CHAPTER 3

Taphonomy and Spatial Distribution

Taphonomy literally means "the laws of burial", and this chapter examines a number of the site formation processes that have affected the frequency and distribution of faunal remains in the Namu midden. Of concern are the differential survival and spatial distributions of elements from particular faunal classes. A major aspect of taphonomy is the survival potential of different skeletal elements, and this problem is considered below as part of an effort to determine whether deer were a major food resource or were hunted more for their hide and bone. The discrete spatial distribution of fauna is examined in order to determine habitation and processing areas, and to provide a basis for interpreting temporal trends while controlling for variation between excavation units.

DEER TAPHONOMY

The utilization of deer on the Northwest Coast, and the particular significance of deer as a food resource are important problems in determining the degree of land-based orientation in the prehistoric subsistence economy. The abundance of deer relative to other mammalian remains indicates their potentially significant subsistence contribution, but ethnographic accounts tend to minimize the importance of deer as a food resource, and instead emphasize their value as a source of hides. Conover (1978:91) follows ethnographic sources in suggesting that deer were only important as food during times of starvation; she further stresses the importance of deer as a source of bone for tool manufacture. A cursory glance at the frequency of recovered deer elements (Tab. 10) supports the conclusion that deer were primarily used as a source of raw materials for tool-making. The emphasis on teeth and lower limbs is what would be expected if only select parts of the deer were returned to the site, specifically the head and limbs to supply bone and antler for tools, with the additional possibility that the hide was left attached to these elements and the whole package returned to the site as a unit (the so-called "schlepp effect" (Daly 1969:149)). If deer were taken at some distance from the site and bone and hides were the desired resources, then it would be expedient to butcher the animal at the kill site and only return select parts of the carcass. Most of the meat could be abandoned at the kill site.

Selective transport is one possible explanation for the Namu pattern of deer element recovery, but it is well known that skeletal elements are more or less resistant to destruction through the feeding actions of humans and dogs (e.g. Brain 1980). Such destruction could account for the observed element frequencies. In order to determine whether particular parts of the deer were selected for return to the Namu site, it was necessary to assess the probabilities of element survival and compare them with the relative frequencies of elements recovered from the site excavations.

Studies of the survival potential of deer elements have not been undertaken, but Brain (1980) has made detailed studies of Hottentot encampments in the Namib desert of southwestern Africa to determine the effects of human and canine attrition on the survival of goat elements. Goats have the same range of elements as deer; therefore Brain's results can be used as an indication of the relative probability of survival among deer elements subjected to similar destructive forces. The data sets can be compared by comparing the rank order of goat element survival to the rank order of deer elements in the Namu deer assemblage. Brain's data are ranked by

Table 10. Frequency of Recovered Deer *(Odocoileus hemionus)* Elements.

Element	Frequency
mandible	140
maxilla	115
distal humerus	27
distal tibia	44
proximal radius	30
scapula	18
proximal metapodial	33
innominate	30
axis	2
atlas	5
distal radius	12
distal metapodial	73
proximal femur	2
tarsal	114
proximal tibia	5
lumbar vertebra	23
distal femur	4
cervical vertebra	12
phalange	289
thoracic vertebra	23
sacrum	2
proximal humerus	1
carpal	100

the probability of element survival, and the Namu data can be similarly ranked according to the probability of element recovery. If the rank order of deer element frequency is equivalent to the rank order of goat element survival, then the relative frequency of deer elements is probably a function of preservation, and not human selection.

There are a number of potential problems with this approach to the question of deer utilization. If rank order comparison indicates that the probability of survival among individual goat elements is unrelated to the probability of recovery among the equivalent deer elements, then it is reasonable to conclude that the Namu deer bone assemblage was the result of element selection, and not differential bone destruction. Because non-meat-bearing elements predominate in the Namu collection, it could be concluded that there was a selection for tool-making raw materials. If there is a significant positive correlation between goat and deer element frequencies, it simply means that there was not a selective return of deer parts. A significant positive correlation indicates that the entire deer carcass was returned to the site, but how it was used once returned remains an open question. Deer could have been used as a source of bone, antler, and hide, while the meat was discarded or used as dog food. The assumption made here is that such outright discard of a meat resource was unlikely if the trouble had already been taken to transport the entire animal back to the site.

