Chapter 4

The Stratigraphy of Bifacial Implements at the Richardson Island Site, Haida Gwaii

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Introduction

The Richardson Island site is located on the Northern Northwest Coast of British Columbia, in the island archipelago of Haida Gwaii[1] (Figure 1). Dating between 9400 and 8400 BP[2], the archaeological deposits at the site span over four vertical meters with over fifty discrete depositional events. The site is associated with a raised marine terrace. Excavations have recovered a large number of lithic manufacturing debris and artifacts related stratigraphically throughout a one thousand year period. The cultural sequence at this site includes the transition at 8750 BP from the Kinggi Complex (dominated by large unifacial core tools and foliate bifaces) to the Early Moresby Tradition, which sees the introduction of microblades to the existing lithic toolkit. In this context of technological change, the following paper addresses the research question: does the bifacial manufacturing technology at the Richardson Site change significantly during the period of occupation? This question is explored through an analysis of bifacial attributes through time. Those attributes found to exhibit change through time are then compared to raw material type; a trait previously found to change throughout the Richardson sequence. We find that the bifacial manufacturing attributes and trends in bifacial raw material usage change minimally during occupation. These findings suggest that towards the end of their early Holocene existence on Haida Gwaii, bifaces remained a conservative technology little affected by the emergence of microblades.

Background

The Richardson Island site was first located in 1993 as a secondary deposit in the indertidal zone on the west side of Richardson Island (Mackie and Wilson 1994). The primary and *in situ* deposits were later identified to be associated with a raised marine terrace 15–16 meters above present day sea level (Fedje and Christensen 1999). Parks Canada and Haida Archaeologists undertook excavations at the site in 1995 and 1997. In 2001 and 2002, the University of Victoria conducted a larger scale excavation project at the site funded by SSHRC (Fedje 2003; Mackie et al. 2004; Smith 2004; Steffen 2006).

Deposition

The excavations at this site revealed a stratigraphic profile containing a minimum of 20 distinct depositional events with evidence of human occupation on their surface (Charcoal rich gravel layers in Figure 2). Debris-flow and gravel accumulation events are interspersed between charcoal rich cultural layers. The result is a four-meter plus profile of subsequent cultural occupations separated by gravel

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[1] Also known as the Queen Charlotte Islands.
[2] All dates are given in radiocarbon years before present.

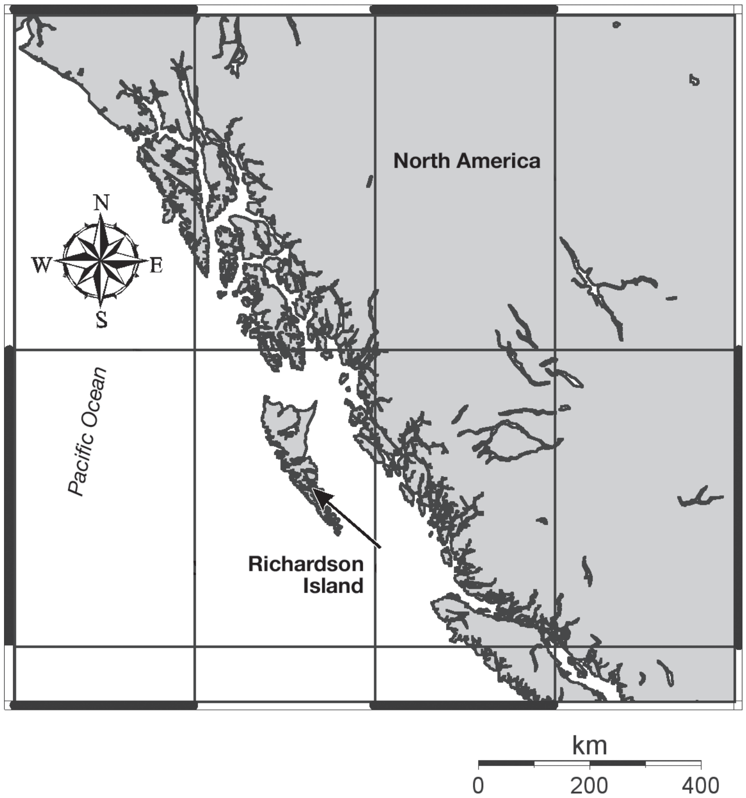


Figure 1. Location of the Richardson Island site.

washes and debris flows resulting in over 50 separable strata. Post-8000 BP alluvial gravels and debris-flow deposits cap the top 50 cm of the site, while archaeological deposits at the site are underlain by a diamicton (Fedje 2003).

Most cultural materials analyzed in this paper were recovered from depositional units represented by a 9400–8500 BP time span.

Dating

A total of 14 radiocarbon dates were obtained from the cultural deposits and one on the underlying diamicton (Fedje 2003). Throughout the sequence the dates are consistent at one-sigma with the exception of one date that is consistent at two-sigma. The dates reveal that the stratigraphy has accumulated without interruption over a 1000-year period. The stratigraphic separation provides a means of defining distinct chronological units. Based on the stratigraphy and associated radiocarbon dates, Fedje et al. (2005) separate stratigraphic units into 100-year intervals (Figure 2). This approach allows for detailed chronological analysis of the cultural material found at the site.

Cultural Occupation

Cultural remains from the site include hearth features, postholes, calcined faunal remains, and lithic artifacts (Fedje et al. 2005; Mackie et al. 2004, 2004; Magne 1996, 2004; Smith 2004, 2005; Steffen 2006; Steffen and Mackie 2005). Analyses undertaken on the lithic materials from the Richardson Island site reveal that there is a major shift in the technology between 8800 and 8700 BP (Fedje et al. 2005, Mackie et al. 2004; Magne 1996, 2004; Smith 2004). This coincides with a period of sea level stabilization after 4000 years of marine transgression. The earlier component of the site, the Kinggi Complex (>9400 to 8750 BP), is dominated by a bifacial industry and large unifacial core tools, named scraper-planes. After sea levels stabilize, these tools begin to decline and, following a period of coexistence with microblades, are eventually replaced by the microblade industry (Magne 2004). The introduction of micro-blades at 8750 BP to the existing

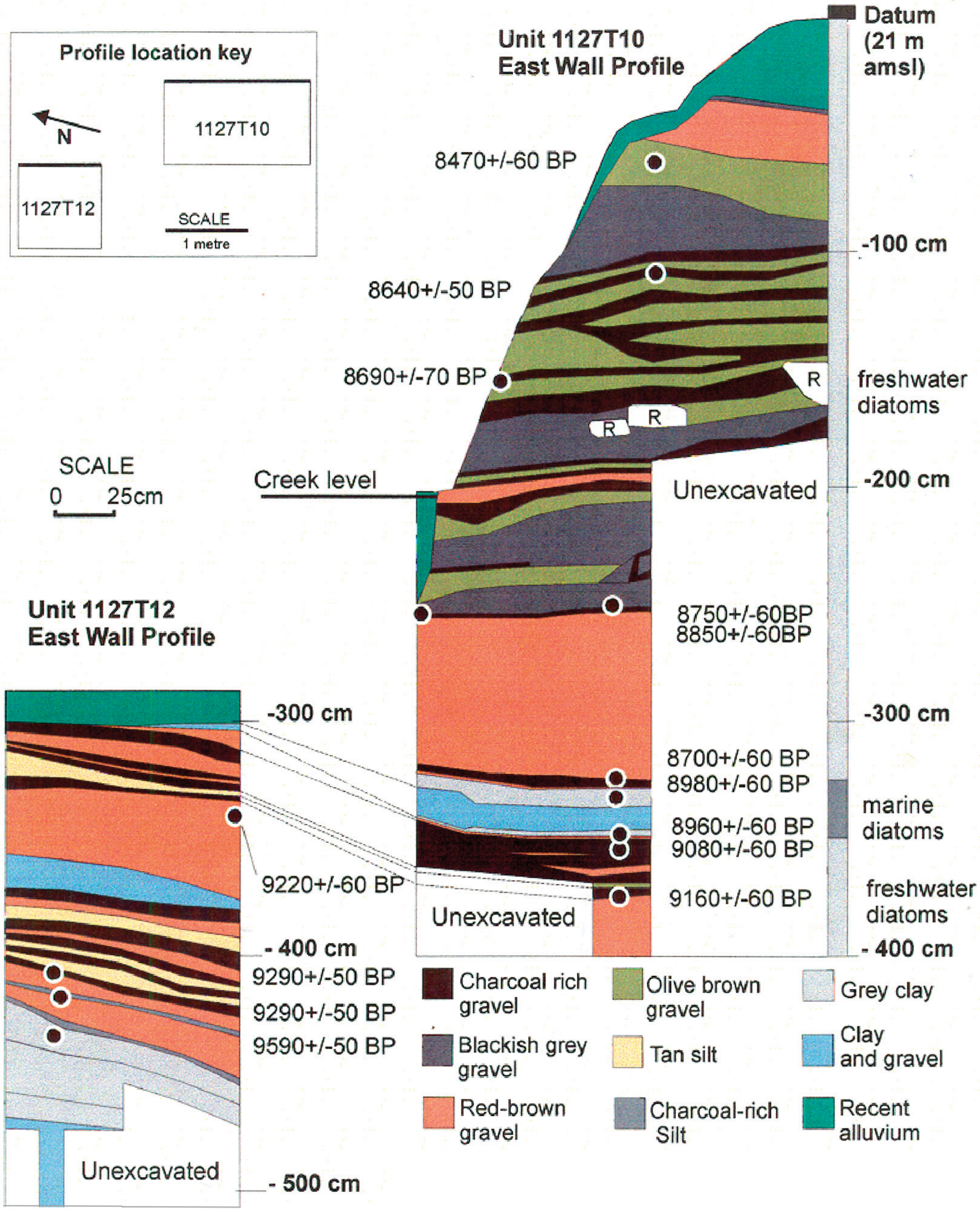


Figure 2. Profile and radiocarbon dates from the Richardson Island site (figure provided by Daryl Fedje).

