Chapter 10

A Sequence of Formed Bifaces from the Fraser Valley Region of British Columbia

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Introduction

This paper presents the results of a temporally oriented analysis of formed bifaces from the lower Fraser Valley region of British Columbia. Formed biface is a term chosen to refer collectively to bifacially reduced projectile points and knives. The objective of this paper is to create a regional sequence of formed biface types for comparative purposes. The typology of bifaces was formulated based on assessments of specific artifact attributes that were evaluated statistically using cluster analysis. Since the majority of the artifacts analyzed in this study were from dated contexts, the types revealed through this analysis are associated with a given time span, which provides a chronological sequence of formed biface types from the region. Overall, we found that some of the types resulting from our analysis persist over long time periods, while others are present over shorter durations. After clustered types were established, the temporal sequence was used to cross-date surface collected artifacts from the Stave Watershed region. Our specific research goals were as follows:

1) To investigate how biface types vary temporally and spatially within the study area.
2) To identify temporal associations between undated, surface collected bifaces from the Stave Watershed and bifaces from dated contexts within the Fraser Valley region.

The study area lies between Hope to the east and the Surrey Highlands to the west (Figure 1), and is included in the territory of the Sto:lo Nation. The Fraser River is the primary watercourse flowing from east to west through the study area and bisecting the Coast and Cascade mountain ranges that rise to the north and the south of the river valley.

The study area is at the periphery of one of the most intensively investigated regions of the Northwest Coast of North America, the Gulf of Georgia (Fladmark 1982; Matson and Coupland 1995; Mitchell 1990). Excavated sites in the lower Fraser Valley have played a significant role in the development of the area's archaeological culture-history, in the western portion of our study area in particular. The canyon of the Fraser River lies to the northeast of the study area and is a region that has also been intensively investigated archaeologically (Archer 1980; Borden 1968; Mitchell 1990; Mitchell and Pokotylo 1996). The area from which materials were drawn from for this analysis lies in between these archaeologically renowned areas of the Fraser Canyon and Gulf of Georgia. Formed bifacial artifacts are found in all known chronological division of both regional culture historical sequences.

Specific sites from which artifacts were analyzed include St. Mungo, Glenrose Cannery, Pitt River, Telep, Hatzic Rock, Skowlitz, Katz, Silverhope Creek, and Hope Highway (Figure 1, Table 1). There are several other dated sites in the study area not included in the analysis for example Macallum (Lepofsky et al. 2004), Spirit Camp (Pokotylo n.d.), Port Hammond (Antiquus 2001), and Fort Langley (Steer and Porter 1984), or which did not have a sufficient number of radiocarbon dates for our purposes

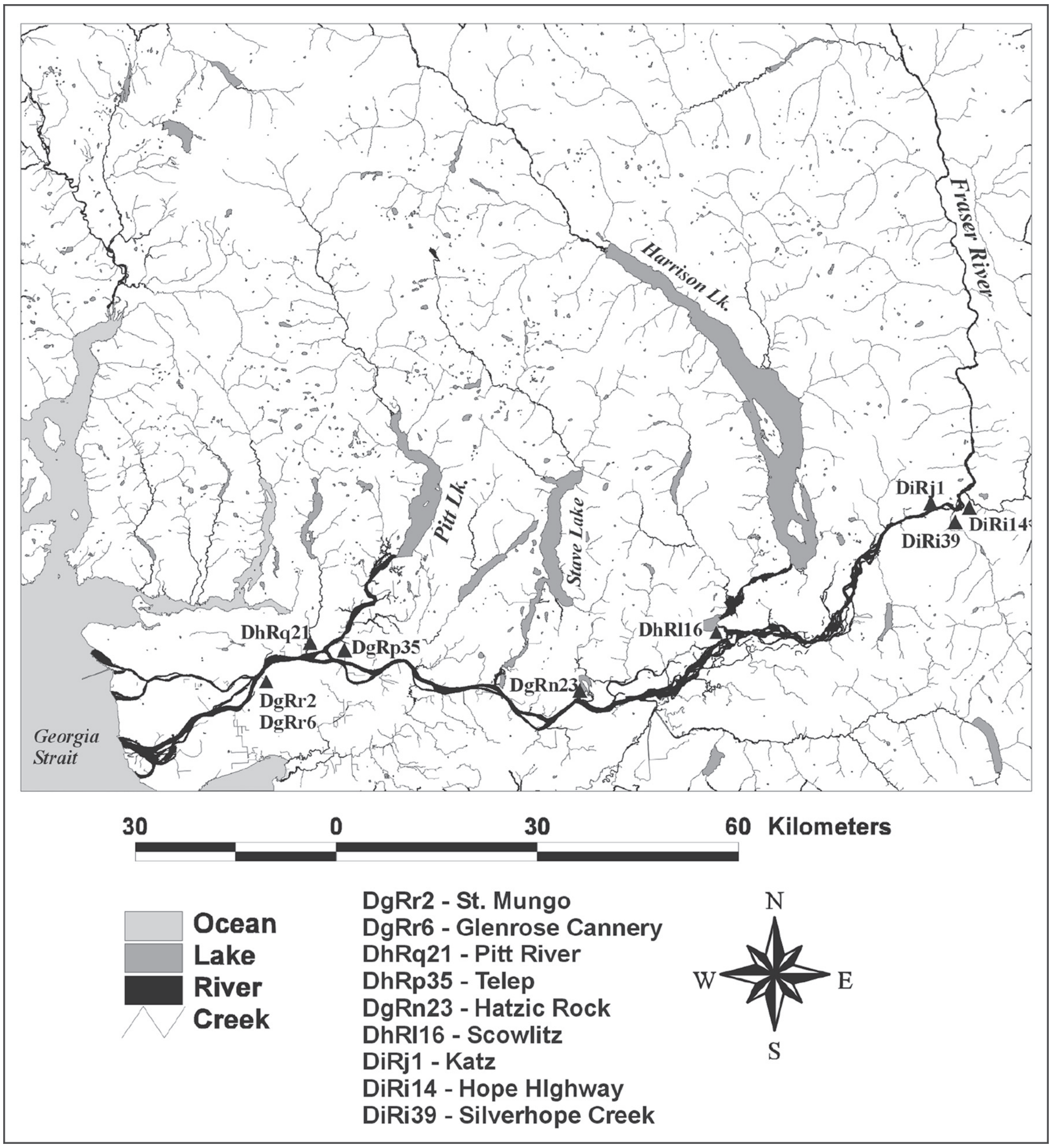

Figure 1. Study area is located in the lower Fraser River Valley east of the Fraser Canyon and west of the Fraser Delta.

(for example the Hope Site), or which have been dated but lack *in situ* bifacial tools (e.g., DhRo–28, DhRn–29 – McLaren 2005).

Several of the sites used in this analysis are of limited use for the creation a regional sequence of formed biface types. This is a result of the often very limited number of radiocarbon dates. For example, Telep, Katz, Silverhope Creek, and the Hope Highway site have very few radiocarbon dates considering the amount of area that was excavated. As a result of this, in some instances it was difficult to determine whether radiocarbon samples characterize the cultural matrices tested. For example, the cultural material from the Pitt River Site Gulf of Georgia culture type component is not typical of other assemblage dating to this time period. In particular, the presence of contracting stem points and labrets is uncharacteristic (Patenaude 1985). In an attempt to resolve this discrepancy, the authors reviewed the excavation profiles, field notes, pictures, and report

Table 1. Sites with analyzed bifaces from dated contexts.

Site Name	Borden Number	Uncalibrated Radiocarbon Date Range BP	Site Description	Source
St. Mungo	DgRr–2	3370 to 4480	Located on southern arm of the Fraser River, this site is the most western site in the study area.	Hamm et al. 1982; Calvert 1969
Glenrose Cannery	DgRr–6	2030 to 2340, 3280 to 4290 and 5730 to 8150	The site is located at the western end of the study area in Delta BC along the south bank of the south arm of the Fraser River.	Matson 1976
Pitt River	DhRq–21	216 to 1190, 2630 to 3300 and 3560 to 4390	This site is situated on the west bank of the Pitt River at its confluence with the Fraser River, in the western part of the study area.	Patenaude 1985
Telep	DhRp–35	2940 to 3180	The site is located at Maple Ridge north of the Fraser River and is situated within the western half of the study area.	Peacock 1982
Hatzic Rock	DgRn–23	4420 to 5050	The site is situated on the eastern bank of the Fraser River in Hatzic near mission, within the central-northern portion of the study area.	Mason 1984
Scowlitz	DhRl–16	330 to 2940	The site is located near the confluence of the Harrison and Fraser Rivers and is within the eastern portion of the study area.	Lepofsky et al. 2000
Katz	DiRj–1	2475 to 2695	The site is in the eastern portion of the study area west of Hope BC and is located on the north bank of the Fraser River.	Hanson 1970
Hope Highway	DiRi–14	2310 to 4080 and 6260	This site is located south of Hope BC and is the most eastern site within the study area.	Eldridge 1982
Silverhope Creek	DiRi–39	310 to 2510	The site is at the eastern end of the study area along the east bank of Silverhope Creek, southeast of Hope, BC.	Archer 1980

pertaining to the Gulf of Georgia component at the site. From these documents it could not be discerned with certainty that the contracting stem bifaces corresponded with features and deposits dated to Gulf of Georgia period. Specifically, the locations from which radiocarbon date samples were selected and the areas disturbed by plough action are not indicated on excavation profiles. Additionally, four of the six Gulf of Georgia radiocarbon dates were from pit hearth features, which were possibly intrusive into older deposits. For these reasons the artifacts are included in the following analysis but are not used to assign biface types to time periods. Unfortunately, this limits the scope of this analysis to the time frame spanning the Old Cordilleran through to the Marpole period in the western part of the study area.

