FORGOTTEN WATERS: A ZOOARCHAEOLOGICAL ANALYSIS OF THE COVE CLIFF SITE (DhRr 18), INDIAN ARM, BRITISH COLUMBIA

by

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ABSTRACT

The Gulf of Georgia is among the most comprehensively studied regions on the Northwest Coast. However, few archaeological studies focus on Late Phase sites (1200 B.P.-250 B.P.) especially those in inlets; examinations of intra-site activity areas are also rare. I analyse the archaeofauna from Late Phase deposits inside and outside a small structure at the Cove Cliff site, Indian Arm, British Columbia. Those results are compared to published results from two other inlet sites and a site on the Fraser River Delta to explore how the inlet environment was utilised. I also test for intra-site spatial patterns that may signify activity areas. My findings suggest people took full advantage of their local environment but also had socio-economic relations with distant groups to procure certain resources. The spatial analyses identify three activity areas. These results begin to address some gaps in our understanding of Late Phase Gulf of Georgia prehistory.

DEDICATION

To my parents

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CHAPTER ONE
INTRODUCTION

Though there has been a manifold increase within the past decade in our understanding of the prehistory of the Northwest Coast of North America, research on the coast tends to be focused on a few regions. One such region is the Gulf of Georgia, which, because of its proximity to two major urban centres and three universities, has probably witnessed more archaeological research than anywhere else on the coast (Ames and Maschner 1999:24, 41). However, even within this region, our archaeological reconstruction of prehistory is incomplete. Most research has focused on the Gulf Islands, southeast Vancouver Island, and the Fraser River Delta. Inlet environments, in particular, have been forgotten waters.

Temporal coverage of the prehistory of the Gulf of Georgia region is also uneven. Most research has focused on the middle prehistoric phase (2400-1200 B.P.). Early sites, while holding the interest of many archaeologists, are relatively uncommon. Late Phase sites (1200 B.P. – 250 B.P., following Lepofsky *et al.* 1996), while relatively common, have received less attention by archaeologists (Matson and Coupland 1995:267-270). In part, this is because of the preconceived notion held by some researchers that the Late Phase witnessed little change in cultural practices, and that this period can be best described by reading ethnographic accounts of the region (Ames and Maschner 1999:95).

Within the Gulf of Georgia, as elsewhere on the coast, excavation of ancient villages has been a focus of research. In recent years, many Northwest Coast archaeologists have shifted strategy at such villages away from the deep excavation of middens to reconstruct culture histories, to the areal excavation of plank houses to address various social questions (e.g., Coupland *et al.* 2003; Grier 1999; Matson 2003; Morrison 1997; Samuels 1991a, 1994; Schaepe 1998). To date, however, few studies have combined data from areal excavation of houses and the detailed excavation of exterior middens to arrive at a fuller understanding of the social and economic relations of the settlement as a whole. Coupland *et al.*'s (2003) work at McNichol Creek on Prince Rupert Harbour, British Columbia, however, demonstrates that such research can provide insight into the use of both private and public space within a village.

This thesis focuses on these three less studied elements of Northwest Coast archaeology— utilisation of the inlet environment in the Gulf of Georgia, the Late Phase, and extramural areas within a settlement. It is a detailed examination of the faunal remains from the Cove Cliff shell midden (DhRr 18) located on Indian Arm (Fig. 1).

Excavation of the Cove Cliff site took place in the summer of 2000 as a joint project of Simon Fraser University and Tsleil-Waututh Nation. Urban use prevented access to the portion of the site outside Strathcona Park, a small neighbourhood park. Therefore, investigators were forced to bypass the usual focus of archaeological inquiries, the central midden, and investigate a peripheral area of the site. The faunal remains analysed in this thesis were recovered on the western edge of the site from what was inferred to be a small structure and an associated processing area. Areal excavation of these deposits, which date no earlier than 500 years ago (Dana Lepofsky, personal communication 2001), afford a look at the use of animal resources by one group of inlet peoples who lived during the Late Phase of Gulf of Georgia prehistory. These results, in combination with the published results from three other Gulf of Georgia sites Belcarra Park (Charlton 1977, 1980), Cates Park (Alexander and Grier 2000; Charlton 1974; Williams 1974), and Tsawwassen (Arcas 1991, 1999; Kusmer 1994a, 1994b, 1994c), provide the foundation for a broader understanding of the use of

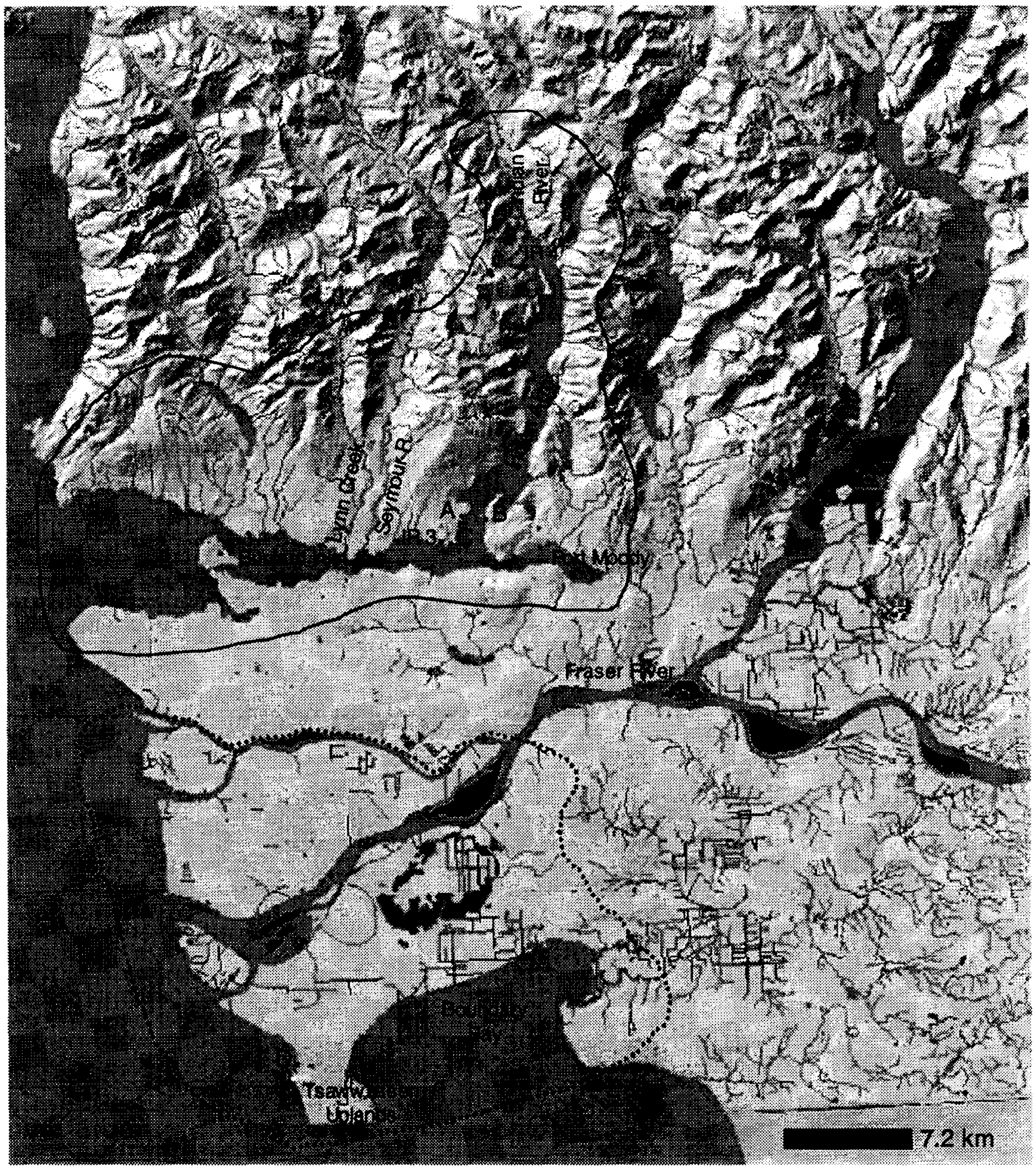

Figure 1. Burrard Inlet-Indian Arm locality and the Fraser River Delta. A-Cove Cliff site, B-Belcarra Park site, C-Cates Park site, D-Tsawwassen site. Solid line indicates boundaries of the Inlet locality. Dotted line indicates boundaries of the Fraser River Delta, after Butler and Campbell (1987). Adapted from Department of Fisheries and Oceans [DFO] (2004).

