CULTURAL AND NON-CULTURAL VARIATION IN THE
ARTIFACT AND FAUNAL SAMPLES FROM THE
ST. MUNGO CANNERY SITE, B.C., DgRr 2

by

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ABSTRACT

The records of both the faunal remains and artifacts recovered from the St. Mungo Cannery site in the Fraser Delta, British Columbia during 1968-1969 are analysed quantitatively for evidence of processual cultural change. Descriptions of the site and site habitat are given, and methods used to recover, describe, and analyse the two records are detailed. The patterns of variation through time are given in tables of the relative frequencies of types found in excavation units C1 and C2. Multidimensional scalogram analysis is used to delineate and visually present the separation of components. An attempt is made to distinguish cultural variation in the two records from non-cultural variation produced by sampling procedures, and to control for the latter. The relationship between sample size and the number of artifacts and faunal types found is statistically demonstrated as a major sampling error. Some comparisons are made between the patterns of variation observed in faunal and artifact types theoretically related as evidence of particular activities. The information contained in the faunal record is found to be additional as well as parallel to that contained in the artifact record.

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CHAPTER I

INTRODUCTION

The initial purpose of this study was to examine the internal cultural variation in a Northwest Coast midden site located in the Fraser Delta, British Columbia, by comparing the record contained in the artifact sample with that contained in the faunal sample. The intention was to see if the faunal evidence of utilization of animal resources varied quantitatively through time in a manner that corroborated the evidence of the artifact record. It was expected that the two records would show a pattern of concomitant variation through time.

Little attention has been paid to faunal remains in archaeological reports on Northwest Coast sites, although the excellent preservation of shell and bone in most middens makes faunal studies particularly applicable. In most instances the faunal remains have been relegated to a few paragraphs giving a list of species identified, with little or no attempt at quantitative description. This has been partly the result of difficulties encountered in obtaining identification of quantities of fragmentary bones and partly because of the amount of time required to carry out quantitative analysis of such samples. Recent studies done for other geographic areas, however, have shown that a great deal of useful information can be extracted from the faunal record if quantitative methods are used in the description and analysis of the remains. Most of this work has been directed towards arriving at a description of the subsistence economy within one archaeological unit of time (Thomas 1969; Daly 1969; White 1953), or has dealt with preservation problems or culturally induced sampling problems (Thomas 1971; Zeigler 1965; Thomas 1969; Casteel 1971; Lyons 1970). The study of faunal remains as indicators of the season of occupation has also received considerable attention. As Daly (1969:146) has pointed out, the faunal remains preserved at a site are as much a cultural record of the activities carried on at that site as are the artifacts. The very presence of these particular bones and not others is the result of cultural activity. The species found are a culturally selected sample of all animal resources available to the occupants of the site, and as such are a record of economic exploitation directed by cultural preference and technology as well as by availability.

This being the case, an examination of the faunal record for evidence of cultural variation would add another dimension to the information obtained from the artifact record alone. If patterns of concomitant variation can be found, such evidence would increase the confidence that could be placed on the resulting interpretations. The belief that similar patterns of variation can be found in the two records is based on the following reasoning. Artifacts represent activities, tentatively identified by the use of ethnographic and experimental analogs. Variation through time in artifact form and frequencies is taken to represent a corresponding variation in activities. Non-artifactual evidence of these activities should vary in a parallel pattern. Binford (1967) has compared demonstrable variation in features and theoretically related artifacts. It should be possible to use faunal remains associated with activities in a similar way. The following situations indicate ways in which the faunal evidence might be used to further elucidate the variation observed in the artifact record:

1. If a change in the frequency of an artifact type through time is paralleled by a corresponding change in the frequency of theoretically related faunal remains, there is then additional support for the reality of that change and for the assumed function of the artifact type.
2. If a change in the relative frequency of an artifact type is not paralleled by a corresponding change in the related faunal remains, several explanations are possible:
   a) A change in the type of artifact used to perform the implied activity, which suggests looking for an opposing pattern of variation in another arti-

fact type that could be used to perform the same function.

b) Misidentification of function.

c) Sampling error in either or both of the records.

3. If a change occurs in the faunal but not in the artifact record, several alternatives are again possible:

a) A change in the function but not the form of an artifact type. This might be identified by an examination of wear patterns.

b) Misidentification of function.

c) Sampling error.

4. If there is faunal evidence of an activity, but no artifactual evidence can be identified, it is possible that the related artifacts have not been preserved, or that the function of some artifact type has been misinterpreted or incorrectly limited. The non-artifactual record may help in assessing the degree to which the recovered artifact assemblage is representative of the cultural activities performed at the site.

5. If parallel changes suggesting the increasing or decreasing use of particular resources can be observed in both records, it may be possible to determine if these changes form a pattern that would be consistent with a change in available resources, that is, a change in local habitat. A change of this type would

affect all the species living in an area in definite, predictable ways. For example, an increase in marshy areas at the expense of forest and grassland habitats would provide room for more beavers, muskrats, and some types of migratory birds, but would decrease the areas available to support deer, wapiti, coyote, and other forest or grassland animals. Change in habitat, then, would show up in changing patterns for more than one or two types, which could be explained by the same ecological factors. If no such pattern emerges, it suggests that the change in resource use may be one of cultural selection from a relatively stable environment. Other evidence of environmental change such as pollen profiles, sea-level, and geomorphological data can then be considered to determine which of the alternatives is most likely.

As the study progressed, it became increasingly obvious that sampling problems were strongly affecting any patterns of variation that could be observed in either the faunal or artifact records from the St. Mungo site. The major problem was the actual identification of cultural change as distinct from non-cultural fluctuations in the records produced by numerous random and non-random factors. Unless this distinction can be made in such a way that the effects of the non-cultural influences can be quantified, measured, and controlled for, there is little point in comparing the two records. Such uncontrolled comparisons would be based on distributions of artifact and faunal types that are known to reflect variations other than purely cultural ones. Working with the kind of sample obtained from the St. Mungo site -- small, non-random, and from one area of the site -- only one non-cultural influence was identified without question and to some degree statistically measured. That influence is sample size. Type of deposit also affects the kinds of artifacts found, but the small sample size did not permit the identification of a consistent bias that could be completely controlled. Season of occupation might also influence the kinds of artifacts found and would have to be taken into account in any attempt to identify long range processual changes in cultural variation over and above those variations produced by different use occupancy of the site area sampled. The season of occupation was partially determined for most of the matrix divisions of the sample. This factor is relatively constant for this particular sample of the site area.

As only three factors influencing the distributions were identified, and only one of these could be expressed quantitatively, full comparisons of the faunal and artifact records were not made. The study concentrates on the description of the two records. The influence of sample size, other sampling problems, and the additional information provided by the analysis of the faunal remains are discussed.

The use of multidimensional scalogram analysis in delineating components is also discussed. Although the full comparisons are not made, and the actual results of using MSA on this sample can be questioned, the methods used to quantify description of the two records would probably produce the expected results if used on an adequate sample. For this reason the theory underlying the initial proposal was outlined above.

CHAPTER II

SOURCE OF THE DATA

The data on which this study is based were excavated by the author in 1968 and 1969 from the St. Mungo Cannery site (DgRr 2), a Fraser Delta shell midden located on the south bank of the South Arm of the Fraser River, British Columbia, opposite Annacis Island and the northeastern tip of Lulu Island. The following paragraphs give a brief description of the nature of the deposits, the present and past local habitat of the site area, and the ethnographic region.

Site Description

The St. Mungo Cannery midden is now located about thirteen miles from the mouth of the Fraser River (Figure 1). The deposits must originally have extended for about 300 yards along the river bank and for about 100 yards back from the water's edge. Much of the site is now built over with residences and the buildings of the cannery, which is still in operation. A considerable portion has been bulldozed into the river to provide a platform on which to draw up the cannery fishing boats, and both River Road and a line of the Great Northern Railway cut through the deposits. The excavations were made in a relatively undisturbed section of the site at the western end of the midden. An area of 205 square

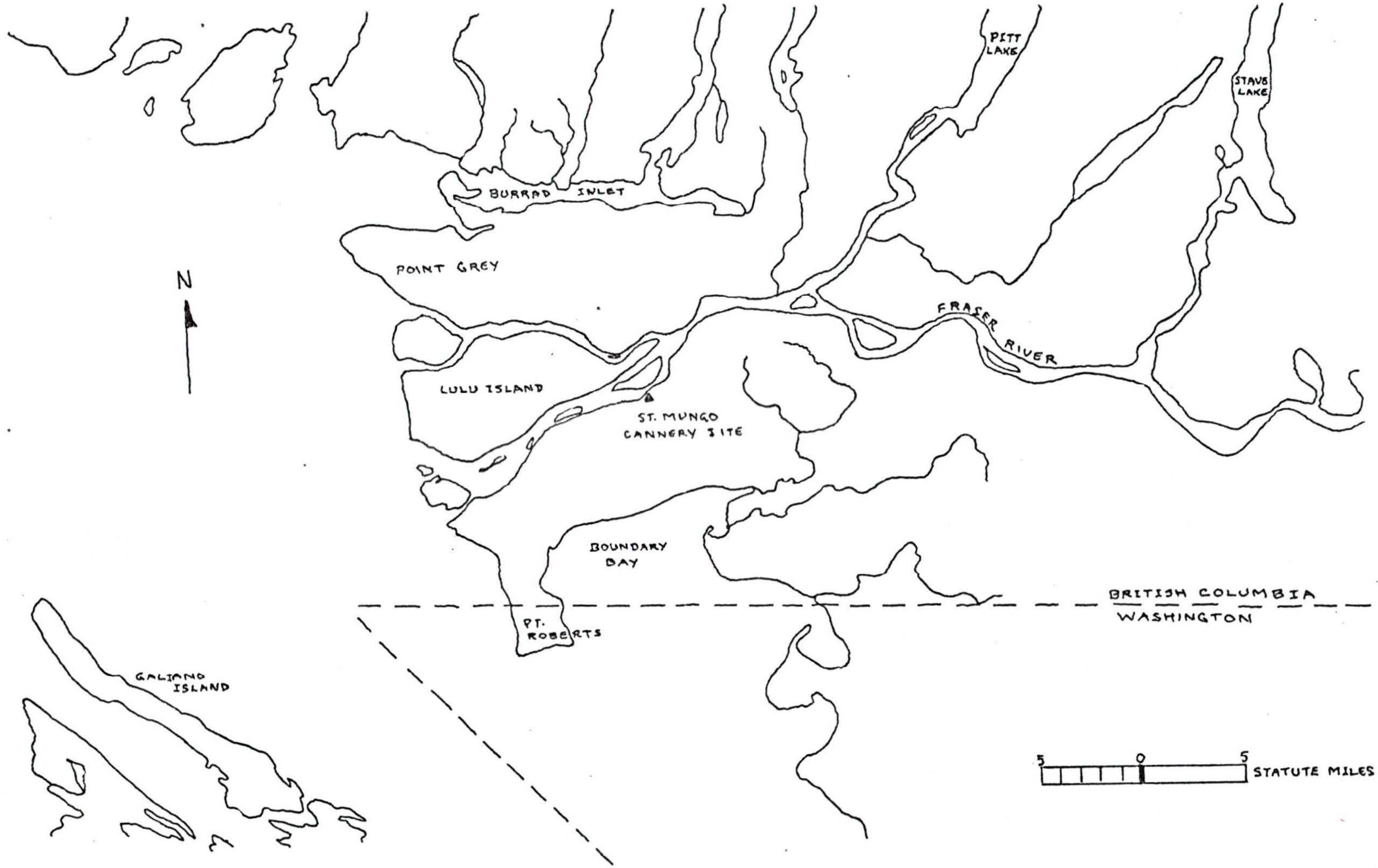

FIG. 1: MAP OF THE FRASER RIVER DELTA, BRITISH COLUMBIA, SHOWING THE LOCATION OF THE ST. MUNGO CANNERY SITE

feet was excavated in six adjacent cuts. This is less than one per cent of the estimated site area. In this portion of the site, the deposits were between six and seven feet deep. The top of the midden averages 27 feet above present mean sea-level.

The stratigraphy of the deposits is typical of south coastal shell middens. Below a thin top-soil layer that is considerably disturbed is a living floor scattered with small hearth areas surrounded by extensive ash deposits in a main matrix of brown humus and low density finely crushed shell. Two radio-carbon estimates were obtained for this layer, which is from six inches to a foot thick. An estimate of A.D. 1560 ± 95 (I-4686) was obtained on a wood charcoal sample from excavation unit C1, and an estimate of A.D. 1150 ± 95 (I-4687) on a wood charcoal sample from a hearth dug down into the next stratigraphic layer in excavation unit C2.

Beneath this living area is a large, irregularly shaped pit of sandy brown and red soil with little or no shell, which cuts down into the earlier deposits in excavation units D2, D3, C1, and C2. Intrusive in this layer, but capped by the layer above, are two complete and two incomplete burials. A radio-carbon estimate of A.D. 830 ± 95 (I-4689) was obtained for a wood charcoal sample from the sandy pit, found at a depth of 1.7 feet below the surface of the deposits. At its deepest point this unit was three feet thick, the sides tapering up to the surface so that the cross section is roughly bowl-shaped. Numerous stake and root molds extend downwards from the bottom of this pit.

The remaining layers of the site are finely stratified deposits of alternating highly concentrated shell dump layers, layers of less highly concentrated shell in brown to grey humus soils, and living floors marked by hearth clusters and extensive ash deposits. The bottom two to three feet of the midden are more finely stratified and compacted than the upper layers. The bottom layer, of highly concentrated fine shell and ash spreads, lies directly on top of a hard, greenish, river deposited clay. Three radio-carbon estimates were obtained for these lower layers. An estimate of 2020 B.C. ± 105 (I-4685) was obtained for a wood charcoal sample from a layer of hearths in excavation unit C1, four feet below the surface and about two and a half feet above the clay. Estimates of 2360 B.C. ± 110 (I-4053) and 2290 B.C. ± 105 (I-4688) were obtained for wood charcoal samples from the layer immediately overlying the sterile clay in excavation units A1 and C2 respectively. The layers in this horizon indicate a gradual accumulation of cultural debris.

Although no sterile soil horizon was observed separating the uppermost hearth layer from the lower deposits in those excavation units in which the sandy pit did not exist, the radio-carbon estimates suggest there is a considerable time hiatus between these two horizons. The three estimates for the lower deposits are close enough to suggest that they may be estimates of the same date. A test of the significance of the difference between these dates was calculated to examine this possibility, using the method outlined by Spaulding (1958:309). For the pair of estimates 2360 ± 110 B.C. and 2020 ± 105 B.C., a *t* value of 2.23 with a probability value of between .05 and .02 was obtained. This means that differences as large as those between these two estimates could occur in two estimates of the same date between two and five times in a hundred. Differences as large as those between the estimates 2290 ± 105 B.C. and 2020 ± 105 B.C. could occur in two estimates of the same date as often as between five and ten times in a hundred. With these levels of probability, the possibility that these are three estimates of the same date cannot be discounted. The mean of the three estimates is probably more representative of the actual date than any one of the estimates, giving a probable estimate of about 2200 B.C. for the lower deposits.

These tests suggest that, despite the two to three feet of deposit separating the earliest estimates from the estimate of 2020 B.C., the time span of those deposits is not great. It further suggests that the time span of the whole lower portion of the site is not nearly as long as the depth of deposit would intuitively suggest. The state of preservation of the molluscan remains in these deposits tends to support the antiquity of the whole unit. Throughout these levels shell remains are finely fragmented. It is highly probable, then, that a considerable time gap exists between the deposition of the top layers of the lower unit and the deposition of the sandy pit.

Site Habitat

The site habitat is discussed in terms of present and past conditions.

Present Conditions

The present climate of the Fraser Delta is mild and wet with a moderate rainfall occurring mainly in the winter months. Snowfall is generally light and temperatures moderate without extreme fluctuations, although in particularly severe winters stretches of the Fraser River may freeze over. The natural climax vegetation of the area is a dense coniferous forest of western red cedar, grand fir, Sitka spruce, and western and mountain hemlock on the mountain slopes, with the valley floor cover including smaller stands of red alder, western birch, broadleaf and vine maple, and black cottonwood. Douglas fir and yew are also present, though in less abundance. The wandering channels of the Fraser River mouth and the influence of the tides formerly produced extensive areas of marsh and tidal flats in the areas that are now Delta and Richmond municipalities. Even now, most of the land to the west and south of the site is below sea level and would be marsh land flooded every year, except for the network of protecting dykes.

Prior to white settlement and draining of the marshes, the delta was good winter range for wapiti and deer, and ideal beaver country (McTaggart-Cowan and Guiget 1965). It still remains a major feeding ground for large flocks of migratory ducks, geese, and swans. Riverine resources include numerous fresh-water and inter-tidal fish (Carl, Clemens and Lindsey 1971), and the Fraser River runs of all five species of Pacific salmon and of eulachon are the largest of any British Columbia coastal river. Sea and other inter-tidal resources include numerous species of bivalve and univalve molluscs (Griffith 1967; Quayle 1970), crabs, barnacles, sea urchins, sea cucumbers, and many kinds of marine fish (Carl 1964). Sea mammals were also available, some hair seal breeding in Harrison Lake. Vegetal foods, too, are abundant, including a wide variety of berries, several kinds of seaweeds, arrowroot and camas lily. In short, the Fraser Delta is one of the richest ecological areas in the Northwest Coast in terms of abundance and variety of available food stuffs, even though most of the resources are only seasonally available.