There are a number of specific problems to consider in comparing Brain's goat data to the frequencies of deer elements in the Namu midden. Although their elements are comparable, deer are larger than goats, which may affect rates of element attrition. Furthermore, a Northwest Coast shell midden is not a Hottentot

Table 11. Comparison of the Percentage Survival of Goat Elements (after Brain 1980:117) and the Recovery of Deer Elements (Element MNI).

Element	Goat Survival %	R1	MNI	R2	R1-R2
mandible	91.4	1	11.67	7	-6
maxilla	78.1	2	9.58	8	-6
distal humerus	64.0	3	13.5	6	-3
distal tibia	56.3	4	22.0	1	3
proximal radius	50.8	5	15.0	4	-1
proximal metapodial	27.7	6	8.5	11	-3
scapula	27.4	7	9.0	10	-5
innominate	26.6	8	15.5	5	-4
axis	21.9	9	2.0	18	-9
atlas	18.8	10	5.0	13	-3
distal radius	17.2	11	6.0	12	-1
distal metapodial	16.8	12	18.25	3	9
proximal femur	14.1	13	1.0	21	-8
tarsal	11.7	14	19.0	2	12
proximal tibia	10.1	15.5	2.5	15	0.5
lumbar vertebra	10.1	15.5	3.83	14	1.5
distal femur	7.0	17	2.0	18	1
cervical vertebra	3.8	18	2.4	16	2
phalange	2.7	19	9.03	9	10
thoracic vertebra	2.5	20	1.64	20	0
sacrum	1.6	21	2.0	18	3
proximal humerus	0.0	22	0.5	22	0
carpal	—	—	(8.33)	—	—

Rsc=.64

camp, and the cultural pattern of bone attrition and the effects of the physical environment on bone survival can be expected to vary substantially. If bone destruction is largely due to the chewing actions of dogs, then differences in the size and breed of dog also could have a significant effect on element survival. The validity of direct comparison can be questioned on all of these grounds. Although valid, such objections are only relevant if a correlation does not exist between the data sets. If a positive correlation is found, then it must exist for a reason, and the most parsimonious explanation is that similar element frequencies derive from similar taphonomic processes of human and canine consumption.

Brain's (1980:117) goat data are based on the percentage survival of elements from a known number of goats. For the Namu deer assemblage there is no way to determine the base number of deer that were brought to the site. Deer element recovery rates were determined by dividing recovered element frequencies by the number expected in a single individual. This calculation yields a rough minimum number of individuals (MNI) estimate based upon each element. This measure is not MNI as it is commonly used to measure species abundance. MNI is not used here to estimate the number of deer represented in the assemblage. It is an indication of the number of deer minimally required to produce the recovered frequency of each element. Given that all the deer elements were drawn from the same original population of deer, the relative magnitude of the element MNI is an indication of the relative survival of elements from the original deer assemblage. The MNI

Table 12. Comparison of the Percentage Survival of Goat Elements and the Recovery of Deer Elements (Element MNI) by Excavation Unit and Period.