bifacial toolkit marks the beginning of the Early Moresby Tradition (Fedje and Christensen 1999). Richardson Island is one of the few early-Holocene sites on the Northwest Coast to contain both bifaces and microblades in the same depositional context (Fedje and Mackie 2005; Fedje et al. 2005). Although reduced in frequency, bifaces are present in the microblade-bearing strata at Richardson Island. This analysis of Richardson bifaces presents a unique opportunity to examine tool-manufacturing patterns over a 1000-year chronology spanning two cultural complexes[3].

[3] The Late Moresby Tradition, distinguished by a lack in bifacial technology and presence of microblade technology (See Fedje et al. this volume), is represented at the Richardson Island site but has yet to be sufficiently identified and tested.

Richardson Island Biface Types

Fedje et al. (this volume) have proposed two classifications for the formed bifaces of Haida Gwaii dating to the early Holocene. The two proposed biface types, Xil and Xilju, are distinguished according to general morphology (see Fedje et al. this volume for a complete description of these types), but are also separated temporally with Xil occurring in the Kinggi component and Xilju co-occurring with the Early Moresby tradition. Xil are more characteristic of spear points and Xilju of atlatl darts, although without haft elements this is a conjectural assessment of function. Further excavation of early Holocene sites in Haida Gwaii and analysis of bifacial implements will help to refine the classifications of these bifacial types.

This paper provides a detailed look at different strategies and raw material used in the manufacturing of bifacial implements at the Richardson site through time. Our analysis was designed to distinguish differences in manufacturing strategies through time. Despite the apparent morphological and possible functional differences between the Xil and Xilju types, all bifaces from the Richardson site were studied together. The evidence from this paper reveals an underlying regularity in biface manufacture throughout the 1000-year occupation represented at Richardson.

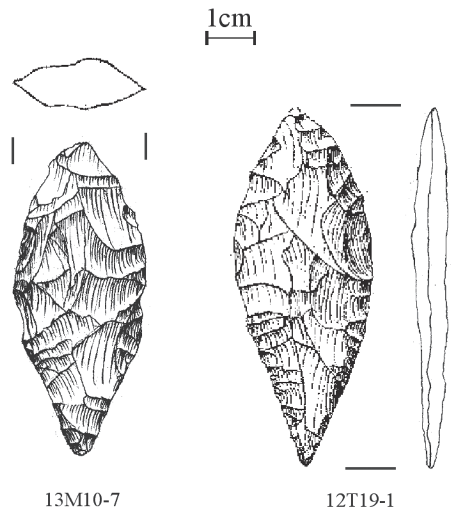


Figure 3. Xil bifaces from the Richardson Island site (9400–8800 BP). These objects were likely used to arm spears and have reworked and shortened tips. A longer variant from Gaadu Din Cave is illustrated in Fedje et al. (this volume).

Richardson Island Raw Materials

In a previous study, Smith (2004) identified the most commonly occurring raw material types at the Richardson Island site. Classification of these types was established using macroscopic visual assessment of the materials, major element compositions as determined through Electron Microprobe Analysis (EMPA), and trace element compositions as determined through Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS) (Smith 2004). Twelve chemically distinct material types were identified (Figure 5). These include: siliceous argillite, shale/argillite[4], three chemically distinct types of rhyolite, varvite, dacite, wacke, tuff, chert, andesite, and basaltic andesite. One visually distinct mate-

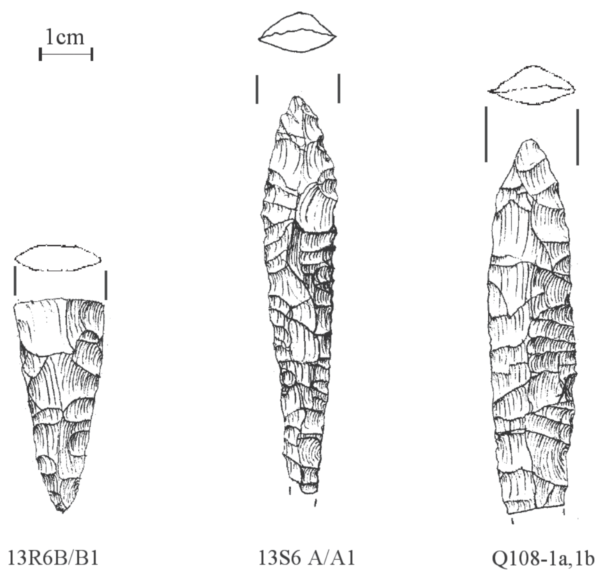


Figure 4. Examples of the Xilju type formed biface from Richardson Island (8800-8700 BP). These objects are stratigraphically separated from the lower Xil type and may have served to arm atlatl darts.

[4] Shale and argillite fall along a continuum of metamorphosed sediment. The Richardson material appears to fall within the transition between these materials.

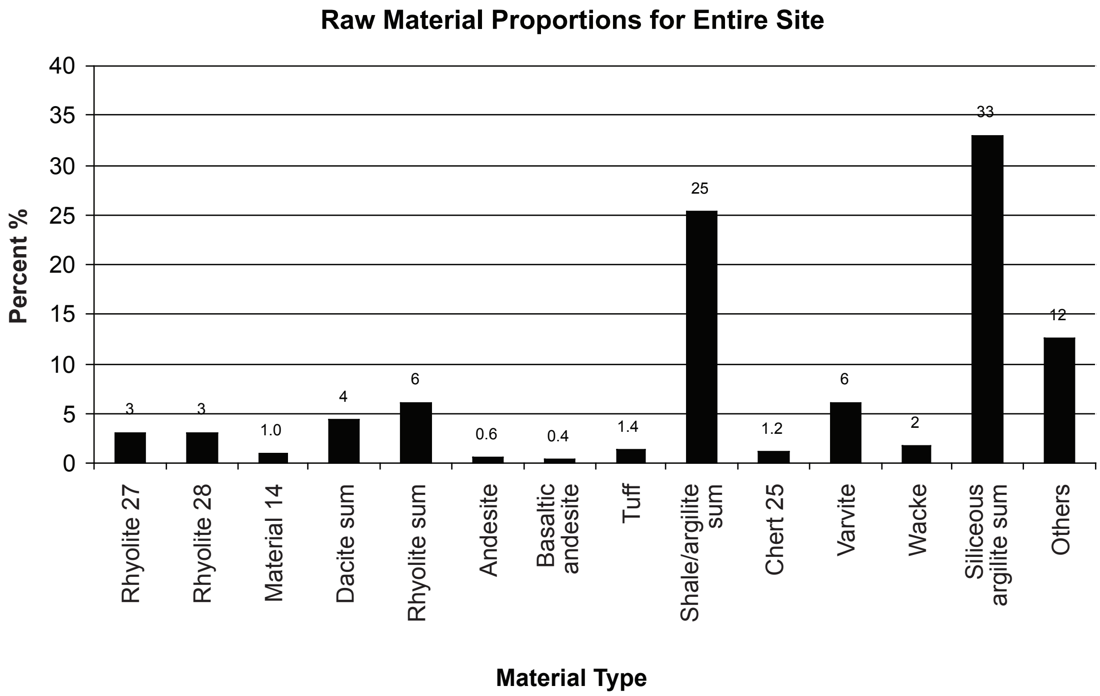


Figure 5. Total raw material proportions for the Richardson Island site (1127T) for all formed tool types.

rial (material 14) was contaminated during analysis and remains unidentified. Infrequently occurring material types were not tested chemically and were lumped into an 'others' category. These 'other' materials account for twelve percent of the raw material assemblage. The most commonly occurring material type at the site is siliceous argillite (Smith 2004).

Figure 5 shows the raw material proportions for the site as a whole. However, both Magne (2004) and Smith (2004) have demonstrated that the raw material proportions at Richardson are not consistently represented through time, and that these changing trends are statistically significant. Figure 6 provides a simple visual of how the proportions of raw material types differ between the Kinggi and Early Moresby components. Most notably there is a decreased dependence on siliceous argillite from Kinggi to Early Moresby, coupled with an increased use of shale/argillite.