The range of dates from excavated sites with formed bifaces spans 8100 to 250 BP (Figure 2) (all dates used in this article are radiocarbon years BP). Most of the sites in the study area date to the later half of the Holocene and as a result we examined a

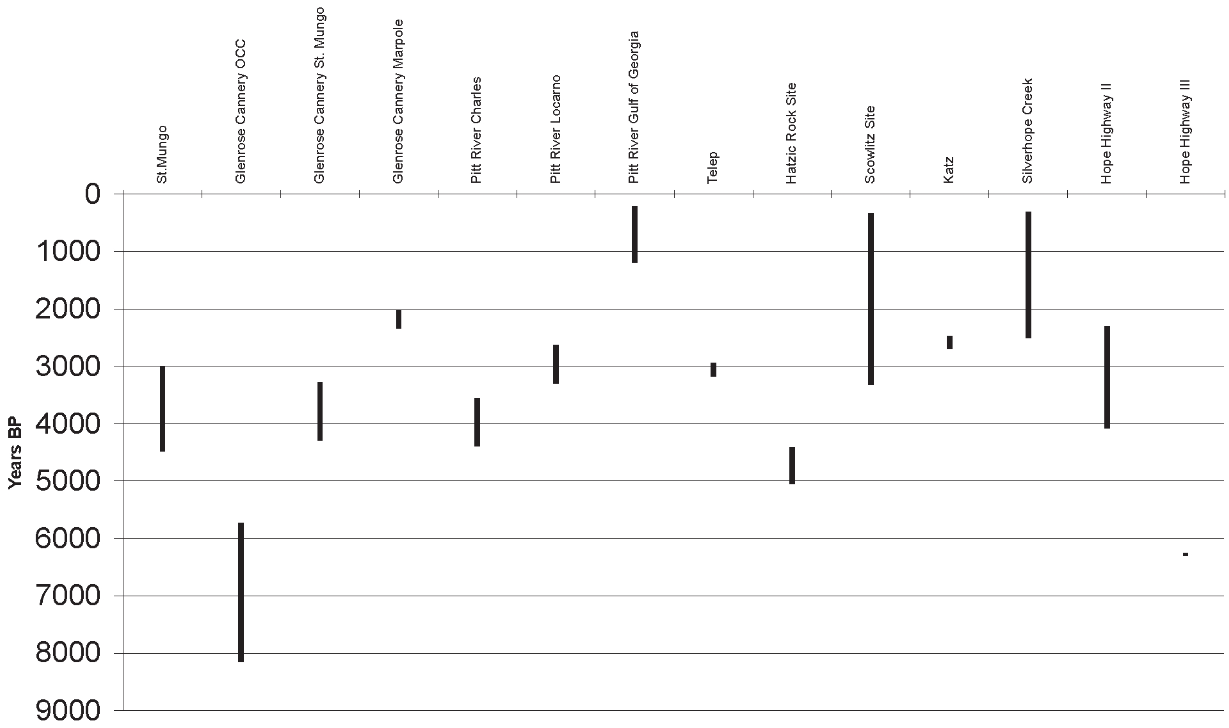

Figure 2. Date ranges for archaeological components from sites used in this analysis.

greater proportion of material that date to the later periods than to earlier phases.

One of the main objectives of this study was to compare undated surface collected material from the Stave Watershed with material from dated contexts in surrounding areas. The Stave River enters the Fraser River at the center of the study area (Figure 3). Archaeological work was initiated in the Stave Watershed by the Kwantlen First Nation and BC Hydro as archaeological inventory and impact assessment projects in the draw down zones of Stave and Hayward reservoirs (McLaren et al. 1997; McLaren and Maxwell 1998). This work resulted in the identification of over 70 archaeological sites. The majority of these are lithic scatters. Artifacts are regularly left in surface scatters as lag deposits while finer sediments are washed away by erosion related to reservoir operation (McLaren et al. 1997). In total, over 100 formed bifaces have been recovered from surface contexts in the Stave Watershed region of British Columbia (McLaren 2003). These lithics are not directly dateable as they are not in their primary depositional contexts. However, based on the general form of collected artifacts it was felt that there is a good possibility that styles from periods spanning the entire Holocene were represented in the collection (McLaren et al. 1997). In a previous study investigating the relative temporality of these objects, a seriation-based analysis was employed (Figure 4) (McLaren 2003). The sequence was cross-dated through a comparison with materials from the different components at the Glenrose Cannery site. The exercise was found to be significant in its ability to associate surface collected material stylistically related to the Glenrose Cannery Old Cordilleran bifaces (8150–5730 BP) and to differentiate these from other surface collected bifaces (presumably dating to other time periods). Surface collected bifaces more stylistically related to the St. Mungo (4290–3280 BP) and Marpole (2340–2030 BP) components could not be distinguished from one another as bifaces from these different temporal periods have many stylistic similarities.

Carlson (1983) undertook an earlier chronological study of bifaces from the surrounding area. This analysis of chipped points from the lower Fraser River and Gulf Islands region reveals a sequence characterized by leaf-shaped points in the

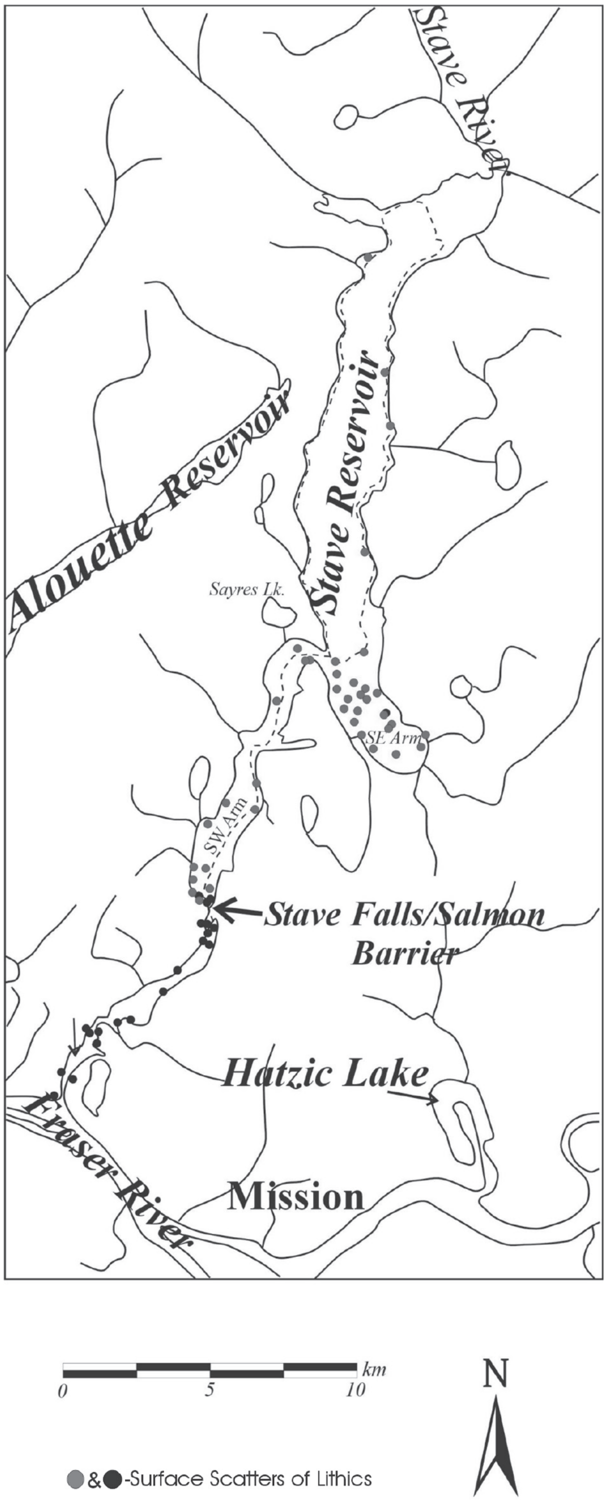

Figure 3. Map of the Stave Watershed where 116 surface scattered bifaces used in this analysis were collected in areas deflated by reservoir operations.

early Holocene, contracting stem forms in the mid-Holocene, and triangular and notched forms being restricted to later Holocene periods. The typology presented here differs in that a broader selection of biface attributes are used to characterize artifacts from various time periods.

The analysis presented in this study expands the comparative basis for cross-dating purposes by including formed bifaces from multiple dated contexts from the region surrounding the Stave area. Several different stages of analysis were undertaken, these include: the recording of the presence or absence of attributes for each bifacial tool, the creation of a typology by grouping bifaces with similar complements of attributes through cluster analysis, and the relating of types to chronological periods by direct association of types to their dated contexts. The surface collected materials from the Stave region were included in the formulation of the typology and so are related to bifacial artifacts from dated contexts by the presence of shared attributes.

Methodology

Biface preforms were distinguished from later stage bifaces following the classification suggested by Johnson (1989:124): formed bifaces were classified as such due to a lack of cortex and existence of straightened lateral margins, rather than markedly wavy or irregular margins that are often present on unfinished tools. For the purposes of this paper, "formed bifaces" include implements commonly identified as bifacially shaped knives and projectile points. Preforms were not analyzed.

For the most part, non-fragmented bifaces were selected for analysis from dated contexts, whereas both biface fragments and complete bifaces from surface scatters in the Stave Watershed were included. In total, attributes were assessed for 372 formed bifaces from the nine dated sites and 25 surface collected contexts. Of these, 116 artifacts were from surface contexts and 256 were from dated sites. From Katz and Skowlitz, only representative samples of the bifaces collected were used in the analysis presented here.

Attributes

The characteristics of all bifaces were assessed using 15 different attributes that were recorded for each

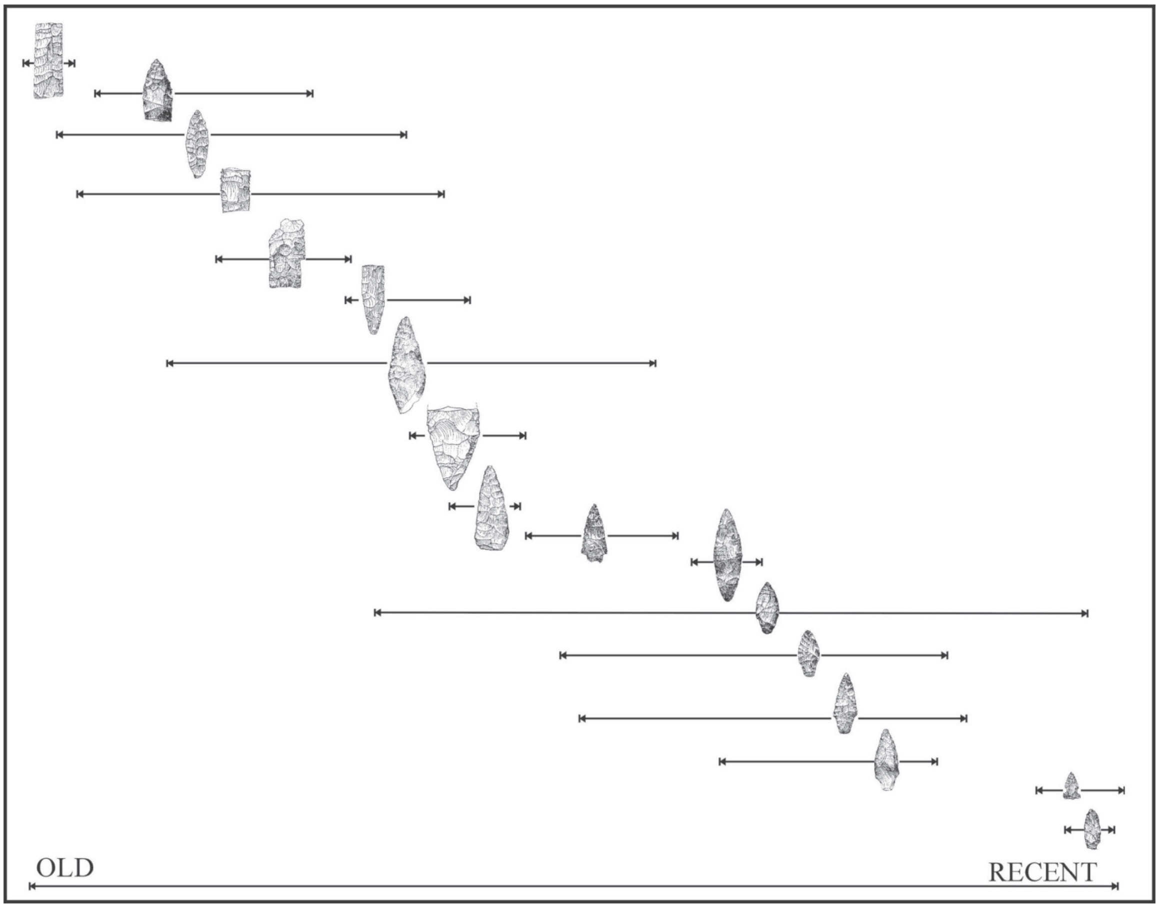

Figure 4. Results of a seriation analysis of surface collected artifacts from the Stave Watershed. Further details of this analysis are provided in McLaren (2003).

artifact. The attributes used for this analysis are derived from other studies of formed bifaces (Callahan 1979; Gotthardt 1990; McLaren 2003; McLaren and Smith this volume; Sanger 1970). Several of the chosen attributes, particularly those associated with flake scars, were selected because they allow the inclusion of formed biface fragments (Gotthardt 1990). The following attributes were recorded for each artifact.