		DEER ELEMENT MNI BY EXCAVATION UNIT AND PERIOD							
Element	GOAT % SURVIVAL	68-70S 4-10W 32-34S 2-10W	32-34S 4-10W	68-70S 2-10W	Site Total	Period 5	Period 4	Period 3	Period 2
mandible	91.4	8.42	2.83	5.58	11.67	3.08	5.25	1.08	1.83
maxilla	78.1	7.25	3.00	4.25	9.58	2.42	3.75	1.50	1.83
distal humerus	64.0	8.50	3.00	5.50	13.50	2.00	5.50	2.00	3.50
distal tibia	56.3	20.00	4.50	15.50	22.00	5.00	12.5	3.00	1.50
proximal radius	50.8	12.50	4.50	8.00	15.00	4.50	6.50	3.00	0.50
proximal metapodial	27.7	7.25	3.00	4.25	8.50	2.25	4.00	1.75	0.50
scapula	27.4	8.00	4.00	4.00	9.00	0.50	3.00	4.50	0.50
innominate	26.6	13.50	5.50	8.00	15.50	5.00	5.00	3.50	2.00
axis	21.9	2.00	1.00	1.00	2.00	0.00	1.00	1.00	0.00
atlas	18.8	4.00	1.00	3.00	5.00	0.00	2.00	1.00	2.00
distal radius	17.2	6.00	1.50	4.50	6.00	1.50	3.50	0.50	0.50
distal metapodial	16.8	15.75	5.25	10.50	18.25	5.00	7.50	2.50	2.50
proximal femur	14.1	1.00	0.50	0.50	1.00	0.50	0.50	0.00	0.00
tarsal	11.7	15.67	6.67	9.00	19.00	6.00	6.50	3.50	1.83
proximal tibia	10.1	2.00	0.50	1.50	2.50	1.00	0.50	0.50	0.50
lumbar vertebra	10.1	3.33	0.83	2.50	3.83	0.67	1.67	0.67	0.50
distal femur	7.0	1.50	0.50	1.00	2.00	0.50	0.50	0.00	0.50
cervical vertebra	3.8	1.40	0.20	1.20	2.40	1.00	0.60	0.20	0.60
phalanges	2.7	7.22	1.94	5.28	9.03	2.56	3.59	1.31	.91
thoracic vertebra	2.5	1.14	0.64	0.50	1.64	0.36	0.57	0.14	0.43
sacrum	1.6	2.00	1.0	1.00	2.00	0.00	0.00	0.00	2.00
proximal humerus	0.0	0.50	0.50	0.00	0.50	0.00	0.00	0.50	0.00
carpal	—	(7.00)	(2.50)	(4.50)	(8.33)	(2.42)	(3.83)	(0.92)	(1.08)

measure merely indicates the potential for element survival; for this purpose, it was not necessary to consider side, size, or age categories in the calculations. The element MNI was the basis for ranking deer element recovery rates. Brain's goat element survival percentages were similarly ranked, and a Spearman's rank order correlation coefficient (Marascuilo and McSweeney 1977:431-436) was calculated to determine the similarity of the two ranking orders. Table 11 gives a detailed presentation of the calculations used to determine the rank order correlation of goat element survival and deer element recovery.

The possibility that deer utilization varied through time or in reference to different site areas was assessed by calculating correlation coefficients for each temporal period, each main excavation trench, the combined main trenches, and the entire site. Table 12 presents the element MNI calculations for these separate units compared to the rankings for the percentage survival of goat elements. Table 13 lists the results of the Spearman's test of rank order correlation. All deer element distributions show a significant positive correlation with Brain's goat element survival data. The relative frequency of recovered deer elements is roughly equivalent to the relative percentages of goat elements that survived human and canine consumption in Hottentot encampments. It is reasonable to conclude that the frequency of deer elements in the Namu midden is the result of similar processes of attrition. The implication is that the Namu inhabitants were not selecting for the return of particular deer elements; the entire deer carcass was returned to the site.

Table 13. Spearman's Rank Order Correlation Coefficient (Rsc) for the Relationship Between the Recovered Frequencies of Deer Elements (MNI) and the Percentage Survival of Goat Elements.

Unit	Element Frequency	Rsc	p
68-70S,4-10W	583	.61	<.005
32-34S,2-10W	303	.61	<.005
68-70S,4-10W + 32-34S,2-10W	886	.68	<.005
Site Total	1106	.64	<.005
Period 5	297	.47	<.025
Period 4	453	.70	<.005
Period 3	166	.64	<.005
Period 2	144	.31	<.1

Although comparatively weak, the results for Period 2 do not necessarily indicate the selective return of deer elements to the site at that time. The largest Period 2 deviation from the survival ranking of goat elements is the high ranking for the sacrum. It is unlikely that the sacrum would be present unless the entire deer carcass was brought to the site.