The fine stratigraphic resolution at Richardson allows for a detailed look at raw material use through time. Smith (2004) finds that as one moves from the oldest depositional units to the most recent, siliceous argillite use declines steadily and is replaced by shale/argillite as the most commonly used material at 8850 BP. Shale/argillite had been increasing from 9300 BP until 8750 BP at which point it started to decrease in use. Soon thereafter, rhyolite becomes dominant material types. In these later years (8800–8400 BP), dacite use is enhanced and there is a brief occurrence of chert.

Smith attributes many of the raw material changes in the Early Moresby component to the introduction of microblades, a technology that appears to have developed *in situ* (Magne 2004; Smith 2004). The initial microblades at the site were made out of existing or known material types starting 8750 BP. For the next 100 years, however, there was a period of raw material experimentation in which microblades were manufactured out of numerous material types; many types which were not used at the site previously. By 8600 BP rhyolite 27 and rhyolite 28 dominate the microblade assemblage (Smith 2004). Despite the temporal changes in raw material at the site, bifaces remain quite static in raw material use.

Raw Material Use Among Bifaces

Preferred Material of Manufacture

The types of raw material chosen for biface manufacture were identified as part of a broader raw material study at the Richardson site (Smith 2004).

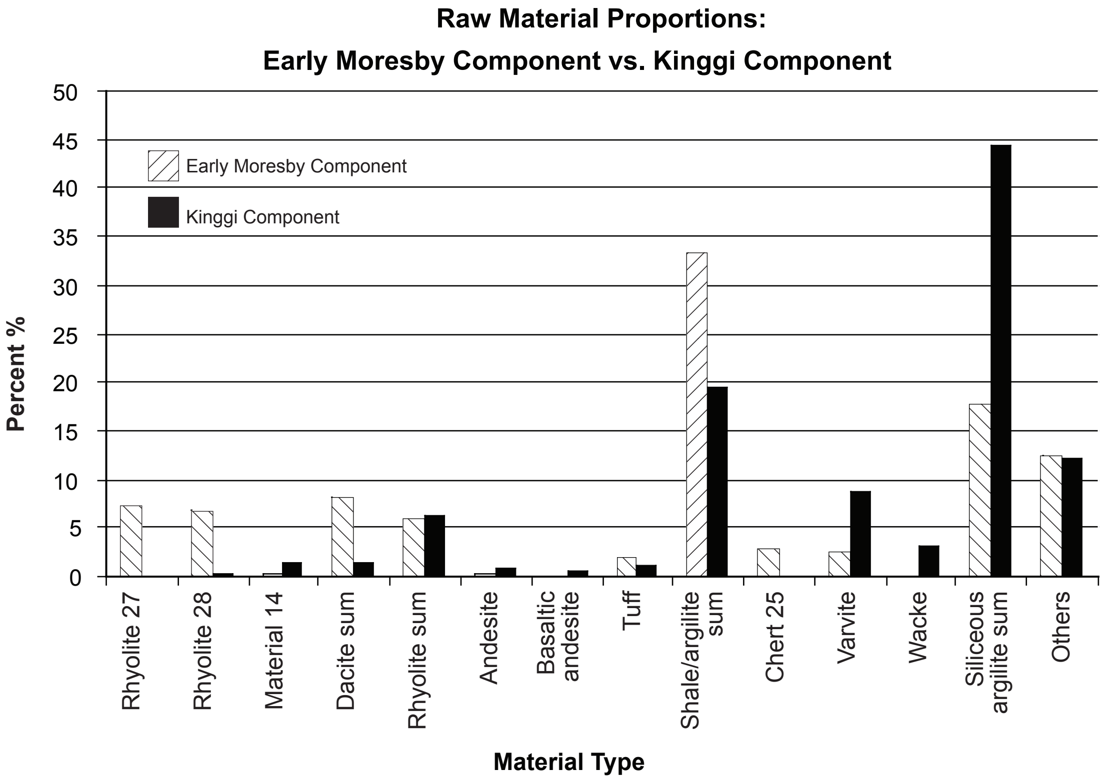


Figure 6. Raw material proportions: Early Moresby Component vs. Kinggi Component for all formed tool types.

Smith found that the most commonly used materials for biface manufacture were siliceous argillite, varvite, shale/argillite, and dacite. Figure 7 illustrates the raw material percentages within the bifacial tool class for the site as a whole, and compares these proportions to the raw material percents in all tools. Figure 7 also indicates that siliceous argillite and varvite occur at higher percentages in bifaces than they do among all the other tools. Smith found that 56% of bifaces were made from siliceous argillite while the same material accounts for 33% of all tools. Varvite accounts for 8% of bifaces and 6% of all tools. 2 x 2 chi-square analyses were run for each of these materials to see if the greater representation of these materials among bifaces was statistically significant, thus indicating a 'preference' for these material types. The results of the chi-square tests indicated that a greater use of siliceous argillite among bifaces was significant ($p = .000$) while varvite use was not significant ($p = .368$). Thus, Smith concluded that the Richardson inhabitants preferred siliceous argillite for biface manufacture (2004).

Bifacial Raw Material Use Through Time

Smith also explored raw material trends through time for individual tool types and found that in comparison to other tools, bifaces changed little in raw material use through time. Figure 8 illustrates the raw material proportions among bifaces in both the Kinggi and Early Moresby components.

Again 2 x 2 chi-square tests were run for each material to determine whether the changes in material proportions between the Kinggi and Early Moresby components were significant. The results[5] revealed that the only statistically significant change was among the shale/argillite group whose proportional use increased in the Early Moresby period.

Viewed alone, these data highlight a change in raw material use among bifaces between the Kinggi and Early Moresby components; an increase in shale/argillite use. Yet in similar raw material analy-

[5] The 'p' values for each material were as follows: siliceous argillite 0.126; varvite 0.735; shale/argillite 0.003; and dacite 0.284 (Smith 2004:146).

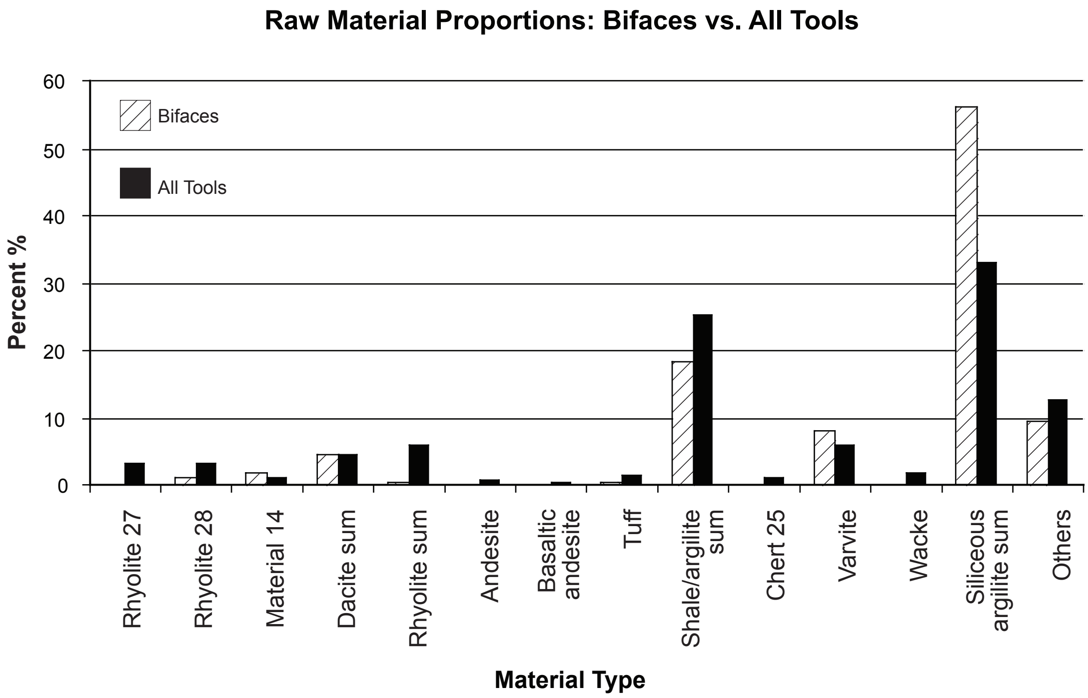


Figure 7. Raw material proportions: bifaces vs. all tools.