Form. This attribute refers to the general outline of the tool. In most cases a complete or near complete artifact was needed in order to record this attribute. One of the following general forms was assigned in each case: foliate, lanceolate, notched, pentagonal, stemmed, and triangular (Figure 5).

Foliate and lanceolate points were distinguished from one another based on the position of the widest point. In foliate forms the widest point tended to be situated at the middle or closer to the base of the artifact, in lanceolate artifacts the widest point tended to be situated between the middle and the tip of the artifact or were characterized by long, parallel, and straight blade margins.

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

Outline of Flake Scars. Variability in the final stages of flake scar removal can be attributed to different strategies of manufacture. Gotthardt (1990) distinguishes four variants (Figure 5):

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

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

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

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

The presence of multiple scar patterns may be the result of manufacturing, re-sharpening, or curation after breakage. Expanding, parallel, and lamellar flake scar patterns are not always present independently. In some instances the presence of multiple flake scar patterns resulted in our recording the presence of more than one of these variants for a single artifact.

Orientation of Flake Scars. Gotthardt (1990) relates four variables of this attribute. These are described in terms of their orientations with respect to the longitudinal access of the tool (Figure 5). In some instances different flake scare attributes were noted on the same tool and were noted and recorded as such.

a) Colateral: Flake scars regularly removed perpendicular to the medial axis.

b) Sub-radial: Flake scars regularly removed perpendicular to the margin of the tool.

c) Oblique: Flake scars regularly removed diagonally to the longitudinal axis.

d) Random: Irregular placement of final flake scars.

Cross-Section. The cross-section of finished artifacts is related to the flaking strategies adopted by the maker and to the morphological characteristics of bifaces themselves. Several cross-sectional variants were recorded and are depicted in Figure 5.

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

Blade Form. The blade refers to the lateral margins of the bifacial tools from the shoulder or widest point to the tip. The general shape of the blade was characterized as excurvate, straight, recurved, or incurvate (Figure 5).

Denticulate. Blade margins with a denticulate (serrated) edge were recorded as having this attribute.

Stem Form. The stem shape attribute refers to artifacts that have been classified as stemmed. Stemmed artifacts tend to have narrower basal-lateral margins than the width between the blades, the two areas being distinctly separated from one another by a prominent shoulder. The stem variables recorded are illustrated in Figure 5.

Basal Margin. One of several different variables was recorded in order to describe the basal margin of analysed bifacial tools. The variables of this attribute that were recorded are illustrated in Figure 5.

Removals. Two types of removals were recorded: notching and indentation. Notching refers to the intentional removal of small notches in the margins of biface points for hafting purposes. Indentation refers to smaller intentional removals and was recorded only on the basal margin. The indentation and notch variables that were recorded are illustrated in Figure 5.

Shoulders. Shoulders refer to the intersection point between the blade margins and the basal lateral or stem margins of a biface. Shoulders are generally located at the widest place of the biface. Shoulder type was recorded for notched and stemmed biface forms. Shoulder variables that were recorded are listed in Figure 5.

Basal or Lateral Grinding. This attribute was recorded for any point base that displayed basal lateral grinding or basal margin grinding. It is generally thought that grinding was done to dull the sharp basal edges of bifaces in order to aid in handling and hafting.

Length of Complete Specimens. The length of all complete specimens was measured in millimetres. This attribute was not recorded in cases where the entire length of the biface was not present due to

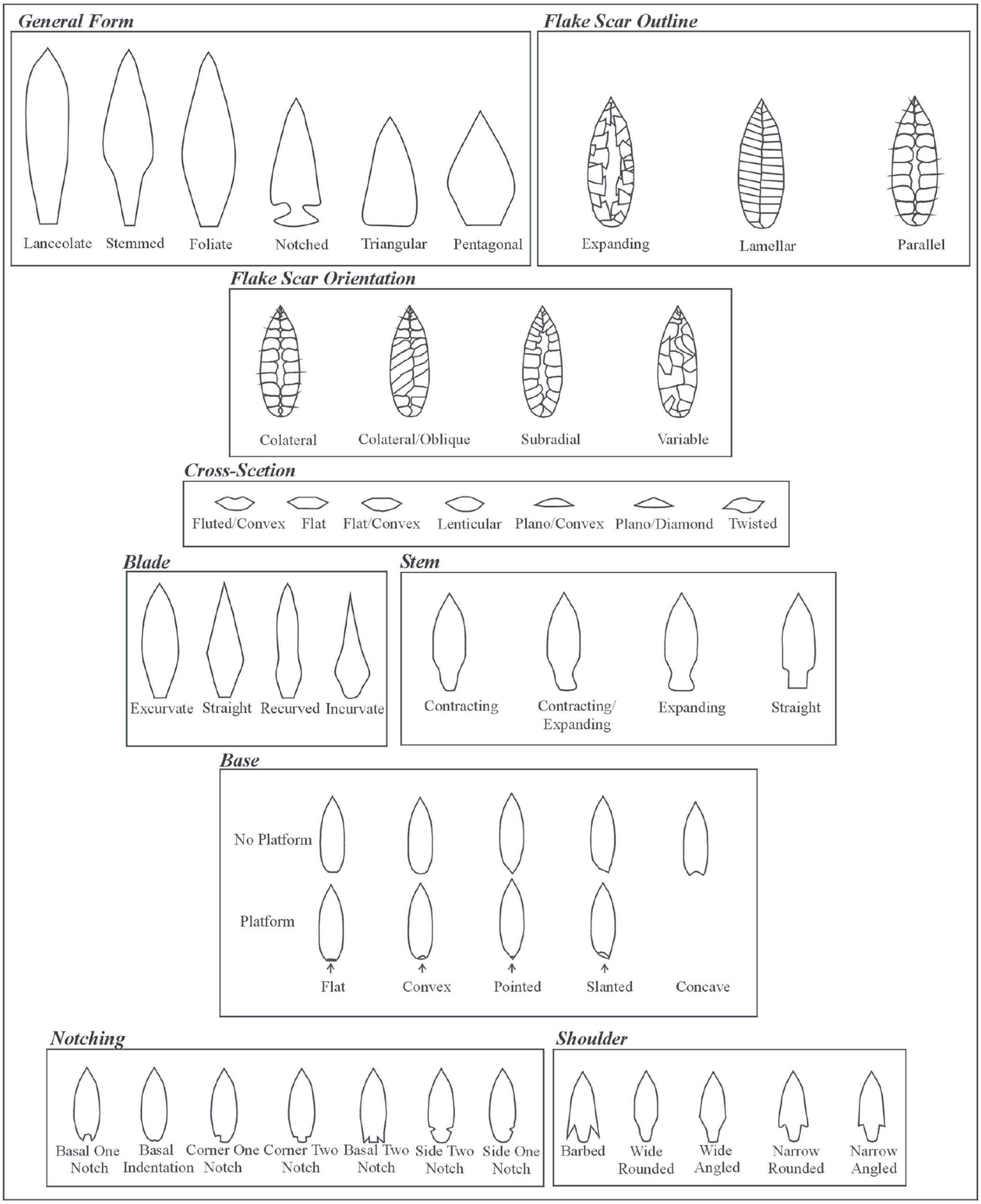

Figure 5. Illustrations used to exemplify variables of biface attributes used in this analysis. The attributes used for this analysis are derived from other studies of formed bifaces (Callahan 1979; Gotthardt 1990; McLaren 2003; McLaren and Smith this volume; Sanger 1970).

breakage. Four variables, each representing a range of lengths, were used to distinguish the relative length of complete specimens. One of the following categories was recorded as present for each biface:

Leng1: 0–29.9 mm
Leng2: 30–59.9 mm
Leng3: 60–89.9 mm
Leng4: 90+ mm

Width/Thickness Ratio. The maximum width and thickness of each formed biface was measured in millimetres and was then compared as a ratio. Callahan (1979) used width/thickness ratios to characterize the completeness of the artifact, with a high width to thickness ratio being considered closer to a complete projectile and those with lower width/thickness ratios being closer to preforms. The following variables were used to categorize the measurements:

W/T1: 0–1.99
W/T2: 2–2.499
W/T3: 2.5–2.99
W/T4: 3–3.499
W/T5: 3.5–3.99
W/T6: 4–4.499
W/T7: 4.5–4.99
W/T8: 5–5.499
W/T9: 5.5 +

Analysis

The variables of each attribute were recorded for the 372 bifaces examined according to the preceding criteria. Then, using the WINbasp statistical package for archaeologists, this data was tabulated as being present or absent for each artifact. A cluster analysis was then run in order to separate the formed bifaces into types based on similarities of attributes.

Cluster analysis is a technique used for ordering dataset characteristics to determine which entities are most similar (Kaufman and Rousseeuw 1990; Sokal and Sneath 1963). In this study, hierarchical cluster analysis was used to identify groups of similar bifaces.

Hierarchal clustering procedures consist of two main components. First, one must determine how to measure similarity between cases, which involves the selection of an appropriate method of calculating a matrix of resemblance. The Dice coefficient was chosen for this analysis and can be expressed as:

$$2a/2a+b+c$$

The Dice coefficient measures the frequency of co-occurring shared and unshared variables or attributes. This is expressed in the equation above, where category *a* represents the number of agreements or the joint presence variables within the cases being compared; *b* and *c* indicate the number of disagreements or mismatches. This coefficient is designed for binary datasets in which it is the presence of shared attributes that are of importance. The Dice method disregards paired negative matches and adds additional weight to cases of mutual agreement (Finch 2005). As a result, in cases where artifacts are fragmented (and for which particular attributes could not be recorded), the Dice coefficient does not count the missing attribute as an indication of similarity.

Second, having chosen a method for measuring similarity between cases one must select a method for grouping the individual cases together. This requires the choice of a clustering algorithm. Agglomerative clustering algorithms begin by grouping the two most similar cases together and then cases are added to groups at different levels of similarity until each case has been grouped. The average linkages algorithm was used for this study. This method defines similarity between cases based on the average of the similarity coefficients within successive clusters. This average is the basis for membership by new cases (Kaufman and Rousseeuw 1990). The average linkages algorithm is the most widely used method for archaeological clustering analyses (Shennan 1990).

