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Table of Contents/ Table des matières

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Subsistence at *Si•čə’nəł:* The Willows Beach Site and the Culture History of Southeastern Vancouver Island

Ila Moana Willerton[1] and Kathlyn M. Stewart[2]
[1] Department of Anthropology, University of Victoria, Victoria, BC, imwillerton@gmail.com
[2] Canadian Museum of Nature, P O Box 3443, Stn D, Ottawa, ON, kstewart@mus-nature.ca

ABSTRACT

Archaeological excavations at the Willows Beach site (DcRt-10) on southeastern Vancouver Island have revealed the presence of two distinct culture types – characteristic artifact assemblages generally associated with particular time periods – during the site’s 2630–270 BP occupation. Following Croes’s theory that culture type change reflects subsistence intensification, Willows Beach faunal assemblages are examined for evidence of change over time. Analysis of faunal remains from dated, stratified units associated with the two culture types suggests that at least some subsistence change occurs commensurate with changes in subsistence artifacts and culture type. Reference is also made to faunal changes at the nearby Esquimalt Lagoon and Maplebank sites. Greater sample sizes are needed to further support this association.

RÉSUMÉ

Les investigations archaéologiques du site Willows Beach (DcRt-10) dans le sud-est de l’Île Vancouver sont démontré la présence de deux *culture types* – des associations caractéristiques des objets généralement liés avec des périodes particulières – distinctes dans l’occupation de ce site entre 2,630–270 BP. Aprés la théorie de Croes que les changements des *culture types* réfléchent l’intensification de la subsistance, des collections fauniques de Willows Beach sont examinées pour vérifier s’il y a des changements temporels. L’analyse des restes fauniques provenant des niveaux des dates connus associés avec les deux *culture types* indique que la changement des culture types à Willows Beach est la résultat d’un changement de la subsistance. La référence est également faite aux sites Esquimalt Lagoon et Maplebank. Des échantillons plus larges sont nécessaires pour soutenir cette association.

The Gulf of Georgia region of the Pacific Northwest has received considerable archaeological attention, much of it focused on the lower Fraser River Delta. Sites there contain evidence of remarkable art and architecture and complex technology for the procurement of sea mammals and diverse fish taxa, including the large annual runs of salmon (e.g., Matson 1981; Matson and Coupland 1995). Less attention has been paid to the archaeology of southern Vancouver Island, which was seen as slower to adopt newer technologies (Mitchell 1971, 1990). However, recent studies are now suggesting that the latter may have undergone a different cultural trajectory from the Fraser Delta region, indicating that further study is warranted (Clark 2000, 2010).

The prehistory of the Gulf of Georgia region has been divided into distinctive, temporally diagnostic artifact assemblages known as culture types, yet the exact significance of changes in these assemblages, particularly in southern Vancouver Island, is not clear. A closer examination of the correlation between changes in faunal assemblages and the artifact-based culture types may shed light on subsistence and technology in this region (see also Willerton 2009). In this paper we examine variation in faunal and artifact-based assemblages from the Willows Beach site (Borden designation DcRt-10), a large stratified shell midden located within Songhees traditional territory in the city of Victoria on southern Vancouver Island (Figure 1).

Willows Beach is located at the southeastern tip of Vancouver Island near the confluence of the Straits of Georgia and Juan de Fuca, a small area distinguished from the greater Gulf of Georgia by a climate milder and drier than that of the surrounding region (Burley 1980; Lepofsky et al. 2005; Suttles 1974, 1990). The Willows Beach site was occupied until 1843 (Suttles 1974, 1990), and its inhabitants had access to abundant natural resources. Located in a low, flat area bounded to the north by the rocky bluff of Cattle Point and to the south by Bowker Creek, which is a source of fresh water, the site faced several small offshore islands. These were frequented by seabirds and would have had open meadows suitable for hunting and gathering on their landward side (Kenny 1974). The terrestrial ecosystems were dominated by Douglas fir (*Pseudotsuga menziesii*), arbutus (*Arbutus menziesii*) and Garry oak (*Quercus garryana*) with a significant amount of semi-open meadow land (Burley 1980; Lepofsky et al. 2005; Mathews 2006; Mitchell 1971; Suttles 1974, 1990).

Black-tailed deer (*Odocoileus hemionus columbianus*) and elk (*Cervus elaphus*) flourish in this habitat, which also supports other mammals such as black bear (*Ursus americanus*), mink (*Mustela vison*), and beaver (*Castor canadensis*), as well as large numbers of birds, mainly waterfowl (Mitchell 1971; Suttles 1990). The marine environment is rich with fauna: pinnipeds, cetaceans, shellfish and fish including all five species of Pacific salmon (Mitchell 1971; Suttles 1974, 1990). This ecological pattern may have emerged as early as 3800 BP (Beckwith 2004), by which time sea levels in what is now the Victoria area would probably have stabilized at their modern position (James et al. 2009).

Archaeological Background

The prehistory of the Gulf of Georgia region is categorised by archaeologists as a series of temporally-divided culture types, distinguished by artifact assemblages, among other cultural manifestations. Increased regional diversity in culture type assemblages occurred around 2400 cal BP, with types and relative frequencies of artifacts differing between southeastern Vancouver Island and other parts of the Gulf of Georgia region (Clark 2000, 2010). A new culture type (Marpole) with new art and artifacts appeared, focused on the lower Fraser Valley region (e.g., Matson & Coupland 1995). On southern Vancouver Island, changes were more gradual and less drastic, and have been described as the development of a subphase within the Locarno Beach culture type (Clark 2000, 2010).

Researchers have discussed reasons for the increased regional diversity at around 2400 BP. Environmental change has been invoked as one primary cause and has been examined for its effects on local and regional resource availability, which may in turn have led to increased trade, deepening social inequality, and differences in resource distribution (Lepofsky et al. 2005). Croes (1989) has suggested that changes in culture types and artifacts resulted from differing subsistence patterns, probably in response to population growth. Croes's theory on artifact change and subsistence should be testable archaeologically, using changes in artifactual and faunal assemblages from sites with stratified deposits.

The first scientific excavations at Willows Beach took place in the early 1970s; these and subsequent excavations have revealed artifacts, pits, hearths, burials and fauna, with radiocarbon dates (Table 1) suggesting a long history of occupation (Kenny 1974; Owens & Pawlowski 2007; Wigen 1980; Wilson et al. 2007). These features make Willows Beach potentially valuable for examining changes in faunal assemblages and their possible correlation with artifactual culture types through time.

The excavations by Kenny (1974) at Willows Beach were extensive, and revealed two cultural Zones: A and B (see Methodology below). Artifacts and radiocarbon dates link Zone A to the Gulf of Georgia culture type and Zone B to the late Bowker Creek sub-phase of the Locarno Beach culture type. Each Zone has characteristic artifacts and differing proportions of tools suggesting a distinct culture type (Clark 2000; Kenny 1974). Willows Beach appears to lack a discrete Marpole component, the absence of which has also been noted among other southern Vancouver Island sites (e.g., Clark 2010; G. Keddie, pers. comm.).

