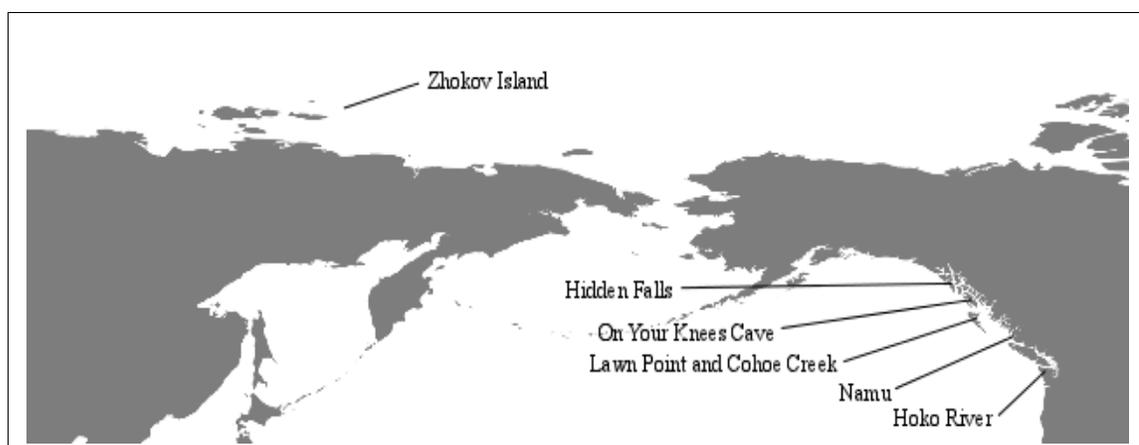
bone, but they are also impervious to breakage due to bending and twisting; a common form of breakage seen among stone projectile points (Knecht 1997:203). This model is supported by recent experiments carried out by Pétillon et al. (2011), which showed that generally only slight (and infrequent) tip crushing is the consequence of impact against bone when using antler-tipped atlatl darts for hunting, and that similar damage (tip crushing and minor tip breakage) occurred in missed shots that impacted a rocky area behind the experimenters' target (Pétillon et al. 2011:1276). Pétillon et al. also reported that several of the inset bladelets separated from the slotted point with each strike (2011:1276), but this is more likely a result of inadequate hafting among the experimental tools rather than failure in the general design of slotted points. This issue is addressed in more detail in Appendix A: hunting weapon experiments.

As described by Torrence (1989:60), Bousman (1993:62), and Elston and Brantingham (2002:112), risk not only takes on the form of instant catastrophic consequences for tool failure (such as a wounded, raging bear confronting a now disarmed hunter), but is also manifested in potential non-returns on invested costs, whether energetic, material or temporal. Bousman's Prey and Patch model of risk (Bousman 1993:61, 65) may be applied in terms of microblades both in regards to raw material availability for lithic tool manufacture, as well as for time-limited resource gathering. Since microblades are among the most economic means of lithic tool production (Sheets and Muto 1972:634), they are often associated with risk or cost mitigation in regions with variable access to adequate tool stone. This may be due to patchiness, where tool stone sources may be few, far between, and/or require significant time and effort to access (Elston and Brantingham 2002:112), or it may be related to

limited temporal access to quarries because of extreme seasonal conditions such as deep snow or frozen ground (Rasic and Andrefsky 2001:64). In either case, microblade technology permits the tool users to maximize their return on investments in raw material acquisition (Elston and Brantingham 2002:111). Elston and Brantingham describe this model in action through the example of wintertime hunters who may adopt a risk-averse microblade production strategy, specifically using a wedge shaped (bifacial) core preparation method in order to minimize the chance of variation in the number of microblades produced (2002:111). The hypothetical hunters are in a situation where retooling with fresh raw material is impossible, either because no fresh stone is available or because they are involved in a very time-sensitive or time-constrained task, and therefore employ a highly reliable, optimally economic technological strategy in order to lower the risk of tool failure (Elston and Brantingham 2002:110-112).

## Chapter 4: Microblades in the North Pacific

Microblade technology is widespread throughout late Pleistocene and early Holocene archaeological sites around the North Pacific rim and Northwest North America (Figure 18). Several distinct microblade traditions have been identified across the North Pacific region, including several in Siberia (Goebel 2002; Keates 2007; Smith 1974; Vasil'ev 2001); Japan (Bleed 2002; Sato and Tsutsumi 2007; Yuichi 2005); Alaska (Ackerman 2007; Dixon 1999; Lee 2007b); the Northwest Coast (Carlson 1996; Fladmark 1989; MacMillan 1996; Magne and Fedje 2007; Mitchell 1968); and the northern interior of British Columbia, the Yukon Territory and northeast Alberta (Ackerman 2007; MacNeish 1954; Sanger 1968; Smith 1974). While each tradition resembles the others in its focus on a microblade-based lithic toolkit, the individual *chaînes opératoires*, specific manufacture techniques, technological strategy and even the modes of composite tool use may vary (Chen 2007:21; Doelman 2008:367). It is beyond the scope of this thesis to provide an encyclopedic catalogue of all North Pacific microblade traditions, so I will focus on those most relevant to Haida Gwaii and the Northwest Coast of North America.



**Figure 18: North Pacific microblade sites discussed in the text.**

## **4.1 Siberia**

The earliest confirmed evidence of microblades in the North Pacific region comes from eastern Siberia, where radiocarbon dated sites containing microblade technology have been dated to between 22,000 and 17,000 BP (Goebel 2002:118; Keates 2007:139; Vasil'ev 2001:24). The northeast Asian microblade industries may have developed out of earlier blade technologies from elsewhere in Eurasia. Sites in western Asia, such as Yabrud rockshelter, Abri Zumoffen, and Douara, have yielded blade assemblages dated to the late middle Paleolithic and early Upper Paleolithic, coinciding with the emergence of modern *Homo sapiens* (Bar-Yosef and Kuhn 1999:326-327). The subsequent microlithization of blade technology appears to have resulted in the earliest emergence of microblades, occurring in Siberia at 35,000 BP (Kuzmin et al. 2007:1). The microblade tradition most closely associated with the late Pleistocene trans-Beringian migration events to the New World is the Dyuktai microblade tradition. Dyuktai sites have been identified throughout much of coastal eastern Siberia, dating from c.18,000-12,700 BP (Chen 2007:21; Doelman 2008:352; Vasil'ev 2001:19). The technology then spread across Beringia into northern North America around 11,000-10,000 BP (Goebel 2002:122). The Dyuktai tradition is characterized by microblades produced on bifacially prepared wedge-shaped cores (Chen 2007:21; Flenniken 1987:119; Taberev 1997:139). Fine preservation conditions in cave sites and in frozen contexts have resulted in the recovery of several composite microblade tools, such as inset slotted points (as discussed in Chapter 3).

### **4.1.1 Zhokov Island**

One of the most important microblade sites is Zhokov Island, off the northeastern coast of Siberia, with occupation levels dating to 8200-7450 BP (Figure 18) (Giria and

Pitul'ko 1994:32). Zhokov Island's importance comes less from its date (it clearly postdates many early North American microblade sites) and more from the 25 preserved inset tools that were recovered from the site; 12 of which are bilaterally slotted and 13 of which are unilaterally slotted. Several of these tools (n=6) still retain *in situ* slotted microblades (Giria and Pitul'ko 1994:32-34). The slotted tools have been identified as likely spear tips (n=2), dart points (n=2), knife handles (n=3) and generalized "points" (n=18). The artifacts are made of antler (n=7), bone (n=14), fossil mammoth ivory (n=3) and walrus ivory (n=1) (Giria and Pitul'ko 1994:33). The knife handles were thus designated on the basis of unilateral rather than bilateral slotting.

One particularly interesting aspect of the Zhokov Island slotted points is the variation in the point cross-sections. Rather than exhibiting a flat or slightly convex cross section as is common in many North American examples, many of the Zhokov Island points retain a strong longitudinal ridge along one surface and a longitudinal concavity on the other. These are clearly remnants from the natural form of the bone or antler section, reflecting the outer surface or the inner surface of the bone's marrow cavity (or the antler's spongy quick) respectively. This indicates that the design constraints driving tool production did not necessarily demand a flattened or uniform tool. This is consistent with the model that the points were hafted very firmly in unique prehensile settings, without expectation that the point may fail and would have to be quickly changed for another. When frequent failure (point breakage) is expected, point design features highly standardized base forms and cross-sections in order to facilitate convenient replacement in ready-made hafts. The variation in base forms among the Zhokov Island osseous points suggests that hafts were made specifically for each individual point, and that haft or spear

failure (and replacement) was at least as likely, if not more so, than point failure. Faunal remains at Zhokov Island include reindeer, polar bear, bird and sea mammal (Giria and Pitul'ko 1994:32). This faunal assemblage indicates that the inset slotted points were likely used for hunting large game, both terrestrial and marine.

The lithic component at Zhokov Island is composed of three primary tool components: axes and chisels, blades, and microblades (Giria and Pitul'ko 1994:34). The chisel and axe industry is represented by a collection of coarse shale flakes and debitage, finished tools, and abraders used to grind the axes and chisels to their final shape (Giria and Pitul'ko 1994:34-35). The blade and microblade industry includes various flint and obsidian microcores, blades, microblades and a very small collection of late-stage core preparation flakes. Interestingly, there is no evidence of early-stage core reduction or preparation flakes, indicating that initial core shaping was carried out off-site and the core preforms were carried to Zhokov Island (Giria and Pitul'ko 1994:35).

The microblade component (referred to by Giria and Pitul'ko as “bladelets” for complete microblades and “insets” for snapped medial segments) includes 126 complete microblades and 27 unmounted medial segments. Giria and Pitul'ko identify seven of these as having once been inset in a slotted tool based on edge damage consistent with the still hafted lithics (1994:36). The medial segments exhibit relatively consistent thickness (1.1-2.2 mm) and width (3.2-7.5 mm). Length is somewhat more variable (5.3-25 mm), but only those segments longer than 11 mm are either hafted or show evidence (through edge damage) of having been hafted. This suggests a selective preference for longer medial microblade segments as insets (Giria and Pitul'ko 1994:36-37). Furthermore, only medial segments are hafted, indicating that microblades were deliberately snapped in

order to produce the straightest and most consistently thin blade segments possible for hafting in slotted points (Giria and Pitul'ko 1994:37).

The microblade production sequence at Zhokov Island is considered unique (Giria and Pitul'ko 1994:36) and follows a complex series of flake removals in order to manufacture microblades. The cores show evidence of bifacial and multidirectional preparation as well as bidirectional microblade flaking (Giria and Pitul'ko 1994:37). Core forms vary between tabular, wedge-shaped and cylindrical. One particularly interesting aspect of core morphology, as identified by Giria and Pitul'ko, is the segmentation of flaking faces on otherwise cylindrical cores. Rather than identifying the cylindrical core reduction sequence as one of continuous circumferential microblade removals, Giria and Pitul'ko suggest that the core would be sectioned into four adjoining but distinct surfaces, each of which would be reduced sequentially (1994:38-39). This would maintain a consistent grade of curvature across all faces of the core, allowing the continued removal of highly standardized microblades. This is in contrast to cores that may be flaked as a unit around the entire circumference, where as each row of microblades is removed, the core diameter shrinks and the morphology of subsequent blades changes in regards to width, thickness and edge sharpness (Giria and Pitul'ko 1994:39).

#### **4.2 Alaska**

Alaskan microblade traditions may be split into two primary geographic subdivisions: interior and coastal (Ackerman 1992:18, 21; 2007:151, 159). The interior group includes sites such as Campus, Swan Point, Lime Hill Caves 1, and Onion Portage. Most of the sites are clustered in the valleys around the city of Fairbanks, but others are located to the west and northwest. The coastal group includes Ground Hog Bay, Chuck

Lake, Hidden Falls, On Your Knees Cave, and Anangula. Many of the coastal sites are found in the islands and fjords of the Alaska panhandle in the extreme southeast of the state, though other sites are known from the Aleutian Islands, Kodiak Island, and a few points along the mainland coast (Ackerman 2007:148). The division between the interior and coastal sites is based on a resource extraction model informed by the available ecologies, rather than on significant differences in the bifacial toolkits as the primary early Alaskan microblade tradition, the Denali complex, is present both on the coast and in the interior. However, Ackerman argues that while the lithic artifacts may appear similar, they represent significantly different economic adaptations, with big game hunters in the interior and fishers and sea mammal hunters on the coast (Ackerman 2007:164).

The Denali complex is typified by the presence of bifacially prepared, wedge shaped microblade cores; distinctive Donnelly-type burins, scrapers and bifacial knives and projectile points (Ackerman 1992:19; 2007:148). The Denali microblade tradition is generally believed to be related to the Siberian Dyuktai microblade tradition, as both traditions share very similar core morphologies and preparation methods and both employ platform tablet removal as the primary means of core rejuvenation. Also, the spread of Dyuktai technology into eastern Siberia by 20,000 BP and the appearance of the Denali toolkit at Swan Point prior to 12,000 BP suggests that Dyuktai people (or at least technologies) may have moved across Beringia into Alaska during the terminal Pleistocene (Ackerman 2007:149). The Denali complex is succeeded by various other microblade traditions, including the Kobuk complex, the Arctic Small Tool Tradition (ASTT) and American Paleoarctic Tradition (ApaT) to the north, the Northwest

Microblade Tradition (NMT) to the east, and the Northwest Coast Microblade Tradition (NCMT) southwards along the coast (Ackerman 1992:22). The Kobuk, NWMT, ASTT and ApaT are beyond the scope of this thesis. The NCMT differs from the Denali complex primarily in that the microblade cores are no longer bifacially prepared wedge-shaped cores, but rather are blocky, tabular, boat-shaped or conical cores (Ackerman 1992:22).

#### **4.2.1 Major Early Holocene Sites in Southeast Alaska**

The Alexander Archipelago in southeast Alaska has yielded several microblade sites with dates and microblade traditions similar to those of Haida Gwaii. The proximity to northern Haida Gwaii (c. 60km), the similarities in local ecology and in lithic technologies, and the ethnohistoric and modern cultural affiliation (the Kaigani Haida occupy part of Prince of Wales Island) all suggest that there were likely high levels of culture contact and exchange between the regions. As such, it is important to consider the southeast Alaskan microblade tradition (part of the Northwest Coast Microblade Tradition (Lee 2007b:168)) in relation to that of Richardson Island. Hidden Falls, on Baranof Island and On Your Knees Cave, on Prince of Wales Island, are both important sites in relation to the early Holocene microblade industry in the region.

##### **4.2.1.1 Hidden Falls**

Located on the northeast side of Baranof Island in the Alexander Archipelago, Hidden Falls is a microblade site that dates from 10,300 BP to 7175 BP (Davis 1996:422). The microblade assemblage included nine microblades and 14 microblade cores. 12 of the microblade cores were produced on wedge-shaped, bifacially prepared preforms or along the peripheral margin of flakes. Two were split pebble microblade

cores (Davis 1996:417-418). Several of the cores exhibited keel retouch, similar to that identified on bifacially prepared Denali and Dyuktai microblade cores. A ski spall was also recovered. The rest of the lithic assemblage includes cores, core tools, blade-like flakes, burins, gravers, scrapers, choppers, utilized flake tools, and a foliate unifacial “point or blade” (Davis 1996:419-420). Very little faunal material was recovered: one unidentified fish bone and two fragments of clam shell.

Hidden Falls is notable as its occupation is contemporaneous with that of Richardson Island, overlapping with the Richardson Island biface/microblade transition. No bifaces were recovered from Hidden Falls, though the single foliate uniface is of similar size and shape to many of the Richardson Island bifaces and biface preforms. Also, though Richardson Island and Hidden Falls both have microblade components, the *chaînes opératoires* associated with microblade core preparation appear to be generally quite different. The majority of Hidden Falls microblade cores exhibit evidence of bifacial core preparation. Even the unmodified (or minimally modified) flakes used for microblade cores were flaked parallel to the radial margin, rather than perpendicular to it. Also, the ski spall that was recovered is another strong indicator of a bifacial core preparation strategy. This shows that the Denali complex (or at least a microblade industry with a Denali pedigree) existed in southeast Alaska as late as 10,300-7175 BP (Ackerman 2007:160).

#### **4.2.1.2 On Your Knees Cave**

On Your Knees Cave (OYKC) is located on Prince of Wales Island, in the Alexander Archipelago, southeast Alaska. The site consists of several cultural deposits distributed between two entranceways and primary passages (Lee 2007b:73).

Radiocarbon dates associated with the cultural deposits date occupation between 9430 +/- 140 BP and 8760 +/- 50 BP- at the Main entrance, and 9090 +/- 45 BP and 7140 +/- 30 BP at the Ed's Dilemma entrance (Lee 2007b:98). The lithic assemblage included flakes, bifaces, burin spalls, microblade cores and microblades. Most (448 of 521) of the microblades were recovered from the mouth of the Main entrance of the cave, with 73 from the Ed's Dilemma entrance (Lee 2007b:96). Very few elements of microblade core technology were recovered from OYKC. One split quartz pebble with two small flake scars may constitute the only complete microblade core from the site. The rest of the microblade core elements from OYKC include fluted face rejuvenation flakes from the Main entrance, and fragments of a thermally shocked microblade core from the Ed's Dilemma entrance. No core or platform preparation flakes (such as ski spalls or *lames à crêtes* were recovered (Lee 2007b:91).

OYKC is a particularly relevant site in terms of the development of microblade technology in the region as it provides evidence of microblade weapons being used to hunt bear. Bear remains are prominent in the faunal collection from OYKC, and the recovery of a small collection of microblades from within the Seal passage suggests that a slotted point with microblade insets was lost there, and the organic component did not preserve (Lee 2007b:182).

### **4.3 Northwest Coast**

Microblade technology is a common feature throughout many early Holocene sites along the Northwest Coast from the Alaska panhandle to the Strait of Georgia.

Microblades form significant components in sites from the Moresby Tradition on Haida

Gwaii (Fladmark 1986, 1990; Christensen and Stafford 2005); the Northwest Coast Microblade Tradition at Namu (Carlson 1996), on the Central BC Coast; the Bornite phase at Kitselas Canyon, on the Skeena River (Coupland 1996:159); and later on at Shoemaker Bay in Alberni Inlet, and in the Locarno Beach complex in the Strait of Georgia (Mitchell 1968). The microblade traditions share many common features of core morphology and core preparation methods, and appear to develop sequentially across time, moving from North to South (Magne and Fedje 2007:179).

#### **4.3.1 Namu**

The Namu site, EISx 1, is a shell midden site located on British Columbia's Central Coast. The site represents a cultural occupation lasting from at least 9720 BP into the contact period (Carlson 1996:83). Excavations at Namu yielded a wide variety of flaked and ground stone tools as well as bone, antler and tooth artifacts (Carlson 1996). Included in the lithic assemblage are several hundred obsidian and quartz microblades, and several microblade cores (Hutchings 1996:170). Microblade core preparation at Namu appears to follow the unifacial core preparation method, based on the presence of tabular, boat shaped and conical core forms (Hutchings 1996:172). No evidence of bifacial or wedge-shaped core preparation was identified.

Hutchings (1996) proposed a microblade use model for the site based on Flenniken's (1981) analysis of the hafted microlith assemblage from the Hoko River site in northern Washington State (1996:173). In this model, Hutchings suggests that the obsidian microblades at Namu may have been utilized as disposable knife blades in cedar hafts (Hutchings 1996:174). However, Hutchings' experiments revealed that unlike Flenniken's experimental side-hafted vein quartz microliths, the experimental obsidian

microblades were very poor tools for processing fish (Hutchings 1996:174). One primary reason for this is that the obsidian microblades dull quite quickly when used as cutting tools, and that the short cutting edge becomes “gummed up” by fish flesh (Hutchings 1996:174). A more likely use for the microblades would be lateral insets in slotted points. In this function, the blades would not be used for cutting tasks, and thus would not dull nearly as quickly. Also, this would account for the examples of deliberate unilateral dulling or backing identified on some of the microblades. Hutchings suggests that the backing is indicative of some microblades being handheld, without hafts, but it is more likely that the backing was meant to standardize the microblade width for hafting in a slotted point. The slotted point model is supported by the recovery of a fragment of a bilaterally slotted point from the Namu (Carlson 1996:95). It should be noted that the slotted point fragment from Namu likely represents the base or proximal section of a point, as the lateral grooves terminate approximately 6cm from the tip. Carlson's depiction of the point (1996:101) is contrary to illustrative conventions that depict points and point fragments with the distal tip oriented to the top of the page (Adkins and Adkins 1989:152).

#### **4.3.2 Gulf of Georgia**

The Gulf of Georgia microblade industry is associated with the Locarno Beach and Marpole culture horizons, dating to between 3200 BP and 1600 BP (Mitchell 1968:11). Several microblade-bearing sites have been identified throughout the region, including Montague Harbour, Cadboro Bay, Helen Point, and False Narrows (Mitchell 1968:13). Recovered cores illustrated by Mitchell (1968:13) appear to represent boat-shaped and conical core forms, consistent with unidirectional core preparation methods.

Raw material usage is variable, though earlier period microblades (c.3500-1500 BP) are often made of quartz crystal, while obsidian and fine-grained basalt examples become more prevalent later, during the Marpole period (Croes 1995:191).

#### **4.3.2.1 Hoko River**

The Hoko River site is located on the northern side of the Olympic Peninsula in Washington state. The site dates to between 2750 +/-90 BP and 2210 +/-70 BP. Several microlith and microblade artifacts were recovered from the site. All of the microliths were made from locally collected vein quartz beach pebbles, and microblades were made from quartz crystal. Notably, the wet site component at Hoko River yielded a collection of side-hafted microlith knives and a single end-hafted quartz crystal microblade knife. All of the knives were made with split cedar handles and cedar bark or spruce root bindings (Flenniken 1981:71). The hafted microblade was also set in a cedar handle, but the binding was of cherry bark (Croes 1995:186).

Flenniken conducted an experiment wherein side-hafted microlith knives were used to process fish. He reports that the microlith tools were judged “extremely [efficient]” for fish processing (Flenniken 1981:86). This is in contrast to results from Morin (2006:294-295) and Hutchings (1996:174), who report that similar tools made with microblades are very poor for processing fish. Croes also used side-hafted microlith knives for processing cordage and making basketry. He asserts that microlith tools are very poor for such fibre processing applications (Flenniken 1981:77).

#### **4.3.2.2 Saltery Bay**

Saltery Bay is located on the Sunshine Coast of British Columbia's southern mainland. This site represents a much earlier occurrence of microblade technology in the

Gulf of Georgia region. Component I, from which the majority of microblades were recovered, yielded dates of 5960, 6885, and 7620 BP (Pegg et al. 2007:48). 10 microblades and 27 microblade cores were recovered from excavations at the site (Pegg et al. 2007:52). The Saltery Bay assemblage is notable both for the abundance of microblade cores, and for the core preparation strategy (Magne et al. 2006). Specifically, the microblade cores appear to have been made on split cobbles, and to have experienced minimal core preparation prior to microblade removal. This is indicated by the presence of cortex on several ( $n=8$ ) of the cores. This is to some extent consistent with the core preparation techniques identified at sites along the Somass River in the Alberni Valley on Vancouver Island, where similarly minimal or expedient core preparation methods were employed (McMillan 1996:213). This is in contrast to the microblade core preparation techniques known from Haida Gwaii, where only two known microblade cores from the entire region exhibit cortex on the lateral surfaces (Magne et al. 2006).

#### **4.3.3 Vancouver Island**

Several microblade sites have been identified on Vancouver Island, as well. Notable sites include Shoemaker Bay and Elsie Lake. Both of these sites are located in the Alberni Valley in the centre of Vancouver Island. McMillan (1996:213) describes the Shoemaker Bay microblade assemblage as belonging to the “earlier levels” of the excavation, beginning at 4000 BP. These microblades are made from quartz crystal, similar to those recovered from Hoko River. Other sites along the Somass River in the Alberni Valley have yielded microblades and microblade cores made from argillite, basalt, and chert. Core forms include “wedge-shaped, cylindrical and tabular”, with most being blocky cores made on tabular blanks with minimal platform modification or

preparation. Several of the cores exhibit evidence of multidirectional blade removal, with several platforms being used for flaking (McMillan 1996:211). The core preparation and maintenance on Alberni Valley microblade cores appears to have been less formalized than that elsewhere on the Northwest Coast. Core forms are “rough”, and cores were often discarded after only a few microblade removals (McMillan 1996:123).

Elsie Lake represents an earlier microblade assemblage than Shoemaker Bay. Dates from the Elsie Lake site place microblades at  $6250 \pm 40$  BP (Magne et al. 2006). The microblade technology assemblage includes 305 microblades and microblade fragments, and nine microblade cores and core fragments. The core materials have been identified as andesite, rhyolite and chert (Forgeng et al. 2005:46). Additionally, three obsidian microblades were recovered. The obsidian was sourced to the Anahim Peak region of the British Columbia mainland, indicating the existence of relatively extensive trade networks during this period (Forgeng et al. 2007:47).

#### **4.3.4 Haida Gwaii**

The presence of microblade technology is a defining feature of the Moresby Tradition on Haida Gwaii (Fedje and Mackie 2005:159). Microblade sites are widespread and common, with dates ranging from the early appearance of microblades c.8750 BP to at least 5000 BP, possibly as late as 3000 BP, during what has been termed the “Transitional Complex” or the Early Graham Tradition (Mackie pers.com. 2011). Haida Gwaii microblade technology is characterized by unidirectional core preparation strategies applied to split cobbles, thick flakes (blade removal running perpendicular to the flake edge), and tabular blanks. Fladmark (1989:208) identifies a “deterioration” in the Haida Gwaii microblade industry over the Moresby period. The earlier core forms are

more regularized, with more carefully maintained fluted face, and little or no keel battering. The later microblade cores show greater formal variation, a higher incidence of hinge and step fractures near the distal end, and frequent keel battering, indicating the application of an anvil-supported percussion (or indirect percussion) flaking technique to remove blades (a method with more variable results than pressure flaking) (Fladmark 1989:208).

#### **4.3.4.1 Lawn Point**

Lawn Point, located between Skidegate and Tlell on the southeast coast of Graham Island, is an early Holocene microblade site situated on a stranded beach 15m above modern sea level (Fladmark 1986b:40-41). 168 microblades and 16 microblade cores (or core fragments) were recovered from the Lawn Point excavations. The microblade cores were all made either on split pebbles ( $n=9$ ) or on flakes ( $n=7$ ). All of the cores are examples of the unidirectional core preparation strategy (Fladmark 1986b:45).

More notable is the *in situ* recovery of a group of microblades and adjacent core, arranged in two clusters in such a way as to permit identification of the emic criteria for microblade optimality. In Component 5, Fladmark discovered a cluster of 57 short, relatively curved microblades, often with tapering lateral margins, approximately 15 cm away from a second cluster of 11 uniformly long, straight, parallel-sided microblades and the core from which they had been removed. The larger cluster was in a “disorderly heap”, but the smaller cluster was structured with the blades lying parallel to each other in a stack “two layers deep” (Fladmark 1986b:48). Fladmark postulates that this arrangement may reflect the blades in the smaller cluster having been tied up in a small bundle (Fladmark 1986b:48). In any case, this deliberate separation and formal

arrangement of highly uniform and more variable microblades is indicative of the application of standards for microblade selection. The toolmaker clearly sought to identify those blades that were optimally formed for use in conjunction with a specific haft. Based on the straightness, it is very likely that the application involved side-hafting the bladelets into an already made slot (such as in a laterally slotted point). The suboptimal blade pile, as indicated by the haphazard arrangement, may have contributed some blades to the final tool, but the short, curved blade form was clearly not the desired end result of knapping.

#### **4.3.4.2 Cohoe Creek**

Cohoe Creek is a more recent microblade site, dating from 6980 +/-50 BP to c.4300 BP (Christensen and Stafford 2005:252). Situated at the mouth of the Yakoun River on Graham Island, Cohoe Creek yielded a large faunal assemblage (see chapter 5 for further discussion) as well as an ample lithic assemblage. Among the lithics were 278 microblades, 18 microblade cores, and various scrapers, graters, spokeshaves, choppers, cores and flake tools (Christensen and Stafford 2005:262). The microblade core tradition at Cohoe Creek is consistent with the late Moresby “deteriorated” microblade industry identified by Fladmark. The cores appear to be somewhat rough, with basal battering indicative of anvil-supported percussion blade removal (Christensen and Stafford 2005:268).

The microblade component of this site is of particular note primarily because of its association with a fragmentary slotted antler point (Christensen and Stafford 2005:262). The point fragment is 172mm long, 19mm wide, 11mm thick, and has v-shaped slots (2-3mm wide, 5.5-6.3mm deep) running down either lateral margin. The

slots terminate 45mm from the intact tip of the point (Lee 2007b:158). This suggests that this is the intact base of the point, though it is depicted by Christensen and Stafford (2005:266) with the intact tip oriented towards the top of the page. This artifact provides very strong evidence that the Haida Gwaii microblade tradition included the use of slotted points with side-hafted microblade insets.

## **Chapter 5: Haida Gwaii Paleoecology and Culture History**

### **5.1 Paleoecology of Haida Gwaii**

The late Pleistocene/early Holocene inhabitants of Haida Gwaii lived in a very dynamic landscape. Starting at the last glacial maximum (LGM) at approximately 16,000 BP, until the regional climate stabilized ca. 4,000 BP at a stage similar to current conditions, the Northwest Coast experienced massive sea level fluctuations, temperature and humidity variation and significant changes in local flora and fauna (Fedje et al. 2005b:21-22; Fedje 2003:29; Lacourse and Mathewes 2005:39).

#### **5.1.1 Paleoshorelines**

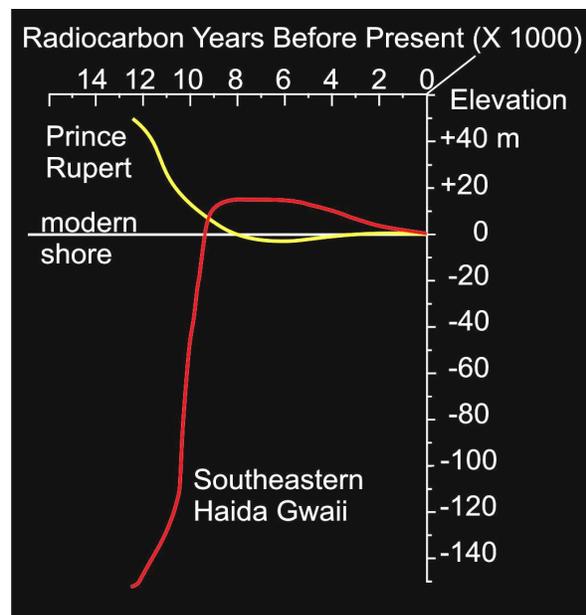
The end of the Pleistocene (ca. 10,000 BP) and the recession of the North American continental glaciers resulted in significant changes to the coastline of northwest North America. Haida Gwaii, situated on the extreme western edge of the North American continental plate, was particularly susceptible to the effects of deglaciation (Fedje et al. 2005b:22). Deglaciation results in two specific effects: glacio-eustatic and glacio-isostatic change. Glacio-eustatic fluctuations are the variations in global sea level caused by the static accumulation of water in the form of terrestrial glaciers (Fedje et al. 2005b:21). At the peak of the Wisconsin glaciation (ca. 17,000 BP), global sea level was approximately 120 metres lower than it is today (Fedje et al. 2005b:21; Fedje and Christensen 1999:638; Josenhans et al. 1997:71). That stored water being released resulted in a very rapid rise in sea level (approximately 1cm per year) during the terminal Pleistocene and early Holocene (Fedje et al. 2005b:22). Glacio-isostatic effects on paleoshorelines are the result of rises and depressions in the earth's crust due to the

weight of the continental glaciers pushing it down (Fedje et al. 2005b:21; Fedje and Christensen 1999:637; Josenhans et al. 1997:73). At peak glaciation, the North American Plate was covered by two major glaciers, each up to three kilometres thick in places. This mass of ice pushed the plate down significantly. Because of the central glacial mass, the elasticity of the crust and the viscosity of the mantle, the ice-free margins of the plate experienced isostatic tilting, also known as peripheral forebulge (Fedje and Christensen 1999:637; Josenhans et al. 1997:73). Haida Gwaii experienced this tilting to a very high degree, as can be seen by the difference in early Holocene sea level curves between Southeastern Haida Gwaii and Prince Rupert, less than 200km to the east (Fedje et al. 2005b:23).

The archipelago's position on the margin of the North American Plate is responsible for Haida Gwaii's unique sea level history. Whereas the mainland coast was depressed under the weight of the Cordilleran Ice Sheet, causing sea levels to be 50 m higher than the present day at Prince Rupert Harbour, and up to 100 m higher on the inner coast at Kitimat, 12,000 BP (Fedje et al. 2005b:31; Josenhans et al. 1997:71). As deglaciation progressed, the land here experienced drastic isostatic uplift (300 metres at Kitimat), offset somewhat by the release of water into the oceans. Haida Gwaii experienced the opposite: isostatic collapse resulted due to a flattening of the glacial forebulge, lowering the Haida Gwaii landmass while the eustatic rebound raised the water level (Fedje et al. 2005b:30-31; Fedje and Christensen 1999:638). This resulted in the drowning of Hecate Strait, the northern and western portions of which were largely dry up to 12,000 BP (Figure 19), and the extremely sharp rise in sea level (Figure 20) (Fedje et al. 2005b:30; Josenhans et al. 1997:73).