Past Conditions

As mentioned above, the St. Mungo Cannery site now lies some thirteen miles from the mouth of the river. It is situated at the base of a high ridge of glacial till named Panorama Ridge (Armstrong 1956 and 1957), and everything to the west and south is considerably lower ground. At the time of the initial occupation it would have been almost on salt water (Johnston 1923; Mathews and Shephard 1962), with low tides producing extensive mud flats and marshy areas. Molluscan resources were abundant and heavily exploited, judging by the high shell content of the midden. They include edible mussel (*Mytilus edulis*, Linnaeus), little-neck clam (*Protothaca staminea*, Conrad), thin-shelled little-neck (*Venerupis tenerrima*, Carpenter), basket cockle (*Clinocardium nuttalli*, Conrad), horse clam (*Schizothaerus nuttalli/capax*, Conrad), and an unidentified species of *Macoma*.

It has been suggested by Heusser (1960:184; 1966), on the evidence of his pollen studies, that between about 8500 B.P. and 3000 B.P. the climate of southern British Columbia was warmer than at present, and also drier in the later part of this period. Around 3000 B.P. conditions became gradually cooler and moister until the climate was much as it is today. Similar evidence was found by Hansen (1940) in a pollen profile from a bog on top of Panorama Ridge, although his succession is not dated. It is not certain, however, that the forest successions recorded in the pollen profiles are indicative of general climatic fluctuations rather than natural, local succession (Hansen 1947; Manley 1966; Frengel 1966). Recent pollen studies of lake sediments from the Fraser Canyon area tend to support the presence of a climatic optimum in the southern interior of B.C. but cannot be considered conclusive for the coastal areas (R. Matthews, pers. comm.). It seems probable that such changes would be less marked in coastal areas where climatic fluctuations are partially modified by the effects of the sea. Heusser (1964:37) suggests that hypsithermal temperatures were no more than one to two degrees higher than today.

While such fluctuations may have been sufficient to result in an expansion of grassland areas in a region where climax species of vegetation are relatively intolerant of temperature and moisture changes, it is unlikely that they were sufficient to exert any major influences on animal ranges in an area such as the Fraser Delta, where regional vegetation patterns are modified by the delta environment in any case. As Smith (1965:635) has pointed out, large, wide-ranging animals such as deer, wapiti, and large migratory birds, are not sensitive ecological indicators because of their adaptive tolerance for a wide range of habitats. It seems, then, that although there may have been gradual changes in the climate from about the time of the initial occupation of the site so that by about 1500 to 1000 B.C. conditions were much as they are now, these changes were probably not of sufficient magnitude to seriously influence the local distribution of larger animal populations.

Sea level has also varied during the time that the site was occupied, although at no time has it been as high as or higher than the basal deposits at the site. The radio-carbon dates place the initial occupation of the site during a period of higher sea-level, according to Fairbridge (1958, 1960).

Throughout the first part of the occupation represented by the lower deposits, sea-level may have been something in the order of ten feet higher than at present. Sometime between 2000 and 1000 B.C. the sea-level began to drop so that by about 1000 B.C. it was probably some ten feet lower than at present. A lowering of the sea-level by twenty feet would have had considerable effect on the outgrowth of the Fraser Delta. The drop in sea-level would increase the gradient of the river mouth relative to its upper reaches, thereby increasing the rate of erosion in those upper reaches, resulting in an increased rate and amount of deposition at the river mouth. The outgrowth of the Fraser Delta may have proceeded at a slightly faster rate during the period of lowered sea-level, so that the distance between the site and salt water was also increasing at a faster rate. The outgrowth may also have been of a different kind than formerly, with deposition occurring mainly on the off-shore beds and the river possibly even redepositing sediments laid down in the period of higher sea-level, when rate of deposition was less, the flow of the river delta channels slower and the fine sediments deposited further up the channels. It is tempting to suggest that these changes in local habitat were some of the factors responsible for the time gap observed in the portion of the site excavated. It is not clear, however, that this time gap holds for the total site. It may be that the area excavated simply did not sample the deposits of that time period.

Ethnographic Area

The site is located on land ethnographically regarded as the territory of the Kwantlem group of the Halkomelem speaking Coast Salish Indians. As very little ethnographic work has been done in the Fraser Delta that is directly applicable to this group, and as Coast Salish culture as a whole is well described by Duff (1952), Barnett (1955), Suttles (1951), and Jorgenson (1969), no attempt will be made to present here a less adequate summary. Although the upper layer of the site can be considered the result of a Coast Salish occupation on the evidence of its dating and artifact types, the actual sample of artifacts is so small that it adds little to what is already known of what has been called the Gulf of Georgia culture type (Mitchell, 1971b) or the Stselax Phase (Borden, 1968a).

CHAPTER III

DISCUSSION OF METHOD

The methods used to recover, identify, and describe the artifacts and faunal remains are discussed in the following paragraphs.

Recovery of the Samples

The material analysed here was recovered from six adjacent excavation units, two measuring ten feet by ten feet, one ten feet by nine feet, one five feet by nine feet, and two five feet by five feet. The deposits were excavated in natural stratigraphic units as distinguished by matrix changes, except where such changes were not discernible, or where a single matrix was exceptionally thick. In the latter instances artibrary subdivisions were used. The deposits were trowelled, then sifted through quarter-ince mesh screens. Artifacts found *in situ* were recorded three dimensionally, depth measurements being taken from arbitrary horizontal Datum Planes. Faunal remains were recovered either *in situ* or in the screens, and collected by the natural stratigraphic units. All vertebrate faunal remains found in the screens were retained.

Artifact and Faunal Typologies

The artifact typology used here is based on existing schemes for the Northwest Coast as presented in other site reports for the area (Drucker 1943; Borden 1950, 1951, 1960, 1968a and 1968b, 1970; King 1950; Kidd 1968, 1969; Mitchell 1963, 1965, 1971a and 1971b; D. Smith 1964; M. Smith 1950; Carlson 1960, 1970). Some additional types not previously reported for the area are described, and some modifications have been made to provide functional types for comparative purposes. On the whole, where formal differences within main artifact types could not be clearly associated with functional differences, they have been ignored. As the range of variation to be expected within the artifact types generally used to describe Northwest Coast materials has not yet been fully established, it seemed better to use more general types than to devise a typology that might have little application beyond the description of this particular sample. Such a typology would be more likely to produce a number of poorly demonstrated and possibly spurious types, which would probably form part of a continuum of variability within a single main type if larger samples were available. These distinctions would be misleading rather than informative. A brief description of the artifact types used here can be found in Appendix I. Table I presents the distribution of artifacts at DgRr 2 by excavation unit and component.

In working out a typology for the faunal remains, both specific and more general groupings have been used. Throughout the faunal tables common names have been used, because

TABLE I

Distribution of Artifact Types by Excavation Unit and Component

Artifact Type	Excav. Unit	C1/C2			D2/D3			A1		B2		Out of Context	Total
	Component	III	II	I	III	II	I	III	I	III	I		
Historical item		4			1							14	19
Antler wedge		8		66	7	1	36		5	1	5	30	159
Bone wedge				17	2		14				3	7	43
Bone flesher		3		27	1	1	15		3		3	4	57
Wapiti rib tools				37	1		17		3		4	5	67
Bone awl I		1		26	1	1	8				4	3	44
Bone awl II				7					2			1	10
Bone point I			2	14			12		1		1	3	33
Unbarbed bone point II		1		11	1	1	4	1	2		3	2	26
Unbarbed bone point III				5			1					3	9
Pointed bird bone			1	9	1	1	4					2	18
Composite toggle harpoon		1										1	2
Barbed and tanged harpoon				1			1						2
Fixed barbed bone or antler point												3	3
Bone and antler flakers I				5			4					1	10
Antler flaker II				5			3				3	1	12

Table I (contd.)

Artifact Type	Excav. Unit / Component	C1/C2 III	C1/C2 II	C1/C2 I	D2/D3 III	D2/D3 II	D2/D3 I	A1 III	A1 I	B2 III	B2 I	Out of Context	Total
Needle				1									1
Mammal bone ring				2			3		1				6
Brow band				11			6		1		1		19
Bird bone bead				5			3		2		1		11
Mammal bone pendant				11			6						17
Blanket pin		1	1										2
Misc. point or awl shaft fragment		4		12	2	2	3		3			5	31
Misc. bone and antler objects		2		24	1	2	9		3		4	5	50
Misc. worked mammal bone fragments		8	6	106	11	6	75	1	6	1	11	5	236
Misc. worked bird bone fragments				18		2	9	1	2	1		2	35
Misc. worked antler fragments		1	2	15	2	1	5				2	1	29
Antler detritus		5		9	3	2	3			1		2	25
Beaver incisor tool				7	1		6		3			3	20
Tooth pendant, charm				2			4		2				8
Pebble tool		1		32		1	6		1		2	15	58

Table I (contd.)

Artifact Type	Excav. Unit	C1/C2			D2/D3			A1		B2		Out of Context	Total
	Component	III	II	I	III	II	I	III	I	III	I		
Boulder spall			1	4			3		1			2	11
Tool flake		1		2			2		1		3	4	13
Large core		1		7			3		1			3	15
Cortex-backed core			1	7		2	4					3	17
Stone wedge complex		7	6	44	11	22	18		1	2	1	14	126
Chipped stone scraper		4	3	47	2	2	27		6		13	14	118
Chipped point I		1	1	2		1	2					4	11
Chipped point II		1	1	4		1	1					4	12
Chipped point III		1		2			1						4
Chipped point IV			1	1		1	2					1	6
Chipped point V				3		2	1					2	8
Chipped point VI				4			1					1	6
Chipped point VII				3		2	1					2	8
Chipped point VIII				3			1		1				5
Possible chipped knife				4					1			2	7

Table I (contd.)

Artifact Type	Excav. Unit / Component	C1/C2 III	C1/C2 II	C1/C2 I	D2/D3 III	D2/D3 II	D2/D3 I	A1 III	A1 I	B2 III	B2 I	Out of Context	Total
Chipped point fragment		1		12	2	4	10					5	34
Bifacial preform		1	1	4		2	3		1		1	4	17
Unifacial preform				3								1	4
Misc. Bifaces		2	1	9	2	1	10	1			1	1	28
Misc. Unifaces		5		13	2	2	11	1	3		4	11	52
Ground slate knife		9		13	12	10						14	58
Ground slate point		1					1			1	1	2	6
Stone disc beads		1	4	1	46	121	5					17	195
Ground stone adze		1		1		1							3
Abrasive stone		3	1	5		2	1	1	2	1		10	26
Misc. Ground stone		4		6		2						4	16
Pecked and ground stone		3				1						1	5
Hammerstone		3		7			2				2	4	18
Ground shell adze,knife		1		5					3		1		10
Totals		91	33	701	112	200	367	6	61	8	74	248	1901

they are more readily understood. A description of the faunal types, indicating what species are included in each type and giving the scientific designations is given in Appendix II. Table VIII (page 39) gives the distribution of bird and mammal faunal types by excavation unit and component for the total identified excavated sample.

Identification of Artifact Components

Both artifact distributions and stratigraphic divisions were used to distinguish three components at DgRr 2. In the preliminary report on this site (Calvert 1970) these components were designated I, II, and III, with Component I being the earliest and Component III the most recent. Component III is represented stratigraphically by the uppermost living area scattered with crude hearths, immediately below the top-soil. Component II is represented stratigraphically by the large sandy pit, and Component I by the remainder of the deposits. Although there is considerable disturbance of the Component III layer, these three major stratigraphic divisions are clearly separable. Because of correlation problems between excavation units, finer, cross-site subdivisions of Component I were not possible. The detailed analysis of variation is therefore restricted to the sample from excavation units C1 and C2, where it was possible to divide Component I in the correlated excavation units into thirteen horizontal stratigraphic divisions. This was done by combining vertically adjacent single matrix divisions that were correlated across both excavation units so that the artifact sample for each of the thirteen divisions was not less than twenty. Excavation units C1 and C2 were chosen because they had the most complete sample of artifact types and could be divided into finer horizontal units than the other cuts.

Two methods were used to determine if the major stratigraphic divisions coincided with variation in the distribution of artifact types. The first method was the presence and absence of artifact types. This method intuitively differentiates the three components. Table II presents these data. The number of traits shared by two components, viewed as a percentage of the total number of whole artifact types, give a numerical statement of the degree of similarity between components. Tables III, IV, and V compare the three components on the presence and absence of artifact types. Considering both common presences and common absences as shared traits, Components III and II share 65.4% of the traits, Components III and I share 53.8%, and Components II and I share 50.0%. Although the differences are not large, Components III and II are more similar than either Components III and I or Components II and I.

A further test was made using chi-square, calculated for a two by three table comparing types shared by components with types found in only one component (Table VI). The resulting chi-square of 15.21 has a p value of less than .001.

TABLE II

Presence and Absence of Artifact Types by Component, Total Excavated Sample

Artifact Type	Component III	II	I	Artifact Type	Component III	II	I
Historical item	+	-	-	Abrasive stone	+	+	+
Composite toggle harpoon	+	-	-	Misc. bone point or awl fragment	+	+	+
Blanket pin	+	+	-	Misc. bone and antler object	+	+	+
Pecked and ground stone	+	+	-	Misc. worked mammal bone frag.	+	+	+
Antler wedge	+	+	+				
Bone flesher	+	+	+	Misc. worked bird bone frag.	+	+	+
Bone awl I	+	+	+	Misc. worked antler frag.	+	+	+
Unbarbed bone point II	+	+	+	Antler detritus	+	+	+
Pointed bird bone	+	+	+	Misc. chipped stone uniface	+	+	+
Pebble tool	+	+	+	Misc. chipped stone biface	+	+	+
Stone wedge	+	+	+				
Chipped stone scraper	+	+	+	Misc. ground stone	+	+	+
Chipped point I	+	+	+	Unbarbed bone point I	-	+	+
Chipped point II	+	+	+	Boulder spall	-	+	+
Chipped point fragment	+	+	+	Cortex-backed core	-	+	+
Bifacial preform	+	+	+	Ground slate knife	+	+	+
Stone disc bead	+	+	+	Ground stone adze	+	+	+

Table II (contd.)

Artifact Type	Component III	II	I	Artifact Type	Component III	II	I
Chipped point IV	-	+	+	Needle	-	-	+
Chipped point V	-	+	+	Mammal bone ring	-	-	+
Chipped point VII	-	+	+	Brow band	-	-	+
Hammerstone	+	-	+	Bird bone bead	-	-	+
Bone wedge	+	-	+	Mammal bone pendant	-	-	+
Wapiti rib tool	+	-	+	Tooth pendant	-	-	+
Beaver incisor tool	+	-	+	Chipped point VI	-	-	+
Tool flake	+	-	+	Chipped point VIII	-	-	+
Large core	+	-	+	Possible chipped knife	-	-	+
Chipped point III	+	-	+	Unifacial chipped stone preform	-	-	+
Ground slate point	+	-	+	Antler flaker II	-	-	+
Ground shell adze/knife	+	-	+	Bone and antler flaker I	-	-	+
Bone awl II	-	-	+	Tanged harpoon	-	-	+
Bone point III	-	-	+				

TABLE III

Comparison of Components III and II on Presence and Absence of Artifact Types, Site Sample

Component III	Component II		Total
	+	-	
+	20	6	26
-	12	14	26
Total	32	20	52

TABLE IV

Comparison of Components I and III on Presence and Absence of Artifact Types, Site Sample

Component III	Component I		Total
	+	-	
+	28	4	32
-	20	0	20
Total	48	4	52

TABLE V

Comparison of Components II and I on Presence and Absence of Artifact Types, Site Sample

Component II	Component I		Total
	+	-	
+	24	2	26
-	24	2	26
Total	48	4	52

TABLE VI

Comparison of Number of Artifact Types Found in Only One Component with Number Found in More than One Component, Total Excavated Sample

	Component			Total
	III	II	I	
Types shared	29	26	33	88
Types not shared	2	0	15	17
Total	31	26	48	105

Chi-square = 15.21

DF = 2

$p < .001$

This means that differences as great as those observed would occur less than one time in a thousand if the three samples were randomly selected from the same population. Chi-square is applicable only to randomly selected, independent samples, which these are not. Thus the results cannot be considered conclusive, only suggestive. If the chi-square value had not been significant at a high level, even assuming the sample to be randomly selected, the implication would have been that the differences were probably not significant in these samples either. As the statistical tests are not conclusive, the best evidence for the separation of the components and their relationships is the stratigraphic divisions and the radio-carbon estimates.

The second method used to distinguish artifact type based components was a multivariate computer technique that clusters cases, viewed as points in space, on the basis of the position of their variables, as measured by the rank order of the variable attributes. This multidimensional scalogram analysis, MSA 1 (Lingoes 1963, 1964, 1966, 1968; Guttman 1955) was run on the artifact sample from the combined excavation units C1 and C2. The cases were fifteen stratigraphic divisions, the variables forty-two artifact types, and the attributes the relative frequencies of artifact types within the stratigraphic units, coded into intervals of 2.0%. The intention was to see if it was possible to separate components on relative frequencies of artifact types, and to see how these patterns compared with those produced by the presence and absence of artifact types. In the analysis, stratigraphic unit 1 represents Component III, stratigraphic unit 2 represents Component II, and units 3 to 15 represent the divisions of Component I, unit 3 being the uppermost and unit 15 the lowest stratigraphic division. The forty-two variables used are those listed in Table XIV as numbers 1-11, 14, 15, 17-20, 22, 23, 25-39, 42, 43, 45-47, 49, 51, and 53. Types that occurred less than five times in the site were not used, except for some of the chipped point types, nor were the amorphous "types" that are really composite groupings of fragmentary or unclassifiable artifacts. The relative frequencies of artifact types were based on the total count of typed artifacts within the stratigraphic division being considered. This total count included those sporadically occurring types not used in the analysis and composite groupings of whole but unclassifiable artifacts, but did not include the composite groupings of fragmentary artifacts such as miscellaneous worked bone fragments. The artifact types on which total counts are based are those given in Table XIV. Table VII gives the sample sizes for each stratigraphic unit used in the multidimensional scalogram analysis.