The results of hierarchical cluster analysis are charted as a dendrogram. In order to attain separate clusters one must decide where to 'cut' the dendrogram so that the optimal number of groups is found. A heuristic approach is most common (Aldenderfer and Blachfield 1984) and was employed in this study.

Results

The cluster analysis was run and a dendrogram was produced (Figure 6). The dendrogram was cut and 17 clusters were identified, leaving 115 artifacts as unclustered residuals. For each cluster, or type, a summary sheet of attributes contributing to those types was generated. This enabled the following description of each type based on the most important attributes.

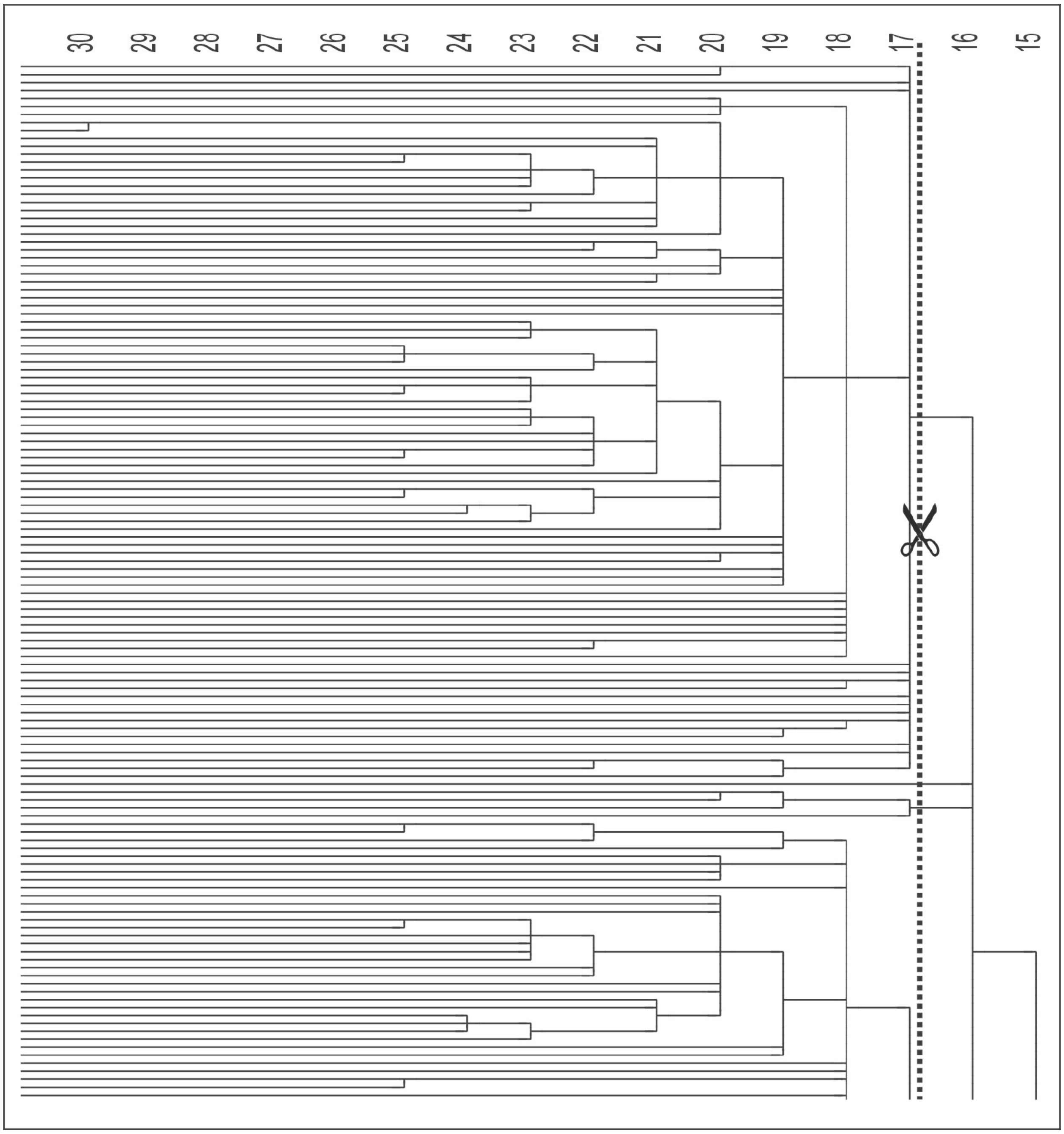

Figure 6. Detail of resulting dendrogram from the cluster analysis used to derive formed biface types based on commonalities in attributes. The dendrogram was cut at the 17th level, which allowed for the maximum number of cases to be included within a coherent number of groups.

The dendrogram was cut at the 17th level, which allowed for the maximum number of cases to be included within a coherent number of groups. We observed that cutting the dendrogram at a lower level would have excluded a very large number of cases from our analysis, conversely, cutting the dendrogram at a higher level would have produced fewer clusters with many members that are more dissimilar.

Cluster 1 (Foliate Type): This is the largest cluster and included 90 formed bifaces. In form, the artifacts comprising this cluster tend to be foliate shaped with lenticular cross-sections, excurvate blade margins, with pointed or convex basal margins. In size these objects are between 30–90 mm in length and tend to have width thickness ratios between 2 and 4. Finishing flake scars are in a subradial or random orientation with expanding or variable outlines, and lack end thinning. This type was recorded at all of the dated sites from which materials were analysed.

Cluster 2 (Basally Thinned Contracting Stem Type): Four artifacts are included in this group. These artifacts are contracting stemmed points with wide angled shoulders, and lenticular cross-sections. They have a width-thickness ratio between 4 and 5. Flake scars are variable in outline and tend to be random in orientation, with one example being colateral. Three of the objects are basally thinned. This type was recorded at one dated site, St. Mungo, which reveals a temporality between 4290 and 3280 BP.

Cluster 3 (Subradially Finished Contracting Stem Type I): Fifty-four artifacts are included in this cluster. These bifaces tend to have contracting stems, excurvate blade margins, wide rounded or angled shoulders, with convex or slanting basal margins. In size these objects are between 30–90 mm in length and tend to have width thickness ratios between 2 and 4. Finishing flake scars are subradial in orientation and end thinning is lacking, with flake scar outlines tending to be expanding or variable. Less than 50% of the objects have finishing flake scars to the center. Artifacts from Hatzic Rock, the St. Mungo component of Glenrose, Hope Highway, the Locarno component of Pitt River, the Marpole component of Glenrose, Silverhope Creek, and Scowlitz, are all present within this cluster suggesting a temporal span between 5050 and 310 BP. Twelve artifacts in this cluster were from surface collections in the Stave region.

Cluster 4 (Subradially Finished Contracting Stem Type II): Two artifacts are grouped into this cluster. These artifacts are similar to those found in Cluster 3 being contracting stemmed with excurvate blade margins. These objects also have subradial flake scar orientations and variable flake scar patterns. One of the objects is from the Marpole component the Glenrose Cannery site suggesting a temporality of between 2340 and 2030 BP. The other biface in this cluster is from a surface scatter context.

Cluster 5 (Colaterally Flaked Type): A total of 34 artifacts are included in this cluster. The artifacts are characterized by having flake scars to the center, colateral flake scar orientations, and lenticular cross sections. A number of the artifacts in this cluster are fragments that come from surface collected contexts in the Stave area. Those that are complete tend to be lanceolate in form with straight or concave basal margins and evidence of end thinning. Three of the objects in this cluster are from the Old Cordilleran component at the Glenrose Cannery site. This suggests a temporal affiliation of from 8150 to 5730 BP. A fourth object from this site is from the Hope Highway site. Unfortunately, a specific date cannot be assigned based on the site report (Eldridge 1982) or catalogue as no radiocarbon samples were taken from the vicinity of the excavation unit that this object was found in. Most of the material from the Hope Highway site dates between 4080 and 2310 BP, and there is one older date of 6260 BP from cultural matrices. We searched for soil samples from this project for the purpose of acquiring an AMS radiocarbon sample but were unable to find one associated with this biface. Due to uncertainty in the dating of this artifact, we have not used this diagnostic point from the Hope Highway site for cross-dating this cluster. The remainder of objects from this cluster are from surface scatter contexts in the Stave Watershed.

Cluster 6 (Variably Flaked Contracting Stem Type): There are 13 formed bifaces in this cluster. These are contracting stem in form and lack end thinning. These objects differ from the contracting stem points in Cluster 3 as they tend to have variable flake scar patterning and non-lenticular cross-sections. Objects in this cluster come from the Charles component of Pitt River, the St. Mungo component of Glenrose, the Locarno Component of Pitt River. The components span between 4390 and 2630 BP. These sites are spatially grouped at the western end of the study area. Four objects from this cluster were collected from surface scatter contexts in the Stave Watershed area.

Clusters 7 and 8 (Types lacking chronological reference): Two bifaces are included in each of Clusters 7 and 8. These consisted only of surface collected materials without dates. For this reason these clusters have been removed from the analysis.

Cluster 9 (Slanting Base Contracting Stem Type): Two objects are included in Cluster 9. These are contracting stemmed bifaces with variable flake scar outlines and slanted basal margins. One of these formed bifaces is from the St. Mungo component of the Glenrose Cannery suggesting a temporal affiliation between 4290 and 3280 BP. The other biface in this cluster is from a surface context in the Stave region.

Cluster 10 (Notched with Narrow Angled Shoulder Type): A total of 34 objects is included in cluster 10. All of these are notched forms with corner or side notching forming narrow angled shoulders. Flake scars are variable in orientation and variable in outline and lack end thinning. The objects in this cluster originate from Hope Highway, Pitt River Locarno component, Katz, Glenrose Marpole component, Silverhope Creek, and Scowlitz sites. These components span 4080 to 330 BP. The vast majority of these artifacts are from sites in the eastern end of the study area. Only three objects are from surface collected contexts in the Stave area.

Cluster 11 (Flattened Cross-Section Notched or Triangular Type): This cluster includes two formed bifaces, one notched and one triangular in form that have random flake scar orientations, variable flake scar outlines, flattened cross-section, end thinning, and a width thickness ratio between 3.5 and 3.99. One biface in this cluster is from the Locarno component of the Pitt River Locarno site suggesting a temporal span of 3300 to 2630 BP. The other object in this cluster is from a surface context in the Stave Watershed.

Cluster 12 (Type lacking chronological reference): Two objects are included in Cluster 12; there were no dated bifaces within this cluster as it was made up of only undated surface collected materials. For this reason this cluster has been discarded from this analysis.

Cluster 13 (Triangular Type): Three formed bifaces are included in Cluster 13. These objects are triangular in general form with excurvate blade margins. They have variable flake scar outlines, random flake scar orientations, and have been end thinned. Artifacts in this cluster are from the Glenrose St. Mungo component and from the Katz site suggesting a temporal interval for this type between 4290 and 2475 BP. No objects from the Stave watershed were included in this cluster.