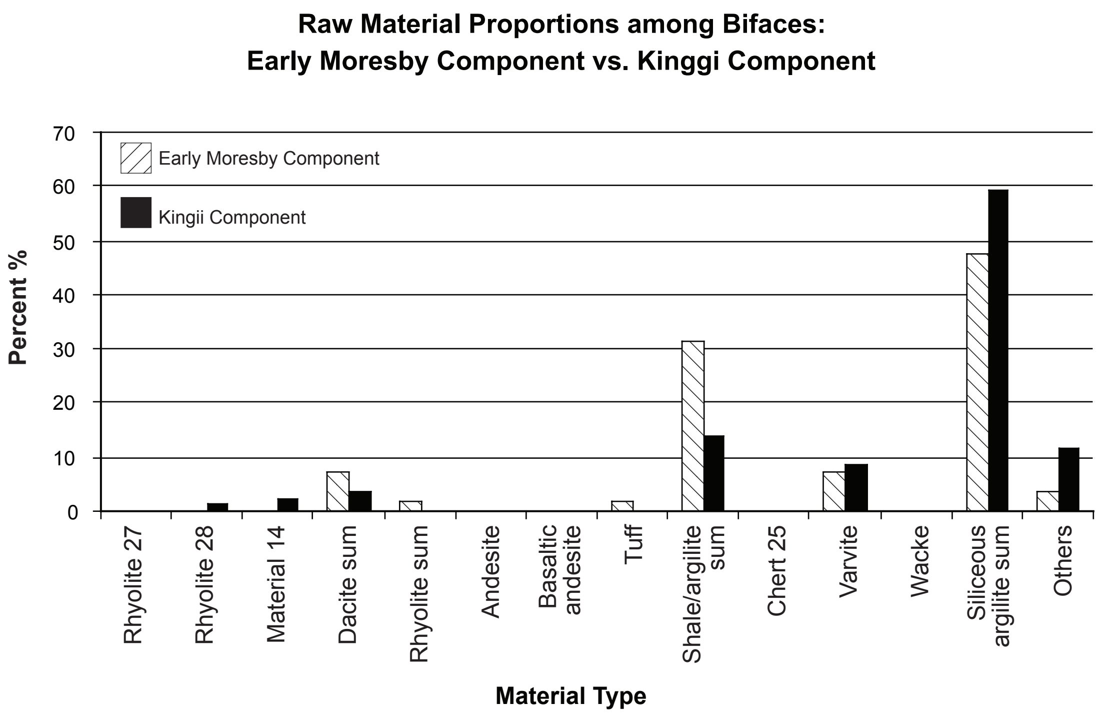


Figure 8. Raw material proportions among bifaces: Early Moresby Component vs. Kinggi Component.

ses for other major tool categories in the Richardson assemblage, bifaces change less than do other tool types. For example, scraperplanes, scrapers, and unimarginal tools show statistically significant decreases in siliceous argillite use between the Kinggi and Early Moresby components, and significant increases in other raw material categories such as rhyolite, dacite, shale/argillite, and tuff (Smith 2004). Thus, the degree to which raw material changes though time varies with tool type.

That the raw material trends are not consistent for each tool type suggests that bifaces had more stringent raw material requirements than other tools and were stable in their raw material patterning. While there was a significant increase in shale/argillite use for bifaces in the Early Moresby component, the proportional use of siliceous argillite, dacite, and varvite was unchanging; this despite an overall significant decrease in siliceous argillite and increase in dacite through time (Magne 2004; Smith 2004).

Methods and Results

This section is divided in two. For ease of readership both sections consider methods and results together. The first section examines binomial, qualitative, and quantitative manufacturing-based attributes of the Richardson bifaces. Eight bifacial attributes (described below) are assessed for the bifacial assemblage, and the occurrence of seven of these attributes through time is presented. The eighth attribute, completeness, is discussed qualitatively. The second section explores the relationship of raw materials and those attributes found to exhibit temporal variation in the Richardson sequence. Given that certain raw materials are time sensitive at Richardson, any apparent temporal trends among bifacial attributes must first be proven not to be influenced by raw material before they are proposed as indicators of purely stylistic or manufacturing change.

Bifacial Manufacturing Attributes

The study of bifaces is multifaceted and can include a number of different insights into past behaviors and relationships. Bifaces are formalized tools that require time and effort to produce as opposed to expedient tools that can be manufactured with little effort (Andrefsky 1998:30). The attributes used in this analysis were selected to distinguish bifacial objects based on manufacturing techniques. Attributes generally used in stylistic analysis, and based on the general outline of the biface, were not used as most of the Richardson examples are foliate bifaces, and lack distinguishing outline features such as notches, defined shoulders, and barbs. Furthermore, some of the bifacial artifacts were very fragmented and it was often difficult to distinguish the tip from the base of these typically bi-pointed artifacts. As the intended goal of this paper is to discern whether there is a change in the bifacial manufacturing practices through time, the chronological character of each biface attribute is presented.

A total of 223 tools classified as bifaces and biface fragments are present in the Richardson assemblage. Smith's (2004) analysis of raw material used in biface manufacture considered all 223 tools. For the purposes of attribute analysis, only 117 were complete enough to undertake the manufacturing practices analysis. The sample sizes from different time periods do vary and this results in some bias in the following results. Table 1 provides a summary of sample size for each temporal unit.

Table 1. Sample size temporal unit.

	Bifaces Used in Manufacturing Strategy Analysis			
100-Year Interval	**Formed Bifaces**	**Biface Blanks**	**Biface Preforms**	**Total**
8500	1	0	0	1
8600	0	0	0	0
8700	3	1	1	5
8800	10	0	3	13
8900	10	2	2	14
9000	6	2	4	12
9100	14	3	12	29
9200	15	5	4	24
9300	5	2	2	9
9400	4	3	3	10
Total	**68**	**18**	**31**	**117**

Manufacturing Stage Attributes

Two attributes were recorded for all of the 117 bifaces analyzed. These attributes are meant to distinguishing technological stages of manufacture within the assemblage.

Biface Manufacturing Stages. To produce a formalized tool such as a biface, a specific manufacturing sequence must be followed (Andrefsky 1998; Bradley 1975; Callahan 1979; Frison and Bradley 1980; Whittaker 1994; Young and Bonnichsen 1994). Based on Johnson's (1989) stages of manufacturing trajectory, the following categories were used (Figure 9):

- Blank: Flake, tabular piece, or spall with a bifacially worked but irregular edge;
- Preform: Biface has a regularized edge (wavy) but not straightened; and
- Formed: Edge straightened.

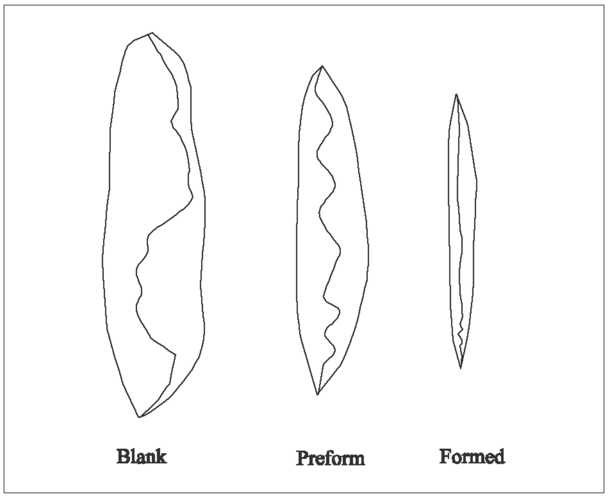
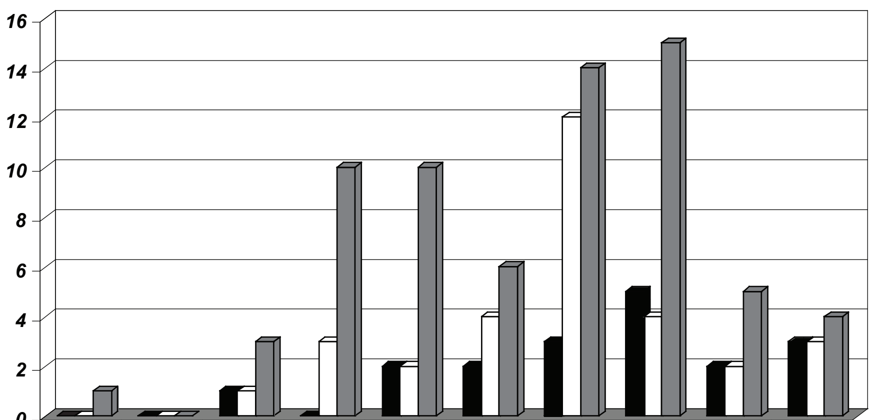


Figure 9. Biface manufacturing trajectory used to distinguish biface stage of manufacture.

Figure 10 demonstrates that the relative amounts of blanks, preforms, and formed bifaces remain fairly constant throughout the Richardson sequence, with formed bifaces dominating each 100-year interval.

Width/Thickness Ratio. The Width/Thickness Ratio of each biface and biface fragment was measured. This measurement was used by Callahan (1979) to distinguish biface manufacturing stages. In general, the ratio increases with each advanced stage of production. This attribute was measured for two reasons: 1) to evaluate whether a scheme for identifying biface manufacturing stage based on width/thickness ratios could be derived from the Richardson material, and 2) to evaluate if different width/thickness ratios were preferred for formed bifaces through time. Biface fragments lacking both lateral margins were excluded from this attribute as were small tip and base fragments.

The analysis of width/thickness ratios reveals that there is a consistent pattern of increasing value (comparatively thinner and wider) as the manufacturing trajectory progresses. Figure 11 reveals relative agreement between stage classification (blank, perform, and formed biface) and width/thickness ratios. This trend appears to be consistent throughout the Richardson sequence.