The MSA 1 programme was run with fifty iterations and a cut-off point for the coefficient of contiguity of 0.99. The coefficient indicates whether a one, two, or three dimen-

TABLE VII

Sample Sizes for the Stratigraphic Divisions of C1/C2 Used in the MSA 1 and Comparative Analyses

Stratigraphic Unit	Artifact Count	Minimum Number of Individuals, Bird and Mammal	Total Fish Weight in Grams
1	66	15	88.4
2	24	7	13.9
3	70	24	234.1
4	68	23	368.0
5	40	14	231.2
6	63	19	329.7
7	21	14	243.9
8	22	17	139.7
9	37	15	291.0
10	36	28	353.1
11	40	33	625.7
12	33	24	338.2
13	29	36	287.3
14	35	24	251.6
15	22	17	144.0
Total	606	310	3,939.8
Mean	40.4	20.6	262.7

sional spatial arrangement best fits the data, with 1.0 being a perfect fit. The results obtained agreed extremely well with those previously obtained by the presence and absence approach. A two dimensional solution was indicated as the best fit for the data by a coefficient of contiguity of 0.956, although this was only slightly better than the one dimensional solution, which had a coefficient of contiguity of 0.942. The three dimensional solution was a less accurate fit, with a coefficient of contiguity of 0.91. The two dimensional solution is presented in Figure 2. Component III (1) is clearly separated spatially from Component II (2) and both are separated from Component I (3-15), the stratigraphic units of the latter nearly all clustering in one quadrant. Again, while some variation is apparent in Component I, the levels clustering into two main groups, the differences are obviously less than the similarities. The variation within Component I will be examined in more detail later.

Identification and Measurement of the Faunal Sample

The faunal remains were identified using the comparative collections in the Osteology Museum at the University of British Columbia and in the zoology section of the Provincial Museum, Victoria. The bird and fish remains were identified by the author, mammal remains by the author with the assistance of two students. The study has concentrated on vertebrate remains because the finely fragmented state of the

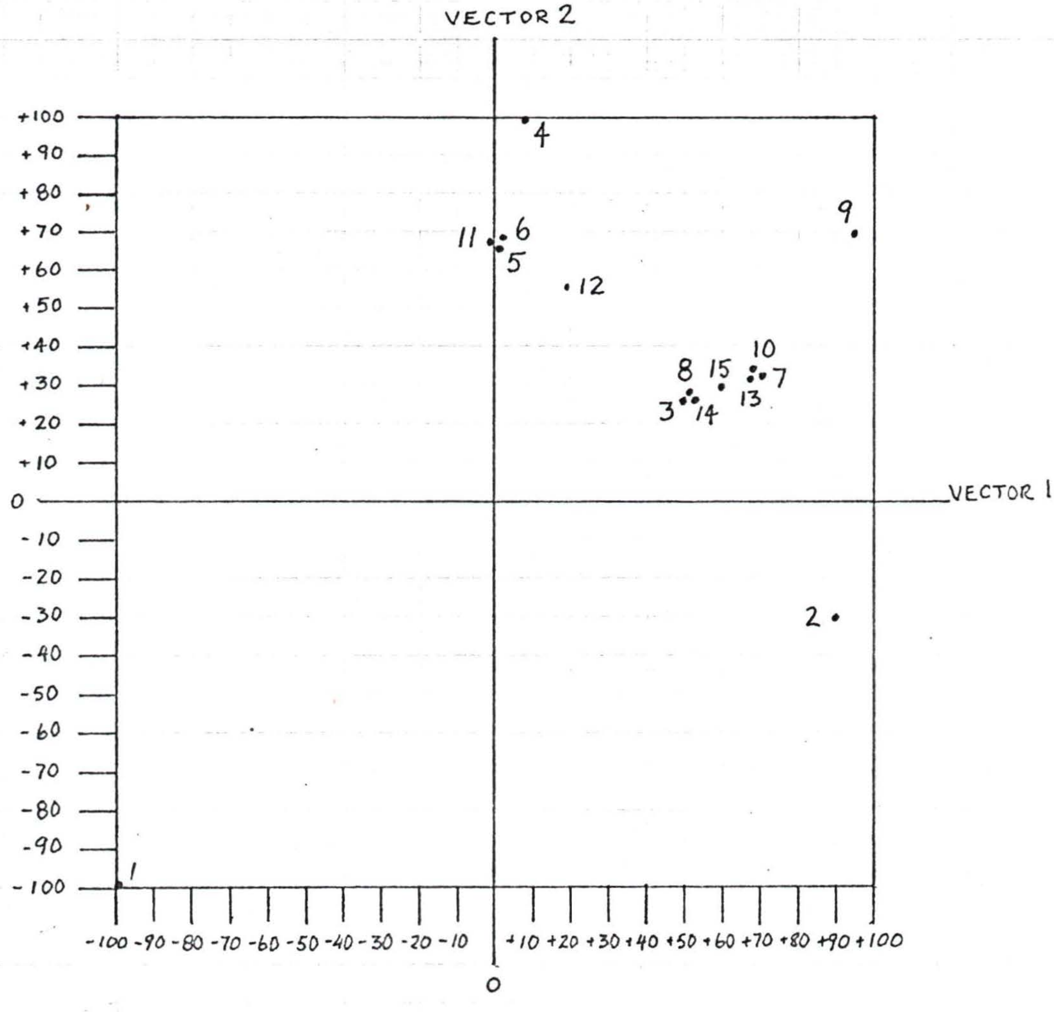

FIG. 2: MSA I SOLUTION FOR THE RELATIVE FREQUENCIES OF FORTY-TWO ARTIFACT TYPES IN EXCAVATION UNITS C1/C2, FIFTEEN STRATIGRAPHIC DIVISIONS, COEF. OF CONT. = 0.956

molluscan remains made the type of quantitative approach being used for the former inapplicable to the latter.

While artifacts are themselves discrete and measurable entities, the identified faunal remains as they are recovered are not. They must be converted into comparable, standard units of measurement. For bird and mammal remains, minimum number of individuals within a designated stratigraphic division was chosen as the unit of measurement. It was considered that this unit held fewer possibilities of sampling bias than such measurements as weight, volume, or simple bone count. When the minimum number of individuals had been calculated for a bird or mammal type within a stratigraphic division, it was then converted into a percentage of the total number of individuals represented by the bird and mammal remains in that segment. In calculating the minimum number of individuals for the single excavation units A1 and B2, component totals are the sum of single-matrix counts. Where excavation units have been combined, as in C1/C2 and D2/D3, minimum numbers of individuals were calculated as follows, using C1/C2 as an example. The deposits in these two pits could be divided into twenty-three single matrix divisions which were correlated across both pits. The minimum numbers of individuals for each of these single matrix divisions is based on the combined bone counts of that division in the two pits. This was necessary to take into account the possibility that the bones of one animal were spread across more than one pit. To arrive at minimum number of individual counts for the fifteen stratigraphic divisions of C1/C2 used in the detailed analysis, cross pit single-matrix counts within a stratigraphic unit were totalled. That is, matrix differences are taken as natural subdivisions separating groups of bones, while subdivisions of the deposits that include more than one matrix type are artificial groupings of bones within which the single-matrix minimum number of individual counts can be legitimately added together. The component totals are the sum of the single matrix counts for the stratigraphic subdivisions in that component.

As comparative collections of fish skeletons were not readily available, it was not possible to calculate minimum numbers of individuals for the fish remains. Fish were simply divided into three types and measured by weight. Type weights were then converted into percentages of the total fish weight in the stratigraphic segment being considered. The handling of the fish remains is open to more possibilities of error than that of the bird and mammal remains both because of the measurement problems and because more confidence can be placed in the full retrieval of the other vertebrate remains during excavation. Fish bones being generally smaller and more fragile, the proportion of these remains lost through the quarter-inch mesh screens is necessarily higher than that of the other vertebrates, although this applies also to small rodent and insectivore species. As a number of meadow voles were living in the site at the time of the excavations, any small rodent remains actually recovered possibly represent recent inhabitants rather than ancient food sources. This was confirmed by the finding of a partial skeleton of a white-footed mouse associated with a cache of gnawed wild cherry pits at the end of an obvious burrow. Obviously, much fragmentary bone was not identified. This portion of the sample has been ignored, because there did not seem to be a meaningful way of measuring it. A description of the faunal types, indicating what species are included in each type, and giving their scientific designations, is given in Appendix II. Table VIII gives the distribution of faunal types by excavation unit and component.

Faunal Components and Stratigraphic Units

The components used in the faunal analysis are those already established on the basis of stratigraphic evidence and artifact distributions. Table IX gives the presence and absence of faunal types in the three components. To test the correspondence between faunal and artifact distributions, two by two tables comparing presence and absence of types for the total site sample were used, as for the artifact sample. Tables X, XI, and XII present these data. Components III and II share 73.3% of the faunal traits, counting both shared presences and shared absences. Components III and I, and Components II and I both share 36.6% of the faunal traits.

TABLE VIII

Distribution of Faunal Types by Excavation Unit and Component,

Site Sample, Bird and Mammal

Faunal Type	Excav. Unit	C1/C2			D2/D3			A1		B2		Total
	Component	III	II	I	III	II	I	III	I	III	I	
Canada goose				12			4		2			18
White-fronted goose				15			2		4		1	22
Goose, general		1		13		1	12		4		3	34
Mallard duck			1	3			2					6
Other duck		1	1	21			13	1	1		3	41
Swan				8			3		2		4	17
Crow				3			1					4
Bald eagle		1		5			2					8
Loon				7							1	8
Cormorant			1	13			7					21
Grebe				7			2				1	10
Merganser				2			1					3
Heron				2								2
Murre/murrelet				1			1					2
Gull		1		15			6	1			1	24
Raven				3								3

Table VIII (contd.)

Faunal Type	Excav. Unit										Total
	Component	III	II	I	III	II	I	III	I	III	I	
Owl				1							1	2
Small bird			1	8			1					10
Grouse				7		1	2		2			12
Wapiti		1	1	35	1	2	22	1	9		11	83
Deer		1		27		2	19	2	3	1	6	61
Dog		3	1	21	4	2	13	1	3		4	53
Bear				1								1
Raccoon		1		3								4
Mustelid				4			1					5
Beaver		2		34	3	1	22	1	5		7	75
Porcupine				1								1
Muskrat				1			1					2
Small rodent		1		1								2
Hair seal		2	1	14	1	2	5	1			4	30
Totals		15	7	288	9	11	142	8	35	2	47	564

TABLE IX

Presence and Absence of Bird and Mammal

Faunal Types by Component, Site Sample

Faunal Type	Component III	II	I	Faunal Type	Component III	II	I
Goose, general	+	+	+	Canada goose	-	-	+
Other duck	+	+	+	White-fronted goose	-	-	+
Wapiti	+	+	+	Swan	-	-	+
Deer	+	+	+	Crow	-	-	+
Dog	+	+	+	Loon	-	-	+
Beaver	+	+	+	Grebe	-	-	+
Hair seal	+	+	+	Merganser	-	-	+
Bald eagle	+	-	+	Heron	-	-	+
Gull	+	-	+	Murre/murrelet	-	-	+
Raccoon	+	-	+	Raven	-	-	+
Small rodent	+	-	+	Owl	-	-	+
Mallard duck	-	+	+	Bear	-	-	+
Cormorant	-	+	+	Mustelid	-	-	+
Small bird	-	+	+	Porcupine	-	-	+
Grouse	-	+	+	Muskrat	-	-	+

TABLE X

Comparison of Components III and II on Presence and Absence of Faunal Types, Site Sample

Component III	Component II		Total
	+	-	
+	7	4	11
-	4	15	19
Total	11	18	30

TABLE XI

Comparison of Components I and III on Presence and Absence of Faunal Types, Site Sample

Component III	Component I		Total
	+	-	
+	11	0	11
-	19	0	19
Total	30	0	30

TABLE XII

Comparison of Components II and I on Presence and Absence of Faunal Types, Site Sample

Component II	Component I		Total
	+	-	
+	11	0	11
-	19	0	19
Total	30	0	30

These percentages indicate more similarity between Components III and II than between Component I and either of the other two components. The discrepancies in sample size, however, definitely affect the observed distributions, so that stratigraphic evidence and dating are again more reliable guides.

Chi-square was also calculated for the faunal comparison of types found only in one component with types found in more than one component (Table XIII). A value for chi-square of 15.45 was obtained, which has a p value of less than .001, suggesting that the differences observed may be real. The same reservations made in the use of chi-square on the artifact sample apply to its use on the faunal sample.

A multidimensional scalogram analysis was also run on the bird and mammal faunal sample from excavation units C1 and C2. The fifteen stratigraphic divisions were the cases, the thirty faunal types the variables, and the relative frequencies of faunal types within the stratigraphic units, coded in intervals of 1.5%, the attributes. The programme was again run with fifty iterations and a cut-off point for the coefficient of contiguity of 0.99. In this case a three dimensional fit was indicated as the best spatial description of the data by a coefficient of contiguity of 0.917. The three dimensional solution was considerably better than either the one dimensional fit, with a coefficient of contiguity of 0.761, or the two dimensional fit, with a coeffi-

TABLE XIII

Comparison of Number of Bird and Mammal Faunal Types Found in Only One Component with Number Found in More than One Site Sample

	Component			Total
	III	II	I	
Types shared	11	11	15	37
Types not shared	0	0	15	15
Total	11	11	30	52

Chi-square = 15.45

DF = 2

$\underline{p} < .001$

cient of contiguity of 0.852. The three dimensional solution is graphed in Figures 3, 4, and 5. Sample sizes are shown in Table VII. Unlike the MSA for the artifacts, faunal variables do not separate the three components. This cannot, however, be interpreted to mean that the changes observed in artifact types are unrelated to changes in economic emphases. The small sample sizes of all the stratigraphic units are undoubtedly influencing the patterns. Units 3 and 13, for example, are consistently separated from the other units. These are the two units with the highest number of different types of fauna represented.

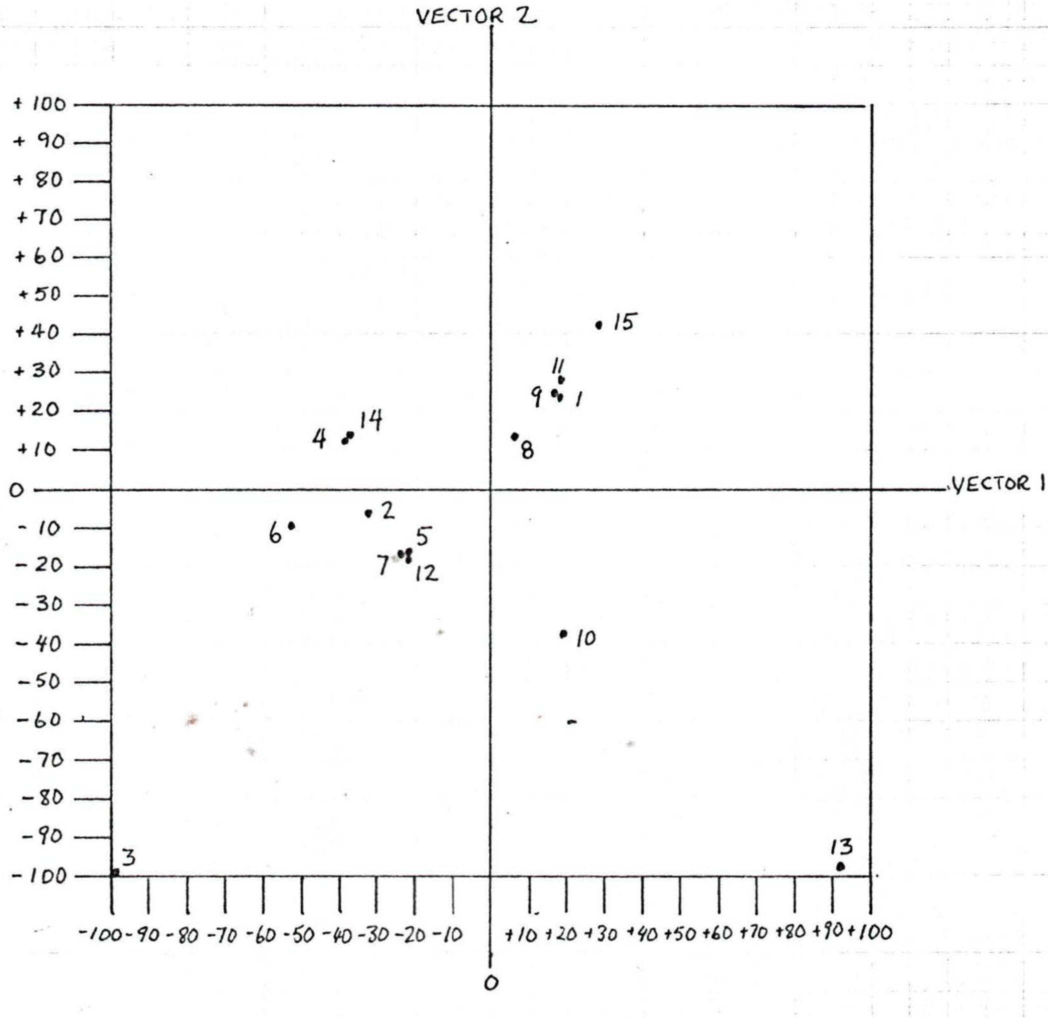

FIG. 3: MSA I SOLUTION FOR THE RELATIVE FREQUENCIES OF THIRTY FAUNAL TYPES IN EXCAVATION UNITS C1/C2, FIFTEEN STRATIGRAPHIC DIVISIONS, VECTORS 1 AND 2, COEF. OF CONT. = 0.917