**Figure 19: Early Holocene Haida Gwaii site map with paleoshoreline (150m below modern) indicated. From Mackie et al. 2008, created by Daryl Fedje. Used with permission.**



**Figure 20: Sea level curve for Prince Rupert and southern Haida Gwaii (west side of Hecate Strait). Image created by Daryl Fedje, used with permission.**

The compound effects of isostatic collapse and eustatic rebound resulted in a marine transgression, where Haida Gwaii sea levels were higher than present day (Fedje et al. 2005b:25). The marine highstand occurred near the beginning of this 4,000 year period and saw sea levels at approximately 16 m above the modern tideline throughout southern Haida Gwaii, and slightly lower further north (Fedje et al. 2005b:25). This is considered the point where sea level stabilized and deglaciation ceased to have a significant effect on shoreline fluctuation. Throughout the early Holocene (ca. 9,000-5,000 BP) gradual tectonic uplift from the collision of the North American Plate and the Pacific Plate caused sea levels to drop slowly (2-3 mm per year) to their present state (Fedje et al. 2005b:25).

This record of sea level fluctuation has had a profound effect on early Holocene archaeology on Haida Gwaii and the Northwest Coast. Many of the earliest sites, likely situated along the ancient coastlines, have been inundated by the rising sea level and are inaccessible to archaeologists (Fedje 2003:37; Fedje and Josenhans 2000:99; Fedje and Mackie 2005:158). However, some inland sites such as caves, and coastal sites dating to the early Holocene marine transgression, have provided valuable insight into this portion of the archaeological record (Fedje 2003:31; Fedje and Mackie 2005:158). This latter group is composed of sites identified in the modern intertidal zone as well as several found on raised beach terraces, set back from and above the modern shoreline (Fedje and Mackie 2005:158; Fedje et al. 2005a:163; Fladmark 1986b:42, 52).

### 5.1.2 Flora and fauna

As deglaciation progressed and sea levels fluctuated, the local ecologies on Haida Gwaii also underwent significant changes. The late Pleistocene landscape transitioned from an open, tundra-like environment of grasses and sedges to lightly wooded parkland and then more dense forest as the Holocene progressed (Fedje 2003:29). Formerly dominant tree species found their ideal environmental niches compromised and were superseded by other trees, better adapted to the changing climate. Terrestrial animals were similarly affected, as species' habitats changed and forest-adapted species became plentiful at the expense of those better suited to open spaces.

The paleoecological record of Haida Gwaii has been reconstructed largely on the basis of evidence provided by lakebed cores (Hebda et al. 2005:64; Lacourse and Mathewes 2005:45). Pollen preserved in the lakebeds provides a progressive image of the changing floral landscape of the area. During the LGM, though alpine regions of Haida Gwaii were covered by ice sheets, much of the archipelago and the low-lying region to the east (now the seafloor of Hecate Strait) was ice free (Lacourse and Mathewes 2005:41). As the Wisconsin Glaciation waned (c.13,000 BP), the ice-free refugia were largely treeless, shrubby tundra, with prevalent grasses and sedges (Lacourse and Mathewes 2005:39). This was replaced by lodgepole pine (*Pinus contorta*), which by 12,500 BP was rapidly expanding throughout the regional landscape. Mountain Hemlock (*Tsuga mertensiana*) was scattered at higher elevations and ferns and Green Alder (*Alnus viridis*) made up much of the forest understory and edges (Lacourse and Mathewes 2005:51-52).

Shortly after 11,000 BP, spruce (*Picea*) began to grow in the pine-dominated forests (Hebda et al. 2005:66; Lacourse and Mathewes 2005:52). This marks an important

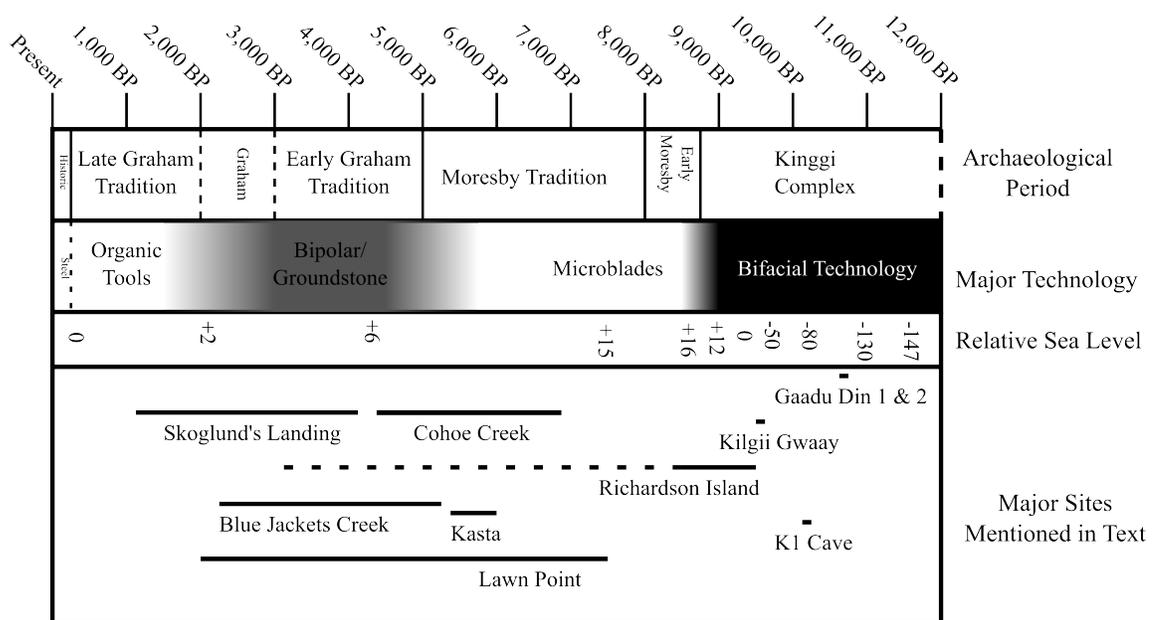
change in the local ecology, as spruces are more shade tolerant than lodgepole pine, and may therefore grow in denser forest conditions. Also, increased seasonality as a result of widespread deglaciation resulted in warm, dry summers and cold, wet winters (Lacourse and Mathewes 2005:52, 56). Also, between 11,000 BP and 10,000 BP, the Northwest Coast experienced a cooling period. This resulted in a spread of Mountain Hemlock through lower elevation forests and a corresponding retreat of the alpine treeline (Lacourse and Mathewes 2005:55). As this cooling period progressed, the forests reverted from dense spruce and pine to more open parkland interspersed with grassy meadows (Lacourse and Mathewes 2005:52; Hebda et al. 2005:66). The earliest known archaeological sites on Haida Gwaii date to this period (Fedje 2003:31; Fedje and Mackie 2005:158).

The brief cooling period was immediately followed by the early Holocene xerothermic period: a 3000 year interval with warmer, dryer climate than at present (Fedje 2003:28; Pellatt and Mathewes 1997:88). During this period, from 10,000 BP to 7,000 BP, significant forest infill occurred and the alpine treeline rose substantially (Pellatt and Mathewes 1997:88, 89). Spruce maintained its prevalence during this reforestation, and both spruce and hemlock expanded into subalpine regions that would otherwise have been marginal environments for it (Lacourse and Mathewes 2005:57; Pellatt and Mathewes 1997:94).

One major effect of this shift in vegetation may be seen in the animal species evident in Holocene Haida Gwaii. For instance, brown bear and caribou remains have both been identified in paleontological sites in Haida Gwaii dating to before and during the LGM (caribou at White Creek at 40,000 BP; brown bear at K1 Cave, 14,500 BP)

(Wigen 2005:99). Both of these species are generally found in non-forested or sparsely treed habitats (Wigen 2005:104, 105). This is consistent with the sedge and grass tundra typical of Haida Gwaii during the Pleistocene. More recent faunal remains show an increase in black bear (and an extinction of brown bear on the archipelago), and the evolution of Dawson caribou (*Rangifer tarandus dawsoni*), a subspecies of caribou with smaller stature and underdeveloped antlers (Reimchen and Byun 2005:83-84; Wigen 2005:105, 111). These changes are believed to be possible adaptations to life in more forested landscapes (Reimchen and Byun 2005:84). It has also been suggested that the smaller body size and antlers are the result of island dwarfism (Reimchen and Byun 2005:83), but caribou bones recovered from the post-glacial archaeological site at Coho Creek indicate that in the early Holocene (6150-4990 BP) caribou on Haida Gwaii were of comparable size to mainland “barren ground caribou” (Wigen 2005:111). This indicates that the reduction in size may be an adaptation to conditions more recent than Haida Gwaii being cut off from the mainland by rising sea levels.

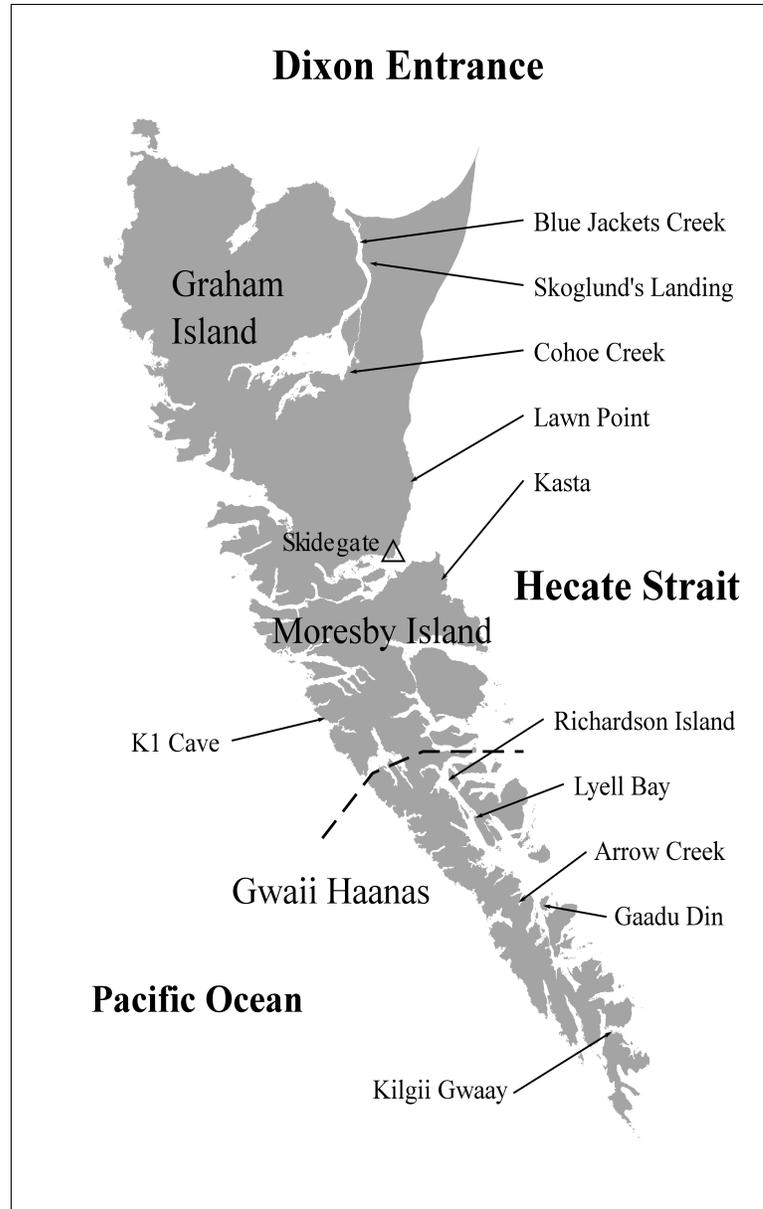
The mid-Holocene (7,000 BP to 3,500 BP) environment saw a gradual shift to a cooler climate with higher precipitation levels (Lacourse and Mathewes 2005:56; Pellatt and Mathewes 1997:89). Spruce continued to be the primary tree species, though its habitat was slightly reduced by a retreating alpine treeline and Hemlock made up a larger percentage of the forest than before (Fedje 2003:29-30; Lacourse and Mathewes 2005:56; Pellatt and Mathewes 1997:94). After 3,500 BP, Cedar and Western Hemlock superseded Spruce as the dominant tree species. This combination persisted into the present (Lacourse and Mathewes 2005:40; Hebda et al. 2005:74).



**Figure 21: Haida Gwaii culture history timeline with major site occupations indicated. The dashed line indicates the poorly understood later occupation period at Richardson Island.**

## 5.2 Haida Gwaii Archaeological History

Human occupation on Haida Gwaii extends back over 10,500 years, into the earliest Holocene period. The span of human occupation has been divided into four major periods: The Kinggi Complex (c. 10,600-8750 BP), the Moresby Tradition (c.8750-5000 BP), the Graham Tradition (c.5000-200 BP) and the contact era (c.200 BP-present) (Figure 21). Each of these periods is characterized by a specific technological suite and a set of subsistence strategies. Also, each one shares many features with contemporaneous mainland cultures.



**Figure 22: Map of Haida Gwaii indicating the sites mentioned in the text. Skidegate (marked with a triangle) is a major modern settlement.**

### 5.2.1 Kinggi Complex

The Kinggi Complex (c. 10,600-8750 BP) marks the earliest archaeologically known human occupation of Haida Gwaii. It is typified by the presence of relatively large

bifaces, a variety of unifacial tools such as scrapers, scraperplanes or flaked stone adzes, as well as expedient core and flake tools (Fedje and Mackie 2005:158). Additionally, bone tools such as awls, needles, a percussor and a point have been recovered from wet site and hearth components at two sites (Fedje and Mackie 2005:158). Microblade technology is absent in this period (Fedje and Mackie 2005:158).

The Kinggi Complex is known from a small group of sites in the southern archipelago, including Gaadu Din 1, Gaadu Din 2, K1 Cave, Kilgii Gwaay and Richardson Island (Figure 22) (Fedje 2003:31; Fedje and Mackie 2005:158; Fedje et al. 2005c:199; Fedje et al. 2008:19-20). Gaadu Din 1, Gaadu Din 2, and K1 Cave are cave sites and yielded small faunal collections as well as several lithic artifacts. Kilgii Gwaay is a wet site and lithic scatter in the modern intertidal zone, and Richardson Island is a raised beach site set back from the modern shoreline, but also includes a secondary depositional component in the intertidal zone (Fedje 2003:31; Fedje et al. 2005d:204). As mentioned earlier, rising sea levels since the end of the LGM have inundated much of the pre-9000 BP coastline, effectively covering any coastal sites that may have been there. The recovery of a lithic artifact from a drowned paleodelta in Werner Bay supports this model of a drowned cultural landscape, though the artifact's assigned pre-10,000 BP date is based on projected paleoshoreline position and organic material found at that depth, rather than direct association with a datable feature (Fedje et al. 2005a:180).

Gaadu Din 1 and Gaadu Din 2 are cave sites located on Gaadu Din (Huxley Island) on the southern periphery of Juan Perez Sound, in eastern Gwaii Haanas. Excavations at Gaadu Din 2 recovered two large (length >12cm) complete bifaces and a broken biface base (Fedje et al. 2008:22). These artifacts were found in association with

large numbers of bear bones, indicating possible use as bear hunting weapons (Fedje et al. 2008:20; McLaren et al. 2005:18). Radiocarbon dates on faunal remains from Gaadu Din 2 indicate that the projectile points were deposited around 10,220 BP and 9980 BP respectively (Fedje et al. 2008:22). K1 Cave is on the northwestern coast of Moresby Island. The site yielded the broken bases of two large bifaces, also associated with bear bones. Both points were dated to 10,600 BP (Fedje et al. 2008:20; McLaren et al. 2005:18).

Kilgii Gwaay is an intertidal wet site located on the south side of Ellen Island in southern Gwaii Haanas (Fedje et al. 2005c:187). The site is a drowned lagoon and ancient beach, capped with gravelly intertidal sediment. Bioturbation from a variety of shellfish species has disturbed much of the cultural component, though intact cultural deposits were also found (Fedje et al. 2005c:193). Site occupation at Kilgii Gwaay is dated to 9450-9400 BP, when sea levels were slightly lower than today (Fedje et al. 2005c:187). During this period, people used the banks of the lagoon as a campsite. Archaeologists recovered over 4,000 lithic artifacts as well as 90 pieces of modified bone, over 100 wooden artifacts, and faunal remains representing 39 vertebrate and 16 invertebrate taxa (Fedje et al. 2005c:196). The lithic assemblage at Kilgii Gwaay is primarily comprised of flakes ( $n=3,801$ ), unimarginal tools ( $n=49$ ), cores ( $n=26$ ), and scraperplanes ( $n=14$ ) (Fedje et al. 2005c:196). No bifaces were found, but one biface fragment and a small unifacial projectile point was recovered (Fedje et al. 2005c:196; Fedje et al. 2008:22). The faunal material at Kilgii Gwaay includes black bear, harbour seal, sea otter, river otter, sea lion, and a wide variety of birds including ducks, geese, auklets and albatross. Rockfish dominates the fish bone (Fedje et al. 2005c:195). Also notable, a small barbed

bone point was recovered, indicating that barbed organic weapon technology was known in southern Haida Gwaii during the early Holocene (Fedje et al. 2001:106).

The Richardson Island site dates from 9400 BP to c. 3000 BP, spanning the Kinggi/Moresby transition (Fedje 2008:15). The site is located on a raised beach terrace approximately 16 metres above the modern tideline. The Kinggi period lithic assemblage includes several bifacial projectile points, both whole and fragmentary (Fedje et al. 2008:23, Fedje et al. 2005d:222-223). A collection of unifacial scrapers, scraperplanes, spokeshaves, unidirectional cores and utilized flakes were also recovered (Fedje et al. 2005d:222-223). This site will be addressed in greater detail in chapter 6.

Kinggi Complex technological organization appears to be the result of a maritime-adapted subsistence strategy with a relatively strong interior hunting component (Fedje et al. 2008:25; Fedje et al. 2005c:202; McLaren 2005:19, 22). Kilgii Gwaay shows a campsite where a variety of animal resources were processed. Black bear is the most common identified faunal element, and is indicative of use of inland forests, though most of the other bones present are from fish, marine birds or marine mammals (Fedje et al. 2005c:201-202). Bear hunting on the Northwest Coast often involved tracking a bear to its den, returning during hibernation, and driving the bear out of the den and onto the spear(s) of the waiting hunter(s) (Hallowell 1926:39; McLaren 2005:9, 22). The discovery of bifaces and bear remains deep within cave sites on Haida Gwaii support this model during the early Holocene (McLaren 2005:22). Similar finds from On Your Knees Cave in southeast Alaska (only with microblades rather than bifaces) suggest that a similar strategy was in use on the Alexander Archipelago during roughly the same period (McLaren 2005:21). Large stone bifaces would have been quite effective tools for use

with this hunting technique, as they would provide a long, relatively robust sharp-edged point on the end of a thrusting spear. They may have been somewhat less practical as tips for atlatl darts, as the shape and balance of the dart is integral to the hunter's ability to throw accurately. Later bifaces, dating from 9300 BP to the early Moresby period (c. 8700 BP) are smaller, foliate and lanceolate projectile points, known as *Xil* and *Xilju* points, respectively (Fedje et al. 2008:23).

The maritime aspect of the economic strategy is evident considering the variety of fish, sea mammal and seabird remains recovered from Kilgii Gwaii (Fedje et al. 2005c:195, 201). Notably, several of the species present such as sea lion, rock fish, halibut, and albatross, are found far from shore (Fedje et al. 2005c:201). Their presence in the assemblage indicates that the site occupants had sea-worthy vessels as well as specialized harvesting technology such as harpoons and heavy-duty fishing tackle (Fedje et al. 2005c:201). Shellfish was also part of the diet of Kinggi period people, though not in the proportion seen among later Northwest Coast cultures (Fedje et al. 2005c:202).

### **5.2.2 Moresby Tradition**

The Moresby Tradition (c. 8750-5000 BP), first defined by Knut Fladmark (1975; 1979; 1989), is known from several sites around Haida Gwaii. The Moresby Tradition may be divided into two components: Early Moresby (8750-8000 BP) and Late Moresby. This division reflects an identified transitional stage between the Kinggi Complex and the more developed Late Moresby Tradition, and is based on the gradual tapering off of bifacial technology and the adoption of microblade technology during the early period (Fedje and Mackie 2005:159; Fedje et al 2005d:239). Early Moresby technology features

a relatively small bifacial tool component made up of lanceolate projectile points, considerably smaller (both in length and width) than the earlier Kinggi Complex bifaces. These points, known as *Xilju* points, have excruciate blade edges and parallel or slightly contracting stem forms (Figure 23) (Fedje et al. 2008:23; McLaren and Smith 2008:44). The Early Moresby period is represented by the Richardson Island and Lyell Bay sites (Fedje and Mackie 2005:160).



**Figure 23: Xilju points recovered from Richardson Island.**

As the bifacial projectile points taper out of the Early Moresby lithic assemblage, microblades, microblade cores and rejuvenation flakes appear and increase in the archaeological record (Fedje 2003:33; Fedje et al 2005d:239). This transition from bifaces to microblade technology has been observed elsewhere on the Northwest Coast, including On Your Knees Cave in Alaska (c. 9200 BP) and Namu on British Columbia's Central coast (c.9000-8500 BP) (Carlson 1996:98; Dixon 1999:159; Fedje et al 2005d:238-239). The sequence of dates from these sites has been interpreted by some as a

southward progression of microblade technology along the Northwest Coast, possibly associated with a population migration event (Fedje and Mackie 2005:160; Fedje et al 2005d:242; Magne and Fedje 2007:186; Yesner and Pearson 2002:134).

The Late Moresby Tradition reflects Fladmark's definition of the classic Moresby culture type: microblades and microblade cores are relatively ubiquitous, pebble tools, cores, flakes and scrapers are present, and bifaces are absent (Fedje and Mackie 2005:160, Fladmark 1989:207; Fladmark et al. 1990:231). This model is represented at Cohoe Creek, Kasta, Lawn Point, Skoglund's Landing and Skidegate Landing (Figure 22) (Fedje and Mackie 2005:160, Fladmark 1986b:45, 53). Richardson Island and Lyell Bay also include some Late Moresby material in upper depositional layers (Fedje et al. 2005d:209, 212). As a result of higher sea levels during the early Holocene, most known Moresby Tradition sites are on raised beach terraces between 15 and 20 m above the modern tide line (Fedje and Christensen 1999:639; Fedje and Josenhans 2000:102; Fedje et al. 2005a:165; Fladmark 1990:185; Fladmark 1989:207; Hobler 1978:11).

Cohoe Creek is one of the more important Late Moresby sites, as it yielded a collection of faunal remains (rare during this period) as well as lithic and organic tools (Christensen and Stafford 2005:252, 261; Fedje and Mackie 2005:160). The site is located on a paleomarine terrace approximately 12 m above modern sea level near the mouth of the Yakoun River in Massett Inlet. Dates from the site range from  $6980 \pm 50$  BP to 4900 BP (Christensen and Stafford 2005:252). Artifacts collected during the main excavation of Cohoe Creek include 278 microblades, 18 microblade cores, bipolar cores, choppers, spokeshaves, scrapers, cores, flakes and thousands of pieces of debitage. Organic tools recovered include a barbed point, needles, awls, bone points, and a single

slotted bone point. Earlier archaeological investigations recorded pebble cores, flakes, microblades, microblade cores, and “chipped bone points, and worked antler” (Christensen and Stafford 2005:261).

The faunal material from Cohoe Creek includes numerous taxa of fish, mammal and bird. The (identified) fish bone assemblage is dominated by mackerel, followed by salmon and flatfish. The majority of land mammal bones represented are caribou, black bear, and dog. Sea mammals present are predominantly harbour seal and sea otter. The most common bird species present are ducks. Shellfish remains are also very prevalent (Christensen and Stafford 2005:253-256). Combined with the artifact assemblage, the faunal remains indicate that the ancient site occupants capitalized on terrestrial, estuarine, and marine resources available at the river mouth (Christensen and Stafford 2005:257). The presence of caribou and black bear represent a terrestrial large mammal hunting strategy, possibly comparable to that identified at Kilgii Gwaay. One important aspect of this is that the hunting toolkit at Cohoe Creek is significantly different, as the slotted point (likely to have been equipped with inset microblades) replaced the earlier large flaked stone bifacial points. Bird remains at Cohoe Creek are consistent with hunting activities on the fluvial plain at the Yakoun river mouth, as the ducks and loons that make up the majority of the assemblage were likely found in the wetlands around Masset Inlet (Christensen and Stafford 2005:257). The fish bones at Cohoe Creek suggest that site occupants also made use of open water fishing grounds. While the Yakoun River supports Haida Gwaii's largest salmon run, mackerel (which dominates the fish bone assemblage) is unknown in Masset Inlet (Christensen and Stafford 2005:259). As such, in order to obtain mackerel in the quantities seen at Cohoe Creek, it is likely that people

travelled over 50 km to the North Coast of Haida Gwaii to fish (Christensen and Stafford 2005:259).

Two other important Moresby period sites are Lawn Point and Kasta. Lawn Point is a raised beach site 15 km north of Skidegate on southeast Graham Island (Figure 22). The artifact assemblage recovered consisted entirely of lithics, including 16 microblade cores and core fragments, 168 microblades, pebble cores, retouched and utilized flakes, scrapers and graters (Fladmark 1986b:44, 49; 1989:208).

The Kasta site is located 10 km south of Sandspit on Moresby Island (Figure 22). The site is a stranded beach site, once situated on the edge of an estuary, but now set approximately 500 m back from the shore of Copper Bay (Fladmark 1986b:52). Like Lawn Point, Kasta yielded no organic artifacts, but did have several microblade cores, microblades, abraders, retouched flakes, cores and pebble choppers (Fladmark 1986b:53). Neither the Kasta nor Lawn Point lithic assemblages included any bifacially flaked stone tools (Fladmark 1986b:54; 1989:208).

### **5.2.3 Graham Tradition**

At approximately 5000 BP the Moresby Tradition began to transition into the Graham Tradition, marked archaeologically by the growth of shell middens, “first evidence of large houses and pole structures”, the presence of ground and pecked stone tools, bone and antler harpoons and points, and the absence of microblades (Fedje and Mackie 2005:161; Mackie and Acheson 2005:285). Archaeological investigation into Graham Tradition sites has been limited, and the major research areas for the early and late components of the Graham Tradition are divided between northern Graham Island

and northern Gwaii Haanas (Mackie and Acheson 2005:276). The early Graham Tradition is known only from a few sites. Blue Jackets Creek (5200-2270 BP) (Figure 22) has provided most of the archaeological evidence for the construction of the early Graham Tradition culture history model (Mackie and Acheson 2005:276). The late Graham Tradition has been investigated somewhat more thoroughly. The Kunghit Haida Prehistory Project and the Gwaii Haanas Environmental Archaeology Project together examined over 20 sites (Mackie and Acheson 2005:289, 294).

Fladmark (1989) identified a transitional period bridging the late Moresby and early Graham complexes (c. 4500-2500 BP). This period, termed the Transitional Complex, was described on the basis of one site, Skoglund's Landing, on northern Graham Island (Fladmark 1989:212; Mackie and Acheson 2005:285). Fladmark argued that the lithic component of the Transitional Complex represented a unique technological development, featuring bipolar reduction and unifacially retouched flake tools (Fladmark 1989:217; Mackie and Acheson 2005:285). However, others (cf. Breffitt 1993) contend that basing the definition of an entire technological tradition on a single site assemblage may be premature, as the Skoglund's Landing toolkit may represent a locally adapted tool specialization rather than an exemplar of a widespread complex (Mackie and Acheson 2005:285). This precaution is prudent, considering the variation between the Kinggi Complex toolkits recovered from Kilgii Gwaay and the other earliest Holocene sites.

Following Fladmark's Transitional Complex, the Graham Tradition is exemplified by finds from Blue Jackets Creek (5000-2000 BP), the Honna River site (3300-3040 BP), Tow Hill (3000-2000 BP), and Kiusta (no date available) (Gessler 1974; Mackie and Acheson 2005:284-285). As mentioned earlier, Blue Jackets Creek provided the majority

of the material used to describe the Graham Tradition. Blue Jackets Creek is a shell midden site located near the northern end of Masset Sound, the 40 km waterway that connects inland Masset Inlet to Dixon Entrance and the Pacific Ocean (Fladmark 1990:186). The site is notable not only because of its prominence in the definition of the Graham Tradition, but also because of the excavation of 28 human burials; the earliest known on Haida Gwaii (Fladmark 1989:212; Fladmark et al. 1990:237; Mackie and Acheson 2005:284). Also, the discovery of postmolds, living floors and fire cracked rock provide the earliest evidence for “a more sedentary pattern of settlement” than identified in earlier phases (Fladmark et al. 1990:237). It should be noted, however, that preservational issues are likely a major factor in the (non)discovery of such features in Moresby and Kinggi period sites (Mackie and Acheson 2005:284). The artifact assemblage from Blue Jackets Creek included bone and antler needles, awls, barbed harpoons, points, combs, and a variety of adornments (including labrets) and decorative pieces (Fladmark 1989:213; Fladmark et al. 1990:237; Mackie and Acheson 2005:284). The lithic component includes pecked and ground chisels, wedges and celts, retouched flakes, cores and pebble tools similar to those of the Transitional Complex (Fladmark 1989:212; Fladmark et al. 1990:237). Two biface fragments were recovered, both of which were made from obsidian (non-local material, likely obtained from the mainland) (Fladmark 1989:212; Fladmark et al. 1990:237; Mackie and Acheson 2005:284).

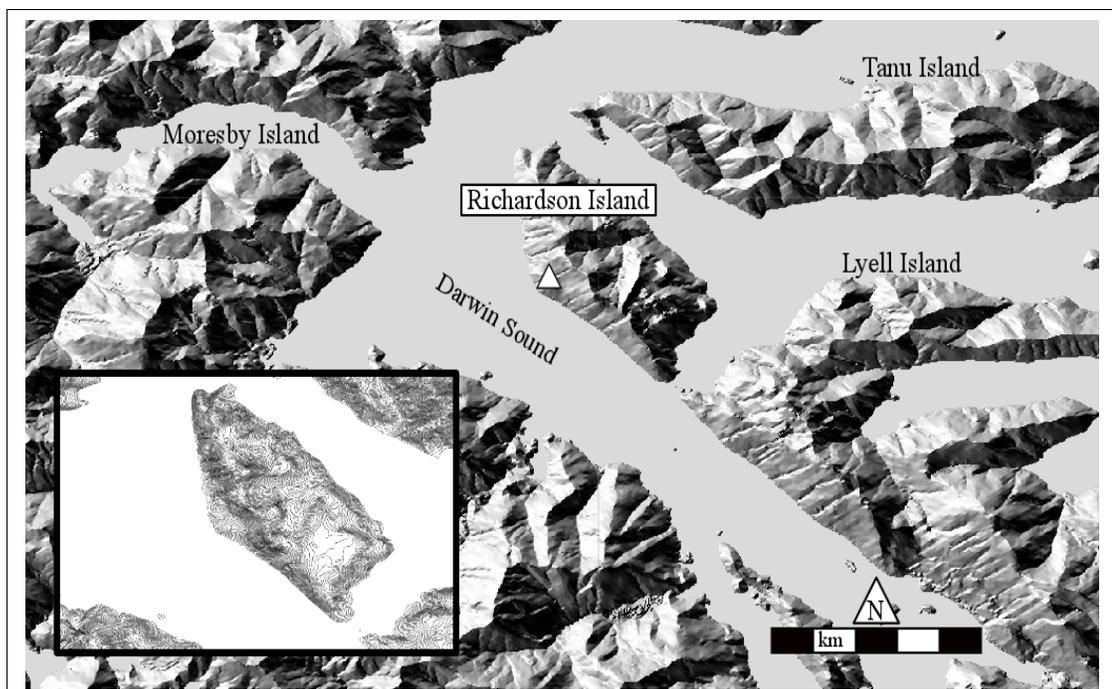
The later Graham Tradition (post 1800 BP) is best known from sites in southern Haida Gwaii. The Kunghit Haida Prehistory Project and the Gwaii Haanas Environmental Archaeology Project, both multi-year research projects, examined a series of sites throughout Gwaii Haanas (Mackie and Acheson 2005:289). A notable shift is evident

between early and late Graham period artifact assemblages: stone tools are nearly absent from later period sites (Mackie and Acheson 2005:290). The few lithic artifacts after 1800 BP appear to be abraders, used to manufacture and maintain the bone and antler tools that dominate the archaeological record for this period (Mackie and Acheson 2005:290-291). Also, the number and size of living floors increases substantially during the late Graham period (Mackie and Acheson 2005:290). Shell middens are still present, and salmon bones appear in greater abundance in the faunal assemblages (Mackie and Acheson 2005:292, 300). However, since the Kunghit Haida homeland (southern Gwaii Haanas) only has small salmon runs, and the islands are quite exposed to the open ocean, deep water fish such as rockfish and halibut, as well as marine mammals such as harbour seal, continue to be important parts of the diet throughout the Graham period (Mackie and Acheson 2005:292, 300). Also, though shell middens are present in late period sites on Haida Gwaii, they do not approach the massive sizes seen in contemporaneous mainland sites such as Prince Rupert Harbour (Fladmark et al. 1990:237). Fladmark posits that by c. 1500 BP, Haida Gwaii material culture reached a stage comparable to that seen in the early contact period (1989:217).

