Matrix Analyses

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INTRODUCTION

My concern has been with treatment of the predominant class of site debris – shell, rock, soil, ash, charcoal, bone, and plant remains – here referred to as non-artifactual materials. Acknowledging the precedents set by investigations in similar site situations elsewhere in the world (Cook and Treganza 1947:135; Meighan 1959:404), it is a major thesis of this report that study of non-artifactual site data provides dimensions of aboriginal life incompletely reflected by artifacts. Furthermore, it is the position of both this report and that of Luebbers (this volume), that integration of artifactual and non-artifactual information permits a cultural reconstruction not fully attainable through interpretation of either kind of data alone.

Our intent is to perform such an integration, employing the artifactual information and the non-artifactual data recovered from the shell middens ElSx 1 in Namu Harbour and ElSx 3 in Kisameet Bay. The immediate objective is reconstruction of the sequence of site utilization and subsistence patterns for each midden. The study is basically a diachronic examination of subsistence history at each, with implications for inter- and extra-site relationships in terms of specific aboriginal settlement formats.

An ultimate objective is recommendation of a specific investigatory approach designed to answer the archaeological problems which, as a result of this research, are now known to be encountered on the coast. The unexpected structural complexity and great time depth of the sites we investigated underscores the need for such an approach. The key to the productiveness of the approach is the coordination of critical sets of site data: artifacts, stratigraphic observations, vertebrate data, midden matrix data, and radiocarbon dates – each acquired and analyzed in a prescribed manner. Northwest Coast archaeology has usually given only cursory treatment to other than artifactual materials, ignoring the fact that midden sites of the Northwest contain the potential for reconstruction of community behaviour patterns. Both intra- and inter-site settlement patterns, as well as diachronic and synchronic statements, may be derived from the midden when it is viewed as possessing structural as well as content features indicative on many levels of aboriginal community life.

MATRIX SAMPLING

The success of the small sample approach depends upon the midden matrix constituents fulfilling three analytic criteria: abundance, even distribution, and fine fragmentation (Meighan, *et al.*, 1958a:4). Should a constituent not meet these criteria well, the results would be less reliable.

We used the matrix sampling approach to generate basic stratum constituent proportions and matrix fragmentation data. While I feel the proportional relationships of constituents seen in the samples are valid, with the exception of shell and rock, no constituent meets the sampling criteria well enough for finer treatment. Consequently, our shellfish species distributions could be adequately computed from matrix sample data. Our artifact and vertebrate species distributions, however, had to be compiled from the large quantities of stratum matrix removed during regular excavation. This matrix is referred to as a field sample. If we had been able to give quantitative treatment to all debris in all field samples, rather than just the artifact and vertebrate debris, we would have been able to account for one hundred percent of data from the excavation area. At present then, our data composite for each stratum is made up of artifactual data, radiocarbon data, and stratigraphic observations (covered by Luebbers). The vertebrate data and matrix sample data are treated in following sections.

Matrix sample collection procedure involves the following questions: Where to locate the sampling area within the excavation area, where to locate the individual sample within the sampling area, what size to make each sample, and how many samples to take.

The intent behind selection of matrix sampling areas was to gain insight into the characteristic composition and disposition of the major strata. The sampling areas at Namu were chosen to enable us to span the site history. Thus we have sample suites FS 1, FS 2, and FS 3 from the extremes of the 1969 excavation area at Namu; suites FS 9, FSC 9, FS 10, and FSC 10 from the extremes of the 1970 excavation area; and FSC 4 from the centre. The 1968 test pit at Namu was located in an attempt to provide a representative preliminary view of midden strata. Its location is comparable on the east-west axis to that of units FS 2 and FS 4. The four suites from Kisameet all represent the same area of the midden – the eastern portion of the east-west trench well away from its front slope. The single suite from Roscoe Inlet represents that site's front slope.

Matrix sampling traditionally has involved two kinds of samples, referred to as columnar samples and mixed samples, denoting the conditions of collection procedure (Treganza and Cook 1948:288; Greengo 1951:2; Meighan, *et al.*, 1958a:4,11) without reference to specific sample size or context requisites. Both are processed for content in the laboratory, and because transport of large chunks of matrix from site to lab is inconvenient, most laboratory samples are small.

Columnar samples have been preferred in recent years, as they provide volume as well as weight measurements. Briefly, these are samples extracted from isolated columns of site matrix. At shallow sites, the whole column may be considered a single sample (Treganza and Cook 1948). At deeper sites, the column may be cut up at arbitrarily determined intervals – with six, ten, and twelve inch intervals common (Meighan *et al.*, 1958a:4). Measurement of the *in situ* volume permits later calculations with the sample constituent. These include estimations of proportions of the major constituents in the site as a whole, usually stated in terms of cubic metres or feet of the constituent. This estimate may be converted into quantity of edible flesh, for faunal remains; quantity of wood burned for fuel, ash in the matrix; and so on. The choice to sample in a manner permitting volumetric information depends upon the plans for use of the analytic results. As sampling and analysis of small columns is not too time-consuming, the columnar approach is often used even though no volumetric calculations are planned. Indeed, most original column samples are cut to a dry work weight before processing ever begins (Meighan, *et al.*, 1958a:4).

More of a problem to process is examination of entire excavation units (Curtis 1959, 1961, 1965; Koloseike and Paterson 1963; Chartkoff 1966; Fredrickson 1969). Few projects, however, can afford the man-power needed for fine analysis of columns 3' x 3' or larger.

The alternative to columnar sampling is sampling without volume control. The so-called mixed samples are quantities of matrix taken "at random" from the site and to represent the site matrix at that point. This was Gifford's (1916) approach. His samples were rarely taken from one vertical plane, and his determination of sample representativeness was based on archaeological judgment. Later investigators standardized usage by sampling several times from single vertical planes – usually at arbitrarily established sampling intervals. In shallow sites each excavation unit might be represented by only one mixed sample, taken somewhere within the unit, avoiding localized deposits (Cook and Treganza 1947). In more complex situations, the mixed samples might be removed at standard intervals from a cleared face of each excavation unit. Except for lack of volume data, these suites of mixed samples were in many cases comparable with column samples.

This last version of the mixed sampling approach was what we used in 1968 and some 1969 collections at our sites. All samples were taken from fifteen centimetre intervals throughout the depth of the sampled units. A number of the suites were collected after complete excavation of a unit, and were extracted from the 15 cm artificial levels marked on one wall. Other suites are composed of samples taken during excavation, each from somewhere within each level. Those suites taken during excavation are prefixed with an FS; those taken after with an FSC.

Mixed samples taken in 1970 were only collected from major strata. Matrix characteristic of the stratum as a whole was collected, avoiding archaeological features such as burials, fire hearths, and boulders. Some areas of the site, however, posed problems of stratum perception. Both samples and stratigraphy recorded during excavation of such areas (*e.g.*, FS 10 at Namu) were re-evaluated after exposure of the full profile of the unit. Occasionally revision of the record was necessary when we had sampled a mixture of strata (*e.g.*, suite FS 10).

An alternative sampling procedure overcame this problem: natural stratum samples were collected from the profile after excavation (FSC). A metre-wide sampling area was marked on the exposure, and a sample was taken from each stratum, throughout the unit's depth with no restrictions on how deep into the wall we might go for the sample. Prior to collection the area was isolated on three sides from surrounding matrix. While this procedure avoids the stratum perception problem, it is subject to the same problem inherent in all columnar sampling: we are likely to encounter at least one localized feature which will bias the sample from that stratum. This applies to certain of our samples (*e.g.*, FSC 4.7 from Kisameet and the upper FS 10 samples from Namu) which include atypical debris.

None of these considerations regulate the sample size. We sought samples large enough to represent the matrix constituents and yet small enough to transport to our laboratory. In the literature, recommended sample sizes are uniformly small, between one and eight pounds. Larger samples were handled in the field, as with our field sample processing for artifacts and bone. Initially our artificial level samples were taken to fill a quart-sized plastic bag. When dried, we had samples ranging from 300 grams (suite FSC 1 at Kisameet) to 1100 grams (FSC 1 from EkSx 1) Table XXXV (Appendix C). By the close of the 1969 field season, it seemed clear that samples of this size would not produce the full range of constituent data desired.

As discussed above, the key sampling criteria are that the sampled matrix constituents must be abundant, finely fragmented, and evenly distributed. However, no specific guidelines were set on these criteria. The site situation must determine the answers.

It appeared that only shell would meet the criteria; the soil/rock component might also, but we lack direction in the interpretation of its cultural significance. Everything else was considerably more rare. Bone was the third most abundant constituent, after shell and rock. A larger sample would clarify the results for all constituents, including shell, since its presence in small and large samples from the same stratum could then be compared. Consequently, we began the 1970 sampling by collecting large quantities of matrix from each natural stratum. In some cases these weighed over 100 pounds wet each; none weighed under 18 pounds, and those few which were this small represented an unavoidably small stratum sampling area. When dried, we reduced as many as possible to a uniform thirty-five pound work weight.

At Namu in 1970 two excavation units (FS 9 and FS 10) were sampled twice. In 1969, both Namu and Kisameet produced two-suite collections from units excavated by artificial levels (suites FS 2 and PS 2A at Namu; and FS 2 and PS 2 at Kisameet). We believed the examination of several samples from one stratum would permit definition of the range of variation present in that stratum. This is an ideal which we would like to have incorporated in all of the sampling. Since we were unable to fulfill this objective for all suites, this point remains a source of criticism of our sample results.

In summary, our excavation activities were undertaken to expose the site in cross-section along the short axis, in order to discover the sequence of site depositional history. The first step in recording this sequence was observation of *in situ* strata utilizing standardized criteria. This observation provided the empirical bases for location of matrix sampling areas and the individual sample selection in 1970. Maintenance of the contextual dimensions of the sample data was of prime consideration to its laboratory analysis.

SAMPLE CONTENT

Considerations of time and sample representativeness determined which of the collected sample suites were to be analyzed. Of first consideration were those larger matrix samples representing natural strata, all those collected in 1970. I chose to analyze the best of these: suites FS 9, FSC 9, FSC 4, and FSC 10 from Namu and suite FSC 4 from Kisameet. The large suite FS 10 collected from the Namu Front Trench during excavation does not precisely represent the stratigraphy perceived after exposure of the profile. We cannot therefore be certain of the content-context relationship for all parts of the suite. The smaller suite from the Roscoe Inlet midden, FBSx 6, was severely damaged by water during a storm while in transit from the site to Namu. On these grounds, it was removed from consideration.

Several smaller sample suites collected prior to 1970 from artificial level excavation were analyzed. Suite FSC 1 from Kisameet and the 1968 test pit suite from Namu were fully examined. The analyses of these five suites must be used with caution due to the difficulty inherent in making content-context relationship statements with samples from artificial level excavation.

The collected matrix samples were transported wet from Namu to the laboratory in Boulder. Those selected for analysis were dried at either room temperature for several weeks, or in a drying oven at 180°F. for one to two days. The literature on midden sampling showed no established drying time or preferred temperature. If mentioned at all (*e.g.*, Treganza and Cook 1948:288), air-drying was generally employed to reduce the moisture content of all samples to a comparable status. An exceptional inquiry into sample moisture content conducted on New Zealand midden material indicated that the greatest amount of moisture was held by the finer debris in each sample, that termed "residue" by most analysts and usually left unprocessed (Terrell 1967:49-51). His information on differential moisture retention among constituents indicates that aspect should pose no problems, in that residue is rarely a concern in analysis. He concludes that for most purposes it is not necessary to dehydrate samples before constituent analysis on a weight basis. His findings served as the rationale for our proceeding without further concern for sample dehydration once the matrix became dry enough to sieve. The greatest moisture content occurs in the finer-than-two millimeter debris which served as our residue. Therefore, the weights and weight-percentages for that fraction should be used with this in mind. Terrell's samples contained an average of 60% of the total sample moisture content in material this fine. For his matrix, this would mean residue moisture accounted for an average of 2.4% of total sample weight.

The dried samples in each suite were in most cases cut to a standard dry weight. These weights ranged from 300 grams per sample in the FSC 1 suite from Kisameet, to 35 pounds per sample for all suites collected in 1970. Given the premise that chosen sample weight, whatever it is, is adequate for reflection of constituent proportions, conversion to a standard work weight is mere convenience. Thus, we used both large and small sized samples to make statements about stratum content. Exceptions are that we chose not to cut the raw sample weights in EkSx 1 and FbTc 1 suites, but rather used the original weights to derive proportions.

Deviations in working weights among a standardized suite derive from several sources. Samples FSC 9.4_2 and FSC 10.10 are each considerably greater than the suite standard of 35 pounds per sample. These were inadvertently processed uncut in the confusion of changing the laboratory location midway through analysis. A number of samples are significantly underweight by suite standards, due to small size of the parent matrix. These were noted in the preceding section on sample context, and include FS 9.6, FSC 9.6, FSC 9.4_1 at Namu and FSC 4.3 and FSC 4.5 at Kisameet. Other causes of underweight samples include inability to estimate how much wet matrix in the field would convert to 35 pounds dry; and inadequate measuring equipment. The fact that we must work with both pounds and grams require a single scale which could accommodate both weighing needs. As it was, we used two different scales which were available to us, the larger of which could not respond below one-quarter pound. The gram scale was adequate for small measurements up to several thousand grams and permitted readings to one-tenth gram. Conversion between the two was necessary but introduced error.

The isolation of matrix sample constituents was facilitated with mechanical separation of the dried and weighed sample into manageable portions. Large visually identifiable material was separated from debris too small to be identified without recourse to magnification or chemical treatment. Thus, while in theory all the sample matrix could be analyzed in terms of constituent proportions, in practice only the larger materials were so treated. We were particularly interested in the proportional status of those large constituents observable *in situ*, as previous investigators (Cook and Treganza 1947:137; Davidson 1964; Greenwood 1961a, 1961b; Meighan 1970) suggested they produced a fair picture of overall midden content proportions.

The same studies recommended the size of matrix portions to be analyzed and portions to be set aside. The segregation of samples traditionally, and for us, involves using a set of super-imposed or nested standard sieves, with uniform sized openings, on a motor-driven shaker which imparts both a circular and a tapping motion to the sieves. The equipment we used included the W.S. Tyler Company (Cleveland) mechanical shaker and the U.S. Bureau of Standards test sieves. The sieve with the largest aperture size is placed on top with smaller screens in descending order below and a catch-pan on the bottom. A flat lid closes the system after sample matrix has been introduced at the top. While the set-up will take all of a small sample in one sieving, the 35 pound samples had to be taken in several sievings each. To my knowledge, a larger standard system is not available for laboratory use, although field set-ups along similar lines have been made (Chartkoff 1966).

No set sifting time is suggested in the literature, although when dealing with friable constituents time in screening ultimately has a detrimental effect on particle size. Most of our samples were shaken less than three-quarters of a minute. Samples not sufficiently sifted in a minute's time were still too damp for processing and were returned to the drying oven.

Previous studies suggested a choice of sieves for the segregation. The choices made by a number of investigators involved in this work, indicates a preference for the 1/8 inch and 1/4 inch aperture screens. Although equipment is not often discussed in reports of sample analysis, I suspect that many have used similar standardized systems in the laboratory. The aperture dimensions expressed in inches are thus conversions from original dimensions expressed in millimetres on the sieves. At any rate, neither the Tyler Company nor the U.S. Bureau of Standards sets contains sieves of precisely 1/4 inch or 1/8 inch apertures. With reference to these sizes, however, investigators choose a critical screen – which sets the size limit on debris to be sorted and studied. Cook and Treganza (1947:137) preferred the 1/8 inch mesh:

> . . . the critical screen size, one-eighth inch, was selected because it retains those particles the nature of which can be detected with reasonable ease with the naked eye. Smaller screens would of course segregate more material but a binocular microscope would be necessary for separation of individual particles, an operation which would preclude the use of sufficiently large samples. With rock, bone, or any other discrete constituent the particle size obviously grades consistently from very large through the readily visible to the microscopic and even the ultra-microscopic. Hence we can never determine by purely mechanical means the absolute total of any component in the entire sample. It is obligatory to draw the line at some standard and convenient screen size and to express results in terms of such dimensions.

Davidson (1964:155) reports a 10% increase in accuracy of estimate when using material this small, and many people prefer the extra expenditure of time necessary to gain that advantage. Various estimates indicate the task can take more than twice as much time using 1/8 inch screen as the next larger screen size (Davidson 1964; Chartkoff 1966; Koloseike 1970). Therefore, the screen with a 1/4 inch aperture size is favored by many (Greenwood 1961a, 1961b; Meighan 1970). Still larger screens are used to filter out very large debris.

The best foundation on which to make the screen size decision is a test-processing of site matrix. In our situation, it was discovered that shellfish species could not be easily identified from fragments smaller than four millimetres. As this size fell between the two favored critical screen sizes of 1/8 inch and 1/4 inch, it became our choice for critical screen size. The two millimetre screen was used in conjunction to help handle the huge quantities of residue produced in sieving the larger matrix samples. While neither the two millimetre fraction nor the residue was formally analyzed, both were superficially examined for a subjective impression of major constituent proportions. These examinations suggest that the four millimetre fraction contains a fair picture of stratum matrix content.

As anticipated from field observations, the soil component of black matrix deposits passes through even the two millimetre screen to become a major constituent in residue. Table XXXV in Appendix C provides the weights and percentages of the total sample from each stratum represented by the four millimetre, two millimetre, and residue fractions. Almost 90% of the black matrix is finer than would be caught by the four millimetre screen and these samples consistently exhibit great residue quantities (Table VIII).

Black matrix samples at Namu reveal on the average a four millimetre screen retention of 11% of the total sample (10% for the ancient basal black matrix strata alone). But of this four millimetre debris, the bulk is rock. In fact, if those strata high in organic conglomerate (indicated by an asterisk in Table VIII) are corrected for that constituent, all strata observed as black matrix exhibit a greater than 90% rock contribution to the total four millimetre fraction weight. The correlation between high residue proportion, four millimetre rock content, and black matrix is quite good. The only discrepancy at Namu is stratum FS 9.6 in the Rear Trench, whose finely pulverized shell produced an analytic result much like a black matrix stratum. This deposit is a peculiarity of the rock outcrop region, and as a rule such shell decomposition is rare. Heavy sampling of fine hearth debris is the cause of the black matrix-like reading for stratum FSC 10.7. Shell admixture is considered to cause the uncharacteristic readings of black, charcoal-laden strata FS 4.5 and FS 4.3 at Kisameet. Although we have not established that recent humic and charcoal deposits behave as black matrix strata, the assumption is made that the black matrix deposits were at one time humic.