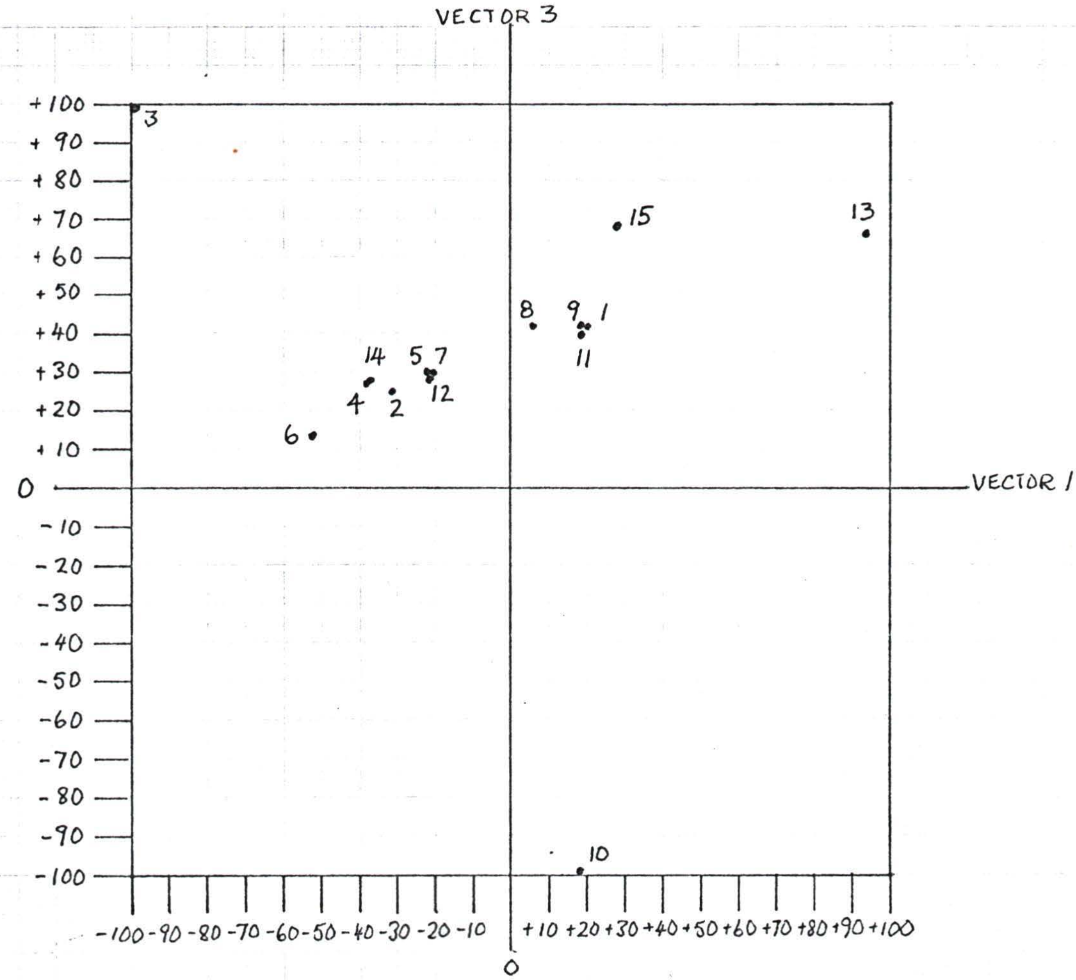

FIG. 4: MSA I SOLUTION FOR THE RELATIVE FREQUENCIES OF THIRTY FAUNAL TYPES IN EXCAVATION UNITS C1/C2, FIFTEEN STRATIGRAPHIC DIVISIONS, VECTORS 1 AND 3, COEF. OF CONT. = 0.917

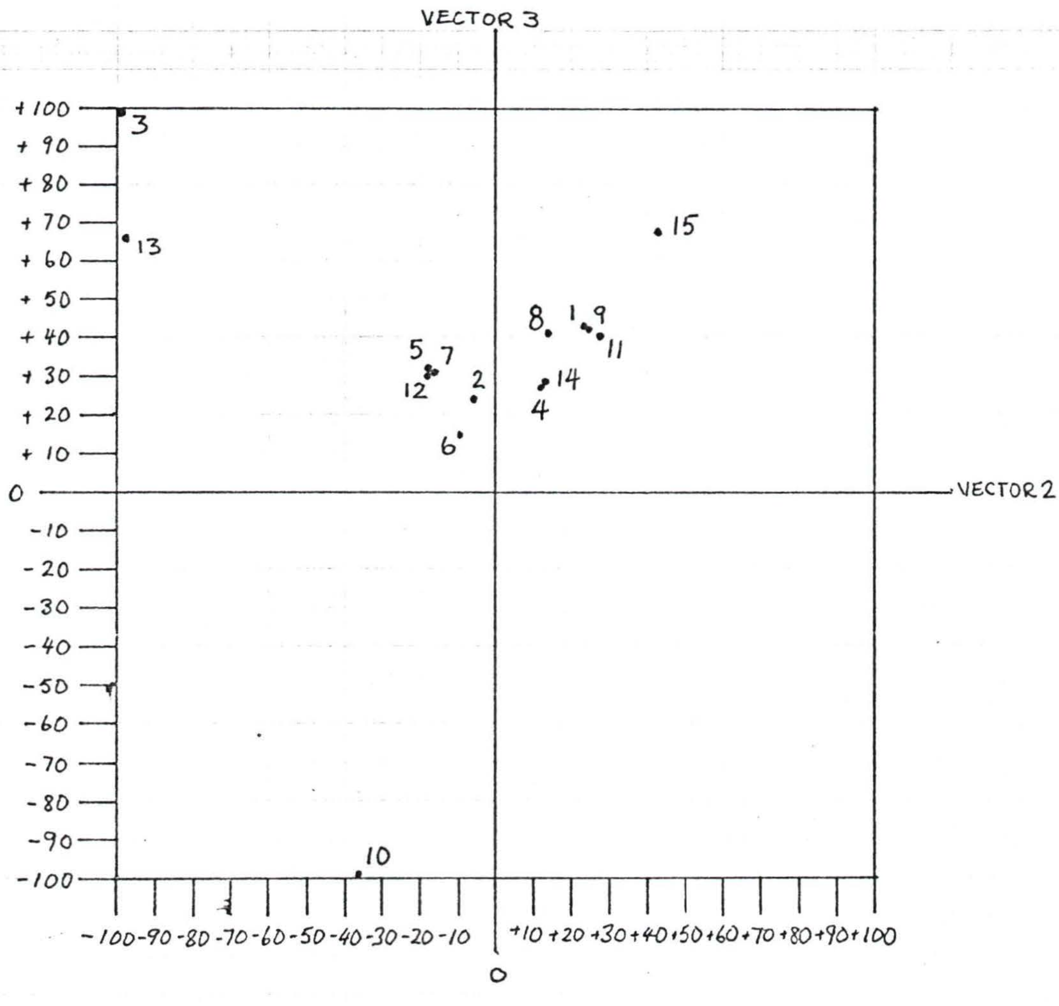

FIG. 5 : MSA I SOLUTION FOR THE RELATIVE FREQUENCIES OF THIRTY FAUNAL TYPES IN EXCAVATION UNITS C1/C2, FIFTEEN STRATIGRAPHIC DIVISIONS, VECTORS 2 AND 3, COEF. OF CONT. = 0.917

CHAPTER IV

PRESENTATION OF THE DATA

Components

Table XIV presents the percentage distribution of the artifact types by component. As noted, composite groupings of miscellaneous fragments are not included. The artifact distributions that are separating the three components are obvious in this table and in Table II.

Historical items and composite toggle harpoons occur only in Component III. Bone awl II, bone and antler flakers I and II, unbarbed bone points III, bone pendants, brow bands, mammal bone rings, tooth pendants, chipped stone points type VI and VIII, possible chipped stone knives, chipped stone unifacial preforms, tanged harpoons, needle, and bird bone bead occur only in Component I. Two artifact types occur in Components III and II but not in I, blanket pins and pecked and ground stone objects. The relative frequency of blanket pins in III and II is almost the same, but pecked and ground stone objects comprise 1.9% of the Component III sample as against only 0.5% of the Component II sample.

Six artifact types occur in Components II and I but not in III, unbarbed bone points I, boulder spalls, cortex-

TABLE XIV

Relative Frequencies of Artifact Types by Component, Excavated Types, Site Sample

Artifact Type	Component III N=162	Component II N=209	Component I N=874
1. Historical item	3.7%	0.0%	0.0%
2. Antler wedge	9.9	.5	12.8
3. Bone wedge	1.2	0.0	3.9
4. Bone flesher	2.5	0.5	5.5
5. Wapiti rib tool	0.6	0.0	6.9
6. Bone awl I	1.2	0.5	4.4
7. Bone awl II	0.0	0.0	1.0
8. Unbarbed bone point I	0.0	1.0	3.2
9. Unbarbed bone point II	1.9	0.5	2.3
10. Unbarbed bone point III	0.0	0.0	0.7
11. Pointed bird bone	0.6	1.0	1.5
12. Composite toggle harpoon	0.6	0.0	0.0
13. Barbed & tanged harpoon	0.0	0.0	0.2
14. Bone & antler flaker I	0.0	0.0	1.0
15. Antler flaker II	0.0	0.0	1.3
16. Needle	0.0	0.0	0.1
17. Mammal bone ring	0.0	0.0	0.7
18. Brow band	0.0	0.0	2.2
19. Bird bone bead	0.0	0.0	1.3
20. Mammal bone pendant	0.0	0.0	1.9

Table XIV (contd.)

Artifact Type	Component III N=162	Component II N=209	Component I N=874
21. Blanket pin	0.6 %	0.5 %	0.0 %
22. Beaver incisor tool	0.6	0.0	1.8
23. Tooth pendant, charm	0.0	0.0	0.9
24. Misc. bone & antler objects	1.9	1.0	4.7
25. Pebble tool	0.6	0.5	4.7
26. Boulder spall	0.0	0.5	0.9
27. Tool flake	0.6	0.0	0.9
28. Large core	0.6	0.0	1.3
29. Cortex-backed core	0.0	1.4	1.3
30. Stone wedge	12.3	13.4	7.3
31. Chipped stone scraper	3.7	2.4	10.7
32. Chipped point I	0.6	1.0	0.5
33. Chipped point II	0.6	1.0	0.6
34. Chipped point III	0.6	0.0	0.3
35. Chipped point IV	0.0	1.0	0.3
36. Chipped point V	0.0	1.0	0.5
37. Chipped point VI	0.0	0.0	0.6
38. Chipped point VII	0.0	1.0	0.5
39. Chipped point VIII	0.0	0.0	0.5
40. Chipped point fragment	1.9	1.9	2.5

Table XIV (contd.)

Artifact Type	Component III N=162	Component II N=209	Component I N=874
41. Possible chipped knife	0.0%	0.0%	0.6%
42. Bifacial chipped preform	0.6	1.4	1.0
43. Unifacial chipped preform	0.0	0.0	0.3
44. Ground slate knife	12.9	4.8	1.5
45. Ground slate point	0.6	0.5	0.2
46. Stone disc bead	29.0	59.8	0.7
47. Ground stone adze	0.6	0.5	0.1
48. Abrasive stone	3.1	1.4	0.9
49. Misc. ground stone	2.5	1.0	0.7
50. Ground shell adze, knife	0.6	0.0	1.0
51. Pecked & ground stone	1.9	0.5	0.0
52. Hammerstone	1.9	0.0	1.3
Total	100.9%	100.3%	99.7%

backed cores and chipped points types IV, V, and VII. The relative frequencies of boulder spalls and cortex-backed cores are similar, while the percentage of bone points I in Component I is three times that of Component II, and percentages of each of the three chipped point types in Component II are at least twice the percentages in Component I. Artifact types found in Components III and I but not in II include tool flakes, large cores, beaver incisor tools, hammerstones, shell adze blades, chipped point type III, mammal bone wedges, wapiti rib tools and ground slate points. The relative frequencies of tool flakes and hammerstones are similar in both components, while ground slate points and chipped stone points type III form a larger percentage of the artifacts in Component III than they do in Component I. The other five artifact types all have considerably higher percentages in Component I than they do in Component III.

Eighteen types occur in all three components. Antler wedges, unbarbed bone points II, and chipped stone points types I and II have similar frequencies in Components I and III, while wedges and bone points II are considerably lower and the chipped stone points higher in Component II. Stone wedges, pebble tools, stone scrapers, chipped stone point fragments, ground stone adzes, and miscellaneous bone and antler objects have similar frequencies in Components III and II, while the frequencies of all these types except ground stone adzes are considerably higher in Component I.

Ground stone adzes have a lower frequency in Component I. Bifacial preforms are similar in II and I, lower in III.

Types with low frequencies in Component II, higher in Component III, and higher again in Component I include bone awl I and bone fleshers. Types with frequencies lowest in Component I and highest in Component III include miscellaneous ground stone objects, abrasive stones, and ground slate knives. Pointed bird bone has its highest frequency in Component I, lowest in Component III. Stone disc beads have a much higher frequency in Component II, lower in Component III, and lowest in Component I.

Differences also occur among components in the use of raw materials and techniques of manufacture. Tables XV and XVI present these data. In both Components III and II there is a much greater use of stone than in Component I, especially in Component II. Bone, antler, and tooth artifacts in Component I have a frequency more than twice as great as their frequency in Component III, while in Component II they have an exceptionally low frequency. Probably preservation problems in Component III and II deposits account for some of this discrepancy. Within the major category of stone artifacts, there is a much higher percentage of chipped stone in Component I than in either of the other two components, which have similar frequencies for this class of artifacts. Components III and II have much higher frequencies for ground stone artifacts.

TABLE XV

Percentage Distribution of Raw Material Artifact Classes

by Component, Excavated Site Sample

Artifact Class	Component III N=162	Component II N=209	Component I N=874
Stone	74.3%	94.7%	40.6%
Bone, Antler, Tooth	21.9	5.3	58.4
Shell	0.6	0.0	1.0
Other	3.0	0.0	0.0
Total	99.8%	100.0%	100.0%

TABLE XVI

Percentage Distribution of Stone Artifact Classes

by Component, Excavated Site Sample

Artifact Class	Component III N=120	Component II N=198	Component I N=355
Chipped	29.2%	27.6%	86.8%
Ground	65.8	71.7	10.1
Pecked and ground	2.5	0.5	0.0
Hammerstone	2.5	0.0	3.0
Total	100.0%	99.8%	99.9%

The artifacts can also be grouped on the basis of their supposed functions into three categories:

1. Food getting or preparing tools: including bone points, ground slate knives, ground slate points, mammal bone rings, pointed bird bone, chipped stone points and chipped stone point fragments, and harpoons.
2. Manufacturing tools: including antler, bone, and stone wedges, bone awls, bone and antler flaking tools, pebble tools, beaver incisor tools, hammerstones, chipped stone scrapers, abrasive stones, shell and stone adze blades, wapiti rib tools, bone fleshers, and needles.
3. Decorative objects: including bone and tooth pendants, brow bands, bird bone beads, blanket pins, and stone disc beads, although the last may have more than a purely decorative function.

The remaining artifact types cannot be assigned a definite function. Table XVII gives the relative frequencies of these categories for the three components. In Component III manufacturing tools make up the largest percentage, with a fairly even split between food processing tools and decorative objects, mainly stone disc beads. In Component I manufacturing tools make up a surprisingly high percentage of the artifacts. This high frequency of manufacturing tools may indicate that this part of the site was occupied year round during the time

TABLE XVII

Percentage Distribution of Functional Artifact Classes by Component, Excavated Site Sample

Artifact Class	Component III N=162	Component II N=209	Component I N=874
Food processing	20.3%	14.4%	16.5%
Manufacturing	38.8	19.6	64.7
Decorative	29.7	60.3	6.9
Unclassified	11.1	5.7	11.7
Total	99.9%	100.0%	99.8%

Chi-square omitting unclassified = 334.84

DF = 4

$p < .001$

of Component I, rather than as a temporary resource exploitation camp. The high percentage of decorative objects in Component II is caused by the number of stone disc beads found in excavation units D2 and D3. Although none was found in direct association with the burials (instead they were found scattered throughout the sandy pit) it seems reasonable to suppose that they are in fact associated with the burials in some way. Chi-square was calculated for the raw frequencies of the patterns shown in Table XVII. The resulting chi-square of 345.2 has a $\underline{p}$ value of less than .001, suggesting that the observed associations may be real, although this is not a random sample. While these variations are noted, it must be pointed out that the differences in sample sizes and in the number of types of artifacts found do bias the frequencies.