	8500	8600	8700	8800	8900	9000	9100	9200	9300	9400
■ Blank	0	0	1	0	2	2	3	5	2	3
□ Preform	0	0	1	3	2	4	12	4	2	3
■ Formed Biface	1	0	3	10	10	6	14	15	5	4

Figure 10. Percentages of biface types.

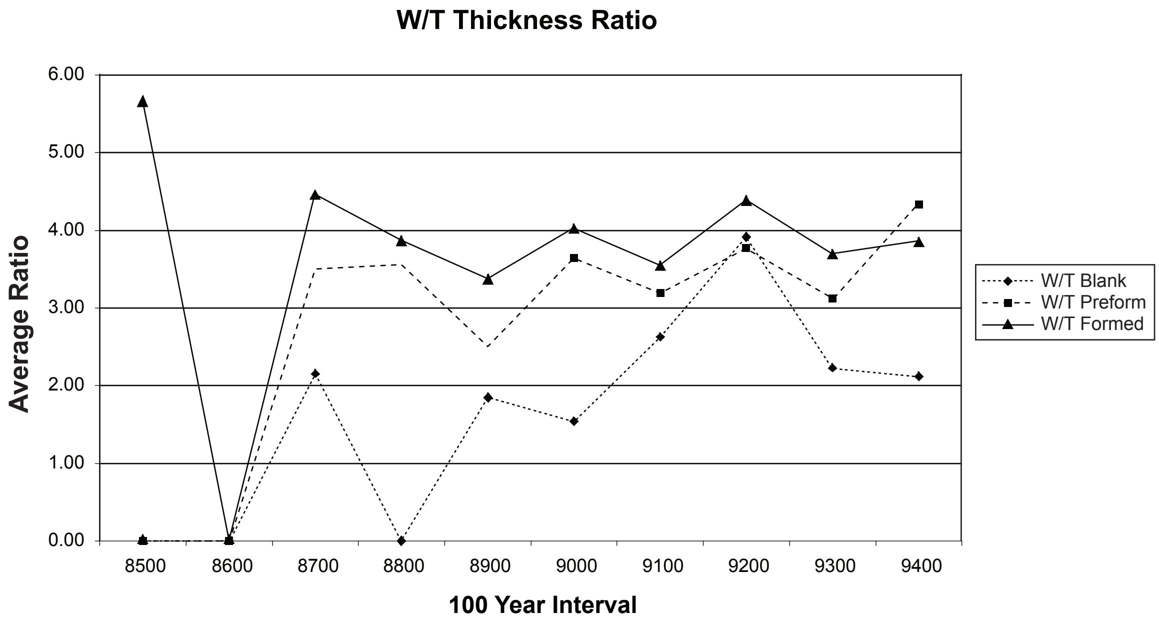


Figure 11. Sequence of identified biface stage and average biface width/thickness ratios for each temporal interval.

Formed Biface Attributes

Six additional attributes were recorded for those artifacts identified as formed bifaces (68 artifacts). These attributes were used to characterize distinct biface manufacturing strategies and are based primarily on steps taken to finish or refinish an artifact.

Flake Scars to Center. When a biface is thinned in its final stages, the flake scars can be knapped so as to travel to or past the medial axis of the object. These long thinning flakes are removed at the final stages of bifacial manufacture for either stylistic or functional reasons. This attribute can be decorative, particularly when flake scars are removed to produce a medial ridge or distinct pattern (Whittaker 1994). This attribute was recorded as present or absent for both sides of each biface.

The distribution of this attribute during the Richardson sequence is presented in Figure 13. This table demonstrates that throughout the historical sequence of biface manufacture at Richardson Island there is a greater tendency to complete biface manufacturing by flaking final flake scars to the center of the artifact on both faces. In the 8700 BP component all of the objects are flaked to the center of the artifact.

Flake Scar Outline. The types of finishing flake scars provide the biface with its final shape and stylistic

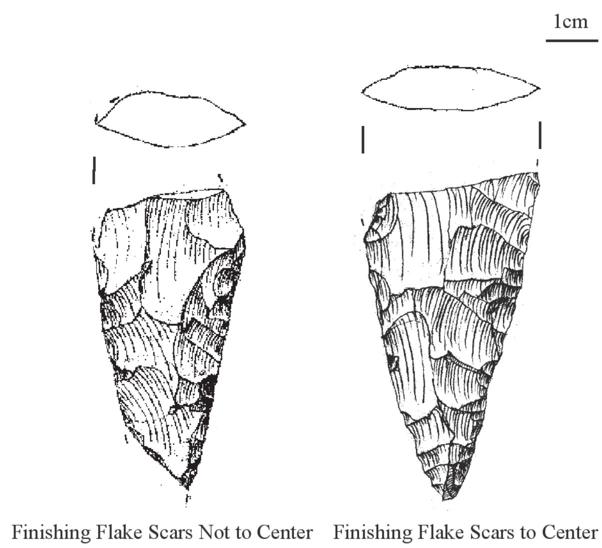
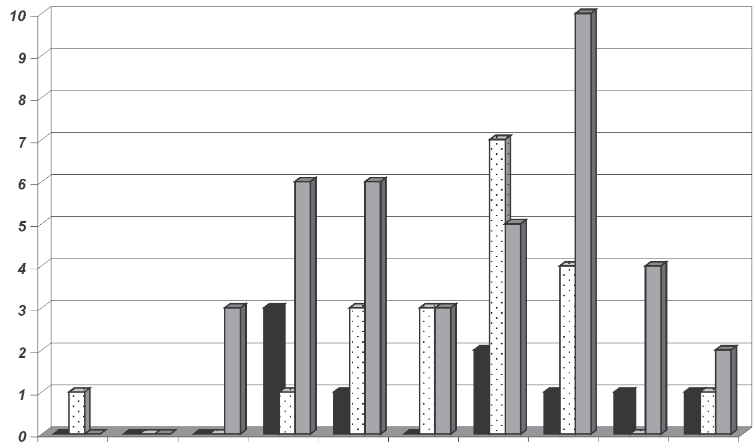


Figure 12. Examples of the finishing flake scars to center attribute.

patterning (Gotthardt 1990). The general flake scar outlines were recorded for the Richardson bifaces, as different manufacturing strategies can produce different flake scar outlines. For example, lamellar flake scars are often indicative of patterned pressure flaking and expanding flake scar are characteristic of soft-hammer thinning (Whittaker 1994). Four variants of this attribute, described below, were recorded during analysis and are pictured in Figure 14:



	8500	8600	8700	8800	8900	9000	9100	9200	9300	9400
Neither Side	0	0	0	3	1	0	2	1	1	1
One Side	1	0	0	1	3	3	7	4	0	1
Two Sides	0	0	3	6	6	3	5	10	4	2

Figure 13. Histogram demonstrating the occurrence of flake scar to center attribute on Richardson Island bifaces.

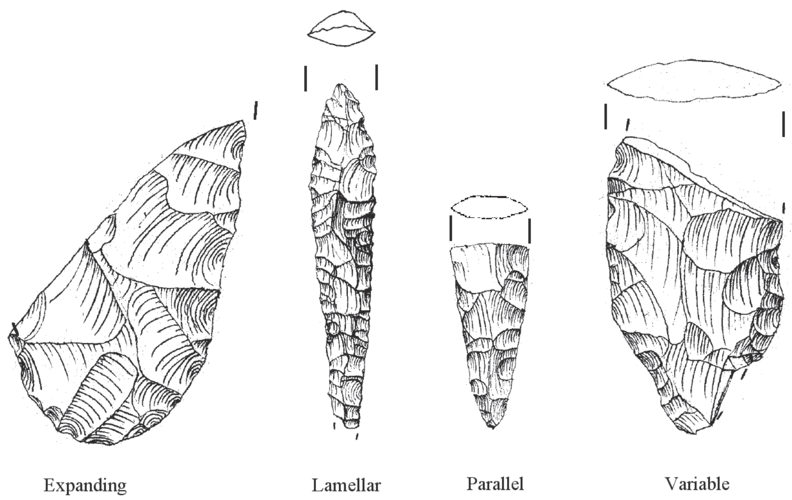


Figure 14. Examples of different bifacial flake scar outlines.

a) Expanding: Flake scars tend to expand towards the distal end of flake scar;
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;
c) Parallel: Flake scars are placed at regular intervals along the margins of the tool, and are struck from a platform located above or below the margins of the adjacent flake scar; and
d) Variable: Flake scars are irregularly placed along the edge of the biface to straighten the edge and/ or thin the biface at chosen locations.

In some instances, traces of two patterns were found on a single Richardson biface and it was necessary to record both variants for the object. Figure 15 reveals that there are some differences in the distribution of this attribute through time. In particular, bifaces with lamellar flake scar outlines appear in the latter part of the sequence. This pattern suggests that this strategy was adopted for bifacial finishing around the commencement of the Early Moresby tradition. The 9000 BP time interval is of interest as all the objects have the variable type of flake scar orientation. Overall the variable form of finishing flake scars is the most common.