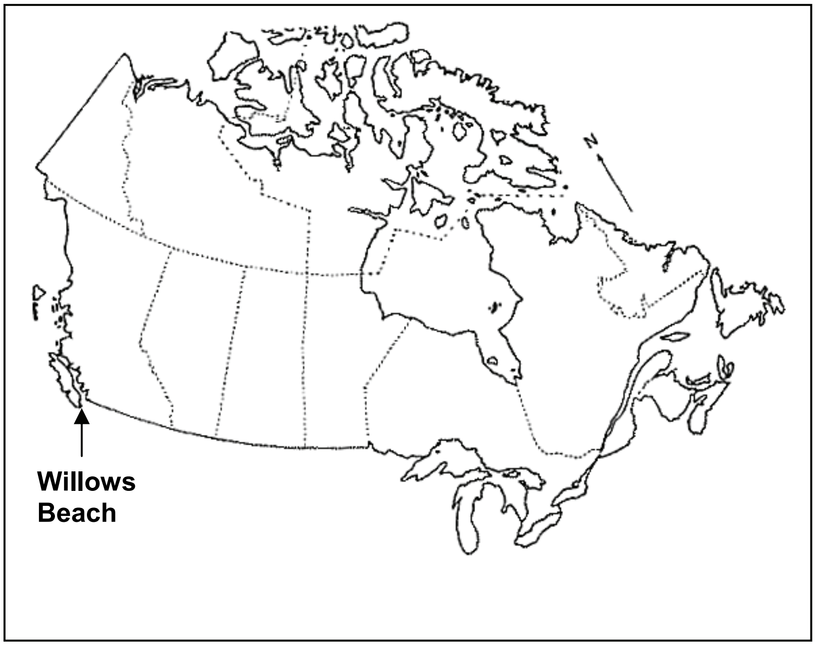

Figure 1. Location of Willows Beach.

	Source (Kenny 1974)	Uncalibrated (Kenny 1974)	Calibrated (BP) using OxCal 4.0.5's IntCal04 Northern Hemisphere atmospheric curve						
			from	to	*1 sigma*	from	to	*2 sigma*	median
Zone A	Charcoal, middle of Zone A	270 ± 65 BP	456	-1	68.1	499	-4	95.4	331
Zone B #2	Charcoal, near top of Zone B	2490 ± 85 BP	2720	2466	68.2	2741	2359	95.4	2561
Zone B #1	Charcoal, bottom of Zone B	2630 ± 95 BP	2863	2516	68.2	2955	2367	95.3	2740

Table 1: Dates used in this study (Bronk Ramsey 1995, 2001; Reimer et al. 2004).

Subsistence Practices	Artifacts Recovered	Inferred Practices (Kenny 1974)	Present in Zone A?	Present in Zone B?
Land Mammal Hunting	Flaked stone points	Using arrows, darts or spears	Yes	Yes
Sea Mammal Hunting	Large ground slate points	Using a killing lance	No	Yes
	Unstemmed triangular ground slate points	Using composite-headed harpoon	Yes	No
	Barbed antler harpoon points	Using a non-toggling harpoon	Yes	No
Fishing	Bipoints (unbarbed)	Fishing with composite hooks, leisters, fish gorges, composite toggling harpoons, or herring rakes	Yes	Yes
	Unipoints (unbarbed)	Fishing with composite hooks, leisters, fish gorges, composite toggling harpoons, or herring rakes	Yes	No
	Composite toggling harpoon valves	Harpooning salmon (or sturgeon)	Yes	No
Bird Hunting	Flaked stone points	Using arrows, darts or spears	Yes	Yes
	Unbarbed bone points	Using arrows, darts or spears	Yes	Yes
	Barbed bone points	Using specialized duck spears/ arrows	Yes	No

Table 2. Subsistence activities at DcRt-10 inferred by Ray Kenny from artifact assemblages (Kenny 1974: Table 103, Table 107). Table modified from Kenny (1974) and Willerton (2009).

Zone A at Willows Beach contains more bone and less flaked stone than Zone B (Kenny 1974: Table 100). In addition, certain artifact types are found only in Zone A, such as barbed bone points, composite toggling harpoon valves and unbarbed bone points (Kenny 1974: Tables 103, 107). These artifact types and trends are considered diagnostic of the Gulf of Georgia culture type (Clark 2010; Matson and Coupland 1995; Mitchell 1990), while Zone B contains microblades and a labret, typically more common in the Locarno Beach culture type (Kenny 1974: Table 100; Clark 2010).

Kenny (1974) has inferred subsistence activities at Willows Beach based on the artifact types occurring in Zones A and B (Table 2, adapted from Kenny [1974]: Tables 103, 107). While the sample size is small, the presence solely in Zone A of barbed bone points similar to those used ethnographically for specialized duck spears or arrows (Kenny 1974: Table 107) may indicate increased hunting of waterfowl. Zone A also contains fishing-related artifacts not recovered in Zone B ─ two composite toggling harpoon valves believed by Kenny to have been used for catching salmon, and six unbarbed bone unipoints, used in making hooks, gorges, leisters, and herring rakes. The presence in Zone A of a large barbed antler point believed to have armed a non-toggling sea mammal harpoon represents some degree of technological change from earlier levels, and could signal intensified sea mammal hunting from Zone B to Zone A (Kenny 1974: Table 107).

Using Kenny's (1974) data on artifacts and function (Table 2) and Croes's (1989) theoretical framework of changing culture types reflecting changes in subsistence patterns, this paper predicts that some of the differences in the Willows Beach Zone A artifact assemblages represent intensification or variation in subsistence practices in the Gulf of Georgia culture type, compared to the artifacts from Zone B, which are associated with the Locarno Beach culture type. These changes should be observable in the Willows Beach faunal assemblages, as discussed below. For a full description of the Willows Beach fauna and its analysis, see Willerton (2009).

Methodology

The Willows Beach site is approximately 1,080 metres long and 40 metres wide, and was first recorded by the province in 1959 (BC Prov. Heritage Register 2000). The faunal material and artifact assemblages described in this study were excavated by Monks and Pollitt (1970) and Kenny (1971, 1974). The Monks and Pollitt excavation took place on the southern part of Willows Beach (Owens & Pawlowski 2007). Three units were excavated: two units were one by four metres in size, while the third was one-and-a-quarter by six metres (Monks & Pollitt 1970).

The Kenny excavation was undertaken on the same property in 1971, adding five 2m x 2m excavation units (Kenny 1974). Six intact strata were noted, grouped into two distinct components: Zone A closest to the surface, and Zone

B below. Both consist of dark sandy shell midden matrix, with the Zone B material generally darker and more compact; deposit depths indicate a greater volume of sediment in Zone B.

The Kenny excavation yielded three radiocarbon dates: 2630 ± 95 BP from the bottom of Zone B, 2490 ± 85 BP from the top of Zone B, and 280 ± 65 from the middle of Zone A (Kenny 1974). OxCal 4.0.5 was used to calibrate these previously uncalibrated dates (see Table 1) (Willerton 2009).

Faunal material from these excavations was screened using a 6-mm screen, meaning that smaller bones (particularly of fish the size of herring and smaller) would fall through the screen. The faunal remains, carefully bagged according to provenience, were stored unanalysed at the Royal British Columbia Museum in Victoria.