The percentage distributions of the faunal types for the components are given in Table XVIII. As with the artifact distributions, the differences are obvious from the tables. The percentage for deer and other duck are very close for all three components. Dog shows a consistent increase from Component I to Component III, and seal also shows higher percentages in Components II and III than in Component I.

Grouping fauna into classes brings out the patterning a little more clearly. As can be seen in Table XIX, percentage for ungulates are similar, the increase for dog and

TABLE XVIII

Percentage Distribution of Faunal Types

by Component, Site Sample, Bird and Mammal

Faunal Type		Component		
		III N=33	II N=18	I N=512
1.	Canada goose	0.0%	0.0%	3.5%
2.	White-fronted goose	0.0	0.0	4.3
3.	Goose, general	3.0	5.6	6.3
4.	Mallard duck	0.0	5.6	0.9
5.	Other duck	6.0	5.6	7.4
6.	Swan	0.0	0.0	3.3
7.	Crow	0.0	0.0	0.8
8.	Bald eagle	3.0	0.0	1.4
9.	Loon	0.0	0.0	1.6
10.	Cormorant	0.0	5.6	3.9
11.	Grebe	0.0	0.0	1.9
12.	Merganser	0.0	0.0	0.6
13.	Heron	0.0	0.0	0.4
14.	Murre, murrelet	0.0	0.0	0.4
15.	Gull	6.0	0.0	4.3
16.	Raven	0.0	0.0	0.6
17.	Owl	0.0	0.0	0.4
18.	Small bird	0.0	5.6	1.8
19.	Grouse	0.0	5.6	2.1
20.	Wapiti	9.1	16.7	15.0

Table XVIII (contd.)

Faunal Type		Component III N=33	II N=18	I N=512
21.	Deer	12.1%	11.1%	10.7%
22.	Dog	24.2	16.7	8.0
23.	Bear	0.0	0.0	0.2
24.	Raccoon	3.0	0.0	0.6
25.	Mustelid	0.0	0.0	0.9
26.	Beaver	18.2	5.6	13.3
27.	Porcupine	0.0	0.0	0.2
28.	Muskrat	0.0	0.0	0.4
29.	Small rodent	3.0	0.0	0.2
30.	Hair seal	12.1	16.7	4.5
	Total	99.7%	100.4%	99.9%

TABLE XIX

Percentage Distribution of Bird and Mammal

Faunal Classes by Component, Site Sample

Faunal Class	Component III N=33	Component II N=18	Component I N=512
Ungulates	21.2%	27.8%	25.8%
Fur-bearing land mammals	21.2	5.6	15.6
Other land mammals	27.3	16.7	8.2
Sea mammal	12.1	16.7	4.5
Water fowl (duck, goose, swan)	9.1	16.7	25.8
Diving and shore birds	6.1	5.6	13.1
Grouse	0.0	5.6	2.1
Small birds	0.0	5.6	1.8
Larger land birds (crow, eagle, raven, owl)	3.0	0.0	3.1
Total	100.0%	100.0%	100.0%

seal as above, while water fowl decrease consistently through time from early to more recent. The percentages for fur-bearing land mammals and for larger land birds are similar for Components I and III, lower for Component II.

Simply dividing the fauna into bird and mammal, as shown in Table XX, clearly indicates the differences between Components III and II on the one hand and Component I on the other. There is a much higher percentage of mammal in the more recent components than in the earlier one. Chi-square was calculated for the raw frequencies of the patterns shown in Table XX. The chi-square of 10.5 has a _p_ value of between .01 and .001, suggesting that the observed differences may be real. Total site figures for fish are not available.

Stratigraphic Units of C1 and C2

The relative frequencies of fifty-two whole artifact types and thirty bird and mammal faunal types for the sample from the combined excavation units C1 and C2 are given in Tables XXI and XXII. Contrary to expectations, little consistent patterning occurs in these distributions. Only when the frequencies exhibit sustained curves, increases, or decreases, can they be taken to represent some sort of real pattern possibly attributable to cultural change. Of the artifact types, only bone and antler flaking tools of both types, pebble tools, ground slate knives, bone pendants, and bone awl type II, show reasonably consistent patterns. Of the faunal types, other duck, gull, swan, small bird, cormorant, hair seal, and dog

TABLE XX

Percentage Distribution of Bird and Mammal
by Component, Excavated Site Sample

Fauna	Component III N=33	Component II N=18	Component I N=512
Mammal	81.8%	66.6%	54.1%
Bird	18.2	33.3	45.7
Total	100.0%	99.9%	99.8%

Chi-square = 10.5

DF = 2

$p < .01$

TABLE XXI

Relative Frequencies of Artifact Types,

Excavation Units C1 and C2 Combined

		Artifact Type (%)								
Strat. Unit	N	Historical item	Antler wedge	Bone wedge	Bone flesher	Wapiti rib tool	Bone awl I	Bone awl II	Unbarbed bone pt. I	Unbarbed bone pt. II
1	66	6.1	12.1	-	4.5	-	1.5	-	-	1.5
2	24	-	-	-	-	-	-	-	8.3	-
3	70	-	14.3	2.9	1.4	1.4	5.7	-	-	4.3
4	68	-	8.8	4.4	5.9	10.3	4.4	1.5	7.4	2.9
5	40	-	20.0	2.5	2.5	10.0	2.5	-	2.5	-
6	63	-	11.1	4.8	9.5	7.9	3.2	1.6	1.6	1.6
7	21	-	14.3	4.8	-	28.6	-	4.8	4.8	-
8	22	-	13.6	4.5	9.1	-	4.5	-	9.1	-
9	37	-	5.4	5.4	8.1	2.7	2.7	5.4	8.1	-
10	36	-	25.0	-	5.6	5.6	2.8	2.8	-	2.8
11	40	-	12.5	2.5	7.5	10.0	12.5	-	2.5	5.0
12	33	-	3.0	-	-	6.1	21.2	3.0	-	3.0
13	29	-	17.2	-	3.4	3.4	3.4	-	-	3.4
14	35	-	11.4	2.9	2.9	8.6	-	-	-	-
15	22	-	13.6	9.1	13.6	4.5	-	-	-	-

Table XXI (contd.)

Strat. Unit	Artifact Type (%)									
	Unbarbed bone pt. III	Pointed bird bone	Toggle harpoon	Tanged harpoon	Bone & antler flaker	Antler flaker II	Needle	Bone ring	Brow band	Bird bone bead
1	-	-	1.5	-	-	-	-	-	-	-
2	-	4.1	-	-	-	-	-	-	-	-
3	1.4	1.4	-	1.4	-	-	1.4	-	-	1.4
4	-	4.4	-	-	1.5	1.5	-	-	7.4	1.5
5	-	-	-	-	2.5	-	-	-	-	-
6	1.6	-	-	-	-	-	-	-	9.3	-
7	-	9.5	-	-	-	-	-	-	-	-
8	4.5	4.5	-	-	-	-	-	-	-	4.5
9	-	-	-	-	2.7	2.7	-	-	2.7	2.7
10	-	2.8	-	-	-	2.8	-	2.8	-	2.8
11	2.5	2.5	-	-	2.5	5.0	-	-	-	-
12	3.0	-	-	-	-	-	-	-	-	-
13	-	-	-	-	3.4	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	4.5	-	-

Table XXI (contd.)

Strat. Unit	Artifact Type (%)								
	Bone pendant	Blanket pin	Beaver tooth	Tooth pendant	Pebble tool	Boulder spall	Tool flake	Large core	Cortex-backed core
1	-	1.5	-	-	1.5	-	1.5	1.5	-
2	-	4.1	-	-	-	4.1	-	-	4.1
3	-	-	1.4	-	11.4	1.4	-	1.4	4.3
4	1.5	-	1.5	-	1.5	-	-	-	2.9
5	-	-	2.5	-	2.5	-	-	-	2.5
6	1.6	-	3.1	-	6.3	-	-	3.1	-
7	4.8	-	-	4.8	4.8	-	-	-	-
8	4.5	-	-	-	-	4.5	-	-	-
9	5.4	-	2.7	2.7	2.7	-	2.7	2.7	-
10	2.8	-	-	-	5.6	2.8	-	-	-
11	5.0	-	-	-	7.5	-	-	-	-
12	6.1	-	-	-	12.1	-	-	3.0	-
13	-	-	3.4	-	13.8	-	-	3.4	-
14	-	-	-	-	8.6	-	2.9	-	-
15	-	-	-	-	-	4.5	-	4.5	4.5

Table XXI (contd.)

Strati. Unit	Artifact Type (%)								
	Stone wedge	Chipped stone scraper	Chipped point I	Chipped point II	Chipped point III	Chipped point IV	Chipped point V	Chipped point VI	Chipped point VII
1	10.6	6.1	1.5	1.5	1.5	-	-	-	-
2	25.0	12.5	4.1	4.1	-	4.1	-	-	-
3	11.4	11.4	-	-	1.4	-	-	-	-
4	10.3	7.4	-	-	-	1.5	-	-	-
5	5.0	15.0	2.5	-	-	-	2.5	2.5	-
6	4.8	9.5	1.6	-	-	-	-	-	-
7	-	4.8	-	-	-	-	-	4.8	-
8	18.2	-	-	4.5	-	-	-	-	-
9	8.1	10.8	-	-	-	-	-	-	-
10	-	5.6	-	-	-	-	-	2.8	2.8
11	5.0	5.0	-	-	-	-	-	-	-
12	6.1	15.2	-	-	-	-	-	-	-
13	10.3	13.8	-	-	3.4	-	3.4	3.4	3.4
14	17.1	8.6	-	8.6	-	-	2.9	-	2.9
15	18.2	4.5	-	-	-	-	-	-	-

Table XXI (contd.)

Strati. Unit	Artifact Type (%) Chipped point VIIII	Chipped point frag.	Poss. chipped knife	Bifacial chipped preform	Unifacial chipped preform	Ground slate knife	Ground slate point	Stone disc bead
1	-	1.5	-	1.5	-	13.6	1.5	1.5
2	-	-	-	4.1	-	-	-	16.7
3	1.4	1.4	-	-	-	4.3	-	-
4	-	-	-	-	-	2.9	-	-
5	-	2.5	2.5	-	-	5.0	-	2.5
6	-	1.6	3.2	-	-	3.2	-	-
7	-	-	-	4.8	-	4.8	-	-
8	-	-	4.5	-	-	4.5	-	-
9	-	5.4	-	-	-	2.7	-	-
10	-	5.6	-	2.1	-	2.8	-	-
11	-	2.5	-	2.5	-	-	-	-
12	-	-	-	-	3.0	-	-	-
13	3.4	3.4	-	-	-	-	-	-
14	-	8.6	-	-	2.9	-	-	-
15	-	-	-	4.5	4.5	-	-	-

Table XXI (contd.)

Strat. Unit	Artifact Type (%)						
	Ground stone adze	Abrasive stone	Ground shell adze	Pecked & ground stone	Hammerstone	Misc. bone & antler objects	Misc. ground stone objects
1	1.5	4.5	1.5	4.5	4.5	3.0	6.1
2	-	4.1	-	-	-	-	-
3	1.4	1.4	-	-	1.4	5.7	1.4
4	-	-	1.5	-	-	2.9	4.4
5	-	5.0	2.5	-	-	2.5	-
6	-	1.6	3.2	-	4.8	1.6	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	4.5	-
9	-	-	-	-	-	5.4	-
10	-	-	-	-	2.8	2.8	2.8
11	-	-	2.5	-	2.5	2.5	-
12	-	-	-	-	3.0	12.1	3.0
13	-	3.4	-	-	-	3.4	-
14	-	-	-	-	-	11.4	-
15	-	-	-	-	-	9.1	-

TABLE XXII

Relative Frequencies of Bird and Mammal Faunal Types, Excavation Units C1 and C2 Combined

		Faunal Type (%)								
Strat. Unit	N	Canada goose	White-fronted goose	Goose, general	Mallard duck	Other duck	Swan	Crow	Bald eagle	Loon
1	15	-	-	6.7	-	6.7	-	-	6.7	-
2	7	-	-	-	14.3	14.3	-	-	-	-
3	24	8.3	4.2	4.2	4.2	4.2	-	-	4.2	4.2
4	23	-	8.7	8.7	-	4.3	-	4.3	-	-
5	14	-	-	-	7.1	7.1	-	-	-	-
6	19	5.3	-	-	-	5.3	-	-	5.3	-
7	14	7.1	7.1	-	-	7.1	7.1	-	-	-
8	17	5.9	5.9	5.9	-	11.8	-	-	-	-
9	15	-	6.7	6.7	-	-	-	-	6.7	-
10	28	3.6	10.7	3.6	-	7.1	3.6	-	-	-
11	33	3.0	9.1	6.1	-	12.1	-	-	-	3.0
12	24	12.5	-	4.2	4.2	8.3	8.3	-	4.2	4.2
13	36	5.6	2.8	5.6	-	8.3	2.8	2.8	2.8	5.6
14	24	-	8.3	8.3	-	8.3	8.3	4.2	-	-
15	17	-	-	5.9	-	5.9	5.9	-	-	11.8

Table XXII (contd.)

	Faunal Type (%)								
Strat. Unit	Cormorant	Grebe	Merganser	Murre/ murrelet	Gull	Raven	Owl	Heron	Small bird
1	-	-	-	-	6.8	-	-	-	-
2	14.3	-	-	-	-	-	-	-	14.3
3	8.2	4.2	-	-	4.2	-	-	4.2	4.2
4	4.3	-	-	-	-	-	4.3	-	8.7
5	7.1	-	-	-	-	-	-	-	7.1
6	5.3	5.3	-	5.3	10.5	-	-	-	5.3
7	-	-	-	-	7.1	-	-	-	-
8	-	5.9	5.9	-	11.8	-	-	-	5.9
9	6.7	-	-	-	13.3	-	-	-	-
10	-	-	-	-	10.7	-	-	3.6	3.6
11	6.1	-	-	-	6.1	3.0	-	-	-
12	4.2	-	-	-	-	-	-	-	4.2
13	5.5	2.8	-	-	5.6	-	-	-	-
14	4.2	4.2	4.2	-	-	4.2	-	-	-
15	5.9	11.8	-	-	-	5.9	-	-	-

Table XXII (contd.)

Strat. Unit	Faunal Type (%)								
	Grouse	Wapiti	Deer	Dog	Bear	Raccoon	Mustelid	Beaver	Porcupine
1	-	6.7	6.7	20.0	-	6.7	-	13.3	-
2	-	14.3	-	14.3	-	-	-	-	-
3	4.2	4.2	8.3	8.3	-	-	4.2	12.5	-
4	4.3	8.7	8.7	8.7	-	4.3	-	13.0	-
5	-	14.2	7.1	21.4	-	-	-	21.4	-
6	5.3	15.8	10.5	5.3	-	-	-	10.5	-
7	7.1	14.3	7.1	7.1	7.1	-	-	14.3	-
8	-	5.9	5.9	5.9	-	-	-	11.8	-
9	-	6.7	13.3	13.3	-	-	6.7	13.3	-
10	3.6	14.3	17.9	10.7	-	-	-	3.6	-
11	-	6.1	12.1	3.0	-	-	-	15.2	3.0
12	-	16.7	8.3	4.2	-	-	-	12.5	-
13	2.8	11.1	8.3	-	-	2.8	2.8	13.9	-
14	4.2	12.5	4.2	12.5	-	-	-	8.3	-
15	-	11.8	5.9	5.9	-	5.9	5.9	5.9	-

Table XXII (contd.)

Strat. Unit	Faunal Type (%) Muskrat	Small rodent	Hair seal
1	-	6.7	13.3
2	-	-	14.3
3	4.2	-	-
4	-	-	8.7
5	-	-	7.1
6	-	-	5.3
7	-	-	7.1
8	-	-	11.8
9	-	-	6.7
10	-	-	3.6
11	-	-	-
12	-	-	4.2
13	-	2.8	5.6
14	-	-	4.2
15	-	-	5.9

show relatively consistent patterns. For the fish weights, the patterns of all three types are sustained, indicating an increasing dependence from early to more recent times on salmon, relative to all other types of fish. Relative frequencies of fish weights are given in Table XXIII. The frequencies of sturgeon show a steady decrease from early to more recent levels, while other fish also shows a steady decrease from unit 10 up. If salmon vertebrae are compared with all other fish taken together, the pattern is even clearer. Below unit 6, all other fish are consistently more than fifty per cent of the sample, while from unit 6 up the pattern is reversed. A check of the samples showed that in the other fish type, number of vertebrae relative to number of other skeletal elements is reasonably constant, so that the observed patterns are reflecting more than sampling error caused by the inclusion of more or fewer salmon non-vertebral elements in the other fish category.

TABLE XXIII

Relative Frequencies by Weights of Fish Types, Excavation Units C1 and C2 Combined

Strat. Unit	Fish Type (%) Salmon Vertebrae	Sturgeon	Other Fish	N
1	49.5	36.5	13.8	88.4 g.
2	50.4	17.4	32.2	13.9
3	66.7	15.2	18.1	234.1
4	56.7	21.4	21.9	368.0
5	64.9	10.8	24.3	231.2
6	58.7	24.1	17.3	329.7
7	31.3	43.2	25.5	243.9
8	42.7	28.4	28.8	139.7
9	35.8	28.7	35.5	291.0
10	18.1	32.0	49.2	353.1
11	32.9	23.0	49.2	625.7
12	43.1	27.4	29.5	338.2
13	12.1	65.8	22.1	287.3
14	10.8	70.3	18.9	251.6
15	11.4	37.4	51.2	144.0

CHAPTER V

INTERPRETATION OF OBSERVED DISTRIBUTIONS

When the lack of consistent patterning in the majority of types was observed, it became obvious that the variations were reflecting more than cultural change. An attempt was therefore made to identify and control some of the influences of sampling error.