## Chapter 6: Richardson Island Site Background

### 6.1 Location of Richardson Island

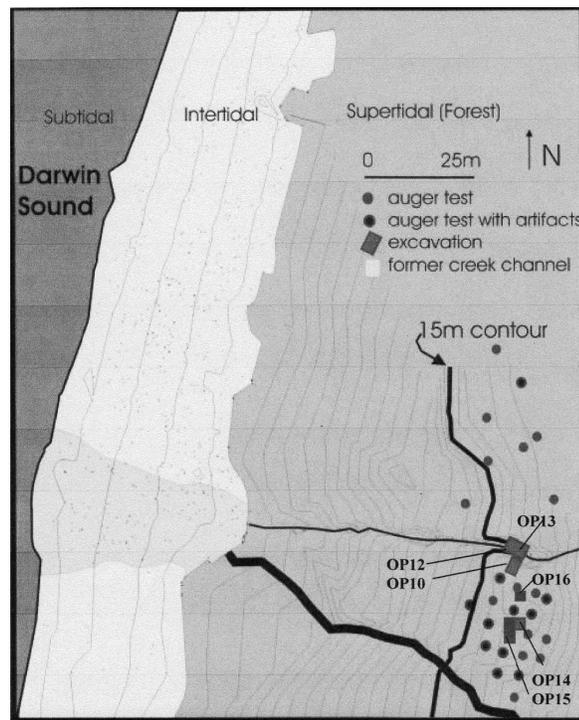
Richardson Island is a small island (approximately 6 km long by 2.3 km across the widest point), approximately one km off the east coast of Moresby Island, in southern Haida Gwaii . The island forms the northeast boundary of Darwin Sound, a sheltered body of water running roughly north/south between Moresby Island and Richardson and Lyell Islands. Richardson Island is protected from the closest open water (Hecate Strait) by Tanu Island, Kunga Island, and Lyell Island. The terrain around Darwin Sound is characterized by steep-sided hilly or mountainous islands with steep, rocky shorelines and scattered narrow beaches composed of gravel, cobbles and bedrock outcrops. Because of its sheltered situation, wave action in Darwin Sound is limited.



**Figure 24: Map of Darwin Sound. Richardson Island 1127T is indicated by the triangle in the shaded relief map. Inset contour map shows the low-angle beach and debris flow below the main 1127T site area.**

## 6.2 Setting of the Archaeological Site (Richardson Island 1127T)

The archaeological site (1127T) is situated on the west side of Richardson Island, on a small debris flow running into Darwin Sound (Figure 24) (Fedje et al. 2005d:204). The site covers an area of approximately 3 hectares, extending from the gravel/cobble beach back into the forest up to about 16 m above modern sea level (Fedje et al. 2005d:204). The site is currently overgrown with a hemlock and cedar forest, and a small, intermittent stream has cut through the upper portion of the cultural deposits. The debris flow marks the area of most moderate incline on the west coast of Richardson Island; the coastlines to the north and south are quite steep. The upper portion of the site is on a raised beach terrace that marks the early Holocene marine highstand (Fedje et al. 1996:142).



**Figure 25: Richardson Island site map. From Storey 2008, created by Daryl Fedje, used with permission.**

### 6.3 Discovery and Excavation of Richardson Island 1127T

The initial discovery of the Richardson Island site took place in 1993 with the identification of an intertidal lithic scatter at the base of the debris flow (Fedje 1996:142). A large number of waterworn lithics were found during surface survey, including three bifaces, 18 microblade cores, and 11 pebble cores that were collected. Over 500 flakes and unformed tools were recorded (Fedje et al. 1996:143). Limited shovel and auger tests were also carried out at this time in order to collect datable material to establish the timeline of marine transgression (Fedje et al. 1996:143).

In the following field season (1994), investigations along the stream bed above the identified site revealed several lithic artifacts *in situ* in a stratified vertical exposure 14-19 m above the tideline (Fedje 1997:7). Several charcoal samples taken from the exposure revealed a date bracket of 8500-9010 BP (Fedje 1996:7). 12 test units (11 shovel tests and one 1 by 2m unit) were also excavated in the intertidal zone. These tests revealed minimal stratification, attributed largely to bioturbation by various shellfish inhabiting the beach (Fedje 1996:7). Several artifacts were recovered, varying between pristine condition and severely waterworn. It was not possible to determine whether these artifacts were deposited prior to the early Holocene marine transgression or if their presence was due to erosion out of contexts higher on the shore (Fedje 1996:7).

In 1995 a 1 by 1.5 m test unit (1127T10) was excavated in the raised beach section of the site, adjacent to the exposure in the streambank. This unit yielded over 4,600 lithic artifacts and a small quantity of calcined bone. Dates from nine charcoal samples showed a range from 8500 BP in the upper layers of the unit, to 9160 BP near the base. Excavations did not reach the bottom of the cultural deposits (Fedje and Sumpter 1999:17).

A second unit (1127T12), 1 by 1 m, was excavated 50 cm downstream from 1127T10 in 1997. Stratigraphy in this unit was linked to the stratigraphy of 1127T10, providing timeline continuity for analysis of the finds. One hearth was identified, and over 4000 lithics were recovered from 1127T12 (Fedje and Sumpter 1999:18). The hearth yielded 1400 identifiable bones and over 3300 unidentifiable bone fragments (Wigen 2003). The lithic assemblage was dominated by reduction flakes, though bifaces and scrapers were also present. Microblades were only found in the “mixed stream deposits capping the intact strata” (Fedje and Sumpter 1999:18).

In 2001 and 2002 a joint research team from Parks Canada and the University of Victoria excavated a 2 m by 3 m unit on the stream bank near 1127T10 and 1127T12. Also in 2001, a test excavation on the raised beach ridge, 20 m south of the stream, provided cultural material and an occupation date of c. 5000 BP (Smith 2004:30).

#### **6.4 Richardson Island 1127T Stratigraphy and Site Formation**

Richardson Island 1127T is particularly notable due to the high degree of stratigraphic definition throughout the occupation period. Repeated periods of cultural occupation interspersed with depositional episodes have resulted in over 50 identifiable layers, at least 23 of which include cultural material (Fedje 2003:31; McLaren and Smith 2008:41-42). This structure facilitates the identification of precise changes in material culture over definable periods of time, rather than relegating analysis of change to examining massive blocks of relatively unstratified sediment, deposited over centuries (McLaren and Smith 2008:42).

The cultural deposits at 1127T are underlain by a non-cultural diamicton deposit. This unstratified debris-flow layer is immediately overlain by a layer of paleosol, rich in stone tools, that contained a charcoal sample that was radiocarbon dated to  $9590 \pm 60$  [CAL 11,100] BP (CAMS# 39877, sample #1127T12R21) (Fedje 2003:31; Fedje et al 2005d:207). These layers have been designated Stratum 1 (Figure 26).

Stratum 2 is a very complex, highly stratified sediment block encompassing the *in situ* cultural deposits and inter-occupation depositional events. Stratum 2 has been subdivided into (from lowest to uppermost) Stratum 2a, Stratum 2b, and Stratum 2c (Fedje et al. 2005d:207). Stratum 2a includes the earliest *in situ* cultural layers of 1127T, dating to  $9290 \pm 50$  [CAL 10,600] BP (CAMS# 39876, sample #1127T12T20) (Fedje 2003:31; McLaren and Smith 2008:41-42). They are made up of a series of layers of greasy, black, gravelly, artifact and charcoal-rich sediment lenses alternating with caps of silty non-cultural layers (Fedje et al. 2005d:207-208). The silt composition of the B horizons and the presence of fresh water diatoms indicate alluvial deposition from upstream debris flows as the source for the non-cultural matrix (Fedje et al. 2005d:207). The presence of gravel in the cultural layers has been hypothesized to represent deliberate efforts on the part of site occupants to put down beach gravel surfaces in activity areas (Fedje et al. 2005d:208); a practice observed both archaeologically (Ackerman 1996b) and ethnographically (Deans 1899).

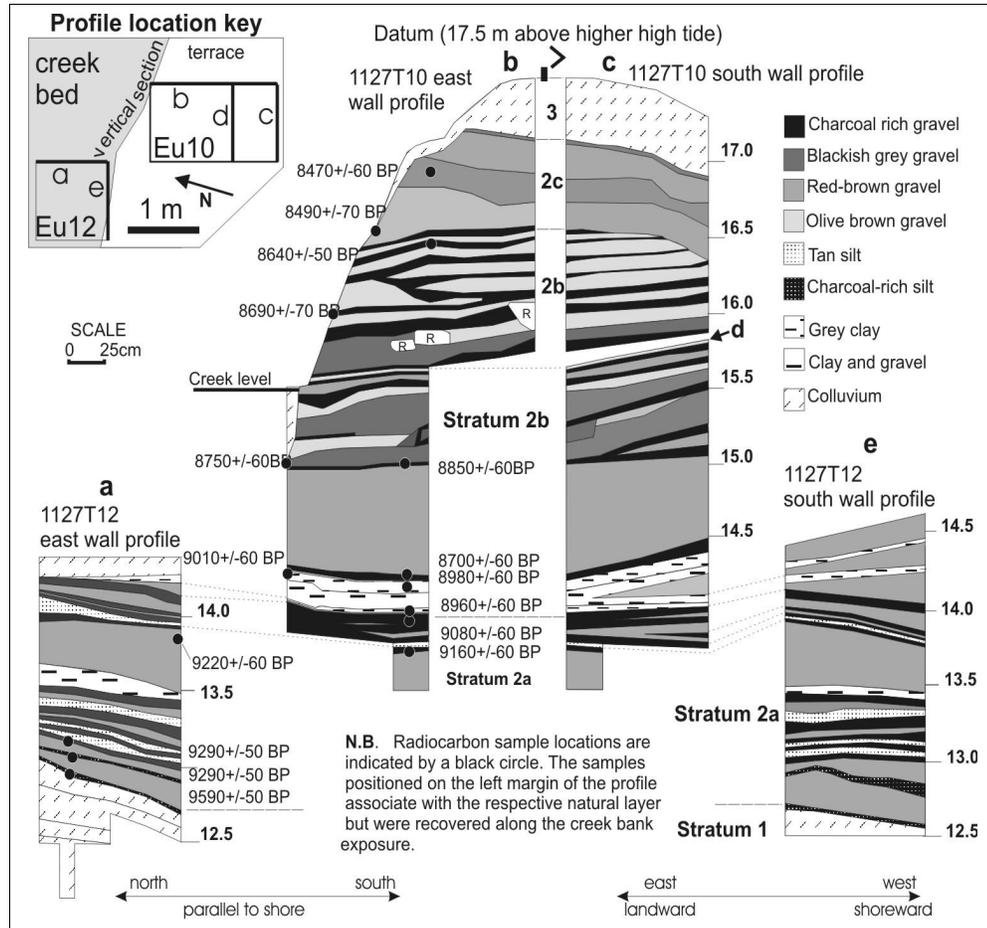
Stratum 2b continues the trend of natural depositional events interspersed with charcoal and artifact-rich cultural layers, but the source of the non-cultural layers changes, as they are made up largely of gravel, rather than silt. The landward incline of the Stratum 2b layers suggest that the gravels were deposited as “berm overwash during

major storm events or tsunamis” (Fedje 2003:32). Together with the rising sea levels prior to the 8900 BP marine highstand, these wave events effectively capped each successive layer of occupation surface while building up the berm, permitting reoccupation for a few years (Fedje 2003:32). Occasional clay and silt lenses indicate that alluvial deposition was still occurring (Fedje 2005d:208). A pair of massive (50cm and 70cm thick, respectively) unstratified gravel layers, one in Stratum 2a and one in Stratum 2b, are indicative of a pair of significant and rapid depositional events, such as a Tsunami, a major storm surge, or submergence resultant from a severe subduction earthquake (Fedje et al. 2005d:208). The latter of these depositional events effectively filled the trough on the landward side of the berm. Subsequent depositions began to construct a new berm, interspersing gravel overwash with cultural material lenses (Fedje et al. 2005d:208).

Stratum 2c reflects the maximum of the marine transgression, with alluvial silty clay and beach gravel deposition layers slanting shoreward rather than landward. Stratum 3 is solely composed of debris flow and forest soils, as the sea level slowly retreated over the mid to late Holocene (Fedje et al. 2005d:208).

Based on the stratigraphic development at Richardson Island 1127T, occupation may be modelled as an activity area located on the tongue of a debris flow, on the landward side of a beach berm. Rising sea levels during the early Holocene gradually encroached on the activity site, but ongoing alluvial deposition served to build up the landform, maintaining the relationship between berm and tideline and providing a new platform for occupation. Over 4 m of sediment was deposited over a millennium,

corresponding closely with sea-level change over the same period (Fedje et al. 2005d:208-209).



**Figure 26: Stratigraphic profiles of Operations 10, 11 and 12. Created by Daryl Fedje, used with permission.**

## 6.5 Site Contents

### 6.5.1 Features

Two feature types were identified during excavations at 1127T: post-moulds and hearths. Post-moulds are the negative impression of stakes or posts that were at one time

embedded in the ground. When the post decomposes or is removed, the remaining hole is filled with soil and creates a stratigraphic transgression through lower layers of intact sediment (Bahn 2001:365; Steffen 2006:31). 11 post-moulds were discovered, one in layer 11 and 10 in layer 12 of unit 1127T13, the 2 m by 3 m unit excavated during the 2001 and 2002 field seasons. Layer 12 corresponds with the Kinggi Complex occupation phase, dating to between 9080 and 9160 BP (Steffen 2006:31). Steffen has identified the post-moulds as likely evidence of fish drying racks (2006:226).

16 hearth features were discovered during the 2001 and 2002 excavations. All of the hearths date to between 9290 and 9120 BP (Steffen 2006:30; Storey 2008:33). Each hearth represents a short-term event, with one or more burnings taking place. Each hearth contained fragments of calcined bone, providing the only direct evidence of faunal material and animal-focused activity at the site (Steffen 2006:30).

### **6.5.2 Fauna**

The faunal assemblage from Richardson Island 1127T is dominated by fish bone (91.2%, NISP:1817), followed by mammal (7.82%, NISP:156) and a small amount of bird bone (0.8%, NISP:16). 97% of the identifiable fish bone is composed of five primary species. Rock fish (*Sebastes sp.*) is by far the most common (77.2%, NISP:1403), with lingcod (11.1%, NISP:212), dogfish (4.1%, NISP:75), salmon (2.9%, NISP:52) and Irish lord (1.5%, NISP:27) making up the others (Steffen 2006:59). Of the mammal bones, the majority could not be identified as belonging to any specific taxa ( $n=148$ ). Six bone fragments were from rodents, and two were from mid-sized carnivore (Steffen 2006:64). Similarly, 15 of the 16 bird remains could not be identified beyond size: medium ( $n=8$ ) or

small ( $n=7$ ). The remaining bird bone was from a mid-sized member of the auk (*alcid*) family (Steffen 2006:64).

Faunal distribution varies between hearths as well. Rockfish, in addition to being the most frequent taxa, is also the most common. It was present in 15 of the 16 hearth features. Lingcod and dogfish are also relatively ubiquitous, but salmon remains were only recovered from four hearth contexts. Mammal remains were found in 75% of hearths and bird remains in 40%, indicating consistent use of both animals (Steffen 2006:61).

A small sample ( $n=228$ ) of faunal material was also recovered from non-hearth contexts. These elements were also calcined, but were not directly associated with any of the hearths, or were found in the screens, rather than *in situ*. Rockfish and (unidentified) mammal remains dominate this assemblage. Two mammalian skeletal elements were identified as belonging (respectively) to a large carnivore and a deer mouse (Steffen 2006:67-68).

## **6.6 Artifacts**

### **6.6.1 Organic Artifacts**

Four organic artifacts were recovered from hearth contexts: two small fragments of pointed bone and two other worked bone fragments (Steffen 2006:80-81). None of these exceed 15 mm in any dimension and it is impossible to identify their original function.

### **6.6.2 Lithic Artifacts**

The Richardson Island 1127T artifacts assemblage is composed almost entirely of lithics. 3200 stone tools were recovered, along with approximately 47,953 pieces of

debitage (Storey 2008:36). Several categories of lithics are represented in this assemblage (Table 1). Elements of both the biface-based Kinggi Complex and microblade-based Moresby Tradition toolkits are recognizable, along with large numbers of unifacial tools, flakes and cores.

#### **6.6.2.1 Flakes and Unifacial Tools**

The unifacial assemblage from Richardson Island 1127T has been the subject of intensive research elsewhere (see Storey 2008), so it will be addressed briefly here.

The unifacial and flake tool lithic assemblage at Richardson Island is composed of several tool types (Table 1). These tool types may represent a variety of tasks and activities having been carried out at the site. It should be noted, however, that tools may have performed multiple functions, and that varying stages in a tool's use life may also affect formal attributes, resulting in a reduction sequence trajectory that passes through several archaeologically defined categories. Similarly, the tool categories defined in Table 1 should not be considered to be mutually exclusive, as a single artifact may simultaneously exhibit features consistent with multiple tool types (Storey 2008:36).

The unifacial and flake tool assemblage may be used to infer some of the site activities that were carried out at Richardson Island. Based on the identified tool forms, the site activity suite may have included tasks such as cutting and scraping (as evidenced by the utilized flakes, spall tools, scrapers, and several of the unimarginal and bimarginal tools), and shaping wooden or bone implements (based on the graver/burins, spokeshaves, scrapers, scraperplanes, wedges and abraders) (Storey 2008:38).

Tool Type	Definition
Abrader	Coarse stone, often with a flat surface, used to shape stone, bone, antler or wood objects, and to maintain striking platforms and biface edges.
Biface	A flaked stone artifact with evidence of flaking on both faces. The term “biface” is often interpreted as referring to formal tools with bifacial flaking, in contrast to bimarginal tools.
Biface Preform	A flaked stone artifact exhibiting preparatory flaking prior to final shaping into a formal bifacial tool.
Bimarginal Tool	A flaked stone artifact with evidence of flaking on two margins or faces. This term is often reserved for informal tool forms.
Burin	A flaked tool with a robust edge, less acute than a cutting edge. Burins may be used for incising or scraping tasks.
Chopper	Large, often roughly flaked artifacts with a sharp modified edge used for chopping hard material such as bones or wood.
Core	The node of parent material from which flakes are removed.
Denticulate Scraperplane	A scraperplane with pointed peaks protruding from the scraping edge, parallel to the plane surface..
Graver	A stone tool with a sharp, pointed tip used for incising or engraving in organic material such as bone, wood or antler.
Hammerstone	A stone used to strike flakes from a core or flaked stone tool. Hammerstones often exhibit battering and/or crushing on the working surface, which permits definition from other unmodified cobbles.
Microblade	A small (<11mm wide) flake, at least twice as long as it is wide, with parallel edges in its unmodified state. See chapter 3 for more discussion.
Microblade Core	The prepared core from which microblades are produced. Microblade cores may be identified by the fluted surface created by microblade flake scars.
Microblade Core Preform	Small objective pieces of stone from which flakes have been removed in order to shape the piece for optimal microblade removal. No microblade scars are visible.
Scraper	A flaked artifact with an edge modified to be robust (rather than sharp enough to cut), and not so sharp or notched as to gouge a surface.
Scraperplane	A generally large, unifacially flaked tool with a robust scraping edge adjacent to a flat surface.
Spall Tool	An artifact with a significant amount of cortex on its dorsal surface, and evidence of use or modification.
Spokeshave	A tool with a modified sharp-edged concave notch.
Unifacial Tool	An artifact with evidence of flaking only on one side.
Unimarginal Tool	An artifact with flaking visible only on one edge.
Utilized Flake	An unmodified flake that shows evidence of use, through edge damage or use-wear.

**Table 1: Haida Gwaii lithic tool categories. Modified from Storey 2008.**

### **6.6.2.2 Unifacial Tool Continuity Over the Kinggi/Moresby Transition**

While bifaces characterize the Kinggi Complex toolkit, and microblades are exclusive to Moresby Tradition assemblages, unifacial technology is common throughout both periods (Fedje and Mackie 2005:159; Storey 2008:36). Recent research has addressed the subject of unifacial technological continuity between the Kinggi Complex and the Moresby Tradition (see Storey 2008). Richardson Island 1127T provided an excellent data source, as the majority of lithic artifacts recovered from the site were unifacial tools, and they were found in strata spanning the occupation period. The Kinggi Complex unifacial assemblage was significantly larger than the Moresby unifacial assemblage, but this may be due more to sampling bias than to an actual difference in tool use frequency (Storey 2008:40). The relative frequency of individual tool types in the assemblages is quite comparable, and Storey concludes that there is no indication of significant change in unifacial tool use at the site between the two periods (Storey 2008:194).

This inference is of particular significance, as it helps address the question of whether or not the Kinggi/Moresby technological shift seen in the biface to microblade transition at Richardson Island is the result of population replacement, or is a development within a continuing community (Storey 2008:202).

### **6.6.2.3 Bifaces**

223 bifaces and biface fragments were recovered from the Richardson Island site. The bifaces were recovered from contexts spanning approximately 1000 years of

occupation from 9400 BP to 8500 BP (McLaren and Smith 2008:48). The majority of the bifacial tools were found in layers dated to the Kinggi Complex (pre-8750 BP), with a smaller collection dated to the Early Moresby Tradition (8750-8500 BP) (McLaren and Smith 2008:42, 48). Two primary stylistic projectile point categories are represented among the Richardson Island bifaces: the *Xil* (Haida: 'leaf') and the *Xilju* (Haida: 'little leaf') forms. Both are foliate point styles with contracting to parallel-sided stem forms and no notching.

#### **6.6.2.3.1 Formal Styles**

##### ***Xil***

Two complete *Xil* points and 11 basal fragments were recovered from Richardson Island. *Xil* points are foliate bipoint bifacial projectile points with an excurvate to recurved blade edge distal of the widest dimension, with a straight or very slightly excurvate, contracting stem form and a pointed or rounded base (Figure 28) (Fedje et al. 2008:21). The complete specimens measure 74mm and 65mm respectively, though several large broken fragments indicate that lengths above 100 mm were not uncommon (Figure 27).

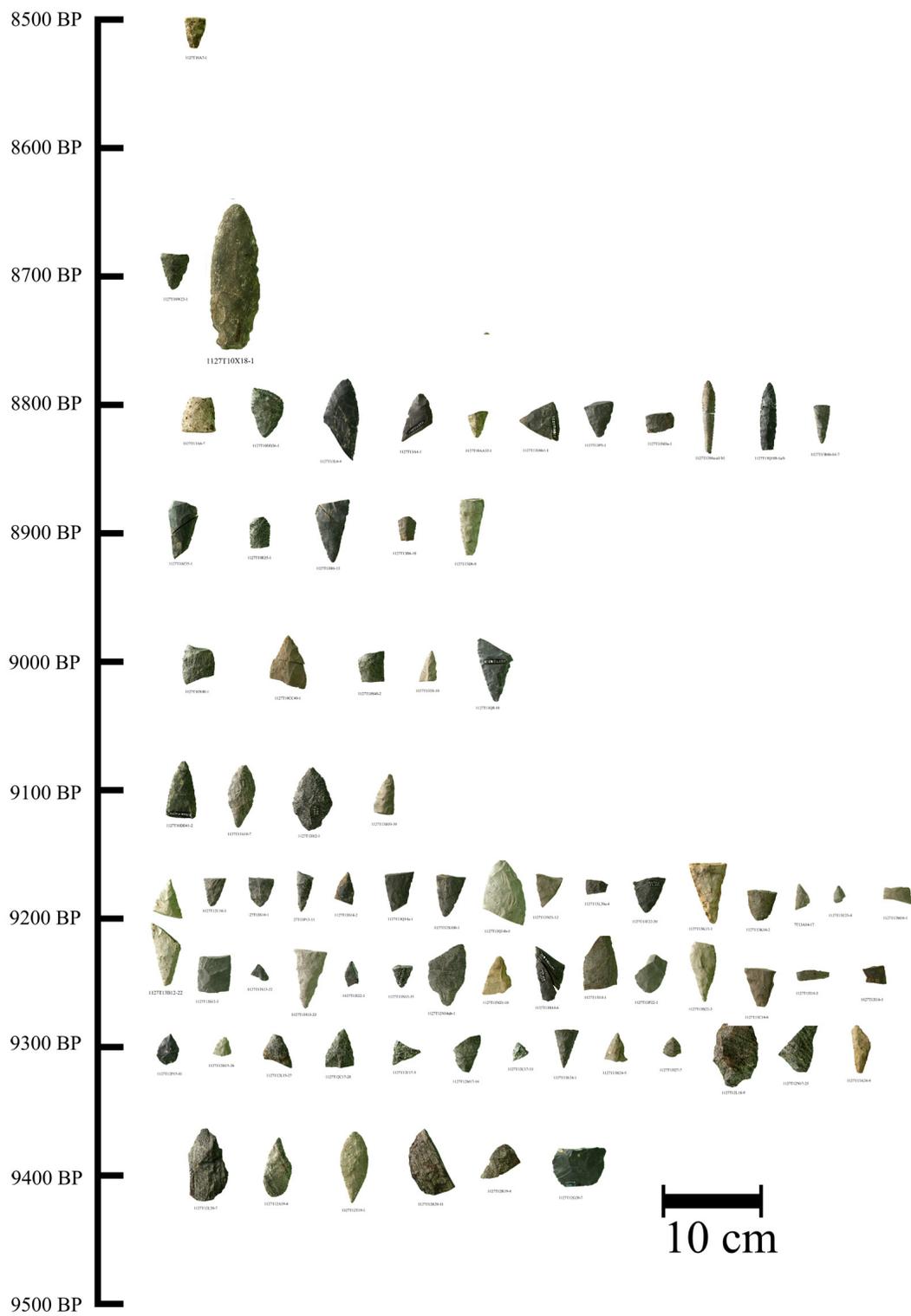
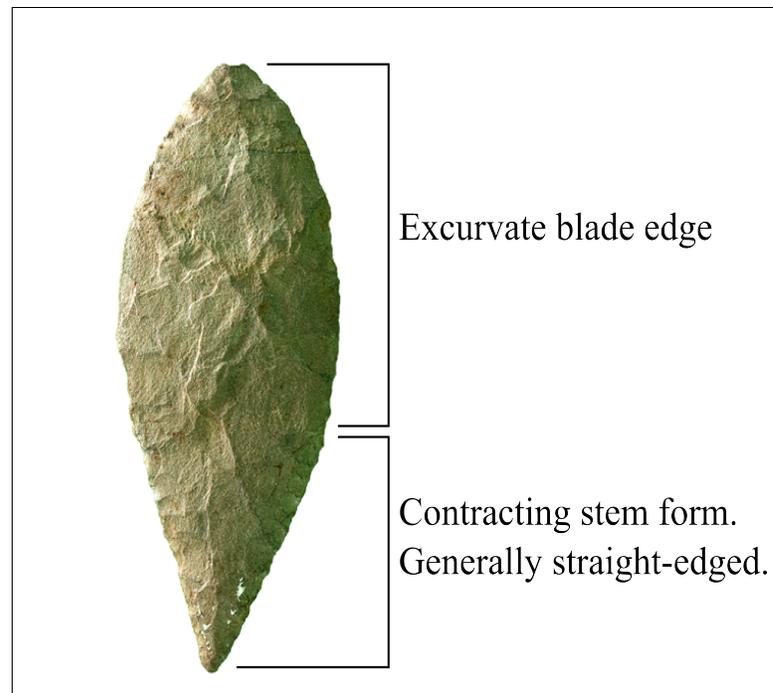


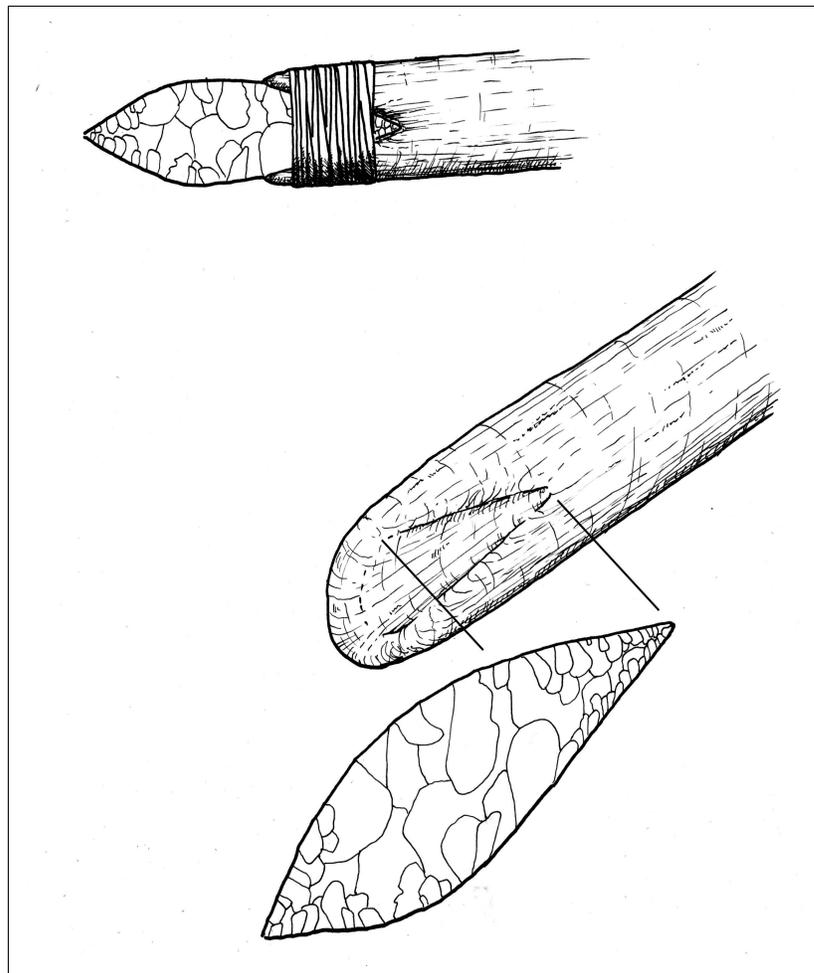
Figure 27: Richardson Island bifacial projectile point timeline.