Burrard Inlet and Indian Arm by ancient peoples. Cove Cliff, Belcarra Park, and Cates Park sites, located on the shores of Indian Arm and Burrard Inlet within 2 km of each other, share a similar environment. I compared the three inlet sites' archaeofaunal assemblages to the Tsawwassen site's archaeofaunal assemblage for three reasons. The Tsawwassen site is located within a different environmental setting, all of the faunal remains at Tsawwassen were analysed, and the methods used to recover and analyse the faunal remains were similar to those used for the Cove Cliff faunal remains.

Environmental context

The Burrard Inlet, Indian Arm, and Fraser River Delta encompass five environmental zones, which are home to a plethora of animals (Table 1, Fig. 2, Appendix A). The Burrard Inlet-Indian Arm locality is comprised of two land-based biogeoclimatic

Table 1. Ecozones of the Burrard Inlet-Indian Arm locality and Fraser River Delta.

	Mountain Hemlock	Coastal Western Hemlock	Coastal Douglas-fir	Coast Intertidal	Coast Subtidal
Location	900-1800 m elevation.	Sea level to 1050 m elevation.	Below 150 m elevation.	Spray zone to the extent of the lowest low tide.	From the low tideline to the edge of the continental shelf.
Ecosystems	Coniferous forest, wetlands and streams, subalpine meadows, rocky outcrops/ talus.	Coniferous forest, mixed deciduous and coniferous forest, rocky cliffs/talus, upland grassy areas, wetlands and streams, lakes.	Coniferous forest, mixed coniferous and deciduous forest, wetlands and streams, lakes.	Rocky shore[1], sandy shore, estuaries, sand-/mud-flats, cobblestone shore[2], swamp or marsh, eelgrass/kelp.	Rocky substrate, sand substrate, mud substrate, cobblestone substrate, eelgrass/kelp, open waters.

[1]Includes shores consisting of large boulders and/or rock cliffs. [2]Sand-mud beach/substrate with rounded stones or gravels, typically found in protected waters.
Sources: Land-based biogeoclimatic zones adapted from Meidinger and Pojar (1991). Coast intertidal and subtidal ecozones compiled from Canadian Hydrographic Service maps 1930, 1938, 1960; Gibson 1999:98-112; Snively 1980.

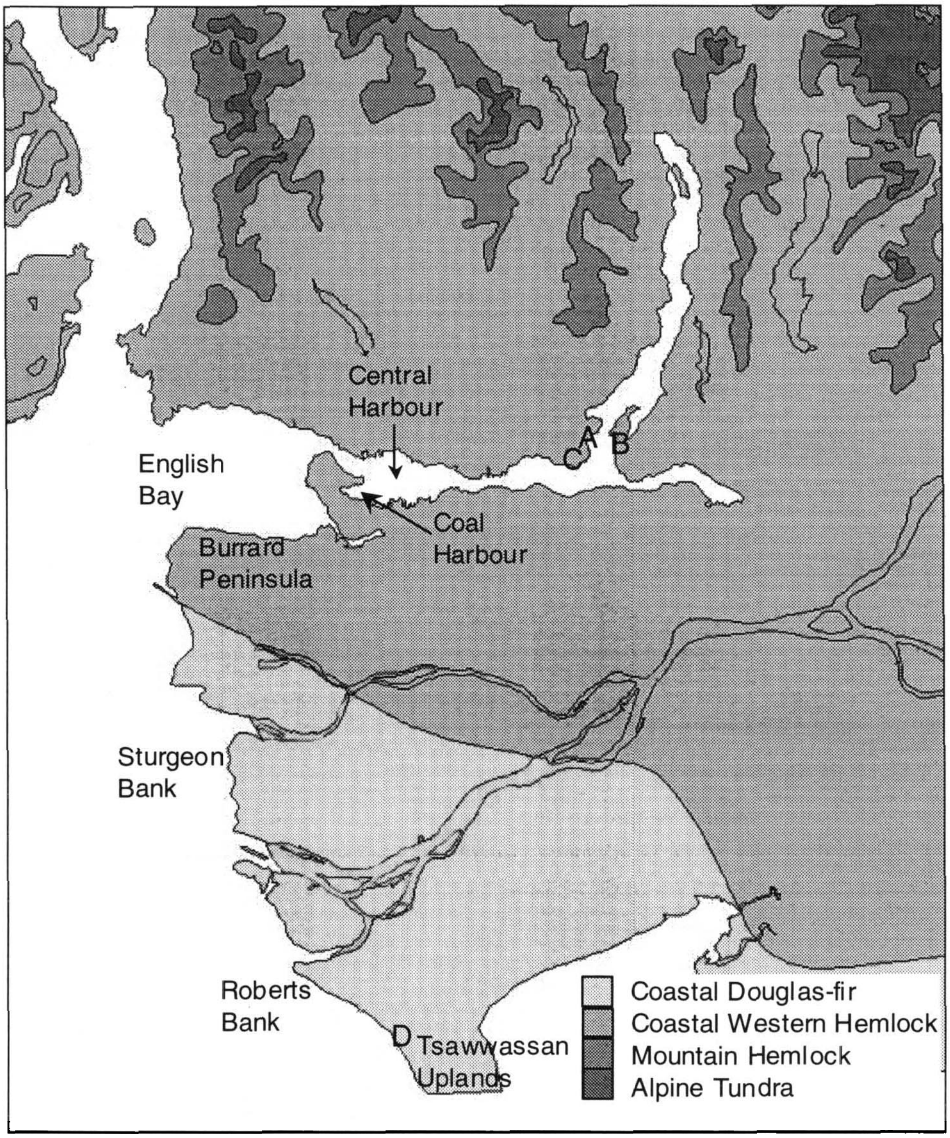

Figure 2. Distribution of land-based ecosystems in the Burrard Inlet-Indian Arm locality and surrounding region. A-Cove Cliff site. B–Belcarra Park site. C–Cates Park site. D-Tsawwassen site. Note: Present day shoreline. Adapted from Ministry of Forests (2003), Provincial Digital Biogeoclimatic Subzone/Variant Version 5.0, by permission.

zones—the Mountain Hemlock and Coastal Western Hemlock (Meidinger and Pojar 1991:98), as well as the water-based Coast Intertidal and Coast Subtidal. The three inlet sites are located within the moist maritime variant of the Coastal Western Hemlock zone. Tsawwassen is within the Coastal Douglas-fir biogeoclimatic zone (Meidinger and Pojar 1991:98). All four sites are in proximity to coast intertidal and subtidal ecosystems but the specific type of shore adjacent to each site varies. Today, the urban landscape has greatly altered what once was an area of dense forest, swamps, bogs, and numerous streams (Armitage 2001:268; DFO 1995; Canadian Hydrographic Service 1930, 1938; Matthews 1955:173; Vancouver Natural History Society [VNHS] 1995:23).

For this thesis, the local environment is comprised of land and water that can be reached within two hours; this allows a one-day round trip with approximately six hours to procure resources. By canoe, this is a distance of approximately 9 km given good weather and 5.4 km if the weather is bad (Ames 2002:30). From Cove Cliff, and the other inlet sites, this area spans from Lynn Creek east to the end of the Port Moody Arm of Burrard Inlet and north to just over half the distance to Indian River (Fig. 1). From Tsawwassen, people could travel north and reach the south arm of the Fraser River or travel south, round the Tsawwassen Uplands, and reach Boundary Bay (Fig. 1). Overland travel is more difficult to assess because at certain times of the year inland waterways were more amenable to travel via canoe and the topography varies from extremely steep to relatively flat. I estimate an average travel speed of 2 km per hour based on hikes on the east shore of Indian Arm. This places the Mountain Hemlock zone just outside Cove Cliff's local environment.