Sampling Problems

The first problem was to determine if the fluctuations in relative frequencies were large enough to be considered real changes rather than the kind of random fluctuations that one would expect to find in small samples from similar populations among which there was in fact no change. As the samples worked with are small and not randomly selected, such inferential statistics as difference between means tests cannot be used. While the relative frequencies control for sample size, they do not indicate the degree to which sample size is affecting the distributions. To determine how much of the variation in actual frequencies of individual types can be accounted for by variation in sample size, the statistical measure of linear association between two variables, Pearson's r, was calculated for the raw frequencies of types that occurred in at least five stratigraphic divisions in the C1/C2 sample, paired with the raw frequencies of total whole artifact or minimum number of individual counts for the C1/C2 sample. The results are presented in tabular form in Tables XXIV and XXV. The *p* values for the obtained *r*'s give the level of probability that the observed values for *r* measure real linear relationships, rather than sampling error.

For seven artifact types, chipped stone scrapers, unbarbed bone points II, mammal bone wedges, ground slate knives, beaver incisor tools, hammerstones, and shell adze blades, *r* values of between +.55 and +.73 and *r*-squared values of between .30 and .53 were obtained. The *r* values indicate the strength and direction of the association, the *r*-squared values indicate the percentage of the variation in one variable that can be attributed to its linear relationship with the other variable. As zero cases lower the value of *r*, for all but stone scrapers, these values are deflated. The *r*'s for the above types all have *p* values of .05 or less, indicating strong probability that the association is real. This means that between 30% and 50% of the variation in the distributions of these types can be explained by fluctuations in sample size.

Nine artifact types, miscellaneous bone and antler artifacts, pebble tools, stone wedges, bone fleshers, cortex-backed cores, abrasive stones, large cores, antler wedges,

TABLE XXIV

R and R-squared Values for Artifact Type Distributions and Sample Sizes, Excavation Units C1 and C2 Combined

Artifact Type	*r*	*r*-squared	No. of 0 cases	*p* value of *r*
Chipped stone scraper	+.73	.53	1	<.01
Unbarbed bone point II	+.72	.51	7	<.01
Mammal bone wedge	+.70	.49	5	<.01
Ground slate knife	+.65	.42	6	<.01
Hammerstone	+.62	.38	9	.05
Shell adze	+.62	.38	10	.05
Beaver incisor tool	+.55	.30	9	.05
Stone wedge	+.54	.29	2	.05
Bone flesher	+.53	.28	3	.05
Cortex-backed core	+.48	.23	10	n.s.
Pebble tool	+.47	.22	3	n.s.
Misc. bone & antler objects	+.46	.21	2	n.s.
Abrasive stone	+.44	.19	9	n.s.
Antler wedge	+.44	.19	1	n.s.
Large core	+.38	.13	8	n.s.
Bone awl I	+.35	.12	4	n.s.
Wapiti rib tool	+.25	.06	3	n.s.
Boulder spall	-.23	.05	10	n.s.
Bone point III	+.21	.04	10	n.s.
Bone point I	+.17	.03	7	n.s.
Pointed bird bone	+.15	.02	8	n.s.
Chipped point frags.	+.15	.02	6	n.s.
Bone & antler flaker I	+.09	.01	10	n.s.
Bone awl II	+.07	.004	9	n.s.
Bone pendant	-.07	.004	7	n.s.
All chipped points	+.05	.003	4	n.s.

TABLE XXV

R and R-squared Values for Faunal Type Distributions and Sample Sizes, Excavation Units C1 and C2 Combined

Faunal Type	$\underline{r}$	$\underline{r}$-squared	No. of 0 cases	$\underline{p}$ value of $\underline{r}$
All geese together	+.89	.79	2	<.01
Deer	+.79	.62	1	<.01
Wapiti	+.78	.61	0	<.01
Other duck	+.77	.59	1	<.01
Beaver	+.74	.53	1	<.01
Goose, general	+.67	.44	5	<.01
All duck together	+.63	.39	1	.05
White-fronted goose	+.62	.38	6	.05
Canada goose	+.53	.28	7	.05
Cormorant	+.51	.26	4	.05
Loon	+.52	.27	10	.05
Gull	+.41	.16	6	n.s.
Grouse	+.41	.16	8	n.s.
Swan	+.31	.10	9	n.s.
Grebe	+.13	.02	9	n.s.
Dog	-.17	.03	1	n.s.
Seal	-.11	.01	2	n.s.

and bone awls type I, have values for r-squared of between .10 and .29. The values for cortex-backed cores, large cores, and abrasive stones are lowered by the number of zero cases in these distributions. Only the r values for stone wedges and bone fleshers have significant p values. The r values for the remaining types could be produced by sampling error and do not necessarily measure a real association.

Of those types for which low values of r and r-squared were obtained, only the values for wapiti rib tools, all chipped points together, and chipped point fragments, are based on nearly complete distributions. The other seven types have many zero cases. For bone pendants and boulder spalls, the association is negative. Thus, for nine types sample size accounts for between 28% and 53% of the observed variation in actual frequencies. For only three types can this association definitely be considered less important, although it is possible that the higher r values for pebble tools, miscellaneous bone and antler objects, and bone awl type I are the result of sampling error rather than a real association between the two variables. Because the occurrences of bone awls type II and bone pendants cluster in adjacent levels, the low r and r-squared values for these two types might also be considered meaningful.

For the fauna, eleven types have r-squared values of between .20 and .79. Of these, which include wapiti, deer, beaver, other duck, all geese together, goose general, all duck together, white-fronted goose, Canada goose, cormorant, and loon, the values for loon, white-fronted goose, and Canada goose are lowered by the high number of zero cases. The *p* values for the *r*'s of all these types are .05 or less, indicating a strong probability that the association measured is real. Of the types with *r*-squared values less than .20, only the values for seal and dog can be taken to indicate that sample size is not strongly affecting the actual distributions. The other four types have very incomplete distributions. The *p* values for none of these types are significant, suggesting that the values obtained for *r* could be the result of sampling error.

When the patterns of relative frequencies of major artifact classes such as chipped stone are compared with the patterns of the number of types of artifacts of that class found in each stratigraphic unit for C1/C2, a second factor influencing artifact distributions is apparent. The two kinds of distributions are markedly similar. In effect, increased or decreased percentage measures, in part, an increase or decrease in the diversity of artifacts found. To measure the strength of this association, the statistic Spearman's rho, which compares rank order on one variable with rank order on another, was calculated for the three major artifact classes, bone, antler, and tooth; chipped stone; and ground stone. For bone, antler, and tooth a rho of +.64 and a rho-squared of .41 was obtained. For chipped stone, rho is +.56 and rho-squared is .32, and for ground stone rho is +.91 and rho-squared is .83. The values for rho indicate strong positive associations. The rho-squared values indicate the percentage reduction of error in predicting rank order on one variable that is obtained if knowledge of the rank orders of the second variable is added to knowledge of the first variable's distribution alone. Rho and rho-squared were also calculated for the paired rank orders of number of artifacts found and number of types of artifacts found, for the sample from excavation units C1 and C2 combined. Values of rho = +.90 and rho-squared = .81 were obtained, indicating a very strong positive association between these two variables. A similar test for number of faunal types and number of individuals for the C1/C2 sample gave a rho of +.77 and a rho-squared of .59.

These tests indicate that increasing sample size not only increases the chances of finding more artifacts of any one kind, but also increases the chances of finding more types of artifacts. The association between sample size and the number of types of artifacts found is probably only important within a certain range of sample sizes, as there is obviously a limited range of types to be found in a site. The minimum sample size necessary to override the association, however, is as yet undetermined. The effects of this on attempting to identify and quantify cultural change are obvious. In small samples, absences of certain types cannot be considered real absences. At least there is no way of distinguishing between real absences and absences that are the result of sampling procedures. The association between sample size and number of types also influences the relative frequencies of types within stratigraphic units, because the smaller the sample and the fewer the types, the higher will be the percentages of individual types. In other words, if there is a high frequency for a type in a stratigraphic unit with few types and small sample size, part of that frequency can be accounted for by the effects of these two variables, although the portion cannot actually be measured. To further complicate matters, the relative frequencies within a stratigraphic unit are interdependent.

Different use occupancy through time of the area excavated, as identified by differences in matrices, also affects the frequencies of artifact and faunal types. Although some instances of this, such as the high frequency of bone awls in Unit 12, which contains a red-ochre covered living floor, and the low frequencies for chipped points in Units 6, 9, and 12, all of which include living floors, have been identified, the size of the artifact sample does not permit the identification of consistent biases that can be measured.

A fourth factor, that affects the kinds of artifacts or faunal remains found, is the season of occupation. It was possible to determine the season of occupation for most single-matrix levels of the site area excavated, at least to a minimum degree. That is, faunal markers were found for summer, and fall and/or spring, but it is not possible from the faunal remains to determine whether both spring and fall are represented in a level, or only one of these seasons. Nor were any definite markers found for winter.

As indicators of summer, the presence of very young mammal individuals was used. Individuals were classed as very young if epiphyses of long bones, phalanges, metatarsals and/or meta-carpals were naturally missing and the individual was considerably smaller than adult individuals of that species. Jaw fragments with fully or partially erupted primary teeth were also used as summer markers. Ungulates were not used as markers because epiphyseal union is generally late for the long bones of these species, nor were Canis individuals used.

Indicative of fall and/or winter and/or spring was the presence of red-throated loon, western grebe, red-necked grebe, western gull, Bonaparte gull, and trumpeter swan individuals. Individuals of the species Heerman's gull indicate late summer and/or fall, those of California gull fall and/or winter. These are the seasons at which these species of birds are presently found in the Fraser Delta (Guiget 1967a, 1967b, 1970b, 1970e).

Using these indicators it was possible to determine that throughout the occupation of the site area excavated, summer and fall and/or spring occupancy is consistently indicated, and possible winter occupancy is also indicated for the upper levels of Component I and for Component III. Although no faunal remains indicative only of winter occupancy were found, this does not necessarily mean the site was not occupied in winter, because very few species of animals found in the Fraser Delta are there only in winter. Perhaps the most interesting observation concerning season is the fact that animal bones indicative of more than one season were consistently found in clearly separated single-matrix units. The factor of seasonal variation as affecting artifact type distributions, then, can be considered relatively constant for this sample, as indicators of possible winter occupancy in the upper levels might also indicate fall or spring.

It is possible, then, to identify four variables affecting artifact and faunal distributions, two non-cultural and two cultural, and to some extent it is possible to measure the strength of effect of the two non-cultural variables.

Recalculated Distributions of Selected Types

The distributions presented in Tables XXI, XXII, and XXIII, then, cannot be considered representative of purely cultural change. Consequently, an attempt was made to control for the effects of sample size and number of types found, using the sample from excavation units C1/C2. The observed relative frequencies of types can be viewed as deviations from the frequency that one would expect to find if there was no change through time. It is then possible to see in which stratigraphic units the observed frequencies represent more than random fluctuations about the expected frequency. Fluctuations that cannot be reasonably accounted for by the relationship of sample size and number of types found represent probable real cultural changes. A further check can be made to see if these theoretically real changes might be explained by the difference in use occupancy, represented by difference in type of deposit. If consistent patterns of variation remain unexplained by these comparisons, such patterns can be considered as possible indications of processual cultural change.

In order to make these comparisons, it was necessary to work out the expected frequencies for a type if there was no change through time, given the number of artifacts of a type found and the distribution of sample sizes. To calculate the expected values, the number of whole artifacts in each of the fifteen stratigraphic units was converted into a percentage of the total sample number of whole artifacts. For sixteen artifact types with reasonably complete distributions, the expected number of artifacts was calculated for each unit by multiplying the total number of artifacts of that type in the sample by the unit percentage. The expected numbers were then converted into percentages of the total number of whole artifacts in that unit. For each type, the calculated expected relative frequencies were then subtracted from the observed relative frequencies to give a series of positive and negative differences. The distributions of these differences are given in Table XXVI.

The distributions of number of types represented can also be viewed as deviations from a measure of central tendency, using the mean as a standard. Sample size is also viewed in this way, the mean measuring the central tendency. Table XXVIII shows these patterns.

The same procedure was carried out for the thirteen bird and mammal types that occurred in five or more units. For the number of faunal types found, the median is used as the measure of central tendency as it is more representative of a skewed distribution. Tables XXVII and XXVIII show these patterns.

Discussion and Comparison of the Recalculated Frequencies

In general, there is less sustained patterning in the artifact types than in the faunal types. The patterns for bone awls I, antler wedges, wapiti rib tools, mammal bone wedges, bone points II, and chipped stone scrapers tend to be relatively stable, and are indicative of no real change. Observed fluctuations beyond random ones in these distributions can be accounted for by the affect of sample size, number of types, and/or specialized type of deposit. Some indications of a sustained pattern of variation over and above the fluctuations accounted for by the three variables

TABLE XXVI

Relative Frequencies of Selected Artifact Types as Deviations From the Expected Frequency, Excavation Units C1 and C2

Strat. Unit	Artifact Types (%)							
	Bone pendant	Ground slate knife	Large core	Pointed bird bone	Bone point I	Antler wedge	Bone awl II	Wapiti rib tool
1	-1.8	10.0	0.1	-1.7	-2.8	0.2	-1.1	- 5.9
2	-1.7	- 3.8	-1.3	2.4	5.8	-12.1	-1.3	- 5.8
3	-1.9	0.7	0.1	-0.3	-2.6	2.2	-1.1	- 4.7
4	-0.3	- 0.8	-1.3	2.8	4.8	- 3.4	0.3	4.2
5	-1.8	1.2	-1.3	-1.8	-0.3	7.7	-1.3	4.0
6	-0.1	- 0.5	1.8	-1.6	-1.1	- 1.1	0.5	1.9
7	2.9	1.0	-1.4	7.6	1.9	- 2.0	3.8	22.4
8	2.7	0.9	-1.4	2.7	6.4	1.3	-1.4	- 5.9
9	3.5	- 0.8	1.3	-1.6	5.4	- 6.8	4.3	- 3.2
10	1.1	- 0.8	-1.4	1.1	-2.5	12.8	1.7	- 0.5
11	2.2	- 3.8	-1.3	0.7	-0.3	0.2	-1.3	4.0
12	4.3	- 3.6	1.8	-1.5	-2.7	- 8.8	1.8	0.3
13	-1.7	- 3.8	2.0	-1.7	-2.8	4.8	-1.0	- 2.8
14	-1.7	- 3.7	-1.4	-1.7	-2.6	- 0.9	-1.1	2.6
15	-1.8	- 3.6	3.1	-1.8	-2.7	1.3	-1.4	- 1.4

Table XXVI (contd.)

Strat. Unit	Artifact Types (%) All chipped points together	Bone wedge	Bone point II	Stone wedge	Bone flesher	Pebble tool	Chipped stone scraper	Bone awl I
1	0.6	-2.7	-0.4	1.4	-0.3	-3.8	-2.7	-2.9
2	8.5	-2.7	-2.1	15.8	-5.0	-5.4	3.7	-4.6
3	- 1.2	0.2	2.3	3.3	-3.6	6.0	2.5	1.3
4	- 2.4	1.6	1.0	0.9	0.9	-3.9	-1.4	0.0
5	3.5	-0.3	-2.0	- 4.5	-2.3	-3.0	6.0	-2.0
6	- 2.3	2.0	-0.3	- 4.2	4.6	0.9	0.7	1.2
7	1.1	1.9	-1.9	- 9.0	-5.2	-0.9	-4.2	-4.3
8	0.4	1.8	-1.8	8.7	4.1	-5.5	-8.6	0.0
9	- 4.0	2.7	-1.9	- 1.4	3.3	-2.7	1.9	-1.6
10	1.7	-2.8	1.3	1.0	-1.4	8.3	4.9	-1.6
11	- 4.0	-0.3	3.0	- 4.5	2.7	2.0	-4.0	8.0
12	- 3.9	-2.7	1.2	- 3.3	-4.8	6.6	6.4	16.7
13	12.7	-2.8	1.3	1.0	-1.4	8.3	4.9	-1.1
14	10.4	0.0	-2.0	8.7	-1.9	3.2	-0.2	-4.6
15	- 4.1	6.4	1.8	8.7	8.6	-5.4	-4.1	-4.5

TABLE XXVII .

Relative Frequencies of Selected Faunal Types as Deviations From the Expected Frequency, Excavation Units C1 and C2

	Faunal Types (%)						
Strat. Unit	Wapiti	Deer	Beaver	Dog	Seal	Swan	All duck together
1	-5.3	-2.0	2.0	12.0	8.0	-2.7	- 2.0
2	1.4	-8.6	-11.4	5.7	8.6	-2.9	20.0
3	-7.5	-0.9	0.8	0.4	-5.4	-2.5	- 0.4
4	-3.0	-0.4	1.3	0.4	3.0	-2.6	- 4.4
5	2.2	-2.2	10.0	13.5	1.4	-2.9	5.6
6	3.7	1.6	- 1.1	- 2.6	0.0	-2.6	- 3.6
7	2.2	-2.2	2.9	- 0.5	1.4	4.2	- 1.5
8	-5.9	-2.9	0.0	- 2.3	6.5	-2.4	3.0
9	-5.3	4.6	- 4.6	- 1.3	1.4	-2.7	- 8.7
10	2.5	9.0	- 7.8	1.1	-1.8	1.1	- 1.5
11	-5.7	3.0	3.7	- 5.2	-5.5	-2.4	3.4
12	5.0	-0.9	0.8	- 3.7	-1.2	5.8	3.7
13	-0.8	-0.6	2.2	- 8.1	0.0	0.3	- 0.3
14	0.8	-5.0	- 3.4	4.6	-1.2	5.8	- 0.5
15	0.0	-2.9	- 5.9	- 2.3	0.6	3.5	- 2.9

Table XXVII (contd.)