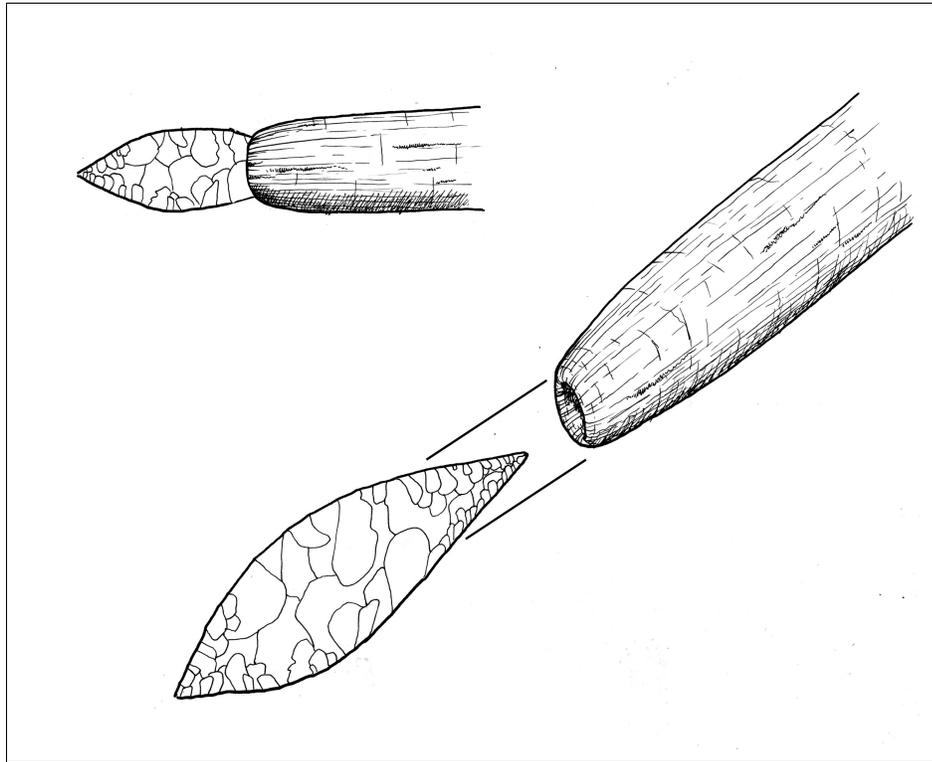
**Figure 28: Xil biface form.**

*Xil* point stem angles range from  $23^{\circ}$  to  $32^{\circ}$  (mean= $28^{\circ}$ ) and occasionally display some grinding or crushing along 30-40mm of the proximal lateral margins (Fedje et al. 2008:24). The proximal portions and basal fragments of the *Xil* points also show a higher frequency of small, regular flake scars consistent with pressure flaking (Andrefsky 2005:118; ), indicating careful standardized shaping of the hafting elements (McLaren and Smith 2008:52). Fedje et al. propose that the width of the *Xil* stems is consistent with use in thick-shafted spears, rather than thinner atlatl darts, indicating that the points may represent a hunting strategy based around the use of thrusting spears at close range: a strategy identified in ethnographic accounts of Northwest Coast bear hunting practices

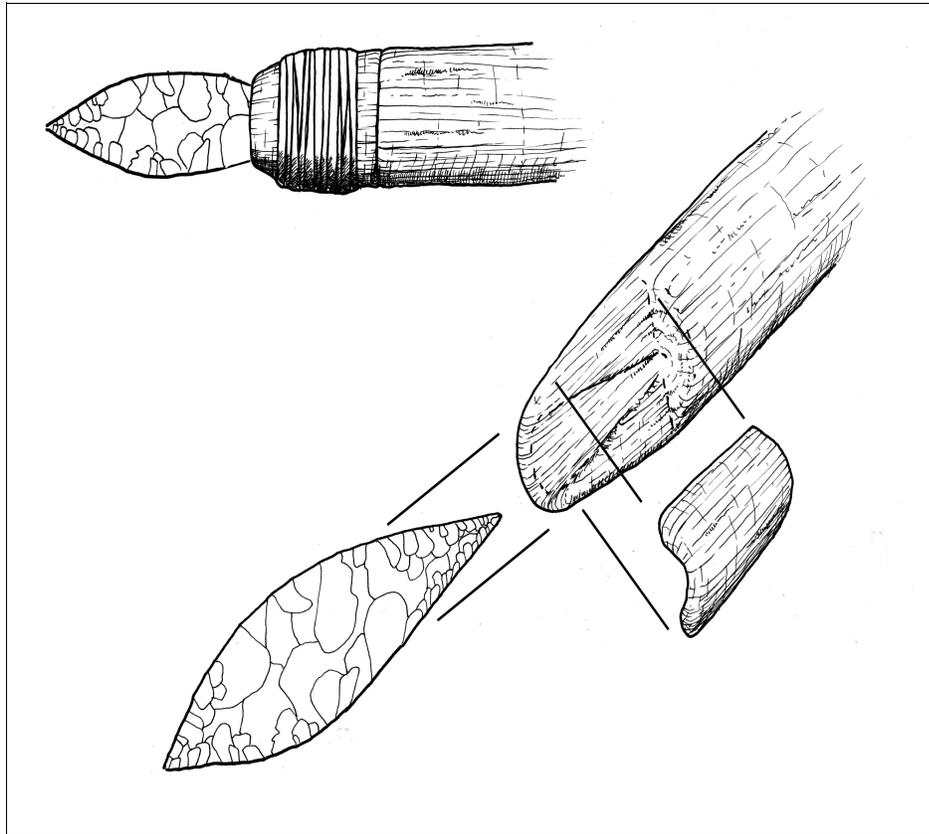
(Fedje 2008:22-23; McLaren and Smith 2008:44). The recovery of foliate points with intact hafts from an Arctic Small Tool Tradition (AST) site in West Greenland have provided an analogy for the *Xil* points, as well as a suggested hafting technique. Based on the hafted AST point, *Xil* points may have been side-hafted in one-sided sockets, bound in place with sinew, hide or fibre wrapping and possibly some form of mastic (Figure 29) (Fedje et al. 2008:26). Alternatively, the contracting stem form is also suitable for hafting in a full socket (Figure 30) or a multi-part socket. A wooden artifact recovered from Kilgii Gwaay appears to be such a socket, with a larger portion with a hemicylindrical carved concavity running along the distal portion and a smaller section that binds on facing the concavity, holding the hafted tool in place (Figure 31) (Mackie pers.com. 2011). No *Xil* points or fragments were recovered from Kilgii Gwaay, however, so this inferred tool application is somewhat conjectural.



**Figure 29: Artist's reconstruction of a side-hafted Xil biface.  
After Grønnow in Fedje et al. 2008.**

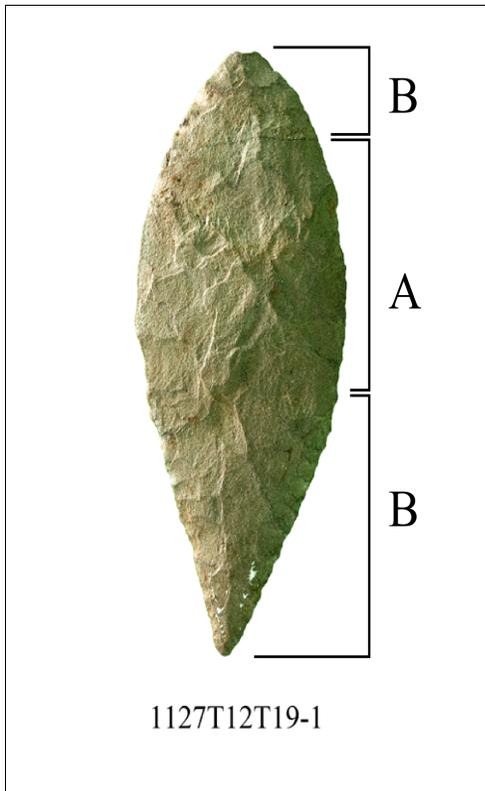


**Figure 30: Artist's reconstruction of a socket haft with Xil biface.**



**Figure 31: Artist's reconstruction of a side-socket haft, after a wooden artifact recovered from Kilgii Gwaay.**

The reduction sequence identifiable based on *Xil* morphology includes soft-hammer percussion to thin and shape the biface, and pressure flaking to finish the distal tip and regularize the stem section. A high frequency of “variable” flake scar patterns (after McLaren and Smith 2008), often including, shallow, expanding flake scars with minimal negative bulbs of percussion overlain by smaller parallel-sided flake scars (Figure 32), is consistent with the use of soft-hammer percussion followed by pressure flaking.



**Figure 32: Xil biface exhibiting flake scars indicative of soft-hammer percussion thinning (most visible in region A) and pressure-flake final retouch (region B).**

McLaren and Smith identify some temporal variation in biface manufacture technique with lamellar flaking patterns appearing on later point forms, while variable flaking peaks two centuries earlier (2008:51, 53). While this appears to be the case, statistically, the identified difference in the flaking patterns may be more to do with the breadth of objective piece rather than reflecting a genuine change in the *schema opératoire* of the tool maker. For instance, McLaren and Smith's definition of lamellar flaking, “b) Lamellar: Flake scars are placed at regular intervals; platforms tend to be

placed so as to allow the force of the flake removal to follow the later edge of the adjacent flake scar”(2008:51), is most evident on artifacts that have experienced a high degree of basal finishing, with extensive pressure retouch being used to achieve an optimally regularized base form. Among these, the *Xilju* points, recovered from post-8900 BP contexts (Fedje et al. 2008:22), display long, narrow stems with very carefully flaked margins. The flaking appears to be almost exclusively pressure flaking, as the narrow stem form allows even short to moderate-length pressure flake scars to travel to the point's longitudinal midline (Figure 33). The larger *Xil* points also exhibit pressure flake finishing along stems and distal points, but much less so along medial blade edges. It is rarely completely absent, but appears to be applied in more localized areas to regularize or resharpen a blade edge, rather than to shape the point in general as is the case with the smaller points. As such, the apparent variation in flaking technique over time appears to reflect variation in point form, rather than in flaking strategy. The narrower points were more likely to break under direct soft-hammer percussion, so pressure flaking was employed to finish the shapes. These points also have a more exaggerated lenticular crosssection with a higher thickness:width ratio (McLaren and Smith 2008:54), while the wider points are relatively flatter, as would be expected from a soft-hammer thinning/shaping technique (Whittaker 1994:185).



**Figure 33: Xilju point. Note the narrower silhouette and long, nearly parallel stemform in comparison with the Xil point style.**

Two biface blanks or early preforms were recovered from the site, and these may provide some insight into the earliest stages of the bifacial reduction sequence.

Specifically, the preforms show that bifaces were produced by spalling off large, chunky flakes from relatively large raw material cores. These flakes were then roughly trimmed to shape by hard-hammer percussion, as indicated by the deep negative bulbs of percussion and flake scars, before being shaped further by soft-hammer percussion.

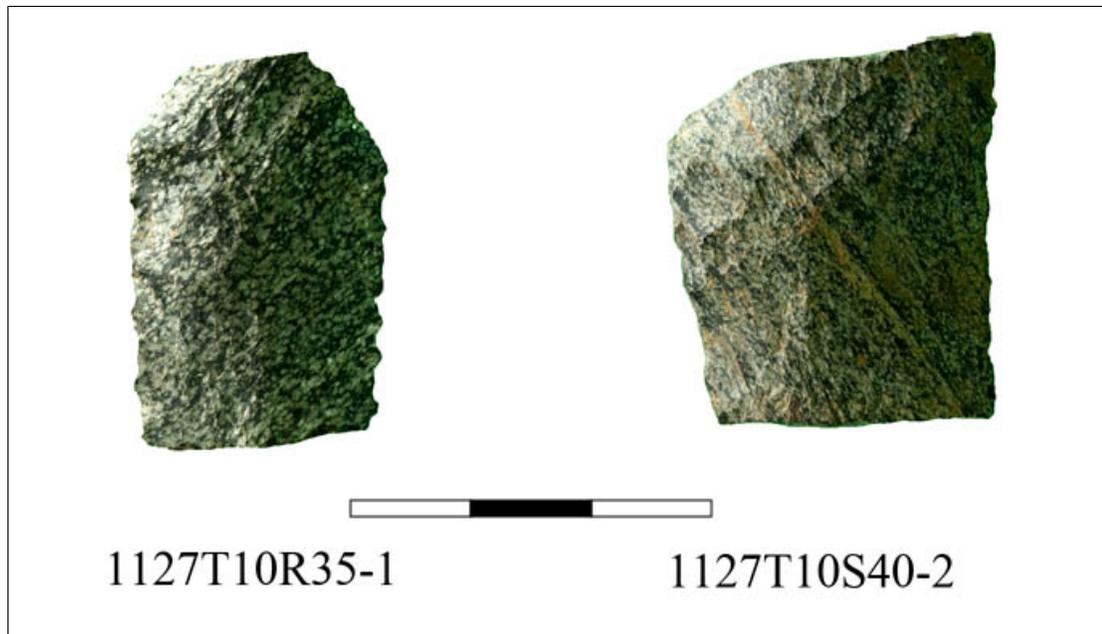
Neither of the two preforms show any clear evidence of this later stage reduction, though both have been trimmed to a rough foliate shape. One of the preforms is thoroughly flaked on either face, but the other still exhibits a large remnant ventral flake surface, indicating that it was manufactured on a flake, rather than out of a core.

### *Xilju*

Four *Xilju* points were recovered from Richardson Island: one refitted complete specimen, one basal fragment, one medial fragment, and one nearly complete point with the base missing (Fedje et al. 2008:23). The *Xilju* point style is typified by long, narrow projectile points with excurvate distal blade edges, nearly parallel contracting stem forms ( $11^{\circ}$ - $15^{\circ}$ , mean= $13.25^{\circ}$ ), with parallel or lamellar pressure flake scars along all margins (Fedje et al. 2008:23; McLaren and Smith 2008:51). The complete point is 74 mm long. Like the *Xil* points, *Xilju* points have no notching, barbs or shoulders, and exhibit a pointed or rounded base form. The cross-section of *Xilju* points tends to be quite lenticular, with a greater thickness:width ratio than that of the *Xil* specimens. Fedje et al. identify *Xilju* points as a later development in Haida Gwaii, as they were recovered from layers dated to approximately 8800-8700 BP (Fedje et al. 2008:22, 24). It should be noted that the four *Xilju* specimens from Richardson Island are the only known examples of the point style on the Northwest Coast.

One interesting aspect of the *Xilju* point style is that they are noticeably narrower than *Xil* points, resembling near-parallel sided lanceolate point forms to a greater degree than willow-leaf-shaped foliate point forms. Close similarities in terms of contracting stem forms with careful finish flaking and standardized straight hafting element edges,

and excurvate distal blade edges shows a degree of stylistic connectivity between the two point styles (McLaren and Smith 2008:52), but the dissimilarity in point width has caused some to suggest a difference in point function. Based on Grønnow (1994:220), Fedje et al. (2008:23, 26) and McLaren and Smith (2008:52) suggest that *Xilju* points were used as atlatl dart tips, rather than as points on thrusting spears. The narrow width of the *Xilju* points is consistent with examples of atlatl dart foreshaft diameter (Fedje et al. 2008:26). It is worth noting, however, that two medial projectile point segments (1127T10R35-1, 1127T10S40-2) that were not identified as *Xilju* points by Fedje et al. exhibit the same range of straight, narrow-angle (8° and 10°, respectively) lamellar/parallel-flaked blade edge and lenticular cross-section as the other examples, but are 21% and 53% wider than the widest identified *Xilju* example (Figure 34). These specimens and other fragments that cannot be definitively identified as *Xil* or *Xilju* may indicate that *Xilju* points were produced in a greater range of sizes than has been suggested, and that they may therefore also exceed the standard diameter of atlatl dart foreshafts, and thus be examples of long, narrow thrusting spear points.

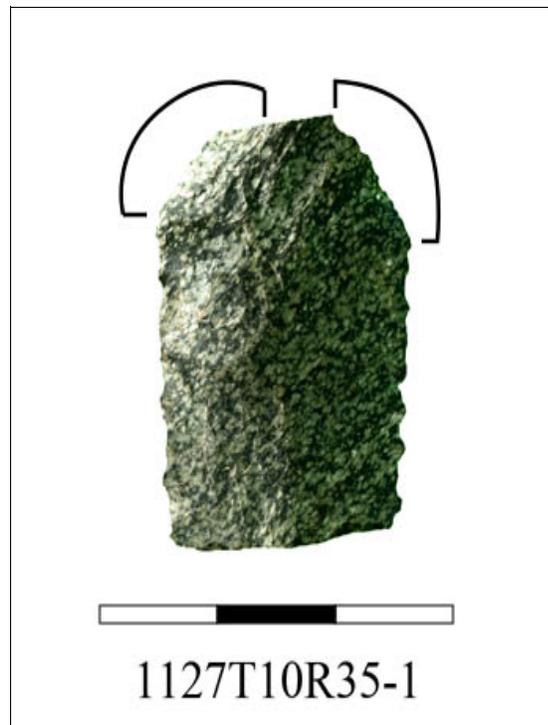


**Figure 34: Wider Xilju point sections.**

In this vein, the *Xilju* points may have developed to accommodate an alternative hafting strategy. Fedje et al. suggest that, like *Xil* points, *Xilju* points were side-hafted, and that this hafting method may have provided some measure of shock absorption and thus guard against end-impact point breakage (2008:23, 25). While this may be logical, firmly binding a point in a sidehaft would almost certainly require the use of a mastic such as hide glue, which must be heated in order to haft or unhaft the tool (Keeley 1982:800). However, use of end-socket hafts may allow the tool user to eschew binding altogether, and rather apply a spruce gum mastic to hold the point in the socket. In this setting, a long, narrow base with a rounder (rather than flatter) cross-section would be optimal. The spruce gum mastic does not require heating, so tool maintenance and point replacement could be achieved quickly and easily, without requiring a fire or heating vessel. This hafting strategy will be discussed in greater detail in Appendix A.

#### 6.6.2.4 Discussion of the Richardson Island Bifacial Projectile Points

The bifacial tool component of the Richardson Island artifact assemblage plays a particularly important role in facilitating the identification of the site as a camp site rather than as a kill site. In addition to the hearth features and post-moulds found during excavation (Steffen 2006:31), the presence of a large number of basal projectile point fragments along with several distal tips indicate that one of the activities that was carried out at the site was the production, maintenance and refitting of hunting weapons (Fedje et al. 2008:25). Specifically, this site appears to have been a destination for people immediately after a hunting session, as otherwise the weapons may have been refitted at an intermediate campsite, in preparation for opportunistic hunting activity *en route* to the final habitation destination (Binford 1979:266). Furthermore, several of the projectile points display evidence of repairs. One particularly interesting example is 1127T10R35-1, a medial projectile point fragment which appears to have been snapped, partially repaired, but broken again during the re-shaping process and discarded (Figure 35). The distal tip and basal fragment were not recovered.



**Figure 35: Partially repaired point fragment. The brackets indicate retouch beginning to re-point the broken biface. The opposite fracture appears to have occurred during the flaking process and caused the knapper to abandon this piece.**

One notable stylistic outlier among the Richardson Island biface assemblage is 1127T10X18-1 (Figure 27). The largest of the bifaces, at 151 mm long and 52 mm wide, this artifact displays a markedly different form to the *Xil* and *Xilju* formed tool styles. The blade edge is excurvate, but rather than having a contracting stem form, this biface exhibits what appears to be a wide-angle side-notched hafting element, with rounded shoulders and a straight or slightly recurved base. That said, the biface is relatively thick and though weathering has obliterated many of the flake scars, those that are visible suggest that the reduction sequence likely involved percussion flaking to achieve the

shape, but apart from possible pressure flaking to produce the notch, no precise finish flaking. It is possible, therefore, that this artifact is actually a large preform, representing the stage between rough shaping of the blank and final thinning and blade edge formation. The notch (only one margin exhibits a clear notch; the other appears to have been obliterated by the shoulder snapping off below where the notch was/should be) may then simply be a deeper flake scar produced during the interrupted shaping process, rather than a deliberate design feature of a finished tool. If this is the case, it shows a level of flexibility in terms of the ideational models guiding the *chaîne opératoire*, as the unequivocal preforms both exhibit the foliate shape early on, while this biface does not have much of an indication of the *Xil* contracting stem form at all.

## Chapter 7: Richardson Island Microblades

### 7.1 Methodology

#### 7.1.1 Measurement and Recording

All quantitative measurements were taken using digital callipers with 0.01 mm precision. Artifacts were examined macroscopically as well as under a lowpower (6.3x-40x) stereoscopic microscope. The microscope was used to identify detailed chipping or flaking, directionality of fluting (when possible), platform damage, and other features otherwise invisible without magnification.

##### 7.1.1.1 Recorded Microblade Attributes:

**Length:** Maximum dimension along the longitudinal axis of the flake, as determined by dorsal arrises. Trapezoidal blades were still measured along the same long axis, rather than diagonally, with the step-fractured/snapped margins flush with the callipers. Thus, microblades were not necessarily measured along their longest dimension (though this was often the case).

**Width:** Maximum dimension perpendicular to the longitudinal axis.

##### **Thickness:**

**Maximum:** Maximum thickness was measured at the thickest point of the flake; frequently the striking platform in the case of complete blades and proximal segments, and occasionally the overshot termination in the case of distal segments.

**Medial:** Medial blade thickness was measured at the point nearest to the distal termination of the bulb of percussion. This measurement therefore does not represent maximum thickness, but rather a representation of thickness for the working section of the blade. For medial and distal segments, thickness was measured at the point closest to the proximal end of the blade segment (if orientation could be determined). This method

of measurement was selected in order to better represent the cross-section of the blades, as variation in striking platform thickness, prominence of bulbs of percussion and thick overshoot distal terminations may distort perspectives of blade standardization.

**Curvature:** Blade curvature was recorded with a subjective and qualitative presence/absence indicator based on the degree of curvature relative to the thickness of the blade. Those blades with curvature (the distance between a straight longitudinal plane projected from proximal to distal tip and the furthest point of the ventral surface) visibly greater than their thickness were marked as “curved”, while those with greater thickness than curvature were marked as straight.

This metric was selected in order to represent whether the curvature of a blade was significant enough to warrant consideration beyond the blade's other physical properties, especially in relation to known microblade applications such as inset points. As a result, the index of curvature may be more appropriately interpreted as an index of the likelihood that a microblade or segment may fit into a side-mount in a slotted projectile point without additional modification to straighten it (through snapping). A brief trial of Andrefsky's method of measuring flake curvature (1986:50; 2005:110) resulted in variable measurements and a tendency of material mass in bulbs of percussion and/or distal overshoot terminations to result in an over-representation of relative curvature. While this method may prove to be useful for future research, I decided not to follow it for this project.

**Fragmentation:** Microblades were classified as “complete”, “proximal segment”, “medial segment”, or “distal segment”. It should be noted that several microblades identified as “proximal segments” may in fact be “complete” blades, but because of an

abrupt, flat distal termination due to core morphology could not be distinguished from step-terminated proximal segments. However, the infrequency of step terminations on the extant microblade cores suggest that most of this breakage likely occurred after flake removal (through snapping during removal, just after separation from the core may also be a factor).

**Termination:** Description of the distal termination is marked as “feather termination”, “step fracture” (or abrupt step termination), “hinge fracture”, and “overshot”. Overshot terminations are similar to feather terminations, except that instead of feathering out on the same core face as the main body of the blade was removed from (the fluted face) these blades “hook” around the end of the blade and terminate on the core’s distal surface.

**Dorsal arrises:** How many dorsal arrises are visible on the blade’s dorsal surface.

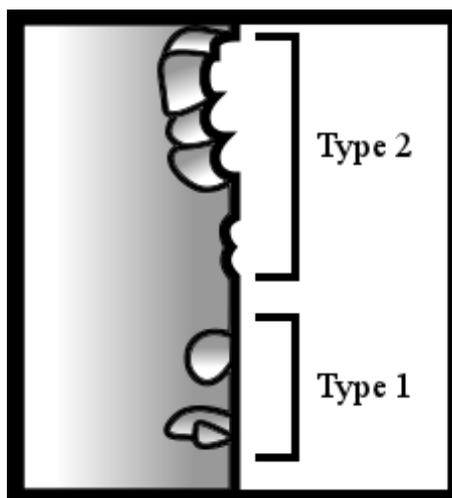
Intersecting arrises that merge on the dorsal surface are considered one arris, rather than two (or more). This provides an indication of prior blade removals and overlapping flaking techniques.

**Semi-crested blade:** This presence/absence data records instances of truncated lateral flake scars, not produced by blade modification, but rather as indicators of core preparation.

### **Edge Damage**

Edge damage was recorded following two basic models: edge damage that includes flake scars that are visible but do not affect the blade profile (Type 1), and flake scars, chips or nicks that interrupt the straight lateral edge of the blade (Type 2) (Figure 36). These categories were selected in order to differentiate between degrees of edge

damage on artifacts, potentially related to different applications. This edge damage was recorded as a presence/absence category, and it was indicated whether one or both margins were affected by each type of edge damage. It should be noted that varying degrees of chemical weathering prevents the identification of edge damage on many artifacts.



**Figure 36: Edge Damage Diagram.**  
**Type 1 edge damage does not compromise the blade edge, Type 2 edge damage interrupts the blade edge.**

No attempt was made to determine whether the edge damage was the result of use wear, trampling damage or other taphonomic processes, though some details of the chipping or flaking was generally noted in the “comments” field. Only “trowel/screen retouch” was noted definitively, as it results in damage to the weathered surface of the artifact, leaving a bright scar in stark contrast to the rest of the surface. Weathered chips are therefore inferred to have occurred either during use, deposition, or while the artifact was interred, rather than during excavation.

**Weathering:** This marks whether chemical or physical weathering as affected the blade enough to obscure edge detail (such as edge wear or damage), evidence of platform crushing, nature of termination fracture, and orientation of flake scars.

**Comments:** Observations on anything out of the ordinary and more detailed descriptions of edge damage.

#### **7.1.1.2 Microblade Core Attributes**

Microblade core attribute recording primarily followed Magne's framework (1996:153) , with some additions (Figure 37).

**Maximum Platform Length:** The maximum dimension measured across the longest axis of the striking platform.

**Maximum Platform Width:** The maximum dimension measured generally perpendicular to the maximum platform length.

**Chord Length:** The direct distance across the striking platform from one lateral margin of the fluted face to the opposite lateral margin.

**Maximum Flute Length:** The maximum dimension of the fluted face measured from the striking platform to the distal termination of the longest microblade scar. Measured parallel to the fluted face.

**Core Height:** The maximum dimension of the core measured perpendicularly from the striking platform to the distal end of the core.

**Core Angle:** The striking platform angle at the fluted face. This measurement could vary depending on the width of the fluted face or if there were several fluted faces on one core.

**Microblade Scar Count:** A count of flake scars that could be identified as microblade removal events with long, parallel edges, a narrow profile, and several overlapping scars.

**Flake Scar Count:** A count of non-microblade flake scars. No attempt was made to differentiate between core preparation flake scars and core rejuvenation flake scars.

**Platform Retouch:** A presence/absence indication of evidence of flaking on the platform in order to achieve the desired platform angle or core form.

**Platform Undulation:** A presence/absence indication of undulation on the platform indicative of the use of a thick flake as a microblade core. The ventral surface of the flake, usually utilized as the core's striking platform, will tend to undulate gently.

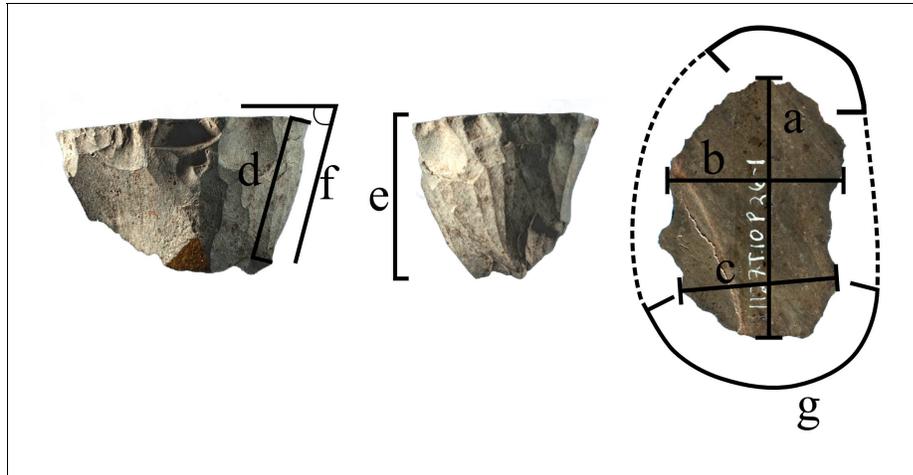
**Keel Battering:** Chipping, microflaking or other damage visible on the core's distal end, often indicating the use of an anvil in flake removal.

**Fluted Faces:** The number of discrete surfaces that microblades were removed from.

**Cumulative Percentage of Flaked Circumference:** The total relative amount of the core's lateral surfaces that have had microblades removed.

**Curvature:** The amount of curvature evident in the fluted faces. This was measured following Andrefsky's method (1986:50; 2005:110) for measuring flake curvature. This data was taken in consideration of Giria and Pitul'ko's observations regarding segmented-surface core reduction (1994:39). Giria and Pitul'ko argue that standardized fluted face curvature was maintained deliberately during microblade production in order to achieve a consistent microblade edge angle and to restrict blade thickness (1994:39). The fluted face curvature measurements among the Richardson Island cores were taken in order to assess whether there was a high level of consistency or standardization in fluted face curvature maintenance.

**Comments:** Any additional observations. Core morphology was recorded here (ie. Bullet-shaped core, boat-shaped core, etc.) as well as whether otherwise contiguous fluted surfaces may be separated based on Gira and Pitul'ko's model (1994:39). Possible instances of core rejuvenation were also recorded here.



**Figure 37: Recorded microblade core attributes, after Magne 1996. a: maximum platform length. b: maximum platform width. c: maximum cord length. d: maximum flute length. e: maximum core height. f: core angle. g: cumulative fluted face circumference (fluting indicated by solid line; non-fluted face by dashed line).**

### 7.1.2 Software

Primary recording was undertaken using OpenOffice.org 3 for Macintosh. Files were formatted as .xls in order to maximize compatibility with Microsoft Excel users and on-campus computers.

Statistical investigations were carried out using the R 2.12.2 statistical program for Macintosh. Images and graphics were analyzed and created using Photoshop CS4 for photographic images and Inkscape for other figures. QGIS was used for cartography.

OpenOffice.org ([www.openoffice.org](http://www.openoffice.org)), R ([www.r-project.org](http://www.r-project.org)), Inkscape

([www.inkscape.org](http://www.inkscape.org)) and QGIS ([www.qgis.org](http://www.qgis.org)) are free, opensource products available for download from the internet.

### 7.1.3 Parks Canada Terminology

Richardson Island falls within the Gwaii Haanas National Park Reserve. Parks Canada employs a method of archaeological recording with terms that are distinct from the common language used elsewhere in British Columbia and Canada. This system may be at first confusing to those who are unfamiliar with it and are accustomed to the conventional “units”, “layers” and “levels” that are employed elsewhere. Below is a short glossary of Parks Canada terminology.

**Site numbers:** Rather than employ the Borden grid system (common throughout the rest of Canada), Parks Canada numbers each archaeological site found within a National Park or National Park Reserve. Thus, Richardson Island is also referred to as 1127T.

**Operation:** “Operation” has essentially the same meaning as “excavation unit” elsewhere. However, “operation” may also be used to refer to surface collections, auger tests, shovel tests and evaluative units, as well as excavation units and trenches of varying dimensions. Whereas each 1x1m square elsewhere may be given a separate designation, even if they are adjacent, any contiguous excavation (ie. a 2x3m excavation or a 5mx50cm trench) is referred to as a single operation. Operations are designated by a number.

**Sub-operations:** “Sub-ops” or “quads” are vertical subdivisions within an operation. A 1x1m operation divided into four 50x50cm quadrants is considered to have four sub-operations. The number of sub-operations is generally dictated by the excavation strategy

being employed and the time constraints under which the excavators are working. Sub-operations are designated by a letter.

**Lots:** “Lots” are among the most misunderstood entities in the Parks Canada system. The term “lot” is relatively analogous to “level”: the systematic depth intervals within which the archaeologist excavates. On this context, the “lot” system is effectively an excavation methodology based on arbitrary levels without regard to layers, rather than the level-within-layer system that is popular elsewhere in the province. Lots numbered in sequence from the surface of the excavation to the lowest point. Only very rarely are subdivisions made within lots.

That said, excavators are cognizant of stratigraphic changes within lots, and will generally carefully excavate to the top surface of a new soil horizon. Depending on the stratigraphic makeup of the unit, some archaeologists will close the current lot at the surface of the new soil horizon and start the next lot on that layer, but others prefer to measure and make note of the change in soil within the lot and maintain the regular lot interval throughout the excavation. Lots are numbered sequentially within each operation, with no reference to other operations. At Richardson Island, because of the high resolution stratigraphy, the lots were almost exclusively natural layers rather than arbitrary levels (Mackie pers. Com. 2011).

**Artifact Identification Numbers:** Artifact identification numbers reflect the intricacies of the Parks Canada archaeological recording system. Each artifact is numbered sequentially within its lot, sub-operation, operation and site. Thus, a microblade core recovered from Richardson Island (site 1127T), operation 10, sub-operation Z, lot 19 is labelled 1127T10Z19-1. The final number is the artifact's unique identification within the

artifacts recovered from the same context. The “1” does not indicate that this was necessary the first artifact found, but rather that it was the first one catalogued and labelled.

## **7.2 The Richardson Island 1127T Microblade Assemblage**

A total of 448 microblades and seven microblade cores were collected from excavations at Richardson Island 1127T. Another 17 microblade cores were recovered from the surface of the gravel and cobble beach downstream from the intact deposits. This thesis will focus on those microblade artifacts recovered from archaeological contexts dateable to the early Moresby tradition, between 8,750-8,000 BP. This period marks the development of microblade technology on Haida Gwaii, and may provide valuable insight into the factors that contributed to the establishment of the Moresby microblade industry that endured for over four millennia.

### **7.2.1 Assemblage Composition by Unit and Age**

The majority of early Moresby microblades were recovered from operation 10 ( $n=343$ ), with another 29 from operation 13. Four microblades were recovered from operation 12, but these almost certainly represent intrusive elements knocked or washed into the 1x1 excavation unit from later contexts as all lots in operation 12 are dated to pre-microblade ages (9000 BP and earlier). No microblades were recovered from the corresponding lots from operation 13, either (Mackie pers. com 2011). Operation 10 dates range from c.9200 BP to 8500 BP, and operation 13 dates range from c. 9400 BP to 8700 BP. 76 microblades were recovered from operations 14 ( $n=37$ ), 15 ( $n=26$ ) and 16 ( $n=13$ ),

but since the excavated contexts of these operations have been dated to the later Moresby period, these microblades and cores are excluded from further discussion.

### 7.2.1.1 Age of Microblade Components

There is a gradual increase evident in the frequency of microblades at Richardson Island. Based on the soil strata groupings identified by Smith (2004) and Magne (2004), it is clear that microblades gradually grew in popularity over time. Table 2 shows the increase in microblades relative to time and soil strata.

Date (BP)	Depositional Unit	<i>n</i>	%
8500	I	86	23.06%
8600	II	42	11.26%
8700	III	80	21.45%
	IV	57	15.28%
	V	27	7.24%
	VI	51	13.67%
8800	VII	15	4.02%
	VIII	4	1.07%
	IX	4	1.07%
8900	X	5	1.34%
9000	XI	1	0.27%
9100	XII	3	0.80%

**Table 2: Microblade frequency over time. The red fields indicate intrusive artifacts in pre-microblade contexts.**

One notable trend is a significant upswing in microblade frequency after 8800 BP. Interestingly, the last bifacial projectile point was recovered from stratum IV. Thus, we can see how the increase in microblades was concurrent with the ultimate decline (and disappearance) of bifacial points.

### 7.2.1.2 Trends Over Time in the Microblade Assemblage

There are two major temporal trends associated with the development of microblades: (1) raw material usage patterns, and (2) artifact associations. Each of these are interesting in their ramifications regarding the development model for microblades at Richardson Island. The former provides insight into the model for local development of the microblade complex, while the latter permits one to identify patterns in the overall toolkit in place at the site.