Cluster 14 (Notched with Convex Basal Margin Type): Three formed bifaces are included in Cluster 14. These objects are notched in general form with narrow angle shoulders, convex basal margins, and excurvate blade margins. These objects have flake scars to center, a subradial flake scar orientation, and end thinning. Two of the bifaces have been corner notched and the third is basally notched. These objects are between 30 and 59.9 mm in length. Objects in this cluster are from Hope Highway, Katz, and Silverhope Creek. All of these sites occur in the eastern part of the study area and the combined temporal span is 4080 to 330 BP. No objects from the Stave watershed were included in this cluster.

Cluster 15 (Expanding Flake Scar Outline Corner Notched Type): Six artifacts are included in Cluster 15. The artifacts are corner notched. All of these objects have remnant characteristics demonstrating that they are reworked flakes, have expanding flake scar outlines, and random flake scar orientation. These objects are between 30 and 59.9 mm in length. Objects in this type are from the Pitt River Charles components, Glenrose Cannery St. Mungo Cannery, Silverhope Creek, and Scowlitz, suggesting a temporal span between 4390 and 330 BP. No objects from the Stave watershed were included in this cluster.

Cluster 16 (End Thinned Corner Notched Type): Two artifacts are included in this cluster. These are formed bifaces with a general notched form, corner notching, end-thinning, and irregular basal margins. These objects are between 30 and 59.9 mm in length. Objects from this site are associated with the Pitt River Charles component and Scowlitz site with a possible temporal span of 4390 and 330 BP. No objects from the Stave Watershed are included in this type.

Cluster 17 (Sub-Radially Flaked Straight or Expanding Stem Type): Two artifacts are included in this cluster. These are stemmed bifaces in form with one example having straight stem margins and the second having expanding stem margins. The artifacts have expanding flake scar outlines with a sub-radial pattern of flake scar removal and end thinning. These objects are between 30 and 59.9 mm in length. Both of the objects from this type come from the Scowlitz site suggesting a possible temporal range between 3320 and 320 BP.

Residual Artifacts: A total of 115 formed bifaces were not grouped into clusters. Included with these are 43 notched, 37 stemmed, seven foliate, and seven triangular formed bifaces. Twenty-six of these artifacts are from surface contexts in the Stave region, the remainder are from the sites with dated contexts.

Discussion

This analysis establishes broad time frames for groups of similar biface types from various archaeological sites within the Fraser Valley Region. The temporal range for these types was determined based on the presence of bifaces from dated contexts within each cluster. In addition to the human behavioural implications, which are discussed below, there is a methodological basis for our lack of ability in assigning concise time frames to particular artifact types. At the beginning of this study we found that it was often difficult separate the artifact assemblages from each site into different time ranges or components based on the site report or catalogue information. The temporal periods with which specific artifacts are associated could be derived more easily if archaeological cataloguing and reporting procedures routinely incorporated a cross-reference to the date or temporal component linked with each artifact. Regardless of these methodological issues, we were able to address the research questions laid out in our introduction at a broad temporal scale.

How do biface types vary temporally and spatially within the study area?

Examples of artifacts from each cluster and the temporal range associated with these artifacts are displayed in Figure 7. Additionally, the relative percentage of clusters from each dated site is given in Figure 8. We used a conservative approach when assigning temporal periods to the different clusters with the temporal span being defined using the oldest date from the oldest objects in the cluster and the youngest date from the youngest objects in the cluster. More often than not, site documentation did not provide enough specific radiocarbon dating to allow for more constrained time periods to be established.

In general, bifacial manufacturing technology appears to have been practiced conservatively by occupants of this region. In specific reference to the attribute of biface form, for example, the foliate form appears within an at least an 8000 year long period and occurs at all sites in the study area. Contracting stem forms span 5050–216 BP and are found more typically in more westerly sites, showing that the occurrence of these attributes is somewhat spatially constrained. Similarly, notched forms span 5050–310 BP and are found with greater frequency to in the eastern part of the study area. In addition, triangular forms span 4290–310 BP, and lanceolate forms have a more constrained time span of 8150–5730 BP.

The notched form bifaces assessed within this study were present within deposits ranging in age from approximately 5050 to 310 BP and show considerable variability (Figure 9). Unfortunately, the sequence of notched projectile points existing within this study area could not be further distinguished or defined within the current study as it has been for regions such as the interior plateau (Richards and Rousseau 1987; Rousseau this volume; and Stryd and Rousseau 1996). However, the concentration of notched forms in sites at the eastern end of our study area suggests that there was an interior influence on these forms. It is likely that the latter Holocene sequence of notched forms from the interior may be related to the lower Fraser valley region.

In general, triangular form bifaces tend to be found in greatest abundance in the coastal Georgia Strait region of British Columbia (Keddie, this volume) (Figure 10). The low frequency of triangular forms within the study area suggests that this type of point may have been better suited to activities at coastal sites; however, the presence of triangular bifaces at several sites in the study area does show that there were interactions between people within these two regions. Most notably, triangular points occur in contexts dating between 4290 and 310 BP from sites located in both the western and eastern parts of the study area.

Contracting stem forms are found at most sites in the study area but appear to have the greatest frequency within the more westerly situated sites (Figure 11). One contracting stem is catalogued as being from the Old Cordilleran component at the Glenrose Cannery site. A review of the of the catalogue reveals that this object may be more readily associated with the St. Mungo component. Excluding the Glenrose Old Cordilleran artifact and material from the Gulf of Georgia component at Pitt River, the time span for contracting stem points was found to occur between 5050 and 310 BP in both western and eastern parts of the study area.

Overall, this study shows that techniques and style in formed biface manufacturing were conservatively practiced over very long periods of time. Subtle changes in manufacturing do occur and new types

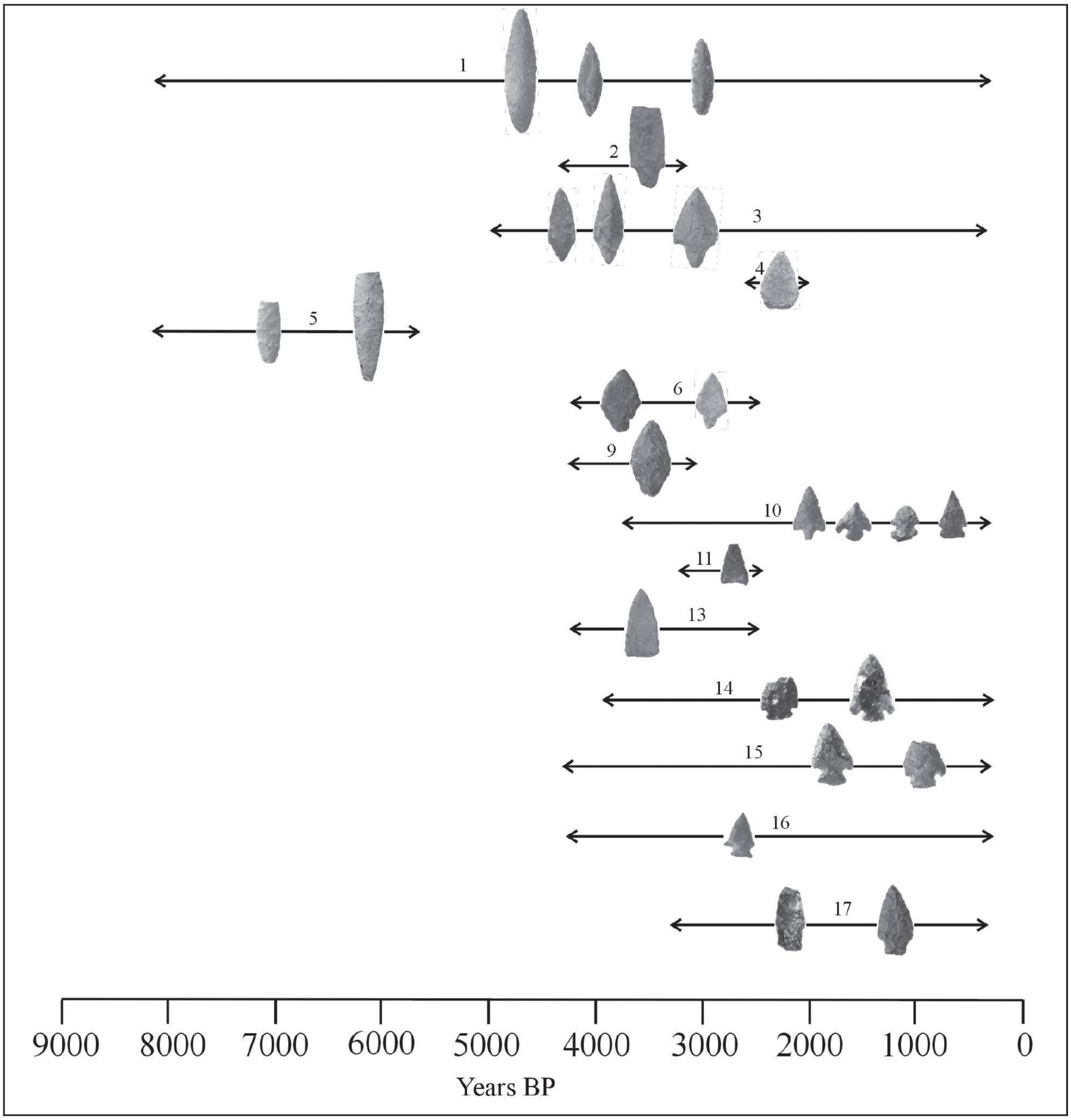

Figure 7. Chart demonstrating the formed biface cluster types and associated dates in radiocarbon years before present.