In spite of the general agreement between the deer element frequencies and Brain's element rankings, there are some specific differences from Brain's element rankings that require explanation; these include:

1) mandibular and maxillary teeth - the Namu MNI values for these elements consistently rank lower than the ranks for goat mandibles and maxillae. This discrepancy is probably the result of MNI values that are based on the division of identified specimens by the total number of teeth expected in an individual, even though some of the identified archaeological specimens are maxilla or mandible fragments that contain more than one tooth. As a result, MNI values for teeth slightly under-represent their true relative frequency.

2) distal metapodials - these elements consistently rank higher for deer than for goat. In part, this pattern may be the result of specimen counts that included individual trochlea as single specimens; there are eight trochlea per individual (two on the end of each distal metapodial). MNI calculations are based upon complete distal ends, of which there are only four per individual. The result is a slight over-representation of distal metapodials, and a resulting higher than true ranking of their frequency.

3) phalanges and tarsals - these elements rank higher for deer than for goat, which may be partly because deer phalanges and tarsals are more robust and have greater survival potential. The reduction of other deer elements in tool manufacture also would result in relatively higher ratios of elements such as tarsals and phalanges, which were not reduced in the same way. It also is possible that there was some minor selection of lower limbs for tools, in addition to the general pattern of returning whole animals to the site.

The most likely explanations for the above deviations from expectation suggest that correlations with Brain's data are probably even stronger than indicated by the figures in Table 13. There is a correspondence between the goat elements that are most resistant to attrition and the deer elements that were most likely to be preserved in the Namu midden. The frequency of recovered deer elements therefore is consistent with a pattern of returning whole animal carcasses to the site for later processing. Given return of the entire animal, it is not unreasonable to assume that the meat was used for food. Although the Namu diet was overwhelmingly marine based, deer made at least some terrestrial based contribution to the diet. Deer was likely the major part of the small portion of the Namu protein intake that was derived from terrestrial sources (see Chisholm et al. 1983).

Table 14 - Distribution of Selected Fauna Abundance in the Rivermouth and Central Main Trenches.

	Period	Rivermouth Trench		Central Main Trench	
		Freq.	% of Mammal	Freq.	% of Mammal
Harbour Seal	5	13	4.7	7	5.1
	4	498	44.3	23	16.9
	3	12	16.4	53	17.9
	2	32	22.2	12	23.1
Sea Otter	5	4	1.4	0	0.0
	4	46	4.1	1	0.6
	3	1	1.4	3	1.0
	2	1	0.7	0	0.0
		Freq.	% of Fish	Freq.	% of Fish
Halibut	5	40	0.51	2	0.11
	4	86	0.18	0	0.00
	3	3	0.05	0	0.00
	2	2	0.13	0	0.00
Cod	5	31	0.40	38	2.03
	4	289	0.61	5	0.05
	3	25	0.38	19	0.26
	2	46	3.06	2	1.36
		Freq.	% of Mammal+Bird	Freq.	% of Mammal+Bird
Birds	5	45	13.9	33	19.5
	4	63	5.3	29	14.1
	3	22	23.2	294	49.8
	2	35	19.6	7	11.8

FAUNA DISTRIBUTION PATTERNS

The two major aspects of fauna distribution considered here are: 1) the deposition of faunal elements in primary butchering areas; and 2) faunal deposition in habitation areas, in which secondary butchering and consumption took place. Spatial patterning in shell deposition, and the effects of burials on the deposition and recovery of faunal material also are examined.

Sufficient material for comparing spatial distributions was only available for the two major excavation trenches, but these exhibit some interesting contrasts in faunal frequencies (Tab. 14). Five categories of fauna show variable distributions between the two trenches. These include halibut, cod, all bird species, sea otter, and harbour seal. Halibut, sea otter, and harbour seal generally were much more abundant in the Rivermouth Trench than in the Central Main Trench.