Smith (2004) identified a complex pattern of raw material usage at Richardson Island over the late Kinggi/early Moresby phase, which is discussed in detail in her thesis (summarized below). Across depositional units X-I, microblades were manufactured on at least 12 distinct raw materials. Importantly, the raw material use pattern indicates a temporal trend where different raw materials were preferred at different points in time (Smith 2004:155). The fundamental sequence for microblade manufacture is as follows: siliceous argillite was the initial preferred raw material. It gradually declined as shale/argillite rose in importance. Dacite briefly superseded shale/argillite as the preferred raw material type, followed by chert and then rhyolite. Rhyolite gained in popularity quickly and made up the overwhelming majority of microblades in the upper depositional units (Smith 2004:155). This pattern is interesting primarily because the earliest microblades were made on the same raw materials as were the bifaces that they replaced (Smith 2004:140). This suggests that after having encountered the microblade concept and having incorporated it into the extant local toolkit (applying specialized knowledge of the local raw material landscape), the ancient toolmakers developed, adapted and improved the technology over time.

Along with changes in raw material, other aspects of the Richardson Island toolkit also witnessed shifts in the tooltypes present in the assemblage. Clearly, the most obvious change was the decline and disappearance of bifaces and concurrent appearance and rise of microblade technology, but several other tool types also fluctuated in terms of prevalence. Storey (2008:194) described a continuum of unifacial tool use throughout the terminal Kinggi/early Moresby period, but within this general continuum there were instances of increase and decline among these tool types relative to microblades. Most notably, tabular cores occupy an increasing percentage of the lithic toolkit during this period (Magne 2004:99; Smith 2004:130). Simultaneously, scraperplanes, denticulate scraperplanes, spokeshaves, graters and unimarginal flake tools decrease in prevalence (Magne 2004:99; Storey 2008:192). Interestingly, while spokeshaves and graters show a decline, spokeshave/graters (single lithic tools exhibiting retouch consistent with use both as a spokeshave and as a grater) do not. This is important as it indicates that it is very likely that the same tasks were being carried out as before, but the toolkit design changed slightly, incorporating a multifunction device.

Magne identifies the relationship between increasing numbers of microblades, microblade preforms, denticulated scraperplanes, and tabular cores as being indicative of the local development of microblade technology (2004:114-115). The reduction sequence employed to manufacture denticulate scraperplanes and to reduce tabular cores is virtually identical to the process of making a microblade core preform. The same unidirectional percussion actions are involved, and the denticulate aspect of the scraperplane edges is consistent with the deliberate establishment of somewhat denticulate microblade core striking platform edges to facilitate the optimal removal of an

inaugural blade. Furthermore, artifacts identified as microblade core preforms display some level of edge denticulation (Figure 38). It should be noted, however, that the microblade core preforms are defined as such partly on the basis of that denticulation. They are effectively merely small flake cores, not yet exhausted of potential flakes, with intact striking platforms and a form that is suitable for microblade production. No microblade scars are visible, so the association with microblade technology is largely subjective on the part of the archaeologists classifying the tools (Magne 2004:115).



**Figure 38: Microblade core preforms from Operation 12.**

## 7.2.2 Microblade Assemblage Physical Characteristics

### 7.2.2.1 Segmentation

One key area of morphological variation within the Richardson Island microblade assemblage is the segmentation of microblades, that is, the frequencies of complete microblades and proximal, medial and distal segments (Table 3). The assemblage shows possible variation in segment selection and function based on shape, size and curvature.

Microblades	<i>n</i>	%	Curved	%	Straight	%
<b>Complete</b>	83	22.2%	48	57.8%	35	42.2%
<b>Proximal</b>	173	46.3%	22	12.7%	151	87.3%
<b>Medial</b>	56	15.0%	8	14.3%	48	85.7%
<b>Distal</b>	62	16.6%	32	51.6%	30	48.4%
<b>Total</b>	374		110	29.4%	264	70.6%

**Table 3: Microblade Segmentation and Curvature. This table shows the relationship between curvature and microblade segmentation.**

### Proximal Fragments

There is quite a high number of proximal blade fragments relative to medial and distal fragments. It must be noted that this is likely to some extent an artifact of sampling bias, as every broken flake leaves a proximal fragment (somewhere), but if a flake is broken into two pieces rather than three, there is no medial fragment produced. However, for every theoretical proximal fragment there must be a distal fragment, yet the proximal/distal relationship in this Richardson Island assemblage is not even. Proximal segments make up 46% of the microblade assemblage ( $n=173$ ), while distal segments only compose 16.6% of the assemblage ( $n=62$ ). This suggests that the proximal fragments likely experienced a different curation pattern than the other two fragment types.

Following Pitul'ko and Giria's selection model (1994:36) for microblade insets, proximal fragments may be more likely to be disposed of at the site of microblade manufacture and weapon refitting, as they are snapped off and discarded immediately. This is predicated on the idea that additional mass around the striking platform and bulb

of percussion makes proximal fragments suboptimal for use in as side-mounted insets in slotted tools. This is born out by a combination of the curvature metric, and the slot fit model. While proximal fragments are the straightest category of microblade segment, they are also among the least likely, along with curved complete microblades and curved distal fragments, to be selected for hafting because of the added thickness of the bulb of percussion. Thus, it is unsurprising that the majority of the microblades discarded at the site (and by inference not transported elsewhere) are proximal fragments.

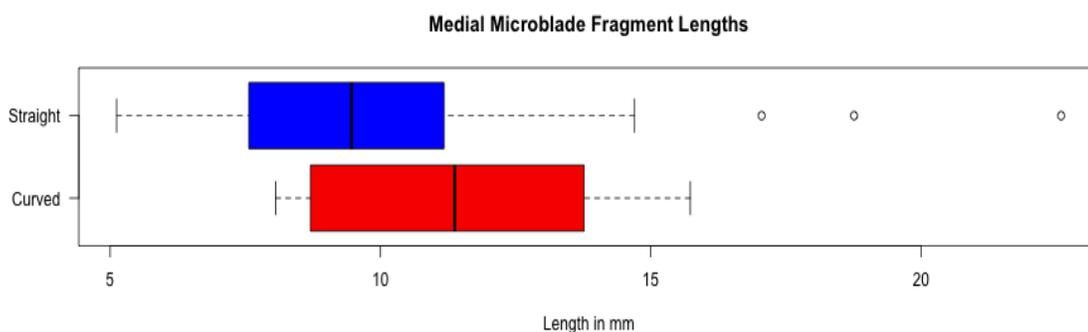
### **Medial Fragments**

The medial microblades at Richardson Island 1127T follow the predicted model: they are less frequent than any other category of microblade segment (15%,  $n=56$ ), and the majority (85.7%) of medial fragments are straight. As mentioned above in regards to the relative frequency of proximal segments, medial segments are expected to be less frequent than proximal or distal segments as they are produced when both the proximal and distal ends of a microblade are snapped off. The latter of the two statements is easily explained for three reasons: the nature of microblade flake morphology, the nature of a diminishing circumferential line, and through human agency. First, because microblade cores tend to taper somewhat towards the distal end of the fluted face, microblades tend to become more curved towards the distal end as well. Thus, distal microblade fragments and complete microblades will tend to be more curved than proximal and medial fragments. Second, as two points on a circle come closer together, the line between them becomes straighter. Thus, as medial fragments become shorter (and medial fragments are the shortest class of microblade segment) (Table 4), they too become straighter (Figure

39). Finally, optimal insets for side-mounted applications in composite tools are straight and thin. Thus, one may expect the toolmaker to snap off curved distal portions and thicker proximal portions, leaving a collection of primarily straight, thin medial microblade segments. See section 7.2.5.1 for a more detailed discussion of microblade segmentation selection processes.

Microblades	Length Min	Length Max	Mean	STD Error	SD	CRV
Complete	5.85	30.96	16.75	0.24	5.00	29.82%
Proximal	4.77	30.43	11.54	0.28	3.74	32.40%
Medial	5.12	22.59	10.11	0.46	3.41	33.72%
Distal	5.79	23.37	11.76	0.45	3.57	30.34%

**Table 4: Microblade Segment Lengths in mm.**



**Figure 39: Boxplot showing length of straight and curved medial microblade fragments.**

### Distal Fragments

Distal fragments compose 16.6% ( $n=62$ ) of the Richardson Island microblade assemblage. Of these, 32 (51.6% are curved), making this the second most curved segment class after complete microblades. Distal segments also have the highest tendency

to end in overshoot terminations (25.8% vs. 10.8% for complete microblades). This conforms to the model that the curved or overthick sections of microblades were being snapped off and discarded in order to allow straighter, thinner segments to be hafted in slotted points. See section 7.2.5 for a more detailed discussion of the relationship between distal microblade segmentation and hafting.

### **Complete Microblades**

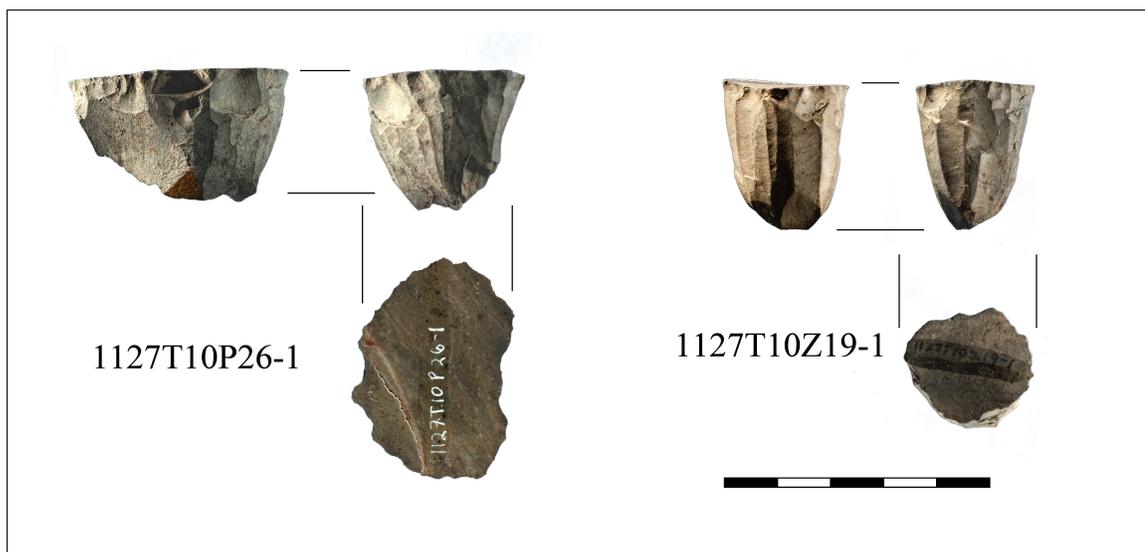
The complete microblades display the highest degree of variability in terms of curvature, width and thickness of any microblade category. This is unsurprising considering that the complete microblades form the starting point for the segmentation/selection sequence (see 7.2.5), and that they therefore represent not only the microblades that are selected for use in a composite tool, but also represent the non-desirable attributes, such as severe curvature or excess width or thickness. Overly large, curved microblades that are beyond modification may still function as small flake tools, and may thus be left intact.

#### **7.2.3 Microblade Cores**

Four microblade cores were recovered from operations 10 ( $n=2$ ) and 13 ( $n=2$ ), along with three from operations 14 and 16, and another 17 from the surface of the beach below the intact archaeological deposits. The four microblade cores from operations 10 and 13 will be the primary focus of this discussion, as they are the only ones from confirmed early Moresby contexts. Cores were examined following, to a large extent,

Magne's attribute list (1996:153), with some additions. See section 7.1.1.2 for a description of the measurement methodology.

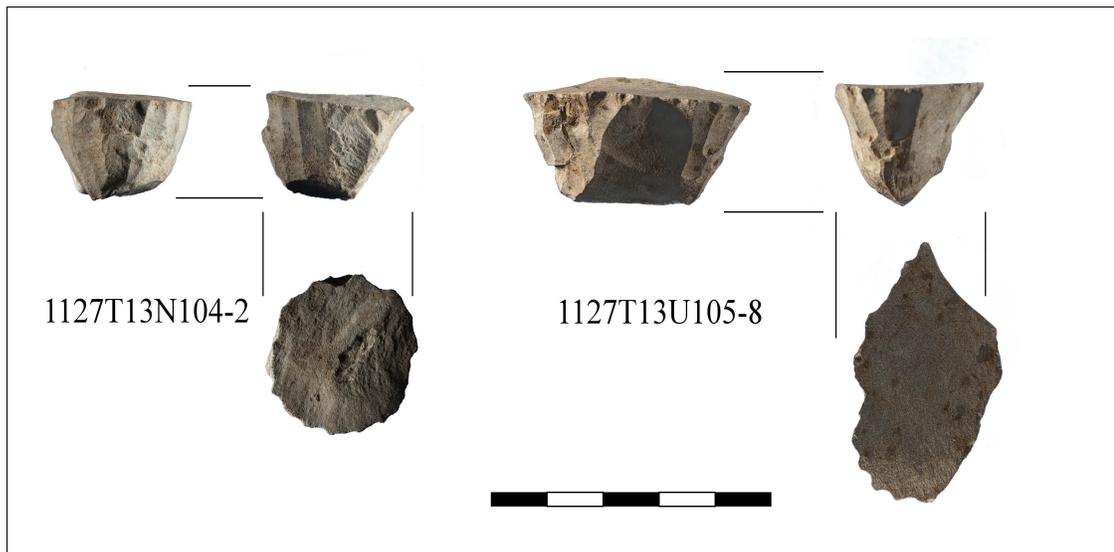
The operation 10 microblade cores include one conical core, approaching bullet-shaped, and one boat-shaped core (Figure 40). Both cores were unidirectionally flaked. It is likely that both cores were made on tabular pieces of raw material, based on the very flat, completely unretouched striking platforms. Both cores have been flaked around the entire circumference, but while one (1127T10Z19-1) exhibits microblade scars on all sides, the other (1127T10P26-1) only shows microblade scars over approximately 40% of the flaked surface. While superficially conical, when examined closely 1127T10Z19-1 appears to have three distinct fluted surfaces rather than a round vertical cross-section.



**Figure 40: Microblade cores from Operation 10.**

Of the two microblade cores from operation 13, one (1127T13U105-8) is boat-shaped and the other (1127T13N104-2) is shaped like a tapered cylinder or truncated cone, with a flat distal surface rather than a keel (Figure 41). The former has two fluted faces, and only 20% of its lateral surfaces exhibit microblade scars. The striking platform

exhibits a slight undulation consistent with the ventral surface of a thick flake. The latter has had microblades removed around the entire circumference, but shows a slightly angular vertical cross-section with three identifiable fluted faces.



**Figure 41: Microblade cores from Operation 13.**

#### 7.2.4 Microblade Core Preparation and Microblade Manufacture Methods

The morphological characteristics of the microblade cores provide valuable insight into the operational sequence of core preparation and microblade production. First, the core platforms indicate that whether the cores were made on tabular or blocky pieces of raw material, or on thick flakes, the core preparation employed was unidirectional flaking. The deep negative bulbs of percussion evident on some of the non-microblade flake scars are consistent with direct hard-hammer percussion, which would be a logical choice for trimming the cores to shape.

As suggested by Magne (2004:114), the core preparation reduction sequence is very similar to that of the denticulate scraperplanes. However, it should be noted that the

cognitive aspects of the *chaînes opératoires* of the two tool types differ. As described in chapter 2, the *chaîne opératoire* concept includes not only the sequence of operations, but also the cognitive model that informs the gestural sequence (Sellet 1993:107). The ultimate goal of the denticulate scraperplane *chaîne opératoire* was to produce an effective working edge with the desired protruding points. The flaked surface adjacent to the operative edge did not affect tool performance and was therefore relatively unimportant. As such, stacked step fractures, hinge fractures, and overlapping flake scars creating rounded flaked faces occur not infrequently, without compromising tool integrity. In the case of a microblade core (or microblade core preform), such inconsistencies on what would become the fluted face could have the potential to ruin the core. The fundamental principle behind microblade production is that the core form promotes the sequential removal of uniformly (and optimally) shaped flakes (microblades). Variability in the quality of lateral core surfaces is not desirable, as it has the potential to severely compromise the shape or number of microblades that may be removed from the core. As such, the ancient knappers who prepared each microblade core would not only work to create suitable platform angles and to establish a guiding ridge for the inaugural blade, but would simultaneously maintain the integrity of the lateral core surfaces. The gestural knapping behaviours may therefore be superficially similar between the two tool types in that both involve unidirectional percussion on similarly shaped blanks, but the individual flaking actions associated microblade core preparation require a higher degree of skill and technical understanding than do those of denticulate scraperplane production.

A small number of crested flakes, similar to ski spalls or *lames a crêtes*, were identified among the Richardson Island artifacts, potentially indicating that bifacial core preparation had been practiced at the site. This would challenge the generally understood model for Haida Gwaii microblade core technology (Magne 2004:114) and would support the theory that the Richardson Island microblade industry was directly descended from the Alaskan Denali microblade tradition. However, further investigation of the crested flakes and the debitage associated with discoidal core reduction showed that these flakes were most likely the result of this process, rather than of microblade core preparation. Variation in the extent of the lateral margins of a few of the crested flakes revealed that they represent flakes removed along the circumferential ridge, possibly in order to remove sharp platform angles and thus prepare striking platforms for subsequent percussion flaking. Experimental discoidal core reductions produced similar crested flakes, supporting this explanation.

The absence of semi-crested blades also supports the unidirectional microblade core preparation theory. Microblades removed from the lateral margins of the fluted face of a bifacially prepared core will generally exhibit some slight residual fluting on the dorsal surface to one side of the dorsal aris (Odell 2003:95; Waber 2010:56). Each rank of microblades (a layer or row of overlapping blades, removed successively across the breadth of a fluted face) removed from a bifacially prepared core will include at least two such crested blades. As a result, a high proportion of semi-crested blades is consistent with bifacial core preparation, while a low proportion is associated with unidirectional core preparation (Waber 2010:58). Experimental microblade production (Appendix B) has indicated that bifacial core preparation may result in as much as 34% of blades being

semi-crested, while only 3% of unidirectional core microblades are semi-crested (Waber 2010:57). The Richardson Island microblade assemblage includes only 23 (6.15%) semi-crested blades distributed between strata 1 through 7, providing strong evidence against bifacial microblade core preparation.

The microblade core morphology also provides insight into the specifics of microblade manufacture. Based on the relatively steep (close to 90°) striking platform angles, the high degree of width uniformity among microblades and microblade scars, and the paucity of crushed striking platform edges, near-edge step fractures, and overhung striking platform edges, it is evident that microblade production was almost certainly carried out by pressure flaking. Morphological features of at least one of the beach cores provides very strong support for the use of pressure flaking at this site (though the surface-collected core cannot be positively dated beyond the general Moresby tradition) as it displays a striking platform angle of at least 100°. Experiments carried out by Callahan (1984:93, 95) demonstrated that microblades could be removed from cores with obtuse striking platform angles using pressure flaking. Any form of percussion flaking would only result in a glancing blow, and incipient cone, or at best an uncontrolled flake. Pressure flaking permits the knapper to apply pressure downwards on a slightly roughed platform, and then to shift the direction of force towards the fluted face, maintaining contact and thus removing each blade (Callahan 1984:89).

Core rejuvenation appears to have been achieved through unidirectional percussion flaking to remove material from the core's fluted face. This is shown by the presence of at least eight fluted face rejuvenation flakes. These flakes exhibit relatively wide striking platforms, prominent bulbs of percussion, thick medial sections and broad

lateral margins, all consistent with percussion flaking. No platform tablet flakes were identified, indicating that core rejuvenation was achieving by removing material from the lateral fluted face rather than from the striking platform.



**Figure 42: Fluted face rejuvenation flakes.**

The Richardson Island microblade makers most likely used some form of vise for microblade core support. This is suggested by two primary aspects of core morphology: the very small size of one of the *in situ* cores (1127T13N104-2), and the separation of fluted faces even on cores with 100% circumferential fluting. First, 1127T13N104-2 has a maximum platform length of 26.31mm, a core height of 16.3mm, and 100% circumferential fluting. A core this size is extremely difficult to remove blades from when using handheld support as it tends to rotate under pressure. The consistency of the microblade scars and the absence of any striking platform edge crushing or step fractures indicates that the core was held firmly immobile throughout blade production.

The second indicator of the vise-supported pressure microblade removal is the presence of multiple distinct fluted faces on the two cores with complete lateral fluting (Giria and Pitul'ko 1994:39). Both 1127T10Z19-1 and 1127T13N104-2 exhibit microblade fluting around 100% of the lateral core surfaces, but show at least three individual fluted faces. In each case, the vertical cross section of the cores reveals consistently curved fluted faces separated by angular corners. Giria and Pitul'ko argue that (at least in the case of the Zhokov Island microblade core assemblage) this is indicative of a deliberate strategy to maintain a consistent curvature of the fluted face, and thus control the width, thickness and cutting edge angles of each microblade (1994:39). This may be the case for Zhokov Island, where a complex multidirectional microcore tradition exists, but does not appear to be present at Richardson Island. Both of the cores in question show two fluted faces with relatively shallow curvatures, and one with a deeper curve. This is inconsistent with Giria and Pitul'ko's model. The most likely explanation for this aspect of the core morphology is that the cores were held in a vise during blade production. This restricts the extent of lateral blade removals, resulting in multiple independent yet contiguous fluted faces.

#### **7.2.5 Interpretation of Microblade Artifacts and Reconstructed Use Model**

Interpreting the ancient application of the Richardson Island microblades is a particular challenge as microblades may be one of the most fundamental archaeological examples of a component of a composite tool, and the missing organic haft component is what largely defined the tool form and application. As such, the microblade attributes themselves must be examined to provide insight into this question. To do this, I will

examine a set of hypotheses presented earlier in this thesis (Chapter 1.) in relation to the properties of the microblade assemblage. The primary guiding hypothesis of this analysis is that the Richardson Island microblades were employed as insets in slotted bone or antler points. Within this model, it I expect that these slotted points came to replace bifacial projectile points as tips for spears because the slotted points provided advantages both in terms of (a) deadliness and (b) durability. This hypothesis will be addressed in sequence in the following subsections.

#### **7.2.5.1 Selection and Modification of Microblade Insets**

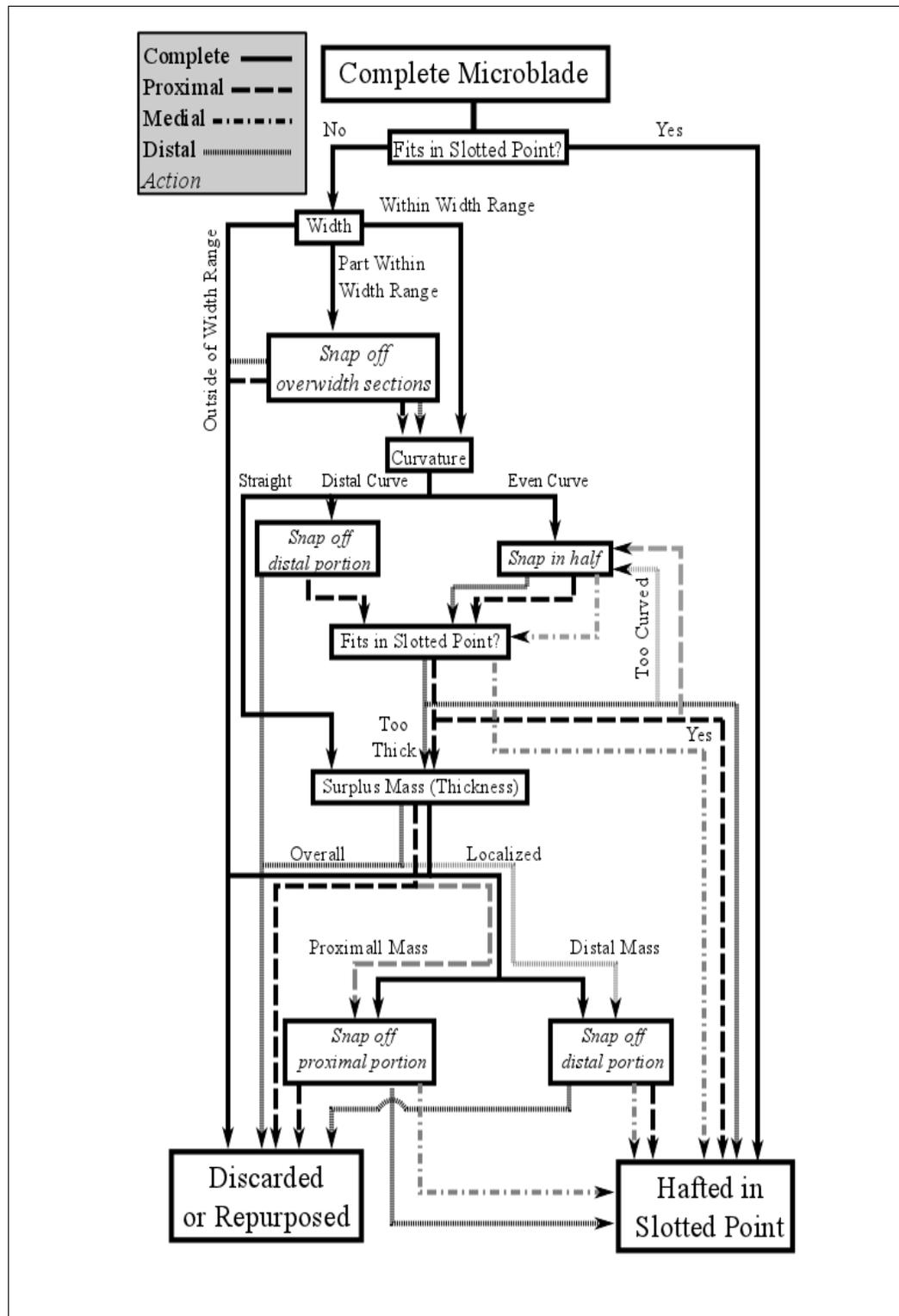
The application of microblades as insets in slotted points involves a particular set of prerequisites. First, as established in Chapter 3.4, the antler component of the slotted point represents the most durable section of a reliable tool, and also the greatest investment in time and resources. Microblades act as a set of parallel (both literally and figuratively), redundant slicing components, the loss of any one of which does not entail total tool failure. The tool design incorporates the maintenance plan that, as microblades are lost or broken they may be easily disposed of and replaced, while the osseous component remains intact. Thus, the microblades must achieve a base level of standardization in order to be compatible with the lateral slots of the point.

This standardization is manifest in the width, thickness and straightness of each microblade. Width may be the most variable of the three categories, as a microblade may be pressed to a variable depth into the hafting mastic inside the slot. The only requirements are that a blade must be wide enough to be firmly set in the mastic with sharp blade edge exposed, but narrow enough that it does not protrude significantly

beyond the neighbouring insets. Slot depth will restrict this arrangement to some extent, but ideally the microblades will be arranged in such a way that the blade edges will create an effectively continuous cutting edge for the length of the slotted section (Elston and Brantingham 2002:104; Lee 2007b:154; Pétilion et al. 2011:1274). Microblades that are significantly wider than the desired model are likely to be discarded or repurposed for another role.

Similarly, microblades that protrude too far from the sides of the blade (even when they are of similar width to adjacent microblades) are likely to be selected against. Pétilion et al. (2011) used several points with microblades extending uniformly quite far from either side of the slotted point (up to 100% of the haft's width in some cases), and recorded a high number ( $n=13$ ,  $\%=43$ ) of strikes where the insets were stripped prior to or during penetration (2011:1276-1277). This may be due to some extent to inadequate slot depth and poor blade settings, but is also likely due to the excess protrusion of the blades themselves.

Thickness and straightness are more rigidly controlled, as the width of the slot is constrained by the overall antler point width as well as the desirability of a narrow, parallel-sided slot for holding blades and mastic more firmly than a wider V-shaped slot. As a result, thin and straight blades and blade segments are optimal, and suboptimal microblades will often be modified to achieve the ideal parameters (Giria and Pitul'ko 1994:37; Lee 2007b:88). A reconstructed sequence of decision-making in regards to microblade selection, modification and rejection may be visualized using the flow chart in Figure 43.



**Figure 43: Flow chart describing the sequence of decisions and actions associated with microblade segment selection for side-hafting in composite tools.**

As illustrated above, starting with a complete microblade, the tool maker must assess whether or not it will fit into a side haft without modification. If so, it may be hafted and the process begins again with the next microblade. If not, the first criteria to be assessed is the width of the blade. If the fit is poor because of the microblade width, it may potentially be backed somewhat (flakes removed from the margin opposite the cutting edge), or more likely discarded or repurposed as another tool. Very few ( $n=6$ , 1.6%) of the Richardson Island microblades exhibit edge damage identifiable as possible backing, indicating that this method of modification was not commonly employed at the site. If the width is within the parameters appropriate for that set of insets, the curvature of the point is assessed. If the microblade exhibits an even, gradual curve over the length of the blade, then that will prevent the blade from being slotted and so it may be broken in half, creating two segments: one proximal and one distal. If each of these is suitably straight, they may progress to the third stage of assessment. If either is still too curved, that segment is either broken again (creating a medial segment in addition to the extant proximal/distal fragment) or discarded if it is too short. If the curvature is primarily restricted to the distal portion (as in an overshoot blade termination), the distal portion is snapped off and discarded.

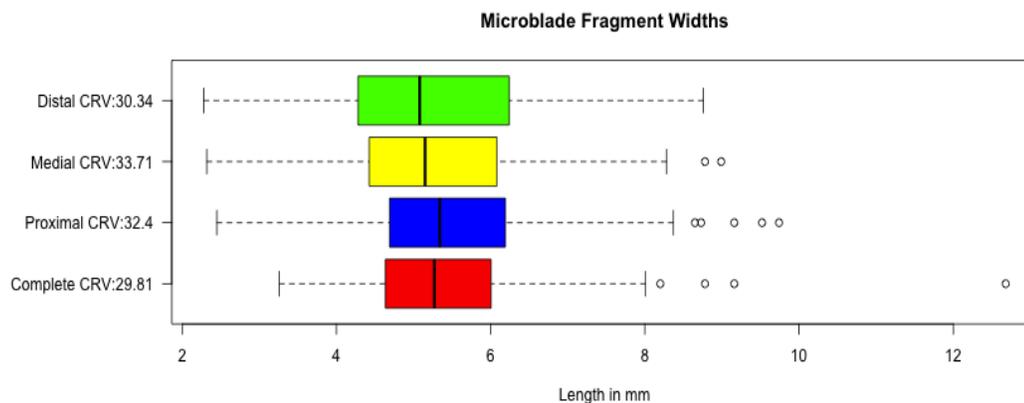
The next stage in the selection sequence focuses on the thickness of the microblade (or segment) in relation to the hafting slot. Like the curvature, a microblade may be too thick to fit in a slot because of the overall thickness of the flake (in which case the blade is discarded) or because of a mass concentrated at the distal and/or proximal end. In the case of a distal mass (once again, generally related to an overshoot flake) the distal end is snapped off and discarded, leaving either a proximal segment (in

the case of the microblade having been complete up to this point) or a medial segment. The same process, reversed, is applied to proximal segments where the bulb of percussion and/or the striking platform is too wide to fit in the slot. When enough of the thick portion(s) of the microblade has been snapped off, the blade may be inset in the haft. Gira and Pitul'ko (1994:37) describe this snapping process occurring at Zhokov Island, as evidenced by the preference for medial blade segments for inserts in the intact slotted points. Lee (2008:90) identified a positive relationship between the perpendicularity of the snapped termination (broken by bend-fracture) to the long axis of the microblade, and the prominence of lipping on one of the broken ends (though lipping does not occur on all snapped microblades). While this may be indicative of deliberate snapping, microblades may also be snapped accidentally, or deliberately snapped using a twisting action or at an angle other than 90° to the long axis. Lipping may be more useful in distinguishing snapped microblades from those that are technically complete, having left a step fracture on the core. Chemical and mechanical weathering on over 25% ( $n=74$ ) of the Richardson Island microblade segments obscured details such as lipping, so meaningful inference regarding snapping or step fractures is difficult. However, based on the infrequent presence of step-fractures on early Moresby tradition microblade cores (Magne 1996:153) the observed terminations are likely the result of post-production snapping rather than step termination on the core.

#### **7.2.5.2 Microblade Selection and Use at Richardson Island**

The above sequence of actions and selections in a slotted point manufacture and maintenance behavioural realm is evident in the microblade morphology observed in the archaeological realm of the Richardson Island microblade assemblage. First, the

microblade assemblage reflects a high degree of standardization in terms of width. This may indicate a program of deliberate snapping to obtain suitably uniform segments to be inset into slotted points. Evidence of such a strategy would be manifested in complete microblades exhibiting higher levels of width regularity than is evident in snapped microblade segments. This is due to the non-standard width sections of microblades being snapped off and discarded, or grouped with other similarly sized segments for use together in another haft or application. If a complete microblade fit within the desired width range and was suitably thin and straight, it was unlikely to be deliberately broken. Support for this model is illustrated by the boxplot in Figure 44, showing a higher degree of variability among the segmented microblades than among the complete microblades (aside from outliers), peaking with the distal segments. If the microblades were being snapped randomly, through some other agency, one would expect to see the distribution of the complete microblades trending towards the wider end of the scale. Instead, we see that the wider microblades were being snapped in order to acquire narrower segments suitable for hafting. The complete microblades that were within the range of desired standardization were left intact when possible. It is worth noting that the lone complete microblade outlier at over 12mm wide is a curved blade, over 30mm long and 3mm thick. It was likely excluded from use in a slotted point because it was too thick to fit in most hafts, and could not be improved by snapping.