Flake Scar Orientation. This attribute is associated with the final thinning of a biface. Carefully oriented final flake scars can produce a particular decorative pattern and are indicative of stylistic choices (Gotthardt 1990). The flake scar orientation variants are defined by the manner in which the finishing flake scars are oriented relative to the longitudinal axis of the tool. Four orientations were recorded for the Richardson bifaces (Figure 16):

a) Co-lateral: Flake scars regularly removed perpendicular to the medial axis;
b) Co-lateral/Oblique: Flake scars regularly removed diagonally to the longitudinal axis; and
c) Sub-radial: Flake scars regularly removed perpendicular to the margin of the tool;
d) Variable: Irregular orientation of final flake scars.

In some instances, it was necessary to record combinations of these manufacturing strategies for individual objects.

Figure 17 reveals that there are some changes in the distribution of this attribute through time. Colateral/oblique and subradial variables do not occur in the early part of the sequence, but are present with varying frequency through the middle sequence and the transition to the Early Moresby Tradition. The colateral variable is absent in the late part of the sequence.

Cross-Section. A variety of cross-sections can result from the flaking strategies, decorative elements, and morphological character of formed bifaces themselves. Six cross-section variants were recorded: flat, diamond, lenticular, plano-convex, plano-diamond, and irregular (Figure 18).

There is little variability in the occurrence of this attribute at Richardson. With the notable exception of the earliest 9400 BP interval (Figure 19), there is an overall tendency for bifaces to have a lenticular cross-section. The plano-convex form is present in the early part of the sequence but is not found in the latter part.

Retouch. This attribute records the presence or absence of retouch along the lateral margins of each formed biface. Retouch may result from reshaping, or from an attempt to regularize the edge of the biface prior to its initial use. The presence of retouch was recorded as present or absent. When present, retouch was classified as bifacial or unifacial.

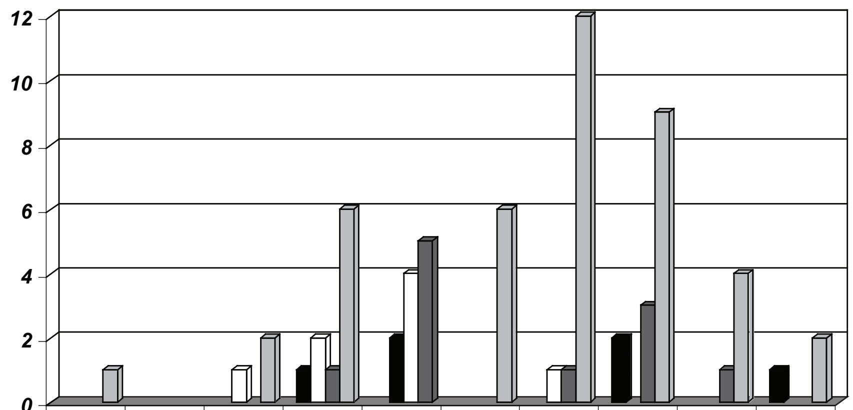
This attribute is relatively consistent through time with all variables represented to varying degrees through time (Figure 20). Overall, the majority of formed bifaces from the collection have been retouched. This pattern suggests that bifacial implements were being resharpened or reshaped for hafting with regularity.

Completeness. A tabulation of whether the formed bifaces analyzed were complete or fragmented was maintained. Only five of the 117 formed bifaces were found to be complete specimens. The remaining 112 objects are fragments the majority of which are basal fragments.

In the case of the Xil type (Figure 3), the end that served as the tip of the implement was at first difficult to determine with certainty. Indeed, some of these same artifacts have been illustrated in other volumes oriented with the elongated part upwards indicating it as the tip (e.g., Fedje 2004). However, it is clear from the later Xilju type (Figure 4) that the elongated part of these objects is indeed stem-like, the Xilju examples being too thin and narrow to withstand any substantial blow without the added buffering protection of a haft element. We argue below that based on the conservative approach to biface manufacturing during the 1000-year occupation at Richardson Island that Xilju technology is derived directly from Xil technology. For this reason, the elongated part of all of the formed bifaces may be considered to be the base or stem.

The following characteristics were considered in distinguishing the bases from the tips of these implements.

- To accommodate the bulk of the haft, the basal half of the biface will be thinner in longitudinal cross-section than the tip.
- There is a tendency for greater retouch and care through retouch to form the haft element so it can fit a specific haft.
- Implements identified as stems have a similar width morphology suggestive of shaping to fit a particular haft size (see Fedje et al. this volume).
- Through microscopic examination (10x–30x) some light grinding and rounding was noted on a few of the objects along the basal margins. In some cases slight indentations were noted along the basal lateral margins of the artifact.



	8500	8600	8700	8800	8900	9000	9100	9200	9300	9400
■ Expanding				1				2		1
□ Lammelar			1	2	2		1			
■ Parallel				1	4		1	3	1	
□ Variable	1		2	6	5	6	12	9	4	2

Figure 15. Histogram demonstrating the distribution of the flake scar outline attribute through time.

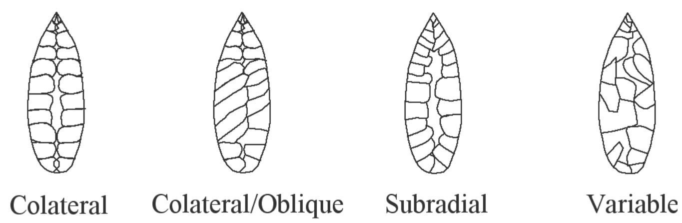
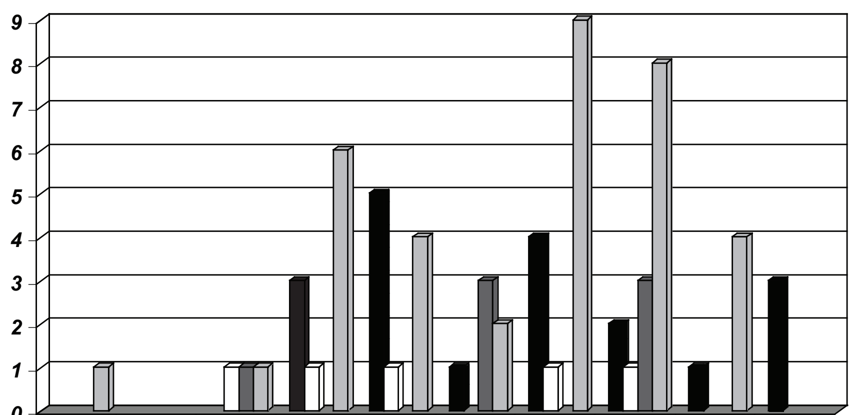


Figure 16. Idealized examples of the flake scar orientation attribute.



	8500	8600	8700	8800	8900	9000	9100	9200	9300	9400
■ Colateral				3	5	1	4	2	1	3
□ Colateral/Oblique			1	1	1		1	1		
■ Subradial			1			3		3		
□ Variable	1		1	6	4	2	9	8	4	

Figure 17. Histogram demonstrating biface flake scar orientation through time.

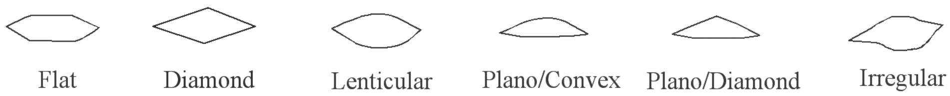
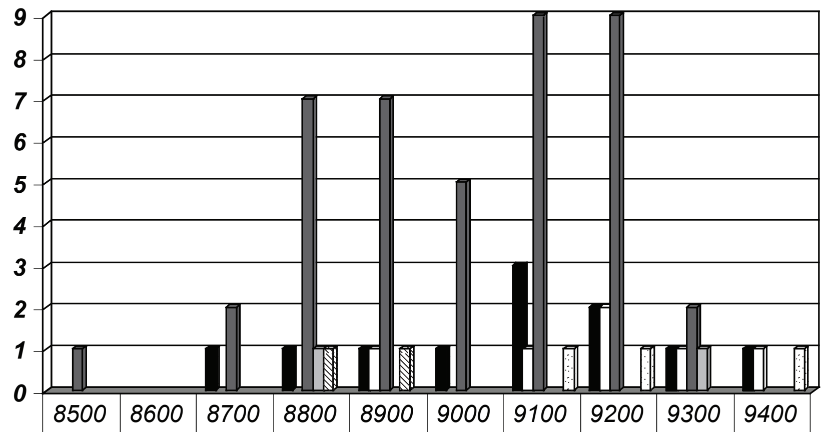
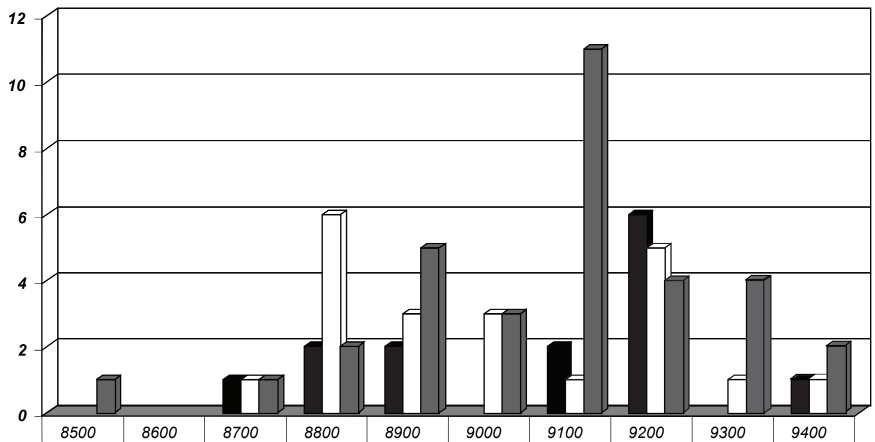


Figure 18. variables of the cross-section attribute recorded for formed bifaces at the Richardson Island site.