Key to this thesis is the spatial and temporal distribution of animals that may be indicative of ancient peoples' use of the land- and seascape to obtain animal resources. A comparison of the list of species described in the ethnographic record (Barnett 1955; Bouchard and Kennedy 1986; Matthews 1955), archaeological record (Charlton 1977; Galdikas-Brindamour 1972; Williams 1974), and recent studies (e.g., Breault and Watts 1996; Hanrahan 1994; Department of Environment [DOE] 1971; Quamme *et al.* 1998; VNHS 1995) suggests little change in taxonomic diversity overtime. Whether or not the distribution or abundance of animals has remained consistent is not clear. Recent surveys of nearshore (maximum depth 11.8 m) marine fauna at Belcarra Park and Cates Park identified several taxa present in the archaeological remains from Cove Cliff—the plainfin midshipman, buffalo and Pacific staghorn sculpins, rock and English soles, starry flounder, and a variety of gobies, sculpins, and flatfish (ECL Envirowest Consultants Ltd 1993; Hardon *et al.* 1985). Unfortunately, these surveys are not reflective of seasonal changes in the structure of the fish population. Notable differences in fish distribution between the Burrard Inlet-Indian Arm locality and the Fraser River Delta are the absence of northern anchovy, plainfin midshipman, greenling, and rockfish in the waters of the Delta (Northcote 1974:12-13; Northcote *et al.* 1978:6-10).

Fish that were available in large numbers at specific times of the year include salmon, Pacific herring, and smelts. Information regarding migratory fish species in the Burrard Inlet and Indian Arm was primarily obtained by speaking with Eric Olsen, a longtime volunteer at a local salmon hatchery and Matt Foye, a biologist with the Department of Fisheries and Oceans Canada. Records regarding fish distribution generally date back to the 1930s, after urban development had occurred. Therefore, it is not known how accurately present day distributions of fish taxa reflect the ancient past.

Four species of salmon were relatively accessible to people in the Burrard Inlet and Indian Arm. The Indian River has one of the largest natural spawning runs of pink salmon (100,000s), which run in large numbers only in odd-numbered years. In even-numbered years, if a run occurs, the fish number in the 100s (Matt Foye, personal communication 2003). Chum, coho and probably chinook, also spawn in the streams flowing into Burrard Inlet and Indian Arm (Morvan 1976; Matt Foye, personal communication 2003; Eric Olson, personal communication 2004). All five species of salmon run in the Fraser River drainage system, but coho occurs in relatively lower numbers (+100,000; Northcote 1974).

The distribution of Pacific herring is less well understood. The ethnographic record describes herring being procured when spawning on the north shore of English Bay and in Coal Harbour, where it was found in large numbers (Fig. 2; Bouchard and Kennedy 1986; Matthews 1955:252). These ethnographic accounts are supported in part by the presence of suitable herring spawning habitat in existence along the north shore of English Bay (DOE 1971:e-19). However, herring spawning statistics dating back to 1934 suggest such events are rare and the number of spawning herring small, particularly in the inner Burrard Inlet east of Lynn Creek (Fig. 1; DFO n.d.). Whether this pattern applies to prehistory is not known. An informant told ethnographers (Bouchard and Kennedy 1991:152) that herring used to spawn in the waters near Tsawwassen. This memory is supported by the presence of eelgrass beds capable of supporting herring in the southern portion of Roberts Bank (Fig. 2; Beak Consultants Ltd.1977:B21-B30).

Land mammals are less constrained in their distribution than are fish; however, within the study area a few animals tend to be found in certain locales. The mountain goat, grizzly bear, and snowshoe hare are more common at higher elevations of the Mountain Hemlock and Coastal Western Hemlock zones than the lowlands of the Fraser River Delta (Cowan and Guiguet 1956:100-101, 296-297, 389; Meidinger and Pojar 1991:89-91, 106-108, 122; Nowak and Paradiso 1983:1292; Stevens 1995). Beaver prefer slower running water on relatively flat terrain (Cowan and Guiguet 1956:170; Nowak and Paradiso 1983:560-563). Larger sea mammals tend to inhabit the more open waters of the Gulf of Georgia or English Bay.

Bird populations within the study areas—Burrard Inlet, Indian Arm, and Fraser River Delta, are large and diverse (Appendix A). The bird population of the Fraser River Delta overshadows that of the Burrard Inlet and Indian Arm with a mean population of

39,000 birds in summer and 177,300 aquatic birds in the fall (Butler and Campbell 1987:11-15). Burrard Inlet is home to only about 7,000 birds in the summer and approximately 25,000 in December, with the largest congregations found in the Central Harbour (Fig. 2; Breault and Watts 1996:iii). In comparison, Indian Arm has a relative paucity of birds; however, it has a greater density of bald eagles and serves as a flyway for migratory birds (Breault and Watts 1996:iii, 23-24; VNHS 1995:59). Near the three inlet sites, where Indian Arm flows into Burrard Inlet, an upwelling of nutrient rich water occurs that attracts fish and their predators, including numerous birds (VNHS 1995:45). These behaviours of birds may be reflected in native tradition, "It was well known that flocks of ducks flew past here [Belcarra] and that when they passed all the people in the village shouted loudly so that the ducks would become stunned and could then be gathered" (Bouchard and Kennedy 1986).

Three distinct types of shorelines are associated with the study sites based on site visits and shoreline descriptions (Table 2). Immediately adjacent to Cove Cliff and Belcarra Park are cobblestone shores intermixed with sand- and mudflats and rock formations. The shore within Cates Park is sandy with relatively large boulders. The

Table 2. Intertidal ecosystems in the immediate vicinity (0.25 km) of the study sites.

	Cove Cliff	Belcarra Park	Cates Park	Tsawwassen
Rocky shore	X	X	X	
Sandy shore	x	x	X	
Estuaries				X
Sand-/Mudflats	x	x	x	X
Cobblestone shore	X	X	x	
Swamp or marsh				x
Eelgrass/kelp beds[1]	?	x	x	x

X=Relatively large expanse present; x=small patches present. [1]This ecosystem represents habitat suitable for herring to spawn. *Sources*: Based on observations during site visits and Alexander and Grier 2000; Beak Consultants Ltd. 1977; Bouchard and Kennedy 1991; Canadian Hydrographic Service maps 1930, 1938, 1960; Charlton 1977, 1980; DFO n.d.; Stryd 1991a:7-19; Eric Olsen, personal communication 2004.

Fraser River Delta shore west of the Tsawwassen site consists almost entirely of sand- and mudflats. Although Euro-Canadian settlement has resulted in extensive change to the Burrard Inlet in general, the only noticeable change to the shoreline near the inlet sites is the seeming disappearance of a small beach west of Turtle Head that is noted on a 1930's hydrographic map (Fig. 3). Today, on an average low tide only a rock formation is visible where the beach should be. The Tsawwassen shore has undergone change due to the continual progradation of the delta. At 1000 B.P., the shore was an estimated 2.4 km inland from its present-day position. The primary ecosystems then were extensive tidal sand- and mudflats and tidal marsh. Rocky intertidal shores were found to the south of the site (Kusmer 1994c:191-192, 203-205).

Cultural Context

In the Historic era, the Cove Cliff site and the three other study sites are located within the territory of the Halkomelem-speaking Coast Salish. The household, an extended family group and its slaves, was the fundamental social and economic unit within Coast Salish society. During the winter, household members dwelled in plank house villages and subsisted primarily on stored goods. Spring through fall, household groups dispersed into smaller familial units who traveled to resource patches to harvest foods and raw materials as they became available. At these seasonal villages and camps, food was consumed immediately and processed for winter stores (Barnett 1955; Carlson 2001; Duffield and McHalsie 2001; Suttles 1974, 1987a, 1987c, 1987d, 1990). In addition to adopting a seasonal round of subsistence to accommodate both temporal and spatial scarcity of resources, the Coast Salish developed a complex resource-exchange system. The "infrastructure" for this system of exchange was the affinal and