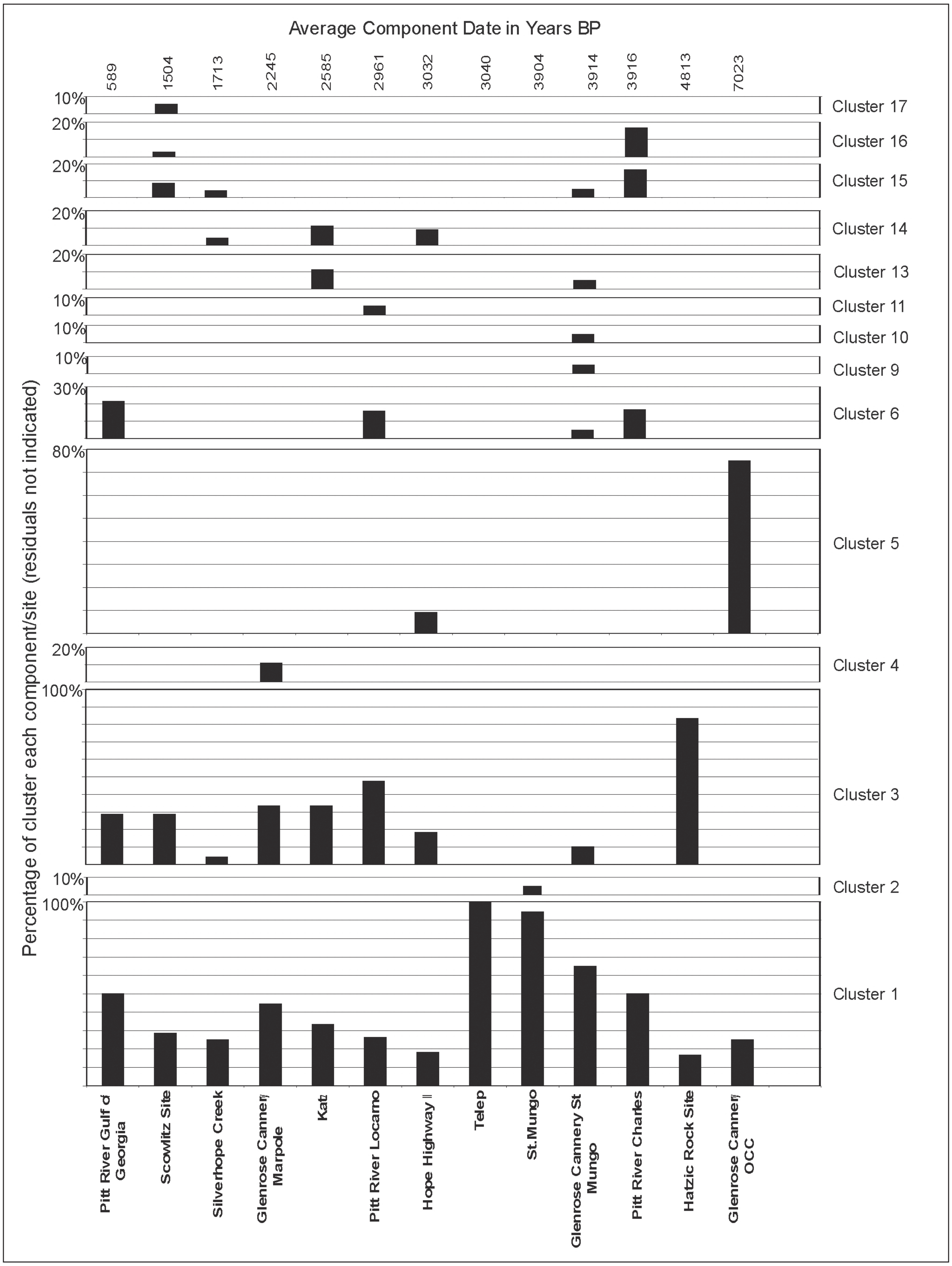

Figure 8. Chart demonstrating the relative percentage of clustered types for each site.

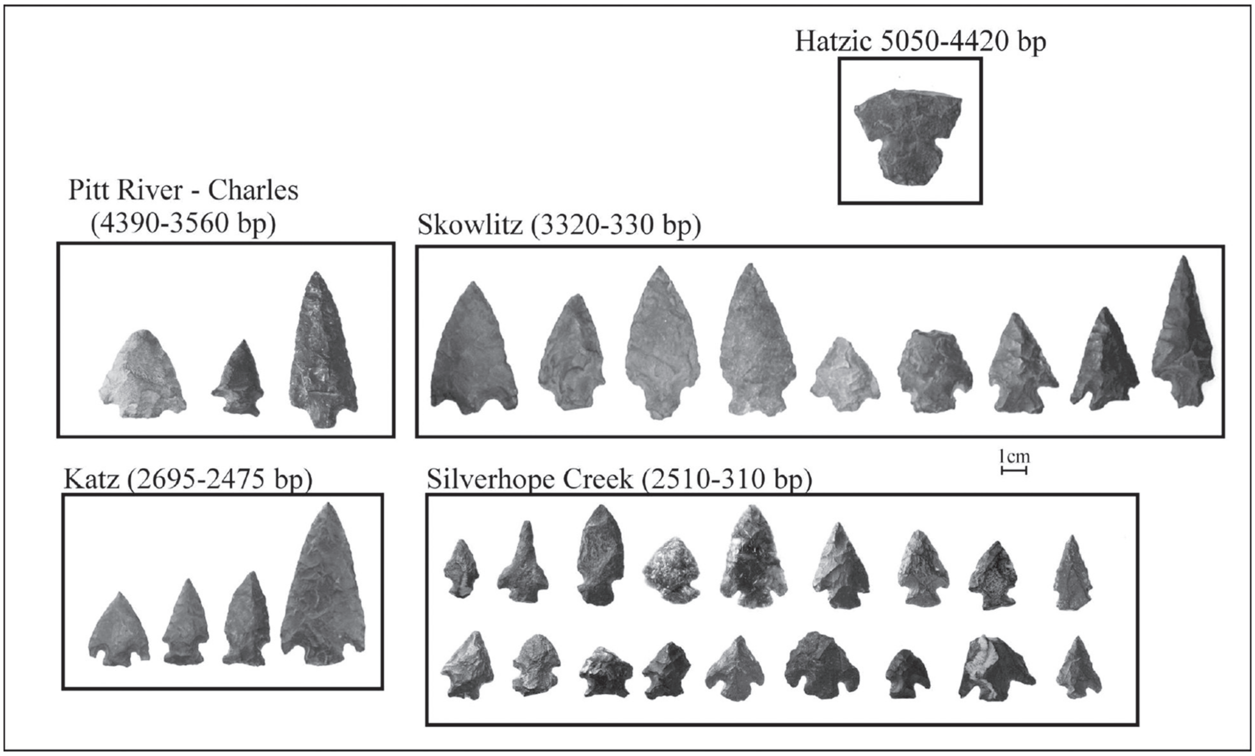

Figure 9. Notched bifaces from dated sites in the study area.

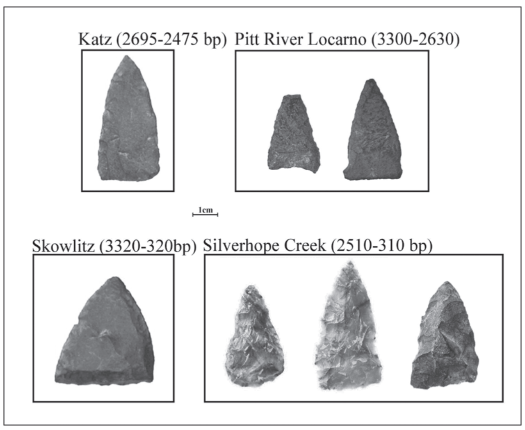

Figure 10. Triangular bifaces from dated sites in the study area.

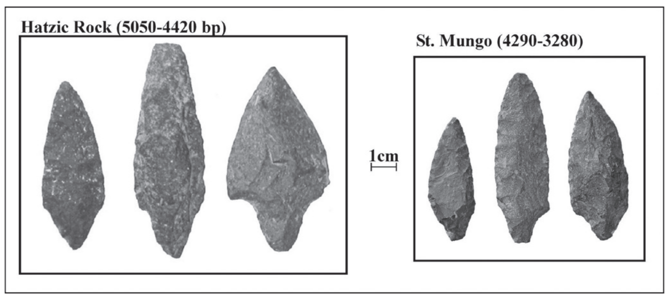

Figure 11. Contracting stem bifaces from dated sites in the study area.

are introduced. However, some types, particularly foliate, have very long durations in the archaeological record. This long-term practice of biface manufacturing tradition, in addition to our troubles encountered in attributing artifacts to specific site components, has made it difficult to separate biface types into smaller temporal frames than are presented here.

How does surface collected material from the Stave Watershed compare temporally to other bifaces within the Fraser Valley region?

One of the objectives of this study was to assess the relative temporality of undated, surface collected bifaces from the Stave Watershed by comparing them to dated types. Hence, by examining the occurrence of surface collected material within each type cluster some generalization regarding the relative age of sites in the Stave Watershed can be made. Table 2 shows the number of artifacts from surface contexts within each cluster.

As shown in Table 2, the type with the highest frequency of artifacts from the Stave region is Cluster 5. These objects tend to have colateral flake scar patterns and are most closely associated with materials from the Old Cordilleran component at the Glenrose Cannery site (8150–5730 BP).

In regards to finishing flake scar orientation, the early and mid Holocene objects tend to have colaterally oriented flake scars and finishing flake scars to the medial axis. Later Holocene formed bifaces have subradial or variable flake scar orientations. The illustration in Figure 12 highlights the unique flake scar patterning and narrowness of the Stave Watershed artifacts within Cluster 5. The fine workmanship and uniqueness of these artifact types differentiates them from later bifaces. Further, similar types to these are known from early Holocene contexts on the Columbia Plateau and Great Basin (Bryan 1980), Plains (Frison 1983), and northern Northwest Coast (Fedje et al., this volume). As has already been stated, elements of these styles are also present in some of the material from the Old Cordilleran component at the Glenrose Cannery site.

The illustrations presented in Figure 12 through Figure 15 present a sequence of formed bifaces from the Stave Watershed region as they were organized in the seriation analysis based on shared attributes (McLaren 2003). Each artifact includes a number at the bottom right corner that indicates the cluster into which that particular artifact was placed in the analysis described above. These artifacts follow a sequential order, with the oldest being depicted on the first page of illustrations and the latest being depicted on the last page. From this figure, it appears that there is relatively good agreement between the seriation results (the relative order of artifacts) and the cross-dating derived from the cluster analysis presented here.

Since undertaking this analysis, further fieldwork has been conducted in the Stave Watershed region. A selection of recently collected bifaces associated with cluster type 5 is presented in Figure 16.

Conclusion

This paper has presented a statistically based approach of comparing formed bifaces from dated contexts to bifaces from undated contexts, for the purposes of cross-dating. A total of 372 artifacts from the lower Fraser Valley region were analyzed from nine radiocarbon dated archaeological sites and 25 surface lithic scatters from the Stave Watershed. Specific attributes for each formed biface were recorded and then a typology was created by comparing objects using cluster analysis. This analysis resulted in the identification of 17 clusters, 14 of which contained artifacts from dated contexts. A temporal span was assigned to each cluster based on the material from dated contexts within each cluster. By extension, this temporal span was used to assess the relative temporality of the surface collected artifacts from the Stave Watershed.

We found that there are temporal and spatial differences between formed biface types in the region. Temporally diagnostic types can be distinguished at broad time scales. By relating common attributes between formed bifaces from dated components with formed bifaces from surface scatters we argue that it is possible to provide relative dates for the decontextualized materials.

This paper has presented a statistical method of evaluating the relatedness of formed bifaces through time and to formulate types based on complements of attributes. The very long duration of several of the formed biface types examined, particularly foliate forms, reveals that lithic tool manufacturing endured as a tradition throughout the Holocene period despite the environmental, social, and other technological shifts that occurred.

Table 2. Cross-dating results for archaeological sites in the Stave Watershed region of British Columbia.

Cluster	1	2	3	4	5	6	9	10	11	13	14	15	16	17	Relative Date Span Excluding Cluster 1
Oldest Associated Date (BP)	8150	4290	5050	2340	8150	3560	4290	4080	3300	2695	4080	4390	4390	3320	
Youngest Associated Date (BP)	216	3280	4813	2030	5730	216	3280	330	2630	2475	310	330	330	330	
DhRo–1	1														N/A
DhRo–10	8		3			3	1			1					5050-216
DhRo–11 (5920-3290 BP)*	1	1	1		6										8150-3280
DhRo–13					2										8150-5730
DhRo–14	1				1										8150-5730
DhRo–16			1		2			1							8150-330
DhRo–17	1				2										8150-5730
DhRo–18			1												5050-4813
DhRo–21									1						3300-2630
DhRo–26 (2530 BP)*	4		2		1	1									8150-216
DhRo–28 (316-287 BP)*								1							4080-330
DhRo–32		1	2	1	1										8150-2030
DhRo–36	2														N/A
DhRn–8					1										8150-5730
DhRn–11 (5570-4790 BP)*	1		1		4										8150-4813
DhRn–14	2	1			2										8150-3280
DhRn–15					1										8150-5730
DhRn–18	1				1										8150-5730
DhRn–25					1										8150-5730
DhRn–26								1							4080-330
DhRn–27					1										8150-5730
DhRn–29 (9270-8590 BP)*	1		1		1										8150-4813
DhRn–32					1										8150-5730
DhRn–33					1										8150-5730
DiRn–2	1														N/A
Total Surface	24	3	12	1	29	4	1	3	1	1	0	0	0	0	79
Total from Dated Contexts	66	1	42	1	4	9	1	31	1	2	3	6	2	2	171

*Dates are ranges based on preliminary testing at these site and does not necessarily apply to the surface collections

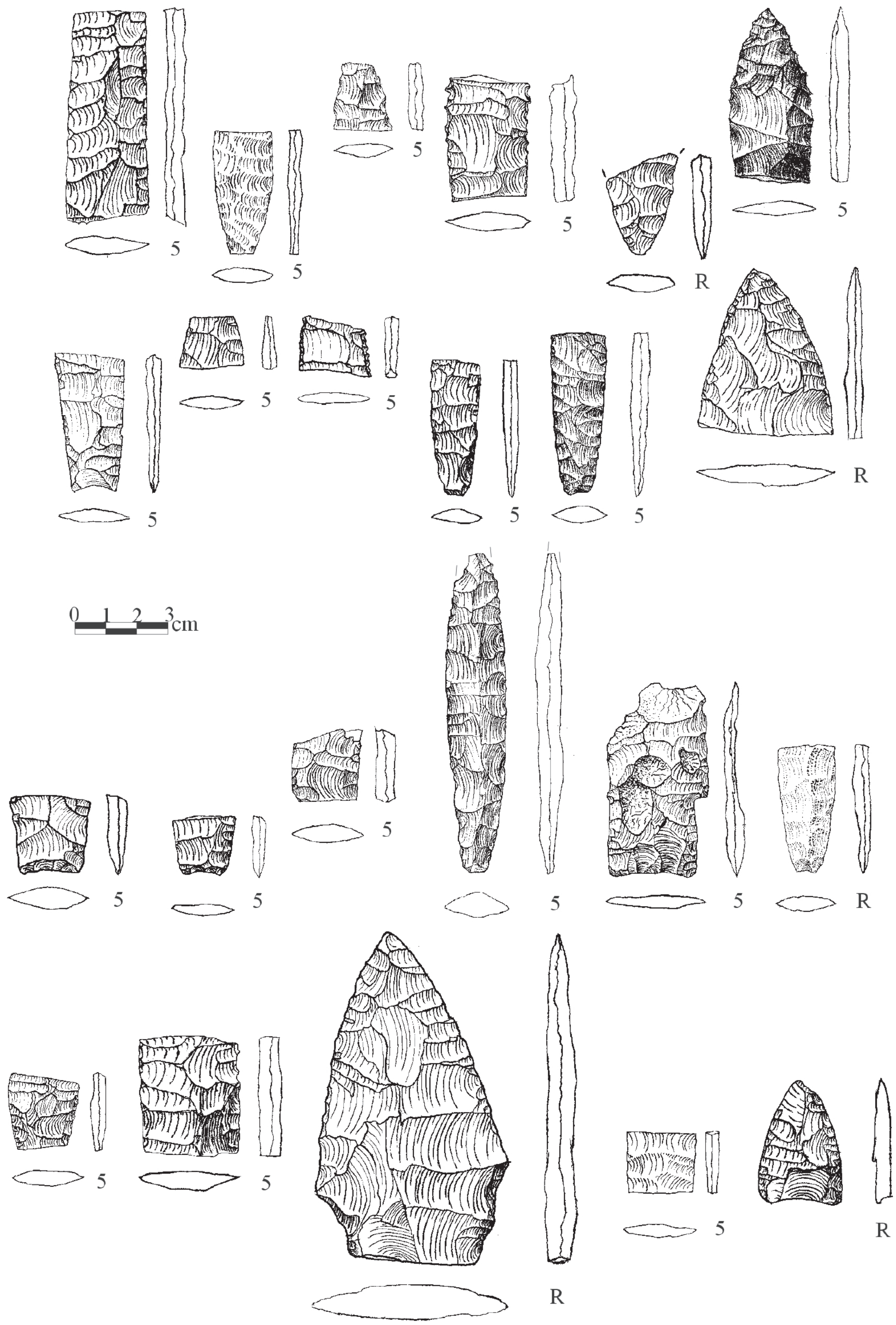

Figure 12. A sequence of bifaces from the Stave Watershed. The formed bifaces illustrated in Figures 12 to 15 have been ordered sequentially based on a seriation analysis presented in McLaren (2003). Cluster types are included as a number at the bottom right corner of each illustration ('R' = residual). The oldest object is at the top left hand corner and the youngest at the bottom right hand corner. This sequence is ordered in rows and continues in Figure 13. Cluster type 5 cross-dates between 8150–5730 BP.

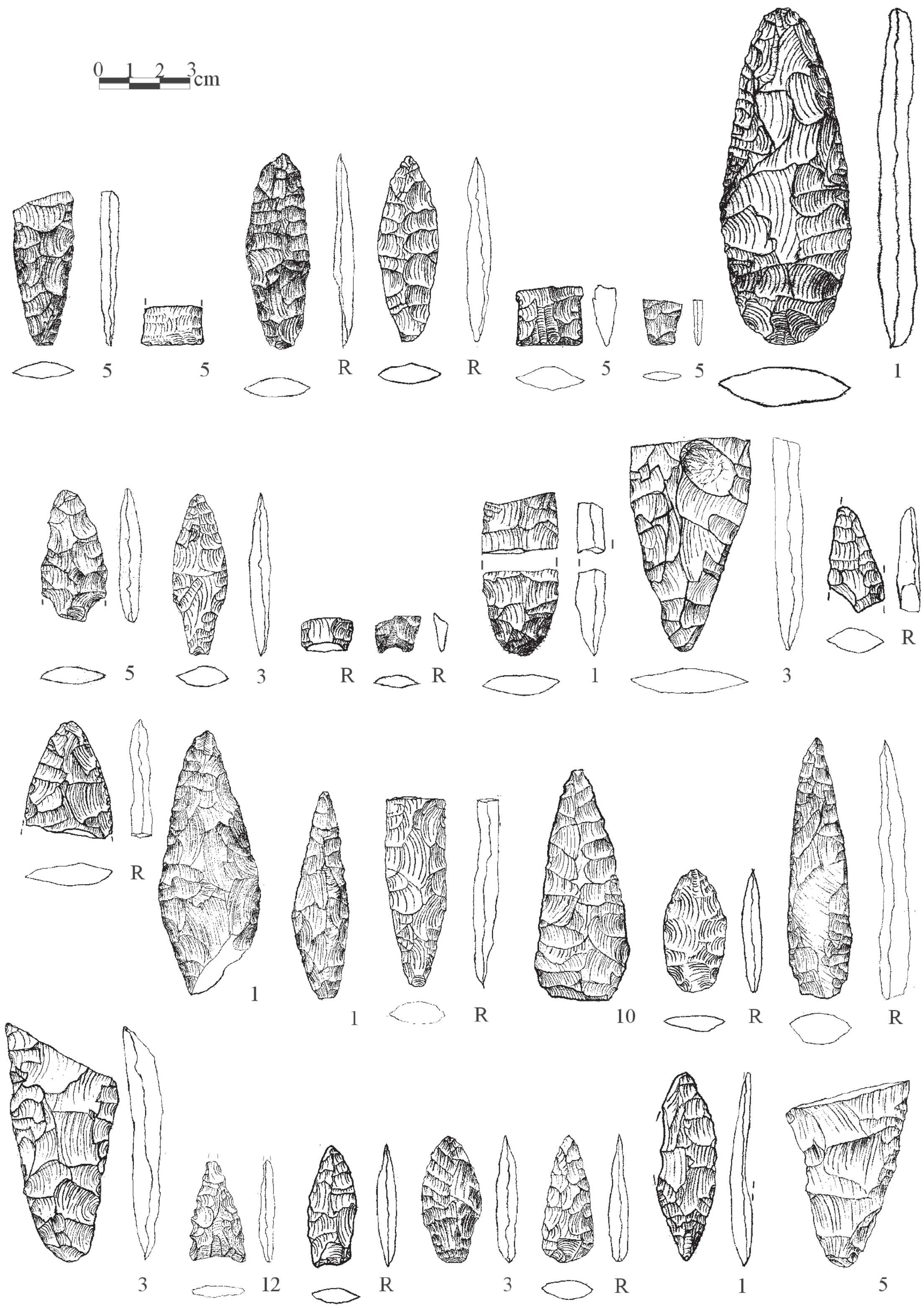

Figure 13. Continued sequence of bifaces from the Stave Watershed. This chronological ordering of formed bifaces continues from Figure 12. Cluster type cross-dates based on the analsyis presented here are as follows: 5: 8150–5730 BP; 3: 5050–310 BP; 1: 8150–310 BP; 10: 4080–310 BP; 12: N/A; and R: N/A.