	8500	8600	8700	8800	8900	9000	9100	9200	9300	9400
Flat			1	1	1	1	3	2	1	1
Plano-Convex					1		1	2	1	1
Lenticular	1		2	7	7	5	9	9	2	
Diamond-Convex				1					1	
Diamond				1	1					
Irregular							1	1		1

Figure 19. Histogram demonstrating frequencies of the cross-section attribute through time.



	8500	8600	8700	8800	8900	9000	9100	9200	9300	9400
No Retouch			1	2	2		2	6		1
Unifacial Retouch			1	6	3	3	1	5	1	1
Bifacial Retouch	1		1	2	5	3	11	4	4	2

Figure 20. The percentage of bifacial objects with retouch.

- A few of the objects have transverse flake scars dulling the basal margins.
- Based on the broad variety of tools, hearth and structural features, high debitage frequencies, and fauna, Richardson Island is considered a base camp as opposed to a kill site. Rehafting and a higher percentage of base elements would be expected at a campsite, discarded tips at a kill site.

In general, the classification of basal elements was formulated on the basis of more retouch, thinness, and edge smoothing. However, it is sometimes difficult to distinguish a base from a tip in this foliate bi-point technology. Indeed in re-sharpening and re-using the implements, the unique use-life history of bipointed bifaces is practiced. For as both ends are pointed, either can be re-fashioned after breakage into a tip or a base.

Most of the formed bifaces at Richardson Island were manufactured using siliceous argillite, varvite, and shale/argillite (Smith 2004). The sedimentary origins of these rocks have lent to tool fragmentation along shear bedding planes. Thus, several factors have resulted in the highly fragmented assemblage of bifaces found at Richardson Island: breakage along bedding planes during manufacture, breakage through use, and post-depositional damage.

Bifacial Attributes and Raw Material

Of the attributes examined above, two are suggestive of change in manufacturing behavior over time; flake scar outline and flake scar orientation. However, these are also the variables most likely to be influenced by the physical properties of raw material. Raw material constraints have been highlighted as a primary factor influencing tool use-life and assemblage variability (Rolland and Dibble 1990). Two features of raw material that have been shown to affect assemblage variability are: 1) the availability, or accessibility, of raw material (Andrefsky 1994; Bamforth 1986; Dibble 1987; Holdaway et al. 1996; Kuhn 1991; Rolland and Dibble 1990; Roth and Dibble 1998), and 2) the physical characteristics of the material itself (Dibble 1985; Jones 1978, 1984; Kuhn 1991, 1992; Moloney 1988; Moloney et al. 1988). For the analysis of bifacial attributes at Richardson we are most interested in the second point, as the most abundant raw materials have been found to be locally available in high quantities (Smith 2004).

The physical characteristics of stone which have been shown to affect the overall morphology of the tool are the shape and size of the raw material nodule or blank (Dibble 1985; Jones 1978, 1984; Kuhn 1991, 1992), and also the quality or texture of material (Jones 1978; Moloney 1988; Moloney et al. 1988). Different raw materials have been found to exhibit unique flaking characteristics which can limit the morphological outcomes of a tool and influence the degree to which a tool will be retouched (Jones 1978; Moloney 1988; Moloney et al. 1988). Given that the mechanical properties, quality of cutting edge, and number of usable flakes vary according to raw material type, there is a need to consider the role of raw material when analyzing the attributes of a tool assemblage. This is especially true when multiple material types are present at a site, as is the case at Richardson Island.

Thus, to what extent are the bifacial attributes at Richardson influenced by raw material? And how does this affect our understanding of apparent flaking changes in the Early Moresby component of the site? To address these questions, the two attributes (flake scar outline and flake scar orientation) were examined for raw material trends. Flake scar to center, a variable unaffected by time, was also tested for raw material associations. A series of 2 x 2 chi-square tests were used to compare the raw material proportions within each of the bifacial attribute categories. Due to small sample sizes only three material types were considered for each attribute: dacite, shale / argillite, and siliceous argillite.

Raw Material and Flake Scar to Center. The proportions of the material types (siliceous argillite, shale/argillite, and dacite) were examined for occurrences of flake scars approaching center for two sides of the biface, for one side, and for neither side. All chi square tests (again 2 x 2 tests) produced non-significant results, which suggest raw material does not affect whether a biface is flaked to the center.

Raw Material Choice and Flake Scar Orientation. The four types of flake scar orientation (colateral, colateral/oblique, subradial, and variable) were also examined for significant associations with the three raw material types. Only one significant chi-square result was found. This result appeared in the colateral category in which 35% of the shale/argillite bifaces exhibited colateral flake scar orientation, while only 14% of bifaces produced on other materials did. A 2 x 2 chi-square analysis revealed that this is a significant difference ($p = 0.019$), suggesting a relationship between colateral flake scar orientation and shale/argillite.

Raw Material and Flake Scar Outline. The four flake scar outlines described previously (lamellar, expanding, parallel, and variable) were also examined for significant associations with raw material. The expanding flake scar outline was the only category that did not have a significant relationship with a specific raw material type. The remaining three outlines, as summarized below, were each found to have a significant relationship with a distinct material type.

- Lamellar flake scar outline: Twenty five percent of the dacite bifaces possessed lamellar flake scars while only 4% of the other materials did. A 2 x 2 chi square analysis revealed that this was a significant difference ($p = 0.008$) suggesting a relationship between dacite and lamellar flake scars. Both shale/argillite and siliceous argillite produced non-significant results ($p = 0.387$ and 0.414 respectively) for similar tests suggesting that they do not have a relationship with lamellar flake scar outlines.
- Variable flake scar outline: Ninety percent of the bifaces made from siliceous argillite have variable flake scar outlines while 75% of bifaces made from the remaining material types have variable scars. This is a significant difference as revealed by a chi-square test ($p = 0.034$), which indicated a significant positive relationship between siliceous argillite and variable flake scar outlines. Sixty-one percent of bifaces made from shale/argillite have variable flake scar outlines while 87% of bifaces made from the remaining material types have variable scars. This is also a significant difference as revealed by a 2 x 2 chi square test ($p = 0.003$), which suggests that there is a negative relationship between shale/argillite and variable flake scars. Dacite produced a non-significant result ($p = 0.590$) for a similar test suggesting there is no relationship between it and variable flake scar outlines.
- Parallel flake scar outline: Twenty-six percent of bifaces made from shale/argillite were found to have parallel flake scar outlines in comparison to the four percent of bifaces made from other materials with parallel outlines. A 2 x 2 chi-square test revealed that this difference is significant ($p = 0.001$) which suggests that there is a relationship between shale/argillite and parallel flake scars. A similar test for siliceous argillite produced a non-significant result ($p = 0.195$) while the sample size was too small to warrant testing for dacite specimens with parallel flaking.

Discussion

One of the defining features of early components on the Northern Northwest Coast is the foliate biface (Carlson 1996; Matson and Coupland 1995; Fedje et al. this volume; Carlson this volume). This tradition is eventually replaced in Haida Gwaii by microblade technology (Fedje et al. 2005). In other areas of the Northwest Coast, microblade technology is introduced after the appearance of foliate bifaces, but the microblade tradition does not completely replace the bifacial tradition (Carlson 1996). Overall, the bifaces from the Richardson site are related to the early Holocene bifaces from other parts of the Northwest Coast being in general, foliate shaped. The general foliate shape of formed bifaces at Richardson Island remains very consistent throughout the sequence.

The sequence of manufactured bifaces is exemplified in Figure 21, which provides a visual representation of the stratigraphic relationship of select bifaces from the collection. For each 100-year time interval the earlier reduction and larger use stages are illustrated on the right, and the later reduction and smaller use stages on the left. The tips and bases of these bipointed bifaces were likely used interchangeably throughout the use-life history of the artifact. For this reason, it can be difficult to determine the tip of these tools from the base. While the transition from Xil to Xilju type bifaces emerges between 8800 and 8700 BP, there are unmistakable elements of continuity between the illustrated objects.