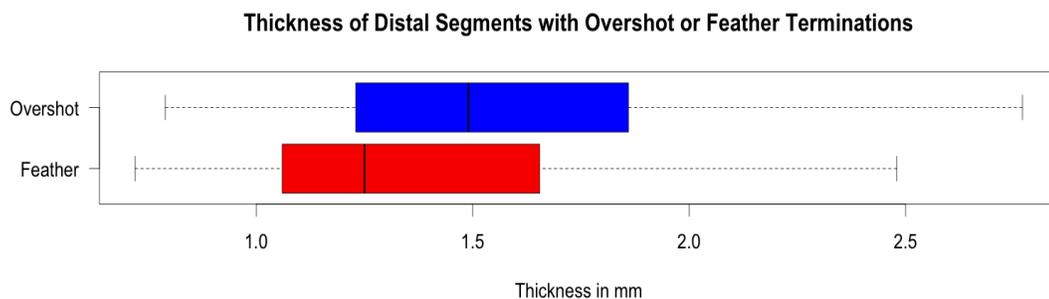


**Figure 44: Boxplot of microblade fragment widths in mm.**

The curvature of a microblade dictates the second stage selection trajectory. Microblade curvature generally follows one of two structures: either a relatively steady overall curve, or a curve primarily focused in the distal portion of the blade. In the Richardson Island assemblage, 57.8% of complete microblades and 51.6% of distal portions exhibit some degree of curvature, as opposed to 12.7% and 14.3% of proximal and medial segments respectively (Figure 39) (see section 7.1 for a definition of curvature as used in this thesis). This is consistent with the model that curved microblades would be snapped to produce straight insets, as distal segments show a higher frequency of curvature than do proximal or medial segments. Obviously this is partially due to the distally tapering form of microblade cores (a regular aspect of core morphology) dictating that flakes will become increasingly curved as they travel down the lateral surface of the core, but the disproportionate frequencies of curved distal segments in the assemblage shows that the ancient toolmakers were deliberately snapping them off.

The practice of snapping microblades with overshoot terminations is also evident in the assemblage. Overshoot terminations tend to remove mass from the distal end of the

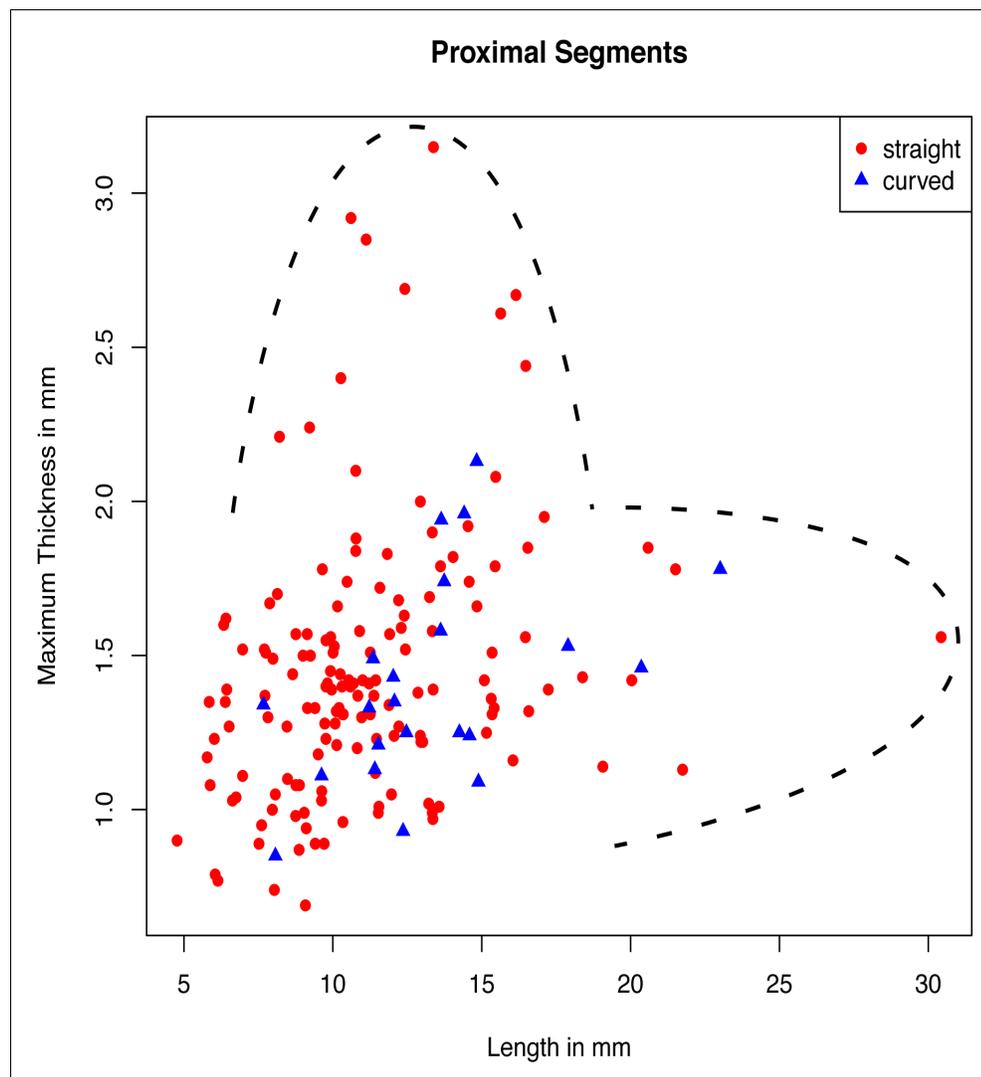
core, creating a thick cross-section on the distal portion of the flake as well as an aggressive curve (Andrefsky 2005:87; Odell 2003:57; Whittaker 1994:19). Both aspects are undesirable in inset microblades, so distal microblade sections with overshoot terminations tend to be snapped off and discarded. Figure 45 shows the difference in thickness between overshoot and feathered curved distal segments. Also, while 25% of distal segments in the assemblage have an overshoot termination, only 13% of complete microblades do. This is consistent with the model that overshoot distal ends were selected against and were snapped off, supporting the hypothesis that the microblades were made to be used as insets in slotted points.



**Figure 45: Comparison of thickness in distal segments with overshoot or feathered terminations.**

As with overshoot terminations, excess thickness at the proximal end of a microblade was also selected against. Pronounced bulbs of percussion and prominent striking platforms have the potential to prevent proximal microblade segments from fitting into lateral slots. As a result, thick proximal blade sections would be snapped off, leaving uniformly thin distal or medial segments to be hafted. The Richardson Island microblade assemblage shows evidence of this in the relationship between thickness and length in proximal microblade segments (Figure 46). Two point clusters extend from the

central crowd of relatively thin, relatively short proximal fragments: the group of long, thin segments marked with a dashed ellipse extending along the X axis, and the short, thick segment group marked with an ellipse rising along the Y axis. Based on this pattern, we may infer that thicker proximal segments were snapped off in order to use the thinner medial/distal segment, while those proximal segments that might fit into a slotted point could be used, and would be longer.



**Figure 46: Proximal microblade segments indicating the relationship between thickness and length. Long proximal segments are unlikely to be thick, and thick proximal segments are unlikely to be long.**

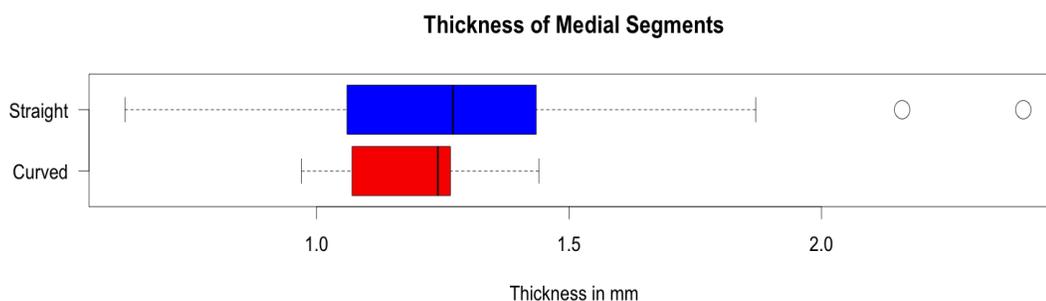
As described by Giria and Pitul'ko (1994:37), medial segments are the most desirable section of a microblade for use as a side-hafted inset in a slotted point. At Richardson Island, the medial segment morphology supports this model. The medial segments are among the straightest and thinnest microblade sections, with the lowest morphological variability. 86% of medial segments are straight, compared with 42% of complete microblades and 48% of distal segments. Proximal segments have a marginally higher frequency of straightness, as is to be expected based on standard core morphology and the curvature determination technique employed, but are on average approximately 25% thicker than medial segments. Medial segments have the lowest mean thickness and the lowest degree of thickness variation based on the CRV (Table 5).

<b>Microblades</b>	<b>Thickness Min</b>	<b>Thickness Max</b>	<b>Mean</b>	<b>STD Error</b>	<b>SD</b>	<b>CRV</b>
<b>Complete</b>	0.69	3.18	1.56	0.02	0.51	32.76%
<b>Proximal</b>	0.69	3.15	1.44	0.03	0.42	28.98%
<b>Medial</b>	0.62	2.40	1.25	0.04	0.34	26.74%
<b>Distal</b>	0.72	2.77	1.35	0.05	0.43	31.79%

**Table 5: Microblade segment thicknesses.**

The few curved medial sections tend to be slightly longer than their straight counterparts (Figure 39), possibly indicating that the proximal sections were snapped off close to the bulb of percussion in order to obtain suitably thin medial segments. These curved medial segments are also generally thinner than straight ones, which have a greater range. The thinness of the curved medial segments would allow them to likely still be useful as insets (Figure 47) as the curve is relatively minor compared with that of

an overshot flake, and no proximal or distal mass would prevent the segment from fitting in the haft. This being said, curved medial segments represent the lowest minority of the assemblage ( $n=8$ , 14.3% of medial segments, 2% overall). Also,  $t$  tests considering both the length ( $t=-1.4$ ,  $p=0.19$ ) and thickness ( $t=-0.9$ ,  $p=0.37$ ) comparisons between straight and curved medial sections indicate that the null hypothesis may not be rejected. Further excavation and a larger assemblage may provide greater insight into their relationship to the other microblade segments.



**Figure 47: Thickness of straight and curved medial microblade segments in mm.**

### 7.2.5.3 Edge Damage

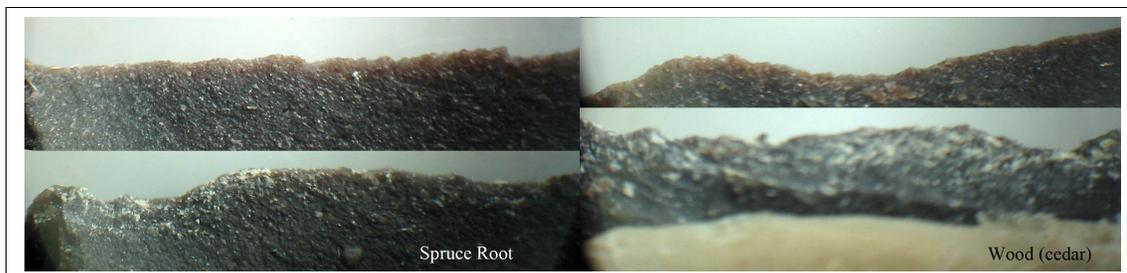
This section will discuss edge damage identified on the Richardson Island microblades. As discussed earlier in section 7.1.1.1, it is not in the scope of this thesis to examine the microblades under a scanning electron microscope (SEM) to attempt to identify usewear at a microscopic level, and the exercise would likely be foiled by the weathering present on most artifacts in the assemblage. Low power microscopy was used to inspect the blade margins and identify edge damage, allowing classification into one of two categories (Figure 36). Type 1 edge damage represents instances where chipping, flaking, dulling or other damage is visible on the blade edge, but the profile of the edge is

not compromised. Type 2 edge damage is defined as chips, flake scars, nicks or other edge damage that alters the blade edge profile. As with SEM work, this method of edge damage identification is limited to a large extent because of chemical weathering on many ( $n=101$ ,  $\%=27$ ) of the microblades. The weathering obscures many surface details, and often even obfuscates edge detail.

One common factor among microblades with edge damage is that the damage (especially Type 2 damage) was only occasionally present along all of one or both margins. This is an important consideration in assessing whether edge damage may be the result of tool use or of post-depositional processes such as trampling. Following Tringham et al. (1974:113), trampled lithics tend to exhibit microflakes randomly positioned around all lateral edges of the artifact, whereas utilized tools exhibit consistent edge wear on the active margin. Because many of the microblades with edge damage exhibit variable chipping and flaking around the margins, it is likely that trampling contributes to the high rates of edge damage witnessed in the Richardson Island assemblage. Tringham et al.'s observation that trampling damage was restricted to one surface (the one opposite the trampler) does not take into account the movement and flipping of artifacts (Nielsen 1991:500).

A brief, informal experiment were carried out to identify other possible factors in the production of edge damage on the Richardson Island microblades. Microblades were hafted in a unilaterally slotted antler handle, similar to those recovered from Zhokov Island. This knife was then used to cut a variety of different materials and the resulting edge damage from each task was recorded. Fresh microblades were hafted for each task. The experiments revealed that Type 2 edge damage may be achieved through a number of

actions. First, the use of microblades as side-hafted knife blades, used either to cut fibre (spruce root) or to carve wood (cedar) resulted in Type 2 edge damage (Figure 48). This damage usually appears as microflakes visible on one or both surfaces adjacent to the blade margin as well as nicks in the edge.



**Figure 48: Edge damage from cutting spruce root and cedar. Top frames represent undamaged microblade edges. Note the type 2 chipping along the blade edges.**

Second, microblades may sustain edge damage from hafting. The act of pressing microblades into place in the spruce gum appears to cause some edge damage in what becomes the unexposed edge. This damage tends to be somewhat crescent-shaped chips, notches and/or snaps (Type 2) with fewer surface (Type 1) microflakes. Finally, as revealed by the point-hafted microblades from the bone impact experiment (Appendix A.2), Type 2 edge damage also occurs when a slotted point glances off a bone, slicing along it with a lateral edge.

This experiment does not provide immediately applicable analogies for specific edgewear identification as it was not within the purview of this thesis to produce an exhaustive experimental usewear comparative catalogue. Nonetheless, it is useful in that it demonstrates that edge damage is not restricted to the exposed edge of a side-hafted microblade, and that Type 2 edge damage may be produced through actions other than trampling. Because of the possibility of edge damage occurring as a result of hafting as

well (or instead of) as a result of use, microblades with edge damage to both margins are still eligible to be interpreted as having been used as insets in slotted points. Alternative hypotheses for double-sided Type 2 edge damage include that the microblades were used as end-hafted microblade knives.

One important observation regarding microblade cutting tool utility is that microblades are suboptimal for cutting processed fibre (especially twisted spruce root). While microblade knives slice through cedar inner bark (cured, soaked and twisted, 3mm thickness) relatively efficiently, and can cut through untwisted strands of spruce root (cured and soaked, 2-3mm thickness) adequately, cutting double-strand twisted spruce root twine (cured and soaked, 3mm thickness) is quite difficult. Whereas the cedar bark and untwisted spruce root could be cut by looping the fibre over the knife blade and slicing upwards, this method not only would not cut through the twisted spruce root but would result in a crushed or notched blade edge. Cutting could only be achieved by tensioning the twine (generally by biting on one end and holding the other end taut) and then slicing or sawing through it. Variable edge damage was observed, including some crescent-shaped notching near blade ends (with visible microflaking around the notch) and more consistent edge-long microflaking and chipping. Similar observations regarding microlith tools are reported, in that replicas of side-hafted Hoko River microlith knives were deemed “worthless” as a cutting tool for any of the activities concerned with basket or cordage production” (Flenniken 1981:77).

If Richardson Island microblades were being used in an end-hafted rather than a side-hafted setting, the blade use trajectory probably did not follow the pattern of selection and modification outlined in section 7.5.2.1. This is due to two primary factors:

(a) that short microblade segments would have been less desirable than longer microblades because of the necessity for a tang or hafting element (a section of blade bound within the haft, and thus unusable for cutting purposes), and (b) that curvature would not have been a significant enough detriment to performance to warrant snapping microblades unless the margins at the distal or proximal end was blunt. Nonetheless, there is some possible evidence for the use of end-hafted microblade knives at Richardson Island. First, there is a slight difference in Type 1 edge damage patterns between complete microblades on other microblade segments. Of any microblade segment category with Type 1 edge damage, complete microblades show the highest rate of unilateral edge damage (Table 6). This suggests that Type 1 edge damage may not be due to trample damage, but rather have come about through a specific pattern of use. Further experimentation and artifact analysis using more sophisticated edgewear identification methods and equipment will be necessary to resolve this question.

Microblades	1 Margin	% of T1 ED	% of all
Complete	23	74.2%	27.7%
Proximal	38	55.9%	22.0%
Medial	14	50.0%	25.0%
Distal	13	44.8%	21.0%
Total	88	56.4%	23.5%

**Table 6: Microblade segments with unimarginal Type 1 edge damage**

The sporadic Type 2 edge damage evident on many of the microblades is consistent with post-depositional trample damage. Edge-long Type 2 edge damage may have been caused by a number of actions or processes. However, some individual microblades exhibit relatively consistent (often edge-long) Type 2 damage opposite edge-long Type 1 edge damage. This is consistent with a side-hafted application. Based on this as well as the pattern of blade snapping, it is most likely that the primary application of the microblades at Richardson Island was to be side-hafted. Because of this, the inverse relationship between microblades and projectile points, and the presence of utilized flakes and flake tools throughout the pre-microblade and microblade bearing layers, it may be inferred that the microblade-composite tools were slotted spear points rather than knives. If microblades represented the introduction of a new, improved cutting implement, it would be expected that there would be a corresponding decline in the frequency of the obsolete or non-preferred older cutting tool types. This decline is not evident. Similarly, the decrease in projectile points indicates that another tool type with a similarly penetrative function was adopted. This is consistent with the slotted point hypothesis.

### **7.3 Models for the Development of Microblade Technology at Richardson Island**

The questions of why and how microblade technology developed on Richardson Island are imbedded in issues of motivation and influence within the early Holocene society in southern Haida Gwaii. As described in chapter 2, technological change does not occur in a vacuum, and is not the result of random chance, environmental determinism, or cold functionalist optimality; rather it is driven by human decision

making relative to real-world lifeways and situations. Following design theory, utilitarian technology must conform to a basic set of principles:

- 1) A tool must adequately perform the function for which it is designed; a knife must cut, a basket must contain objects, etc.
- 2) The technology must be cognitively and physically available to the users and makers. The technical knowledge and skills required to make the tool must already be present, as must the material resources necessary for production. The gestalt product does not necessarily have to be known, but the discrete attributes that make up the whole must be achievable to the toolmakers.
- 3) The expertise to use the tool must also be in place. This expertise includes the suite of gestures appropriate to activating or utilizing the tool, and also the theoretical understanding of how the tool may be integrated into the existing technological suite.
- 4) The tool must conform to societal expectations regarding objects of that type. Abrupt and massive changes in anything from object form to material composition to use application is exceedingly rare. In this vein, cognitive models of standardization, construction qualities and design features or attributes must also be met.

Within these criteria, changes in the local environment, the society, or both will often result in shifts in the design suitability of a tool or toolkit, and may precipitate innovation or redesign. These changes may include raw material scarcity forcing a group to develop technology that either relies less on that material or is more efficient at gathering that material. For example, if a community exhausted its local supply of building stone, future houses may be redesigned to be made of wood. Alternatively, the community may develop a heavy-duty freight wagon suitable to bringing stone in from a

more distant, still active quarry. In either case, the new technologies reflect a societal response to an external pressure. Additional factors, such as issues of social prestige based on housing material, or unfavourable territorial relationships with a neighbouring community that controls the second quarry site, or many other possibilities, will also affect the ultimate design decisions.

In the case of Richardson Island microblade development, it is imperative to first identify hypothetical impetuses of technological change. Each of these development drivers may then be examined in turn, and tested using a combination of lithic analysis, experimental archaeology, culture history, geographic analysis, and theoretical models. This combination of proofs will not provide a completely certain “smoking gun” for microblade development, but will at least place each model on a scale of plausibility.

### **7.3.1 Microblades and Migration**

The first possible development driver to consider is that microblades were brought to Richardson Island by an incoming population from the mainland. This model incorporates a variety of archaeological data and theory regarding the spread of microblades. The Alaskan Denali microblade tradition predates the earliest evidence for microblades on Haida Gwaii by several centuries (Ackerman 2007:151). Also, Lee (2008:193) suggests a formal similarity between not only the microblade cores from On Your Knees Cave and Richardson Island, but also the contracting-stem bifacial projectile points from the two sites. Yesner and Pearson (2002:134) argue that the near-ubiquitous appearance of microblade technology around the early Holocene Northwest Coast, combined with genetic evidence of one or more trans-Beringian migration events are indicative of an “ethnotechnological” expansion. Specifically, the microblade expansion

has been linked to the proposed early Holocene Athapaskan (also referred to as Na Dene) migration event, connecting the presence of early Holocene microblade sites to the ethnohistoric territories of Athapaskan speaking peoples (Magne and Fedje 2007:184; Yesner and Pearson 2002:134, 156).

It is far beyond the scope of this thesis to test the validity of the theory that microblades across northwestern North America are directly related to a major early Holocene Athapaskan migration, but it is appropriate to examine this hypothesis in relation to the restricted Richardson Island case study. This model of technological change through population movement may be tested in a number of ways. First, one must examine the relationship of the Richardson Island early Moresby complex toolkit to preexisting technological traditions both on the mainland and on Haida Gwaii. This will take two primary forms: the microblade industries of the two regions must be compared, as must the non-microblade industry before and after the biface/microblade transition on Richardson Island. Consistency in the former two assemblages would indicate a likely outside source for microblade technology, while consistency in the latter would suggest a high degree of internal continuity within the local community.

First, it is clear that there is a significant difference between Richardson Island microblade technology and the earlier Alaskan Denali complex. Both industries are characterized by the presence of microblades, but the core preparation methods show stark variation. The Denali microblade cores are traditionally bifacially prepared (Ackerman 2007:161), with microblades removed along the axis of the biface's radial circumference. As described in chapter 4, this pattern is exhibited at sites in Southeast Alaska such as Hidden Falls and On Your Knees Cave, which are roughly

contemporaneous to the early occupation layers Richardson Island. The Richardson Island microblade core preparation method relied on unidirectional flaking on split pebbles or thick flakes. The axis of blade removal was perpendicular to the (flake) core's edge, rather than parallel to it. This shows a distinct cognitive break between the two microblade traditions, as the differences in the *chaînes opératoires* are fairly significant. The mental modelling of optimal core form, understanding of core orientation, and cultural knowledge of the gestural suite required to produce microblade cores are all quite different between the Denali and Moresby microblade traditions. As such, the concept of microblade tools may have come to Haida Gwaii from Denali groups in Alaska, but the technological tradition itself probably did not.

Later Alaskan sites in Alexander Archipelago (Chuck Lake and Thorne River) exhibit unidirectionally prepared microblade cores similar to those of Richardson Island (Lee 2007b:44). However, because Richardson Island's earliest microblade-bearing deposits predate either of those sites by several centuries, the source of technological influence was likely not Southeast Alaska.

The theory that microblade technology represents an influx of migrants from the mainland is also unlikely. There is a high degree of continuity over the biface/microblade transition both in the non-microblade tool types present at Richardson Island, and in the raw materials used to make the tools (Magne 2004:108; Smith 2004:160; Storey 2008:187). This indicates that the technological knowledge base beyond bifaces and microblades remained constant. Later variability in raw material selection for microblade manufacture indicates that other raw material sources were available, but the siliceous argillite that was used for both late bifaces and early microblades was preferred. This

suggests an established community tradition of siliceous argillite use that would not necessarily be in place for incoming groups. There, the expected model would be for the incomers to use either preferred raw material based on their earlier mainland traditions, or the most conveniently accessible raw material for microblade manufacture. The change from siliceous argillite to whatever other material was used would likely have been quite abrupt, occurring immediately at the introduction of microblade technology. However, the gradual changes identified in the lithic raw material are more likely reflective of a stable local population rather than an influx of migrants.

### **7.3.2 Microblades as a Lithic Austerity Measure**

The extreme material efficiency of blade and microblade technology is an oft-touted trope among lithic specialists. Blade manufacture experiments by Sheets and Muto (1972:632-633) demonstrated that 820g of stone may yield over 17m of cutting edge, with only 9% material wasted as debitage (including the exhausted core). As a result, microblades are often suggested as technological responses to lithic raw material scarcity. As discussed in Chapter 2, this scarcity may take three forms: patchiness, where the resource is available only in locales that are difficult or costly (whether in terms of time, energy or material) to access; wider distribution but with limited access time, such as a region with long winters and heavy snowfall; or simply very sparse distribution across the landscape (Bousman 1993:62).

In each situation, microblades may provide an optimal solution. First, since microblades (and microblade cores) are very small, a forager may transport a relatively large number of microblade cores or microblade core preforms back from a distant or

difficult to access quarry site. Then, because of the high efficiency of microblade technology, return trips to the quarry would not be necessary as frequently as with another more wasteful technology. In the second scenario, the size and efficiency of microblades also play a role. With a limited collection window, microblade technology may be employed as a stop-gap measure as raw material stockpiles dwindle between foraging seasons. Microblade cores may be made from a variety of other repurposed tools, such as unilateral scrapers and scraperplanes, larger core, chopper or flake tools, and robust bifaces. The material invested in that initial tool may then be recycled and maximized by the production of microblades after the tool's useful life was otherwise exhausted. Finally, microblade cores may be made from relatively small cobbles, split pebbles, and brecciated or fractured raw material. Even cores made on small or suboptimal material may produce microblades that are as viable as those made on premium stone. Thus, the technology may help overcome a general paucity of good tool stone in a region.

Two primary avenues are available to test the model of microblades as a response to raw material scarcity. First, an examination of the raw material usage patterns in the Richardson Island lithic assemblage will provide insight into any shifts between stone types or even tool sizes among non-microblade technologies. If there is a shift in raw material type visible across the Richardson Island lithic assemblage, this would be consistent with the raw material scarcity model. Similarly, if there is a pan-lithic trend of raw material maximization and tool miniaturization, this would support the notion of raw material scarcity as impetus for technological change. However, if raw material selection

and usage, and/or non-microblade tool production and use are unchanged, then it is unlikely that growing raw material scarcity affected technological organization at the site.

Second, the logistical requirements for raw material acquisition at Richardson Island must be addressed. Changing social relationships, fluctuating coastlines and forest infill may have contributed to the challenges facing foragers at Richardson Island. Thus, identification of the geographic distribution of potential raw material sources would be appropriate. If lithic raw material sources are distant or otherwise difficult to access, the scarcity model is supported to some extent (with an adequate explanation for why the access situation changed), while local, easily accessible quarry locales would suggest that the theory is false.

The raw material scarcity model appears to be an unlikely explanation for the development of microblades at Richardson Island. There does not appear to have been a decrease in raw material availability to drive the shift from bifaces to microblades. The raw material sources were local and accessible, the tool making practices do not demonstrate a significant level of material conservation in other aspects of the toolkit, and while microblades may be materially efficient, the surrounding technological suite is not particularly thrifty.

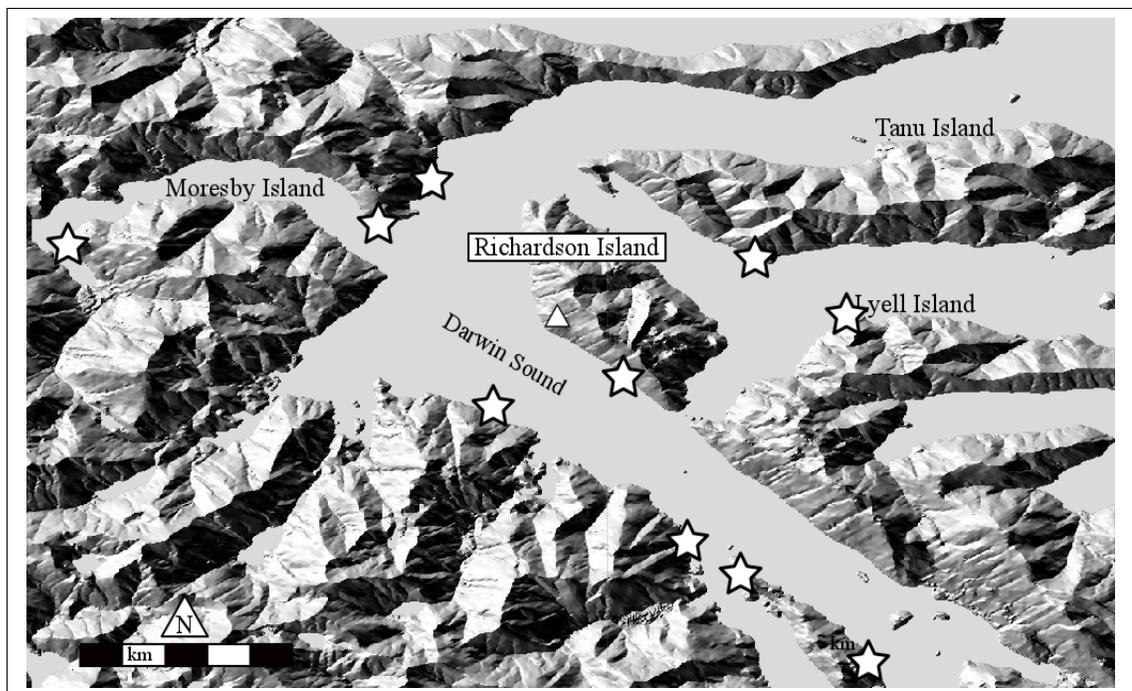
First, as demonstrated by Smith (2004:160), the same raw materials were being used to make early microblades as were being used to make bifaces. This is important as the biface/microblade transition took place after the high stand of the early Holocene marine transgression (Smith 2004:22). Thus, if rising sea levels had submerged any lithic quarries, one would expect the shift to (supposedly) more efficient technology to have occurred earlier. This continuity in raw material usage is also relevant to the continuum of

other lithic tool types. Bifacial projectile point use tapers and ceases to be used during the early Moresby phase, but flake tools and unifacial technology such as scraperplanes continue to be used after the biface/microblade transition. If raw material scarcity were a driving force behind the shift to microblades, these other tool types would also likely have witnessed a decline, or at least a change in curation and retouch practices (which was not the case). Furthermore, the generally accepted paradigm that microblade technology is highly efficient is only partially true. Microblades do indeed allow one to produce a great deal of cutting edge from a minimal amount of raw material (Sheets and Muto 1972:632), but the associated organic technology requires the use of other flaked stone tools to construct. A slotted point must be cut from a bone or antler, carved or scraped to shape, abraded smooth, and then slotted. Every step, save the grinding, requires the use of flaked stone tools. The larger the point or the more complex the haft, the more work must be carried out and the more bone/antler working tools will be consumed.

### **7.3.3 Microblades as a Logistical Adaptation**

Similar to the raw material scarcity model, the notion that microblade technology provides a small, portable toolkit for highly mobile hunter/gatherer groups is also flawed in regards to the Richardson Island assemblage. The ancient inhabitants of the Richardson Island site were likely not overly inconvenienced by logistical concerns surrounding their lithic toolkit. Based on modern outcroppings of analogous material, the local raw material sources were likely quite close by and were accessible by boat (Figure 49). Smith listed 10 possible raw material sources in and around Darwin Sound (Smith 2004:102). A brief shoreline survey of several of the sites revealed outcroppings and cobble deposits of

rhyolite, shale/argillite and dacite. The presence of watercraft allowed the site inhabitants to collect and transport much more stone than would be feasible if they were to cover the same distance on foot (Ames 2002:29). Thus, plentiful raw material could be quickly acquired and easily brought back to camp, and knapping practices were likely not guided by considerations over the (un)availability of stone. Ames' water-born forager theory applies to the toolkit design as well. Without the weight and volume restrictions imposed on terrestrial foragers, the boat-equipped foragers of Richardson Island could make and use fairly large, relatively bulky (within reason) tools, and carry spare weapons (Ames 2002:29).



**Figure 49: Map of lithic sources, indicated by white stars. After Smith 2004:102.**

### 7.3.5 Economic Shifts, Hunting and Risk Mitigation

The third possible source of impetus for the adoption of microblade technology is a shift in economic activity taking place during the early Holocene, with a corresponding change in the associated material culture. A change in one aspect of economic behaviour may necessitate the development of a more suitable tool for the new tasks. Tools not associated with the change in behaviour would not be affected. At Richardson Island, the primary change in the toolkit occurs when microblades replace bifacial projectile points. The unifacial and flake tool assemblage does not exhibit the same change, so we may infer that it is unlikely that microblades were adopted as a preferred cutting tool. Otherwise, if the bifaces were part of a cutting toolkit, the other parts of that suite would likely also decrease with the influx of microblades. Rather, we may infer that the bifaces that gradually taper out of use were employed as points for spears or darts. Thus, microblades are most likely to have been an upgrade to the piercing weapon collection of hunters at the site.