Table VIII Sample Breakdown Correlations (B)

STRATUM	STATUS	% of RESIDUE IN TOTAL SAMPLE	% OF ROCK IN 4 mm FRACTION
FS 9 3	B	91 %	97 %
FSC 9.10^2	B	90 %	96 %
FSC 9. 3^2	B	88 %	99 %
FS 9. 7	B	82 %	99 %
FS 9 10	B	81 %	97 %
FS 9. 3$_1$	B *	78 %	76 %
FSC 4. 8	B	78 %	98 %
FS 9. 8	B	77 %	93 %
FSC 10 7	(1)	77 %	93 %
FSC 10 3	S	77 %	46 %
FSC 9.5-7 8	B *	75 %	97 %
FSC 10. 9	S	75 %	61 %
FSC 10.12	S	74 %	82 %
FSC 4. 7	S	74 %	73 %
(K) FSC 4 14	S	73 %	74 %
(K) FSC 4.10	S	72 %	80 %
FSC 10 10	S +	71 %	61 %
FS 9 6	(2)	70 %	98 %
FSC 10.11	S	70 %	57 %
FSC 10. 5	S	68 %	41 %
FSC 10. 6	S	68 %	77 %
FSC 9. 6	(2)	68 %	91 %
(K) FSC 4. 9	S +	67 %	84 %
FSC 9 3$_1$	B *	67 %	93 %
FSC 4. 4	S	66 %	59 %
FS 9. 5	B	66 %	99 %
FSC 10. 4	S	65 %	33 %
(K) FSC 4.11	S	65 %	78 %
FSC 4. 5	S	63 %	45 %
FSC 4. 6	B - *	63 %	36 %
FSC 10.14	S	63 %	32 %
(K) FSC 4. 7	S	62 %	85 %
(K) FSC 4 13	S	62 %	55 %
(K) FSC 4.12	S	61 %	73 %
(K) FSC 4. 8	S	61 %	65 %
FSC 4. 3	S	59 %	15 %
FSC 9. 4$_1$	S	59 %	28 %
FSC 10. 8	S	57 %	62 %
(K) FSC 4 3	(3) - *	57 %	43 %
FSC 10 2	S	56 %	44 %
(K) FSC 4. 5	(3) - *	55 %	25 %
FS 9. 2	S	55 %	31 %
FS 9 1	S	53 %	25 %
FSC 10. 1	S	49 %	43 %

As Table IX illustrates correlation between four millimetre fraction proportion and the proportion of shell in that fraction, while not perfect, is suggestive. The "pure shell" deposits stand out clearly and the shell less deposits cluster at the opposite end of the distribution. The wide range in between reflects a great variety of shell-soil mixtures with differing degrees of fragmentation. Several shell-bearing strata exhibit smaller four millimetre retentions than black matrix strata, a feature apparent in even *in situ* observation of the deposits. Explanations of the occasional high fragmentation of shell constituents in strata include continual or heavy compaction and reworking of the deposits through heavy utilization of the surface during accumulation. It is certain that the more loosely associated, shell-heavy deposits like FS 4.6 at Kisameet and FS 9.1 at Namu never saw the surface activity which is evidenced in the upper shell strata of the Namu Front Trench. This suggests those strata with high four millimetre contents and concommittant high four millimetre shell contents represent areas of the site utilized more for dumping than habitation.

Table IX Sample Breakdown Correlations (S)

STRATUM	STATUS	% of 4 mm FRACTION IN TOTAL	% of SHELL IN 4 mm FRACTION
(K) FSC 4. 2	S	65 %	80 %
FSC 10.13	S	54 %	94 %
FS 9. 4	S	52 %	89 %
(K) FSC 4. 4	S	51 %	78 %
FSC 9. 4_2	S +	47 %	82 %
FSC 10.15	S	44 %	18 %
(K) FSC 4. 6	S	41 %	94 %
FSC 9. 1	S -	39 %	91 %
FS 9. 2	S	34 %	69 %
FS 9. 1	S	33 %	74 %
(K) FSC 4. 3	(3) - *	33 %	51 %
FSC 10. 1	S	30 %	56 %
(K) FSC 4. 5	(3) - *	30 %	50 %
FS 9. 5	B	25 %	TRACE
FSC 10. 8	S	25 %	38 %
FSC 4. 3	S	24 %	84 %
FSC 10. 2	S	24 %	34 %
(K) FSC 4. 7	S	21 %	14 %
(K) FSC 4.13	S	21 %	45 %
FSC 9. 4_1	S - *	21 %	72 %
(K) FSC 4. 9	S	20 %	15 %
FSC 10. 14	S	18 %	54 %
FSC 10. 6	S	18 %	19 %
(K) FSC 4.12	S	18 %	26 %
(K) FSC 4.11	S	17 %	21 %
(K) FSC 4. 8	S	17 %	33 %
FSC 4. 6	B -	17 %	2 %
FS 9. 6	(2) -	17 %	1 %
FSC 4. 4	S	16 %	39 %
FSC 9. 5-7-8	B	16 %	TRACE
FSC 9. 3_1	B -	16 %	TRACE
FSC 10. 4	S	15 %	61 %
FS 9. 3_1	B *	15 %	TRACE
FSC 10.10	S +	15 %	37 %
FSC 10.11	S	14 %	41 %
FSC 10. 5	S	14 %	57 %
FSC 10.12	S	14 %	18 %
FSC 10. 7	(1)	13 %	3 %
FSC 4. 5	S	13 %	54 %
FS 9. 8	B -	13 %	TRACE
FSC 9. 6	(2) - *	13 %	TRACE
(K) FSC 4.10	S	12 %	19 %
(K) FSC 4.14	S	11 %	26 %
FSC 10. 9	S	11 %	37 %

The graphs on the following pages illustrate the patterns of particle size through time. Fragmentation is viewed here as a function of antiquity and utilization. I include antiquity because our data do not permit us to rule out that possible influence over the status of the oldest shell deposits, most of which exhibit low four millimetre retention. Other than the FS 9.6 anomaly, however, no other causal factor is identified as consistently as areal utilization during and after deposition.

As expected, the two millimetre curve is rather flat. When the 1968 suites from both Namu and Kisameet were originally processed, both one millimetre and half millimetre sieves were used, and both produced similarly flat curves. Residue is generally predominant – except in those "pure shell" strata noted above. The four millimetre and residue curves are nearly mirror images in most cases. Unlike the curves for the 1970 (natural stratum) suites, those for the 1968 and 1969 (artificial level) suites are less revealing of trends. With no supporting stratigraphic data, the FbTc 1 and EkSx 1 confusion is impossible to unscramble. The 1968 curve from Kisameet, however, suggests that some of the problem lies in sample interval sizes, which were all 15 centimetres in this case. According to our records on the 1968 data, the upper portions of the FSC 1 sequence at Kisameet should mirror those in FSC 4, reflecting the shell-black-shell-black alternation in the top metre of midden debris. The 15 centimetre sampling interval seems inappropriate in this case to catch the dramatic distinctions of this sequence. One of the most interesting manipulations of these initial sample data is illustrated in Figure 44 which compares the curves for the four millimetre fraction with those of the four millimetre shell. This is expressed not in terms of its contribution to the total four millimetre weight, but rather in terms of its contribution to total sample weight. The paralleling of the curves suggests a real relationship between shell content and particle size in the strata but at the same time, a relationship which includes the complementary pattern produced in black matrix or non-shell strata.

A second stage of processing produced the shell and other constituent data. The four millimetre fraction was hand-sorted for its constituents, which were placed in the following classes:

1) shell
2) rock
3) bone
4) charcoal
5) plant remains (primarily rootlets)
6) artifacts
7) an 'organic conglomerate"

The frequency distributions for these constituents are given in Table XXXV in Appendix C and are diagrammatically represented in the following graphs. In interpretation of these figures it may be said that whether or not the four millimetre fraction is a true reflection of stratum constituent proportions, the four millimetre debris from all the samples is at least internally comparable. Therefore, we

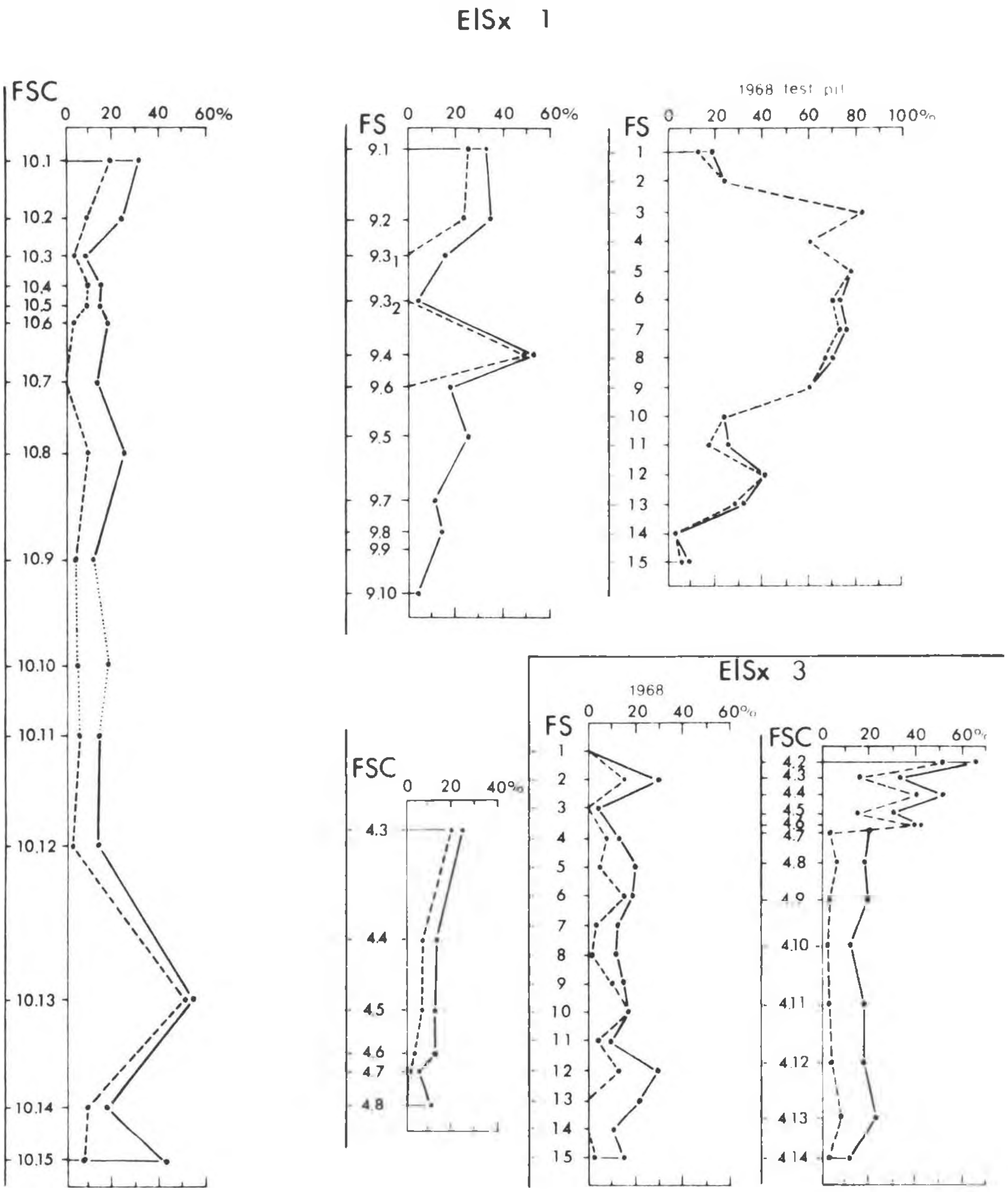


Fig. 44 Correlations between four millimetre shell (dashed line) and four millimetre total (solid line) distributions in terms of percentage of total sample weight per level.

may discuss trends and changes in four millimetre content through time – completely aside, if necessary, from implications for total stratum change. It is, of course, our contention that this debris is reflective of the stratum, and indicative of site utilization.

Among the seven constituent classes, only shell and rock occurred consistently and in quantity enough for manipulation of sample statistics. The low readings for other constituents agree with the *in situ* stratum observations. Except for occasional large-sized bones or artifacts, their proportional representations are probably quite fair. As with the four millimetre fraction and residue curves, the four millimetre rock and shell curves present distributional mirror images in most sequences. Tables VIII and IX demonstrate that black matrix and shell strata behave characteristically with respect to shell and rock content. Data for this stage of analysis is not available for the FS 2A suite, and primary data from EkSx 1 and FbTc 1 suites are not graphed.

Samples from the 1968 test pit suite show the trend in shell content suggested by the four millimetre fraction curve. Although this distribution is not at complete odds with observed sample context, nor with that from FS 4, what it signifies in terms of site utilization is not certain. What is required are stratigraphic associations for each sample. The high shell content and high four millimetre retention suggest an area seeing little intense use but considerable shell disposal; during the period dated by analogy with FS 4 as the 1000 years prior to 1800 BP.

Total sample breakdown in shell and rock from the FSC 1 suite at Kisameet is similar to the natural stratum trends seen in the FSC 4 sequence for the site. It fails in this only at the top of the exposure where strata are too thin to be separated in artificial level extraction. The curves from the four millimetre analysis, however, are quite confusing, for when rock and shell are expressed in terms of their contribution to total four millimetre fraction weight, we get only the barest suggestion of the trend we know to be present. Even the Namu 1968 test pit suite produces a clearer picture of the distribution it should reflect. Expressing these data relative to the total sample (the broken line on the graphs) erases some confusion, but the situation remains unexplained, unless we suggest that the 300 gram sample is too small for recovery of meaningful data.

In general, the percentage of four millimetre constituents relative to total four millimetre weight dramatically emphasizes the natural trends in the deposits. This technique applies for all suites but the problematical FSC 1 from Kisameet, which seems to be uninterpretable. This evidence suggests that trend determination may not be possible using such small samples as those from FSC 1 at Kisameet.

With examination of Figure 45 the graph comparing the FS 9 and FSC 9 suites' shell and rock curves, we encounter the sample size problem from another angle. The reconstructed strata column contains the strata according to superpositioning. As described previously, in collecting suite FS 9 we sampled the area's top shell deposit in two places, producing samples FS 9.1 and FS 9.2. Suite FSC 9 contains only one sample from the deposit which is slightly underweight, about 86% of the weight of the other two samples from the deposit. Theoretically, the three samples from stratum FS 9.1 should produce the same proportions in constituent analysis. In fact, the results are similar as Table X illustrates. The greatest discrepancy lies with the underweight sample, and is present in both the total sample breakdown and the four millimetre breakdown figures — but not in shellfish species proportions. Perhaps we are dealing here with the minimum effective sample size.

A second such group sampled from stratum FS 9.4, contains two deviations from the suite standard sample weight of 35 pounds: sample FSC 9.4_1 represents only 31% of the standard, while sample FSC 9.4_2 is overweight by about 25%. Again, the greatest discrepancy lies with the underweight sample; in this case even the shellfish species distributions are affected.

These observations account for the curve differences as graphed and further suggest the possibility of size limits for sample sensitivity to the stratigraphic situation. No other three-sample sets exist in the collection however, to test these observations further.

A third processing stage generated the shellfish species data provided in Table XXXVI in Appendix C and diagrammed in Figures 46-52. Tables XXXII and XXXIII in Appendix B identify the species taxonomically and locate their habitats within the littoral. Two distribution curves are given for each constituent: one (solid line) in terms of percentage of total four millimetre shell weight, the other (broken line) reflects the four millimetre fraction weight as a percentage of total sample weight.

The fragmented state of most midden shell prevents identification to species. For example, the main distinctions of *Saxidomus giganteus* and *Schizothaerus capax* can occur at the hinge. Therefore the two are graphed together here. While they share habitats, *Schizothoerus* seems somewhat the less common today.

Similar difficulties arose over segregation of *Mytilus edulis,* the small bay mussel, from the much larger sea mussel, *Mytilus californianus.* While both are edible, the larger species provided raw material for artifact and ornament manufacture. Both are fragile and few intact pieces larger than a quarter of an inch remain. These are deteriorated so that it is impossible to separate the thick-shelled *M. californianus* from the delicate *M. edulis.* The two are therefore considered together here. My guess is there is a predominance of bay mussel, *M. edulis.* A considerable amount of pulverized and powdered mussel appeared in both the two millimetre and residue fractions, a fact observed by others (Gifford 1916; Greengo 1951). The mussel contribution to four millimetre composition is therefore smaller than its actual contribution to the stratum as a whole.

Barnacle posed another identification problem because of fragmentation. It is difficult to segregate the three or four species possibly present. The bulk of barnacle at the sites is of a large species of acorn barnacle. Historic records indicate *Balanus nubilus* was the edible large barnacle

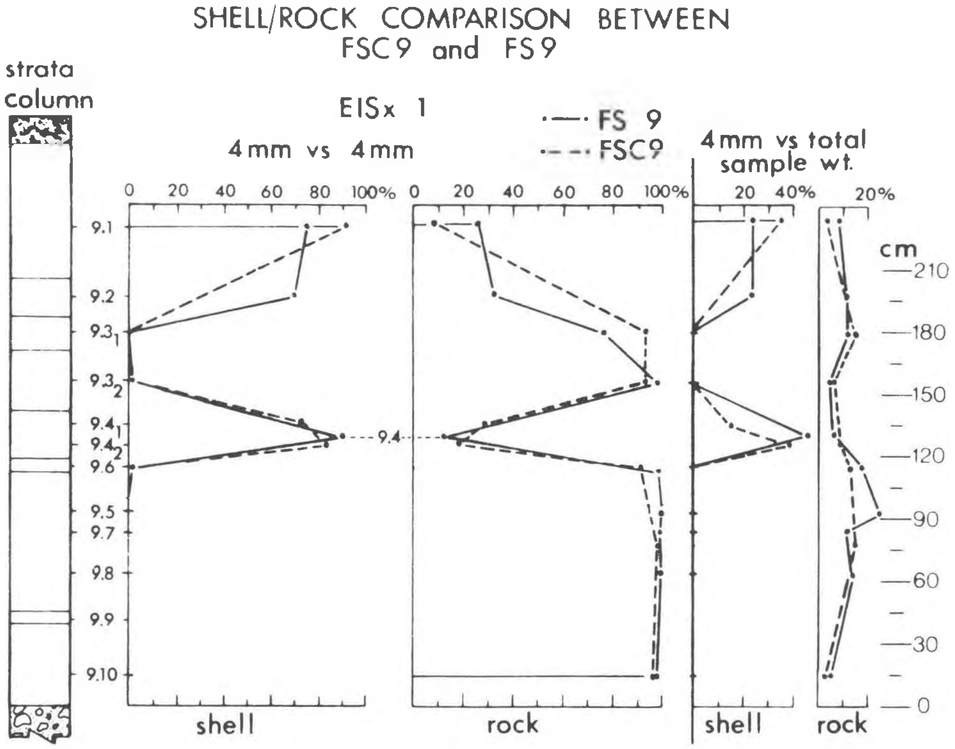


Fig. 45 Comparison between shell and rock content of the four millimetre fraction for suites "FS 9" and FSC 9", EISx 1. Graphs at left express proportions in terms of total four millimetre fraction weight. Graphs at right express proportions in terms of total sample weight. Strata column integrates both sequences according to stratigraphic superpositioning.

Table X Comparison of sample breakdown between three samples from the same stratum

STRATUM FS 9 1	FS 9.1	FS 9.2	FSC 9.1	mean	average variance from mean	average variance as % of the mean
sample weight (lbs.)	34.40	34 50	30.10			
% Residue	53 %	55 %	46 %	51 %	± 3.7	7%
% 2 mm fraction	13 %	11 %	15 %	13 %	± 1.3	10 %
% 4 mm fraction	33 %	34 %	39 %	35 %	± 2.3	7 %
% of shell in 4 mm	74 %	69 %	91 %	78 %	± 8.7	11 %
% of rock in 4 mm	25 %	31 %	7 %	21 %	± 9.3	44 %
% of *S.* in 4 mm shell	66 %	61 %	61 %	63 %	± 2.3	4 %
% of *B.* in 4 mm shell	24 %	33 %	30 %	29 %	± 3.3	11 %

STRATUM FS 9.4	FS 9.4	FSC 9.4$_1$	FSC 9.4$_2$			
sample weight (lbs.)	35.10	11.00	44.40			
% Residue	37 %	59 %	40 %	45 %	± 9.0	20 %
% 2 mm fraction	11 %	20 %	13 %	15 %	± 3.7	24 %
% 4 mm fraction	52 %	21 %	47 %	40 %	± 12.7	32 %
% of shell in 4 mm	89 %	72 %	82 %	81 %	± 6.0	7 %
% of rock in 4 mm	11 %	28 %	18 %	19 %	± 6.0	31 %
% of *S.* in 4 mm shell	73 %	53 %	78 %	68 %	± 10.0	15 %
% of *B.* in 4 mm shell	25 %	40 %	19 %	28 %	± 8.0	29 %

S. represents large clams *Saxidomus* and *Schizothaerus;*
B. represents the barnacle *Balanus.*

favoured by coastal inhabitants. Its preferred habitat is the hold-fast of kelp, where the barnacles congregate and even grow on top of each other. Kelp broken loose in storms is washed ashore, barnacles and all, where it is easily attainable. A close cousin is *Balanus altissimus,* occupying rocks above low tide and thus even more accessible. No indication of edibility is given, however, for the latter. The large size of the archaeological barnacle remains suggests that we have one or both species · *B. cariosus,* (inedible?) are included as well, as it grows currently in the intertidal zone. *B. cariosus* is the only coastal species with a membranous base, and, in fact, we find little evidence of bases, broken or whole, among the site remains. The size of the archaeological shell appears to exceed that of *B. cariosus.* A few remains of the tiny species *Balanus balanus* occur in the site, possibly representing unintentional collection while pursuing other intertidal species.

Barnacle is preserved as well as the larger clamshells in site deposits, but once the shell begins to exfoliate, it becomes difficult to segregate even clam from barnacle. Fragments smaller than those held on the four millimetre screen for both species appear simply as white shell. This affects the smaller clam *Protothaca* and the cockle *Clinocardium* as well. Once the cross-hatching of *Protothaca* or the ribs of *Clinocardium* have been weathered, they too appear as unidentifiable white shell fragments. The purple-grey shell of mussel, which also fluoresces under ultraviolet light, is identifiable even as residue, although it is impossible to extract in that powdery state. The tiny gastropods *Bittium* and *Littorina* are identifiable although they are less than four millimetres in size. Their contribution to the collection is minimal, however.

The presence of some species has interesting ecological implications. The barnacle genus *Coronula,* present in small numbers at both Namu and Kisameet, only grows imbedded in the skin of whales. A few fragments of small *Dentalium* shell occur. The nearest beds of that genus lie to the south, near Vancouver Island. This shell served as a trade good in the south, and it is possible that trade may explain its presence. *(Dentalium* occurs in levels FSC 10.5 at Namu and FS 4.5 and FS 4.6 at Kisameet.) A single fragment of abalone, *Haliotus kamtschatkana,* was found in the basal layer at Kisameet. A single fragment identifiable as crab claw was recovered from stratum FS 10.13 at Namu. Both species are currently present near the site and might be expected in the midden, although both leave quite fragile remains.

A wide range of littoral habitats is represented by the collection. The majority of the six predominant species are classed as intertidal. *Saxidomus, Protothaca,* and *Clinocardium* occur in the sandy tidal flats of fiord channel estuaries. *Schizothaerus* prefers the sand near the low tide mark.

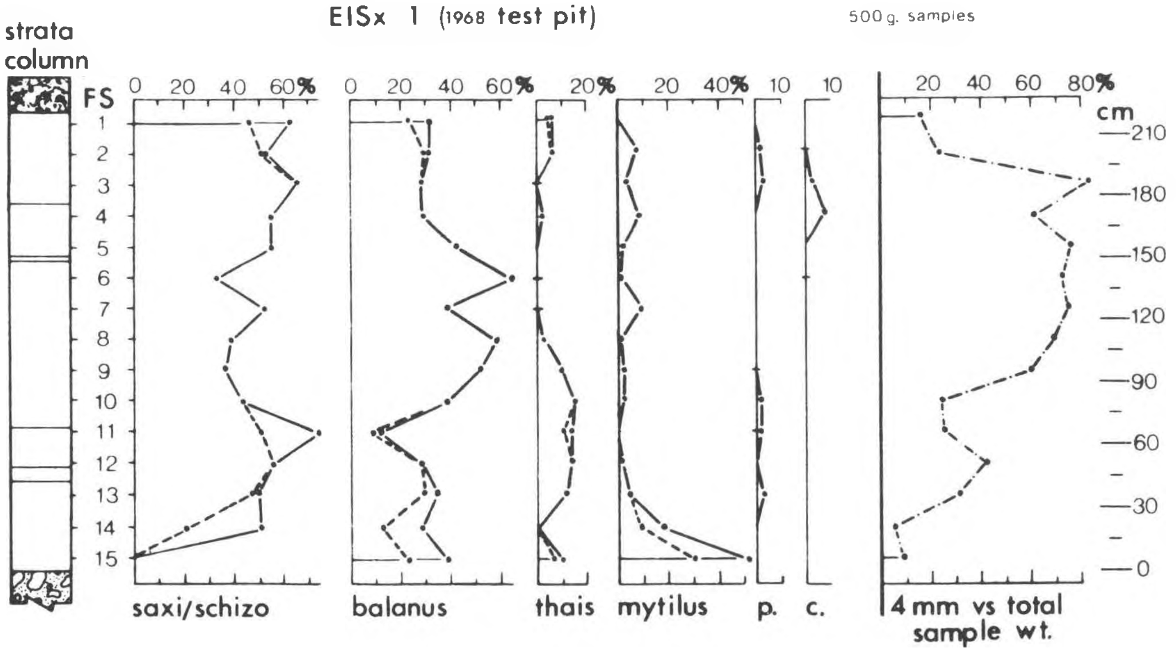


Fig. 46 Shellfish species distributions in terms of percentage of total four millimetre shell weight (solid line) and total four millimetre fraction weight (dashed line) per level. Dash-dot curve at right depicts the distribution of the four millimetre fractions in terms of total sample weight per level. See Appendix C for raw data.

Thais lamellosa prefers the intertidal zone of sheltered, rocky shores. The shell of each *Thais* reflects its habitat: rough-water dwellers exhibit thick, smooth shells, whereas animals growing in more sheltered waters exhibit delicate and many-frilled shells. Both types of shells are present in the collection. The small bay mussel prefers quiet waters below half-tide mark in rocky or gravelly areas of the intertidal zone. The larger sea mussel lives in the intertidal zone of rocky or surf-washed areas on the open coastline. The two largest *Balanus* species occur at or below low tide: *B. nubilus* on kelp hold-fasts and *B. altissimus* on rocks. The smaller barnacle species occupy shells and rocks higher up in the intertidal zone.

Other intertidal zone occupants in the collection include the tiny limpets and periwinkles, both of which grow on stones, pilings, and grasses. The abalone occurs in colonies on rocky beaches at and below maximum low tide. The small gastropod *Bittium* occurs in similar circumstances. Sea urchins live in rock crevices and tidal pools exposed only at low tide.

A single coastal bay may produce a majority of these species. At the ElSx 14 site near Namu, for example, lowest tide provides access to *Thais,* sea urchin, barnacles, limpets, periwinkles, and clams all living within yards of each other. The modern Bella Bella report that in historic times the people generally had favoured collecting locales for the major species. Large sea mussels were once collected from a rocky cove in the Namu area at some distance from the Namu Harbour beaches. Athough the beaches near the site may produce all clam species, other nearby beaches may produce more of certain species. A number of locales seem to have produced the archaeological shell. While we may hypothesize that all were collected near the site proper, we cannot identify which came from specific beds nor isolate which were transported from a greater distance. In view of the great quantities of shell collected to produce sizeable quantities of meat, it seems unlikely that great distances are involved in transport of barnacle and clam to the site. If historic patterns are applicable, the presence of the shell in the site suggests that the meat was extracted there. Historic practices regarding barnacle, however, included steaming the animals from their shells where they grew, thus reducing shell transport. This further suggests local availability for site shellfish species.

The wide variety of littoral and forest fauna sought by the site inhabitants supports the idea that the people we

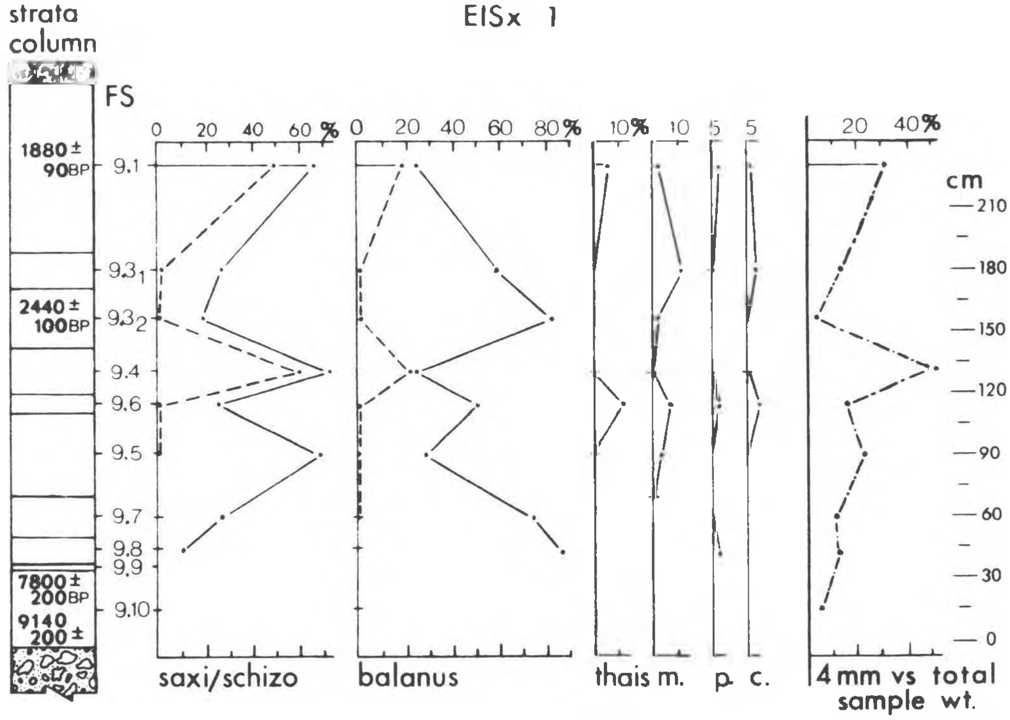


Fig. 47 Shellfish species distributions in terms of percentage of total four millimetre shell weight (solid line) and total four millimetre fraction weight (dashed line) per level. Dash-dot curve at right depicts the distribution of the four millimetre fractions in terms of total sample weight per level. See Appendix C for raw data.

are dealing with were opportunistic in their intensive exploitation of these zones (Shenkel 1971:1). In light of the abundance of fauna in given habitats, it seems that decline in the availability of a utilized resource led in general not to pursuit of that resource in a new area, but rather to change in emphasis of resources exploited in the original area (Luebbers 1971). This might particularly hold in situations involving gradual change in availability of one of two almost equally exploited species – such as barnacle and large clam at Namu and Kisameet. The possibility must be considered in explaining the shellfish and mammal species distribution trends.

As the graphs emphasize, the great bulk of site shell is clam and barnacle, with *Thais* and mussel ranking third and fourth. For much of their distributions, clam and barnacle almost mirror each other, and distinctive trends do seem to be present. The earliest occurrence of shell is that in layer FS 4.7 at Namu, dated about 4540 BP. The presence of shell in black matrix strata are felt to reflect contamination. Presence of a single shell fragment in a black matrix stratum sample must necessarily read as 100% for that species in the sample, greatly distorting the trends illustrated by the solid curve, as the graphs for suites FS 9 and FSC 9 reveal.

Suites FSC 4 and FSC 10 from Namu and FSC 4 from Kisameet contain numerous consecutive shell-bearing deposits in which site trends may be seen. Briefly, barnacle reaches a peak early in site history, accompanied by another rock-dweller, *Thais*; clams of all kinds peak later. Peaks in the occurrence of mussel are more difficult to define owing to its fine fragmentation.

In the oldest shell strata at Namu, the top four species are present in important quantities, with barnacle, *Thais*, and mussel more frequent than clam. *Protothaca* and cockle are not recorded. By 2800 BP however, clam predominates over all, as seen in FS 4 and FS 9 strata. Total shell volume increases in the site at this time, and the less common species increase in frequency, including the cockle and *Protothaca*. Clam, barnacle, and *Thais* reach peak proportions at Namu prior to 1800 BP, with clam and barnacle in nearly equal quantities. Decline in frequency of barnacle and *Thais* after this time accompanies a general site decline in shell quantities. Clam dominates the trio throughout the remainder of site history, showing a slightly greater increase

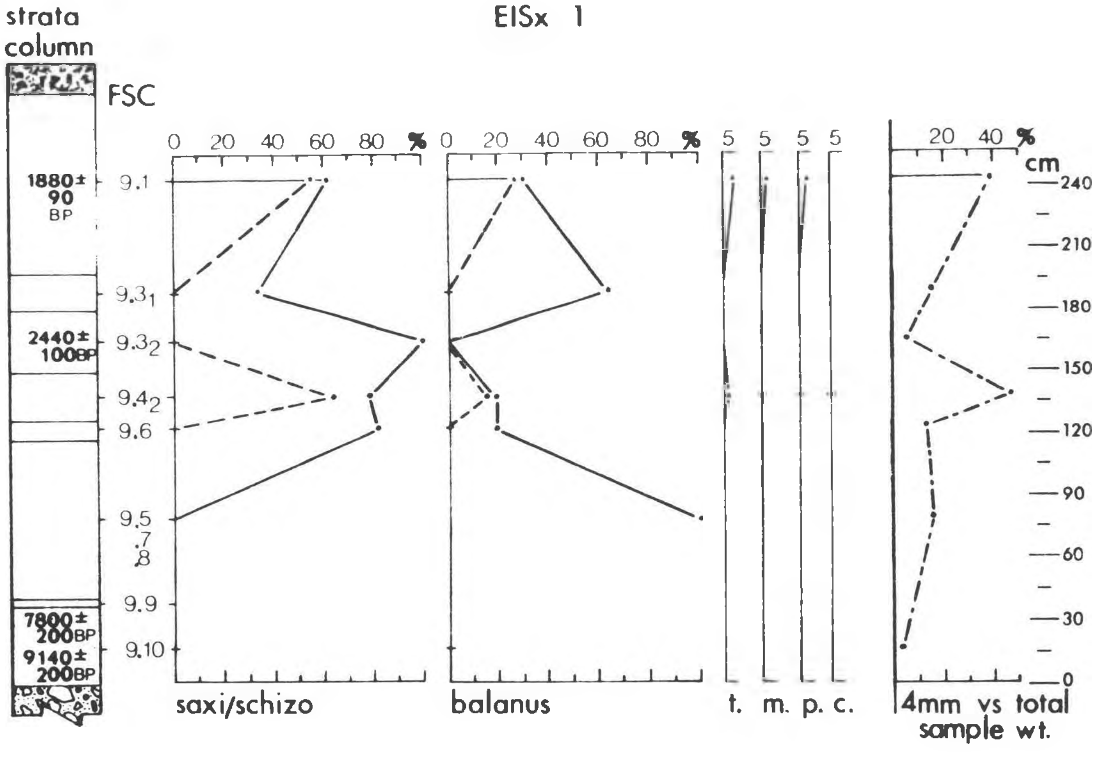


Fig. 48 Shellfish species distributions in terms of percentage of total four millimetre shell weight (solid line) and total four millimetre fraction weight (dashed line) per level. Dash-dot curve at right depicts the distribution of the four millimetre fractions in terms of total sample weight per level. See Appendix C for raw data.

than either of the others between 1800 BP and present. *Thais* all but disappears before 680 BP. Finally, the most recent, younger-than 480 BP strata at Namu exhibit increases for all species, particularly clam and barnacle. Mussel at Namu exhibits two peaks – one prior to 3400 BP accompanying the first barnacle and *Thais* peaks, and one at 480 BP, when other species are making rather insignificant showings. Between the two peaks, mussel remains in the background and does not even participate in the general increase in shell debris between 2880 and 1880 BP. Cockle and *Protothaca* occur in such small quantities that it is difficult to identify trends. It does seem, however, that they follow the large clams' trends more than those of *Thais* or barnacle. Considering the shared habitat, the similarity of clam species' distributions is perhaps to be expected. One might also explain the similar *Thais* and barnacle distributions in the same manner.

The Kisameet distribution gives another aspect of the picture. Unlike Namu, at Kisameet between 2290 BP and 1810 BP there is no great increase in shell at the site.

Barnacle and *Thais* move together, reaching a peak soon after 2290 BP and generally but slowly declining over the next thousand years – matching the Namu trend of roughly the same time. The large clams throughout this period are scarcely present, and neither cockle nor *Protothaca* are recorded. Clam apparently was not processed or discarded at Kisameet during this period. Mussel during this time behaves much as at Namu, with a rather even distribution throughout.

Considerably more recent than 1810 BP at Kisameet, we see a dramatic change in species occurrences, again resembling Namu. The large clams increase and predominate. Cockle and *Protothaca* appear in the collection. *Thais* declines and abruptly disappears, as at Namu. Barnacle reaches a third peak, still dominated by clam, as at Namu. How late the Kisameet deposits extend toward the present is unknown, however. The stratigraphic situations for upper Namu and upper Kisameet deposits are very similar. The fact coupled with the similarity in species trends suggest we are dealing with the last 1000 or even 700 years at both sites.

With respect to shell species within this upper stratigraphic pattern, both sites' curves for clam and barnacle exhibit sharp peaks and declines. These reflect both soil admixture and inclusion of hearth debris in samples of the thin strata, and the sampling of pockets of species-specific shell. Because of humic admixture and the possibly redeposited status of strata FSC 10.1 and FSC 10.2 at Namu, it is best to treat their sample results with caution. Nonetheless, an ' upper shell pattern" apparently correlates with the upper stratigraphic pattern, which exhibits considerable clam and barnacle disposal throughout, significant mussel

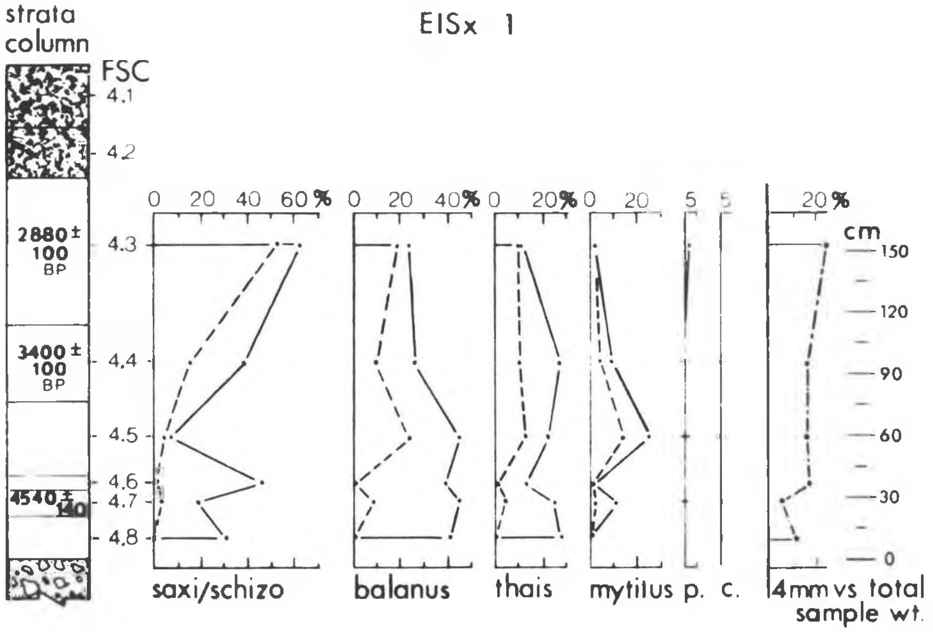


Fig. 49 Shellfish species distributions in terms of percentage of total four millimetre shell weight (solid line) and total four millimetre fraction weight (dashed line) per level. Dash-dot curve at right depicts the distribution of the four millimetre fractions in terms of total sample weight per level. See Appendix C for raw data.

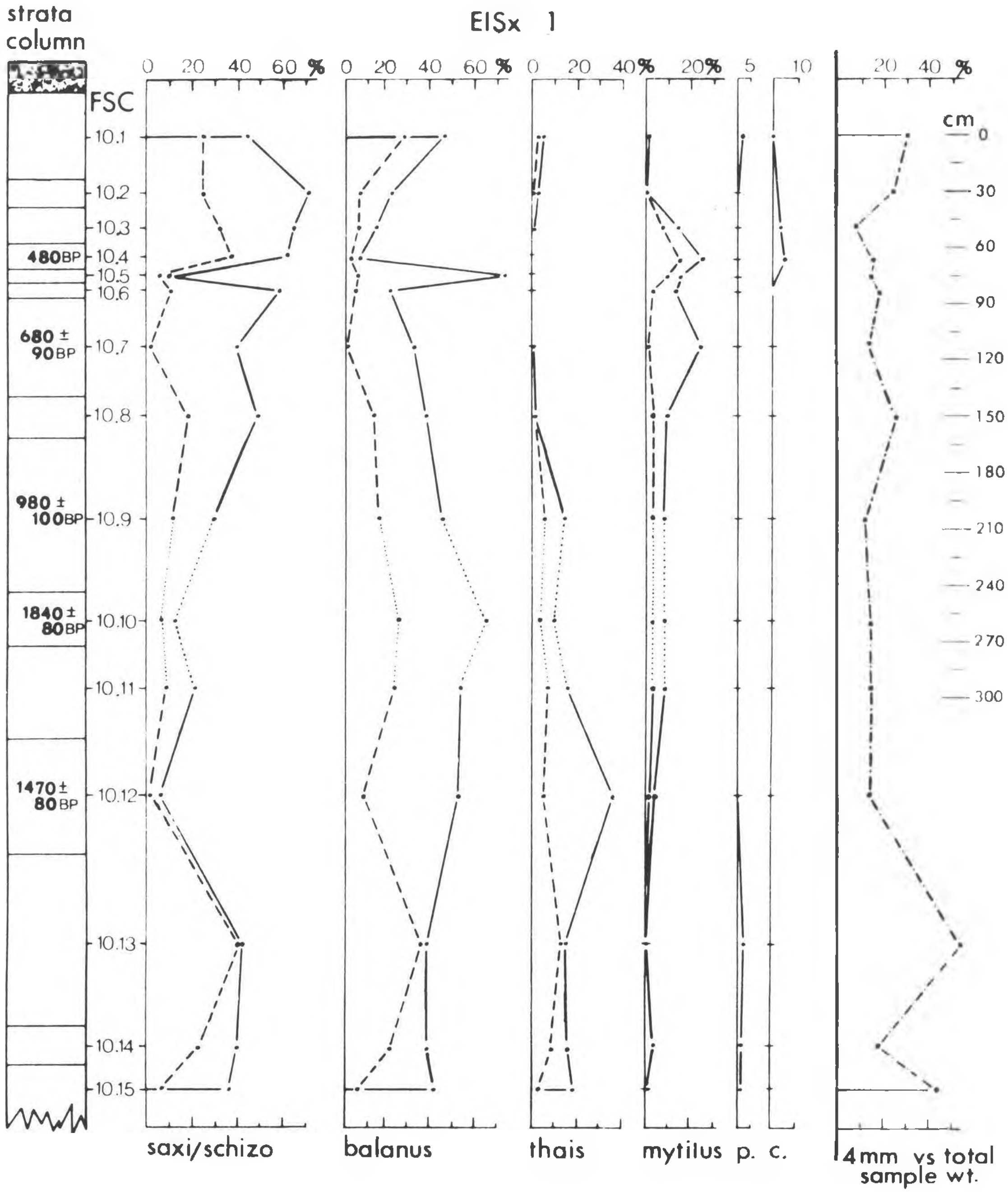


Fig. 50 Shellfish species distributions in terms of percentage of total four millimetre shell weight (solid line) and total four millimetre fraction weight (dashed line) per level. Dash-dot curve at right depicts the distribution of the four millimetre fractions in terms of total sample weight per level. See Appendix C for raw data.

followed by early disappearance of the species, and virtually no *Thais* after the initial strata in the period.

Turning last to the small samples from the artificial levels of unit FS 1 at Kisameet and the 1968 test pit at Namu, we find suggestions of the trends illustrated by the natural stratum suites. Levels 9 or 10 through 14 in the 1968 test pit may well correlate with basal shell strata in FS 4, dating 3400 BP or older. The samples, however, do

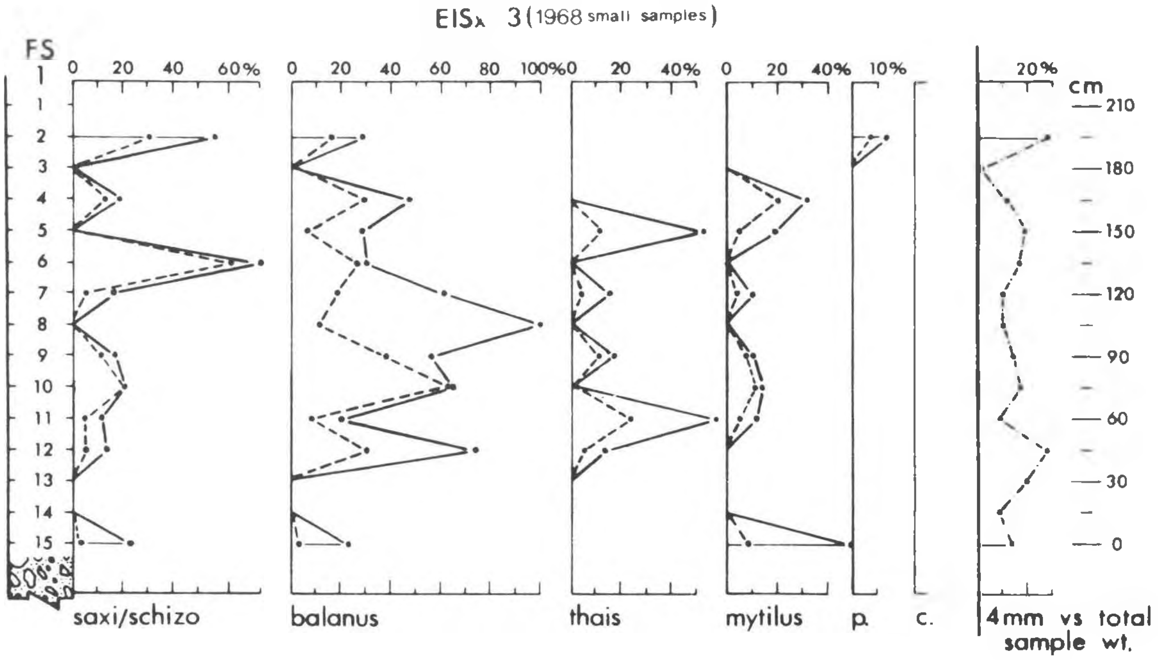


Fig. 51 Shellfish species distributions in terms of percentage of total four millimetre shell weight (solid line) and total four millimetre fraction weight (dashed line) per level. Dash-dot curve at right depicts the distribution of the four millimetre fractions in terms of total sample weight per level. See Appendix C for raw data.

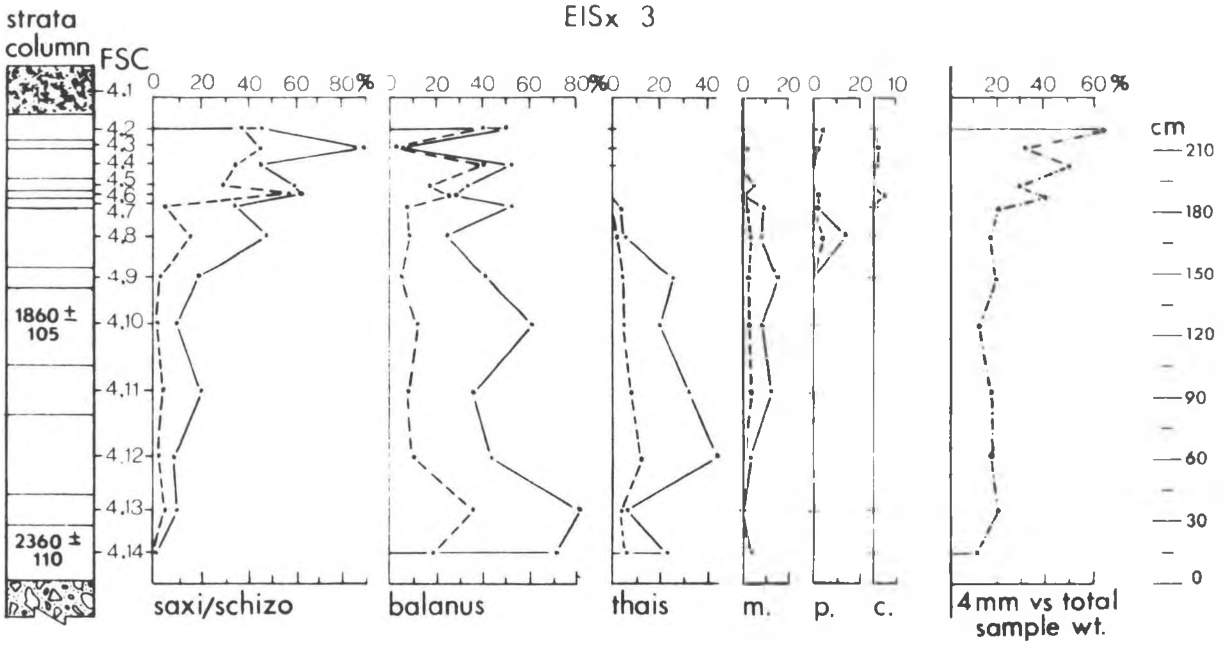


Fig. 52 Shellfish species distributions in terms of percentage of total four millimetre shell weight (solid line) and total four millimetre fraction weight (dashed line) per level. Dash-dot curve at right depicts the distribution of the four millimetre fractions in terms of total sample weight per level. See Appendix C for raw data.

not reveal quite the same picture as those from FS 4. The top four species are present in some quantity, mussel shows its first peak in these deposits, and *Thais* indicates one as well – all as in the FS 4 situation. Clam however predominates over all. There is also *Protothaca* present in these early strata; and a small early barnacle peak does not match the distribution suggested in FS 4.

In shell deposits possibly dating between 3400 BP and 1800 BP in the 1968 test pit, clam and barnacle behave more characteristically. Clam continues to increase toward a peak throughout, and barnacle peaks within the period of maximum shell content and then begins to decline. *Thais* is similar to the barnacle trend but has more dramatic peaks and declines than those in the FS 4 sequence. Mussel is more regular in distribution than *Thais* and therefore resembles the FS 4 sequence.

The Kisameet correlation is much rougher. Barnacle is predominant, and *Thais* makes an early and strong showing as in the FSC 4 suite. The peaks in species distributions in the FSC 1 and FSC 4 suites match well. The exaggerated peaks and declines throughout the FSC 1 curve obscure the rather smooth trends present as seen in the FSC 4 sequence, and the distinction between lower and upper stratigraphic patterns is virtually lost.

Summary

What significance may therefore be implied from these curves? Do we have a meaningful covariation which is habitat-related – as between clam and barnacle or between inhabitants of tidal sands and rock-dwelling species? There is the strong suggestion at least of a predominance of barnacle and *Thais* early in site history giving way to a later increase and dominance of clams. This increase through time in the abundance of beach-dwelling species coincides with a maturing of locally exploited estuaries. As clams became more abundant the inhabitants would change their collection habits – possibly even preferring clam for its greater accessibility. The time difference between the first large clam peaks at Namu and Kisameet might be then explained in terms of a difference in maturity of the respective estuaries, the Kisameet locale being much younger. If the clam peaks coincide or follow estuary maturation, then that status did not occur until after 3400 years ago at Namu and 1800 years ago at Kisameet. Furthermore, both sites exhibit a simultaneous increase in clam in the last 1000 years, a similarity not presaged by prior depositional differences nor by their presently distinct estuarine conditions. The answer must be derived from both the cultural and environmental data.

VERTEBRATE REMAINS

Bones, like artifacts, help us understand the aboriginal technology and economy. Such remains have potential in the explanation of aboriginal community-ecosystem relationships and the history of the paleoenvironmental situation (Heizer and Cook 1956:229,235). Unlike artifacts, vertebrate materials are not effectively studied one by one. Small quantities of bone are of limited interpretive value. By comparison with the quantities of bone recovered from middens elsewhere, our vertebrate sample is prohibitively small for full interpretative treatment. In the matrix samples from Namu and Kisameet, bone averaged less than 1% of the total debris. Of this quantity, less than one-quarter is identifiable to family or genus.

Keeping in mind the caution necessitated by the small size of the collections, we will consider the faunal data to elaborate upon our separately derived stratigraphic observations, artifactual data, and matrix sample data.

With exception of the few most abundant species, the occurrence of other species in our collections may mean no more than fortuitous exploitation of available individuals. A great many are edible, and many provide good pelts, hides, quills, or feathers, or suitable bone, antler or ivory for fashioning implements. In our speculations about uses of these species, the historic pattern recorded for coast inhabitants will serve as our guide.

Vertebrate remains caught by the field screens were classed as bird, fish, or mammal and sent to appropriate specialists for further identification. Lynn Harper has studied the fish remains, and Dr. Howard Savage of the Royal Ontario Museum, Toronto, is responsible for the avian study. Dr. Charles Repenning of the U.S. Geological Survey at Menlo Park, California, analyzed the mammal materials, and his identifications form the heart of the following discussion of site faunal evidence.

Approximately 24% by weight, nearly 1800 specimens, of the mammal bone collected at Namu was identifiable to family level. At Kisameet, only unit FS 2 was comparably examined, producing 112 identifiable mammal specimens. The informally collected faunal materials, from FbSx 6, EkSx 1, and FbTc 1 were identified where possible and together constitute 134 specimens.

Our analytic objective has been to quantify the relative occurrence, and presumably the exploitation, of each animal. Because of the wide size range of these animals, we decided that a species-by-bone-weight figure would not be as useful as species-by-number-of-bones. In analyzing bone from a given stratum, Dr. Repenning was frequently able to match fragments from one bone. In presenting a stratum-by-stratum identified bone count for each species we are thus producing a count of individual bones rather than one of many fragments of the same bones (the single exception consists of teeth from one jaw). Bone counts appear in Appendix A.

Attempts to estimate the numbers of animals represented by the collections were dissuaded by several factors. The best collection, that from Namu, involves only 1800 specimens scattered over 9000 years of depositional history. Secondly, the majority of the bone is too fragmented and decomposed to be identified, and some strata have only such bone. Third, bone for the most part does not meet our criteria of abundance and even distribution. Furthermore, in the historic tradition resource processing and utilization involved several sites at once. Thus we cannot be certain how an animal represented by a few bones in the collection was actually used. And finally there is the problem of correlating data collected by artificial levels to the corresponding natural levels – a difficulty affecting almost half the Namu collection and all of the Kisameet collection.

The following graphs (Figs. 53-62) illustrate the distribution of mammal species, by number of identified bones per level for each of ten excavation units at Namu and for FS 2 at Kisameet. Units FS 4, FS 11, and FS 12 at Namu were not systematically examined for remains, although bone recovered from those areas is included in the 1800 specimen site total. Bone from the surface is included, as is bone collected during facing of profiles. At Kisameet, only FS 2 bone is graphed, although bone informally collected from other parts of the site contributes to the site total.

In each graph, the schematic strata column at left presents the major stratigraphic boundaries observed on the excavation unit walls after excavation. All graphs except those for units FS 9 and FS 10, Namu, illustrate bone recovered in the 1968-1969 excavations in fifteen centimetre levels, surface to substratum, in each pit. Units FS 9 and FS 10 were excavated in 1970 according to natural strata. It is often difficult to be positive about the exact stratigraphic correlation of bone removed from a fifteen centimetre level. Familiarity with the site situation, however, permits such assignment. When possible, the correlation of strata and radiocarbon dates is indicated.

In addition to the bone counts, we have some pertinent comments by Dr. Ian McTaggart Cowan of the University of British Columbia, bearing upon the presence of certain species in the collections (Cowan 1971: personal communication). His remarks provide a framework for the following presentation. A most important point of Dr. Cowan's comments is his suggestion of trade as a causal factor for the presence of some species. Taken in conjunction with Wilmeth's report suggesting trade in obsidian, the presence of "unexpected" species may reflect trade with inhabitants of the Bella Coola valley. Thus, the presence of exotic species may have little to do with local environments.

In the discussion below, I have indicated the rough ratios of body parts for many species. I must emphasize that these are *not* anatomical ratios, since most of the latter would be smaller than the ratios presented here. With the exception of avian data, anatomical ratios were not systematically recorded during analysis. Those species heavily

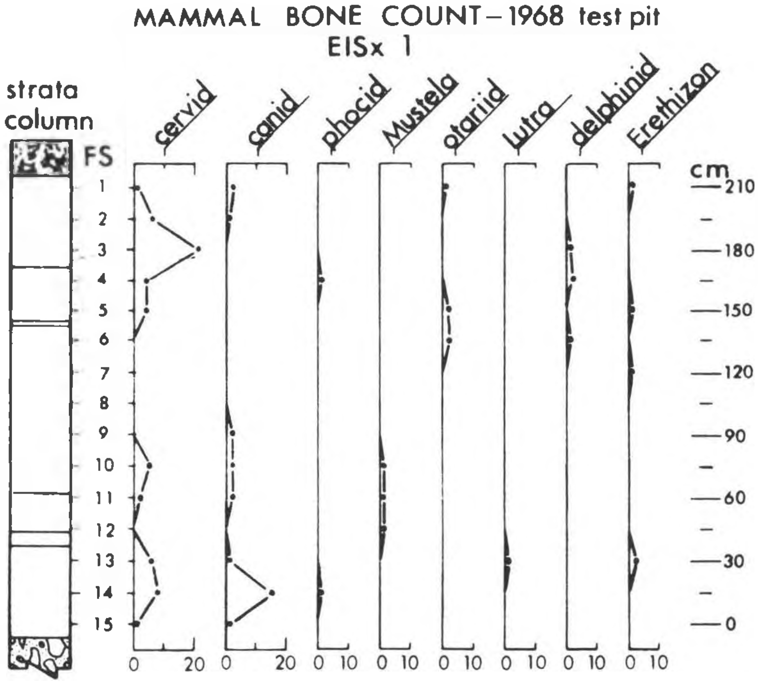


Fig. 53

Mammal species distributions, the 1968 Test Pit, EISx 1. Bone counts in absolute numbers. Correlation between natural strata and artificial excavation intervals approximate.

represented by teeth – each of which, if not in a jaw, counts as one bone – will exhibit the greater discrepancy between anatomical and absolute ratios. In the same context, those species predominantly represented by teeth, digits, or vertebrae will be over-represented. Reference to the anatomical ratios and "weight" of body parts might reduce the seeming abundance of deer, canid, phocid, river and sea otters, and otariids. The apparent representation of delphinids would be significantly decreased, whereas the use of anatomical ratio in mink representation would make little difference.

Bighorn Sheep

> The bighorn sheep has been found for many years in the areas of the Chilcotin, inland from your study area. The nearest examples would be in the mountains adjacent to Taseko Lake. The Bella Coola people may have hunted in there but it is just as possible that they got the material from the Athabascans of the Chilcotin area by trade, as they did so much of the obsidian, which came from the same general region [Cowan 1971].

We have only two sheep bones from Namu – a mandible section shaped as an artifact, and a cheek tooth, both from lower shell-bearing strata of FS 10. The fragments occur in different strata and thus might represent two animals. At Kisameet, a juvenile animal's horn core was found midway in the deposits, and a tooth, scapula fragment and phalanx occurred in a lower shell-bearing stratum. The radiocarbon dates suggest the ages of the enclosing strata to be between 2100 and 1800 years BP. Bone numbers for the species are so few that I hesitate to attempt further speculation on their significance.

Mountain Goat

> Mountain goat, though they are not perhaps found today in the immediate vicinity of Bella Coola and Namu, are widespread along the coast. I don't know of any one of the inlets that does not have mountain goats on the adjacent mountains and on many of them, the goats come down to the beach during periods of heavy winter snow. [Cowan 1971].

We recovered goat only from FbSx 6, from one of the oldest shell-bearing strata. Both a horn core and a metacarpal fragment were found. The meaning of their presence is difficult to assess because of the small numbers. The midden lies only a few miles from the present goat habitat.

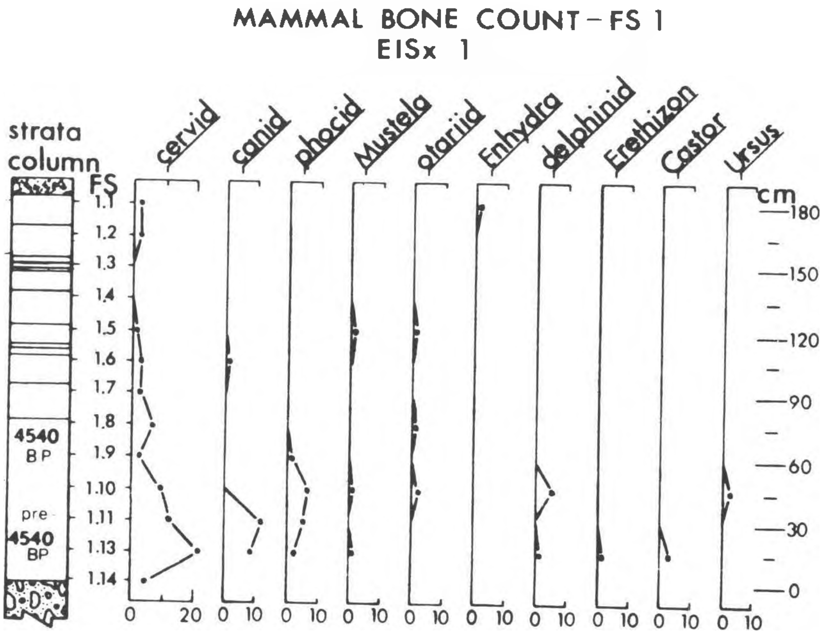
Deer

> The coast black-tail *(Odocoileus hemionus columbianus)* is available up and down the coast the entire length of the province and on almost all the offshore islands. The larger race, *O. h. hemionus,* or mule deer, is available on the interior plateau, and a small population comes down close to Hagensborg in the wintertime [Cowan 1971].

Cervids are the predominant animals in both the Namu and Kisameet collections. While the identification "cervid" may, as Dr. Repenning cautions, include some specimens of bighorn sheep, mountain goat, moose, or elk, by far the majority of identified bones are deer. Dr. Repenning was

Fig. 54

Mammal species distributions, pit FS 1, ElSx 1. Bone counts in absolute numbers. Correlation between natural strata and artificial excavation intervals approximate.



cautious in assigning species and even identifications at the generic level to cervid remains because of the difficulty in distinguishing between them. It is thus possible that our collections contain both coast black-tail and mule deer. The present local availability of the black-tail implies that the majority of cervid in the sites should be that race. The presence of mule deer could be due to trade or inland hunting. Both adults and fawns are present. The latter suggest procurement some time in the first six months or so of the animal's life, after birth in June. Bones from head (including antlers) and limbs are almost equally represented, while other body parts are scarce. In this connection, it must be remembered that assignment of rib fragments and other bones of trunk to even family level is often impossible. Examination of the sites' unidentifiable bone suggests that most of it is predominantly cervid as well. Deer were the most common species throughout site history — and are found at Namu even in deposits dated 7800 BP and older.

Lynx

> In looking at the carnivores, every one of them would be available locally at some time or another. The genus *Lynx* is represented in that area by the bobcat, though rather casual in occurrence, and the Canada lynx, which is abundant during periods of rabbit "peaks" in the interior, and then immediately after the crash of the rabbit population, the lynx spread out widely and appear as far as the tide-line all up and down the coast where the interior populations are closely adjacent [Cowan 1971].

There were only two specimens (premolars) identifiable as belonging to the genus *Lynx*. These come from the bottommost stratum at Kisameet, dated 2290 BP. At Namu, one bone tentatively identified as *Felis* (cougar ?) comes from an older shell-bearing stratum in the Rear Trench. This latter species occurs in the Namu vicinity today.

Canids

Among carnivores represented, canids predominate; and they are second only to deer in frequency of occurrence in the total mammal collection. Canids identified with certainty to species are all domestic dog, at Namu and FbSx 6; dog was not identified at Kisameet. Coyote remains may possibly be present, and wolf is suggested at Kisameet. As with cervids, it is difficult to isolate the species with such fragmented material. Both pups and adults are present, and canid, if not dog, appears throughout the Namu deposits.

For the canid collection as a whole (all sites), head bones outnumber limb bones three to one and other body parts fifty to one. In at least three cases at Namu, we uncovered a fully articulated skeleton. Dr. Repenning attempted to discover, through reconstruction of one of the many fragmented skulls, indications of purposeful fracturing to gain access to the brains for eating. The skull was too shattered for conclusive judgment. Dogs may have been used for food, wool, hunting, as pets or for all four. They undoubtedly scavenged the midden for garbage, and were responsible for some of the observed ancient disturbance of site deposits.

In view of their primarily inland ranging habits, the presence of coyote in the collections may be fortuitous. Wolf are more common than coyote on the coast. They also follow their prey in their seasonal movements between high country and lower forests. Although wolf may have been purposely hunted, it seems more likely they indicate occasional individuals encountered during local hunts or animals felt to be too close to the community for comfort.

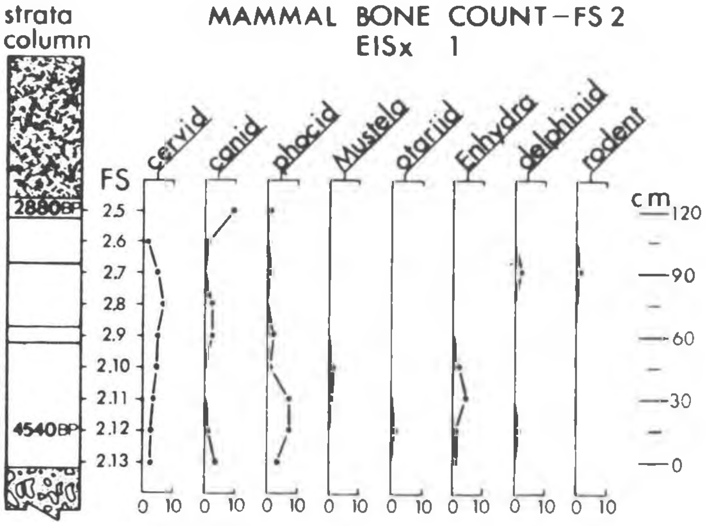


Fig. 55

Mammal species distributions, pit FS 2, ElSx 1. Bone counts in absolute numbers. Correlation between natural strata and artificial excavation intervals approximate.

Mink, Weasel and Marten

Mink *(Mustela vison)* was common throughout the Namu deposits, with head and limb bones comparably represented, although no bones from the trunk were found. At Kisameet, on the other hand, only one mandible fragment was found, just below modern humus. Mink are common today at the shoreline and seem little bothered by nearby human presence. The weasel *(Mustela erminea)* is represented in the topmost humus (redeposited midden ?) stratum at Namu by a single mandible. Four fragments identified as marten come from widely scattered locations at Namu. All three of these small mustelid species are available locally today. It may be suggested they were aboriginally sought for their pelts.

Otter

Both river and sea otter remains were identified in the collection. Sea otter *(Enhydra)* occurs at all sites except FbSx 6. In the largest collection, from Namu, limb bones outnumber head bones four to one, and a few trunk bones are present. At one time sea otter inhabited the entire British Columbia coast, frequenting kelp beds, rock islands, reefs, and shallow waters. At Namu, we find sea otter remains throughout the deposits.

The river otter *(Lutra)* is best represented at Namu, with similar frequencies of head and limb bones. A stratum pre-dating 1810 BP at Kisameet produced one skull, the only specimen from that site. The animal inhabits both land and freshwater and is abundant on the coast near freshwater ponds and streams. Based upon historic analogy, both sea and river otter were probably sought for their pelt. These were important trade items in the post-contact period. The fur trade was the reason for the drastic decline in the sea otter within the historic period.

Raccoon

The raccoon *(Procyon)* appears scarce along the coast as far north as Namu, but I do have records from there and there is every reason to believe that this is not something new [Cowan 1971].

The presence of raccoon does pose a problem, in that despite its rather rare occurrence along the coast, it is common in the Namu collection – and present at FbSx 6 and Kisameet as well. Raccoon at Namu is represented by completely articulated skeletons as well as fragments. It is suggested that the raccoon may have been a tolerated competitor with the dog for site refuse. It is also possible that the animals were kept as pets. Five fragments occur from a Kisameet stratum more recent than 1810 BP. One bone was found in a shell-bearing stratum just below humus at FbSx 6. At Namu, raccoon remains occur in deposits dated from 2440 BP to the present.

Wolverine

From an upper level in the 1968 test excavation at

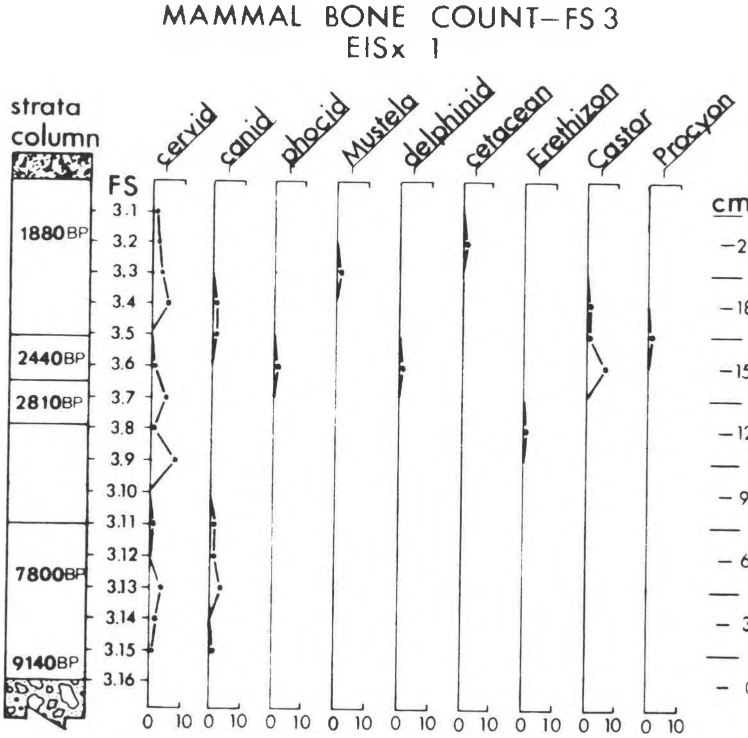


Fig. 56

Mammal species distributions, pit FS 3, ElSx 1. Bone counts in absolute numbers. Correlation between natural strata and artificial excavation intervals approximate.

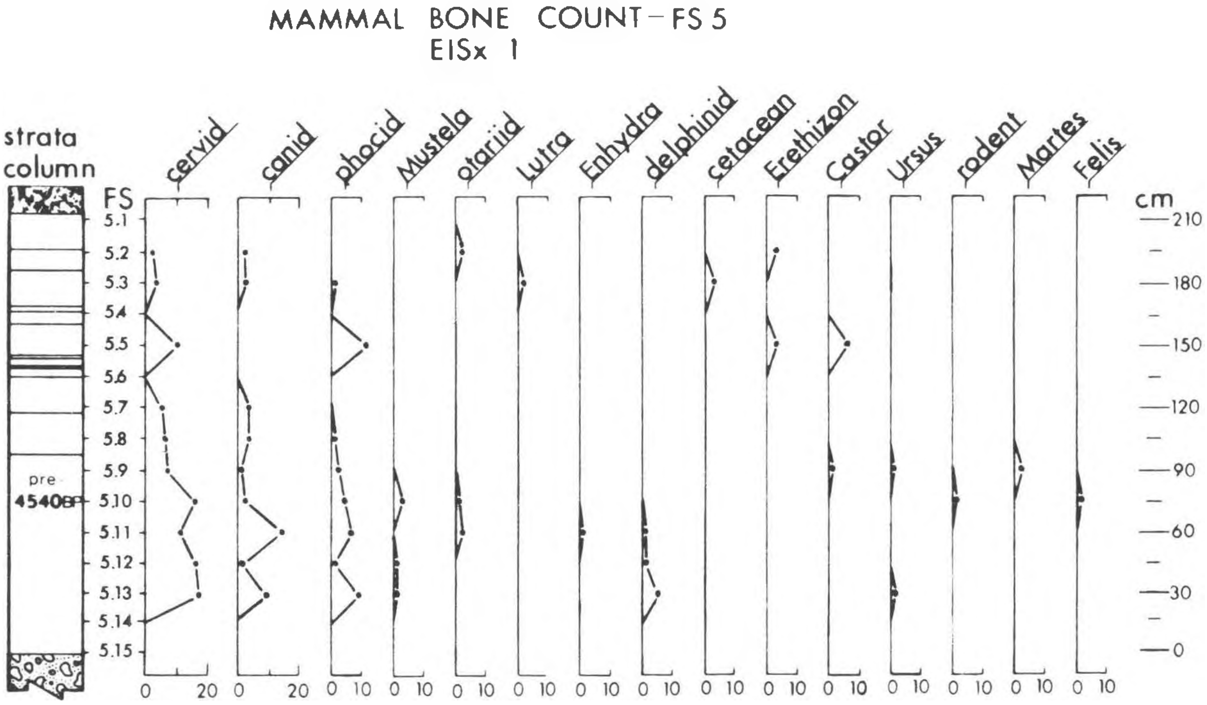


Fig. 57 Mammal species distributions, pit FS 5, EISx 1. Bone counts in absolute numbers. Correlation between natural strata and artificial excavation intervals approximate.

Namu a single fragment of a femur was identified as wolverine *(Gulo)*. No other area at Namu or any other site sampled produced evidence of the species. The wolverine prefers mountainous regions of the Coast Range and is rare on the coast proper, although specimens have been reported from Bella Coola (Cowan and Guiguet 1962:324).

Bear

Black bear were identified from six levels in the Rear Trench at Namu which dates 4540 BP or earlier. The species is presently common on the coast. Fragments assigned to grizzly from both FS 9 and FS 10 were identified by Dr. W.H. Burt, the University of Colorado Museum. Bones used in artifact manufacture at Namu include grizzly ribs. In general, however, bear remains of either species are far too rare and scattered to suggest a rationale of procurement.

Cetaceans and Pinnipeds

The cetaceans and pinnipeds present no problems of availability. *Phoca* and *Eumetopias* are year-round residents. *Callorhinus* is represented every winter by varying numbers of young individuals close in shore. The species is also available to pelagic hunters during the spring migration in April, May and June. I have seen Indians coming in with them from within 20 miles off-shore during May. The only problem animal there is the walrus and this is really a puzzler. We have no way of knowing what the ancient distribution of walrus was. It could have been found much farther south than it presently occurs. On the other hand, there was almost certainly a trade up and down the coast in walrus ivory but I would be more skeptical of trade being involved if the bony elements of the skeleton were what you were finding [Cowan 1971].

In fact, we found only teeth of walrus. In deposits later than 680 BP at Namu, we recovered two cheek teeth, one of which was juvenile. The age of this juvenile animal is not known. If quite young, without sizeable tusks, why would it have been traded? What environmental differences are suggested? In light of the recent age of the specimens, I would tend to rule out environmental difference in favour of either trade or fortuitous catch of single animals out of their common range. The only other walrus evidence in the site occurs in the form of harpoons and ivory gaming pieces (?) found in a 4000 year-old burial.

Among pinnipeds in the collections, hair or harbour seal is predominant, with limb bones outnumbering head bones two to one, and a few other body parts represented. Phocid remains occur throughout Namu deposits, on the surface at FbSx 6, and in deposits younger than 1810 BP at Kisa-

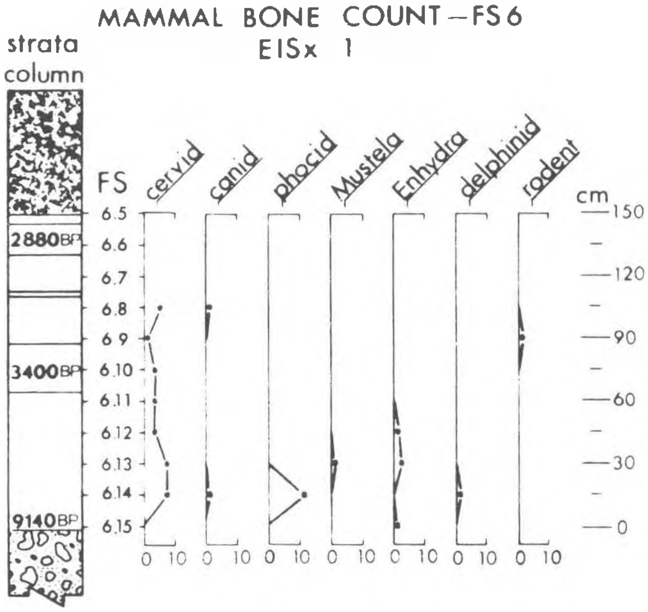


Fig. 58 Mammal species distributions, pit FS 6, ElSx 1. Bone counts in absolute numbers. Correlation between natural strata and artificial excavation intervals approximate.

meet. Adults are most common, although remains of a pup were found in strata more recent than 480 BP at Namu. Their frequence and local availability suggest that they were regularly hunted.

Sea lion *(Eumetopias)* is also principally represented by limbs, with teeth and a few vertebrae the only other remains. Fur seal *(Callorhinus)* is represented by five teeth at Namu, dated between 2800 and 1800 BP, and by limbs and skull fragments in surface collection from the more seaward FbTc 1 site. One fragment of a fetal otariid, species unidentifiable, was recovered at Namu. According to Mathisen, Baade, and Hopp (1962) the northern sea lion give birth between May 24th and June 27th. These dates imply the Namu female was taken prior to then, probably in early May.

Delphinid remains are common at all sites except EkSx 1. In the Namu collection, bones of the skull and teeth outnumber other elements more than six to one. Scapula, rib, and vertebra fragments also occur. Within the whole mammal collection, petrosa, the hard rounded portion of the tympanic bulla, from delphinids, deer, hair and fur seal, dog and river otter are found separate from the rest of the temporal bone. In the case of delphinid petrosa, which occur with considerable frequency, some exhibit a smooth "polish" and rounding through abrasion. Dr. Repenning comments that:

> . . . an unusually large percentage of the delphinid records in the material from your middens were based upon such specimens and many of them were similarly abraded. Although the bone is dense and more durable than other parts of the skeleton, there are only two of these bones per porpoise skeleton and the high percentage in the middens is curious. Furthermore, the abrasion is the sort that one often sees when an isolated petrosum is found washed upon the beach, and as a rule the (rest of the) midden bones were not abraded [Repenning 1969].

His point is that the inhabitants may have brought such petrosa back from the beach entirely apart from the hunting of delphinids. What the petrosa were used for is unknown. None recovered indicate any shaping or perforation by man.

No remains specifically identifiable as whale were found. Among the two dozen "cetacean" bones from Namu some may be of one of the coastal whale species. While whale-hunting may have been pursued, it seems unlikely that the carcasses were transported to Namu. The presence of whale in that site could be accounted for by utilization of a stranded individual.

Rodents

> Among the rodents, the porcupine *(Etethizon)* is not usually abundant on the coastal slope of the mountains but becomes abundant as soon as you enter the jack pine areas *(Pinus contorta)* of the region around Anahim Lake and eastwards [Cowan 1971].

We have relatively large quantities of porcupine from Namu, and they are present in the much smaller collections from Kisameet, FbSx 6, and FbTc 1. Teeth and jaws outnumber limbs nearly three to one, with incisors the most common remains, and elements other than jaw or limbs unrepresented. Given the inland occurrence of these animals, I cannot explain their presence in such numbers unless a flourishing trade is responsible, or porcupine hunting inland was a frequent pursuit. The abundance of teeth suggests these were the culturally desirable elements, although the presence of limbs indicates they brought back more than just jaws. In the same context, absence of other body parts seems puzzling when so many strata contain the species. The remains are distributed at Namu throughout and at Kisameet and FbSx 6 in the upper strata.

Beaver *(Castor)* was recovered at Namu in strata older than 1800 BP. As with porcupine, both limbs and teeth are present. The absolute quantities are too small for speculation on their significance. The animal ranges the entire coastal slope and the near-shore islands. Thus, its presence in the collection is not unexpected.

In summary, Cowan comments that:

> . . . in this assortment, just three species suggest any substantial contact with the interior plateau. There are the

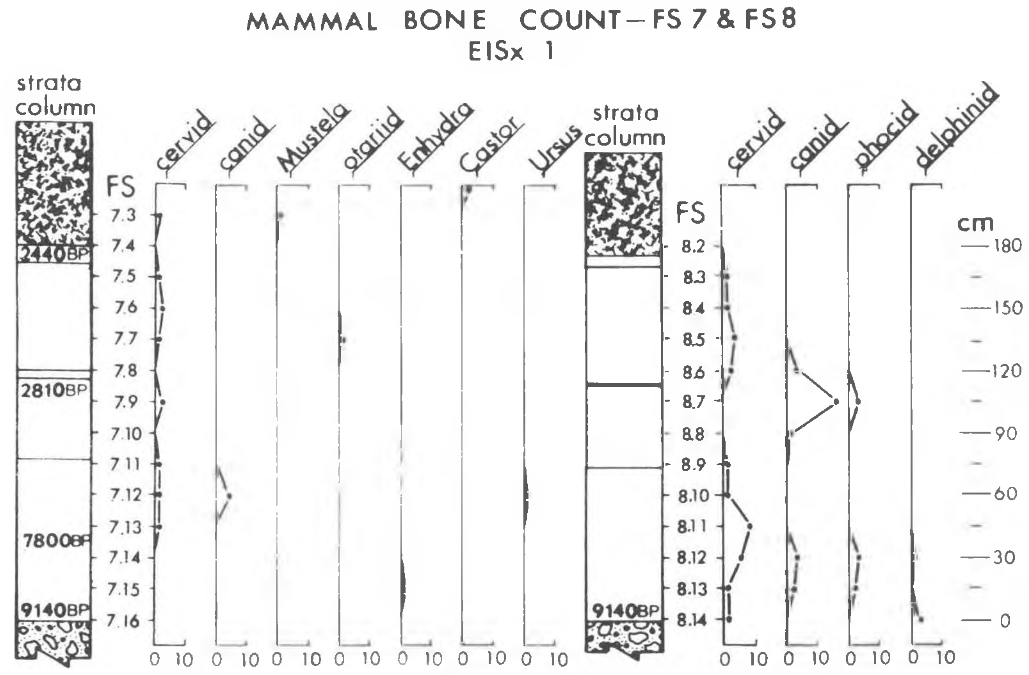


Fig. 59 Mammal species distributions, pits FS 7 and FS 8, EISx 1. Bone counts in absolute numbers. Correlation between natural strata and artificial excavation intervals approximate.

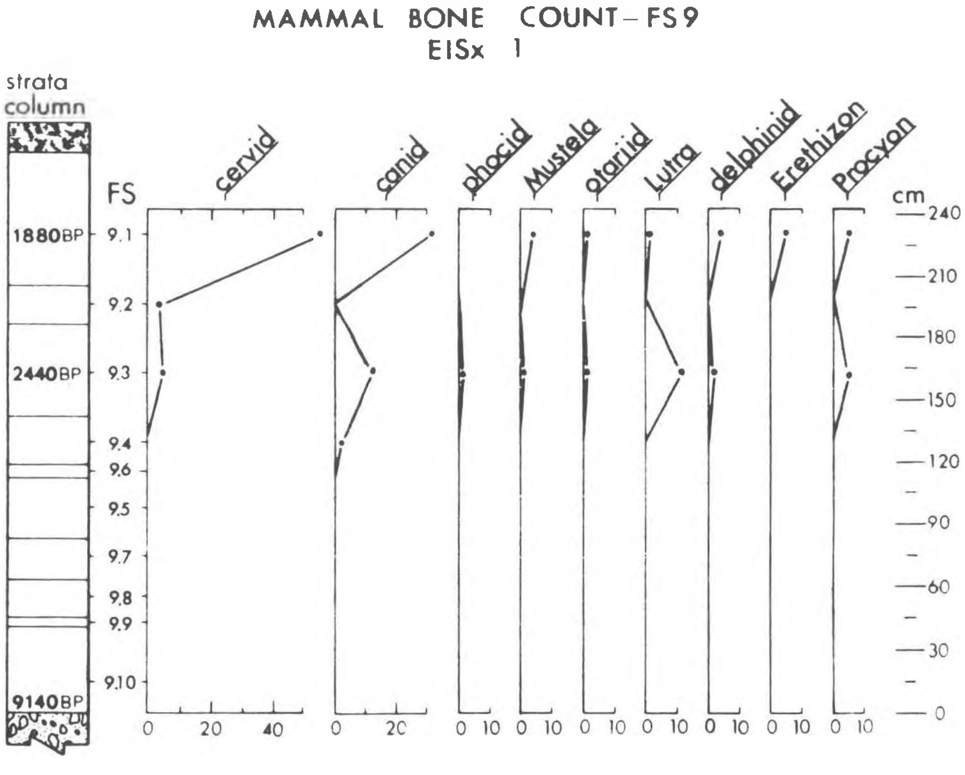


Fig. 60 Mammal species distributions, pit FS 9, EISx 1. Bone counts in absolute numbers.

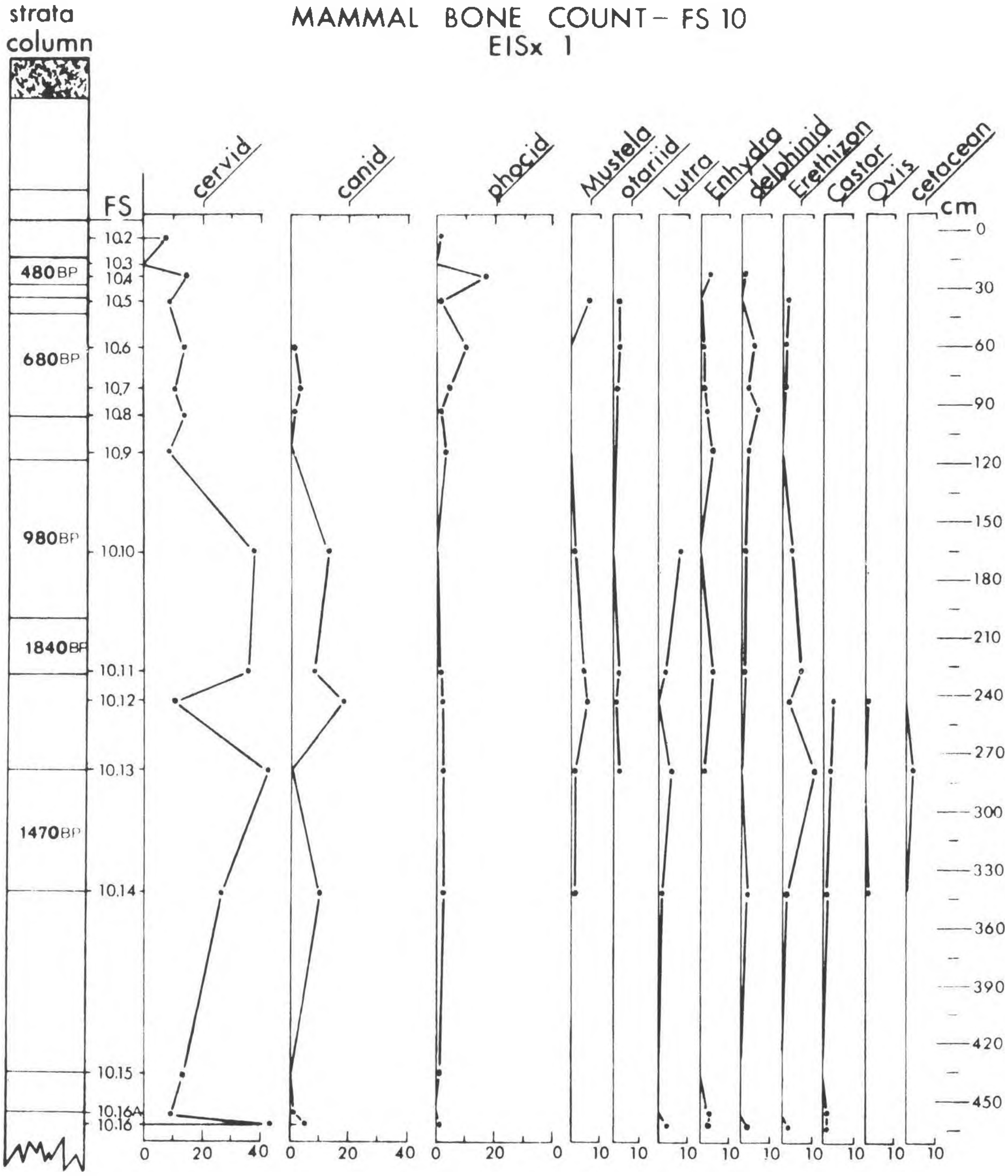


Fig. 61 Mammal species distributions, pit FS 10, EISx 1. Bone counts in absolute numbers. Strata column illustrates FS sequence, not FSC sequence, as data were collected during excavation rather than after.

sheep, the lynx, and the porcupine. The lynx and porcupine do occur from time to time on the coastal slope and would probably occur reasonably regularly toward the head of the Bella Coola valley. The sheep never come west of the grassland ranges of the interior [Cowan 1971].

In these discussions, I have suggested where formal hunting practices, trade or accident might explain the presence of unexpected species. The problem species such as lynx, walrus, and sheep are all too rare to justify speculations about environmental change. Porcupine, on the other hand, is so widely distributed at Namu that, as with raccoon, one wonders if it were not present locally. If, however, porcupine requires a jack-pine habitat and could not thrive in a coastal forest situation such as that at Namu now, then we must seek cultural rather than environmental causes for explanation, especially when a number

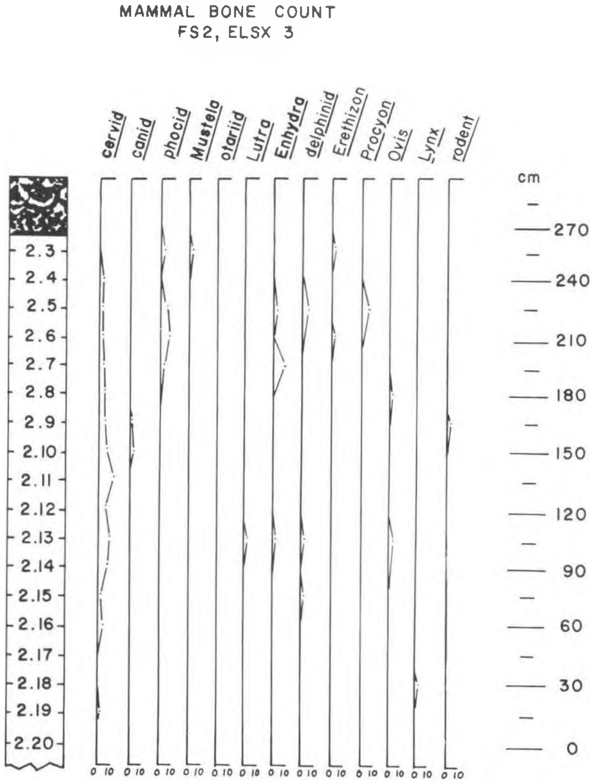


Fig. 62 Mammal species distributions, pit FS 2, ElSx 3. Bone counts in absolute numbers. Correlation with natural strata not attempted.

of remains occurred in deposits dating within the past several hundred years.

By bone count, land mammal remains at Namu outnumber sea mammal nearly five to one; at Kisameet, the ratio is over two to one. The species of most frequent occurrence and greatest numbers at Namu are cervids, canids, phocids, and delphinids – with cervids and phocids present throughout site history. Canids are present from the earliest deposits until 680 BP, and delphinids present from the earliest layers until 480 BP. The sea otter and mink also occur for most of Namu history. At Kisameet, cervids, phocids, sea otter and delphinid predominate – and among these, only cervids occur throughout the site's 3000 year history in quantity. The small FbSx 6 collection also indicates a cervid predominance, with lesser amounts of canid. At the more seaward FbTc 1 midden, otariids dominate the collection. At EkSx 1, sea otter outnumber other species. How accurate a reflection of food preferences these informal collections from FbSx 6, FbTc 1, and EkSx 1 are remains to be seen. A higher frequency of large marine mammals, otariids and delphinids, is expected at sites in more exposed portions of the coast, such as FbTc 1.

The heaviest exploitation of land mammals is focussed on the Coast Forest. If the canids were domestic dog, then land hunting emphasized deer, with some interest in procuring both raccoon and mink. Trade or far-ranging hunting expeditions may have brought porcupine and bighorn sheep to the site. Fortuitous encounter or specialized hunting may be responsible for the presence of river otter, beaver, black and grizzly bear, cougar, lynx, wolverine, marten and weasel.

In marine animal exploitation, the Coast Littoral was the area of concentration, with the fur seal the only pelagic species hunted. Phocids appear to have been the primary objective throughout the recorded prehistory. Delphinids and sea otter were also target species, and fur seal and sea lion were occasionally hunted. Neither Namu nor Kisameet were well situated for hunting the last two species. The small hair seal, on the other hand, is locally abundant. Walrus offers the only real suggestion of trade.

The uses of these species are surveyed in the literature (Boas 1897; Drucker 1955). Deer were used for food only in times of starvation by the historic Southern Kwakiutl. The hide was instead the desired resource. We discovered indications of cutting on deer bone specimens only on the limbs, and possibly at the base of one antler. Of these limb bones, the shafts were usually missing. Bones of the feet and vertebrae were intact and identifiable; scapulae are common, but in all cases the thin, platey portion was broken out. Very few pieces of the cranium were identified. These patterns suggest tool manufacturing as the majority of bone tools are of deer long bone or metapodials.

Mountain goat, hunted by the Wikeno peoples (a Bella Bella group) with dogs, is reported to be the only mammal whose flesh was dried for winter. Its horns and wool were prized and tallow was preserved for winter consumption. Black bear and cougar were sought for the skin, with a deadfall being the means of capture. The literature does not indicate hunting of grizzly. In fact, the opinion held is that sea mammal flesh was the preferred meat.

In applying these ideas to our data, it must be recalled that these records pertain to the historic situation. Determination of how far back in time that situation is present is therefore one of our primary concerns.

BIRD DATA FROM KISAMEET

Eighty avian specimens were recovered from FS 2 at Kisameet, and all were identified by Dr. Savage to at least taxonomic family. Identifications and bone counts are provided in Appendix A. Distribution of the remains is illustrated in Figure 63. Of the seventeen species identified, all are medium or large birds capable of providing meat as

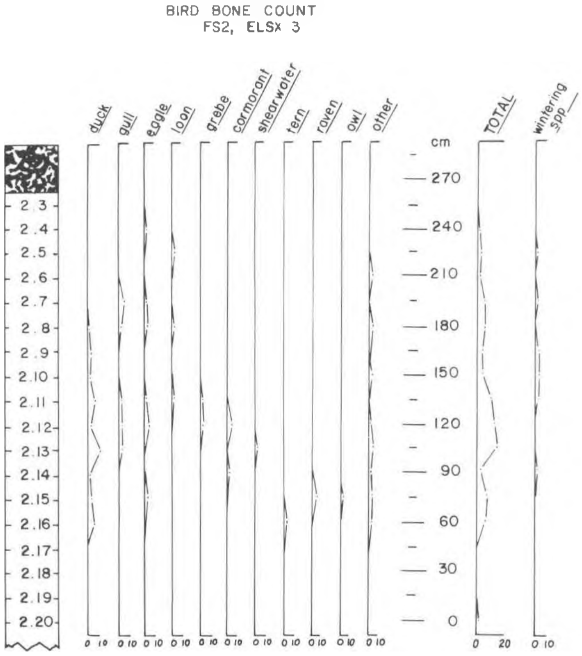


Fig. 63 Bird species distributions, pit FS 2, ElSx 3. Bone counts in absolute numbers. Correlation with natural strata not attempted.

food. Dr. Savage suggests a minimum number of twenty-one individual birds are present in the collection. Ducks are most common (33 bones), with bones of the wing or pectoral extremity ten times as common as bones of the leg or four to one by corrected anatomical ratio. Savage comments that:

> . . . the occurrence of wing extremity bone over four times more frequently than the leg elements indicates a different usage of the former. The presence of the large pectoral muscle mass is suggested as giving this area and the adjacent wing a favoured position when the bird was being prepared as food. Discarding of the backbone, legs and feet elsewhere than in the village midden may be inferred.
>
> Such a discarding of the non-wing portion of the ducks also suggests a plentiful supply of food during the times of occupation of the site, . . . [Savage 1970].

Gulls also exhibited the wing-over-leg bone predominance. Their smaller numbers, however, make interpretation uncertain.

Our best evidence of seasonal site usage comes from five species of birds known currently to winter at the site. These are the Red-necked and Horned Grebes, the King Eider, and the Glaucous and Herring Gulls. The distribution of these species suggests a fall-to-spring site utilization for the lower half of the Kisameet strata (levels FS 2.7 through FS 2.16). All other species may be present at any time of the year. In summary, Kisameet avian materials support winter occupation for at least the early portion of site history (strata dated 2290 BP to less than 1810 BP). Site utilization during other seasons of the year is not supported or discredited by the other bird remains. It may be noted, however, that most of the bone recovered came from these strata. Strata more recent than FS 2.7, the last to contain a wintering species, had very little bird bone of any kind.

DATA INTEGRATION

The varieties of context and content information for the sites may be correlated to produce an archaeological interpretation of site history. There are two aspects to data treatment at this stage. One involves the data integration, aligning the various sets of site data and identifying critical attributes. The other step involves explaining the meaning of the various trends in the data sequences in terms of site habitation history. Figures 64 and 65 compile basic data sets according to vertical and horizontal relationships. The composite graphs in Figures 66 and 67 illustrate the correlation in terms of major trends at Namu and Kisameet. These are in fact the graphic end-products of this research. How the alignments in these last two figures were made and the pattern boundaries determined is the topic of this section.

Graph Format

All varieties of site data are to some extent included in the composite illustrations. Stratigraphic observations are least represented in the graphs. How these data influenced pattern determination will be discussed in the text. On each composite graph, the strata column at left represents the full sequence of site deposits perceived in the excavation units. The Namu column is a composite, as the strata do not all occur in a single vertical profile. The Kisameet column represents the strata as they actually occur in the FS 4 area. The numbers immediately to the right of the column indicate the strata used in the reconstruction -- and in compiling the shellfish distributions to their right. Where two stratum designations occur together, the illustrated stratum represents both, for they are considered to represent the same period of deposition in different locations. Only strata studied in 1970 represented by the large natural stratum matrix samples, are involved in construction of the strata column and the shell and shellfish species distributions.

Radiocarbon dates are located in the strata producing them or inferred to correspond to them. Stratum FS 4.3 very probably is no more recent than the 2880 BP date suggested for it. Although it may be older (but no older

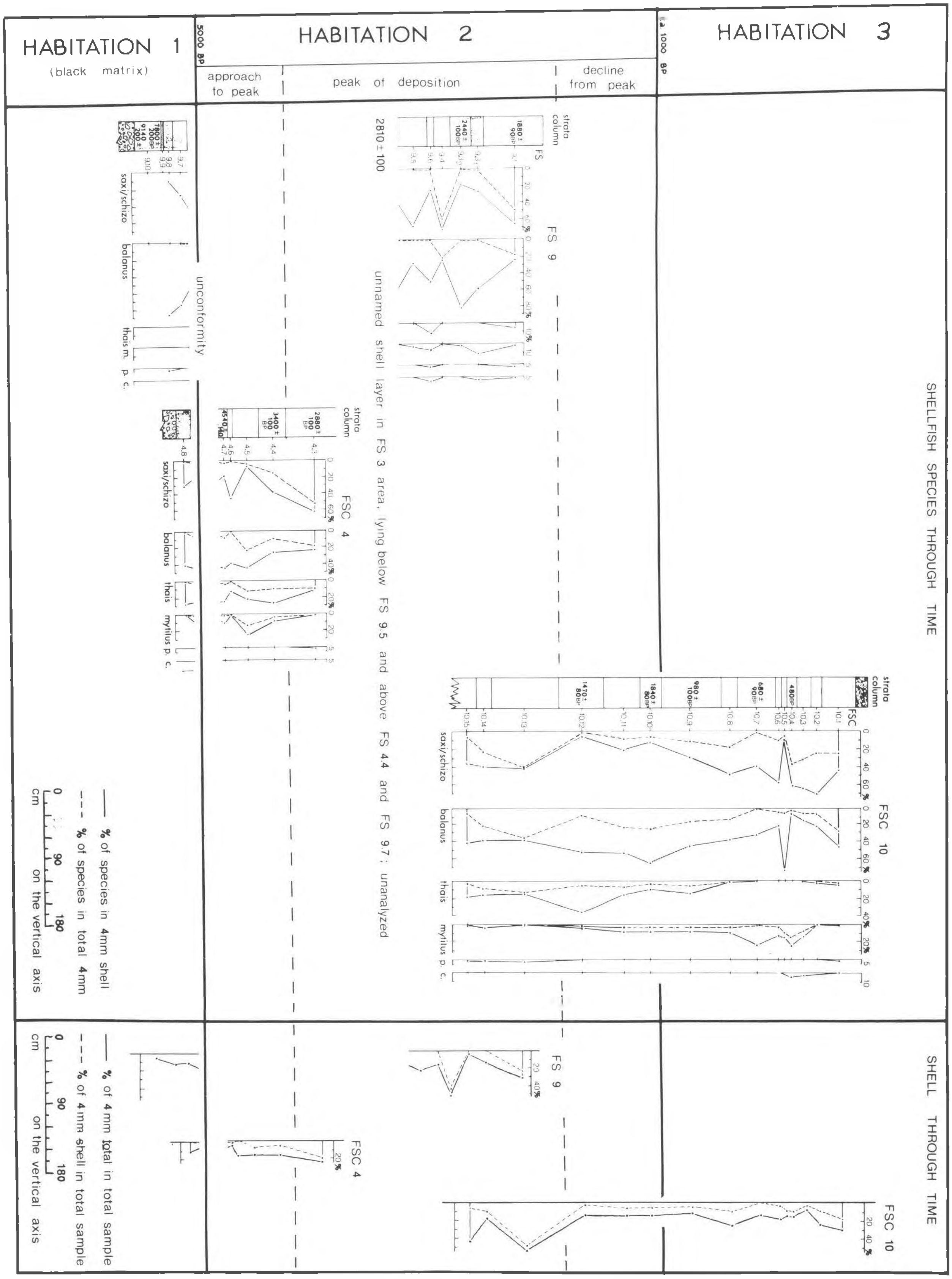


Fig. 64 Data compilation chart A: unit by unit correlation of Namu shell data. See Fig. 44 and Figs. 47 through 50, and Tables 35 and 36 in Appendix C, for primary data used in this illustration. This correlation is the basis for the schematic profile, shell through time curve, and shellfish species identified pie charts in Fig. 66. Refer to discussion of Fig. 66 on placement of stratum FS 9.5 in the sequence.

than the preceding stratum dated at 3400 BP), its content and physical status suggest it belongs to the period producing strata FS 9.4 and FS 9.1, beginning at 2880 BP. In other words, its content and configuration are congruous with a pattern with established boundary dates. Stratigraphically it is separated from other deposits in the pattern, and its spatial relationship to them is difficult to define. Temporally, we simply know it is younger than 3400 BP.

That the basal strata of unit FS 10 (*i.e.,* FSC 10.13 and FSC 10.12) date 1840 BP and older is based on acceptance of the 1840 BP date for stratum FSC 10.10 as being more reliable than the 1470 BP date for stratum FSC 10.12. By this reasoning strata below FSC 10.10 are 1840 years or older. Content and configuration data suggest stratum FSC 10.13 is part of the pattern reflected by FS 9.1. If the 1840 BP date on FSC 10.10 is correct then the basal FS 10 strata may be considerably older, perhaps as much as 2440 BP. A definitive resolution of this problem is impossible without further radiocarbon assays.

Deletion of strata FS 9.9, FS 9.6, and FS 4.6 is based on their status as localized features of less than site-wide significance. Stratum FS 4.8 is a black matrix deposit considered to correspond to FS 9.8. Its inclusion in the graph would signify no difference in data distributions. Elimination of the black interruptions FS 9.5 and FS 9.3_1/FS 9.3_2 derives also from their uncertain site-wide significance. As it stands, we have illustrated stratum FS 9.5 with the basal black matrix strata because it lies in that sequence in the FS 9 area. Both this first non-shell interruption of shell deposition at Namu, and the one following it around 2440 BP (FS 9.3_1 and FS 9.3_2) are difficult to interpret in site-wide terms because of their disappearance in the western portion of the Rear Trench. Thus, while stratum FS 9.5 is illustrated, strata FS 9.3_1 and FS 9.3_2 are excluded as probable localized episodes of non-shell deposition affecting only the eastern parts of the Rear Trench. The placement of either on the column would only interrupt the illustrated shell distribution, not change it.

The Kisameet radiocarbon date placements are based on correlations between the illustrated FS 4 strata and the FS 2 artificial levels from which the dates come.

The graphs' single distribution curves, "Shell through Time", illustrate the most important stratum content data for use in pattern determination – fragmentation, as indicated by four millimetre retention, and shell quantities. The four millimetre curve is expressed in terms of what percentage that size shell represents of the total (thirty-five) pound sample.

The pie charts of "Shellfish Species Identified" are composed of species data from the same matrix samples producing the "Shell through Time" curve. Only the abundant large clam and barnacle species are consistently reliable in their occurrence; other species generally are present in quantities too small to establish patterns. The pie charts express each species' percentage of the total four millimetre shell weight, per sample. The figures on each chart are averages of the proportions for all samples in the group. Illustrated in this manner, the species distributions indicate the gradual change in occurrence of the predominant species, barnacle and large clam.

Pie charts illustrating the distribution of "Mammal Species Identified" likewise represent averages for all strata included in the group. Data come from field screening of excavation unit matrix rather than from the stratum samples. The figures represent all units producing bone in 1969 and 1970. The 1968 test pit bone, the FS 4 (1969) bone, and FS 11 bone from Namu were not collected in a comparable manner and are not included. At Kisameet, only unit FS 2 was systematically examined for bone content and graphed.

The "Habitats Exploited" charts to the right involve the same data with a different internal grouping. All species are assigned to either the Coast Forest or Coast Littoral (Cowan's biotic provinces). The pie charts illustrate two ways of looking at mammal distributions by habitat. The solid line divides the habitats by numbers of *bones* in each; the dashed line divides them by numbers of species in each. Thus, considering the top Namu chart for example, we have a 55% Coast Forest representation by absolute bone count – but only 44% representation by species count. The numbers to the right of these charts are the bone counts involved in the calculations.

Following the same groupings adhered to in presentation of shellfish and mammal data is a general indication of artifact trends throughout Namu history. The same trends are believed to occur at Kisameet and are therefore not illustrated on that graph. Treatment of artifacts in illustration is similar to that of the mammal data as all of the 1969 artifacts reflect artificial level excavation.

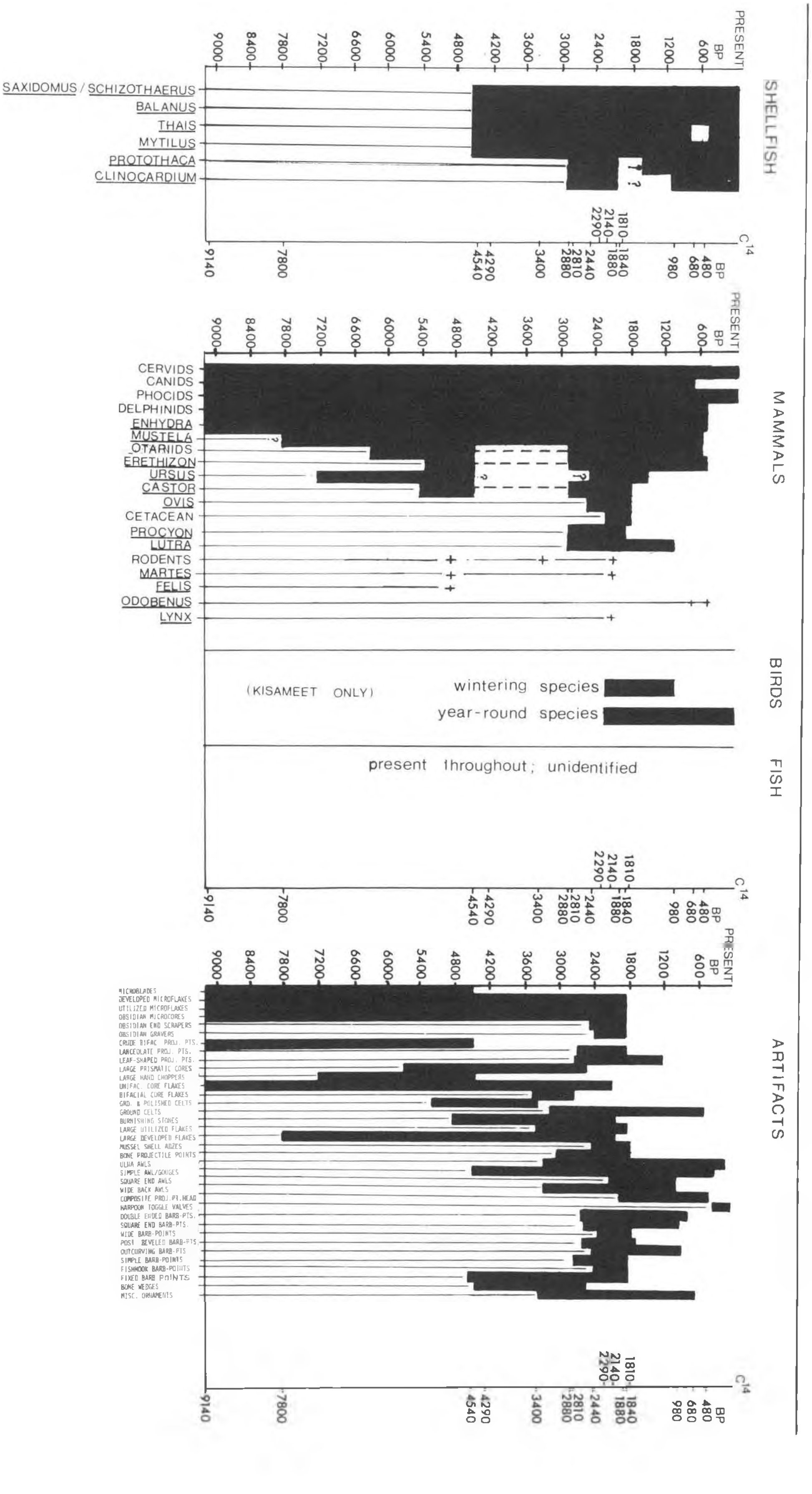
The Kisameet graph contains in addition the avian distributions determined by Dr. Savage, and follows his conclusions in emphasizing the occurrence of wintering species. Bone counts appear immediately to the right; species counts are included within the bars.

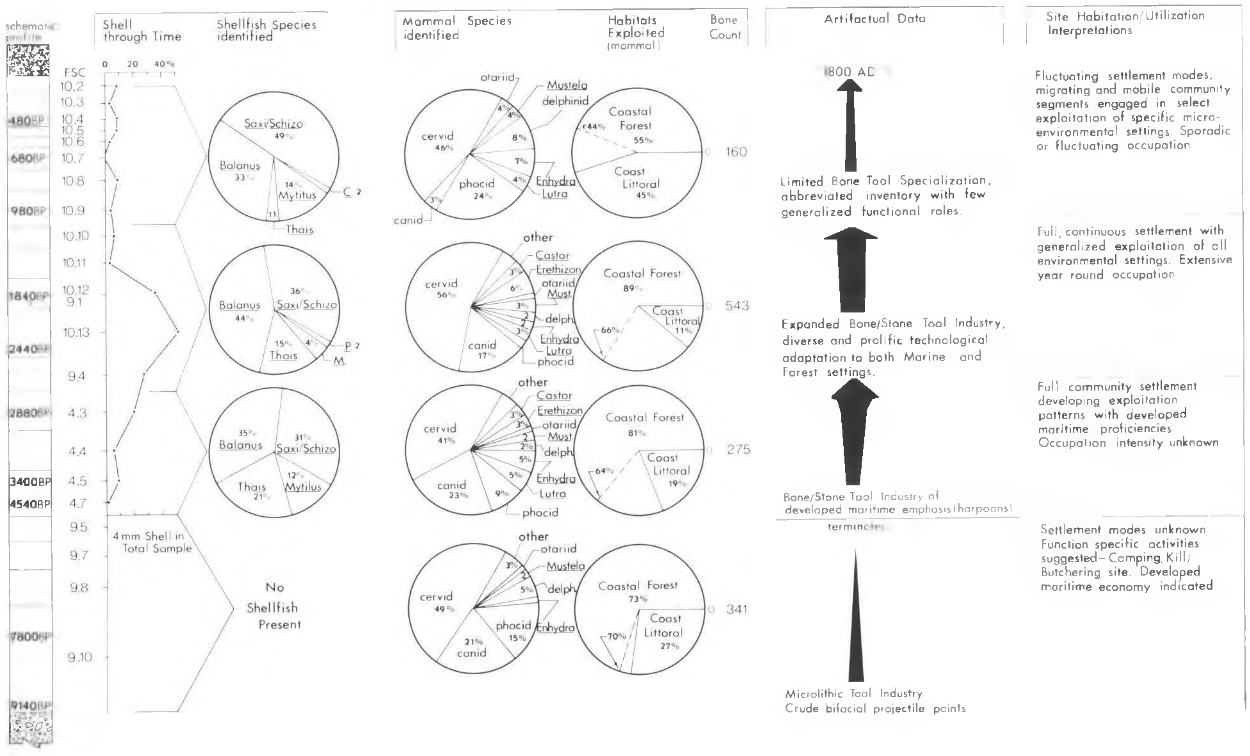
Data Groupings

At this point it is appropriate to consider how the four-fold Namu and two-fold Kisameet data groupings or divisions of site history were achieved. As indicated previously, such decisions are based on clusterings of strata sharing locational, temporal, content and configuration features such that we feel we are dealing with a succession of deposits reflecting a particular pattern of site utilization. Our interest therefore is in determining the nature of these patterns and when they change. The observations for Namu suggest the

Fig. 65

Data compilation chart B: data distributions. Graphs include both Namu and Kisameet data, unless otherwise stated.





Limited Bone Tool Specialization, abbreviated inventory with few generalized functional roles.

Expanded Bone/Stone Tool Industry, diverse and prolific technological adaptation to both Marine and Forest settings.

Bone/Stone Tool Industry of developed maritime emphasis (harpoons) terminates

Microlithic Tool Industry
Crude bifacial projectile points

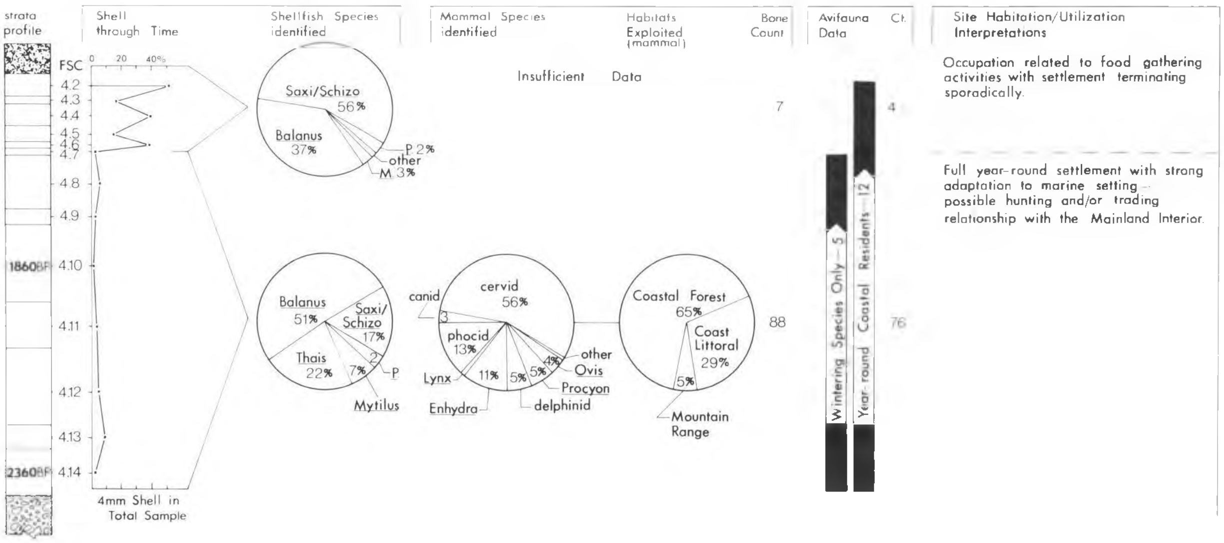
Fluctuating settlement modes, migrating and mobile community segments engaged in select exploitation of specific micro-environmental settings. Sporadic or fluctuating occupation

Full, continuous settlement with generalized exploitation of all environmental settings. Extensive year round occupation

Full community settlement developing exploitation patterns with developed maritime proficiencies Occupation intensity unknown

Settlement modes unknown Function specific activities suggested – Camping, Kill/Butchering site. Developed maritime economy indicated

Fig. 66 Summary conclusions and data integration at ElSx 1, Namu, B.C.



Occupation related to food gathering activities with settlement terminating sporadically.

Full year-round settlement with strong adaptation to marine setting – possible hunting and/or trading relationship with the Mainland Interior.

Fig. 67 Summary conclusions and data integration for ElSx 3, Kisameet Bay, B.C.

following succession of patterns:

1) *At 9140 BP or slightly earlier:* initiation of deposition of the black matrix.
2) *At 4540 BP or before.* the initiation of shell deposition for the site. All previous deposition (from 9140 BP) is non-shell, and exceptionally uniform in content and configuration throughout.
3) *At 2880 BP:* a peak in shell deposition producing thick, unmixed strata of low fragmentation and high shell content. The peak is maintained until at least 1800 BP, after which there is a decline in quantity of shell deposited, an increase in matrix fragmentation, compaction, and homogeneity.
4) *At 980 BP:* an unprecedented stratigraphic morphology appears which typifies all subsequent site deposits. Strata are thin, horizontal, compact, and rather low in shell content. They include clusters of superimposed hearths in direct association with small concentrations of pure shell, generally of one or two species throughout. Thin black bands of charcoal-laden humic debris separate the strata and hearths and visually emphasize the pattern.

At Kisameet, stratigraphic observations suggest only one boundary, separating a pattern similar to the youngest at Namu from an earlier one involving thick, homogeneous deposits of high fragmentation and relatively low shell content. No stratum of the youngest Kisameet pattern is dated. The site's most recent date comes from midway through the initial pattern and dates 1810 BP. Since the younger pattern is similar to the Namu deposits of 980 BP and younger, we believe the upper Kisameet pattern is of equivalent age.

The Kisameet stratigraphy poses no problems in the definition of patterns. Namu on the other hand, offers several problem areas, notably at the 2880 BP boundary and among strata representing the decline from peak deposition between 1800 and 980 BP. This latter situation involves a radiocarbon reversal. For the strata deposited between 1800 and 980 BP, we consider their distinctions as insufficient for separate pattern status on the basis of stratigraphic observations. They are definitely not typical of the post-980 BP morphology, but are more similar to the preceding deposits and therefore are grouped with them.

What then do the other data suggest concerning these stratigraphic patterns? At Namu, they concur. The site's black matrix deposition, dated between 9140 BP and possibly as late as 5000 BP, contains unique data. Its obsidian microlithic industry, is exclusive to those strata, and the absence of the specialized bone tool industry so typical of shell strata is as outstanding as the complete absence of shell. Is this representative of a completely different initial habitation at Namu? The pie charts of the mammal species distributions reveal a certain uniformity of species proportions throughout site history. At Namu the fauna strongly suggest maritime orientation prior to 4540 BP. Whereas many fish species and all shellfish species common in middens can be acquired through exploitation of the littoral and rivers, procurement of seal, sea lion, sea otter, and dolphin requires a formal system of marine exploitation involving watercraft and specialized equipment. This system is as well in evidence at the basal black strata, as it is in the subsequent shell-bearing deposits.

What then do we make of the accompanying artifact inventory? The abundance of unworked bone indicates the absence of bone tools is not due to poor preservation. The microliths and crude projectile points must have been usable in marine hunting as well as in hunting on land. As insets in a composite projectile head of bone or wood, for example, obsidian blades enhance entry of the point into the prey. As part of a composite head, or alone, stone points were used in historic times as lances or pikes (Drucker: 1955:45-48) employed in marine hunting and fishing.

In summary then, the features of the black matrix isolate it from subsequent shell deposits in terms of specific site utilization practices, but not in terms of either general technology or economy. The specific character of the microlithic industry, and the long-term use of the site for other than shell deposition suggest the black matrix represents a unique version of maritime life in the sequence of Namu habitation.

Subsequent deposits at Namu are predominantly shell-bearing and exhibit a characteristic bone tool industry with a developed maritime emphasis. Within this expanse of shell deposition from 4540 BP to the present, we can isolate two distinctive depositional patterns. These two are separated from each other and from the black matrix by two less well-defined periods of deposition, the earlier of which is considered for individual pattern status here and in the graphs. The "shell through Time" curve illustrates the resulting subdivision of the Namu shell sequence. The patterns are described as follows:

4540 – 2880 BP

The initial period of shell accumulation is represented by three and possibly four samples from the FS 4 area, where the sequence begins at 4540 BP. A date of 3400 BP marks a middle deposit, and the top stratum in the sequence is dated around 2880 BP on the basis of stratigraphic correlation. The content data from these strata are relatively scarce to use in reconstruction of a utilization pattern for the period. The distinctiveness of the subsequent and preceding deposits, however, suggests there was difference in site occupation. I have described the sequence as representing an approach to the peak of site utilization indicated in succeeding deposits. The developed bone tool industry typical of the peak period had already appeared full-blown with the earliest shell stratum of this initial sequence, if with fewer tool types and smaller quantities. The quartet of shellfish staples — barnacle, clam, *Thais,* and mussel — also appear in characteristic proportions, with barnacle and *Thais* losing an early predominance to a slowly increasing clam representation. There is the beginning of a proliferation of mammal and shellfish species as the deposits gradually assume the configuration of strata of the following period. The initially low shell content of the matrix increases with a corresponding decrease in matrix fragmentation. The comparatively high compaction, high fragmentation, and even constituent distribution of these early strata prompts suggestion that during their deposition the exposed midden surfaces were involved in rather heavy utilization. The low shell, bone, and artifact contents suggest, further that the utilization was less intense than in later periods with respect to the frequency and variety of activities involved.

2880 — 980 BP

The peak in deposition of quantities of shell, in proliferation of faunal species and numbers, and in proliferation of artifact types and numbers, appears by 2880 BP and extends to 1880 BP in the Rear Trench and to 1840 BP in the Front Trench at Namu. As the "Shell through Time" curve illustrates, many of the strata in this pattern appear as pure shell. At the 2880 BP boundary and throughout the subsequent thousand year peak period we see an increase in the number of new artifact types produced and a reduction in the disappearance of types. A great variety of activities is represented, from formal procurement systems for land and sea fauna involving very specialized items, to tool manufacture using relatively simple equipment. Working in bone, stone, and shell is evidenced; and wood-working is suggested by inference from other implements. The low fragmentation, low admixture, and low compaction of matrix of these deposits suggests less heavy utilization of exposed site surfaces. Rapid build-up may account for much of the preservation. The great quantities and variety of debris suggest more intense interaction with the site during occupation.

The peak period proper seems separated from the next distinctive stratigraphic pattern by three thick Front Trench strata whose content features are most similar to those of the initial shell sequence. The artifacts show continuities from the preceding peak period inventory, but there is a dramatic decrease in both types and numbers, and no new types appear until well into the succeeding depositional period. In response to decrease in shell on the whole, absolute quantities of shellfish species also decline, although proportions are similar to those of the peak period, with clam and barnacle predominant. Numbers of mammal species present in this brief transition period maintain their peak period quantities, and absolute quantities exhibit a surprising peak. This feature of the mammal inventory is in fact the only aspect of the period which is truly distinctive. Temporal boundaries are established at 1800 and 980 BP. On the basis of species proportions and artifact continuities, the deposits are grouped with the peak period strata and mark its decline rather than an approach to the subsequent pattern.

980 BP — present

The site's final distinctive stratigraphic pattern is apparent in the upper Front Trench. The pattern first appears in the upper portions of the stratum dated 980 BP, and continues to present midden surface in a succession of thin, compact deposits containing the site's heaviest concentration of fire hearths and pockets of species-specific shell. The deposits are separated by thin bands of charcoal-laden matrix emanating from the hearths. The number of types of artifacts has sharply declined, as have artifact numbers. Numbers of species have declined for both shellfish and mammals. Clam finally achieves definite dominance over barnacle, and mammals of the Coast Littoral biotic province are predominant over those of the Coast Forest in numbers of species exploited. The strata characteristics are derived from intensive hearth-side activities resulting in the compaction of basic stratum matrix and the presence of unmixed piles of food refuse. The latest date on the sequence is 480 BP, from the fourth stratum below humus. Absence of contact period artifacts suggests the site may have been abandoned during that period.

The comparative simplicity of the Kisameet sequence and the small amounts of usable content data make its pattern definition rather clear-cut. Stratigraphic observations, shell quantities and fragmentation through time, shellfish species proportions, and avian data demark a boundary between two patterns: an initial sequence of strata low in shell content and exhibiting a definite barnacle predominance, and a subsequent sequence of alternating shell-bearing and humic strata exhibiting an equally dramatic clam predominance. Mammal material involves the same species as seen at Namu, with the same predominance of deer. Only the older pattern is represented sufficiently by these materials, however. Avian material was identifiable throughout, with the only distinction being between species which occur in the area throughout the year and those which winter there only. The occurrence of wintering species in the earlier pattern but not in the recent one suggests the site may not have been utilized in the same manner. Matrix fragmentation, compaction, mixture, and stratum configuration differences between the two patterns further indicate utilization distinctions. The shell-heavy strata of the upper pattern suggests light utilization of their exposed surfaces. The debris is relatively unbroken and loosely distributed across the site surface — unlike the compact horizontal distribution of strata of the initial site sequence. As at Namu for the same time periods, the deposition is shell-bearing throughout with the youngest sequence of deposition featuring narrow charcoal-laden bands.

Summary of Distributional Trends

Within the Namu depositional sequence overall, we find a basic dichotomy between an ancient period of non-shell deposition, characterized by microlithic industry, and a succeeding period of shell deposition with its own distinctive bone and stone tool industry emphasizing a variety of harpoon head elements. The two periods appear to exhibit nearly equal durations, of 4000 or 5000 years each. While no trends in artifact distribution are detectable in the non-shell deposits, very definite ones appear within the stratified shell sequence. That sequence may be divided into at least three successive sequences of deposition, each characterized by its own complex of content and morphologic phenomena. Outstanding among these is an apparent peak in the associated artifacts between 2880 and 1800 BP. This peak is evidenced as well in faunal species and in a great increase in quantities of site debris (particularly shell) at the same time. Deposits immediately preceding and following peak deposition exhibit gradual trends to and from peak characteristics. Equally distinctive is the final site depositional sequence whose strata suggest in form and content rather specific habitation activities rather than the wide range illustrated by peak period data. Trends in faunal debris have also been defined. There is a steady increase in predominance of beach-dwelling clams *Saxidomus/Schizothaerus* over rock-dwellers *Thais* and barnacle throughout the 4540 year history of site shell deposition at Namu. The Kisameet data express this trend over a 3000 year period in even sharper terms. Among mammal data at Namu, the trend is a gradual increase in predominance of marine fauna over forest fauna in terms of numbers of species exploited. Both trends culminate in deposits of the last stratigraphic pattern. We should not overdramatize the significance of the pattern distinctions as these trends persisted throughout site history, essentially unaltered by peak period deposition or declines, or for the mammal data, by the dramatic distinctions between the black matrix and shell occupations.