Over the 1000-year sequence, the general bifacial template remains fairly stable. In general this biface manufacturing tradition was oriented at producing a foliate shaped biface with elongated stem-like elements. Formed bifaces tended to have straightened lateral margins and an average width/thickness ratio between 3.5 and 5.5. The preferred manner of finishing these bifaces was to remove final flake scars to the center of the object forming a lenticular cross-section.

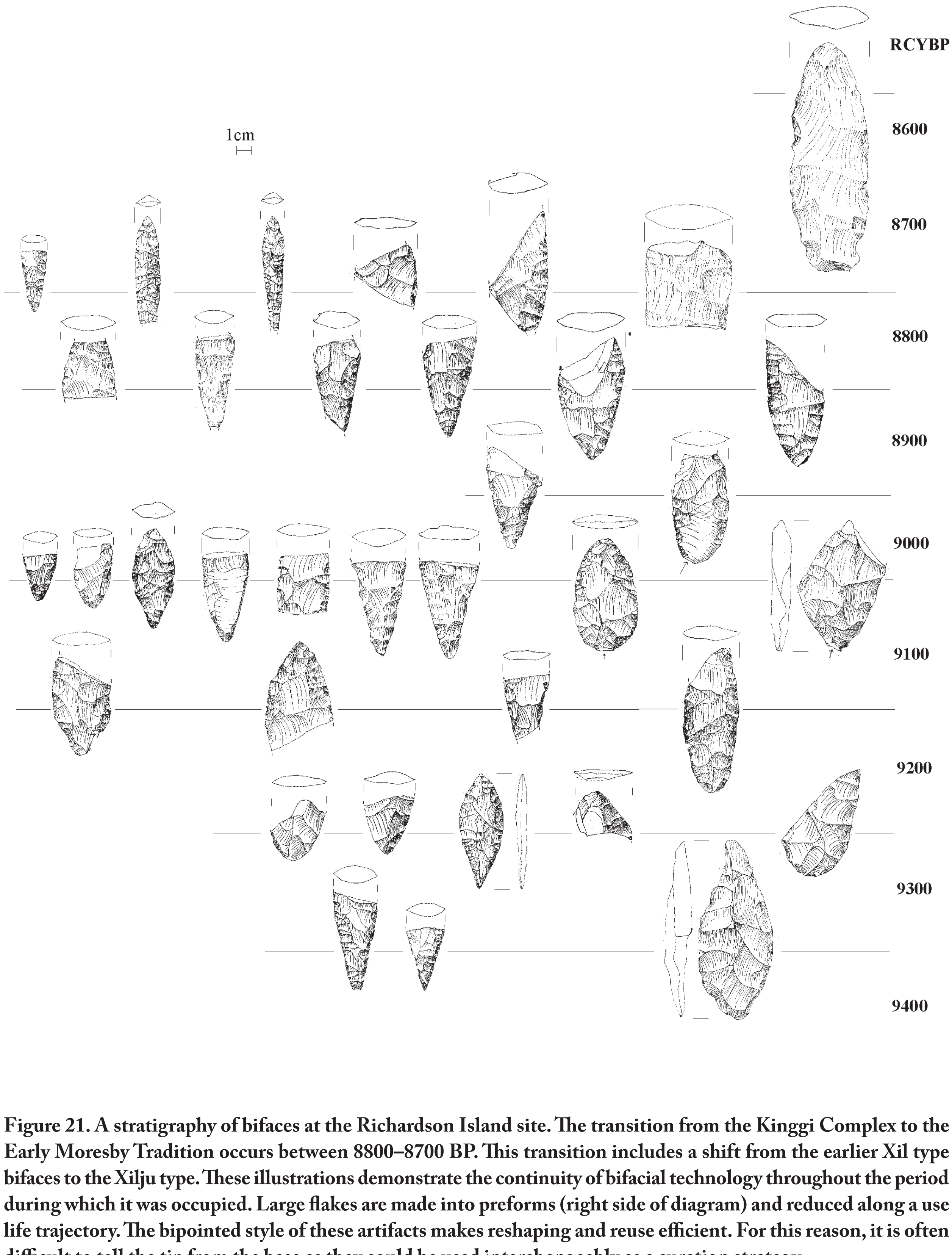


Figure 21. A stratigraphy of bifaces at the Richardson Island site. The transition from the Kinggi Complex to the Early Moresby Tradition occurs between 8800–8700 BP. This transition includes a shift from the earlier Xil type bifaces to the Xilju type. These illustrations demonstrate the continuity of bifacial technology throughout the period during which it was occupied. Large flakes are made into preforms (right side of diagram) and reduced along a use life trajectory. The bipointed style of these artifacts makes reshaping and reuse efficient. For this reason, it is often difficult to tell the tip from the base as they could be used interchangeably as a curation strategy.

Final alterations for hafting involved retouching the margins unifacially or bifacially. Despite this over all conservative approach to biface manufacture through time, there are some changes that can be emphasized, in particular: lamellar flake scar outlines and collateral/oblique flake scar orientations are more common in the latter part of the sequence.

Curiously, these changes occur around the same time as the Kinggi/Early Moresby transition. At first glance, this may be thought to reflect the application of indirect percussion or pressure flaking to biface manufacture. These manufacturing methods are also used in the production of microblades (Whittaker 1994). Significantly this implies that the difference between Xil and Xilju type points is the result of applying microblade type reduction strategies to the manufacturing of bifacial implements. However, when raw material types are taken into account, we found the following positive relationships between attributes and raw material: lamellar flake scar outline with dacite, parallel flake scar outline with shale/argillite, variable flake scar outline with siliceous argillite, and colateral flake scar orientation with shale/argillite. These results suggest flake scar orientation, and particularly flake scar outline, are influenced by raw material.

While all of the materials used for bifaces at Richardson are very fine grained, the different physical properties and homogeneity of the materials (such as bedding planes and fracture patterns), would appear to affect the shape of flake scar. The chi-square results indicate that materials with more homogenous textures such as dacite and shale/argillite offer more controlled flaking possibilities (i.e., lamellar and parallel flake scar outlines). Siliceous argillite, on the other hand, which has the highest silica content of all materials, is less controllable and has a tendency to fracture along bedding planes resulting in variable flake scar patterning. Siliceous argillite is the most commonly occurring material type in the oldest component of the site (Smith 2004), which explains the apparent lack of controlled finishing (i.e., lamellar and parallel flake scar outlines) in the oldest depositional units.

Thus, the increase in lamellar flake scars at the onset of the Early Moresby Tradition may not result from microblade flaking strategies being used on bifaces, but from the increased use of a specific dacite in the Early Moresby component. The increase in dacite use is likely attributable to the period of raw material experimentation associated with microblade production summarized earlier in this paper.

This association of raw material with flake scar outline and orientation is strengthened when one looks at bifaces from Haida Gwaii that pre-date those found at Richardson. Bifaces from K1 cave and Gaadu Din Cave (both caves pre-dating Richardson Island) also have lamellar flaking (see Fedje et al. this volume). The K1 artifacts are made on fine-grained, homogenous chert. The Gaadu Din examples are manufactured from a shale/argillite material. Indeed, lamellar flaking did not emerge in Haida Gwaii after 8800 BP with the introduction of microblades but had been around as a flaking technique for some time.

Interestingly, the 'flake scar to center' attribute has no apparent association with raw material. This suggests it, and other attributes found to have no association with raw material, may be the most reliable attributes for assessing intentional changes to bifacial manufacturing techniques over time. An examination of 'flake scar to center' over time with a larger sample size would make for an interesting follow up study to the results presented here.

Conclusion

This analysis has sought to characterize the bifaces from the Richardson Island site with the aim of identifying changes in manufacturing strategies. Overall, we find there is relative stability in the biface manufacturing tradition at the Richardson Island site. This stability in manufacturing seems to span the transition from the Kinggi Complex to the Early Moresby Tradition.

Superimposed on this stratigraphy of relative stability in bifacial manufacturing techniques are subtle attribute changes that have resulted in the characterization of formed bifaces into two distinct types: Xilju and Xil. The temporal shift from one type to the next occurs concurrently with the Kinggi/Early Moresby Tradition interface when microblade technology is introduced into the assemblage. While Fedje et al. (this volume) suggest that the morphological change may reflect a shift in biface function from spear to atlatl dart, our evidence suggests that the changes in bifacial attributes at Richardson Island are indirectly affected by the emergent microblade technology, which encouraged changes in the relative abundances of raw material types.

Ultimately it may have been the influence of multiple factors (introduction of microblade technology, different raw materials, stabilizing sea levels, and atlatl technology) that led to the morphological shift we see at Richardson These morphological changes, however, were constrained by the existing mental template for biface manufacture. Thus, the change from Xil to Xilju types represents the continuity of the tradition in a changing cultural context. We emphasize that overall, the Richardson bifacial attributes and raw material trends argue for a consistent and conservative bifacial tradition through time. The illustrations of the bifaces from Richardson Island, and their stratigraphic/temporal ordering, the analysis of typological of biface attributes, and the raw material types have been presented here to support to this supposition.

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