Any one of several possible economic shifts may have been the catalyst behind the development of microblade technology. First, the changing climatic conditions on Haida Gwaii resulted in significant forest infill, severely restricting the range of the caribou and brown bear that were previously common on the islands (see chapter 5). While black bear remained, faunal remains in archaeological sites suggest that large land mammals were decreasingly relied upon by ancient hunters on Haida Gwaii (Magne and Fedje 2007:184). Therefore, microblades may be a component of a maritime-adapted hunting toolkit. This is consistent with theories surrounding earlier microblade adaptations in coastal Alaska, where it appears that Denali complex technology was modified from the interior big game hunting economy to fit a coastal economic strategy

(Ackerman 1992:23, 2007:163). This model also fits with Bousman's (1993:61) foraging theory: as the meadows suitable for caribou habitat became fewer, more segmented, further between, and much higher in the alpine (increasing resource patchiness), the time and energy investments associated with hunting caribou became more costly.

Simultaneously, because the caribou populations were becoming smaller and more scattered across less accessible parts of the landscape, the returns were diminishing and the risk of inadequate forage was increasing. As a result, it is logical that another more widely (and locally) available large animal meat source would be selected.

Sea lions and black bears both fit this description. Both inhabit ecosystems much more easily accessible to coastal-based hunters, both provide a good meat yield per individual animal and both were already components (albeit minor ones) of the ancient Haida Gwaii diet. Also, both sea lions and black bears are far more social, and thus more densely distributed across the landscape, than are brown bears. However, both sea lions and black bears are large, top-end predators, and may pose a serious threat to anyone hunting them. Northwest Coast bear hunting methods were extremely bold (see chapter 5), often involving a face-to-face battle between a hunter with a thrusting spear and a bear roused from its den (Hallowell 1926:39; Lee 2007b:149; McLaren et al. 2005:9, 22). Similarly, sea lion hunting requires the hunter to either approach the sea lion on a rocky haul-out, or in the water using a small watercraft. In either situation, an angry, wounded sea lion thrashing about and lashing out at its antagonist could have dire consequences for the hunter. Hunting bear or hauled-out sea lions, an unsuccessful hunter could at least hope to escape with a mauling. However, a swimming hunter whose boat has been capsized by a raging sea lion (probably in the company of its pod) would likely face and

even more bleak (and brief) future. Clearly, the consequences of failure would be extremely high, so a tool that may reduce the likelihood of failure (and with it the overall riskiness of the situation) would be quite valuable.

In this context, microblades (or rather slotted osseous points with microblade insets) may provide an optimal risk-mitigating tool for hunting these large, dangerous animals. A spear tipped with a stone point could be rendered virtually useless if the point broke without killing the prey. This could happen due to a hard impact against bone or snapping due to bending or twisting the end of the spear. Such a situation is entirely feasible if the hunter strikes bone when attacking the prey and the point becomes lodged in the bone of the twisting, writhing animal. The relative elasticity of a bone or antler composite point would make breakage due to impact or twisting less likely (Elston and Brantingham 2002:105; Knecht 1997:202). Thus, the extremely durable slotted point technology would likely be a good choice for mitigating this risk of failure.

In addition to the increased durability from the organic component of a slotted point, the inset microblades would ensure that the point was capable of creating a deadly wound. The sharp microblades, lined sequentially along the lateral edges of the slotted point, create a pair of cutting edges at least as long, if not longer, than those achieved with bifacial stone points. This design could result in the creation of massively traumatic wound channels, leading to a faster prey bleed-out and death (Coles 1973:126; Elston and Brantingham 2002:106). Thus, microblade technology may not only create a tool that is less likely to fail, but also one that is more efficient.

This increased killing efficiency also achieves a measure of risk reduction. As outlined by Torrence (1989:61) and Bousman (1993:62), a reduction in the frequency of

wounded prey escapes would be a valuable achievement in regards to reducing the risk of overall subsistence failure. As such, the slotted points with inset microblades would improve hunting returns from less formidable or aggressive prey than sea lions and black bears. Like hunting sea lions, seal hunting requires the use of a complex maritime-adapted toolkit (Oswalt 1976:94). The slotted point spear would make an excellent addition to this, as it would provide the hunter with the maximum one-strike wound. The seal would be less likely to escape, and the hunter would be less likely to have to strike multiple times, damaging the valuable sealskin. Seals were among the animals already hunted during the Kinggi complex, as indicated by the prevalence of seal bone in the Kilgii Gwaay faunal assemblage (Fedje et al. 2005c:195), and would likely have been similarly exploited as the local maritime economic focus increased during the early Moresby tradition. Similarly, slotted points would improve caribou hunting. With fewer caribou, scattered across less accessible areas of the landscape (Wigen 2005:104), achieving a return on hunting investment would be very important. Caribou hunting was still carried out in some parts of Haida Gwaii during the early/mid Holocene (Christensen and Stafford 2005:253), and the antler material acquired through hunting was likely very valuable for making hard, durable tools (Elston and Brantingham 2002:106; Knecht 1997:202), so it would be logical to apply improved hunting technology to the task of harvesting caribou. As with the other prey animals, a caribou wounded by a spear tipped with a slotted point would likely bleed out and die faster than if the hunter had used a bifacial point. Thus, the caribou would be less likely to escape.

The two models of increased deadliness and durability in hunting weaponry are suitable for examination using experimental methods. By conducting controlled tests

between replicated slotted points with inset microblades and replicated bifacial projectile points, both the durability and the “deadliness” of the two weapon types may be measured. If slotted points outperform bifaces in each test, this would support the theory that microblades are likely to have been selected over bifaces in high-risk hunting situations. Additionally, analysis of relevant faunal assemblages would indicate whether or not there was an increase in reliance on black bear, sea lion, or other high-risk prey during the early Holocene. If this is the case, then it is likely that microblades may be a technological adaptation to high-risk hunting.

The first experiment (see Appendix A.1 for a detailed description) addressed the question of whether slotted points with inset microblades may provide an advantage over bifacial technology in terms of creating a potentially lethal wound in a prey animal. Based on the hypothesis that the inset microblade point would create a more traumatic wound than a *Xil* biface of comparable width, the two weapons were used to stab blocks of ballistics gelatine and the resulting wound channels were recorded, measured and compared. The ballistics gelatine is analogous to mammalian flesh and organs, but is translucent, allowing direct visual observation of the internal wound channel. This experiment showed that although the deeper sections of the wound channels produced by the two weapon types are similar, the slotted points lacerate the upper area, near the surface of the (simulated) flesh, more than the bifacial points do. The wounds generated by slotted points have a wider mouth than the largely parallel-sided biface-inflicted wounds, and would likely result in faster blood loss, blood pressure drop, and death on the part of the prey animals.

The second experiment (see Appendix A.2 for a detailed description) examined whether slotted points were indeed more durable than bifacial points when used as thrusting spears. Two sets of spears (one tipped with slotted points and one with bifacial points) were used to vigorously stab a block of ballistics gelatine with a robust beef metatarsal suspended in it. The spears were struck against the bone either until the point broke or until 40 strikes had been performed. The results showed that the osseous points are significantly more durable than the stone points. The most durable stone point failed after 26 strikes, while the mean breakage point for the stone bifaces was 14 strikes. Neither slotted point broke within 40 strikes. Several microblades were damaged or lost from the slotted points, but most remained intact.

Both experiments support the model that slotted points with intact microblades make effective killing lances, ideally suited for close-range, aggressive hunting of large game. Thrusting spears tipped with slotted points produce more devastating wounds on well aimed strikes, and are less likely to suffer catastrophic failures on poorly aimed strikes, generally increasing the likelihood of hunting success. Combined with the morphological data from the Richardson Island microblade assemblage, which is consistent with the microblades having been made and modified for use as side-hafted insets, as well as the recovery of a nearly complete large slotted point from a Moresby period context at Coho Creek, it is quite likely that the early Moresby microblade industry at Richardson Island arose as a response to increased subsistence risk. The risk took the forms of increasing scarcity of erstwhile game animals (caribou) pushing people towards a maritime adaptation that included hunting dangerous prey such as sea lions and black bears. The slotted points with inset microblades provided the hunters with a

weapon that was unlikely to break against bone and could deliver a mortal wound to a large animal, reducing the likelihood of the hunter suffering the consequences of facing a wounded and enraged top level predatory at close quarters. Thus, the slotted point represents a shrewd technological adaptation to a changing local ecology, facilitating an economic shift that contributed to the subsequent maritime specialization witnessed on Haida Gwaii throughout the rest of its human history.

## **Chapter 8: Conclusion**

This thesis has examined the origin and development of microblades in southern Haida Gwaii. The Richardson Island microblade assemblage has provided insight into technological strategies adopted by coastal hunter-gatherers during times of climatic shift in the early Holocene. It has been shown that hafted microblade composite tools (slotted points, to be specific) came to gradually replace bifacial projectile point technology starting at approximately 8750 BP. The source of the concept of microblade technology is as yet unknown, but based on patterns of raw material usage and particularities of the local *chaîne opératoire* we may infer that the Richardson Island microblade industry was likely a local development. The driver for this innovation, contrary to the common explanations of raw material scarcity and/or tool miniaturization due to logistical constraints, appears to have been risk avoidance. Slotted antler points with microblade insets were employed to improve killing efficiency and minimize chances of catastrophic weapon failure. The basis for these conclusions are the patterns of microblade manufacture and selection evident in the assemblage, combined with paleoenvironmental evidence from the surrounding region, trends and artifacts observed from other sites within the region, and a series of archaeological experiments designed to test the efficacy of microblade weapons.

### **Core Preparation Strategy and Microblade Manufacture Method**

As described in Chapters 3 and 7, the Richardson Island microblade manufacture sequence is based around a unidirectional core preparation strategy. The microblade cores were made on split pebbles or thick flakes, with the lateral sides shaped by unidirectional

percussion applied to the same surface that would subsequently become the striking platform for microblade removals. Microblade manufacture followed, using pressure technique to take off each blade. Core rejuvenation was achieved through percussion flaking of the fluted face. The core would be struck on the striking platform to remove mass from the lateral surface and thus re-establish an optimal striking platform angle and guiding ridges. The cores were likely supported in a vise during microblade flaking.

This model is supported by the microblades, microblade cores, and rejuvenation flakes recovered from the Richardson Island excavations. All of the recovered microblade cores were boat-shaped, conical or bullet-shaped cores, showing no keel battering, minimal flaking on the striking platform, and no evidence of bifacial or wedge-shaped core preparation. No crested flakes were recovered, and only a small number of semi-crested blades were evident, further supporting the unidirectional core preparation model. Vise support was indicated in part by the absence of keel battering (contrary to the later Moresby tradition percussion microblade cores from Coho Creek) and by the presence of multiple discreet fluted faces identifiable on cores with 100% circumferential fluting. Thus, what appear to be conical cores are actually more polyhedral, indicating a knapping practice of removing microblades in sequential rows from a single side of the core before turning it to expose a fresh flaking surface. The regularity in microblade size and shape is also indicative of vise-held pressure flaking technique being applied for blade removal.

### **Microblade Hafting**

A variety of microblade hafting styles have been identified at sites around the north Pacific Rim. An end-hafted wood handled microblade knife was recovered from

wetsite excavations at Hoko River, Washington state (Croes 1995:186); unilaterally slotted and bilaterally slotted bone, antler and ivory artifacts (some with intact microblade insets) were recovered from a permafrost site on Zhokov Island, Siberia (Giria and Pitul'ko 1994:32); and fragments of slotted antler points were found in excavations at Cohoe Creek on Haida Gwaii (Christensen and Stafford 2005:266), and Namu on the British Columbia mainland (Carlson 1996:95). The discovery of a slotted point with preserved spruce gum hafting mastic from Gladstone Icepatch, Yukon Territory contributed even further to our understanding of microblade hafting methods.

The ancient hunters at Richardson Island likely used bilateral slotted antler or bone points. This is consistent with the patterns of microblade snapping and selection observed in the Richardson Island microblade assemblage. The microblades appear to have been selected for and modified to obtain optimally straight and consistent insets. This pattern is also evident at Lawn Point, where the discovery of two *in situ* microblade clusters showed that straight, parallel sided microblades experienced different curation practices than did curved, tapering microblades (Fladmark 1986b:48). A similar pattern emerges at Richardson Island, where curved microblades were snapped to produce straight segments and thick distal or proximal sections were broken off and discarded. This permitted the microblade segments to fit into the narrow slots on either side of the osseous point. The recovery of a fragmentary slotted antler point from Cohoe Creek, another early Holocene site on Haida Gwaii, supports this theory.

While it is possible that a secondary hafting strategy, such as end-hafted microblade knives, was also employed, there is less evidence for it. Several long, curved microblades were left intact, and would have made suitable end-blades for a tool similar

to the microblade knife recovered from the Hoko River wet site (Croes 1995:186). However, any one-time haft has not preserved, and the edge damage visible on the artifacts is generally consistent with trample damage and other such taphonomic processes. Furthermore, the post-transition toolkit, after microblades replaced bifaces, shows no drop in the use of flake cutting tools. If a new cutting tool were introduced, one would expect to see a decline in the use of the older technology akin to the replacement of bifacial stone projectile points with newer composite projectile points.

### **Raw Material Availability and Toolkit Transportability**

This thesis has argued that the move from bifaces to microblade technology was likely not driven by either raw material scarcity or a logistical need for tool miniaturization. Richardson Island is surrounded by nearby lithic resources, and while there is variation in raw material usage for microblade manufacture, that variation occurs after the technology had already begun to overtake bifaces in popularity. Also, as shown by Storey (2008), the unifacial and flake tools were manufactured on the same stone as the microblades and bifaces, and did not exhibit any evidence of raw material scarcity, such as aggressive resharpening or core reduction to exhaustion followed by bipolar percussion. Also, the microblade/biface transition occurred after the high stand of the early Holocene marine transgression, so it is extremely unlikely that the technological switch came about as a result of lithic quarries being drowned by rising sea levels. As discussed by Smith (2004), the raw material variation during the early microblade period is likely the result of experimental local development of the microblade industry, rather than the result of raw material scarcity. This also provides support for the theory that the

Richardson Island microblade industry was a domestic development, rather than an imported technology.

Aside from microblades developing as a response to raw material scarcity, the portability of microblades is often touted as a major factor behind the development of the technology. While this may be true elsewhere, the Richardson Island microblade development does not appear to have been guided by concerns regarding toolkit size and mobility. The ancient hunters at Richardson Island had access to watercraft, which allowed both the gathering and stockpile of large quantities of raw material and the transport of relatively bulky weapons (Ames 2002:39). After all, the fragmentary slotted point from Coho Creek, the complete slotted point from the Gladstone Icepatch, and several of the Alaskan and Siberian examples are significantly larger than the Kinggi complex *Xil* and *Xilju* bifaces, and thus hardly represent a move towards more compact weapons.

### **Slotted Point Design and Risk**

A fundamental driver behind the development of microblade technology at Richardson Island appears to have been risk avoidance during otherwise high-risk hunting activities. As the climate became warmer and wetter during the early Holocene, forest infill and a rising treeline substantially reduced caribou habitat in southern Haida Gwaii (Pellatt and Mathewes 1997:89; Reimchen and Byun 2005:83-84; Wigen 2005:105, 111). The remaining caribou were restricted largely to open spaces at higher elevation, increasing the patchiness of the resource (Bousman 1993:61), increasing the costs of caribou hunting forays, and heightening the chances of inadequate returns on

time and energy invested in the hunt. The local subsistence strategy therefore shifted to take more advantage of the marine mammal resources as well as the increasing black bear population. Both black bears and sea lions (a very common pinniped in southern Haida Gwaii waters) are large predators and offer significant risk to hunters. A wounded caribou may rely on a flight defence, but bears and sea lions are more wont to react with aggression. As such, slotted antler points with microblade insets were adopted in order to improve the killing power and durability of hunting weapons. Also, a wounded, escaped terrestrial animal may yet be tracked and harvested. This is much more difficult in aquatic contexts, where a sure-kill weapon would be very valuable (Oswalt 1976:94).

To test the model that slotted points represent improvements in deadliness and durability over *Xil* bifaces, I conducted a series of experiments comparing the two weapon types in terms of wound channel creation and ability to withstand strikes against a robust bone. In both cases, the slotted points outperformed the bifacial points. Ballistics gelatin was used in place of an animal carcass as it provides analogous density and resistivity, but is translucent and therefore allows direct visual observation of internal wound channel creation.

First, slotted points lacerate the edges of the wound as the point penetrates into (simulated) flesh. This results in a wider wound channel near the wound surface in comparison with the parallel-sided puncture wound typical of *Xil* bifacial points. The biface's shorter exposed cutting edge results in less lateral laceration and more of a puncture wound at the surface of the channel. These results indicate that an animal wounded with a spear tipped with a slotted point with inset microblades would be likely to bleed out and die faster than if it had been wounded with a biface-tipped spear. This

would reduce the risk of failure as the wounded animal would be less likely to fight back effectively, and less likely to escape the hunters.

Second, the two point types were tested by repeatedly and aggressively spearing a large, robust bovine metatarsal. The bifacial points consistently broke well before the slotted points. The breakage exhibited on the bifaces is consistent with that observed on damaged points in the Richardson Island assemblage. The slotted points each withstood nearly twice as many strikes as the most durable individual biface, and three times as many as the biface mean. This indicates that slotted points were far less likely to break when a hunter missed the optimal target location and accidentally struck a bone in the prey animal. To face a wounded bear or sea lion with a broken spear would likely have disastrous consequences, so a more durable spear tip would have been a welcome addition to the toolkit. The slotted point could reduce the risk of a hunter's weapon breaking at the key moment of a hunt. The presence of an adult male human skeleton just inside the entrance of On Your Knees Cave, Alaska may be illustrative of the dangers of hunting bears in their caves (Dixon 1999:118; Saleeby 2010:123).

### **Richardson Island within the Northwest Coast Microblade Tradition**

The development of the Richardson Island microblade industry is quite significant within the picture of the broader Northwest Coast. Much earlier microblade traditions in central Alaska clearly had an influence on technological complexes throughout northwest North America. Similar microblade assemblages have been recovered from southeast Alaska, in the Alexander Archipelago, as well as throughout the Yukon, interior British Columbia, and northern Alberta. Other microblade traditions developed in the high arctic

(the Arctic Small Tool Tradition). However, significant differences in core preparation and maintenance strategy between those earlier Alaskan traditions and the early Moresby tradition on Haida Gwaii indicates a level of cognitive and techno-developmental independence in the latter case. This builds on Magne's cluster analysis of Haida Gwaii microblade cores that indicates that early Haida Gwaii microblade cores are quite distinct from contemporaneous microblade core traditions identified on the mainland (1996:157-158). The germ of the idea of microblades may have entered Haida Gwaii from southeast Alaska, but the development of the technology at Richardson Island was local.

### **Directions for Future Research**

There are three primary avenues for future research on the history of microblade technology on Haida Gwaii: (1) improved understanding of the raw material use practices surrounding the microblade industry at Richardson Island; (2) a larger catalogue of early Moresby tradition microblade sites, especially on Graham Island; and (3) more insight into the end of the microblade tradition on Haida Gwaii. First, while the raw material types associated with the microblade industry (and indeed the broader lithic toolkit) at Richardson Island has been thoroughly investigated (see Smith 2004), the details of raw material preparation and curation in specific regard to microblades are as yet unknown. The rhyolite samples obtained from beach exposures around Darwin Sound were of variable quality. There is a good possibility that heat treatment was employed to improve the workability of the stone (Stueber pers.com. 2011). As such, it would advance our understanding of the lithics industry at the site to understand what preparatory processes the stone had to undergo in order to make it usable, and also how the other stone types are

affected by heat treatment. Similarly, an analysis of tool and debitage deposition at Richardson Island could inform models of site use and settlement patterns, indicating how the occupation may have changed over time.

Second, as mentioned above, microblades are often touted as an extremely efficient technology in terms of raw material cost (Sheets and Muto 1972). However, the associated composite tools, such as slotted antler point, require a significant investment in time and material to construct. This investment includes the use (and thus consumption) of a variety of lithic tools, such as scrapers, gravers, spokeshaves, burins and cutting flakes. To my knowledge, no formal study has been made regarding the necessary lithic investment (beyond microblades) in crafting slotted osseous points as opposed to biface production.

Following the questions specific to the Richardson Island microblade tradition, the early Moresby tradition is also relatively little known. Aside from Richardson Island and Lyell Bay, most of the early post-Kinggi phase sites on Haida Gwaii date to as much as 1500 years after the microblade/biface tradition (though even Lyell Bay is dated to nearly 500 years after the transition). It would be valuable to identify and investigate more earliest Moresby phase sites throughout Haida Gwaii in order to see if a similar technological pattern of biface abandonment and microblade adoption is evident. Without the high resolution stratigraphy of Richardson Island it may be very difficult (or impossible) to reconstruct the detailed timeline of the transition elsewhere, but it would still be valuable at least to see whether Richardson Island represents the earliest instance of microblades on Haida Gwaii, or if there are earlier examples elsewhere in the archipelago. Sites along the northeast coast of Graham Island may be especially

interesting in this regard, as they may provide insight into the possibility of a link to the southeast Alaskan microblade industries, or of geographic isolation resulting in internal parallel development of a similar toolkit.

Finally, the decline and abandonment of Haida Gwaii microblade technology has not been investigated. The terminal Moresby/early Graham transitional period is among the most nebulous in Haida Gwaii culture history (Fedje and Mackie 2005:161). It marks a significant change from a developed microblade industry to one marked by bipolar flake tools and a complex organic toolkit. However, the specific timeline of the transition is unknown (including the terminal date for microblade use in the region), the details of the technological shift is unknown, and the source or developmental impetus of the new technology is unknown. The Graham Tradition is commonly acknowledged as the precursor to the historic period, or the “developed” pre-contact Haida culture. As such, understanding the details of how the Graham tradition techno-economic system related to the preceding Moresby tradition could fundamentally inform the archaeological history of the Haida People.

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## **Appendix A: Microblade Hunting Weapon Experiments**

Two experiments were carried out in order to test the model that slotted bone or antler projectile points with microblade insets provide superior durability and offer greater wound-creation potential than Kinggi complex bifacial projectile points. The first experiment tested whether and how each weapon type suffered damage from impacting with heavy bones in simulated flesh. The second experiment examined the wound channel created by each weapon as it penetrated simulated flesh to a prescribed depth. Both experiments used ballistics gelatin rather than animal flesh in order that the tool actions could be visually observed during penetration.

### **A.1 Wound Channel Experiment**

#### **A1.1 Model and Hypothesis**

In addition to the durability imparted by the bone or antler component of a slotted point, the inset microblades provide a very long, sharp, continuous cutting edge. This edge has the potential to be much longer than those available on most stone bifacial projectile points, which are restricted by the available raw materials (one cannot make a stone point larger than the parent flake or core), and by the increasing brittleness and fragility of very long stone bifaces (Elston and Brantingham 2002:106; Knecht 1997:202). Because of this additional cutting edge, slotted points have the potential to inflict very deep, wide wounds on the prey. The sharp microblade inset edge would slice (rather than tear) deep into the tissue on either side of the spear tip, resulting in a massively traumatic wound which would bleed very heavily. The fast blood outflow would presumably result in a

very fast loss of blood pressure, leading to faster collapse and death for the prey animal. Coles describes instances of weapon design where the tips of hunting arrows are structured to promote maximum blood loss, rather than to stay stuck in the wound (1973:126). In a high-risk hunting context, this model would be well applied. A speared bear or sea lion may bleed out and die much faster from such a wound, thus reducing the exposure of the hunters to a large, wounded, thrashing animal. Thus, the development of inset slotted points may have been at least partially due to an advantage in terms of killing efficiency.

In order to test this model, I constructed an experiment to determine whether there was a difference in wounding potential between inset slotted points and Kinggi phase bifacial stone projectile points. The experiment was guided by the following hypotheses:

- 1) The greater cutting edge of a slotted point with inset microblades will result in a larger wound than is created by a bifacial stone projectile point..
- 2) The wound will be wider at the point of blade-edge contact.

#### **A.1.2 Methodology**

Since I do not have the surgical expertise to dissect carcasses in order to accurately analyze wound channel variation, I decided to use ballistics gelatin to facilitate direct observation of the wound channel. The ballistics gelatin (also referred to as “ordnance gelatin”, “ballistics gel” or “gelatin”) is a high-grade super-consistent pork gelatin product commonly used by law enforcement and forensic investigation firms as an analogue to human flesh. The gelatin recipe is formulated to create a product (a 20cm x 20cm x 60cm gelatin block) that mimics the density and cellular structure of mammalian flesh and organs, and is nearly transparent in order to permit researchers to

visually observe the trajectory, depth of penetration, and wound channel creation of various forms of ordnance. The ballistics gelatin for these experiments, as well as the mixing instructions, was acquired from Gelatin Innovations ([www.gelatininnovations.com](http://www.gelatininnovations.com)). Each block measured 16cm x 16cm x 40cm.

### ▲ **Experimental Weaponry**

All inset slotted points and bifacial projectile points were manufactured by the author.

#### **Slotted Points**

The inset slotted points (Figure 50) were made from elk antler with siliceous argillite, chert and dacite microblade insets. The antler was acquired from a fresh elk carcass from the Alberni Valley, Vancouver Island, British Columbia. It was selected primarily because that particular rack had the straightest beam section of any of the antlers in my stockpile, so additional soaking and straightening of the antler points was not necessary. Also, the dimensions (length, width and thickness) of the sectioned antler beam were comparable to the dimensions listed by Christensen and Stafford (2005:266) and Lee (2008:158) for the Coho Creek slotted point fragment. As the nearest known example of a slotted point to the Richardson Island site, the Coho Creek point was a logical model to follow. The final products were not identical to the Coho Creek point, but resembled it very closely in terms of length, width, thickness, cross-section and taper. The experimental points were slightly longer than the Coho Creek specimen, as that artifact appears to be missing either the proximal or distal tip, and thus was longer when it was intact.



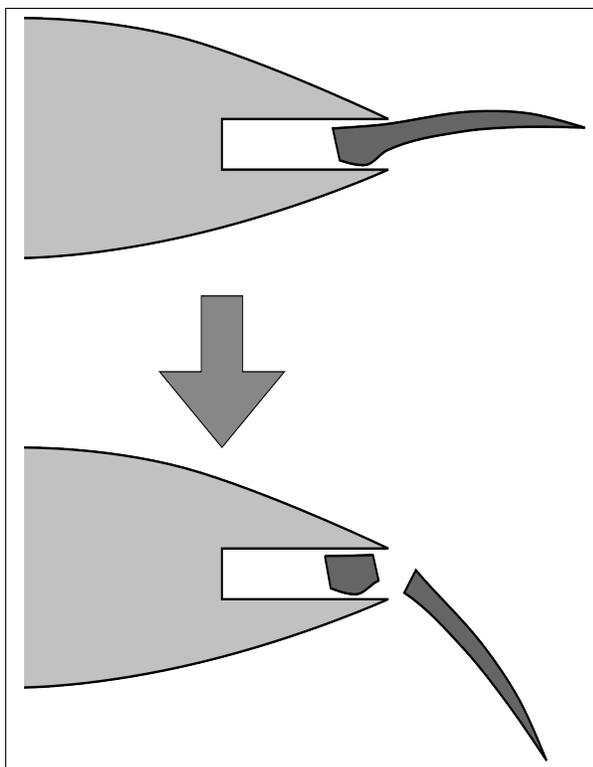
**Figure 50: Experimental slotted point replica, modelled after Christensen and Stafford 2005.**

The experiment was not concerned with issues of manufacture time, carving or abrading tools, or other issues surrounding the processes of working antler, so the antler beam was cut, sectioned and shaped using an angle grinder with either a metal-cutting wheel or a masonry grinding disc. This permitted me to quickly achieve the desired form with a minimum of error and frustration. The lateral slots were cut using a Dremel rotary tool with a heavy-duty cutting disc, and the same tool was used with a sanding drum to smooth the outer surface. Periodically throughout the shaping process, measurements would be taken from various points on the replica and would be compared to the reference set of measurements and illustration for the archaeological guide model. Then the point would be further shaped to bring it to within the appropriate ranges of variation for the archaeological examples.

The inset microblades were produced from a set of microblade cores made from siliceous argillite, dacite and chert. The siliceous argillite was collected from a beach at Benjamin Point, in Southern Haida Gwaii and the dacite was collected from a beach on the southern coast of Tanu Island, Haida Gwaii. The chert was collected from a beach near Victoria, BC. All three stone types are analogous to examples found in the Richardson Island microblade assemblage.

Microblade core preparation followed the unidirectional reduction sequence described in chapter 3.2. The cores were produced on thick flakes, using the ventral surface of the flake as a striking platform. Core rejuvenation was achieved through larger flake removals from the fluted face. The cores were supported in a three-jaw vise and microblades were pressed off using an antler pressure flaker. Over 300 microblades were produced in total.

The microblades were side-hafted in the slotted points. Curved distal portions and thick proximal portions were snapped off to facilitate hafting. The lateral slots on the slotted points were quite effective tools in themselves for gripping and snapping the ends off of microblades (Figure 51). The selected microblade segments were hafted in the slots using a pine gum mastic. The pine gum was harvested from a Shore Pine (*Pinus contortus*) in Victoria, British Columbia. This mastic was selected because of the spruce gum residue found in a preserved slotted point from the Gladstone Icepatch, Yukon Territory (Helwig et al. 2008:286). The icepatch point yielded a sample of spruce gum (*Picea sp.*) that analysis showed was not heated or mixed before use. Thus, rather than making a pine pitch, following Pétilion et al. (2011:1271), I used raw pine gum. The species of pine (*Pinus contortus*) selected appears in the palynological record for early Holocene Haida Gwaii (Hebda et al. 2005:66-67), and has similar properties to spruce gum from *Picea sp.*.



**Figure 51: Idealized illustration of slotted point lateral grooves used as a snapping vise for trimming microblade segments.**

To haft the microblades, I chewed the pine gum until it was soft, smooth and malleable. Then I pinched off a small amount, rolled it into a cylinder approximately 20mm long by 2-3mm wide, and pressed it into the slot. I would then insert a batch of two or three microblades, arranging them to create a sinuous cutting edge, when possible (Figure 52). This process was repeated for the length of each slot. The final tools were 218mm and 275mm long, 17mm and 19mm wide, and 7mm (both) thick at their maximum dimensions. Maximum width was reached at 55mm from the proximal end in both cases, and the points tapered gradually to the distal tip. The slots were 218mm and 220mm long, 1.8mm wide and approximately 3mm deep on the larger point, and 160mm

and 164mm long, 1.75mm wide, and between 2.8 and 3.2mm deep on the smaller. Both points have a cross-section with a flat bottom surface and a very gently rounded top. No decorative motifs were added and the hafting elements (generally the proximal 55mm) were left unmarked. The points were modelled primarily after the slotted point recovered from Cohoe Creek (Christensen and Stafford 2005:266; Lee 2007b:158). The lengths of the two points are slightly greater than that of the incomplete Cohoe Creek specimen, but are within 30mm of the length of the complete slotted point recovered from the Gladstone Icepatch. Thus, the slotted points used for the experiments were of comparable size to the only known examples from the Northwest Coast culture area (all of the other preserved slotted points are from far northwest of Yakutat Bay) (Ames and Maschner 1996:17).



**Figure 52: Hafted replica microblades in an experimental slotted point.**

### **Bifacial Projectile Points**

The bifacial projectile points were made using the Richardson Island Kinggi complex *Xil* points as a model. The *Xil* was selected because of the likelihood that they served a similar role as did the slotted points: tips for handheld spears rather than for thrown atlatl darts (Fedje et al. 2008:26; McLaren and Smith 2008:44). The points were knapped from the same Benjamin Point siliceous argillite as was used for many of the microblades. This material (or at least very similar stone) is known from other Kinggi

phase sties in the region as well, making it a suitable choice for the replicas. Bifacial reduction followed the sequence set forth by Whittaker (1994:199-206), wherein an initial hard-hammer percussion flake is thinned and shaped through soft-hammer percussion, with pressure flaking for the final shape. A heavy (~2kg) sandstone cobble was used for the initial flake removal. Soft-hammer percussion was carried out using a moose antler billet, and pressure flaking was done with an antler tine pressure flaker. The contracting stem forms were flaked to be as similar as possible to each other, in accordance with the standardization exhibited in the archaeological assemblage. The overall point sizes were somewhat variable, though all were within the ranges set by the archaeological examples from Richardson Island. All experimental points were bipointed foliate points with straight contracting stems, excurvate or slightly recurved blade edges, and no notching. A total of 10 points were manufactured (Figure 53), though only one was selected to be used for this experiment. The representative point was selected because it was the largest of the experimental assemblage that was within the range of complete projectile points recovered from Richardson Island, and was also only 0.8mm wider than the experimental slotted point (with inset microblades in place) at 26.4mm at the widest point.



**Figure 53: A selection of experimental Xil biface replicas.**

### **Experimental Procedure.**

Each point was hafted in a socketed wooden foreshaft approximately 100mm long by 18mm thick. Each foreshaft was bound, in turn, to a 120 cm long, 18mm thick hardwood dowel in order to form a suitable spear. The distal end of the dowel and the proximal end of the foreshafts were shaped to fit each other well and to allow fast change-out for other points to be mounted. The spear was set in a guide created by two eye-bolts arranged in a vertical line. The block of ballistics gelatin was placed on the ground beneath this, arranged to allow maximum depth of penetration. The spear was then thrust sharply into the gelatin with all the force I could muster (approximately 120lbs force, based on simple tests). The whole process was recorded using a Canon S3 IS camera shooting 640x480 video. After each thrust, the gelatin block would be rearrange to provide a fresh target and undamaged section, and another test would be run.