Halibut, Harbour seal, and Sea Otter

In Period 4, seal and sea otter remains are concentrated near the river/beach area of the site. Halibut remains are concentrated in this part of the site during all periods. Ethnographic sources indicate that primary butchering of halibut and harbour seal took place on the beach (Boas 1921:241,451-461), and it is reasonable to project the same pattern for sea otter, since they were hunted in the same manner as harbour seal (Drucker 1955:34). If canoes landed with their catches at the river's mouth, the most convenient area for initial processing would be in the vicinity of the rivermouth excavations. The area would provide for convenient disposal of unwanted viscera, etc. Boas (1921:242-248) describes the southern Kwakiutl technique of halibut butchering, in which the flesh was cut away from the backbone on the beach, while only the flesh was normally taken back to the habitation area.

Boas also describes the butchering of harbour seal on the beach, and the Kwakiutl pattern of body-part distribution can be traced in the spatial patterns of skeletal elements within the Namu midden. Boas' description of Kwakiutl seal butchering is more concerned with the ultimate distribution of body parts than with the actual butchering process. A clearer description of seal butchering is given in Boas' (1888:517) ethnography of the Central Eskimo. As described there:

> In dressing the animal [seal] the natives open the belly and first scoop out the blood, then the entrails are taken out, the ribs are separated from the breast bone and the vertebrae, the fore flippers (with the shoulder and the hind flippers) are taken out, the only part remaining being the head, the spinal column, and the rump bone. Generally these are not eaten, but are used for dog's food.

If the butchering technique at Namu approximated that of the Central Eskimo, then there should be a distinct pattern of element distribution, with the greatest proportion of head and vertebral elements deposited at the site of butchering, and a greater percentage of limb elements near habitation areas. Table 15 lists the frequency and percentage of major harbour seal elements relevant to this pattern. The figures in Table 15 clearly show that during Periods 3 and 4, harbour seal were butchered near the river in rough correspondence to the pattern described for the Central Eskimo. Vertebrae and temporals are much more abundant in this part of the site. There also is an indication that limb bones were more likely to be brought to the Central Main Trench area of the site during Period 3. Phalanges are more evenly distributed across both excavation areas. If the flippers were left attached to the limbs, then the bone elements of the flippers must have been dispersed after secondary butchering and consumption.

Conover (1972:171) also reports a high percentage of harbour seal limb bones in the central area of the site, which may indicate a main habitation area. Limb bones would be common among the meat-bearing portions of the seal, which were taken to habitation areas for secondary processing and consumption. The relative absence of limb elements in the Central Main Trench area during Period 4 may indicate that the main habitation area was located in another part of the site, though it could indicate a difference in butchering techniques, in which limbs were no longer removed as a unit to the habitation area. Nonetheless, a shift in habitation area is indicated by a difference in the overall proportion of limb bones in Periods 3 and 4 (Period 4 - 3.0%, Period 3 - 15.4% of the total seal elements recovered). Limb elements are under-represented in the Period 4 excavations, which indicates that they may have been removed to another part of the site at that time. The distribution of bird and shellfish remains also supports the conclusion that the main habitation area shifted over the course of time.

Table 15. Seal Element Distribution.

	Rivermouth Trench 68-70S,4-10W		Central Main Trench 32-34S,2-10W	
Period 4				
	Frequency	**% of Total Seal Elements**	**Frequency**	**% of Total Seal Elements**
vertebrae	45	9.5	0	0.0
temporal	31	6.5	0	0.0
femur/humerus	14	2.9	1	4.3
total seal elements	475		23	
Period 3				
	Frequency	**% of Total Seal Elements**	**Frequency**	**% ofTotal Seal Elements**
vertebrae	3	25.0	3	5.6
temporal	2	16.7	2	3.8
femur/humerus	1	8.3	9	18.9
total seal elements	12		53	

Bird

One of the clearest patterns in fauna distribution is the heavy concentration of bird bone in the Period 3 strata of the Central Main Trench. Bird species composition does not vary between locations and time periods, but the concentration of abundance is clear. Ethnographic accounts indicate that ducks were normally made into soup (Rohner 1967:61). This method of preparation would likely result in the disposal of all skeletal elements at or near the point of consumption. The Period 3 concentrations of bird bone and harbour seal limb bones in the Central Main Trench area suggest that this was a main habitation area. The comparative lack of bird remains in the Period 4 deposits might indicate some shift in the main habitation area at that time, likely more toward the front of the site.