To quantify the bones, one of us (Willerton 2009) recorded NISP (*N*umber of *I*dentified *SP*ecimens), and calculated MNI (*M*inimum *N*umber of *I*ndividuals) (Tables 3-5). MNI is of limited usefulness for small assemblages like these, as it overrepresents taxa with low numbers, as seen below with the bird sample. On the other hand, MNI largely underrepresents fish in this study, primarily due to the fact that vertebrae had to be used as the "diagnostic" element, thereby giving unreasonably conservative MNI numbers for fish taxa. However, MNI counts address the problem of the potential for NISP to represent the same individual multiple times (Lyman 2008; Stahl 1995; Wigen 1980). Therefore, for the purposes of this paper, only the NISP counts will be used in our discussions; MNI counts are recorded for reference.

Specimens were identified by Willerton using the University of Victoria's zooarchaeology collections. Genus, species and skeletal element were recorded. Based on ethnographic and archaeological evidence, taxa that were apparently not food items are listed but excluded from the analysis: dog (*Canis familiaris*), mice (*Peromyscus* sp.), and the introduced European rat (*Rattus* sp.). All other taxa identified are hereafter referred to as "food fauna." Crows and/or ravens may have been kept as pets (e.g., Drucker 1951); however, this is poorly documented and they will be treated here as food fauna.

The bones at Willows Beach were generally well preserved, but taphonomic factors were undoubtedly responsible for some loss of elements (e.g., Lyman 2008; Stahl 1995). However, the presence of small, delicate bones in both Zones A and B suggests preservation is similar between the two Zones.

		Zone B		Zone A	
Taxon	**Common Name**	**NISP**	**MNI**	**NISP**	**MNI**
Squalus acanthias	Dogfish	28	1	33	2
Raja binoculata	Big skate	–	–	2	1
Hydrolagus colliei	Ratfish	7	2	11	2
Acipenser sp.	Sturgeon	–	–	1	1
Clupea pallasii	Herring	2	1	7	2
Oncorhynchus sp.	Salmon	77	2	135	3
Gadus macrocephalus	Pacific cod	1	1	9	1
Damalichthys vacca	Pile perch	1	1	–	–
Sebastes cf. *babcocki*	Rockfish (cf. red-banded)	1	–	–	–
Sebastes borealis	Shortraker rockfish	–	–	1	–
Sebastes proriger	Redstripe rockfish	–	–	1	–
Sebastes sp.	Rockfish	24	1	116	4
Hexagrammos decagrammus	Kelp greenling	2	1	5	1
Ophiodon elongatus	Lingcod	2	1	1	1
Hemilepidotus hemilepidotus	Red Irish Lord	2	1	1	1
Scorpaenichthys marmoratus	Cabezon	2	1	14	2
Myoxocephalus polyacanthocephalus	Great sculpin	4	1	25	1
Cottidae	Sculpin, indeterminate	–	–	4	–
Hippoglossus stenolepis	Halibut	1	1	8	1
Lepidopsetta bilineata	Rock sole	–	–	1	1
Platichthys stellatus	Starry flounder	5	1	9	1
Pleuronectiformes	Flatfish, indeterminate	2	–	1	–
Total Identified to Genus or Species		**161**	**16**	**385**	**25**
Non-Identified Fish		**112**	**–**	**235**	**–**
Overall Total Fish		**273**	**16**	**620**	**25**

Table 3. Fish remains at Willows Beach.

		Zone B		Zone A	
Taxon	**Common Name**	**NISP**	**MNI**	**NISP**	**MNI**
Dendragapus obscurus	Blue grouse	–	–	1	1
Gallus gallus	Chicken	–	–	1	1
Bonasa umbellus	Ruffed grouse	2	1	–	–
Cygnus buccinator	Trumpeter swan	1	1	–	–
Branta canadensis	Canada goose	3	1	8	1
Anas platyrhynchos	Mallard	2	1	1	1
cf. *Anas platyrhynchos*	Duck (cf. Mallard)	–	–	1	–
Aythya marila	Greater scaup	4	1	3	1
Aythya affinis	Lesser scaup	1	1	–	–
cf. *Aythya* sp.	cf. scaup	1	–	–	–
Clangula hyemalis	Long-tailed duck	–	–	1	1
Melanitta perspicillata	Surf scoter	8	2	8	2
Melanitta fusca	White-winged scoter	3	1	9	2
Melanitta sp.	Scoter indet.	1	–	2	–
Mergus merganser	Common merganser	–	–	1	1
Mergus serrator	Red-breasted merganser	–	–	1	1
Oxyura jamaicensis	Ruddy duck	–	–	1	1
cf. *Gavia arctica*	cf. Arctic loon	–	–	1	1
Gavia pacifica	Pacific loon	1	1	3	2
Gavia immer	Common loon	1	1	–	–

Table 4. Bird remains at Willows Beach.

		Zone B		Zone A	
Taxon	**Common Name**	**NISP**	**MNI**	**NISP**	**MNI**
cf. *Phoebastria albatrus*	Albatross (cf. short-tailed)	1	1	2	1
Puffinus griseus	Sooty shearwater	12	1	2	1
Puffinus tenuirostris	Short-tailed shearwater	1	1	–	–
Aechmophorus occidentalis	Western grebe	–	–	1	1
Ardea herodias	Great blue heron	–	–	1	1
Phalacrocorax auritus	Double-crested cormorant	–	–	3	1
Phalacrocorax pelagicus	Pelagic cormorant	–	–	1	1
Pluvialis squatarola	Black-bellied plover	1	1	–	–
Larus canus	Mew gull	–	–	2	1
Larus delawarensis	Ring-billed gull	1	1	–	–
cf. *Larus delawarensis*	cf. Ring-billed gull	–	–	2	1
Larus argentatus	Herring gull	1	1	–	–
Larus glaucescens	Glaucous-winged gull	–	–	3	1
Larus sp.	Gull	1	1	4	1
Rissa tridactyla	Black-legged kittiwake	1	1	–	–
Uria aalge	Common murre	–	–	8	2
Cepphus columba	Pigeon guillemot	–	–	1	1

Table 4. Bird remains at Willows Beach (continued).

		Zone B		Zone A	
Taxon	**Common Name**	**NISP**	**MNI**	**NISP**	**MNI**
Brachyramphus marmoratus	Marbled murrelet	1	1	1	1
Cerorhinca monocerata	Rhinoceros auklet	2	1	–	–
Columba fasciata	Band-tailed pigeon	–	–	2	1
Ceryle alcyon	Belted kingfisher	–	–	2	1
Colaptes auritus	Northern flicker	1	1	–	–
Cyanocitta stelleri	Steller's jay	–	–	1	1
Corvax caurinus	Northwestern crow	24	2	–	–
Total Identified to Genus or Species		**75**	**24**	**78**	**33**
Non-Identified Birds		**62**	**–**	**104**	**–**
Overall Total Birds		**137**	**24**	**182**	**33**

Table 4. Bird remains at Willows Beach (continued).

Results

A total of 2,363 vertebrate specimens from Zone A and Zone B at Willows Beach were identified at least to class, with 43% (1011) identified at least to level of genus. Fish made up 53% of these identified specimens, with salmon and rockfish the most numerous groups (Table 3). Bird specimens made up 15% of the total specimens identified at least to genus, with crows the most numerous species, and ducks the most numerous group (Table 4). Finally, mammal specimens comprised about 32% of those identified at least to genus, with deer and dog the most well-represented species (Table 5).

Comparison of the NISP between Zone A and Zone B indicates that the Zone A fauna are more abundant and diverse, based on raw counts of species (Tables 3-5). Zone A, however, had a smaller volume of sediment than Zone B. While small sample sizes ensure that most MNI differences are of only one or two individuals, the MNI lists also indicate greater species richness and more individuals in Zone A (Tables 3-5). This diversity may reflect the larger sample size in Zone A.

Taxon	Common Name	Zone B		Zone A	
		NISP	MNI	NISP	MNI
Marmota vancouverensis	Vancouver Island marmot	–	–	1	1
cf. *Tamiasciurus hudsonicus*	cf. Red squirrel	–	–	1	1
Castor canadensis	Beaver	–	–	2	1
Peromyscus sp.	Mouse	1	1	7	1
Rattus sp.	Rat	–	–	1	1
Canis familiaris	Dog	49	3	61	2
Ursus americanus	Black bear	4	1	3	1
Eumetopias jubata	Steller's sea lion	–	–	3	1
Procyon lotor	Raccoon	1	1	5	1
Mustela vison	Mink	–	–	2	1
Lontra canadensis	River otter	2	1	1	1
Phoca vitulina	Harbour seal	31	2	28	2
Lagenorhynchus obliquidens	Pacific white-sided dolphin	1	1	–	–
Phocoena phocoena	Harbour porpoise	–	–	1	1
Odocoileus hemionus	Black-tailed deer	47	3	48	2
Cervus elaphus	Elk	5	1	17	1
Total Identified to Genus or Species		141	14	181	18
Non-Identified Mammals		282	–	544	–
Overall Total Mammals		423	14	725	18

Table 5. Mammal remains at Willows Beach.

The NISP change of the fish assemblage composition from Zone B to Zone A is significant beyond the 0.0001 level ($\chi^2 = 33.29$, $p < 0.0001$) with the number of fish specimens identified to genus increasing by almost two and a half times. Zone A therefore contains evidence of more intensive fishing than Zone B, with four more fish taxa and evidence of larger individuals of two taxa (salmon and rockfish). Taxa with large proportional increases in numbers of specimens from Zone B to Zone A include especially the medium-large to large rockfish (15.5% to 30.7%), as well as great sculpin (2.5% to 6.5%). As discussed above, small fish, including anchovy and herring, are poorly represented because the bones were not retained in the 6-mm screen. The birds from Zone A are more numerous (29 species) than those of Zone B (21 species), representing about a 20% proportional increase. There is also an increase of about 24% in waterfowl from Zone B to Zone A, particularly among scoters, which could reflect a change in procurement techniques. The NISP and MNI of sea mammals increase from Zone B to Zone A, perhaps suggesting an intensification of sea mammal hunting.

Discussion

Willows Beach

This study predicted that differences in artifacts between the Locarno Beach and Gulf of Georgia levels at Willows Beach were based on changes and/or intensification of subsistence practices, as observable in the Zone A and Zone B faunal assemblages. The appearance of unbarbed bone points (unipoints) and harpoon valves in Zone A (absent in Zone B) was suggested to correlate with intensification of both fishing and sea mammal hunting (Kenny 1974). Unipoints had a wide range of fishing-related uses, particularly in arming fishhooks, composite harpoons, some spears and herring rakes (Matson & Coupland 1995; Mitchell 1971; Suttles 1974, 1990). The Willows Beach fish assemblage specimens increase almost two and a half times from Zone B to Zone A, particularly in greater numbers of great sculpin and rockfish, and to a lesser extent Pacific cod and halibut. Great sculpin and rockfish frequent diverse (including inshore) habitats, while Pacific cod and halibut are more common inshore in the summer. The ecological behaviour of all four of these groups make them most vulnerable to capture by fishing hooks (Stewart 1977), which may relate to the appearance of unipoints in Zone A. The smaller toggling harpoon valves in Zone A were historically used to harpoon salmon (Stewart 1977), whose remains were more common in that zone.

Barbed bone points, used historically for duck spears or arrows, are absent in Zone B but appear in Zone A at Willows Beach. They appear in Gulf of Georgia levels at other sites. Our faunal data indicate that waterfowl specimens increase from about 59% in Zone B to about 83% in Zone A. In particular, scoters, which belong to the Tribe Mergini (sea ducks), increase in number from Zone B to Zone A. Scoters are especially susceptible to human predation because they often rest in shallow waters in "enormous flocks" (Bellrose 1976) where they are vulnerable to spears or arrows. While the association between spear points and increased numbers of waterfowl may not be causal, particularly given the small sample size, it nevertheless provides support for the idea that hunters in the Zone A time period used the spear points to hunt waterfowl.

The reasons for increased procurement of scoters and other flocking waterfowl may have been driven by external factors. Sooty shearwaters – birds which migrate from New Zealand to western North America each year – make up over 16% of the Zone A specimens at Willows Beach, but only 2.5% in Zone B. A steeper decline in these birds from early to later levels – involving many more individuals – occurred at the Minard site in Washington state. This decline was tentatively attributed to the practice of culling young shearwaters in New Zealand from about AD 1000 on, which meant that few were left to make the long migrations north (Bovy 2007).

Another possibility is that the decline was caused by increasing surface sea water temperatures off western North America which forced the migrating shearwaters to fly further north to cooler waters. Scoters and other waterfowl may have been taken in greater abundance in the absence of shearwaters.

A large barbed antler harpoon point appears in Zone A; these were used in historic times for hunting large sea mammals (Kenny 1974). Remains of Steller's sea lion and a harbour porpoise were recovered in Zone A, while only one large sea mammal element was found in Zone B. Whether these remains represent beached individuals or actively hunted animals is not clear. However, the presence of the large antler harpoon suggests – through ethnographic analogy – that the inhabitants actively hunted these animals in the Gulf of Georgia levels.

While the artifact sample sizes are small, the appearance in Zone A of barbed bone points, unipoints, harpoon valves (toggling), and a large harpoon point (non-toggling) suggests new methods and intensification of hunting sea birds, fish, and mammals in the Gulf of Georgia levels at Willows Beach. The faunal assemblage, while also small, contains evidence that intensification of hunting of seabirds, certain fish, and possibly sea lions did occur in Zone A.

Other Sites on the Coast of Southern Vancouver Island

Because the Willows Beach faunal assemblage reported here is not large, it is important to examine whether the faunal trends observed are mirrored at other sites on the coast of southern Vancouver Island. While several sites have been excavated, not all faunal data were available or suitable for comparisons.

Several excavations have been undertaken at the large Esquimalt Lagoon site (DcRu-2), a site containing a large Gulf of Georgia component and a very small Locarno Beach component (e.g., Blacklaws 1979; O'Regan and Owens 1997). Fauna from certain of these excavations have been reported (e.g., Blacklaws 1979; Crockford 1997; O'Regan and Owens 1997), but different reporting techniques mean that only one report (Crockford 1997) was relevant here. Similar to Willows Beach, the Gulf of Georgia levels of the Esquimalt Lagoon fish assemblage (Crockford 1997: Appendix 2) contained proportional increases in several fish species which are best caught with hooks and line. These included perch, Pacific cod, rockfish, and halibut (Figure 2) (Stewart 1977). The unbarbed bone points which appeared at Willows Beach (and in Gulf of Georgia levels at other sites) may well have been used to arm hooks for catching these fish.

The Esquimalt Lagoon bird assemblage, as reported in Crockford (1997: Appendix 2), is small compared to the Willows Beach assemblage. However, similar to Willows Beach, the proportion of waterfowl at Esquimalt Lagoon increased by about 10% from the Locarno sub-phase to the Gulf of Georgia culture type levels (Figure 3).

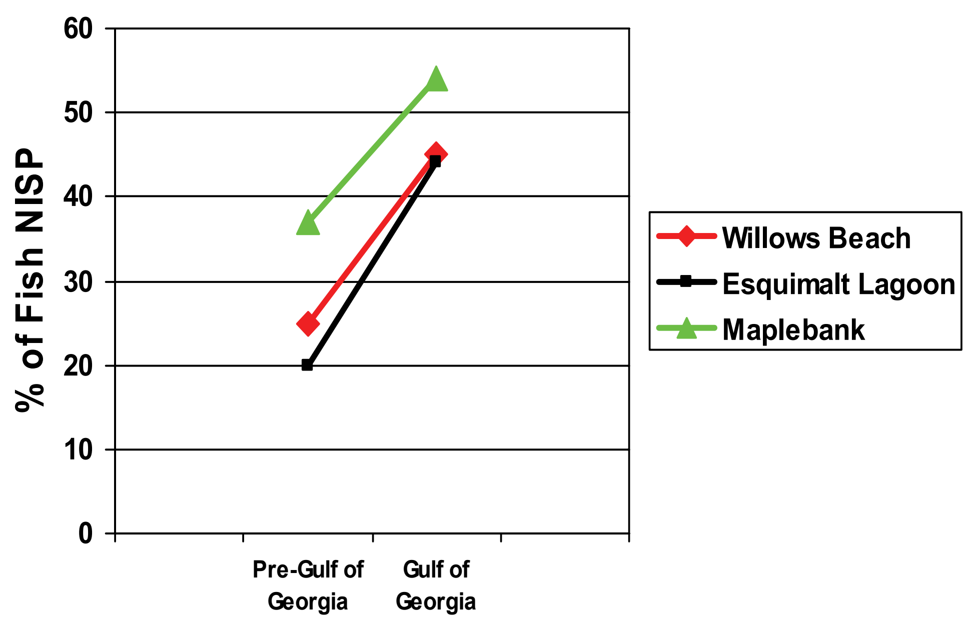

Figure 2. Change in percentage of NISP of fish most efficiently caught with hooks, from pre-Gulf of Georgia levels to Gulf of Georgia levels

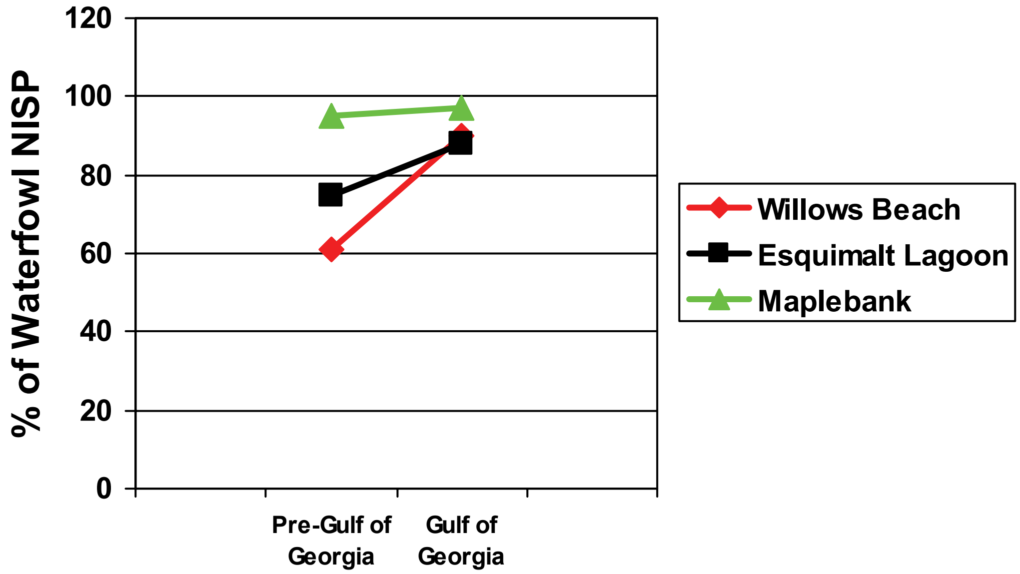

Figure 3. Change in percentage of NISP of waterfowl from pre-Gulf of Georgia levels to Gulf of Georgia levels.

Only two shearwaters were recovered at Esquimalt, and these were from the earlier levels. Finally, very few sea mammals were reported in the Esquimalt Lagoon fauna (4% of the identified mammal specimens), and no differences in exploitation were seen over time (Crockford 1997).

The large and diverse fauna from the Maplebank site (located on Esquimalt Harbour) contained both Locarno Beach and Gulf of Georgia components. Similar to both the Willows Beach and Esquimalt Lagoon assemblages, a proportional increase in fish species which are best caught with hooks was seen from the earlier to later levels. The Maplebank fish fauna also showed a proportional increase in Gulf of Georgia levels of species which can be caught inshore most efficiently with hooks (Figure 2). These included rockfish, perch and sculpin.

Analysis of the large Maplebank bird assemblage indicated that the proportional increase in waterfowl specimens from the Locarno to Gulf of Georgia levels at Willows Beach also occurred at Maplebank, although with a smaller proportional increase (2%) (Figure 3). Similar to the Willows Beach and Minard sites, the shearwater population also declined steeply in the later levels of the Maplebank site. There were also proportional increases in the much greater sea mammal numbers in the later levels of Maplebank, as was the case at Willows Beach.

In sum, the trends seen in the Willows Beach faunal assemblages of the intensification of hunting of seabirds, certain fish and possibly sea lions were also seen in the faunal assemblages of the Maplebank and Esquimalt Lagoon sites.

Conclusion

Despite the widespread use of the culture type concept in Northwest Coast archaeology, the exact significance of artifact assemblage changes is not fully understood. Croes (1989) suggested that different culture types are the result of changing subsistence patterns over time, particularly the intensification and diversification of faunal resource harvesting, as human populations grew. At Willows Beach, despite a small sample size, specific artifact types including barbed bone points, unipoints, toggling harpoon valves, and a large barbed antler point appeared in Zone A (Gulf of Georgia culture type), but were absent in Zone B (sub-phase of the Locarno Beach culture type). These artifacts also appeared in Gulf of Georgia levels in other sites. These implements were suggested to be associated with subsistence activities including increased waterfowl hunting, fishing for species most efficiently caught with hooks and lines and/or with small toggling harpoons, and increased sea mammal hunting (Kenny 1974).

The description of the Willows Beach faunal assemblages has indicated that, while small, these assemblages indeed show proportional increases from early (Zone B) to later (Zone A) levels in specimens of waterfowl, fish species best caught with hooks and lines and small harpoons, and sea mammals. These subsistence differences can be interpreted as changes associated with the transition from the Locarno Beach culture type to the Gulf of Georgia culture type.

Examination of faunal assemblages from two other large southern Vancouver Island coastal sites, Maplebank and Esquimalt Lagoon, provides further support for the faunal trends described from the Locarno Beach levels to the Gulf of Georgia levels at the Willows Beach site.

The Willows Beach faunal assemblages suggest that the Locarno Beach and Gulf of Georgia culture types were the products of different subsistence patterns. This finding may also have broader implications for the understanding of culture types on southern Vancouver Island and perhaps throughout the Gulf of Georgia. In support of such investigation, future research should aim to ensure that often-overlooked faunal assemblages are examined alongside artifact assemblages, and with equal care.

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References Cited

Beckwith, B. R.
2004 "*The Queen Root of This Clime": Ethnoecological Investigations of Blue Camas (Camassia leichtlinii (Baker) Wats., C. quamash (Pursh) Greene; Liliaceae) and its Landscapes on Southern Vancouver Island, British Columbia*. Unpublished PhD dissertation, University of Victoria.

Bellrose, F. C.
1976 *Ducks, Geese and Swans of North America*. Stackpole Books, Harrisburg.

Blacklaws, R. W.
1979 *Excavations at Esquimalt Lagoon. A contribution to Straits Salish prehistory.* Unpublished MA thesis, Simon Fraser University.

Bovy, K. M.
2007 Global human impacts or climate change?: Explaining the Sooty Shearwater decline at the Minard site, Washington State, USA. *Journal of Archaeological Science* 34: 1087-1097.

Bronk Ramsey, C.
1995 Radiocarbon calibration and analysis of stratigraphy: The OxCal program. *Radiocarbon* 37:425-430.

2001 Development of the radiocarbon calibration program OxCal. *Radiocarbon* 43:355-363.

Burley, D.
1980 *Marpole: Anthropological reconstructions of a prehistoric Northwest Coast culture type.* Archaeological Press Vol. 8. Department of Archaeology, Simon Fraser University, Burnaby.

Clark, T. N.
2000 *Prehistoric Culture Change on Southern Vancouver Island: The Applicability of Current Explanations of the Marpole Transition*. Unpublished MA thesis, University of Victoria.

Clark, T. N.
2010 *Rewriting Marpole: The Path to Cultural Complexity in the Gulf of Georgia.* Unpublished PhD dissertation, University of Toronto.

Crockford, S. J.
1997 *Analysis of the fauna from DcRu 2, Esquimalt Lagoon.* Manuscript on file. University of Victoria, Department of Anthropology.

Croes, D. R.
1989 Prehistoric ethnicity on the Northwest Coast of North America: An evaluation of style in basketry and lithics. *Journal of Anthropological Archaeology* 8:101-130.

Drucker, P.
1951 *The Northern and Central Nootka Tribes*. Bureau of American Ethnology Bulletin 144, Washington, DC.

James, T., E. J. Gowan, I. Hutchinson, J. J. Clague, J. V. Barrie, and K. W. Conway
2009 Sea-level change and paleogeographic reconstructions, southern Vancouver Island, British Columbia, Canada. *Quaternary Science Reviews* 28:1200-1216.

Kenny, R. A.
1971 *Preliminary Report – Willows Beach Excavation (DcRt 10). June-August 1971.* Permit 1971-38. British Columbia Archaeology Branch, Ministry of Tourism, Sport and the Arts.

1974 *Archaeological Investigations at the Willows Beach Site, Southeastern Vancouver Island.* Unpublished MA thesis, University of Calgary.

Lepofsky, D., K. Lertzman, D. Hallett, and R. Mathewes
2005 Climate change and culture change on the Southern Coast of British Columbia 2400-1200 CAL. B.P.: An hypothesis. *American Antiquity* 70:267-293.

Lyman, R. L.
2008 *Quantitative Paleozoology*. Cambridge University Press, Cambridge.

Mathews, D.
2006 *Burial Cairn Taxonomy and the Mortuary Landscape of Rocky Point, British Columbia.* Unpublished MA thesis, University of Victoria.

Matson R. G.
1981 Prehistoric subsistence patterns in the Fraser Delta: The evidence from the Glenrose Cannery Site. *B.C. Studies*. 48:64-85.

Matson, R. G., and G. G. Coupland
1995 *The Prehistory of the Northwest Coast*. Academic Press, San Diego.

Mitchell, D. H.
1971 Archaeology of the Gulf of Georgia area: a natural region and its culture types*.* *Syesis,* Vol. 4 Supp. 1. British Columbia Provincial Museum, Victoria, BC.

1990 Prehistory of the coasts of southern British Columbia and northern Washington. In *Northwest Coast*, edited by W. Suttles, pp. 340-358. Handbook of North American Indians, Vol. 7. Smithsonian Institution, Washington, DC.

Monks, G., and J. Pollitt
1970 *Project Report: DcRt 10.* Permit 1970-1971. British Columbia Archaeology Branch, Ministry of Tourism, Sport and the Arts.

O'Regen, D., and D. Owens
1997 *Archaeological data recovery at Esquimalt Lagoon Site 11T (DcRu-2): A summary of past excavations.* Manuscript on file. Archaeological Services, Parks Canada, Victoria, BC.

Owens, D., and D. Pawlowski
2007 *207 Esplanade: An Archaeological Impact Assessment.* Permit 2007-121. British Columbia Archaeology Branch, Ministry of Tourism, Sport and the Arts.

Reimer, P. J., M. G. L. Baillie, E. Bard, A. Bayliss, J. W. Beck, C. J. H. Bertrand, P. G. Blackwell, C. E. Buck, G. S. Burr, K. B. Cutler, P. E. Damon, R. L. Edwards, R. G. Fairbanks, M. Friedrich, T. P. Guilderson, A. G. Hogg, K. A. Hughen, B. Kromer, G. McCormac, S. Manning, C. Bronk Ramsey, R. W. Reimer, S. Remmele, J. R. Southon, M. Stuiver, S. Talamo, F. W. Taylor, J. van der Plicht, and C. E. Weyhenmeyer
2004 IntCal04 terrestrial radiocarbon age calibration, 0–26 cal kyr BP. *Radiocarbon* 46(3):1029–1058.

Stahl, P. W.
1995 Differential preservation histories affecting the mammalian zooarchaeological record from the forested neotropical lowlands. In *Archaeology in the Lowland American Tropics: Current Analytical Methods and Recent Applications,* edited by P. W. Stahl, pp. 154-180. Cambridge University Press, Cambridge.

Stewart, H.
1977 *Indian Fishing*. University of Washington Press, Seattle.

Suttles, W.
1974 *The economic life of the Coast Salish of Haro and Rosario Straits*. Coast Salish and Western Washington Indians, vol. 1:453-475. American Indian Ethnohistory: Indians of the Northwest. Garland Publishing, New York and London.

1990 Introduction. In *Northwest Coast*. Handbook of North American Indians, Vol. 7:1-15, edited by W. Suttles, Smithsonian Institution, Washington, DC.

Wigen, R. J. S.
1980 *A Faunal Analysis of Two Middens on the East Coast of Vancouver Island.* Unpublished MA thesis. University of Victoria.

Willerton, I. M.
2009 *Subsistence at Si•čə'nəł: The Willows Beach Site and the Culture History of Southeastern Vancouver Island*. Unpublished MA thesis. University of Victoria.

Wilson, I. R., K. Bowie, A. Hickok, R. Wigen, and J. Nord
2007 *Archaeological Excavation and Monitoring: Sewer Line Relocation, Willows Beach Site (DcRt 10). 2793 Somass Drive, Oak Bay, B.C*. HCA Site Alteration Permit 2006-190. British Columbia Archaeology Branch, Ministry of Tourism, Sport and the Arts.

Book Review

Quantitative Paleozoology
R. Lee Lyman (2008)
Cambridge Manuals in Archaeology, Cambridge University Press
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Frances L. Stewart
110 Water Street South, Kitchener, ON N2G 1Z5, frances.stewart@mail.mcgill.ca

Seldom have I enjoyed so much such a difficult book as R. Lee Lyman's *Quantitative Paleozoology.* Reading and re-reading the chapters in this book was like attending lectures in a course on "Statistics for Paleozoology" from a demanding professor who explains difficult concepts well. Because I have benefited so much from this text, I want to let others know about it ─ hence, this review. As Lyman notes, the topic of reliable quantification of animal remains is of great interest to both palaeontologists and zooarchaeologists, and examples from both their fields of study occur throughout this text.

If the title seems familiar, that is because, as Lyman explains in his preface, his 2008 book covers the same ideas as Donald Grayson's *Quantitative Zooarchaeology*, published in 1984. However, Lyman's book is much more than a mere revision of that classic and I suspect that, like its predecessor, it will be a standard reference for many years to come.

The first of eight chapters is titled "Tallying and Counting: Fundamentals". Terminology and definitions are covered in this chapter. For example, Lyman recommends using the word "element" for complete discrete anatomical units, such as a whole bone, tooth or shell, and the word "specimen" for fragments or portions of bones, teeth or shells. This follows what has become general practice for many zooarchaeologists, and I agree with Lyman's suggestion that we all adopt this. The highlight in this chapter is the section on *Mathematical and Statistical Concepts*. Lyman gives a very good explanation of four distinct scales of measurement: nominal, ordinal, interval, and ratio. The examples he uses to illustrate these are excellent. Equally important in this chapter is the introduction of the concepts of *measured* and *target* variables. The relationship between these two is a recurring theme in the book. This chapter, like most of the others, is concluded with a summary discussion of the ideas in it. There is also a final section introducing faunal material from owl pellet samples and mammalian faunal remains from two archaeological sites. These are used throughout the book to illustrate various quantitative methods.

Chapter 2 on "Estimating Taxonomic Abundances: NISP and MNI" is the longest one. (Lyman would probably give the page numbers for all the chapters and a test to show that this chapter is significantly longer than any of the others.) This chapter repeats much of what Grayson (1984) wrote. Remembering Lyman's deep interest in taphonomy, it is not surprising that he begins this chapter with a discussion of the various altering stages that skeletons experience after death. Unfortunately, in my opinion, Lyman chooses to use obscure names for these stages rather than ones that have been in common usage for a long time. For example, Clark and Kietzke's (1967:111) and Klein and Cruz-Uribe's (1984) "life assemblage" is Lyman's "biocoenose," and similarly difficult terms are applied to each of the other stages that a skeletal element goes through from the time of death until it is excavated by an archaeologist or a palaeontologist. When these terms were used later in the book, I found that I had to flip back looking for their meanings. This is a small criticism, and the terms are included in the glossary at the end of the book.

NISP and MNI as quantitative units have been discussed often in the literature, and many of the problems associated with each of them are familiar. Like Grayson before him, Lyman gives a good summary of their uses and then adds more reasons for the use of NISP as opposed to MNI. He includes many examples in this chapter, and these are nicely illustrated with detailed tables and figures to exemplify his main point that MNIs are derived from NISPs, and therefore provide no new information. He returns to topics outlined in the first chapter and concludes that both NISP and MNI are ordinal scale measurements only. Secondly, he finds that much of the disagreement about their usefulness has stemmed from a lack of precision in defining the target variable that is being sought. In our target values, zooarchaeologists are usually trying to determine what the people ate (Lyman's taphocoenose) whereas palaeontologists, including those studying the first humans, more often are those trying to reconstruct what was available in the environment for humans to hunt or scavenge (Lyman's biocoenose). Lyman emphasizes that we must be very clear about what we are trying to establish (our targets). This chapter requires very careful reading but the examples assist the reader in understanding the concepts presented.

One crucial definition in Chapter 2 surprised me. Lyman defines NISP as the "number of skeletal elements (bones and teeth) and fragments thereof – all specimens – identified as to the *taxon* they represent" (p. 27, emphasis added). I originally read this and agreed, thinking I knew what NISP meant. It was only in a later chapter (see below) that I realized Lyman defines NISP as the total of those remains which could be identified to taxon rather than the total number of all of the specimens in the sample, which is how I have used the term. My experiencing this difference farther along in my reading emphasized to me the importance of carefully disclosing how we are using even supposedly well-known terms in our publications. I personally prefer defining NISP as the total number of specimens in the sample because it avoids the issue of different analysts being able to identify more or less of the total sample. We can all count up the specimens but some of us are better than others at identifying them to class, to family or more precisely.

Expanding on his discussion of quantification using NISP or MNI, in Chapter 3, "Estimating Taxonomic Abundance: Other Methods", Lyman reviews other methods. He begins with a consideration of estimating biomass. He shows that, in addition to the problems inherent in MNI, when an analyst decides to multiply the average meat weight of a taxon by its MNI, there is the added problem of determining a correct *average* meat weight. Trying to avoid these problems, some researchers have turned to total bone weights to compare taxa. But bone weights are not similar across classes or species for similar volumes of bone. In fact, we use these differences to help us identify the specimens initially. Lyman next discusses using bone size to establish total body size (allometry) and also finds this procedure lacking. The question of pairing bones to establish the number of individuals represented in a collection could have been included in the previous chapter, but is covered here. I have tried to do this with archaeological beaver bones and agree with White and Lyman that this procedure is both too time consuming and too fraught with possible mis-matches to be useful. In the discussion at the end of this chapter, Lyman concludes that the best quantification measure to use is NISP.

Chapter 4 is on "Sampling, Recovery, and Sample Size". I found the first half of this chapter was easy reading but the second was more challenging. Most of us are very familiar with the effects that different recovery methods, particularly the various screen mesh sizes, have on the faunal samples that we study. Lyman does a nice job of covering this topic, although I was surprised that he did not include flotation here. He includes an interesting discussion of ways to correct for differential loss due to different excavation methods and gives formulas for this. Unfortunately, Lyman argues, these are not very useful because they require the assumption that faunal remains are distributed evenly across a site and most often this is not the case.

Perhaps of greater interest in this chapter are his considerations of comparing samples of different sizes (using rarefaction which is reducing the large sample to a smaller size) and of sampling to redundancy. There are computer programs to help with the first of these issues. For the second, Lyman shows how NISP figures compared to volume excavated can be graphed, and he provides graphs for actual samples to demonstrate this. When the curve levels off, you are no longer gaining new information. As Lyman admits, this could be difficult to use in the field, as faunal specimens generally are not identified and analyzed there, but it could be used in the lab. Once no new information is being derived from the identifications, then they can cease, saving time and money rather than continuing on to finish up a complete sample when no new information is being generated. Again, the analyst would have to keep checking to determine this breaking point. This is not a new idea and many have sampled large fauna collections (mainly to save on time and money) but Lyman's coverage of the topic makes employing it very convincing. Finally in this chapter, Lyman discussed "nestedness," which is a way of determining if samples of different sizes might have been derived from the same underlying population. This concept has been developed by biologists comparing island chain populations and does not seem to be as useful to archaeologists.

"Measuring the Taxonomic Structure and Composition ("Diversity") of Faunas" is the title of Chapter 5. I found that the definitions stated at the beginning of this chapter needed rereading because I was unaccustomed to his use of the term "diversity". For Lyman, diversity "signifies the structure and composition of a fauna" (p. 176) which include the particular taxa represented, the total number of taxa represented (i.e., the richness of the sample), and the number of specimens within each taxa (i.e., the taxonomic evenness of the sample). Diversity has been used in the past by many zooarchaeologists to indicate the combined number of taxa and the number of individual specimens in those taxa, but here Lyman uses the term "heterogeneity" for that concept. In this chapter, the variables making up diversity are considered and quantitative indices for each of these variables are discussed, beginning with the number of identified taxa for which Lyman uses the abbreviation NTAXA. This is followed by a discussion of the "Indices of Structure and Similarity," beginning with the simplest, taxonomic richness, and proceeding through taxonomic composition and taxonomic heterogeneity to taxonomic evenness. These sections are well illustrated with tables and graphs which assist in the comprehension of the occasionally difficult concepts. In zooarchaeology, taxonomic abundances in samples are used to answer basic questions regarding diet, and comparisons are often made between spatially discrete units at a site, over time on one site or between and among sites. Using the methods explained in this chapter, the validity of such comparisons can be enhanced. Lyman ends the chapter by reminding researchers that they must be clear about what they are comparing and how area or time is being conflated in the comparisons.

Closely related to the issues covered in Chapters 2 and 3, MNE (the minimum number of elements) is the topic of Chapter 6: "Skeletal Completeness, Frequencies of Skeletal Parts, and Fragmentation". Lyman's review of the history of MNE shows that the concept was first used by taphonomists (specifically Voorhies in 1969) who were most concerned with explanations of assemblage formation and why some elements were more common in a collection than others. The same disproportionate numbers of particular animal bones interested Binford and others (Binford and Bertram 1977 and several Binford publications from 1978 on, cited by Lyman).

A problem which arises with MNE is how the values are derived, and Lyman shows that many different methods have been employed in the past, including even using GIS imaging which in Lyman's trials was unsuccessful. Obviously, once again clear explanations must be given in reports about the way MNE is determined. Because MNE is really just a variant of MNI, all of the weaknesses (sample size, aggregation, and definition) in the latter apply to the former, and MNE is an ordinal scale measurement only. This is nicely demonstrated with skeletal part numbers of zooarchaeological deer and wapiti and graphs using those figures.

Lyman next discusses Binford's introduction of MAUs ("Minimal Animal Units") as an attempt to standardize the MNEs by dividing the observed number of elements by the number of times that element occurs in the complete skeleton. Often the MAU figures are normed by "dividing all MAU values by the greatest observed MAU value in a particular collection and multiplying each resulting value by 100" (p. 234) which aids in comparisons. Several other methods for standardizing MAUs have been devised and Lyman reviews these as well as Shotwell's failed attempts to accurately measure skeletal completeness. Although MNE has been used in attempts to measure skeletal part abundance, skeletal completeness and bone fragmentation, Lyman concludes that it is not valid for any of these targets. He does allow that determining MNE might be of interest when one element is more fragmented than another. This would become apparent in the differences between the pairs of NISP and MNE figures for the elements. Lyman goes on to argue that if the two values are strongly correlated then it is better to use NISP numbers. He does not comment on the opposite condition - if the two values are not correlated - but rather he reiterates the inherent problems with MNE. If we abandon both MNI and MNE, as Lyman recommends, how do we let readers of our reports know that, in one or more of the totals in our NISP column of represented species, there is a disproportional number of specimens from one element?

Not surprisingly, considering Lyman's extensive research on taphonomy, including his oft-cited, comprehensive book on this topic (Lyman 1994), the second last chapter of this text is "Tallying for Taphonomy: Weathering, Butchering, Corrosion, and Butchering." Lyman begins this seventh chapter with a nice definition of a taphonomic *signature* which is "a modification feature evident on a skeletal part that is known (or believed) to have been created by only one process or agent… It is a signature because it is unique to that agent or process." (p. 264). The signatures considered in this chapter include those caused by weathering, chemical corrosion, mechanical abrasion, burning, gnawing and, finally and in greatest detail, butchering. Methods for tallying these marks and the many associated pitfalls are discussed.

In this chapter Lyman introduces two more acronyms and so highlights a problem with the definition of NISP mentioned above. The new acronyms are: *NSP* for the number of specimens and *NUSP* for the Number of Unidentified Specimens. He gives this equation, NISP= NSP-NUSP. I have always used NISP to mean the total number of *individual* specimens in a sample or Lyman's NSP and have listed his NUSP figures in my tables and given them as a percentage of the total sample in the introduction to a report. I wonder if I am alone in this? In any case, this certainly highlights a main theme of the book which is to be sure we have given precise definitions for the terms we use to describe our faunal samples. I was also somewhat surprised to read that few people give NUSP. I agree the acronym is not in general use but many reports do include the number and percentage of unidentified specimens for the total sample and within classes too.

In the last short chapter, Lyman offers his "Final Thoughts". Here he reviews the main points of the book ending with a repeated caution for researchers to be explicit in the identification of their target variables and then to take into account how the variable they measure either does or does not actually reflect the magnitude of the target variable. The explanations in the body of this text will help researchers to do just that.

This book ends with a useful, three page glossary, 30 pages of references and an index. Thus, in addition to the excellent explanations within this text itself, there are many more sources provided for the reader to consult.

I borrowed this book from the library but, halfway through reading it, realized that I wanted my own copy. I imagine returning to it often in the future and recommend its purchase to you.

References Cited

Binford, L.R.
1978 *Nunamiut Ethnoarchaeology*. Academic Press, New York.

Binford, L. R. and J. B. Bertram
1977 Bone frequencies and attritional processes. In *For Theory Building in Archaeology*, edited by L. R. Binford, pp. 11-153. Academic Press, New York.

Clark, J. and K. K. Kietzke
1967 Paleoecology of the Lower Nodular Zone, Brule Formation, in the Big Badlands of South Dakota. In *Oligocene Sedimentation, Stratigraphy, Paleoecology and Paleoclimatology in the Big Badlands of South Dakota*, edited by J. Clark, J. R. Beerbower and K. K. Kietzke, pp.111-137. Fieldiana: Geological Memoirs, Volume 5, Field Museum of Natural History.

Grayson, D. K.
1984 *Quantitative Zooarchaeology. Topics in the Analysis of Archaeological Faunas.* Academic Press, Orlando, FL.

Klein, R. G. and K. Cruz-Uribe
1984 *The Analysis of Animal Bones from Archaeological Sites*. University of Chicago Press, Chicago.

Lyman, R. L.
1994 *Vertebrate Taphonomy.* Cambridge University Press, Cambridge.

Voorhies, M. R.
1969 *Taphomony and Population Dynamics of an Early Pliocene Vertebrate Fauna, Knox County, Nebraska.* University of Wyoming Contributions to Geology Special Paper No.1, Laramie.