Following the tests, the video files were downloaded and single-frame images were captured from the moment that downward force ceased to be applied. This point was selected because it would show the maximum wound channel, without showing any post-thrust splitting of the gelatin from lateral pressure or movement of the spear shaft. The images were each opened using Inkscape, resized to a consistent scale if necessary, and vector lines were drawn outlining the maximum extent of each wound channel. These wound profile images were then compared for wound breadth at four intervals: (a) point of maximum weapon width, (b) juncture where the haft joins with projectile point, (c) point of penetration, and (d) 50% distance between (a) and (c). This data was then compared between the two point types to see how each weapon performed. The primary attributes compared were differences in the mean values for each measurement, the percentage variation that the difference represented, and the difference between the wound channel width and the maximum point width.

Depth of penetration was not measured. This was for two primary reasons. First, the spears (both those tipped with bifaces and those with slotted points) generally penetrated the gelatin block completely, often striking the wooden base beneath the block. Second, as demonstrated by Waguespack et al. (2009:794, 797) in a comparison of arrows tipped with stone bifaces and arrows made with a sharpened wooden tip, the penetration depth differences between two tip types may be statistically distinguishable, but negligible (<10%, or ~2cm within 22+cm of penetration) in terms of real-world consequences for an ancient hunter.

### A.1.3 Results

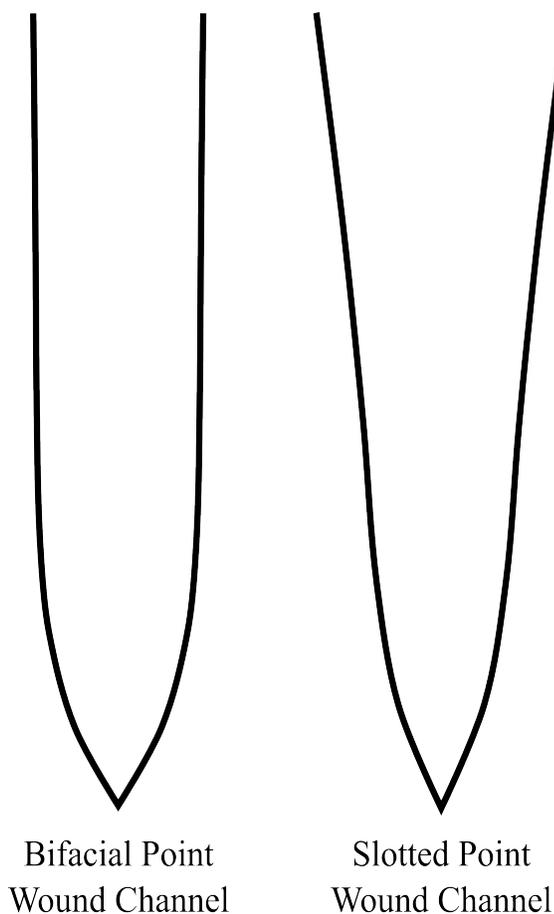
**Table 1** shows the measurements of the wound channels created by the two point types. The wound channel widths at the point of maximum projectile point width show little difference (8.6%) between the slotted points and the bifacial points. The halfway measurement is similarly close (6.66% difference). The main difference occurs at the point of penetration, where the slotted points show a 16.45% difference over the bifacial points ( $t=2.1$ ,  $p=0.05$ ). It is worth noting that three individual bifacial point strikes scored much higher than the rest (52.6mm mean over a 33.1mm mean), drawing the overall mean upwards. If these three are excluded from consideration, the mean difference between slotted points and bifaces is 13.5mm or 28.9% ( $t=5.83$ ,  $p=5.25e-05$ ). In each of the three cases, the gelatin block was struck near the edge and buckled slightly, causing the spear's trajectory within the gelatin to angle slightly off of vertical. The torsion created by the spear shaft on the upper area of the gelatin may have affected the width of the wound channel in this situation. A similar buckling occurred twice with the slotted point as well, but on both occasions, rather than angle deeper into the centre of the block, the spear stabbed through the side, exiting the gelatin. As a result, no measurements could be taken and those strikes were discarded. Figure 54 shows a composite profile image for each point type, based on the mean values at each measurement stage.

Point	Widest Pt	Haft pt	Penetration	50.00%
SP09	27.52	33.04	44.04	30.12
SP08	25.99	33.47	52.37	35.59
SP07	26.92	29.1	41.81	31.18
SP06	29.68	31.92	47.78	37.42
SP05	29.75	32.26	56.79	35.84
SP04	30.98	31.34	46.76	50.27
SP03	34.55	34.83	40.72	39.52
SP02	29.23	34.19	50.26	40.07
SP01	27.32	28.14	39.75	31.75
BF12	26.64	27.2	31.7	28.33
BF11	25.87		30.94	27.85
BF10	25.21	27.59	30.38	
BF09	27.12	28.81	31.56	31.83
BF08	24.74	27.03	31.26	29.55
BF07	28.36	32.48	38	36.87
BF06	26.77	27.63	38.44	33.35
BF03	27.72	36.09	51.36	48.74
BF02	27.39	30.91	53.28	46.25
BF01	27.48	31.35	53.23	48.6

SP mean	29.10	32.03	46.70	36.86
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BF mean	26.38	28.45	33.18	31.29
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**Figure A5: Table of wound channel width measurements (in mm). "Widest Pt" is measured at the widest spot on the projectile point, "Haft Pt" is measured where the haft meets the point, "50%" is measured halfway between the distal tip of the point and the surface of the gelatin, and "Penetration" is measured at the point where the spear enters the gelatin block. The red highlighted fields indicate the biface tests that buckled during penetration and were excluded from mean calculation.**



**Figure 54: Composite wound channel profiles based on mean wound channel measurements.**

#### **A.1.4 Discussion**

The wound channel experiment demonstrated that there is a difference between the wounds created by slotted points and those created by bifaces. While the bulk of the internal wound channels remained quite close to the edges of the respective points, a significant flaring is evident at the point of penetration in the case of the slotted point. This appears to be due largely to the long, sharp cutting edges created by the sequential microblades slicing somewhat deeper laterally into the upper portion of the ballistics gel

block as the spear is thrust downward, while the shorter cutting edge of the bifacial point results in a somewhat more round puncture wound rather than a gash. In this latter case, the spear shaft enters the wound much sooner after penetration, replacing sharp lateral cutting edges with round wood at the surface of the gelatin. One important observation is that the gelatin displaces and rebounds (as does flesh) when struck. As such, shortly after impact the gelatin appears to bounce back towards the spear. In the case of the slotted points, because of the length of the point and cutting edges, this upwards motion appears to increase the amount of upper level laceration occurring. The bifacial point is past the upper (simulated) flesh surface by the time the rebound occurs, so further damage is restricted to the deep wound channel.

This pattern of wound channel creation supports the hypothesis that a slotted point may create a larger wound than will a bifacial point of comparable width (H1). It does not, however, provide clear support for H2: that the wound channel will be wider at the point of contact with the blade edge. The wound channel measurement data shows that neither slotted points nor bifacial points produce a wound channel that is significantly wider than the point itself for the entirety of the wound. However, the deeper structure of the wounds may show some difference. If one extrapolates from the nature of the wounds at penetration, where the long blade edges of the slotted point lacerate as penetration occurs, it is logical to expect that similar laceration will take place deeper in the wound as well. The deeper areas of the wound channel may not widen as much as the upper wound channel simply because of the surrounding mass of (simulated) flesh. However, it is conceivable that the increased internal laceration may result in increased bleeding from deep within the wound. Unfortunately, it is beyond the scope of my skills

and knowledge to interpret surgical details beyond the simple shape of the internal wound structure.

Regardless of the deep internal wound structures, the difference between wound channels near the point of penetration indicates that slotted points with inset microblades do produce more traumatic wounds than do *Xil* bifaces of comparable width. The wide gash in the upper 5-10cm of flesh combined with the deep penetration of the spear would likely result in a grievous injury to the prey animal. Furthermore, the openness of the upper wound channel would allow for blood from deeper within the wound to flow more freely, likely resulting in faster bleedout, faster loss of blood pressure, and thus faster death. This is largely due to the increased (and very sharp) cutting edge provided by the microblades. It is possible that a very long, large stone biface (such as a large Clovis point) could have an effect similar to a slotted point, but the *Xil* and *Xilju* points recovered from late Kinggi contexts do not approach these dimensions. Based on this experiment, we may conclude that the slotted point appears to produce a more traumatic wound than the *Xil* biface. This appears to be largely because of the significantly longer cutting edges created by the microblades inset in the slotted points.

## **A.2 Bone Impact Experiment**

### **A.2.1 Model and Hypothesis**

The high durability of slotted bone or antler points with inset microblades (and indeed most osseous weaponry) is a commonly recognized attribute that many archaeologists (ie. Elston and Brantingham 2002; Knecht 1997; Pétillon et al. 2011) associate with the development and spread of microblade and composite tool technology. The fundamental principle is that because the organic component of the tip is hard and

sharp yet somewhat elastic, it will be more resilient than a brittle lithic point if it strikes bone in a prey animal or if a strike misses and the weapon hits a tree or rock (Pétillon et al. 2011:1276). This model suits the identified situation at Richardson Island well, where there are indications that subsistence hunting practices may have shifted from focusing on caribou to hunting large sea mammals and possible black bear (see Chapter 5). On this basis, microblade technology may reflect a design response to the increased risk associated with hunting large, predatory animals. To test the validity of the model that slotted points with inset microblades may be used to mitigate risk in high-risk hunting scenarios, I carried out the following experiment.

The experiment was guided by the following hypotheses:

Slotted points with inset microblades are more likely to be immediately reusable after striking heavy bone than are Kinggi Complex projectile points.

Kinggi phase *Xil* bifacial projectile points are more likely to break when striking heavy bone than are slotted points with inset microblades.

Bone or antler point components are more likely to bend, slide or glance off the bone, thus making breakage less likely.

### **A.2.2 Methodology**

In order to test the hypotheses, I had to strike two sets of weapons against a heavy bone under controlled and measurable conditions. The weapons used were the same as were used in the wound channel experiment, as well as the nine unused bifaces. See Appendix A.1.2 for a description of weapon production.

### **Experimental Procedure**

Each point was hafted to a spear in the manner described in Appendix A.1.2. A heavy bone (a beef metatarsal) was placed between two slabs of ballistics gelatin (see Appendix A.1.2 for description). The bone was then vigorously attacked with the spear. If the tester noticed the point break against the bone, the test would be paused. Otherwise, after every ten strikes the test would be paused and the point examined for damage. Any damage would be recorded, and the test would continue. The test was stopped after either a total of 30 bone strikes was reached or after the point broke. The figure of 30 bone strikes was selected because I consider it highly unlikely that any hunter would be called upon to use his or her spear more than 30 times between opportunities to refit damaged weapons (Binford 1979:266). The following fields were recorded: Breakage by strike 10/20/30; the number of strikes before breakage; the type of breakage (snapping/crushing/bend-fracture, etc.); description of breakage; notes on marks on the bone; any missing pieces off the point; other observations.

### **A.2.3 Results**

Of the 10 bifaces tested, all 10 broke within 30 strikes. The most durable biface lasted 26 strikes before the tip broke off. The mean breakage point was 14 strikes. The fastest breakage occurred in 6 strikes. Five of the bifaces exhibited tip damage, where 5-8mm of material was lost from the distal end. The nature of the fracture is somewhat similar to the removal of a flake through percussion (Figure 55). The other five points snapped, showing lipping consistent with impact/bend breaks (Figure 55) (Andrefsky 2003:28; Odell 2006:48; Whittaker 1994:165, 216). The bend fractures generally occurred quite close to where the point was hafted. One point was also damaged at the proximal end, within the socket haft. A spall flake was removed from the proximal tip,

12mm down one lateral margin, much like a burin spall. This appears to have been caused by the force of the base of the socket pressing against the base of the point. Eight of the points exhibited some battering to the blade edges.



**Figure 55: Biface tip damage. Left: flaked tip damage. The gray outline shows the tip flake detached at impact. Right: Impact bend fracture. Note the lipping visible in the side-on view.**

Neither of the slotted points broke within 30 strikes, though both suffered damage to the inset microblades. Both had lost some microblades (4 and 6, respectively) by the 10<sup>th</sup> strike. One lost all of the microblades from one of the lateral slots by the 30<sup>th</sup> strike. The other lost a total of 14 out of 41 (34%) microblades. Several microblades were found

embedded in the gelatin block. Others were recovered from the ground around the testing area. Damage to the intact microblades included snapping and edge damage (often severe battering and chipping), nearly to the point of the exposed blade edge being sheared off (Figure 56). Damage to the slotted points was restricted to blunting and flattening of the distal tip (Figure 57). One slotted point was subsequently struck against the bone until failure, when it snapped 30mm above the haft on the 46<sup>th</sup> strike. The other was used for another 10 strikes (40 total), and did not break beyond the tip flattening noted earlier.



**Figure 56: Damaged experimental microblades. a: partially sheared microblade. b: sheared microblades (the microblade remnants are still present in the slot). c: microblade exhibiting Type 2 edge damage.**



**Figure 57: Slotted point tip flattening and microblade damage after 40+ strikes. All of the microblades in one slot of the righthand point were stripped over the course of the impact experiment.**

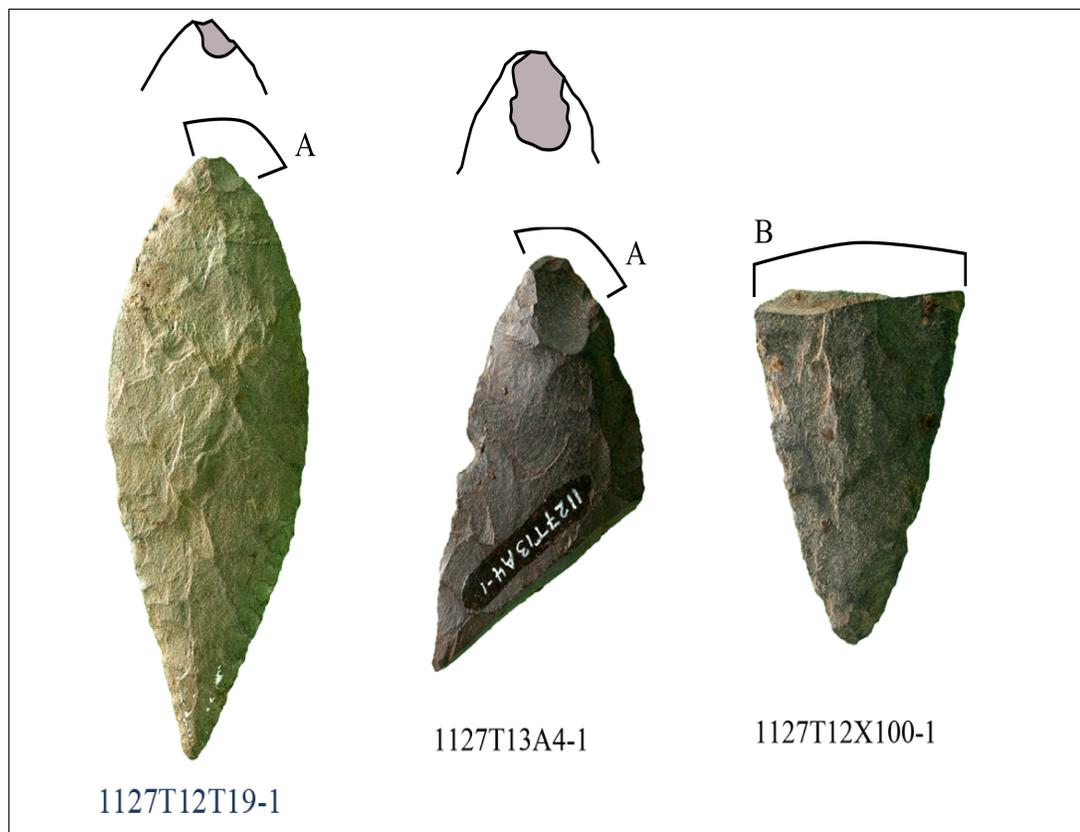
#### **A.2.4 Discussion**

The slotted points proved to be significantly more durable than the bifacial stone points. Only one bifacial point lasted over 20 strikes, whereas both slotted points lasted at least 40. This result strongly supports hypotheses 1 and 2.

The damage to the points also showed significant differences. The tip fractures on the bifacial points are similar to flake scars that may be achieved through direct percussion, indicating that the points were likely broken due to hard, end-on impact against the bone. Those bifacial points that had lost their tips may still have been immediately usable in an emergency situation, despite being much more dull than prior to the damage occurring. However, the likelihood of further weapon failure (such as failure

to penetrate hide) would make the prospect of continuing the hunt with a damaged spear point quite unappealing. It would be the matter of a few minutes work with a pressure flaker to resharpen the tips and restore the bifaces' lethality, but that would require a pause in the hunting action.

The bend breaks represent total weapon failure, where the hunter would be left holding what is effectively a straight, unsharpened stick. No further hunting could take place until weapon repair or replacement had been affected. Some of the longer basal segments may have been able to be resharpened into a usable point, but this would involve unhafting the basal remnant and devoting more time and attention to entirely reshaping the fracture to form the distal portion of the point. While this repair could be carried out in the field, it may have been preferable to postpone it until a return to camp. The bend breaks are consistent with situations where the point tip is held immobile, while torsional force is applied to the spear shaft. Thus, these breaks are likely due to the point sticking in the bone and being twisted until breaking. No point segments were left stuck in the bone, but deep gouges and chips were observed. Both of these point breakage types are evident among the Richardson Island biface assemblage (Figure 58), indicating that violent action resulting in point breakage was not uncommon for the early Holocene hunters, and similar incidents of weapon failure were a reality.



**Figure 58: Bifacial projectile points from 1127T showing damage. Brackets A indicate flakes removed from tips. The line profile above the artifacts show the shape of the tip flake. Bracket B shows damage consistent with an impact fracture (Whittaker 1994).**

The slotted points were much more resistant to total failure than the stone points. Neither slotted point broke within 30 strikes, demonstrating their reliability for aggressive hunting applications. The damage to the points was restricted to loss of and damage to microblades and blunting of the distal tip. This blunting was by no means catastrophic, and the points could likely continue to be used as an effective penetrating spear, even if the lateral cutting edge sharpness was compromised by the loss or destruction of several microblades.

Repair to the points may be conceived of as a two-stage process. The missing and damaged microblades could be replaced almost immediately from a stock of ready-made blades. All that would be required of the hunter would be to pry out the remnant blades and hardened spruce gum, soften (by chewing) a new batch of mastic, and then select and inset the new blades. Non-desirable distal and proximal microblade ends may be snapped off using the slot as a crude ad-hoc plier. The replacement of insets is fast and easily performed in the field. To resharpen the tip of the slotted point requires more time and effort. Depending on the extent of the damage, the repairs may range from simply re-grinding the tip with an abrader, to soaking the antler and re-grinding and re-carving the distal or proximal end completely. The former process may take a few minutes, but in the case of the latter, just soaking the antler may take over 24 hours, followed by several hours of carving and grinding. Giria and Pitul'ko identify a specimen from Zhokov Island that, based on the presence of bilateral grooves running the entire length of the artifact, is likely an example of a damaged point that was re-worked and reused (1994:34).

One interesting aspect of the slotted points was that contrary to the model set out in hypothesis 3, the points did not always slide or glance off of the bone target. Instead, the slotted points frequently made hard, direct impact against the bone, resulting in several small (<4mm diameter, ~3mm depth), generally round punctures when strikes occurred where there was more cancellous bone. This demonstrates that the durability of the antler points is not necessarily dependent on the material's ability to bend and slide off of bone, but rather extends to robusticity in incidents of hard, direct impact.

The resilience and firmness of the inset microblade settings is also noteworthy. Pétillon et al. noted that when spears tipped with slotted points penetrated the hide of

their target, the inset blades were often stripped from their settings and did not enter the body of the animal (2011:1276). This appears to be largely due to the inadequate hafting method employed. With a slot depth of 0.5-1mm, rather than setting their insets within each point's lateral slots, Petillon et al. used the slots as a “gutter [to] prevent the mastic from slipping on the sides of the point”, and thus had the microlith insets held only by the applied mastic (Pétillon et al. 2011:1272-1273). With deeper slots and microblades set within the slots with the cutting edge protruding beyond the slot and mastic, I did not encounter any difficulties with premature microblade ejection. Several microblades did come loose as a result of impact against bone, but as indicated by the presence of several deep, long cuts in the bone, many others withstood both glancing and direct strikes and remained hafted. The lost microblades appear to have been ejected in one of two ways: either by being stripped out through direct contact with the bone, or by being popped out by flexure in the point. The former involves the microblade catching the bone as the point moves past and being ripped from its setting. The latter occurs when the slotted point strikes the bone and flexes somewhat, cracking the hardened spruce gum and briefly loosening the setting of one or more microblades, which then fall out. A modern analogy for this process may be seen in twisting an icecube tray. The rigid setting flexes, breaking the existing bonds and allowing the contents to fall out.

### **A.3 Conclusions**

As these experiments have demonstrated, slotted points with inset microblades are both more durable and more deadly than *Xil* bifaces. Used as spear tips, slotted points provided ancient hunters with highly reliable weapons, ideally suited for high risk hunting activities. A successful strike, penetrating deep into a prey animal, would result in

a very traumatic wound, and would likely lead to faster blood loss and death than if the same strike were performed with a spear with a stone biface tip. Alternatively, an unsuccessful strike where the slotted point spear hit a heavy bone would have a lower chance of resulting in a broken weapon, and thus an effectively unarmed hunter facing a wounded, enraged animal. Instead, the hunter would still have a usable spear, probably even with many microblades intact, providing the additional killing potential. To summarize, in a functional context the slotted point is a superior weapon component to the *Xil* biface.

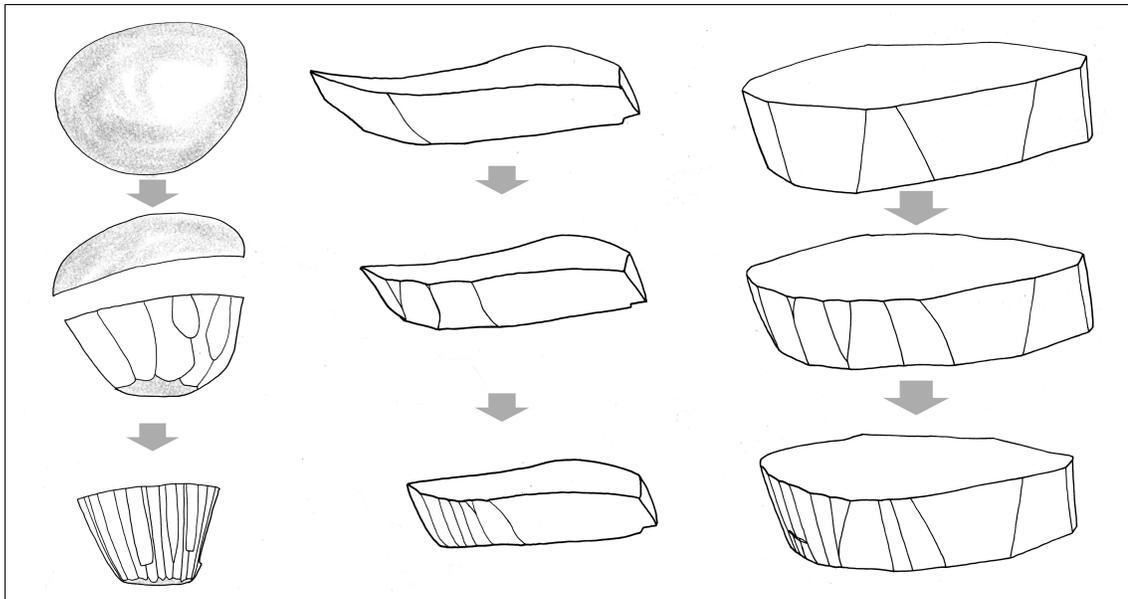
## Appendix B: Microblade Manufacture Experiment: Semi-crested Blades

### B.1 Model and Hypothesis

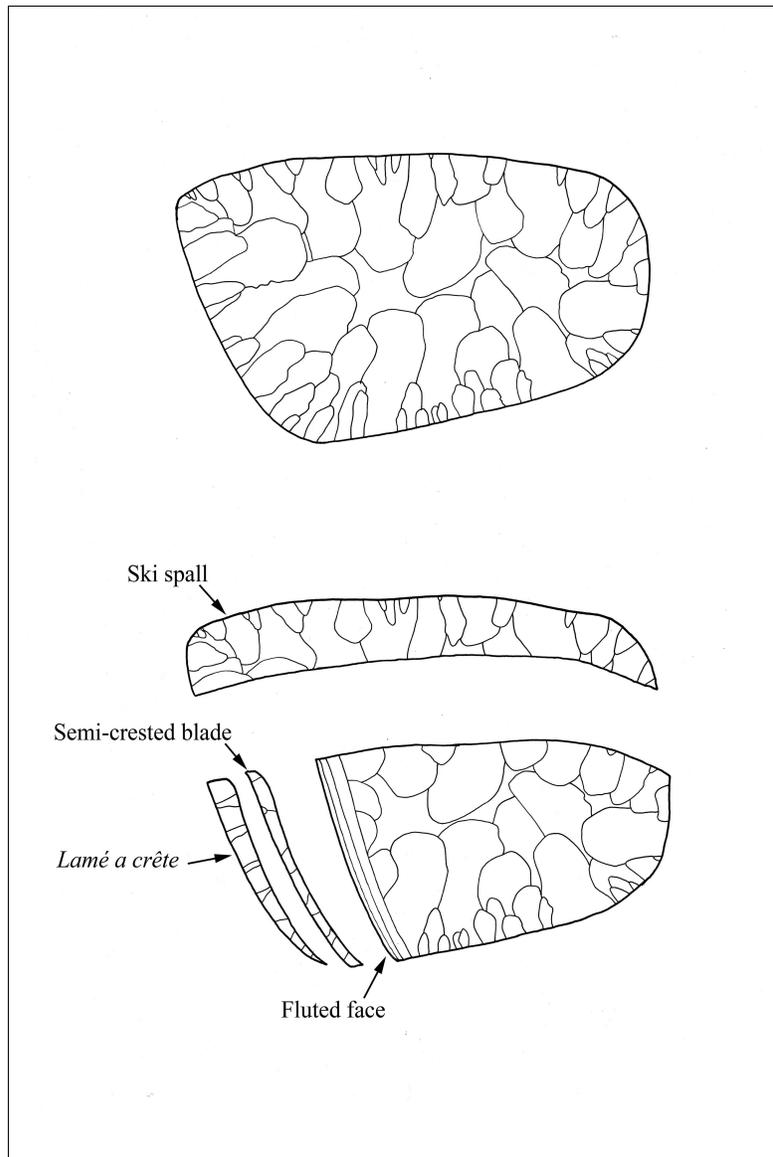
This experiment was conducted in order to assess the potential of semi-crested microblades as diagnostic indicators of core preparation method. The research, done in the course of research for this thesis, was presented at the University of Toronto's graduate student lithic technology symposium in February 2010, and published as Waber 2010. This is a brief summary of that research (see Waber 2010 for more detail).

Two primary methods of microblade core preparation have been identified in northwestern North America: unidirectional or conical core preparation, and bifacial or wedge-shaped core preparation. The former follows a reduction sequence wherein a thick flake or a tabular or split-cobble blank is flaked unidirectionally in order to establish a suitable striking platform angle and create one or more guiding ridges for blade removal along the lateral surface(s) (Figure 59). The striking platform for the flake removals is generally the same as for the subsequent microblade removals. The bifacial core preparation reduction sequence begins with the creation of a robust ovoid or trapezoidal biface blank. This is followed by a flake removal along the long axis of the blank, struck parallel to the edge in a manner similar to burin spall removal. The flake removed, called the “ski spall”, is a crested flake in that it exhibits lateral flake scars on either side of its dorsal aris. The resulting flake scar functions as the striking platform of the microblade core. Following ski spall removal, the incipient blade is flaked from the circumferential ridge running perpendicular to the ski spall's flake scar (Figure 60). This blade is also crested and is referred to as the *lame à crête*. The ridges at the lateral margins of the flake scar left by the *lame à crête* serve to guide subsequent microblade removals on what

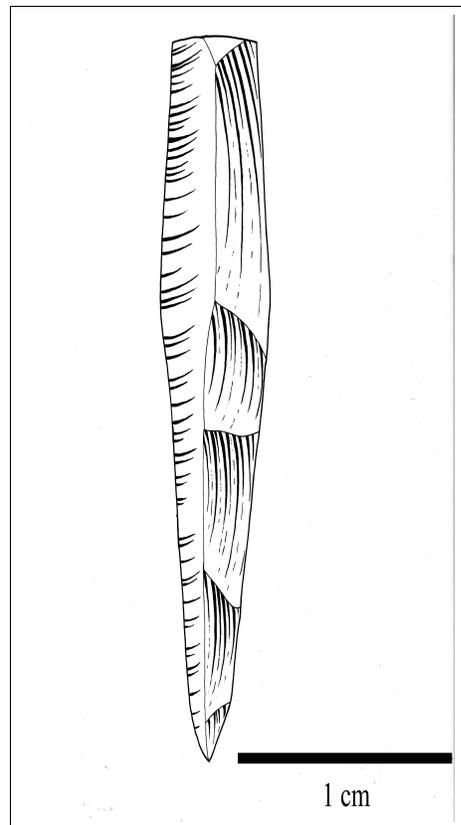
becomes the core's fluted face (Flenniken 1987:121). Following the removal of the *lame à crête*, any blade removed from the lateral margins of the fluted face will exhibit a pattern of lateral flake scars similar to the other crested blades, but only on the surface to one side of the dorsal arris (Figure 61) (Waber 2010:56).



**Figure 59: Unidirectional core preparation methods.**



**Figure 60: Bifacial core preparation method. Adapted from Waber 2010.**



**Figure 61: Semi-crested blade. Note the direction of the lateral flake scars. From Waber 2010.**

These semi-crested blades provide archaeologists with a valuable proxy marker for core preparation methods in cases of microblade assemblages where no cores are present, or the cores recovered were exhausted to the point where the preparation method is not distinguishable (as are many narrow cylindrical or bullet-shaped cores). Since semi-crested blades only have lateral flake scars to one side of the dorsal arris, the opposite margin is as sharp and straight as a regular microblade, and thus semi-crested blades may experience patterns of use, curation and discard more akin to those of regular

microblades than the crested blades, which are unusable for cutting applications, and are thus likely to be discarded as debitage (Waber 2010:56).

This experiment was guided by four primary hypotheses:

- 1) Bifacial (Campus/Denali) core preparation methods will result in the presence of lateral flake scars along the margins of the core's working face.
- 2) Microblades removed from these margins will exhibit segments of the lateral flake scars on the surface to one side of the dorsal arris(es).
- 3) These semi-crested microblades will compose a significant portion of an assemblage created using the bifacial core preparation method.
- 4) While occasional semi-crested blades may be present in NWCV assemblages, there will be significantly fewer semi-crested blades than in a comparable Campus/Denali assemblage. (Waber 2010:56).

## **B.2 Methodology**

Microblade production followed the pressure technique set forth by Flenniken (1987:118-121), with a three-jawed vise used for core support (Callahan 1985:33; Tabarev 1997:145). 11 unidirectional cores produced 270 microblades, and 10 bifacial cores produced 112 microblades (total  $n=382$ ). The microblades from each core were collected, labeled and stored independently of their parent core. Then, each collection of microblades was examined under a 20x-40x binocular microscope for evidence of lateral flake scars. The number of semi-crested microblades was counted and compared with the number of total microblades for each core assemblage as well as for each core preparation method (Waber 2010:57).

No core rejuvenation was practiced, so the microblades represent all removals possible from the initial fluted surface and striking platform (Waber 2010:57). This process was selected in order to avoid confounds that may result from differing core rejuvenation techniques; either platform spall removal or lateral flaking (see chapter 3) are viable means of rejuvenating bifacial cores, but the former does not introduce “fresh” lateral flake scars to the edges of the fluted face, while the latter certainly does.

### **B.3 Results and Conclusion**

As predicted, the bifacially prepared core assemblages yielded significantly more semi-crested blades than did the unidirectional core assemblages. 100% of the bifacial core assemblages included semi-crested blades, while 45% ( $n=5$ ) of the unidirectional core assemblages had them. Of all microblades from each core category, 34% ( $n=38$ ) of the microblades from bifacial core assemblages were identified as semi-crested blades. In contrast, under 3% ( $n=8$ ) of the unidirectional core microblades were semi-crested (Waber 2010:57).

Based on the disparity between the rates of semi-crested blades from experimental unidirectional core assemblages and bifacial core assemblages, I am fairly confident that these artifacts may be used as diagnostic indicators of microblade core preparation technique in coreless assemblages. That said, to my knowledge this method has yet to be applied to any archaeological assemblage case studies aside from this thesis's investigation of the Richardson Island microblade assemblage. A survey of assemblages with known core preparation methods would be a valuable proofing exercise.