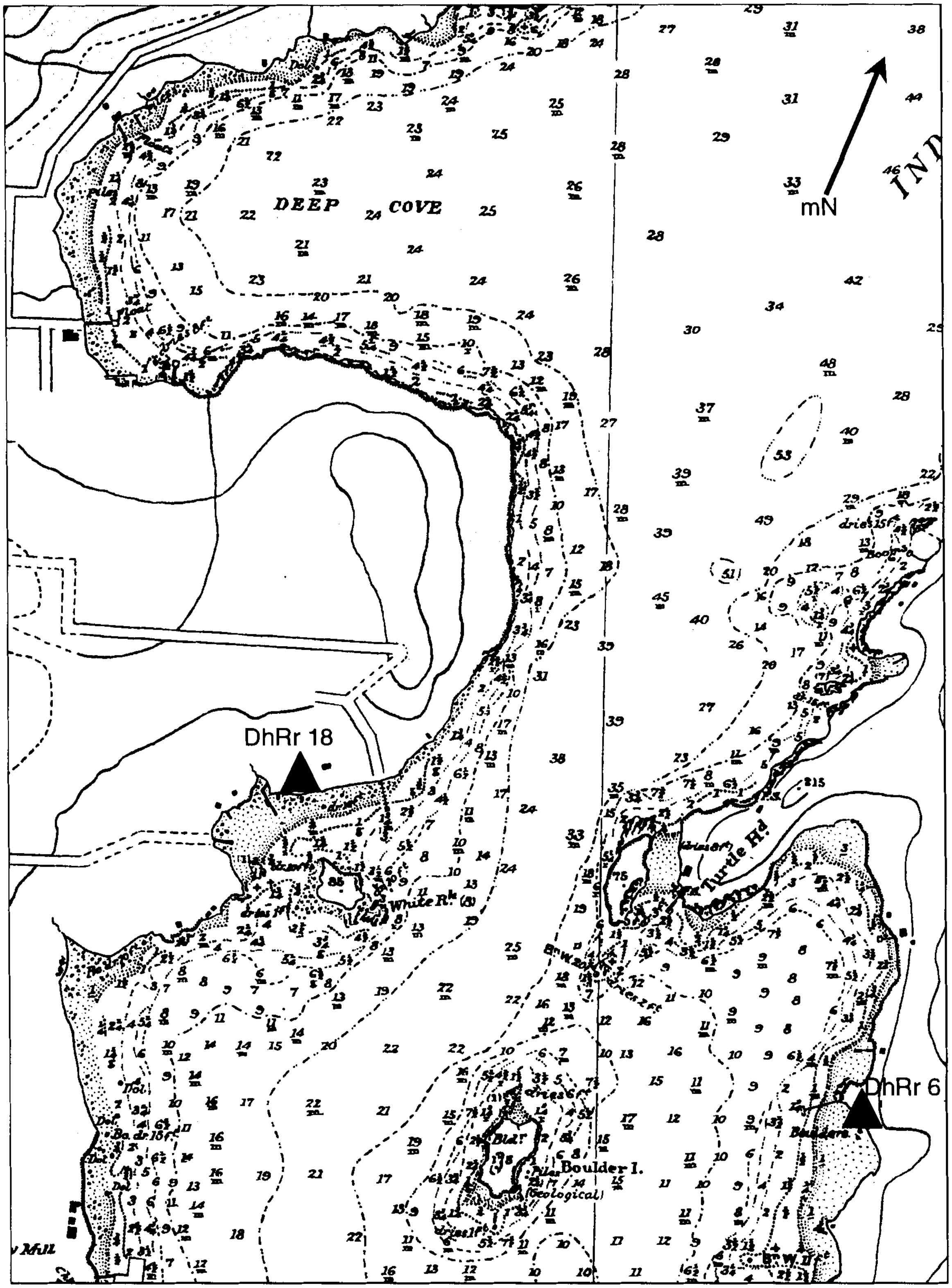

Figure 3. Cove Cliff site (DhRr 18) locality. Depth in fathoms. Contour interval=100 m. Adapted from Canadian Hydrographic Service (1930), by permission.

consanguineal relations connecting individual households or local groups (Barnett 1955:241-266; Carlson 2001; McHalsie 2001; Schaepe 2001; Suttles 1974, 1987a, 1987b, 1987c, 1987d, 1990).

The ethnographic record contains little information regarding the people that inhabited the Burrard Inlet and Indian Arm prior to the Historic era. Maud (1978:11) comments,

> This Burrard tribe has made practically no appearance in recorded history. ...But it makes sense that there would be a fiord people in Indian Arm. There is a fundamental [ecological] difference between Deep Cove and the Southlands [i.e., Fraser River], and one chose by temperamental preference.

Mention of Tsleil-Waututh ancestors in other ethnographic sources suggests that they were a people distinct from their Squamish-speaking and Halkomelem-speaking neighbours to the north, south, and east (Alexander and Grier 2000:7-8). Recent ethnographic research describes the "Tsla-a-wat" territory as extending,

> ...from Lions Bay across to Point Grey and included all the waters of English Bay and Burrard Inlet east to Port Moody and Indian River. Many small bands of the tribe lived in this area, and at one time their numbers exceeded two or three thousand (Carter 1972:45).

Probable reasons for our lack of information regarding these ancient inlet peoples is a smallpox epidemic dating to 1782, ten years prior to face-to-face contact with Europeans, and increased warfare in the Late Phase leading to a sharp decline in population of this Burrard tribe (Alexander and Grier 2000:8; Harris 1994). Given that the Late Phase deposits recovered at Cove Cliff likely date no earlier than 500 years ago, the people who created the Cove Cliff shell midden were probably affected by these events.

Little is known about settlements within the Burrard Inlet and Indian Arm. Tsleil-Waututh oral history places winter villages at Belcarra Park, Cates Park, Seymour River, Port Moody, and at their current village, Burrard Indian Reserve (IR) 3 (Alexander and Grier 2000:8-9; Fig. 1). *Selilwettulh*, the villages that are now Burrard IR 3 and IR 4 (Fig. 1), derived their name from *selil* or piled up blankets, which refers to the highly valued mountain goat blankets woven by the Coast Salish. These villages are also known as major pink, coho, and chum salmon fish camps (Bouchard and Kennedy 1986). At least during historic times, the neighbouring Squamish Nation, Musqueam Indian Band, Kwayhquitlam (Coquitlam) First Nation, and groups living on the Fraser River traveled seasonally to camps/settlements in the Burrard Inlet to harvest resources such as shellfish, fish, and berries (Alexander and Grier 2000:9-10; Barnett 1955; Duffield and McHalsie 2001:62-63; Morvan 1976).

Since there is a paucity of ethnographic data on the people of the Burrard Inlet and Indian Arm, I used sources from the greater Coast Salish region to understand the general use of animal resources in this sub-region (Table 3). Uses of animal resources were for food, raw materials (e.g. bone, sinew, feathers), hide/fur, bait, objects of trade, and decorative/symbolic/ceremonial objects. Some taxa are categorised as "incidentals;" these are secondary prey species likely caught when seeking more important prey. "Inadvertents" is a category that describes taxa that were not mentioned in ethnographic accounts as being used by the Coast Salish and were likely brought to the site mixed in with a collection of desired animals resources (following Wessen 1994:148). Although I combine information on several Coast Salish groups, I expect there to be differences among them depending on their specific social and environmental contexts. Information primarily on the Squamish and recent environmental studies provide a picture of where animals were harvested or were found in relatively large numbers (Fig. 4).

Table 3. Ethnographic description of animal use, procurement, and processing. Primary use listed first. "?" means use inferred.
Ethnographic use: F=food, R=raw material (e.g., bone, sinew), H=hide/fur, B=bait, IC=incidental, IA=inadvertent, D=decorative/symbolic/ ceremonial, X=trade/exchange, following Wessen (1994:148).
Procurement method: B=bow and arrow, C=club, F=gaff (for larger fish), G=gig, H=hook and line, L=leister, N=net, O=noose snare, S=spear, T=tidal trap, W=weir.
Processing method: F=raw, D=dried, P=roasted in a pit, R=roasted by fire, S=steamed.
Note: Only information recorded in the sources listed are shown; there may be other uses and methods related to a particular resource. Taxa not mentioned in ethnographic sources are considered incidental if edible by today's standards or inadvertent if inedible by today's standards. Only fish species categorised as something other than, or in addition to, food are shown. Few descriptions on the processing of mammals were located. *Sources*: Compiled from Barnett 1955; Gunther 1972; Jenness n.d., 1977; Matthews 1955; Hill-Tout 1978; Maud 1978; Morvan 1976; Stern 1969; Suttles 1974, 1987a, 1987c, 1987d, 1987e, 1990.