Strat. Unit	Faunal Types (%) All goose together	Loon	Grebe	Cormorant	Gull	Grouse
1	- 6.6	-2.0	-2.0	- 4.7	1.5	-2.0
2	-12.9	-2.8	-2.8	10.0	-5.7	-2.8
3	- 0.8	2.1	2.1	3.6	-0.8	2.1
4	4.4	-2.2	-2.2	0.0	-5.2	-2.8
5	-12.9	-2.1	-2.1	2.8	-5.0	-2.3
6	- 7.9	-2.1	3.2	0.6	5.2	3.2
7	1.3	-2.1	-2.1	- 4.3	2.1	5.0
8	4.2	-2.4	3.5	- 4.7	6.5	-2.4
9	0.1	-2.0	-2.0	2.0	8.0	-2.0
10	4.7	-2.1	-2.1	- 4.6	5.7	1.5
11	5.2	0.9	-2.1	2.1	0.9	-2.3
12	3.4	2.1	-2.1	- 0.4	-5.0	-2.3
13	0.9	3.4	0.6	1.1	0.3	0.6
14	3.3	-2.1	2.1	- 0.4	-5.0	2.1
15	- 7.6	9.4	9.4	1.2	-5.3	-2.4

TABLE XXVIII

Sample Sizes and Number of Types as Deviations from Measures of Central Tendency, Artifact and Faunal Sample from Excavation Units C1 and C2 Combined

	Artifact Sample		Faunal Sample	
Strat. Unit	No. of types as deviations	No. of artifacts as deviations	No. of types as deviations	No. of individuals as deviations
1	+8	+25.6	-2.8	- 5.6
2	-6	-16.4	-6.8	-13.6
3	+8	+29.6	+5.2	+ 3.4
4	+5	+27.6	+0.2	+ 2.4
5	+3	- 0.4	-4.8	- 6.6
6	+4	+22.6	+0.2	- 1.6
7	-6	-19.4	-1.8	- 6.6
8	-4	-18.4	+0.2	- 3.6
9	+3	- 2.4	-2.8	- 5.6
10	+3	- 3.4	+0.2	+ 7.4
11	+1	- 0.4	-0.8	+12.4
12	-4	- 6.4	+0.2	+ 3.4
13	0	-10.4	+5.2	+15.4
14	+5	- 4.4	+1.2	+ 3.4
15	+5	-18.4	+0.2	- 3.6

or by random factors were found in the other ten artifact types.

Pebble tools and large cores tend to decrease in relative importance from early to more recent levels. Bone awls II, bone pendants, unbarbed bone point I, and pointed bird bone have restricted distributions, in Component I. Ground slate knives have a restricted distribution and a marked increase for Component III. Stone wedges tend to have lower frequencies in the middle units, with an initial high frequency. All chipped points together have an initial high frequency, whereas bone fleshers have an initial high frequency but tend to increase slightly in the middle units, then decrease.

The patterns for wapiti, deer, all duck together, and grouse are relatively stable, showing little change through time. Fluctuations above merely random ones in their distributions can be explained by one or more of the three variables. The distribution of grebe is too interrupted to show any patterning. Increase in relative importance from early to more recent levels are suggested by the patterns for dog, hair seal, and possibly also for beaver and cormorant. The patterns of the latter two types are not very marked. Those of dog and hair seal show clear increases that cannot be explained by the effects of the three variables. Similarly, decreasing importance from early to more recent levels is indicated by the patterns for swan, all goose together, and loon. Gull also appears to show an increase in the middle units of Component I that cannot be accounted for by sampling error.

These patterns indicate that there are some changes in importance of artifact and faunal types in Component I which could be real changes. If the same patterns were found in samples from other areas of the site, they might then be accepted as evidence of processual cultural change. As this sample is a small one from one area of the site, it cannot be considered representative of the whole site, because the patterns observed might still be the result of other random and non-random sampling errors that have not been identified.

A few comparisons between the faunal and artifact records for this sample can still be made, although they cannot apply to the site as a whole. Pointed bird bone artifacts, which could have been used for larger fishing implements, are more common above unit 12. Although corrected frequencies were not calculated for fish weights, there is an increasing percentage of salmon vertebrae from early to more recent levels, and a decreasing percentage of other kinds of fish. Ethnographically, however, salmon were taken in this area with either composite toggle harpoons or nets, of which there is no evidence in Component I. As harpoons are very rare in this sample, other implements seem to have been used, possibly hooks armed with fixed barbs of pointed bird bone. It may also be that wooden implements which have not been preserved were used. The increase from early to more recent levels of ground slate knives, ethnographically reported as fish knives (Duff 1952:63-64), coincides with the increasing percentage of salmon.

Although the test was not made on this sample, it is possible that fish remains could be used to indicate whether the fish were being eaten fresh or preserved. It seems reasonable to suppose that the use of a thin ground slate knife would allow faster, more efficient preparation of salmon for preserving. If this is so, an increasing frequency of ground slate knives may indicate that an increasing percentage of the salmon are being preserved for winter use. It may be possible to observe this change in two ways in the faunal record. Firstly, one might expect to find that a higher percentage of the salmon remains come from fish taken at the same time of year, the peak of the various runs. This could be identified by an examination of the growth rings on vertebrae and scales (Casteel 1972:406-409). Secondly, if salmon were prepared for preserving in earlier times as they were prepared by the Upper Stalo ethnographically, the heads would have been removed before preservation (Duff 1952:63-64). One would then expect to find an increased percentage of post-cranial skeletal elements relative to cranial elements, if the majority of salmon were being eaten dried or smoked. Such information might also be used as evidence of winter occupation.

Except for the initially high percentage of all chipped points together, the pattern of little change for chipped points agrees reasonably well with the patterns for deer and wapiti, which could have been taken with spears or projectiles armed with chipped points. As it is ethnographically reported that larger game animals were hunted with implements armed with wooden or bone points as well as with traps and deadfalls (Duff 1952:59), the rather abrupt initial decrease in frequency of chipped points may represent a change to the use of wooden points, which have not been preserved, rather than a decreasing emphasis on hunting land mammals. The stable distributions of antler wedges, wapiti rib tools, and mammal bone wedges, all implements made from wapiti and deer bone, and of chipped stone scrapers and bone awls I, which could be used to manufacture objects from the raw materials provided by deer and wapiti, tend to support the evidence of a relatively unchanging use of large land mammal resources.

It has not been possible to identify any artifacts which could have been used for taking birds or beaver, while the two tanged harpoons are the only artifacts that might have been used for seal. This suggests either the use of wooden implements or the use of nets for birds as ethnographically reported (Duff 1952:72). Seals may have been taken with wooden clubs at hauling out or breeding places. The high occurrence of young or female hair seal individuals and the fact that hair seals formerly used Harrison Lake as a breeding ground supports this view. It seems clear that a greater variety of birds were being used in the earlier levels of the site.

While it was not possible to determine if smaller dogs are more common in more recent levels, because of the fragmentary state of the bones, it is tempting to link the increase in dogs with the beginning of the use of dog wool for weaving. This is, however, highly speculative, especially as this may not be the pattern for the site as a whole. The possibility that dogs were eaten cannot be overlooked, as in one instance the lower fore-leg of a dog which had been cut off just below the elbow and through the wrist joint was found intact, while in two instances the first two vertebrae were found isolated but naturally aligned.

The clearest evidence supporting the idea that many implements were made of wood in earlier times, as is reported ethnographically for the area, is the high percentage of types of artifacts that can be interpreted as possible woodworking tools. These include antler and bone wedges, stone scrapers, abrasive stones, beaver incisor tools, pebble tools, and adzes, though some of these could also have functioned as bone and antler working tools. In Component I these types form 35.9% of the artifacts, in Component II, 2.9%, and in Component III, 16.6%. The low frequency in Component II is undoubtedly the result of the specialized nature of that deposit.

Because of the sampling problems encountered, component comparisons of artifacts and fauna do not seem worthwhile. Although the MSA 1 analysis of the faunal record does not separate the artifact based components, suggesting that changes in artifact frequencies among components are not related to changes in subsistence patterns, both MSA 1 analyses are based on the original relative frequencies and cannot be considered too reliable.

CHAPTER VI

CONCLUSIONS

The study made in this thesis has pointed out the importance and the difficulty of distinguishing real cultural change from non-cultural change in type distributions produced by the influence of both random and non-random factors introduced by sampling procedures. It has shown that before any attempt is made to attribute observed changes in artifact or faunal frequencies to cultural differences in the groups represented by the two records, as many sampling influences as possible should be identified and controlled.

The effect of sample size on the number of types of artifacts or fauna found has been statistically demonstrated as a major sampling error in small samples. Type of deposit has also been identified as a factor influencing the kinds of artifacts found. The use of statistical measures of association, such as Spearman's rho and Pearson's r, was found to be a useful method of describing the effect of sampling errors. Viewing variations through time in type frequencies as deviations from the frequency to be expected, if there is in fact no change, is also shown to be an effective method of distinguishing possible real cultural change from random fluctuations.

Some indications of possible processual cultural change were found in both the faunal and the artifact records. Although they are fewer than originally expected, and cannot be considered to represent the site as a whole, their identification suggests that such changes can be distinguished from random change. It is clear, however, that attempts to identify and describe processual change should be based on samples that are both large and representative of a wide area of the site. Sampling a wide area of the site will help to offset the biases introduced by differential use occupancy of site areas at one time. It is not enough that the total artifact count from the site be high. A large sample must be recovered from each horizontal stratigraphic division of the site, as the factors producing sampling biases operate at each level of occupation. A large total sample from a finely stratified site, that is in fact made up of small samples from each horizontal division, will still be biased.

Some of the problems involved in identifying cultural components in small samples have been discussed. Unless a large, random sample is used, statistical methods of identifying components, based on presence and absence of types, produce inconclusive results. In small samples, the best evidence for the separation of components is still the stratigraphy and the dating. Multidimensional scalogram analysis, based on relative frequencies of artifact types, is shown to be an effective method of delineating components.

This method has the added advantage of presenting a clear, visual statement of that separation. The components identified on the basis of artifact type distributions do not necessarily describe observed faunal variations. This may be because different factors influence the deposition of the two types of cultural remains, and does not in itself prove that the artifact variations are unrelated to the faunal variations.

The study of the faunal remains has shown that the information contained in their record is additional, as well as possibly parallel, to that found in the artifact record. Through their analysis it has been possible to identify the season of occupation of most levels of the site area excavated, to show that a single matrix type spans more than one season, and to identify activities not recorded in the artifact sample. An increasing dependence on salmon relative to other kinds of fish has been demonstrated for this sample. It is obvious that if 64.7% of the artifacts in an assemblage are manufacturing tools, as in the Component I assemblage from DgRr 2, little reliance can be placed on subsistence interpretations based on a mere 16.5% of the artifacts. Such interpretations cannot help but be strongly biased. Only by a study of the food remains themselves can some assessment be made of the relative importance of various food resources. While only vertebrate food resources have been considered here, a complete analysis should include molluscan and vegetal food remains as well.

Although it has not been possible to carry out the comparison between artifact and faunal records as fully as originally intended, the few comparisons made suggest that such a study would produce the expected results if done on an adequate sample. It would only be possible to examine the faunal record as environmental evidence, however, if all the cultural and sampling biases could be controlled for. In this respect, it seems likely that confirmation of environmental changes could be extracted from occupational food remains only after regional cultural patterns are established, and only if such changes are sufficiently drastic as to result in major shifts in local animal population.

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APPENDIX I

THE ARTIFACT TYPOLOGY

1) Historical Items. A mixed bag of artifacts of non-aboriginal manufacture, ranging from the odd trade bead, Canadian coins from the turn of the century, and square nails, to recent shirt buttons.
2) Antler Wedge (Calvert 1970:65, Fig. 17a). Whole and incomplete wedges made from both split beam sections and antler tines. The distribution of these two sub-types was not found to be mutually exclusive, nor to show any demonstrable variation through time or space in the sample. Although there may well be a functional difference in the choice of a short, broad, straight wedge, or a relatively long, thin, and curved wedge, such difference has not been clearly described ethnographically. All but a few of the wedges are of wapiti antler. Where poll and tip fragments that might have come from the same wedge were found in one level, they were counted as one rather than two artifacts.
3) Mammal Bone Wedge (Calvert 1970:65, Fig. 17e). Includes mammal long bone artifacts with unifacially or bifacially bevelled, chisel-shaped bits and straight butts that are frayed and chipped from being pounded. Width of the bits

ranges from 1.1 to 5.1 cm., and length ranges from 4.1 to 32.2 cm. Where butt and tip were found in the same level and might have come from the same artifact, they were counted as one artifact. While they have been called wedges, some of the sharper-bitted ones might have functioned as chisels.

4) Bone Flesher (Calvert 1970:62, Fig. 15b). Complete and fragmentary bone artifacts made of longitudinally split deer canon bone and closely resembling bone wedges. They are distinguished from these by the lack of any evidence of battering on their butt ends and highly polished, unevenly worn tips. Where tip and butt fragments possibly from the same artifact occurred in one level, they were counted as one. Mean length of the five complete fleshers is 10.6 cm.

5) Wapiti Rib Tools (Calvert 1970:62, Fig. 15g). A group of bone artifacts whose common feature is that they are made of whole or longitudinally split wapiti rib. The working ends are finished into a variety of shapes, including sharply pointed, bluntly pointed, narrow, and widely spatulate. They are all relatively long and fragile, and the tips are generally highly polished. No meaningful pattern of variation through time could be observed for tip shape or whole or split rib. They may be fiber working tools.

6) Bone Awl I (Calvert 1970:62, Fig. 15c-e). Includes both bird and mammal bone awls, although mammal bone predomin-

ates. Mammal bone awls include both splinter and split ungulate canon bone awls. Although three artifacts of deer ulnae were found, they are incomplete and could not be definitely classified.

7) Bone Awl II. Mammal bone artifacts tentatively identified as bone drills. Because this functional identification is not certain, they have been classified as an awl sub-type. They are distinguished from bone awl type I by a distinctive wear pattern on their working ends which has given them a "shouldered" appearance, with the tips being considerably thinner than the body of the awl. In some cases minute, partially encircling striations are visible, but it is not clear whether these are use or manufacturing marks.

8) Unbarbed Bone Point I (Calvert 1970:62, Fig. 15h-k). The unbarbed bone points have been divided into three classes simply on the basis of length. While there is definitely variation in the finishing of the base, and in cross-sections, no study is yet available associating most of these formal differences with functional differences. Although there are two tip fragments and a number of central shaft fragments of antler, there are no whole points of antler. The length divisions are based on a frequency distribution of the lengths of whole points. Unbarbed bone points I includes points of 1.5 to 3.95 cm. in length. This includes one point with a round cross-

section, sides tapering to the butt and abruptly to the tip, that could have been the insert for a small composite toggle harpoon. The remainder are generally made of bird bone, with flat, slightly curved cross-sections.

9) Unbarbed Bone Points II (Calvert 1970:62, Fig.15l-n). Includes bone points from 4.0 to 7.95 cm. in length. It also includes a single bi-point of 5.3 cm. in length and a wedge-based point of 4.8 cm. in length. As these two well established point types occur only once each in the site, they were arbitrarily included here. They come from Components I and III respectively.

10) Unbarbed Bone Points III (Calvert 1970:62, Fig. 15o-q). Includes bone points from 9.0 to 13.5 cm. in length. This is the least distinct class, with few artifacts and considerable variation in form.

11) Pointed Bird Bone. Splinters of bird bone, roughtly pointed at one end. Size range is from 2.7 to 8.0 cm. in length.

12) Composite Toggle Harpoon. Two valves of composite toggle harpoons come from the site, both slotted for the insertion of a cutting blade, and both of antler. One was excavated, one from the beach (Calvert 1970:65, Fig. 17c).

13) Barbed and Tanged Harpoon. A single, broken, unilaterally barbed harpoon with tang and one line guard was found (Calvert 1970:65, Fig. 17b). The single bilaterally barbed harpoon (Calvert 1970:65, Fig. 17d) is missing the

basal section and therefore cannot be positively identified as a harpoon, but it seems too heavy to have been a fixed point. Both are of antler.

14) Fixed Barbed Bone or Antler Point. The three artifacts of this type are all surface finds. One is the tip section of a unilaterally barbed antler point with two fairly low, open barbs, and length of 3.5^{+} cm. The second is the butt end of a bone point with a long, tapering tang and one low, enclosed barb, and a length of 8.9^{+} cm. The third is a bilaterally barbed antler point, 7.75 cm. long. The two barbs on one side are low and open, the three on the other side very low and angular, and appear to be unfinished.

15) Bone and Antler Flakers I. Antler and bone artifacts which may have been used as indirect percussion or pressure flaking tools. They exhibit sturdy, flattened points, obviously worn. Some show evidence of battering on their proximal ends, and one antler and two of the bone artifacts show pronounced cross striations on the tip surface such as would be produced by use as a pressure flaking tool.

16) Antler Flakers II. Mainly antler tines which show areas of localized battering on their convex sides just a little way back from the tips. Two are based on antler wedges which were previously broken.

17) Needle (Calvert 1970:62, Fig. 15f). A single needle with

a slotted, proximal eye was recovered. Length is 10.62 cm.

18) Mammal Bone Rings. Narrow cross-sections of hollow mammal long bone, carefully ground smooth. Three of the finished specimens have cross grooves worn into the inner surface of the ring, suggesting heavy wear at that particular place. They could have been used as the rings for sliding bag nets.

19) Brow Bands. There is one complete brow band plus numerous sections, all made of mammal rib. Both perforation and notches are used for attachment of thongs (?). The two types of modification do not show any patterned variation through time. The complete brow band is small and bears a geometric design incised on the convex surface.

20) Bird Bone Bead (Calvert 1970:64, Fig. 16f). Short sections of bird long bone, neatly finished.

21) Mammal Bone Pendant (Calvert 1970:64, Fig. 16d and e). Small, flat, oblong pieces of mammal long bone with single, bi-conically drilled perforations in one end. Two are considerably larger than the others, one being made of deer (?) scapula, long-oval shaped with a double perforation at one end, and the other being a rather crudely finished long, flat section with notches cut into each edge at one end. Most are smoothly finished and undecorated.

22) Blanket Pin. Two blanket pins, one plain and one with a decorated knob, were found.

23) Miscellaneous Bone Point or Awl Shaft Fragments. Fragments of worked bone with cylindrical to rectangular cross sections, which are probably the central sections of bone or antler point or awl shafts.

24) Miscellaneous Bone and Antler Objects. This is a composite grouping of all unclassifiable whole or nearly whole bone and antler artifacts. It includes, among others, an antler carving of a whale (Calvert 1970:64, Fig. 16k); four small spindle-shaped bone objects with encircling grooves (Calvert 1970:64, Fig. 16j); a decorated, flat, slotted needle (Calvert 1970:64, Fig. 16a); two antler cylinder hammers; and a possible antler haft.

25) Miscellaneous Worked Mammal Bone Fragments. Unclassifiable fragments of bone artifacts.

26) Miscellaneous Worked Bird Bone Fragments. Fragments of worked bird bone plus a few unclassifiable whole artifacts.

27) Miscellaneous Worked Antler Fragments. Includes unclassifiable fragments of finished antler artifacts.

28) Antler Detritus. Pieces of antler which have been cut, incised, ground or otherwise modified, but are not finished artifacts. It also includes a number of curled up shavings of antler, which must have been made with a very sharp implement, and includes hacked off but other-

wise unmodified antler tine tips.

29) Beaver Incisor Tools (Calvert 1970:64, Fig. 16b). These are mainly based on whole incisors from the mandible. Three are ground down so that the working edge is less than the original width of the tooth. Of the five complete tools, three have the root end reground as well as the cutting edge.

30) Tooth Pendant or Charm (Calvert 1970:64, Fig. 16c and i). Pendants of carnivore canine and wapiti canine and incisor, either grooved or bi-conically perforated for suspension. This type also includes one human molar which has had the root ground off flat across.

31) Pebble Tool (Calvert 1970:67, Fig. 18). Large, unifacially flaked chopping tools, most based on whole or split river cobbles, but also seven based on naturally split-off slabs of rock, and five which have partially or wholly bifacially flaked cutting edges. The cobble based tools include examples of Borden's types Ia, Ib, Id, II, VIII and IX, the majority being Ia, having a convex working edge (Borden 1968b). No consistent pattern of variation through time was observed in the distribution of the types.

32) Boulder Spall. Large, heavy flakes, struck off by percussion from cobbles or lumps of rock, but also including three artifacts based on chunks of rock split off along natural cleavage planes in the material. Of the spalls

definitely struck off, five are primary flakes, four secondary. On three of the secondary and one primary flake, the striking platform forms an obtuse angle with the ventral flake surface. Two of the primary flakes show some secondary retouch which would have made it possible to haft them, and all exhibit some use retouch along the working edge. Size ranges from 10.4 by 7.0 cm. to 7.4 by 5.0 cm.

33) Tool Flakes. Include five primary and eight secondary flakes which have been used but show no purposeful secondary retouch on their working edges, although two of the primary flakes have been thinned at the back edge, possibly for hafting. As a group they tend to be considerably thinner and smaller than the boulder spalls. Materials include quartzite, basalt, and fine-grained igneous rocks. Size ranges from 4.9 by 3.6 cm. to 8.6 by 4.9 cm.

34) Large Cores. Include large lumps of rock with many flake scars on all or both faces.

35) Cortex-backed Cores. A series of small, oval to round nodules, mainly of basalt, with one surface flaked all around and the other left entirely in cortex. They may have been used, but wear patterns are insufficiently clear to be certain. The distribution of these artifacts suggests that they may be associated wit the stone wedge complex. Possibly they are the initial stages in the production of stone wedges.

36) Stone Wedge Complex. This includes small stone artifacts based on flakes, generally rectangular in outline, which exhibit evidence of bi-polar battering on at least two opposing edges. They have elsewhere been called pièce esquillé (MacDonald 1968). Many also exhibit blade-like flake scars originating from the areas of bi-polar percussion. A small number of blade-like flakes which appear to be the by-products of the use of stone wedges, have been included in this complex. The wedges themselves include two-sub-types, those which are relatively thin and are wider than they are long, and those which tend to be thicker and are longer than they are wide. Length here describes the axis between two opposing edges exhibiting bi-polar percussion. Main material is basalt.

37) Chipped Stone Scraper. A large series of unifacially flaked artifacts, based on flakes, predominantly of a very fine grained basalt, with a considerable variety of edge shapes. They tand to be flaked on all edges with an extremely fine pressure retouch. Unifacial retouch on opposing faces is also used. Although one intuitively separates the heavier scrapers with straight or convex edges from those based on very thin basalt flakes, the separation cannot be statistically demonstrated. A frequency distribution of maximum thickness exhibits a unimodal curve. On only one of the heavier scrapers was the

characteristic wear pattern of heavy cross striations, associated with scraping tools, observed. The remainder exhibit some polish on the working edges, but no clear directional wear. Most exhibit tiny hinge fractures on the working edges, which could have been produced by use on a hard material. They may be wood or bone working tools, although some of the heavier ones could be skin scrapers. As they cannot be clearly separated, they have been treated as one series. The range of thickness is from 0.2 to 1.7 cm., with a modal category of .4 to .6 cm.

38) Chipped Point I (Calvert 1970:69, Fig. 19h). Small leaf-shaped points with lenticular cross-sections. Length range is from 3.5 to 9.9 cm. All but two are of basalt, one of chalcedony and one of chert..

39) Chipped Point II (Calvert 1970:69, Fig. 19k). Leaf-shaped points with the sides tapering convexly to the tips and to a straight base. Cross section is lenticular. Length ranges from 3.6 to 12.3 cm. Material is mainly basalt, but includes obsidian and sandstone.

40) Chipped Point III. Four asymmetrically leaf-shaped points with straight bases. The sides taper convexly to the tip and base, but one side is more convex than the other. Cross section is lenticular. Three are of basalt, one of a cryptocrystalline material. Length ranges from 4.2 to 5.85 cm.

41) <u>Chipped Point IV</u> (Calvert 1970:69, Fig. 19c). Stemmed points with sides converging convexly to the tips, contracting stems and slight shoulders. Three are basalt, one quartz and two some cryptocrystalline material. Length ranges from 3.1 to 4.6 cm.

42) <u>Chipped Point V</u> (Calvert 1970:69, Fig. 19b). Points with sides converging convexly to the tips, pronounced shoulders and straight stems. Materials include jasper, chalcedony and basalt. Length ranges from 3.3 to 7.05 cm.

43) <u>Chipped Points VI</u> (Calvert 1970:69, Fig. 19g). Points with sides tapering straightly to the tips, pronounced shoulders and contracting stems. Material is basalt and one petrified wood. Length ranges from 4.15 to 6.2 cm.

44) <u>Chipped Point VII</u> (Calvert 1970:69, Fig. 19f and e). Points with sides converging convexly to the tip, straight stems and either one shoulder or with one shoulder considerably more pronounced than the other. Material includes obsidian, basalt, jasper and chert. Length ranges from 2.9 to 7.25 cm. They might be knives rather than points, but wear patterns are inconclusive.

45) <u>Chipped Point VIII</u> (Calvert 1970:69, Fig. 19i-j). These include one-of-a-kind points that cannot be included in the above classification. Materials include chert, chalcedony, basalt, and quartz.

Within each chipped point type there is a size gradient, but if all types are taken together, a frequency distribution of length forms a bi-modal curve with peaks at 4.45 and 5.45 cm. There is a slight tendency for larger points to be more common in earlier levels, smaller ones in more recent levels.

46) Possible Bifacially Chipped Knives. Crude, bifacially flaked artifacts with a rough semi-circular outline. Their designation as knives is tenuous.

47) Chipped Stone Point Fragments. Tip, base and central fragments identified as point fragments. As type of material, form, and flaking pattern make it possible to say that each is part of a separate artifact, they have been treated as whole artifacts.

48) Bifacial Preforms. Bifacially chipped stone artifacts that appear to be unfinished points or knives.

49) Unifacial Preforms. These four artifacts have been designated preforms for lack of a better term. They are roughly leaf-shaped, with one flat surface and the other flaked all around so that the central cross-section is roughly triangular. No wear patterns could be discerned on the edges.

50) Miscellaneous Bifaces. Miscellaneous whole bifacially chipped stone artifacts that are unclassifiable, and fragments of the same.

51) Miscellaneous Unifaces. A composite grouping of unclassifiable unifacially flaked stone artifacts and miscellaneous fragments of unifacially flaked stone artifacts.

52) Ground Slate Knives. These are all fragmentary and include central fragments and fragments with both straight and curved bifacially bevelled edges. Although the earlier slate tends to be thicker, a frequency distribution of thickness forms a unimodal curve with a mean of .27 cm. and a SD of .11 cm. The range of thickness is from .15 to .66 cm. The six pieces that are decorated with a notched "feather" design along the back edge all come from Component I.

53) Ground Slate Point. The six ground slate points from the site have all been treated as one type for reasons of sample size. A small incomplete triangular point comes from Component III; an incomplete stemmed point that is chipped and ground from Component I; and one crude chipped and ground leaf-shaped point from each of Component III and Component I. The latter are probably unfinished reworked fragments of knives. The surface finds include a leaf-shaped point that is reworked from a knife fragment and a fragment of a large triangular point.

54) Stone Disc Beads (Calvert 1970:64, Fig. 16g). Nearly all the stone disc beads are from Component II. All are made from either siltstone or sandstone and are bi-conically drilled.

55) Ground Stone Adze. Includes two fragments definitely from adzes and one small fragment of ground jadeite which is probably a surface fragment of an adze blade.

56) Abrasive Stone. Includes both flat and dished abraders, and two grooved ones. Both shaped and irregular abraders were found, but most are fragmentary. There seems to be a slight tendency for grooved or dished abraders to be more often shaped than flat abraders, but the sample is too small to be sure. Material varies from very coarse grained sandstone to very fine grained sandstone and slate. There is a slight tendency for more diversity in grain to be found in the upper levels of Component I and in Component III, but again, it is a small sample. This type also includes one large abrasive slab from Component I.

57) Miscellaneous Ground Stone. Includes miscellaneous whole and fragmentary artifacts of ground stone, among which is a large, flat pendant of green phyllite from Component I.

58) Pecked and Ground Stone Objects. Includes four incomplete artifacts and one unfinished pecked and ground stone artifact. An unfinished hand maul was found on the beach, and a possible hand maul fragment, part of a grooved net sinker and two unclassifiable fragments were excavated.

59) Hammerstones. Two sub-types of hammerstones were found, those showing localized battering on the long ends, on the faces near the long ends, and/or the center of the faces (Calvert 1970:72, Fig. 20b), and those which also show flattened areas along both sides and ends (Calvert 1970:72, Fig. 20a), giving them a rectangular or square

outline. Sample size is too small to show variation through time or space of the two sub-types, although the different wear patterns indicate different usage. Material is usually fine grained igneous rock.

60) Shell Adze. These are fragments of cutting blades made from *Mytilus californianus* (Conrad) and ground into shape. Two are complete enough to be identified as adze blades, the others might be either adze or knife blades.

APPENDIX II

THE FAUNAL TYPOLOGY

1) Canada Goose. Includes individuals identified as Branta canadensis (Linnaeus).
2) White-fronted Goose. Includes individuals identified as Anser albifrons (Scopoli).
3) Goose, general. Includes individuals identified as goose but not specifically identified. The three goose types are mutually exclusive. In one level, the bones representing goose, general, could not be part of individuals already designated Branta or Anser.
4) Mallard Duck. Individuals identified as Anas platyrhynchos (Linnaeus).
5) Other duck. Individuals identified as duck but not specifically identified. As with the goose types, the two duck types are mutually exclusive.
6) Swan. Individuals identified as either Trumpeter Swan, Cygnus buccinator (Richardson), or Whistling Swan, Cygnus columbianus (Ord). Most are C. buccinator.
7) Crow. Includes at least Northwestern Crow, Corvus caurinus (Baird), and possibly American Crow, Corvus brachyrhynchos (Brehm). As only one skeleton of each species was available for comparison, the range of size

variation to be expected in *C. caurinus* could not be taken into account, so that the individuals tentatively identified as *C. brachyrhynchos* might be large individuals of *C. caurinus*.

8) *Bald Eagle*. Individuals identified as *Haliaaetus leucocephalus* (Linnaeus).

9) *Loon*. Includes both Common Loon, *Gavia immer* (Brunnich), and Red-throated Loon, *Gavia stellata* (Pontoppidan).

10) *Cormorant*. Includes Double-crested Cormorant, *Phalacrocorax auritus* (Lesson), and possibly also Brandt Cormorant, *Phalacrocorax penicillatus* (Brandt). Indications favour the identification of most if not all as *P. auritus*.

11) *Grebe*. Includes both Western Grebe, *Aechomorphus occidentalis* (Lawrence), and Red-necked Grebe, *Colymbus grisagena* (Boddaert). The majority are *A. occidentalis*.

12) *Merganser*. Includes individuals identified as American Merganser, *Mergus merganser* (Linnaeus).

13) *Heron*. One individual was identified as Great Blue Heron, *Ardea herodias* (Linnaeus), another simply as a heron of some species.

14) *Owl*. One individual identified as Great Horned Owl, *Bubo virginianus* (Gmelin), another as either Screech Owl, *Otus asio* (Linnaeus), or Burrowing Owl, *Speotyto cunicularia* (Molina).

15) *Murre*. Includes Common Murre, *Uria aalge* (Pontoppidan), and one Marbled Murrelet, *Brachyramphis marmoratus* (Gmelin).

16) Gull. Includes at least four species, Glaucous-winged, *Larus glaucescens* (Naumann); Bonaparte, *Larus philadelphia* (Ord); Heerman's, *Larus heermanii* (Cassin); and Western, *Larus occidentalis* (Audubon).

17) Grouse. Includes individuals of the family Tetraonidae.

18) Small Birds. A composite grouping including individuals of the families Fringilladae, finches and sparrows, and Turdidae, thrushes. It also includes one Kingfisher, *Megaceryle alcyon* (Linnaeus), one Stellar Jay, *Cyanocitta stelleri* (Gmelin), and Red or Yellow-shafted Flicker, *Colaptes cafer* (Gmelin), or *Colaptes auratus* (Linnaeus).

19) Raven. Includes individuals identified as *Corvus corax* (Linnaeus).

20) Wapiti. Includes individuals indentified as *Cervus canadensis* (Erxleben).

21) Deer. Includes individuals identified as Coast Deer, *Odocoileus hemionus* (Rafinesque).

22) Dog. Includes individuals identified as *Canis*. Although they might in some instances by coyote, *Canis latrans* (Say), rather than *Canis familiaris*, the variation in size, the presence of very young individuals, and the single complete skull recovered all favour their identification as *C. familiaris*.

23) Bear. Includes one individual identified as bear, but not specifically identified.

24) Raccoon. Includes individuals identified as *Procyon*

lotor (Linnaeus).

25) Mustelids. Includes individuals of the genus Mustela.

26) Beaver. Includes individuals identified as Castor canadenis (Kuhl).

27) Porcupine. Includes individuals of the species Erethizon dorsatum (Allen).

28) Muskrat. Includes individuals identified as Ondatra zibethica (Linnaeus).

29) Small Rodent. Includes individuals of the genus Peromyscus.

30) Hair Seal. Includes individuals identified as Phoca vitulina (Gray).

31) Salmon. Includes vertebrae only of the genus Oncorhynchus.

32) Sturgeon. Includes bones and dermal plates of the White Sturgeon, Acipenser transmontanus (Richardson).

33) Other Fish. Includes all other fish bone not covered by 31 and 32. Besides non-vertebral elements of salmon it includes Pacific Cod, Gadus macrocephalus (Tilesius); Pea-mouthed Chub, Mylocheilus caurinus (Richardson); Halibut, Hippoglossus stenolepis (Schmidt); Herring, Clupea pallisii (Valenciennes); a very few Dogfish, Squalus suckleyi (Girard); and other unidentified species.

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