Cod

There is a clear Period 4 concentration of cod (Gadidae) bones in the Rivermouth Trench. Supporting ethnographic information is lacking, but this pattern may indicate a beach area of cod processing similar to that for halibut in all periods. The concentration indicates primary processing of some form, but it is impossible to determine why it should be in the rivermouth area at this time and not others.

Burials

Burials from Periods 3 and 4 were concentrated in the area of the Central Main Trench. If the interpretation of fauna distribution patterns is correct, this would indicate a pattern of interment within or near dwellings in Period 3. The use of the same circumscribed burial area continues into Period 4, when according to the available faunal evidence the main habitation area was probably in another location. If Period 4 dwellings were located closer to the shoreline (i.e. westward), any evidence of their location would likely have been destroyed during construction of the modern bunkhouse structure (Fig. 2). An examination of the faunal remains from burial levels did not reveal any particular associations between burials and categories of fauna that could be construed as funeral offerings. The faunal material recovered from burial levels is of the same character as that found throughout the strata of these periods.

Shell

Conover (1972:290) observed that shell strata in the central area of the site, which date to later than 2900 cal B.P. (equivalent to Periods 5 and 6), were commonly composed of unbroken and unmixed shell, which would indicate less intensive use of this area at that time. The relatively light deposition of other fauna during this period suggests that the rivermouth and central areas were both peripheral at this time. In neither area is there any evidence of primary processing or habitation. If the excavation areas were peripheral during Periods 5 and 6, then there would be major ramifications for the interpretation of temporal trends in faunal-class abundance, but other indications suggest that site utilization was less intense overall during Periods 5 and 6. If this was the case, then the low degree of shell fragmentation and low faunal frequencies do not indicate particular areas of peripheral site use. This problem is considered in more detail in the Chapter 4 discussion of the Period 5 fauna.

SUMMARY AND IMPLICATIONS

The spatial distribution of certain faunal classes indicates the segregation of activity areas across the site. The primary processing of sea mammals and halibut took place in the area of the Rivermouth Trench. The Period 3 faunal assemblage from the central area of the site indicates the location of secondary processing and consumption of seal and birds, which suggests that this was a main habitation area at that time. It is impossible to trace the shifting focus of habitation in later periods from the available evidence. The presence of multiple burials in the Period 3 deposits of the central site area points to the likelihood of burial near habitation areas, though nothing in the character of the either the Period 3 or the Period 4 deposits suggests that this area was exclusively reserved for burial. The matrix and faunal remains from this part of the site are generally typical of the midden deposits.

The distribution of bird bone suggests that their Period 3 abundance is somewhat exaggerated. If the main habitation area and the location of bird bone deposition later shifted to areas that were not excavated, then the abundance of bird remains recovered from later deposits would not reflect the intensity of their utilization. However, the slightly greater abundance of bird bone in the limited Period 3 deposits in the Rivermouth Trench suggests that the peak abundance of bird might not be entirely a function of sampling effects.

A shift in habitation area also could be responsible for a slight under-representation of harbour seal in the excavated Period 4 deposits. However, the bulk of the harbour seal remains were recovered from the Rivermouth Trench, and it is unlikely that the pattern of harbour seal deposition would have had a significant effect on temporal trends in seal abundance.

Variation in the spatial distribution of fauna indicates the need for caution in interpreting temporal trends on the basis of limited samples of midden deposits. The distinctive fauna deposition patterns in the Central and Rivermouth Trench areas suggest that even large-scale, block excavations, if restricted to a particular area of the site, might yield misleading indications of changing faunal abundance. Samples drawn from across the site provide a greater opportunity for obtaining an accurate assessment of temporal trends in fauna utilization. It may never be possible to completely gauge the effects of partial sampling from complex midden deposits, but apart from the spatial patterns noted in this chapter there is an overall consistency in the period faunal assemblages obtained from different excavation areas. This basic consistency suggests that the large samples available for this study can provide an accurate measure of relative faunal-class abundance over time.