Taxon	Ethnographic use	Procurement method	Processing method
Birds, general		B, S, C, N, O	R, P
Loons and grebes	R, F		
Cormorants (*Phalacrocorax* spp.)	R, F		
Great blue heron	R, F		
Waterfowl (Anatidae)	F, R, D		
Bald eagle	D, F		
Gulls and terns (Laridae)	R, F		
Passerines	IC?, D?		
Mammals, general		B, N	R, D
Coast mole and voles	IA		
Snowshoe hare	H, F	Deadfall trap	
Beaver	H, R, F	Deadfall trap	
Squirrels	H, F	Deadfall trap	
Domestic dog	R		
Cougar, bobcat	IC, H, F?		
River otter, marten, and mink	H, F?	Deadfall trap	
Pinnipedia	F, R	Harpoon	S, D, Boiled for grease
Raccoon	H, F	Deadfall trap	
Bear	F, R, H, D	Deadfall trap	Boiled for grease
Artiodactyla	F, R, H, D		Boiled for grease
Black-tailed deer	F, R, H, D	Pitfall trap, dogs, stone/shell arming points	Boiled for grease
Fish, general		F, G, H, L, N, S, T, W	B, D, R, S
Spiny dogfish	R, F		Boiled for oil
Sturgeon	F, R	Harpoon	F
Pacific herring	F, B	Rake. Roe collected on eelgrass/branches.	S
Salmon	F, X, R, D, B	Harpoon, sites	
Surf smelt	F, B	Rake	S
Eulachon	F, X	Rake	Boiled for oil.
Plainfin Midshipman	IC		
Snake prickleback	IC		
Sculpins	IA		
Cabezon (juvenile)	IA		
Sucker fish	IC		
Invertebrates, general		Shellfish beds	R, S
Blue mussel	F, B		F
Weathervane scallop	D		
Nuttall's cockle	F, B		
Bent-nose macoma	IC		
Gaper clam	IC, R		
Macoma spp.	IC		
Pacific littleneck clam	F, X		D
Butter clam	F, X, D		D
Dentalia	D, X		
Gastropods	IC		
Barnacle	IA		
Sea urchin	IC	Net, trap, spear	F
Crab	F	Trap	
Oysters	IC		

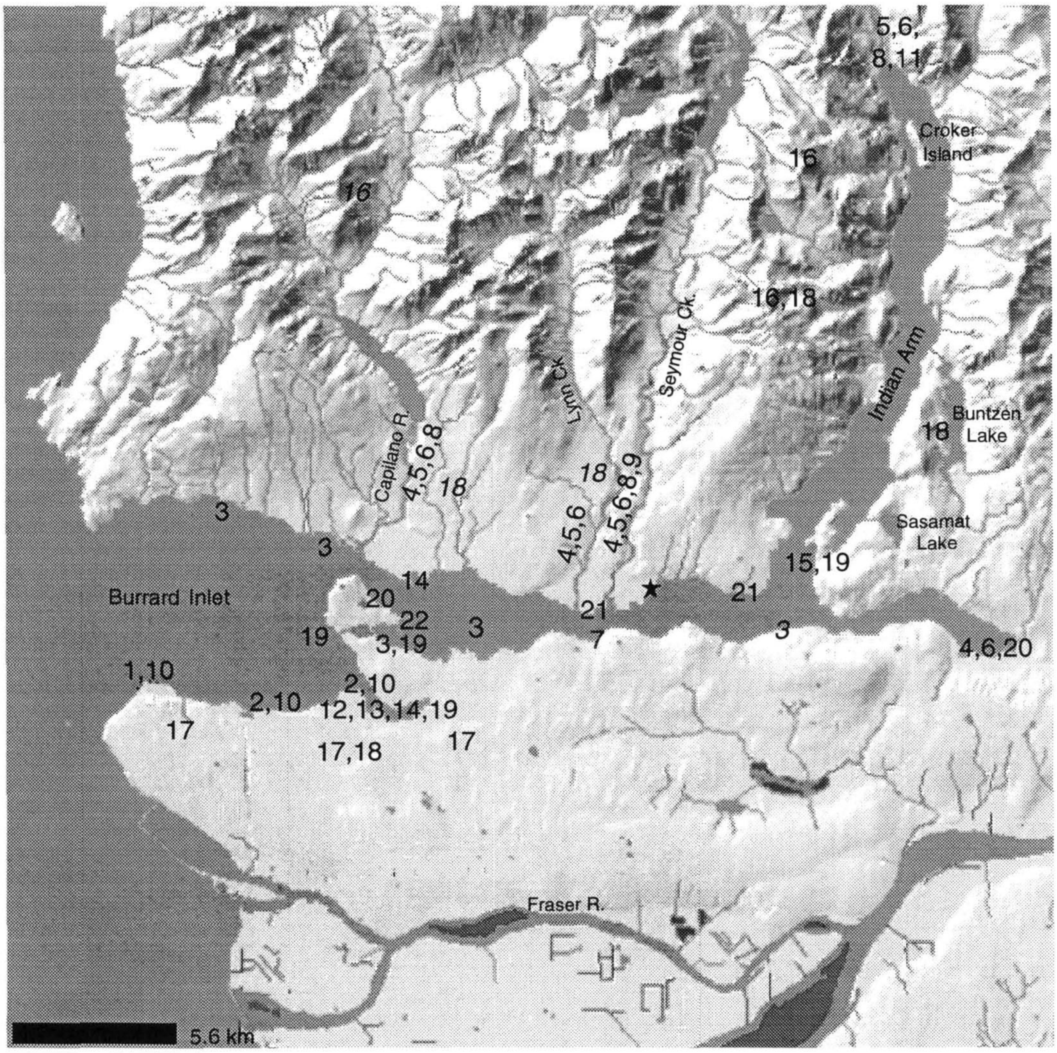

Figure 4. Locations within the Burrard Inlet and Indian Arm where animals have been recorded historically or are currently present. Animal resources: 1 – spiny dogfish, 2 – sturgeon, 3 – Pacific herring, 4 – pink salmon, 5 – chum salmon, 6 – coho salmon, 7 – salmon, 8 – steelhead trout, 9 – trout, 10 – smelt, 11 – eulachon, 12 – perch, 13 – sole, 14 – flounder, 15 – seal, 16 – mountain goat, 17 – wapiti, 18 – deer, 19 – ducks, 20 – clams, 21 – crabs, 22 – octopus. Star indicates location of intertidal fish trap at Maplewood Flats. Croker Island known as good hunting ground. Smaller salmon runs were, and in some instances still are, found in smaller streams throughout the Inlet. Italicised numbers are recently recorded instances of taxa. *Sources*: Compiled from Alexander and Grier 2000; Barnett 1955; DOE 1971; Bouchard and Kennedy 1986; Matthews 1955; Morvan 1976; Reimer 1999. Map adapted from Department of Fisheries and Oceans (2004).

Archaeological context

The provincial archaeological database records 62 archaeological sites in the Burrard Inlet and Indian Arm. The majority of these sites are shell middens, five of which have been identified as villages. Other sites are designated as lithic scatters, rock art, a fish trap, and a burial site. People's use of the Burrard Inlet extends back to at least the Locarno Beach Phase (3500-2400 B.P.; Charlton 1977, 1980; Lepofsky and Karpiak 2001; Matson and Coupland 1995:154). The inlet sites discussed in this thesis—Cove Cliff, Belcarra Park, and Cates Park, are the only sites in the vicinity of Indian Arm that have been extensively investigated and reported on.

Cove Cliff site (DhRr 18) [1]

The areal extent of the Cove Cliff shell midden and the presence of human burials suggest the deposits were associated with a large settlement during at least part of the site's prehistory. However, oral history describes Cove Cliff as a short-term shellfishing campsite. The analyses conducted for this thesis may provide information that will resolve the apparent discrepancy between these two sources of information. Cultural deposits are estimated to extend 200 m along the shore of Indian Arm and 100 m inland. This encompasses Strathcona Park and four adjacent houselots. The midden is estimated to be as deep as 1.2 m in places based on a neighbour's description of the sediments excavated when digging a basement. In the eastern portion of the site beyond the Park's boundaries, three human burials were reported but details regarding them were not found. In contrast to the archaeological record, Lillian George, wife of the hereditary chief of Tsleil-Waututh Nation, remembers that Cove Cliff

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[1] Unless otherwise noted, the following information regarding the archaeology of DhRr 18 is from Lepofsky and Karpiak (2001).

(*Say-umiton)* was an important shellfish gathering spot, and that when it was stormy, it was a sheltered spot to wait out the weather. Elder Dale George also remembers gathering shellfish there. In addition to being visited for its shellfish, Cove Cliff was known as a "place of good water" and as a water source for Belcarra villagers because the lake at Belcarra was "taboo" (Kennedy and Bouchard 1986; Lepofsky and Karpiak 2001:9-10).

During the 2000 excavations, the most exciting discovery at Cove Cliff was a series of overlapping surfaces interpreted as the remains of a small, ephemeral structure (Fig. 5-7). A 12 m x 6 m area was excavated and the structure's interior and exterior area were intensively sampled to test for differential use of those areas. Remains from an historic occupation that intruded into the upper prehistoric deposits are not analysed in this thesis. That deposit lies at the northern end of the excavation and contained evidence of food processing events. In most places, undisturbed prehistoric deposits were found directly beneath the sod. The main exceptions to this were the mixed historic/prehistoric deposit and two previously excavated units (OEU-1 and OEU-2; Fig. 5-7). Although some historic artifacts were present, typically within 10 cm of the surface, excavators' observations indicate the recovered archaeofaunal assemblage is largely prehistoric.

Several lines of evidence suggest the upper strata, which are analysed in this thesis, represent the intramural and extramural areas associated with a small structure. The interior deposit was 30-45 cm thick and composed of layers of finely crushed shell alternating with homogenous layers of charcoal-rich silts (Fig. 7). These alternating lenses (layer 8) were interpreted as a series of charcoal-rich accretional surfaces separated by crushed shell deliberately lain down to construct a floor. This interpretation is supported by the observations of other Northwest Coast archaeologists that finely

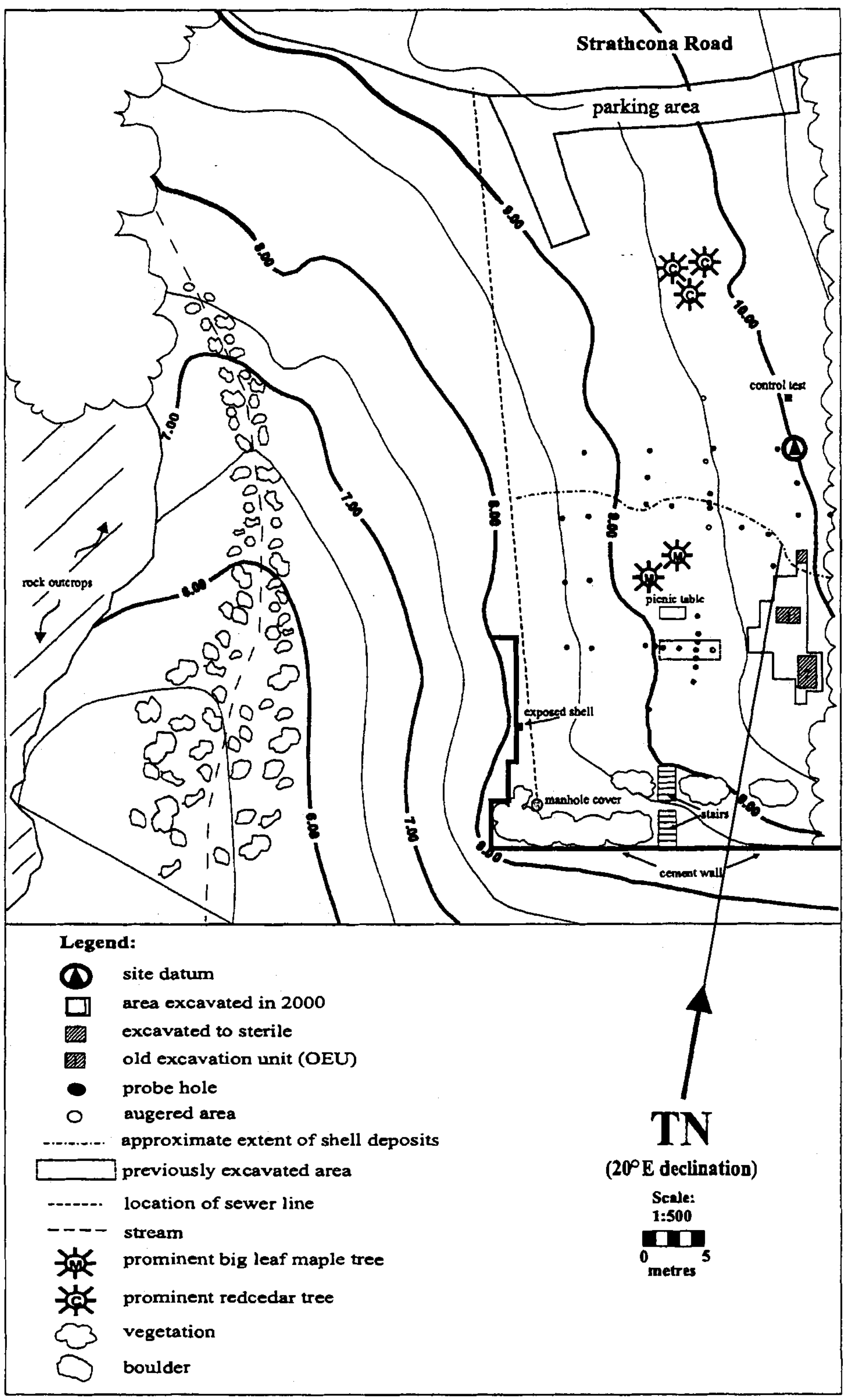

Figure 5. Site map of excavations at DhRr 18 in the summer of 2000. (Lepofsky and Karpiak 2001:8, by permission).

Figure 6. Map of features, Cove Cliff excavation in 2000.
OEU-1 and OUE-2 are previous, unreported excavations.
Level 1: F1 - historic disturbance; F8 - historic posthole; F12 - charred cedar plank in historic disturbance; F13 - historic disturbance, disappeared < 10 cm dbs (depth below surface); F14 - depression filled with silty-sand and concentration of fauna; F15 - filled with large shell, abundant faunal remains; F21 - concentration of frilled dogwinkle; F22 - concentration of FAR, probable food processing event.
Level 2: F16 - depression of charcoal and fire-affected rock, possibly dumping event; F18 - historic disturbance; F23 – probable posthole; F24 – probable posthole; F27 - steaming pit; F28 and F31 - paired post hole (10 cm diameter) and stake hole (4 cm diameter).
Level 3: F4 - horizontally lying charcoal fragments, possibly planks; F30 - concentration of frilled dogwinkle.
Level 6: F25 - partially charred and uncharred planks lying horizontally; F26 - roasting feature. *Horizontal provenience not provided.

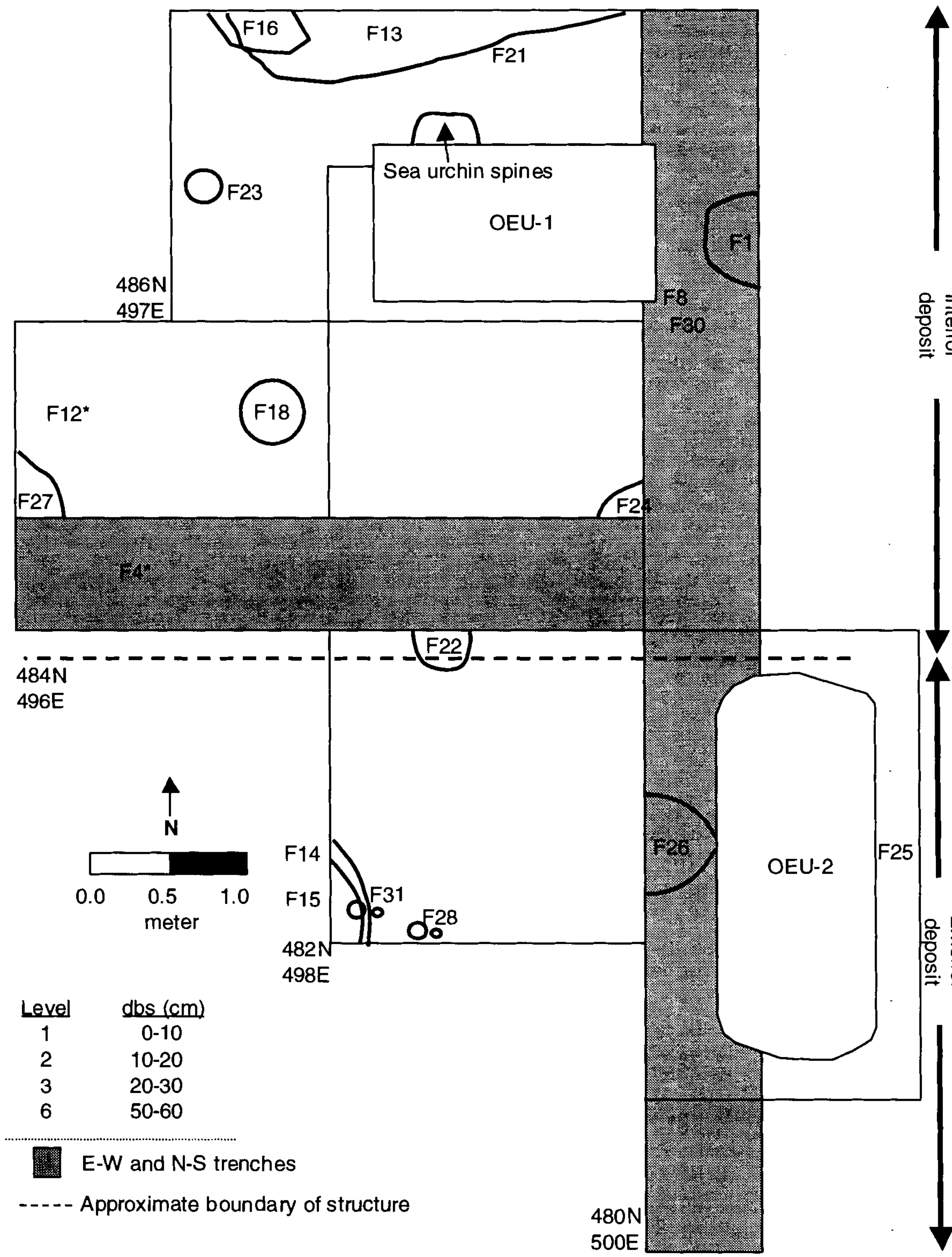

Figure 6. Map of features, Cove Cliff excavation in 2000. See previous page for detailed caption.

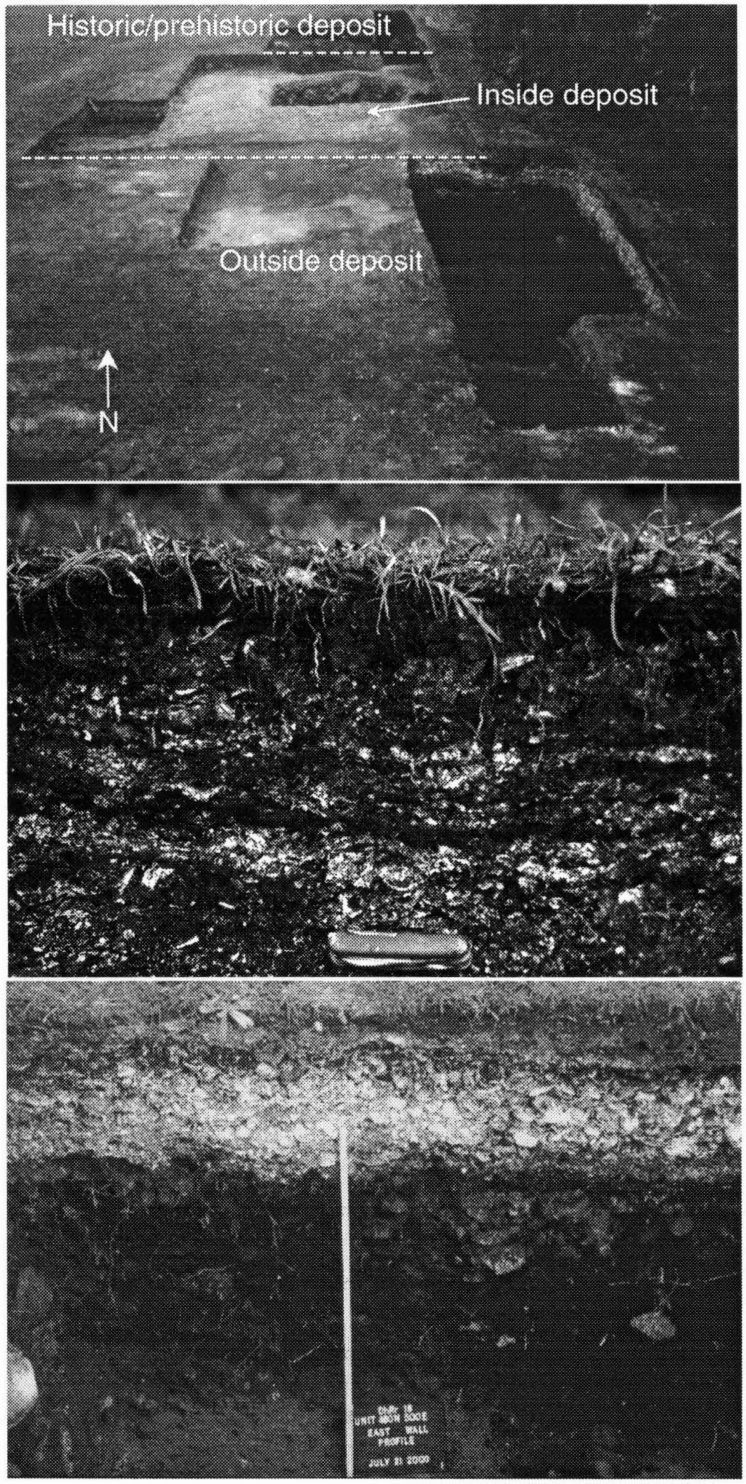

Figure 7. Prehistoric deposits at Cove Cliff. (a) Final view of excavation. Note: In SW corner, burnt, crushed shell possibly used to make interior surfaces. In SE unit, layer of whole shell. (b) Interior deposit, surfaces made of finely crushed shell lenses alternating with lenses of charcoal-rich silts. (c) Exterior deposit, east wall of excavation unit 480N 500E. Note (from top to bottom): ash and charcoal-rich lenses, layer of whole shell, possible house floor, shell-free deposits dating to Locarno Beach phase. Photos: Dana Lepofsky, by permission.

laminated deposits and/or extensive horizontal deposits of crushed shell are likely structural floors (Arcas 1994:38-42, 1999:148; Samuels 1991b:191). Also, investigators found articulated salmon vertebrae and artifacts lying *in situ* on top of the lenses. Two other strata identified within this context were interspersed between the floor layers. One stratum (layer 23) consisted of two lenses of dark brown silty sand that appeared to have a high content of salmon bone. The other stratum (layer 18) consisted of thin, discontinuous lenses of dark brown silty sand and overlapped in extent with layer 23. Though all the boundaries of the structure were not located, the absence of large postholes and hearths, the feathering of the crushed shell lenses with other deposits, and the structure being no more than 6 m N-S suggest the structure was for short-term use, relatively small (*c.f.* Matson 2003:95), open-sided, and underwent rebuilding events.

In contrast to the interior deposit, the deposit outside the structure consisted of whole and partially broken burnt and unburned shells (Fig. 7). This deposit extended approximately 60 cm below ground surface. Highly oxidized soil and abundant ash, in combination with whole clamshells, suggest that bivalves were steamed in this area (layers 12, 16, 22). Interspersed within these shell-rich layers are lenses of charcoal-rich silts that may represent dumping events (layers 10, 14, 15, 17, 24) or, the more horizontally lying layers, may have been surfaces of some kind (layers 11, 21). Despite the disparate thickness due to differential compaction of sediments, the stratigraphic association between the exterior deposit and interior deposit suggest the two were contemporaneous.

Lithic and archaeobotanical analyses support the notion that there are distinct activity areas. More types of formed lithics were found within the interior deposit (9 types inside: 4 types outside) implying a boundary of some sort existed between the two deposits. The lithic assemblage suggests people were involved in hunting, woodworking, processing of "soft-fleshed" animals (e.g., fish), and manufacturing of wooden shafts that may have been used as darts, arrows and/or skewers for drying fish or shellfish (Morin 2002). The distribution of charred seeds recovered from 14 flotation samples is also evidence that the two deposits are different. Preliminary analysis of charcoal suggests the interior deposit contains fewer taxa and a relatively higher frequency of an unidentified softwood, possibly western red cedar. The interior deposit contained the only taxon (*Picea* sp. or *Pinus* sp.) whose ethnographically documented use was not just for technology but also for subsistence, medicine, and ceremony; this implies a domestic context. Quantification of charcoal by size indicated that charcoal from the interior deposit was more fragmented than charcoal from the exterior deposit, possibly due to being trampled underfoot (Ng and Ryan 2001).

Artifacts, archaeobotanical remains, and historic documents were used to date the upper strata and infer season of occupation. Whole and partial toggling harpoon heads, antler wedges, a grinding slab, a thin ground stone point, and a small side-notched projectile point, which comprise a tool set characteristic of Late Phase sites (Mitchell 1990:346), were found lying on surfaces and when screening sediments. The recovery of an uncharred cedar plank from approximately 55 cm depth below surface (dbs) in the southeast corner of the excavation places the age of the deposit at no more than 500 years old based on the rate of wood decay (Dana Lepofsky, personal communication 2001). People's unrestricted use of the land that is now Strathcona Park likely stopped by the late 1800s due to logging and urban development. The archaeobotanical remains and analysis of the seasonal growth rings in bivalve shells suggest the deposits were laid down mid-summer to early fall, although winter is not excluded (Lepofsky and Karpiak 2001:61-62; Ng and Ryan 2001; Ormond 2001).

Approximately 6.8 m^3 of Late Phase deposits were excavated to between 20-30 cm dbs. The backfill from OEU-1 and OEU-2 was excavated to sterile soil (approximately 130 cm and 150 cm dbs, respectively). While the field crew made every attempt to excavate depositional events separately, this was not always possible as was the case with the multiple lenses comprising the interior deposit. In those instances, depositional events of a similar nature were lumped into a single stratigraphic layer. Within thick stratigraphic layers, field workers excavated by arbitrary 10 cm levels. Flotation samples were collected from a 50 cm x 50 cm sampling grid superimposed over the excavation (Fig. 8). Additional flotation samples were taken from strata exposed in the walls of OEU-2. Sampling did not include the uppermost stratum, mainly topsoil, which contained most of the historic remains.

Faunal material was collected by hand, by screening sediments, and by the flotation of matrix samples. Screened sediment was passed through ¼-inch mesh to remove the bulk of the matrix and then the remainder was wet-screened through the ¼-inch mesh. For a portion of the first 20 cm of sediment in the E-W and N-S trenches, faunal remains were only collected if deemed identifiable to skeletal element. Only 30% of the sediments surrounding OEU-2 were screened for faunal material due to the disturbed nature of those sediments. Two students floated twelve of the matrix samples used in this thesis following methods described in Lyons (2000; Appendix B). The resulting heavy fraction consisted of material > 1 mm. These excavation and recovery methods provided me with the material required to characterise animal use at the site level as well as at the intra-site level.

Belcarra Park site (DhRr 6)

Tum tum oeten (Belcarra), the largest of the traditional Tsleil-Waututh villages, was vacated between 1830 and 1860 to the area that is now Burrard IR 3 (Fig. 1;

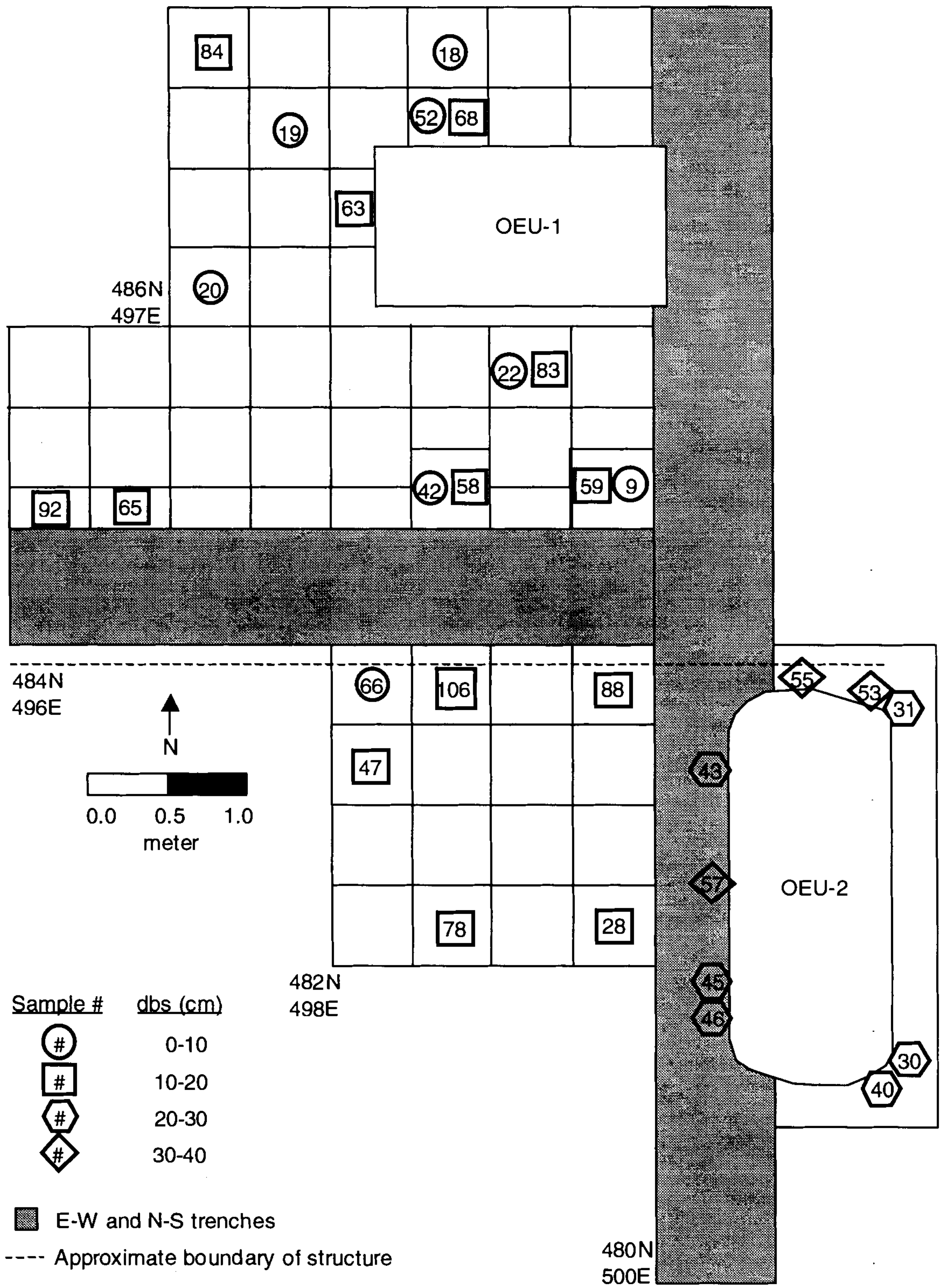

Figure 8. Flotation samples analysed for faunal remains (n=30).

Alexander and Greir 2000:9). The site parallels the shore for at least 150 m and extends inland approximately 40 m (Charlton 1977:18). Artifacts and radiocarbon dates (330 ± 90 A.D., 880 ± 90 A.D.) place occupation of Belcarra into the Locarno Beach Phase and the Late Phase, with a noted absence of cultural material dating to the interim Marpole Phase (2400-1200 B.P.; Charlton 1977:190). Based on the archaeofauna, artifacts, and structural features, Charlton (1977:231-232) proposed the site was a village primarily occupied during fall and winter but use during other seasons was not excluded.

The Late Phase archaeofaunal collection recovered at Belcarra comes from two 2 m x 2 m excavation units with deposits extending < 1 m below the surface (Charlton 1977:21, 24-28). Although not specified in his thesis (Charlton 1977), it is likely ¼-inch screen was used for recovery. