Chapter 8

The Projectile Point Sequences in the Puget Sound Region

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Introduction

The research area discussed in this chapter encompasses what is considered to be the traditional territory of the Lushootseed speaking Coast Salish People, who are sometimes referred to as the Puget Sound Salish (e.g., Thompson and Kinkade 1990:38; Suttles and Lane 1990:485–502). This area begins at Samish Bay, east of the San Juan Islands, and extends southward to the head of Puget Sound, and includes the watersheds of numerous streams and rivers that drain from the Cascade Foothills into Puget Sound (Figure 1).

Comparatively speaking, few systematic archaeological investigations have occurred in this part of the Pacific Northwest, so this paper should be considered a preliminary but much needed synthesis of over 4500 square miles of sheltered "inside" areas between the Olympic and Cascade mountain ranges. The chipped stone projectile point sequence we will present covers the known sequence of lithic traditions in the study area, ranging from the Clovis period (approximately 11,000 BP) through to the time of European colonization.

Environmental Context

Puget Sound is approximately 145 kilometers long, north to south, and averages 140 meters in depth. Due to its large size, it has been likened to an inland sea. In reality, it is a glacially cut fjord where the ocean salt water from the Pacific mixes with freshwater draining from the surrounding watersheds. The Puget Sound environmental region represents approximately 3850 kilometers of shoreline—with an array of beaches, bluffs, deltas, mudflats and wetlands. Approximately 10,000 streams and rivers drain into this region, with at least 80% of the basin's annual surface water runoff coming from the watersheds of eight rivers—the Skagit, Snohomish, Stillaguamish, Cedar/Lake Washington Canal, Green/Duwamish, Puyallup, Nisqually, and Deschutes. To the Lushootseed Salish Peoples, these streams, creeks, rivers, and the Sound itself, as well as the nearby uplands, form the rich basis of their current and ancient livelihoods.

The Sound was formed into the north-south fjord it is today by glaciers that advanced from the

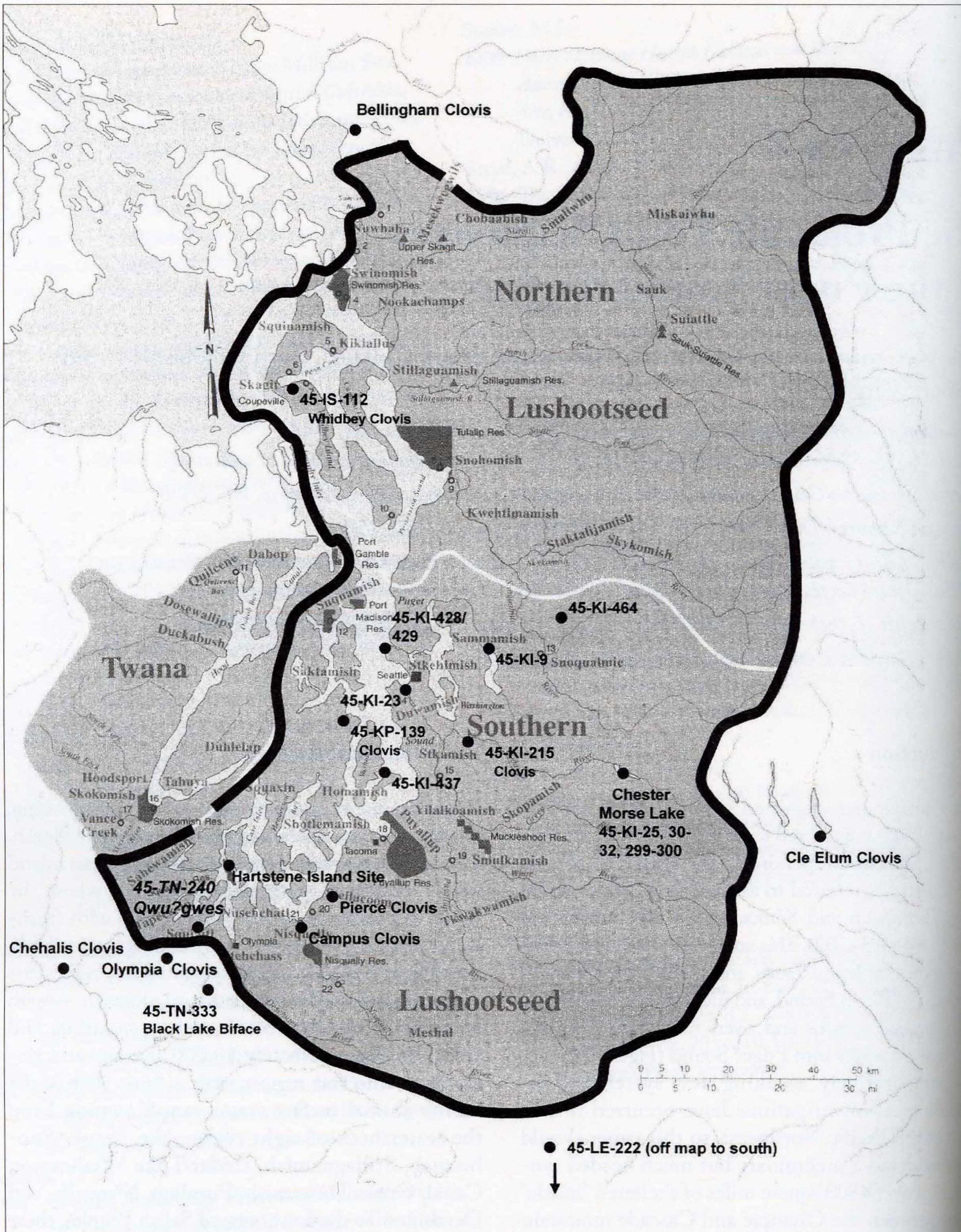

Figure 1. Locations of Puget Sound region sites referred to in this study. Gray shaded areas are considered the traditional territories of southern Coast Salish Peoples. (Base map adapted from Suttles, W. (editor) 1990 Handbook of the North American Indians. Volume 7: The Northwest Coast, Smithsonian Institution, Washington, DC: Southern Coast Salish, by Wayne Suttles and Barbara Lane: 486).

north at least four times (Waitt and Thorson 1983). The Vashon Stade of the Fraser Glaciation was the last major advance. It reached its maximum about 18,000 years ago, and covered everything between the Olympic Mountains and Cascade Mountains as far south as the Black Hills and the capital of Washington State, Olympia. As the Vashon retreated, its melting ice created glacial Lake Russell, a massive fresh water lake with a water level as much as 40 meters above the current level of Puget Sound. Lake Russell's overflow release is thought to have been through the Black Lake spillway in southern Puget Sound, and down the Black and Chehalis rivers to the Pacific Ocean. Interestingly, if people first colonized the Americas via the Pacific Coast, as Fladmark (1975, 1979, 1983) has suggested, the first drainage south of the southernmost extent of the Pacific ice flow they would have encountered would have been that of the Chehalis River.

Projectile Point Collections

We initiated our investigation of the Puget Sound region projectile points by first looking at the southern end of the Sound, with collections from the Qwu?gwes wet site (45–TN–240) and a surface collection from Hartstene Island (no site number assigned) (Figure 1). The excavations at Qwu?gwes are a joint initiative of the Squaxin Island Tribe and South Puget Sound Community College (Foster and Croes 2002, 2004). At the time of writing, seven summer seasons of excavations have provided one of the most controlled collections of stone, bone and shell artifacts in the Puget Sound region. They have also produced a range of basketry, cordage and wooden artifacts to compare alongside the projectile points from this region. Radiocarbon dating suggests that Qwu?gwes dates from 700–150 BP (Foster and Croes 2004).

The Hartstene Island assemblage is a large surface collection from a section of an active beach on the western shore of Hartstene Island that was accumulated over several years by Jack and Carleen Nickels. The Nickels attended an Archaeology Day public seminar at the University of Washington's Burke Museum in 1995 where they learned to label artifacts and to map the location of all future artifacts they found at the Hartstene Site. From that time forward, they meticulously did this with their finds. As a result, about half of the points in the collection are numbered and their locations plotted on a drawing of the shoreline, giving real provenance information for these projectile points. As noted above, however, the points were found in the active tidal zone of the beach, and their context within the site and the nature of the site deposit are unclear at this time. At the moment, the Hartstene Island collection is undated.

From these southern Puget Sound sites in Squaxin Island Tribe traditional territory we expanded our investigations northwards. Four projectile points are included from a two week public excavation at the Burton Acres Site (45–KI–437) on Vashon Island 50 kilometers north (Stein and Phillips 2002). Currently, the cultural materials recovered at the Burton Acres site are thought to have been deposited within the last 1000 years. Also included are projectile points from three sites in the vicinity of Seattle, about 80 kilometers to the north. The Seattle area sites are West Point (45–KI–428 & 429; Larson and Lewarch 1995) and Duwamish No. 1 (45–KI–23; Campbell 1981, Blukis-Onat 1987), both of which are in Seattle, and the Marymoor Site (45–KI–9; Greengo and Houston 1970), which is close to the northern end of Lake Sammamish (Figure 1). Dates from West Point and Marymoor fall into the period 2400 to 4400 BP, which is often referred to as the Locarno Beach Phase (Larson and Lewarch 1995; Greengo and Houston 1970). The dating of Duwamish No. 1 falls into two time periods, one early (approximately 1300 to 1400 BP) and one late (approximately 100 to 500 BP) (Campbell 1981, Blukis-Onat et al. 1987, Matson and Coupland 1995).

A number of sites with older, Olcott Period projectile point styles were also included in the study. These include the Tolt site (45-KI-464; Blukis-Onat et al. 2001) and sites exposed in the Chester Morse Lake drawdown (45–KI–25, 30-32, 299-300; Samuels 1993). The collections from these sites are thought to date from between 10,000 and 3000 BP. The Judd Peak Rockshelter site (45–LE–222) was also included in the study. Located slightly south of the Sound, it has yielded a well-dated, stratified collection spanning the period from 7000–200 years ago (Daugherty et al. 1987). Older styles are also represented by scattered occurrences of Clovis points, recorded as isolated and undated finds from eight locations around Puget Sound (Figure 1).

Though limited in scope, this analysis should at least set the stage for ongoing efforts to refine type chronologies and associate the projectile point styles in Puget Sound with other areas of the Pacific Northwest.

Pre-4,000 BP Projectile Point Styles in the Puget Sound Region

Fluted points from the Paleoindian period are rare in the Northwest (Carlson 1990), and only eight are known from our study region. None of the Puget Sound fluted points is from a dated context. These points are briefly described below and their locations are shown on Figure 1. Clovis points are assumed to represent some of the earliest occupation of the Puget Sound region, given their well-dated context elsewhere in North America. However, it is possible that earlier, non-fluted technologies were present prior to the appearance of the Clovis technology.

At the southern end of Puget Sound, one Clovis point was found "west of Olympia in the Chehalis River Valley" and another was found "in the Black Hills area west of Olympia" by a man who was grubbing stumps (Osborne 1956: 41–42). Avey has reported two fluted point bases, one from a private collection in Pierce County, which he believes was collected at either Hart's Lake or Anderson Island (Avey, 1992), and another from a survey of the Pierce College campus (Avey and Starwich 1985; Avey 1992).

In the mid region of the Sound, two Clovis points have been found with somewhat better provenience. A Clovis point was found in a bog in 1983, and the location (45–KI–215) was investigated by Meltzer and Dunnell (1987). Another Clovis point was found in a peat bog near Yukon Harbor, and the location (45–KP–139) was investigated by Julie Stein of the University of Washington (Figure 2). Additional remains were not found at either location.

In the northern portion of Puget Sound, two Clovis points have been found, one in a garden on Whidbey Island (45–IS–112), and one of unknown provenience in the collections of Western Washington University (Avey 1992:13–16). Another Clovis point known from just east of the Cascades was found on the south shore of Lake Cle Elum (Avey 1992: 14, citing Hollenbeck and Carter 1986; Figure 1).

The cultural traditions that succeeded Clovis in the Pacific Northwest are referred to by a variety of names depending on the researcher—the Old Cordilleran, Olcott, Cascade, Protowestern Tradition, Pebble Tool Tradition, and the Archaic Period (see Carlson 1990; Matson and Coupland 1995; Ames and Maschner 1999). Although each of these labels has, as originally proposed, specific characteristics (or lack of characteristics), over the years they have come to be used interchangeably in the Puget Sound region. Here, the term Olcott, which Carlson (1990:62) has noted is "conveniently vague", will be used for sites older than 4000 years.

Sites from the Olcott period with both large collections of projectile points and materials that can be directly dated are not common in our study area. Because of the widespread acidic soils of the region, it is much more common to find sites containing limited numbers of lithic artifacts but few, if any objects made from other materials. Such sites are often dated by means of tool types or their environmental context, such as on old river terraces. An example of this is a recent find near Olympia of a large, unusually notched biface (Figure 2). The find, designated 45–TN–333, consisted of a single large biface made of weathered igneous rock, found at a depth of one meter below the existing ground surface during landscaping work. Limited testing at the site revealed the deposit to be poorly sorted glacial till materials of the Alderwood series on the edge of the Pleistocene spillway of Lake Russell through the Black River. With its unusual notching style and large size, the artifact is unique to the area. Unfortunately, while its environmental context suggests it is old, its date of origin is uncertain.

The available evidence suggests that a wide variety of projectile point types were used in the Puget Sound area from the early Holocene to the contact period. Collections frequently contain a wide variety of stemmed, notched, and leaf-shaped points (Appendix G), which appear to reflect different functional classes (e.g., dart points, thrusting/dispatching points). The frequency of igneous raw material (primarily basalt) use appears higher in the early and mid Holocene periods than in the late Holocene (Figure 8). However, this conclusion is not certain and may in fact be influenced by sample size. The only definite change appears to be the addition of arrow points in the last 2000 years (Daugherty et al., 1987).

Establishing a Classification for Post-clovis Projectile Points from Puget Sound

The goals of our study were to (1) create a classification of the projectile points in the main collections

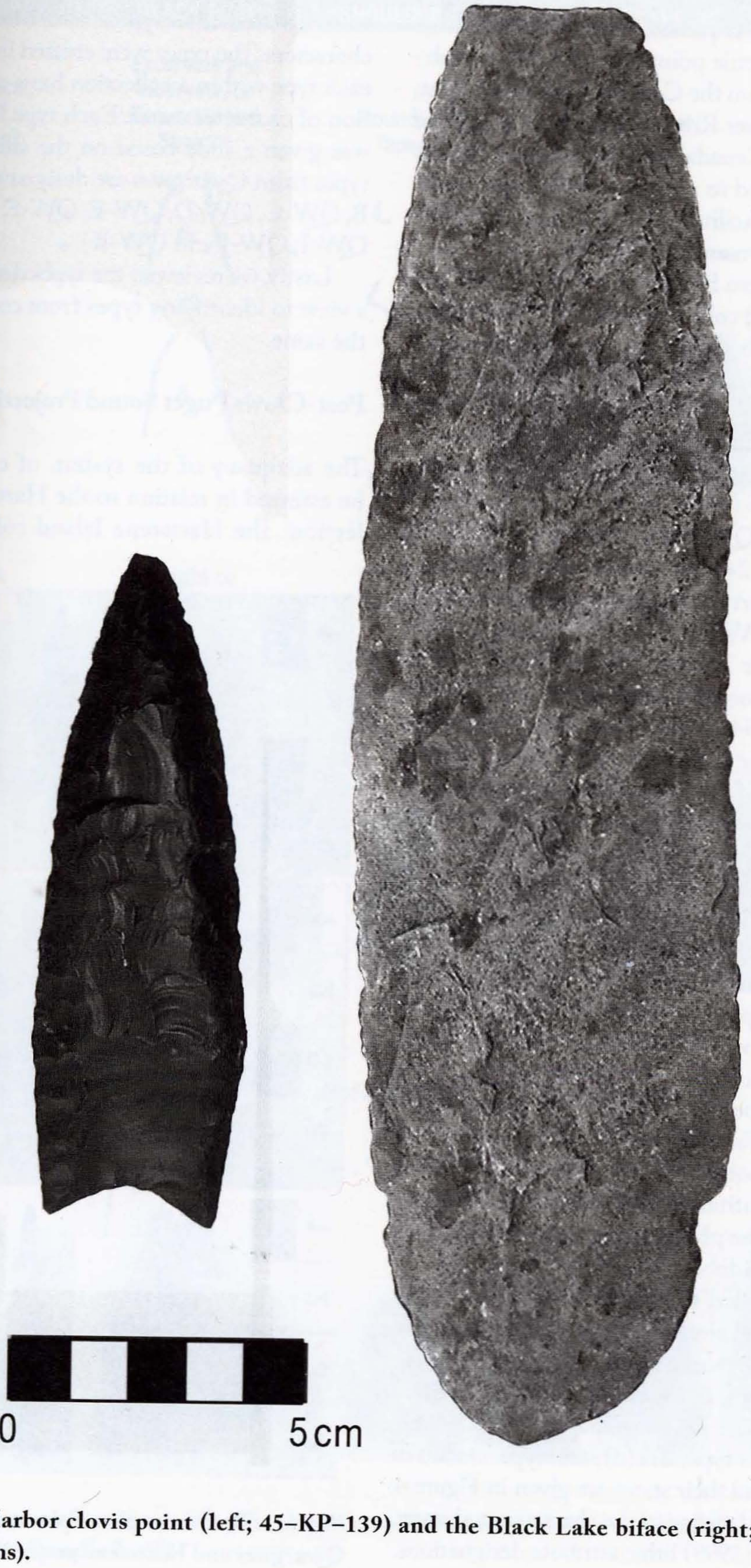

Figure 2. Yukon Harbor clovis point (left; 45–KP–139) and the Black Lake biface (right; 45–TN–333; see Figure 1 for locations).

using explicitly defined types, (2) place the types into a chronological sequence, and (3) compare this sequence with projectile point type sequences established further north on the Central Northwest Coast, especially in the Fraser River and Gulf of Georgia of British Columbia, Canada, and the San Juan Islands of the USA. We tried to make our definitions as explicit as possible to facilitate comparison with regions that are better known archaeologically.

Since the southern Puget Sound Qwu?gwes and the Hartstene Island collections are directly available to us (they are both owned by the Squaxin Island Tribe Cultural Resource Department and curated by the Tribe's Museum Library and Research Center) we initiated the projectile point descriptive recording and classification design with these two sizable collections. Twenty-five projectile points have been recovered *in situ* at Qwu?gwes. The Hartstene Island collection contains 249 points. The other collections included in this part of the study were those from Duwamish No. 1, West Point, Marymoor, Burton Acres and Chester Morse. The collections from West Point, Marymoor, Burton Acres, and Chester Morse contain 22, 54, 4, and 146 points, respectively. At the moment, the exact number of points recovered in the course of the excavations at Duwamish I is unclear. The projectile points from Duwamish No. 1, West Point, Marymoor, Burton Acres, and Chester Morse were not examined directly. Rather, data pertaining to their morphology were obtained from published photographs.

First, because the Qwu?gwes and Hartstene Island projectile point collections have not been analyzed before, we recorded the length, width, thickness, weight, and raw material type of each Qwu?gwes and labeled/numbered Hartstene Island projectile point (Tables 3 and 4). We then drew an outline of each point and photographed both of its sides. The quantitative data were entered into a spreadsheet, and the photographs were compiled for the record using Adobe Photoshop (Figure 3).

Next, we recorded the states of four qualitative characters on the projectile points from Qwu?gwes, Hartstene Island, Duwamish No. 1, West Point, Marymoor, Burton Acres, and Chester Morse. The characters in question are (a) body shape, (b) blade edge outline, (c) shoulder type, and (d) stem type. Details of these characters and their states are given in Figure 4. To standardize our labeling of the characters and states, we used Gumbus' (1999) lithic attribute designations.

Subsequently, the points from each collection were divided into types on the basis of the four characters. The types were created in such a way that each type within a collection has a unique combination of character states. Each type from a collection was given a code based on the site name (e.g., the types from Qwu?gwes are designated QW-A, QW-B, QW-C, QW-D, QW-E, QW-F, QW-G, QW-H, QW-I, QW-J and QW-K).

Lastly, we reviewed the types defined by site with a view to identifying types from collections that are the same.

Post-Clovis Puget Sound Projectile Point Types

The adequacy of the system of classification can be assessed in relation to the Hartstene Island collection. The Hartstene Island collection contains

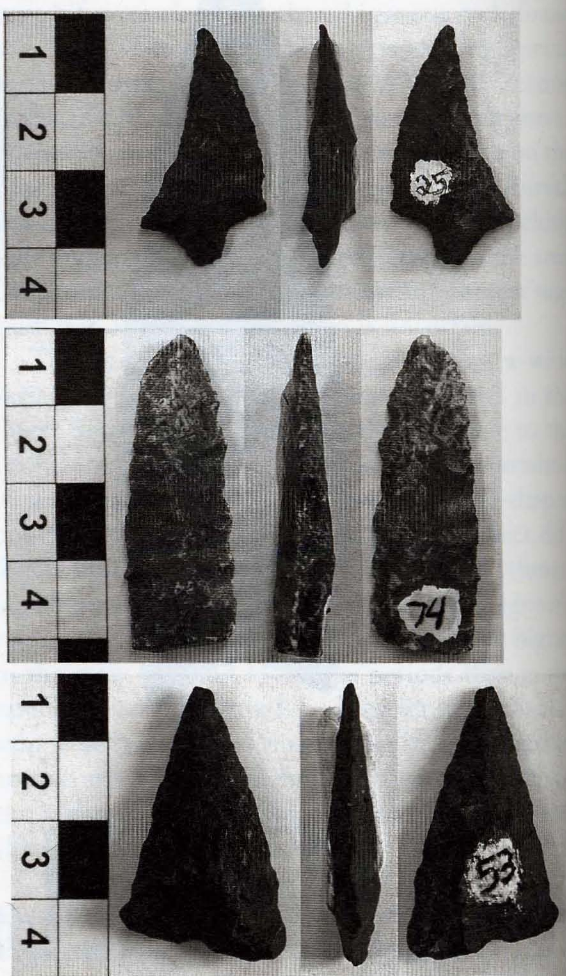

Figure 3. Three examples of photo records taken of each Qwu?gwes and Hartstene projectile points.

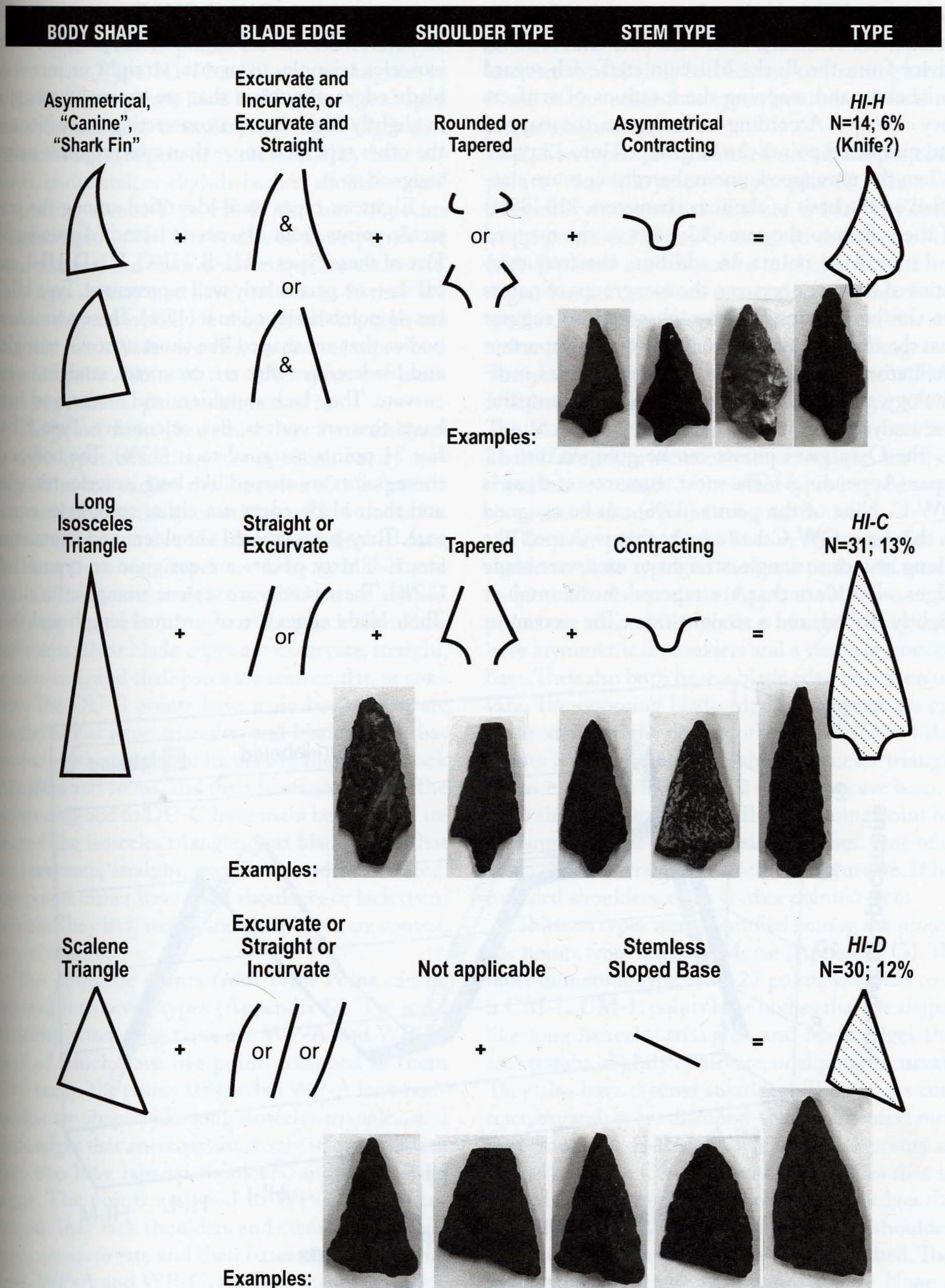

Figure 4. Three examples of how projectile point types were defined from Hartstene Island (HI) and all other sites considered here (see Appendix A–G).

124 mapped and numbered points and 125 points that were collected prior to the Nickels receiving advice from the Burke Museum staff with regard to labeling and mapping the locations of artifacts they collected. According to the system, the mapped and numbered points can be grouped into 13 types. When the unmapped, unnumbered points are classified on the basis of the four characters, 110 (88%) of them fit into the same 13 types as the mapped and numbered points. In addition, the frequency ratios of the types between the two groups of points are similar (Figure 5). These observations suggest that the classificatory system is capturing important qualitative and quantitative patterns of point morphology, and therefore support its use for comparative analysis.

The Qwu?gwes points can be grouped into 11 types (Appendix A). The most numerous of these is QW-C. Nine of the points (35%) can be assigned to this type. QW-C has a body that is shaped like a long isosceles triangle, straight or excurvate blade edges, shoulders that are tapered, horizontal or slightly barbed, and a straight stem. The next most numerous type is QW-F. QW-F accounts for five points (19%). It has a body that is shaped like a short isosceles triangle, recurvate, straight or incurvate blade edges, shoulders that are tapered, horizontal or slightly barbed, and a contracting stem. None of the other types has more than two projectile points assigned to it.

Eighteen types were identified among the projectile points from Hartstene Island (Appendix B). Five of these types—HI-B, HI-C, HI-D, HI-I, and HI-L—are particularly well represented. Type HI-B has 41 points assigned to it (17%). These points have bodies that are shaped like short isosceles triangles, and blade edges that are excurvate, straight or incurvate. They lack shoulders and stems, and have bases that are convex, flat, or concave. Type HI-C has 31 points assigned to it (13%). The bodies of these points are shaped like long isosceles triangles, and their blade edges are either straight or excurvate. They have tapered shoulders and contracting stems. Thirty points are assigned to type HI-D (12%). These points are scalene triangular in shape. Their blade edges are of unequal length and their

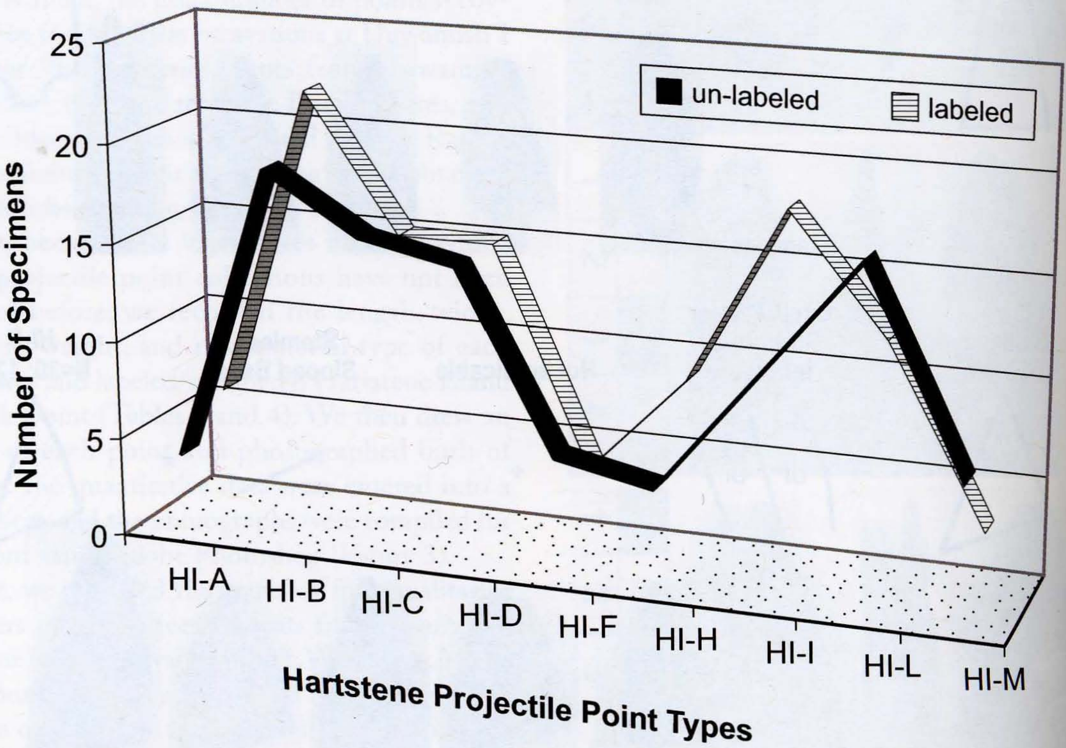

Figure 5. Hartstene Island projectile point types with over 10 examples, demonstrating the similar frequency ratios between the labeled examples (used to develop the original type classification, N=124, Appendix B) and un-labeled examples (N=125).

bases slope. They lack stems and shoulders. The blade edges of HI-D points are excurvate, straight, or incurvate. Type HI-I has 29 points assigned to it (12%). These points have bodies that are shaped like short isosceles triangles, and blade edges that are recurvate, straight, or incurvate. They have tapered, horizontal, or slightly barbed shoulders, and contracting stems. Type HI-L also has 29 points assigned to it (12%). The bodies of these points are lance-shaped, and their blade edges are excurvate. They may or may not have shoulders. If they are present they are weakly developed. HI-L points are stemless. Their bases are flat, sloped, or taper to a rounded point. None of the other types has more than 14 projectile points assigned to it.

The points from Duwamish No. 1 are assigned to eight types, according to our classificatory system. As noted earlier, the exact number of points recovered during the excavations at Duwamish I is unclear at the moment. Based on the published data, the most numerous types are DU-A, DU-B and DU-C. The points assigned to DU-A are shaped like short isosceles triangles. They lack shoulders and stems. Their blade edges are excurvate, straight, or incurvate, and their bases are convex, flat, or concave. The DU-B points have main bodies that are shaped like scalene triangles, and blade edges that are excurvate, straight, or incurvate. They points lack shoulders and stems, and their bases are sloped. The points assigned to DU-C have main bodies that are shaped like isosceles triangles, and blade edges that are incurvate, straight, excurvate, and/or serrated. The points either have weak shoulders or lack them entirely. They lack stems, and their bases are convex, flat, or concave.

The projectile points from West Point can be grouped into seven types (Appendix D). The most frequently occurring types are WP-A and WP-G, both of which have five points assigned to them (23% each). The points assigned to WP-A have bodies that are shaped like long isosceles triangles, and blade edges that are recurvate, straight, or excurvate. They also have tapered shoulders, and contracting stems. The points assigned to WP-G are lance-shaped. They lack shoulders and stems. Their blade edges are excurvate and their bases taper to a point. After WP-A and WP-G, the next most frequently occurring type is WP-D. Four of the points can be assigned to this type (18%). The WP-D points have bodies that are shaped like short isosceles triangles, and blade edges that are recurvate, straight, or incurvate. They also have shoulders are tapered, horizontal, or slightly barbed, and contracting stems. None of the other four types has more than three points assigned to it.

Eleven types were identified among the projectile points from Marymoor (Appendix E). The most frequently encountered of these is MA-F. Fifteen of the points (28%) can be assigned to this type. The MA-F points are lanceolate in shape. Their blade edges that are excurvate or serrated, and their bases are flat, pointed, or sloping. They are stemless, and either have weak shoulders or lack them altogether. The next most frequently encountered type is MA-I. Thirteen points are assigned to this type (24%). The MA-I points are triangular and side-notched. Their blade edges are excurvate or straight, and their shoulders are rounded. The other types have between six points and one point assigned to them.

The four points from Burton Acres can be assigned to three types on the basis of the characters employed in this analysis (Appendix F). Two of the points are shaped like scalene triangles. They both have asymmetrical shoulders and a stemless, concave base. They also both have a blade edge that is excurvate. The opposing blade edge is excurvate on one point and straight on the other. One of the other points is reminiscent of a short isosceles triangle. It has excurvate blade edges and a concave base. It lacks shoulders and a stem. The remaining point has a triangular main body and side-notches. One of its blade edges is straight; the other is excurvate. It has rounded shoulders and a convex pointed stem.

Thirteen types were identified among the projectile points from Chester Morse (Appendix G). The most numerous type, with 27 points assigned to it, is CM-L. CM-L points have bodies that are shaped like long isosceles triangles, and blade edges that are straight, slightly excurvate, or slightly incurvate. They also have tapered shoulders. Their stems contract, expand, or are diamond-shaped. The next most numerous type is CM-H, which has 23 points assigned to it. The CM-H points have bodies that are shaped like short isosceles triangles, blade edges that are recurvate, straight, or incurvate, and shoulders that are tapered, horizontal, or slightly barbed. They have stems, and these narrow proximally. None of the other types accounts for more than 14 points.

The inter-site review identified 29 distinct types among the Puget Sound projectile point collections (Table 1). Based on number of shared types, the collection that is most similar to the one from Qwu?gwes is Hartstene Island. These collections have seven types in common (I, II, IV, V, VI, VII, IX). The collection that is most similar to the one from Hartstene Island is Chester Morse. The Hartstene Island and Chester Morse collections have 12 types in common (I, II, IV, VI, XIII, XIV, XVI, XVII, XVIII, XIX, XX, XXI). The collection from Duwamish No. 1 shares the greatest number of types with those from Hartstene Island and Chester Morse. The types that Duwamish No. 1 shares with the Hartstene Island and Chester Morse collections are II, IV, XIV, XVI, XVIII and XIX. The collection that is most similar to the one from West Point is Marymoor. Six types are present in both collections (III, XVII, XVIII, XXIV, XXV, XXVI). The collection that is most similar to the one from Marymoor is West Point. The Burton Acres collection is most similar to the Hartstene Island collection. The latter contains all three of the types found at Burton Acres, whereas the other collections have at most one of them. The collection that shares the greatest number of types with the one from Chester Morse is Hartstene Island. To reiterate, these collections share types I, II, IV, VI, XIII, XIV, XVI, XVII, XVIII, XIX, XX, and XXI.

Post-Clovis Puget Sound Projectile Point Sequence

The geographically closest, published chipped projectile point sequence is from the lower Fraser River region and Gulf Islands in Canada, just north of our Puget Sound region (Carlson 1983). Since Carlson's (1983) chart is also based on the characteristics of projectile point outline morphology, we identified equivalent projectile point types in his sequence as defined by the four profile dimensions used in our classification above. We wanted to see whether or not the Puget Sound collections follow the established phase sequence patterns that have been well defined by half a century of professional investigations in the Fraser River and Gulf of Georgia (e.g., Carlson 1960). Given that the Hartstene Island collection is a large but undated surface collection, we also wanted to see if its projectile point types could be relatively dated by their styles based on Carlson's sequence.

First, we identified major types in Carlson's (1983) sequence chart that are found at the Qwu?gwes, Hartstene Island, Duwamish, West Point and Marymoor sites. We disregarded the Burton Acres collection on the grounds that it comprises just four points. We did not include the Chester Morse collection because it is derived from

Table 1. Codes for projectile point types found through equivalent site types in the Puget Sound region, with general chronological phase affiliations indicated. BA = Burton Acres. CM = Chester Morse. DU = Duwamish No. 1. HI = Hartstene Island. MA = Marymoor. QW = Qwu?gwes. WP = West Point.

Type Code	Equivalent Site Types	Type Code	Equivalent Site Types
I	CM-G, HI-N, QW-A	XVI	CM-D, DU-C, HI-F, MA-J
II	BA-B, CM-M, DU-A, HI-B, MA-H, QW-B	XVII	CM-K, HI-J, MA-E, WP-E
III	DU-G, MA-B, QW-C, WP-B	XVIII	CM-B, DU-E, HI-L, MA-F, WP-F
IV	CM-F, DU-D, HI-G, MA-I, QW-D	XIX	CM-C, DU-F, HI-M
V	HI-H, QW-E	XX	CM-G, HI-N
VI	CM-H, HI-I, QW-F, WP-D	XXI	CM-A, HI-O
VII	HI-K, QW-G	XXII	BA-A, HI-P
VIII	QW-H	XXIII	BA-C, HI-Q
IX	HI-R, QW-I	XXIV	MA-A, WP-A
X	DU-H, QW-J	XXV	MA-C, WP-C
XI	QW-K	XXVI	MA-G, WP-G
XII	HI-A	XXVII	CM-J, MA-K
XIII	CM-L, HI-C	XXVIII	MA-L
XIV	CM-N, DU-B, HI-D	XXIX	CM-E
XV	HI-E		

a number of sites that likely span several thousand years. We circled and labeled the similar types seen at each site on the chart developed for the Fraser River/Gulf Islands area. The results of this analysis are presented in Figure 6. As can be seen, the Puget Sound chipped projectile point types demonstrate a chronological and typological sequence that is similar to the Fraser River/Gulf of Georgia sites.

Subsequently, we used an approach called cladistics to examine the temporal sequencing of the sites based on the projectile point types. First presented coherently in the 1950s and 1960s (Hennig, 1950, 1966), cladistics is the dominant method of phylogenetic reconstruction used in zoology, botany, and paleontology (Kitching et al., 1998; Quicke, 1993; Smith, 1994). In recent years, it has also begun to be used by archaeologists and anthropologists to investigate cultural evolution (e.g., Collard and Shennan, 2000; O'Brien et al., 2001; Tehrani and Collard, 2002; Jordan and Shennan, 2003; Collard et al., 2006).

Based on a model of descent with modification in which new taxa arise from the bifurcation of existing ones, cladistics defines phylogenetic relationship in terms of relative recency of common ancestry. Two taxa are deemed to be more closely related to one another than either is to a third taxon if they share a common ancestor that is not also shared by the third taxon. The evidence for exclusive common ancestry is evolutionarily novel or "derived" character states. Two taxa are inferred to share a common ancestor to the exclusion of a third taxon if they exhibit derived character states that are not also exhibited by the third taxon.

In its simplest form, cladistic analysis proceeds via four steps. First, a character state data matrix is generated. This shows the states of the characters exhibited by each taxon. Next, the direction of evolutionary change among the states of each character is established. Several methods have been developed to facilitate this, including communality, ontogenetic analysis, and stratigraphic sequence analysis (Kitching et al., 1998; Quicke, 1993; Smith, 1994). Currently the favored method is outgroup analysis. This entails examining a close relative of the study group. When a character occurs in two states among the study group, but only one of the states is found in the outgroup, the principle of parsimony is invoked and the state found only in the study group is deemed to be evolutionarily novel with respect to the outgroup state. Having determined the probable direction of change for the character states, the next step in a cladistic analysis is to construct a branching diagram of relationships for each character. This is done by joining the two most derived taxa by two intersecting lines, and then successively connecting each of the other taxa according to how derived they are. Each group of taxa defined by a set of intersecting lines corresponds to a clade, and the diagram is referred to as a tree. The final step in a cladistic analysis is to compile an ensemble tree from the character trees. Ideally, the distribution of the character states among the taxa will be such that all the character trees imply relationships among the taxa that are congruent with one another. Normally, however, a number of the character trees will suggest relationships that are incompatible. This problem is overcome by generating an ensemble cladogram that is consistent with the largest number of characters and therefore requires the smallest number of *ad hoc* hypotheses of character change or "homoplasies" to account for the distribution of character states among the taxa.

We based our cladistic analysis on the presence and absence of the projectile point types at the various sites (Table 2, Figure 7). The analysis was run in the widely used phylogenetics program PAUP* 4 (Swofford, 1998). The collection of points from West Point was used as an outgroup on the grounds that West Point is the oldest of the sites studied and therefore its projectile points can be expected to retain the largest number ancestral character states.

The cladistic analysis returned a single most parsimonious cladogram (Figure 7). The fit between the cladogram and dataset can be assessed with the Consistency Index and the Retention Index. The Consistency Index assesses homoplasy as a fraction of character change in relation to a given cladogram. It ranges between 1.0 and 0.0, with values close to 1 indicating a good fit between the cladogram and the data set and values close to 0 indicating a poor fit. The Retention Index (measures the number of similarities in a data set that are retained as homologies in relation to a given cladogram. It also ranges between 1.0 and 0.0. As with the Consistency Index, values for the Retention Index that are close to 1 indicate a good fit between the cladogram and the data set, and values that are close to 0 indicate a poor fit. The Consistency Index for the Puget Sound projectile point cladogram is 0.82. Its Retention Index is 0.54. Thus, the fit between cladogram and the dataset is good.

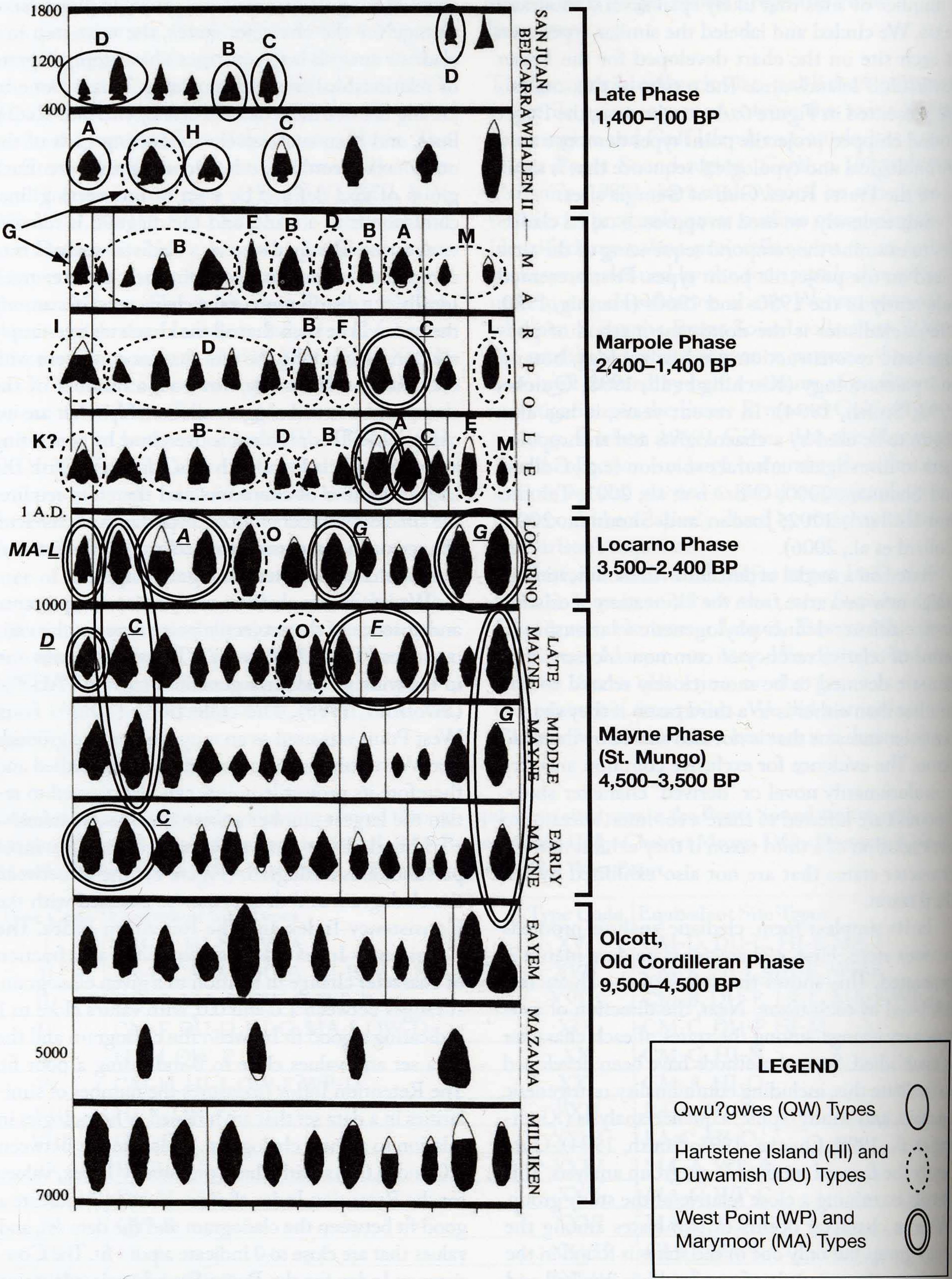

Figure 6. Central Northwest Coast projectile point chronology established for the Fraser River region (after Carlson 1983:27) and how the defined Puget Sound projectile points fit by site types and in corresponding phases.

Table 2. Presence/absence of defined projectile point types found at each of the five main Puget Sound sites in this study (0 = absence, 1 = presence).

Site \ Type	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
Qwu?gwes	1	1	1	1	1	1	1	1	1	1	1	0	0	0
Hartstene	1	1	0	1	1	1	1	0	1	0	0	1	1	1
Duwamish 1	0	1	1	1	0	0	0	0	0	1	0	0	0	1
West Point	0	0	1	0	0	1	0	0	0	0	0	0	0	0
Marymoor	0	1	1	1	0	0	0	0	0	0	0	0	0	0

Site \ Type	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	XXVII	XXVIII
Qwu?gwes	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Hartstene	1	1	0	1	1	1	1	1	1	0	0	0	0	0
Duwamish 1	0	1	1	1	1	0	0	0	0	0	0	0	0	0
West Point	0	0	1	1	0	0	0	0	0	1	1	1	0	0
Marymoor	0	1		1	0	0	0	0	0	1	1	1	1	1

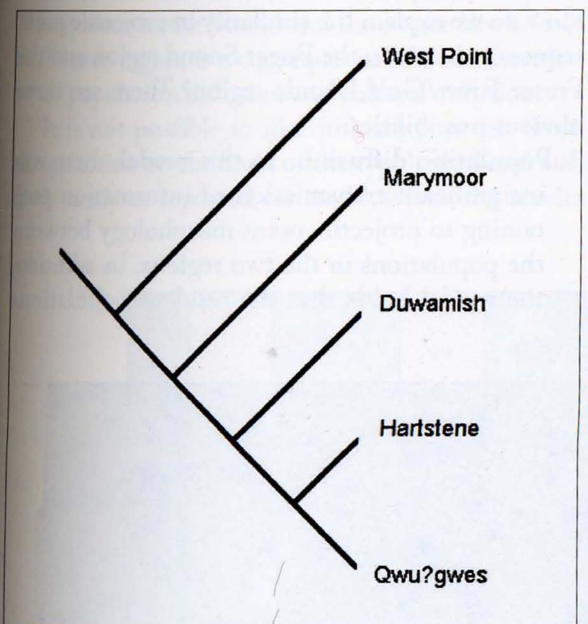

Figure 7. Cladogram derived from Puget Sound site projectile point types. Cladogram rooted on West Point.

Because West Point was used as the outgroup, the cladogram can only shed light on the relationships of the collections from Duwamish, Qwu?gwes, Hartstene and Marymoor. The cladogram suggests that the collections from Qwu?gwes and Hartstene are more closely related to one another than either of them is to the collections from Duwamish or Marymoor, and that the collection from Qwu?gwes, Hartstene and Duwamish are more closely related to each another than any of them is to the collection from Marymoor. This implies that the collections from Qwu?gwes and Hartstene share novel types that are not shared by Duwamish or Marymoor. It also implies that the collections from Qwu?gwes, Hartstene and Duwamish share novel types that are not shared by Marymoor.

In terms of relative recency of origin, the cladogram suggests that the collection from Marymoor is older than the collections from Duwamish, Qwu?gwes and Hartstene, and that the collection from Duwamish is older than the collections from Qwu?gwes and Hartstene. Significantly, this is consistent with the available dating evidence. To reiterate, West Point and Marymoor are dated to between 2400 to 4400 BP, while the dates from Duwamish fall into two time periods, 1300 to 1400 BP and 100 to 500 BP. Radiocarbon dates from Qwu?gwes suggest that it dates from 700–150 BP. Thus, the results of the cladistic analysis further support the notion that Carlson's ((1983) phase sequence is valid for the Puget Sound region.

With regard to the date of the Hartstene Island collection, its position on the cladogram suggests that it is either (a) older than Qwu?gwes but younger than Duwamish, (b) the same age as Qwu?gwes, or (c) younger than Qwu?gwes. Typologically, the Hartstene Island assemblage, like the one from Duwamish, fits well into the Fraser/Gulf Island Marpole Phase. Furthermore, it is most similar to the Duwamish assemblage in terms of type frequencies. Most of the Duwamish and Hartstene types are small triangular point types (HI-B and HI-D), lanceolate point types (HI-L and HI-O) and triangular drill-like types (HI-F). They occur in a surprisingly close percentage ratio at each site (Figures 7 and 8). In addition, when comparing the ratio of basalt to non-basalt projectile points at all the major sites considered, the Duwamish and Hartstene Island assemblages demonstrate a strong emphasis on basalt in contrast to sites considered later and earlier chronologically (Figure 9). As such, it seems reasonable to conclude that of the three dating options for the Hartstene Island collection suggested by the cladogram, the most plausible is the second one, namely that it is older than the Qwu?gwes collection but younger than the one from Duwamish. In view of the dates for Qwu?gwes and Duwamish, this suggests that the Hartstene island assemblage dates from between 1500 and 100 BP.

With the aid of a second phylogenetics program, MacClade 4.0 (Maddison and Maddison, 1998), we also investigated the unambiguous changes that delineate the clades of the cladogram. This analysis indicated that Marymoor is differentiated from West Point by the gain of two types, XXVII and XXVIII. The analysis also indicated that the clade comprising Duwamish No. 1, Hartstene Island and Qwu?gwes is differentiated from West Point and Marymoor by the loss of three types, XXIV, XXV and XXVI. Within the former clade, the Hartstene Island and Qwu?gwes assemblages are distinguished from the assemblage from Duwamish 1 by the gain of four types, I, V, VII and IX. The assemblage from Qwu?gwes uniquely lacks type XVIII and is unique in possessing types XVIII and XI. Qwu?gwes also exhibits a reversal to absence of type XVI, which is present in the Marymoor, Duwamish No. 1 and Hartstene Island assemblages but absent in the assemblage from West Point. The Hartstene Island assemblage has a large number of novel types compared to the other sites. These include types XII, XIII, XV, XX, XXI, XXII and XIII. It is also unique in lacking type III.

Processes of Cultural Evolution on the Northwest Coast

How do we explain the similarity in projectile point sequences between the Puget Sound region and the Fraser River/Gulf Islands region? There are three obvious possibilities:

1. **Population diffusion.** In this model, there was insignificant transmission of information pertaining to projectile point morphology between the populations in the two regions. In addition, the model holds that the resident populations

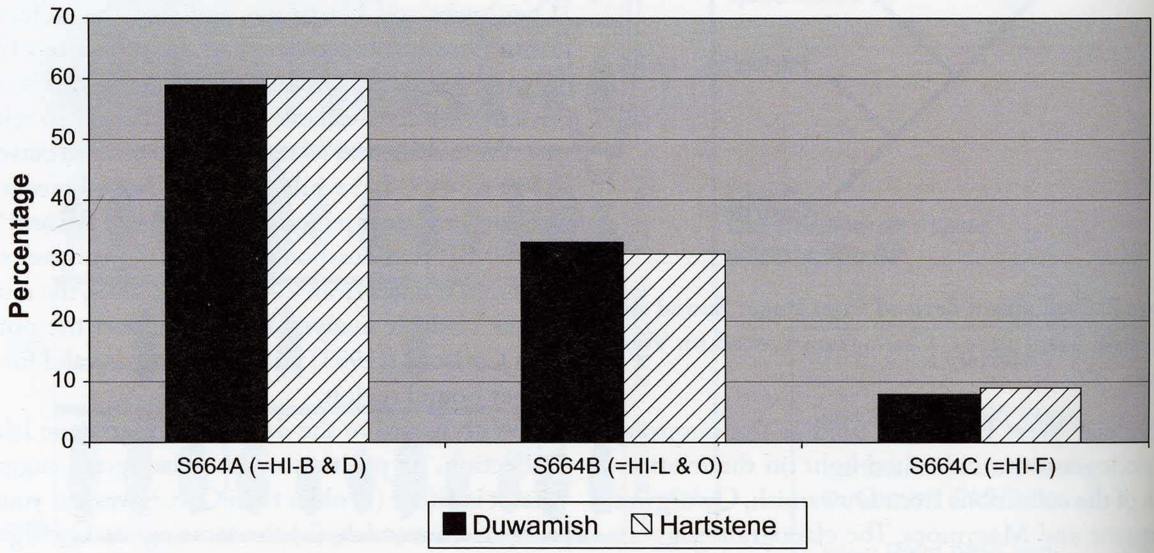

Figure 8. Duwamish No. 1 site and Hartstene Island site major projectile type percentages—note the very close percentage ratios. Since our type definitions included more attributes, the S664A types (Campbell 1981) included both our HI-B and HI-D (also referred to as "San Juan Triangular" in Carlson 1960:570) and Campbell's S664B types included both HI-L and HI-O types (see Appendix B).

in both regions were repeatedly replaced by migrating populations with different projectile point assemblages. Thus, according to this model, each phase of the phase-sequence represents the influx of a new population who either absorbed or displaced the preexisting populations.

2. **Cultural diffusion.** This model contends that there was long-term population persistence in both regions between 11,000 and 100 BP rather than repeated episodes of population replacement. It also contends that there was at least periodic transmission of projectile point morphology-related information between the populations in the two regions. Hence, in this model each phase of the phase-sequence represents the spread of novel ideas rather than the spread of people.

3. **Movement of individuals and information.** In this model the similarity between the projectile point sequence in the Sound and the Fraser River/Gulf Islands region is a consequence of a combination of population diffusion and cultural diffusion.

It is not possible to discriminate between these three models on the basis of the typological and cladistic analyses reported earlier. However, the results of a recent analysis of artifacts recovered from central Northwest Coast wet sites are suggestive in this regard. Croes et al. (2005) used cladistic techniques to investigate whether basketry artifacts cluster the sites in the same way as artifacts constructed from stone, bone, and shell. They found that the most parsimonious cladogram derived from the baskets differed from the one yielded by the stone, bone and shell artifacts. The stone, bone and shell artifact cladogram was consistent with the phase-sequence conventionally employed on the central Coast since the major clades comprised sites that are assigned to the same phase. In contrast, the major clades of the basketry cladogram consisted of sites that are geographically close but assigned to different phases. This was interpreted in terms of models of population history and cultural transmission. Specifically, Croes et al. (2005) argued that the basketry cladogram reflected vertical transmission of stylistic information in the context of long-term population persistence, while the cladogram derived from the stone, bone and shell artifacts reflected horizontal transmission among the populations of information about food-getting and manufacturing technology. Thus, Croes et al.'s (2005) study suggests that of the three possible explanations for

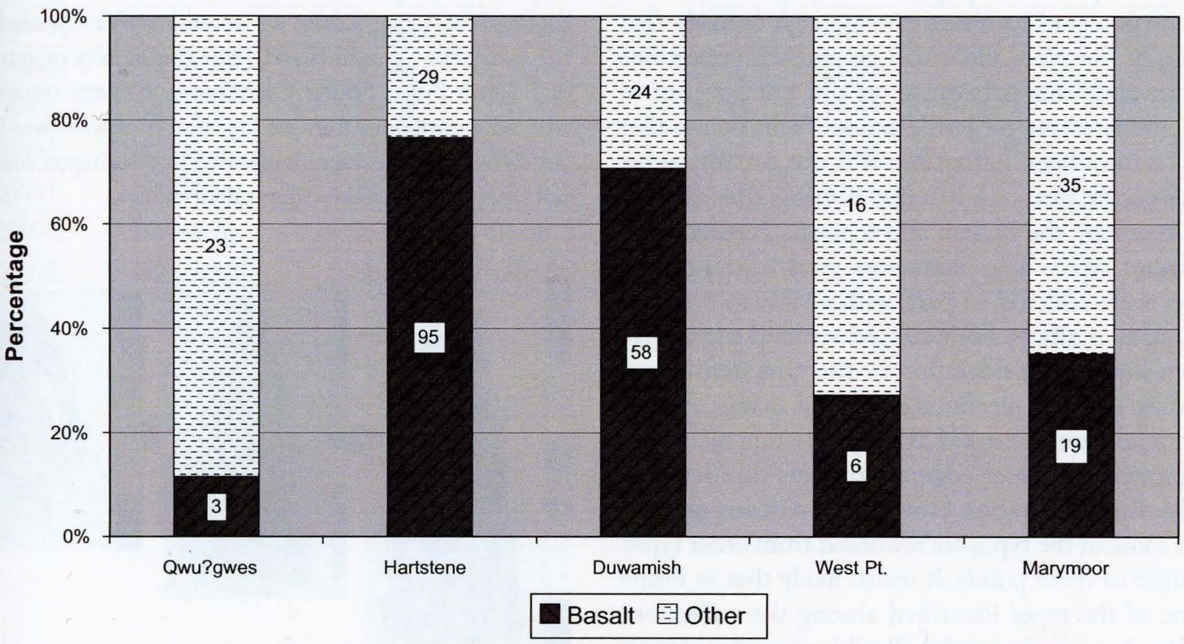

Figure 9. Ratio of projectile points of basalt and non-basalt at the major sites compared in this study. Note that the late Qwu?gwes site has the highest ratio of non-basalts (mostly chalcedonies), Hartstene and Duwamish No. 1 have similar high ratios of basalt points, and the earlier period West Point and Marymoor sites again have a higher and similar ratio of non-basalt projectile points, but not as high as in the late period.

the similarity between the projectile point sequences in the Puget Sound region and the Fraser River/Gulf of Georgia region, the most plausible is the second, namely that it is the result of cultural diffusion between the two regions in the context of long-term population persistence and cultural continuity within each region (see also, Croes 1995, 2005).

Concluding Remarks

In this chapter we have focused on projectile point assemblages from the Puget Sound region that date from approximately 11,000 to 100 BP. Through a combination of conventional typological analyses and novel cladistic analyses, we have shown that the pattern of projectile point evolution in the Sound is similar to that observed in the Fraser River/Gulf Islands region during the same period of time. We have also demonstrated that the important but hitherto undated collection of projectile points from Hartstene Island can be tentatively dated to between 1500 and 100 BP. Lastly, we have highlighted evidence that suggests that the similarity between the projectile point sequences in the Puget Sound region and the Fraser River/Gulf of Georgia region is likely a consequence of cultural diffusion rather than repeated episodes of population replacement.

With regard to future directions, it is likely that some of the types identified among the collections are invalid. This is because we did not attempt to differentiate true projectile points from points that might have been hafted but did not actually serve as projectile weapons. It is also possible that some of the types are the broken and rejuvenated fragments of other types. The characters used to define the types were selected, in part, with a view to avoiding this state of affairs. For example, serrated edges were given limited consideration in the type definitions, because in the collections examined it was obvious that points were serrated as a rejuvenation technique to provide a sharper edge on artifacts that had low width:thickness ratios. However, it remains possible that some of the types are reworked from other types. In light of these points, it seems likely that in future some of the types identified among the collections will be shown to be invalid. Possible examples of types in the first of these categories include QW-E from the Qwu?qwes collection and HI-H from the Hartstene collection (Figures 3 and 4, Appendices A and B), and MA-L (Appendix E) from the Marymoor collection. These artifacts are asymmetrically shaped and probably functioned as hafted knives rather than projectile points. Possible examples of types in the second category include QW-C, QW-D, and QW-F. These artifacts may represent a continuum of point use and rejuvenation, with QW-C being the early stage on the point life cycle and QW-D and QW-F representing progressively more reworked fragments of the once larger point (Figure 10). In the next phase of our work we will test these hypotheses with the aid of morphometric and microwear analyses.

Acknowledgments. We thank Roy Carlson for inviting us to contribute to this volume even though we did not actually participate in the symposium from which it arose. We also thank the Squaxin Island Tribe Cultural Resources Department, the Squaxin Island Tribe Museum, Library and Research Center, South Puget Sound Community College, Karen and Ralph Munro, and Jean and Ray Auel for their on-going support of the Qwu?gwes project. We are grateful to Jack and Carleen Nickels for donating the Hartstene Island site collection of projectile points to the Squaxin Island Tribe Museum, Library and Research Center so that it can be analyzed and used for public exhibition. We are also grateful to Rhonda Foster, Tribal Historic Preservation Officer and Director of the Cultural Resources Department, Squaxin Island Tribe, for reviewing earlier drafts of this paper. Lastly, we would like to acknowledge the numerous Squaxin Island Tribe community members and South Puget Sound Community College students who have participated in the Qwu?gwes project over the last eight years. The research reported in this chapter would not have been possible without their efforts.

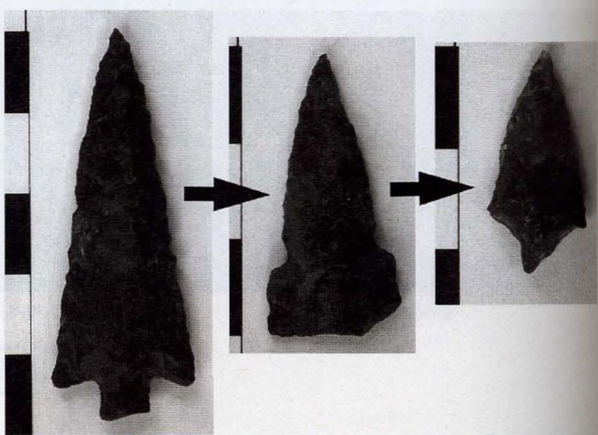

Figure 10. Example of proposed stages of rejuvenation of points at Qwu?gwes, from type QW-C to QW-D to QW-F (see Appendix A).

Table 3. Projectile point data from Qwu?gwes (45–TN–240). Types are defined in Appendices A and B. Level is in centimeters. Point measurements are in millimeters, and weights in grams. Measurements in brackets are estimates from incomplete examples.

Type	Square #	Level	Material	Length	Width	Thickness	Weight
QW–A	N25/E23	55-60	Chalcedony	31.49	25.80	7.80	4.90
QW–B	N26/E24	0-15	Basalt	20.31	17.57	3.47	1.00
QW–C	N08/E24	Surface	Chalcedony	30.22	17.02	5.63	1.80
QW–C	N15/E16	5-10	Jasper	27.96	15.40	4.68	1.50
QW–C	N21/E14	65-70	Chert	21.77	19.57	6.40	2.40
QW–C	N24/E22	50-55	Chert	48.13	17.59	4.08	3.40
QW–C	N29/E26	10-15	Chalcedony	33.26	14.25	4.02	1.60
QW–C	N30/E26	40-45	Basalt	28.55	17.14	3.17	1.40
QW–C	N34/E14	Surface	Chalcedony	28.66	17.50	4.35	1.80
QW–C	N52/E25	35-40	Chert	22.37	14.16	3.63	0.80
QW–C	N42.5/E19.1	Surface	Chert	37.91	19.47	5.28	2.70
QW–D	N24/E22	Slump	Chert	29.11	14.66	4.31	1.60
QW–E	N20/E13	0-5	Chert	31.06	15.08	3.59	1.60
QW–F	N18/E14	15-20	Jasper	21.86	11.38	4.96	1.00
QW–F	N18/E16	55-60	Chalcedony	25.39	15.82	6.02	2.00
QW–F	N19/E31	Surface	Chert	25.40	12.50	4.96	1.30
QW–F	N23.7/E9.7	Surface	Chalcedony	17.80	15.10	3.26	0.70
QW–F	N51/E26	25-30	Chert	33.06	19.90	5.41	2.50
QW–G	N29.02/E15.60	Surface	Chert	27.15	17.62	5.62	2.20
QW–H	N16/E17	Surface	Jasper	24.89	18.64	3.72	1.40
QW–H	N45/E15	Surface	Chert	28.16	21.63	5.04	2.00
QW–I	N16/E17	15-20	Chert	21.43	17.83	3.74	1.10
QW–I	N20/E15	50-60	Jasper	17.60	15.62	2.75	0.50
QW–J	N19/E14	10-15	Chert	30.68	20.25	6.57	3.20
QW–K	N30/E26	35-40	Basalt	28.81	18.09	2.75	1.40
QW–L	N23.3/E10	Surface	Chert	31.11	16.90	4.28	1.90

Table 4. Projectile point data from Hartstene Island. Types are defined in Appendices A and B. Measurement in brackets are broken, incomplete examples. All points were surface-collected.

Type	Number	Material	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
HI-A	HI-001	basalt	[35.21]	28.54	6.74	5.50
HI-A	HI-003	basalt	[22.47]	19.82	3.45	1.60
HI-A	HI-004	basalt	[29.37]	19.26	5.68	3.60
HI-A	HI-005	chert	38.02	23.26	6.37	4.40
HI-A	HI-009	chalcedony	50.07	17.35	5.71	5.30
HI-A	HI-016	petrified wood	37.80	16.89	4.25	2.00
HI-B	HI-017	basalt	18.47	15.68	2.99	0.70
HI-B	HI-021	chert	44.90	22.65	5.74	5.30
HI-B	HI-025	red jasper	30.42	15.06	5.08	1.70
HI-B	HI-026	red jasper	[18.13]	18.23	4.16	1.40
HI-B	HI-027	chalcedony	36.62	15.55	4.78	2.90
HI-B	HI-028	agate	42.83	17.74	9.27	6.40
HI-B	HI-029	chalcedony	24.29	14.96	4.96	1.70
HI-B	HI-031	basalt	[28.65]	24.76	4.88	2.70
HI-B	HI-034	basalt	[27.97]	18.6	4.17	1.50
HI-B	HI-035	basalt	[33.51]	24.65	4.48	3.00
HI-B	HI-037	white chalcedony	[28.42]	20.04	4.49	2.60
HI-B	HI-039	basalt	[29.74]	15.72	7.86	3.60
HI-B	HI-040	basalt	43.16	19.39	8.72	3.80
HI-B	HI-040b	basalt	[26.02]	21.65	5.57	—
HI-B	HI-041	basalt	29.25	14.29	4.74	1.80
HI-B	HI-044	basalt	26.55	26.6	4.07	2.80
HI-B	HI-045	basalt	27.76	19.48	4.45	2.70
HI-B	HI-046	basalt	43.16	19.39	8.72	7.70
HI-B	HI-052	basalt	[37.37]	16.27	4.97	2.70
HI-B	HI-053	basalt	31.71	20.99	6.25	3.30
HI-B	HI-054	basalt	[31.93]	22.28	6.45	3.40
HI-B	HI-055	basalt	39.43	14.63	7.49	3.40
HI-C	HI-056	basalt	25.78	18.29	5.04	2.10
HI-C	HI-057	basalt	26.04	19.31	5.93	2.00
HI-C	HI-058	basalt	20.36	16.57	3.50	1.50
HI-C	HI-063	red jasper	23.27	11.72	5.19	1.40
HI-C	HI-064	basalt	27.11	13.88	5.74	2.20
HI-C	HI-066	basalt	[40.21]	28.97	9.12	10.60
HI-C	HI-067	basalt	[23.52]	21.62	4.66	1.90
HI-C	HI-068	basalt	43.10	27.65	6.58	6.30
HI-C	HI-069	basalt	52.61	22.31	9.56	9.70
HI-C	HI-071	basalt	48.12	30.05	10.08	14.60
HI-C	HI-074	brown chalcedony	[40.36]	13.97	7.08	4.20
HI-C	HI-075	basalt	36.23	29.15	6.97	5.10
HI-C	HI-076	basalt	38.39	17.63	6.90	3.10
HI-C	HI-077	basalt	29.04	16.59	4.52	2.40
HI-C	HI-079	basalt	24.82	18.09	3.39	1.40
HI-D	HI-080	brown chalcedony	23.50	14.28	3.94	1.40
HI-D	HI-081	basalt	[40.18]	19.95	8.03	5.90
HI-D	HI-083	red jasper	23.22	14.15	4.92	1.60
HI-D	HI-084	purple chalcedony	31.08	13.84	4.92	2.00
HI-D	HI-085	basalt	[35.31]	13.74	6.71	4.10
HI-D	HI-086	basalt	26.48	15.58	2.74	1.30
HI-D	HI-087	chert	44.12	25.78	6.51	6.20
HI-D	HI-088	brown chalcedony	[30.50]	18.25	5.11	2.40
HI-D	HI-089	basalt	[32.62]	18.83	5.68	2.60
HI-D	HI-092	basalt	[39.16]	28.71	7.86	7.20
HI-D	HI-094	basalt	29.73	15.46	3.44	1.60
HI-D	HI-095	basalt	40.98	18.23	6.98	—
HI-D	HI-096	basalt	43.21	19.57	7.06	4.50
HI-D	HI-097	basalt	[32.25]	18.38	5.99	2.80
HI-D	HI-098	white chalcedony-agate?	[23.03]	11.72	5.06	1.20
HI-E	HI-099	red jasper	18.03	14.92	4.06	0.80
HI-E	HI-100	basalt	42.36	18.63	4.86	4.20
HI-E	HI-101	basalt	54.32	25.53	7.38	7.70
HI-E	HI-102	basalt	28.89	29.95	6.88	4.00
HI-E	HI-103	basalt	35.85	20.07	4.61	3.50

Table 4 continued.

Type	Number	Material	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)
HI-E	HI-104	basalt	43.54	17.05	7.55	4.50
HI-F	HI-105	basalt	46.17	29.7	8.35	11.20
HI-F	HI-106	basalt	[39.83]	16.72	6.40	3.30
HI-F	HI-107	basalt	31.78	27.06	7.15	5.30
HI-F	HI-109	basalt	39.70	23.04	7.00	4.40
HI-G	HI-112	basalt	[25.34]	15.67	2.94	1.40
HI-G	HI-114	basalt	[39.23]	17.86	6.41	5.00
HI-G	HI-115	red jasper	[28.1]	18.23	6.98	4.30
HI-G	HI-119	basalt	40.20	24.24	7.57	4.90
HI-H	HI-120	basalt	35.09	14.61	4.08	2.10
HI-H	HI-121	basalt	[29.79]	27.77	9.34	8.40
HI-H	HI-123	chert	39.30	19.43	6.32	3.90
HI-H	HI-126	basalt	27.21	13.47	4.88	1.30
HI-H	HI-129	basalt	28.37	18.75	4.78	2.20
HI-H	HI-131	basalt	41.82	18.73	6.75	5.70
HI-H	HI-132	red jasper	[22.96]	14.24	4.34	1.50
HI-H	HI-133	basalt	33.13	19.88	7.69	4.30
HI-H	HI-135	basalt	38.69	22.49	7.45	5.40
HI-I	HI-135a	basalt	37.09	33.1	5.85	5.50
HI-I	HI-136	jadeite-metamorphic	[32.35]	27.08	3.91	3.10
HI-I	HI-137	basalt	16.68	17.46	3.18	0.90
HI-I	HI-139	red jasper	22.44	15.37	4.68	1.00
HI-I	HI-140	basalt	37.43	12.73	4.50	2.10
HI-I	HI-141	basalt	[34.73]	16.49	7.12	4.40
HI-I	HI-142	petrified wood	48.56	21.78	7.31	6.60
HI-I	HI-143	basalt	[34.16]	19.69	4.92	2.80
HI-I	HI-144	basalt	[44.13]	29.25	8.80	8.60
HI-I	HI-145	basalt	47.06	20.84	7.25	6.10
HI-I	HI-146	basalt	[37.37]	19.64	2.17	2.60
HI-I	HI-147	basalt	35.14	27.57	4.05	4.30
HI-I	HI-149	white chalcedony-agate?	22.94	12.16	5.3	1.70
HI-I	HI-150	chert	[23.05]	15.2	4.15	1.40
HI-I	HI-151	basalt	39.74	22.29	5.27	4.40
HI-I	HI-152	basalt	36.30	20.16	4.95	4.10
HI-I	HI-153	basalt	[28.63]	17.86	5.14	2.50
HI-I	HI-154	basalt	[39.38]	14.6	3.89	2.60
HI-J	HI-156	basalt	28.72	20.98	4.00	2.40
HI-J	HI-159	basalt	40.15	30.54	4.70	6.60
HI-J	HI-160	basalt	34.26	20.9	4.29	2.60
HI-K	HI-161	basalt	[24.04]	17.94	5.05	1.50
HI-K	HI-162	basalt	31.58	15.3	3.27	1.30
HI-K	HI-163	basalt	[34.73]	15.65	3.51	2.30
HI-K	HI-164	basalt	30.17	18.37	5.52	3.00
HI-K	HI-166	basalt	25.06	14.03	4.59	1.90
HI-K	HI-167	basalt	34.60	18.37	6.44	3.90
HI-L	HI-169	basalt	27.52	22.05	4.52	3.00
HI-L	HI-170	basalt	32.48	15.35	5.49	2.20
HI-L	HI-173	basalt	36.33	22.54	4.42	2.90
HI-L	HI-174	basalt	[34.60]	27.62	6.71	4.30
HI-L	HI-175	basalt	[32.42]	23.06	5.04	2.70
HI-L	HI-176	basalt	33.93	29.13	6.19	4.80
HI-L	HI-177	basalt	[30.15]	17.53	6.36	2.90
HI-L	HI-179	basalt	[31.30]	26.28	7.17	5.70
HI-L	HI-180	basalt	39.00	18.53	4.05	3.10
HI-L	HI-182	basalt	[22.63]	17.7	3.82	1.50
HI-L	HI-183	basalt	28.02	17.23	4.22	1.90
HI-L	HI-184	basalt	32.88	13.64	3.49	2.20
HI-M	HI-185	chert	34.50	17.47	5.45	3.40
HI-M	HI-185b	basalt	[33.51]	22.35	3.31	2.40
HI-M	HI-186	red jasper	[40.55]	19.12	7.43	4.60
—	HI-187	basalt	38.80	19.43	6.66	3.80
—	HI-189	basalt	[33.00]	12.31	4.56	2.00

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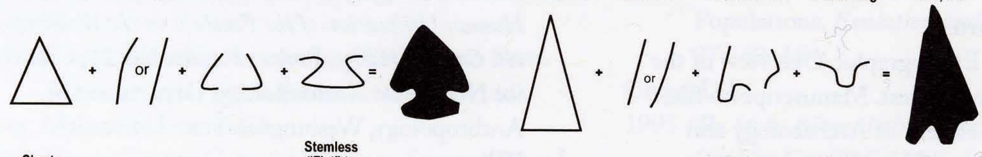
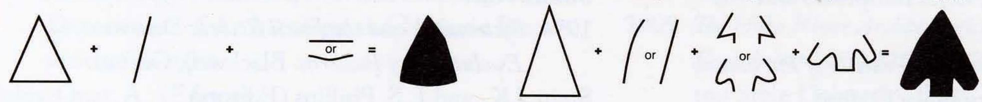
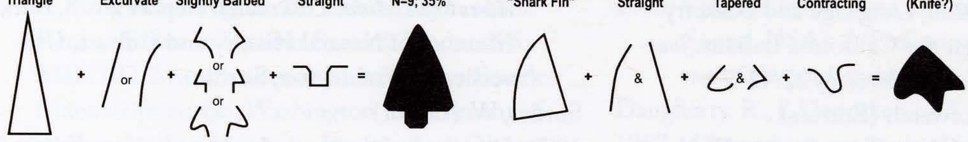
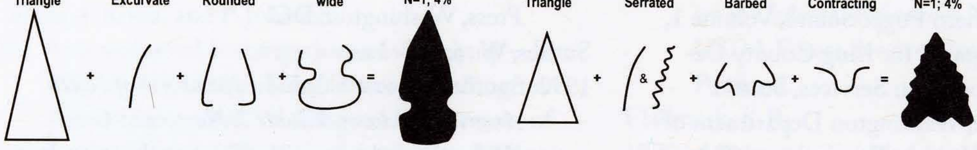
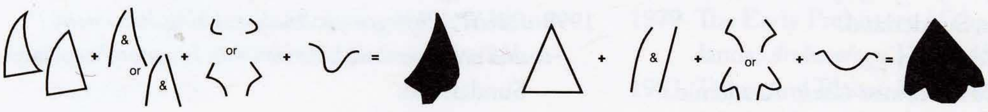
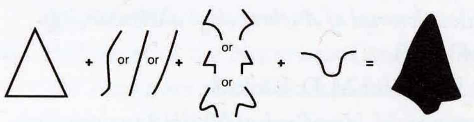
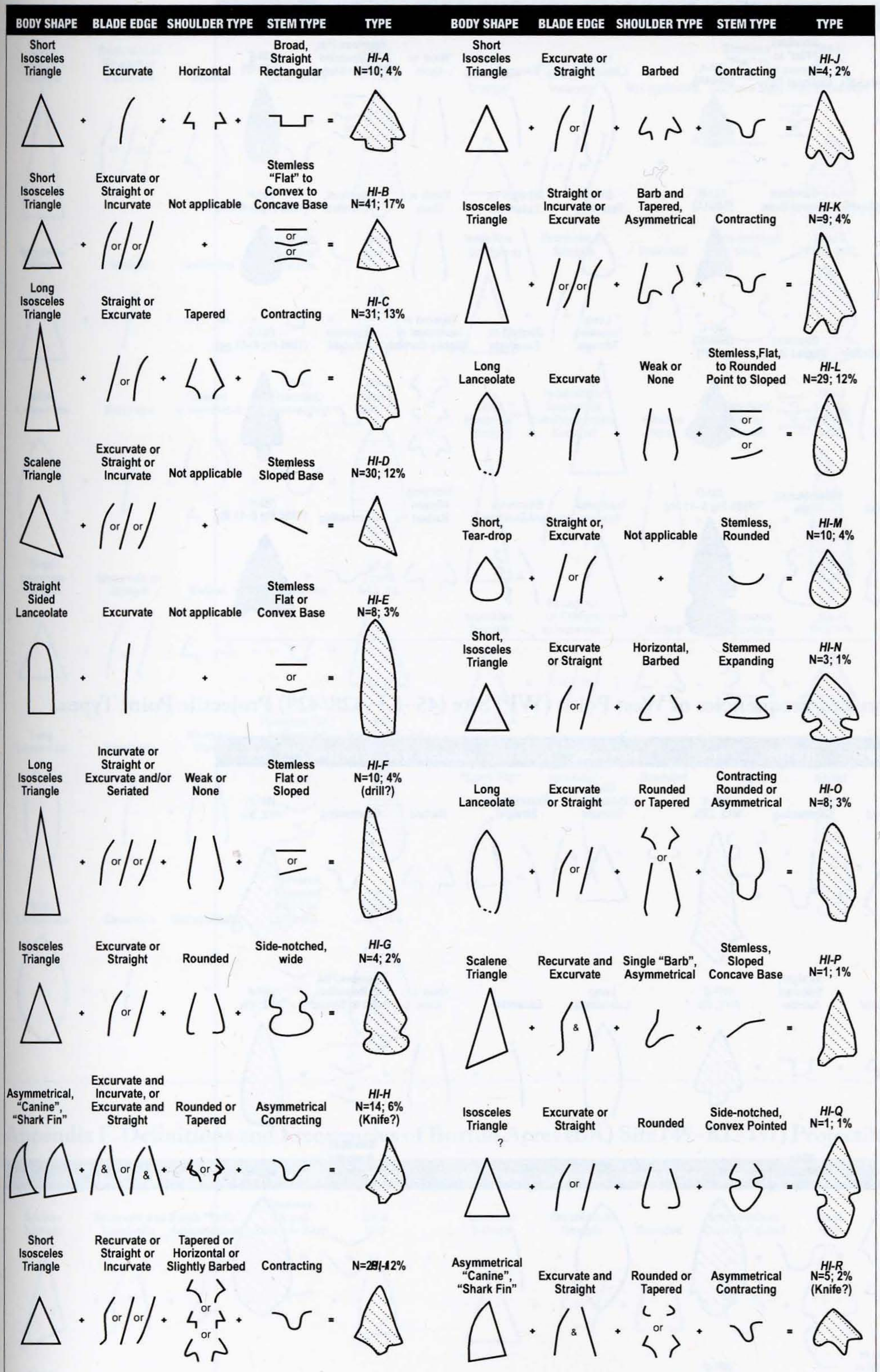
Appendix A. Definition and Frequencies of Qwu?gwes (QW) Site (45–TN–240) Projectile Point Types.

BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE	BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE
Short, Isosceles Triangle	Excurvate or Straight	Horizontal, Barbed	Stemmed Expanding	*QW-A* N=1; 4%	Isosceles Triangle	Straight or Incurvate or Excurvate	Barb and Tapered, Asymmetrical	Contracting	*QW-G* N=1; 4%
									
Short, Isosceles Triangle	Straight	Not Applicable	Stemless "Flat" to Convex to Base	*QW-B* N=1; 4%	Isosceles Triangle	Excurvate or Straight	Acute or Drooping Winged	Straight Stemmed, Squared	*QW-H* N=2; 8%
									
Long Isosceles Triangle	Straight or Excurvate	Tapered or Horizontal or Slightly Barbed	Stemmed Straight	*QW-C* N=9; 35%	Asymmetrical "Canine", "Shark Fin"	Excurvate and Straight	Rounded or Tapered	Asymmetrical Contracting	*QW-I* N=2; 8% (Knife?)
									
Long Isosceles Triangle	Excurvate	Rounded	Side-notched, wide	*QW-D* N=1; 4%	Isosceles Triangle	Excurvate and Serrated	Drooping Winged Barbed	Contracting	*QW-J* N=1; 4%
									
Asymmetrical, "Canine", "Shark Fin"	Excurvate and Incurvate, or Excurvate and Straight	Rounded or Tapered	Asymmetrical Contracting	*HI-E* N=1; 4% (Knife?)	Short Isosceles Triangle	Excurvate and Straight	Tapered or Slightly Barbed	Stemmed Rounded	*QW-K* N=1; 4%
									
Short Isosceles Triangle	Recurvate or Straight or Incurvate	Tapered or Horizontal or Slightly Barbed	Contracting	*QW-F* N=5; 1% thought to be Re-sharpened *QW-Cs*					
									

Appendix B. Definition and Frequencies of Hartstene Island (HI) Site Projectile Point Types.



BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE
Short Isosceles Triangle	Excurvate	Horizontal	Broad, Straight Rectangular	*HI-A* N=10; 4%
Short Isosceles Triangle	Excurvate or Straight or Incurvate	Not applicable	Stemless "Flat" to Convex to Concave Base	*HI-B* N=41; 17%
Long Isosceles Triangle	Straight or Excurvate	Tapered	Contracting	*HI-C* N=31; 13%
Scalene Triangle	Excurvate or Straight or Incurvate	Not applicable	Stemless Sloped Base	*HI-D* N=30; 12%
Straight Sided Lanceolate	Excurvate	Not applicable	Stemless Flat or Convex Base	*HI-E* N=8; 3%
Long Isosceles Triangle	Incurvate or Straight or Excurvate and/or Seriated	Weak or None	Stemless Flat or Sloped	*HI-F* N=10; 4% (drill?)
Isosceles Triangle	Excurvate or Straight	Rounded	Side-notched, wide	*HI-G* N=4; 2%
Asymmetrical, "Canine", "Shark Fin"	Excurvate and Incurvate, or Excurvate and Straight	Rounded or Tapered	Asymmetrical Contracting	*HI-H* N=14; 6% (Knife?)
Short Isosceles Triangle	Recurvate or Straight or Incurvate	Tapered or Horizontal or Slightly Barbed	Contracting	N=28 *HI-I* 12%
Short Isosceles Triangle	Excurvate or Straight	Barbed	Contracting	*HI-J* N=4; 2%
Isosceles Triangle	Straight or Incurvate or Excurvate	Barb and Tapered, Asymmetrical	Contracting	*HI-K* N=9; 4%
Long Lanceolate	Excurvate	Weak or None	Stemless, Flat, to Rounded Point to Sloped	*HI-L* N=29; 12%
Short, Tear-drop	Straight or, Excurvate	Not applicable	Stemless, Rounded	*HI-M* N=10; 4%
Short, Isosceles Triangle	Excurvate or Straignt	Horizontal, Barbed	Stemmed Expanding	*HI-N* N=3; 1%
Long Lanceolate	Excurvate or Straight	Rounded or Tapered	Contracting Rounded or Asymmetrical	*HI-O* N=8; 3%
Scalene Triangle	Recurvate and Excurvate	Single "Barb", Asymmetrical	Stemless, Sloped Concave Base	*HI-P* N=1; 1%
Isosceles Triangle ?	Excurvate or Straight	Rounded	Side-notched, Convex Pointed	*HI-Q* N=1; 1%
Asymmetrical "Canine", "Shark Fin"	Excurvate and Straight	Rounded or Tapered	Asymmetrical Contracting	*HI-R* N=5; 2% (Knife?)

Appendix C. Definition of Duwamish No. 1 Site (DU) (45–KI–23) Projectile Point Types.

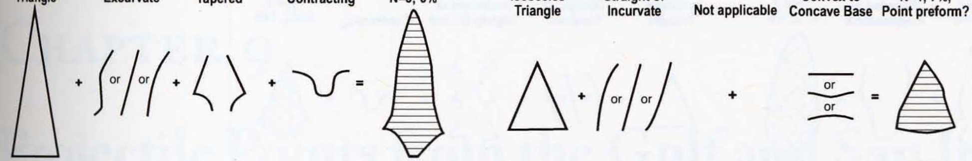
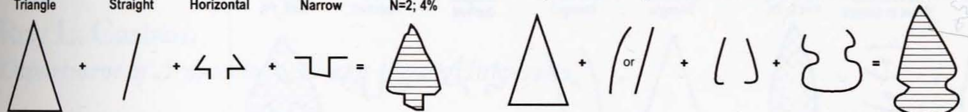
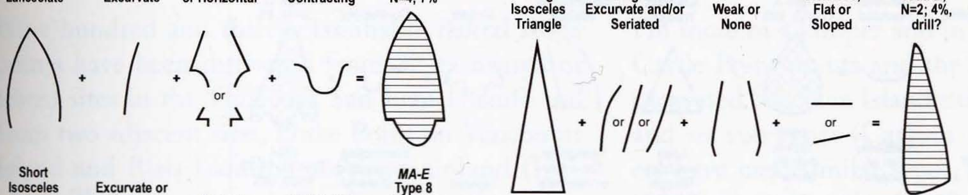
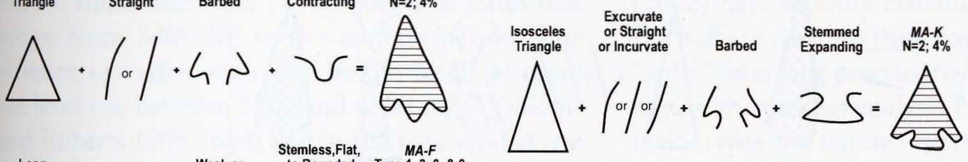
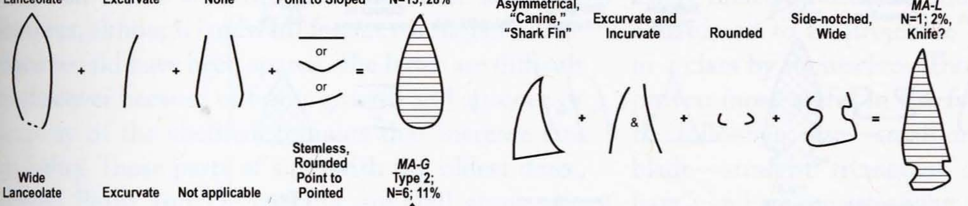
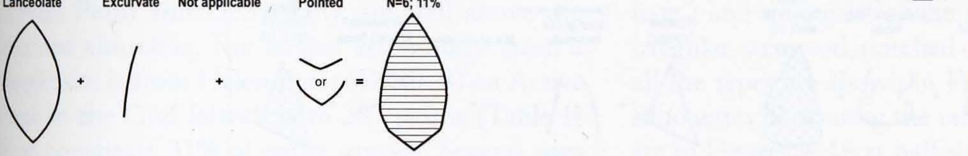
BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE	BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE
Short Isosceles Triangle	Excurvate or Straight or Incurvate	Not applicable	Stemless "Flat" to Convex to Concave Base	*DU-A* (S664A)	Long Lanceolate	Excurvate	Weak or None	Stemless,Flat, to Rounded Point to Sloped	*DU-E* (S664B)
Scalene Triangle	Excurvate or Straight or Incurvate	Not applicable	Stemless Sloped Base	*DU-B* (S664A)	Short, Tear-drop	Straight or, Excurvate	Weak or None	Stemless, Rounded	*DU-F* (1986 Fig 6–9 e–k)
Isosceles Triangle	Incurvate or Straight or Excurvate and/or Seriated	Not applicable	Stemless Sloped Base	*DU-C* (S664C) (drill?)	Long Isosceles Triangle	Straight or, Excurvate	Tapered or Horizontal or Slightly Barbed	Stemless Straight	*DU-G* (1986 Fig 6–11 gg)
Long Isosceles Triangle	Excurvate	Rounded	Side-notched, wide	*DU-D* (1986 Fig 6–11 hh)	Isosceles Triangle	Excurvate and Serrated	Drooping Winged Barbed	Contracting	*DU-H* (1986 Fig 6–11 ff)

Appendix D. Definition and Frequencies of West Point (WP) Site (45–KI–428/429) Projectile Point Types.

BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE	BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE
Long Isosceles Triangle	Recurvate or Straight or Excurvate	Tapered	Contracting	*WP-A* N=5; 23%	Short Isosceles Triangle	Excurvate or Straight	Barbed	Contracting	*WP-E* N=2; 9%
Isosceles Triangle	Straight	Horizontal	Straight, Squared Narrow	*WP-B* N=1; 5%	Long Lanceolate	Excurvate	Weak or None	Stemless,Flat, to Rounded Point to Sloped	*WP-F* N=2; 9%
Wide Lanceolate	Excurvate	Tapered or Horizontal	Wide, Rounded, Contracting	*WP-C* N=3; 14%	Wide Lanceolate	Excurvate	Not applicable	Stemless, Rounded Point to Pointed	*WP-G* N=5; 23%
Short Isosceles Triangle	Recurvate or Straight or Incurvate	Tapered or Horizontal or Slightly Barbed	Contracting	*WP-D* N=4; 18%					

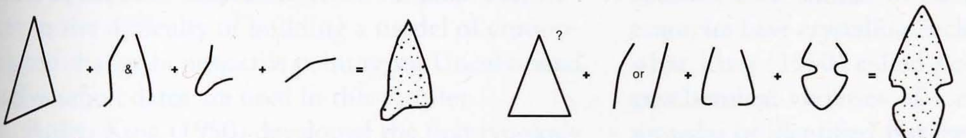
Appendix E. Definition and Frequencies of Marymoor (MA) Site (45–KI–9) Projectile Point Types.

BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE	BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE
Long Isosceles Triangle	Recurvate or Straight or Excurvate	Tapered	Contracting	*MA-A* Type 4; N=3; 6%	Short Isosceles Triangle	Excurvate or Straight or Incurvate	Not applicable	Stemless "Flat" to Convex to Concave Base	*MA-H* Type 8, N=4; 7%, Point preform?
Isosceles Triangle	Straight	Horizontal	Straight, Squared Narrow	*MA-B* Type 4; N=2; 4%	Isosceles Triangle	Excurvate or Straight	Rounded	Side-notched, Wide	*MA-I* Type 5, N=13; 24%,
Wide Lanceolate	Excurvate	Tapered or Horizontal	Wide, Rounded, Contracting	*MA-C* Type 4; N=4; 7%	Long Isosceles Triangle	Incurvate or Straight or Excurvate and/or Seriated	Weak or None	Stemless, Flat or Sloped	*MA-J* Cat. D; N=2; 4%, drill?
Short Isosceles Triangle	Excurvate or Straight	Barbed	Contracting	*MA-E* Type 8 N=2; 4%	Isosceles Triangle	Excurvate or Straight or Incurvate	Barbed	Stemmed Expanding	*MA-K* N=2; 4%
Long Lanceolate	Excurvate	Weak or None	Stemless,Flat, to Rounded Point to Sloped	*MA-F* Type 1, 3, 6, & 8 N=15; 28%	Asymmetrical, "Canine," "Shark Fin"	Excurvate and Incurvate	Rounded	Side-notched, Wide	*MA-L* N=1; 2%, Knife?
Wide Lanceolate	Excurvate	Not applicable	Stemless, Rounded Point to Pointed	*MA-G* Type 2; N=6; 11%					

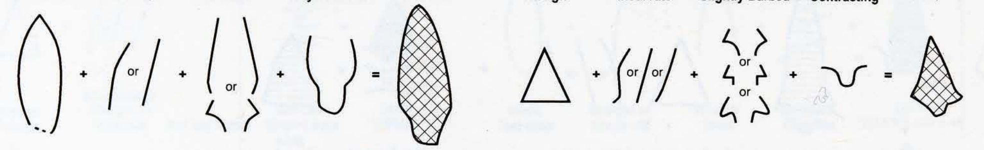
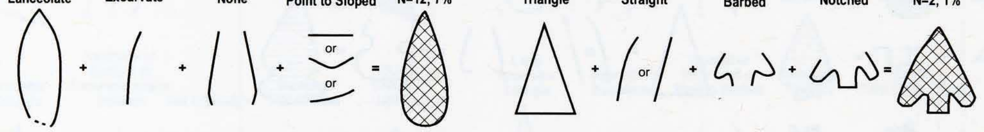
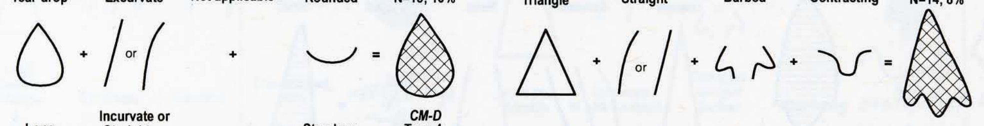
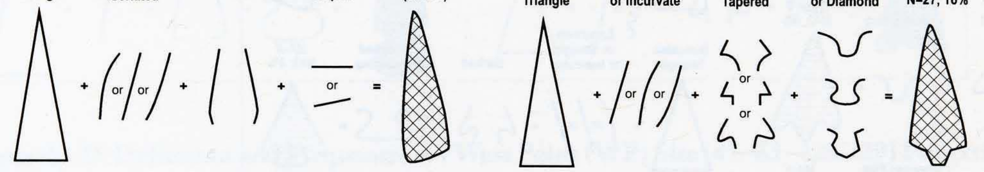
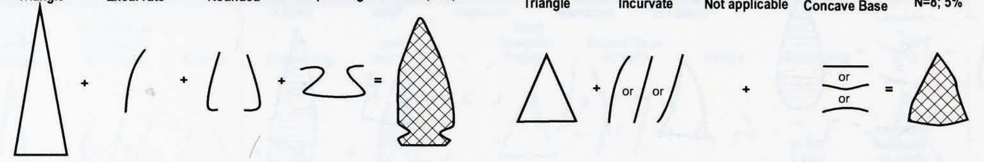
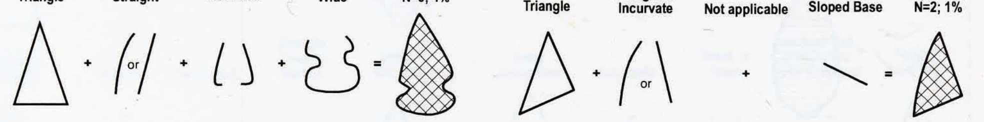
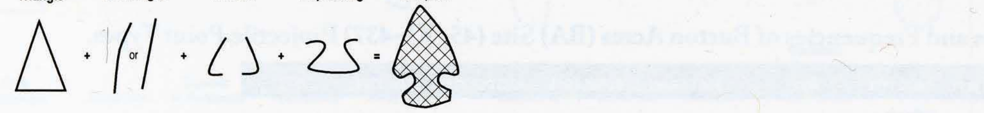







Appendix F. Definitions and Frequencies of Burton Acres (BA) Site (45–KI–437) Projectile Point Types.

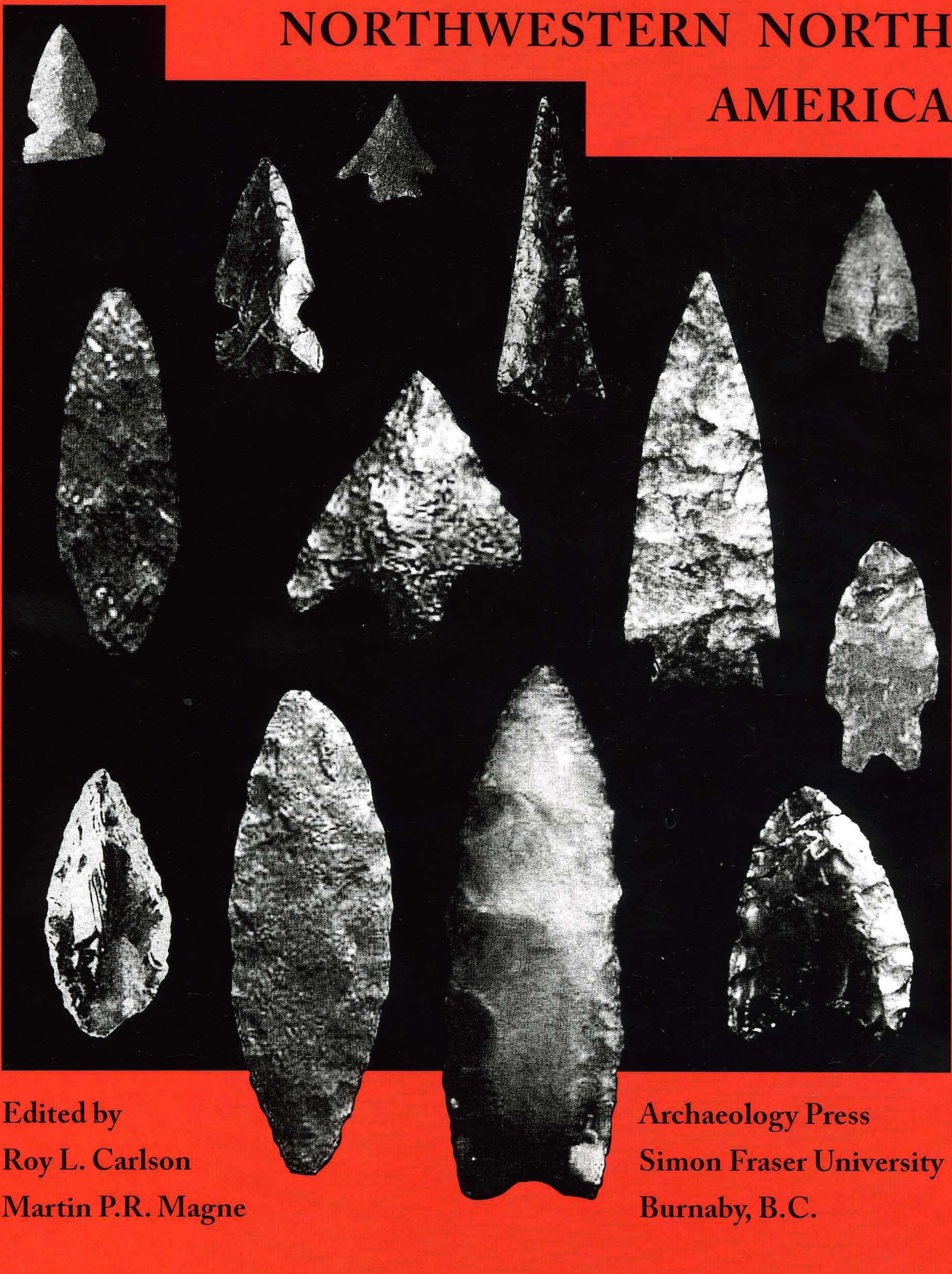
BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE	BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE
Scalene Triangle	Recurvate and Excurvate	Single "Barb", Asymmetrical	Stemless, Sloped Concave Base	*BA-A* N=2	Isosceles Triangle	Excurvate or Straight	Rounded	Side-notched, Convex Pointed	*BA-C* N=1
Short, Isosceles Triangle	Excurvate	Not applicable	Stemless Concave Base	*BA-B* N=1					




Appendix G. Definitions and Frequencies of Chester Morse Lake (CM) Sites (45–KI–25, 30-32, 299-300) Projectile Point Types.

BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE	BODY SHAPE	BLADE EDGE	SHOULDER TYPE	STEM TYPE	TYPE
Long Lanceolate	Excurvate or Straight	Rounded or Tapered	Contracting Rounded or Asymmetrical	*CM-A* Type 1 N-10; 6%	Short Isosceles Triangle	Recurvate or Straight or Incurvate	Tapered or Horizontal or Slightly Barbed	Contracting	*CM-H* Type 9, N=23, 14%
									
Long Lanceolate	Excurvate	Weak or None	Stemless,Flat, to Rounded Point to Sloped	CM-B Type 2, 6; N=12; 7%	Isosceles Triangle	Excurvate or Straight	Drooping Winged, Barbed	Basal Notched	*CM-J* Type 11, N=2, 1%
									
Short, Tear-drop	Straight or Excurvate	Not applicable	Stemless, Rounded	*CM-C* Type 3, N=15; 10%	Short Isosceles Triangle	Excurvate or Straight	Barbed	Contracting	*CM-K* Type 12, N=14, 8%
									
Long Isosceles Triangle	Incurvate or Straight or Excurvate and/or Seriated	Weak or None	Stemless, Flat or Sloped	*CM-D* Type 4; N=8; 5%, (drills?)	Long Isosceles Triangle	Straight or Excurvate or Incurvate	Tapered	Contracting or Expanding or Diamond	*CM-L* Type 13, 14, 15 N=27, 16%
									
Long Isosceles Triangle	Excurvate	Rounded	Stemmed Expanding	*CM-E* Type 6; N=12; 7%,	Short Isosceles Triangle	Excurvate or Straight or Incurvate	Not applicable	Stemless "Flat" to Convex to Concave Base	*CM-M* Type 17, N=8; 5%
									
Isosceles Triangle	Excurvate or Straight	Rounded	Side-notched, Wide	*CM-F* Type 7, 16 N=6; 4%	Scalene Triangle	Excurvate or Straight or Incurvate	Not applicable	Stemless Sloped Base	*CM-N* Type 19, N=2; 1%
									
Short, Isosceles Triangle	Excurvate or Straight	Horizontal, Barbed	Stemmed Expanding	*CM-G* Type 8, N=7; 4%					
									

PROJECTILE POINT SEQUENCES IN NORTHWESTERN NORTH AMERICA



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