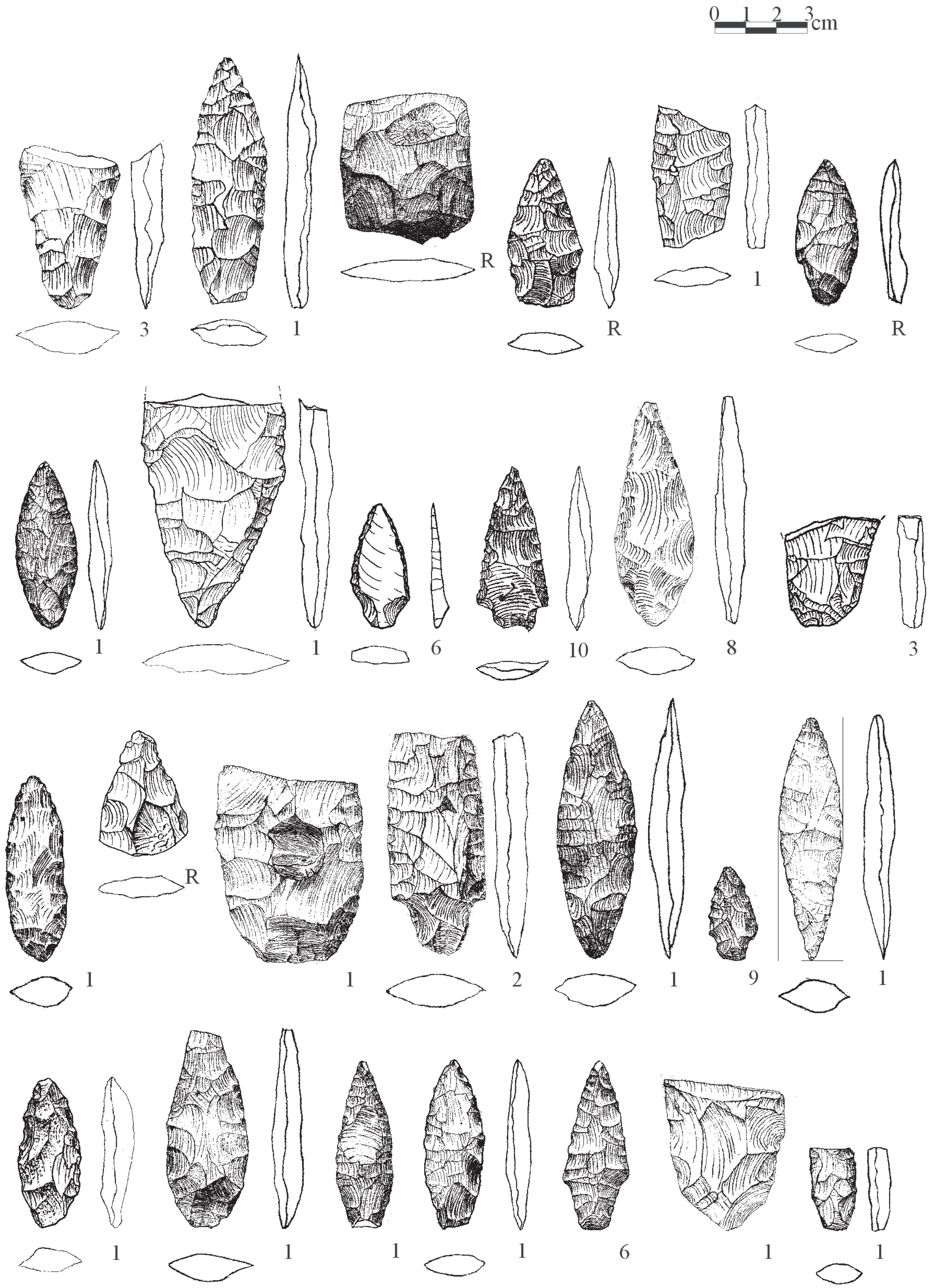

Figure 14. Continued sequence of bifaces from the Stave Watershed. This chronological ordering of formed bifaces continues from Figure 13. Cluster type cross-dates based on the analsyis presented here are as follows: 3: 5050–3 10 BP; 1: 8150–310 BP; 6: 4390–2630 BP; 10: 4080–310 BP; 8: N/A; 2: 4290–3280 BP; 9: 4290–3280 BP; and R: N/A.

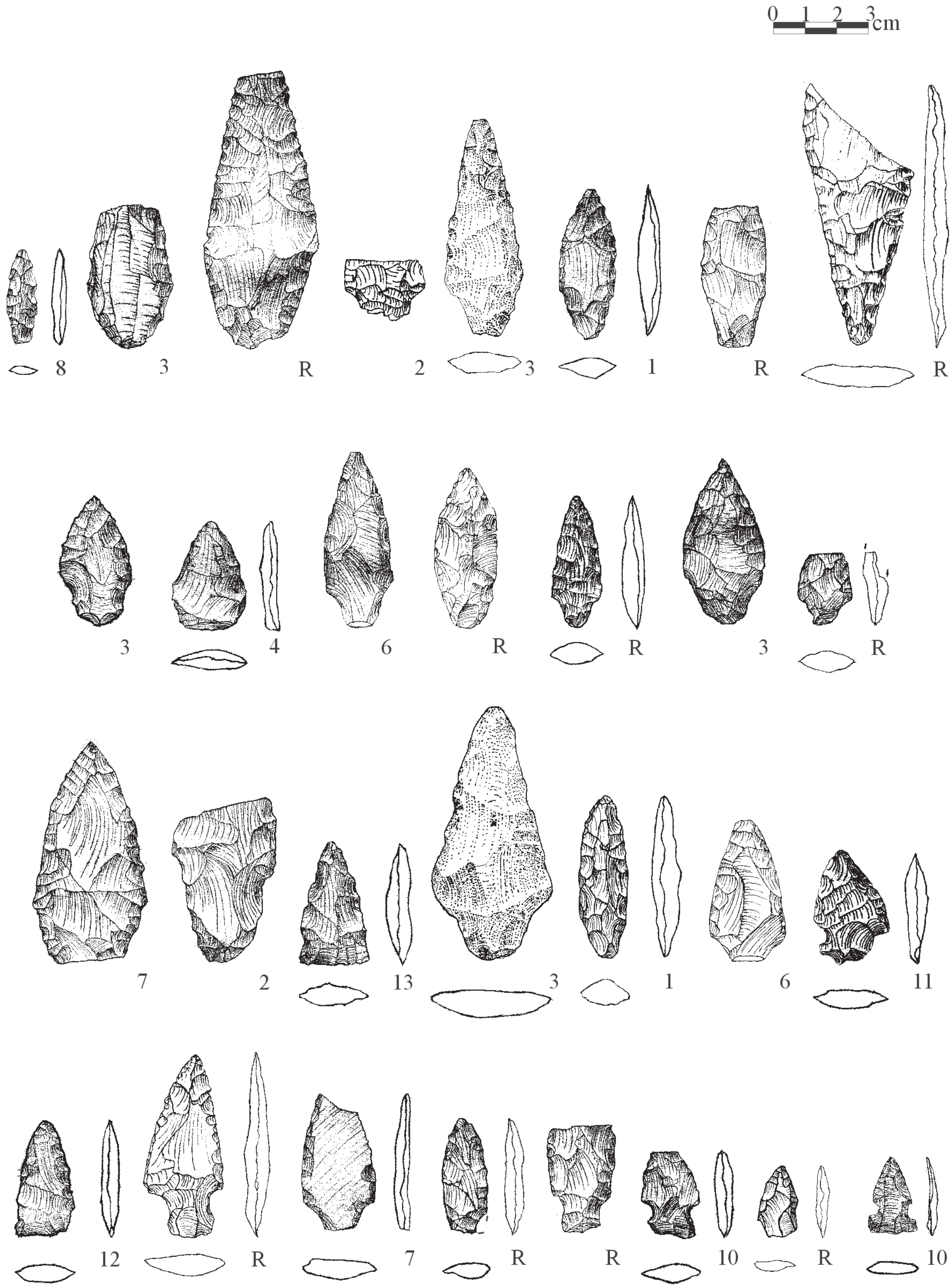

Figure 15. Continued Sequence of Bifaces from the Stave Watershed. This chronological ordering of formed bifaces continues from Figure 14. Cluster type cross–dates based on the analsyis presented here are as follows: 8: N/A; 3: 5050–310 BP; 2: 4290–3280 BP; 1: 8150–310 BP; 4: 2340–2030 BP; 6: 4390–2630 BP; 7: N/A; 13: 4290–2475 BP; 11: 3300–2630; 12: N/A; 10: 4080–310 BP.

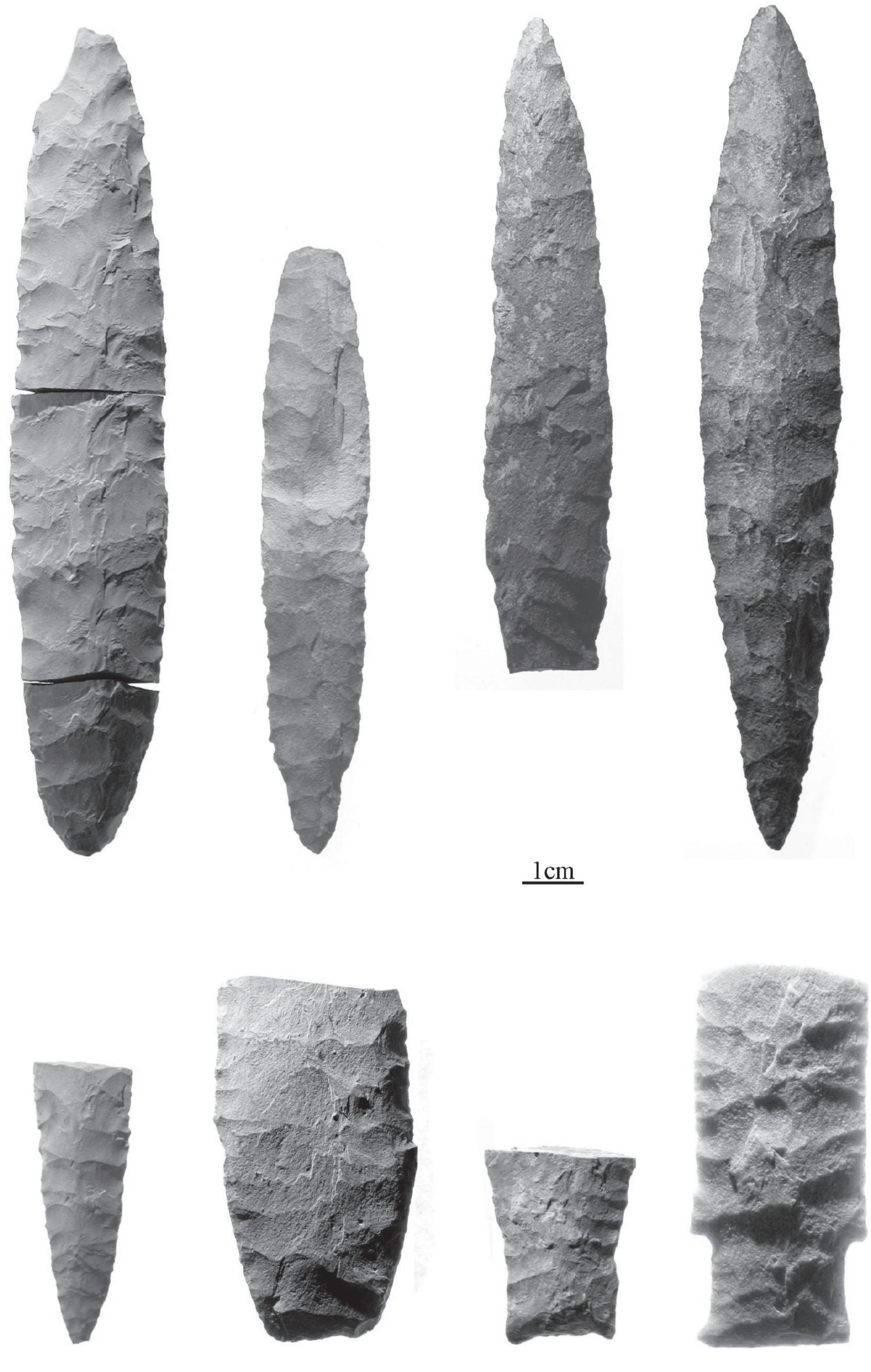

Figure 16. A selection of bifaces recently surface collected from Stave Reservoir after the analysis presented here was completed. These objects most closely relate to Cluster 5 type artifacts and cross-date between 8150 and 5730 BP. Top row from left to right: A: DhRn–16, B: DhRn–18, C: DhRn–23, D: DhRn–46; Bottom row: E: DhRo–52, F: DhRn–25, G: DhRn–25, H: DhRn–16.

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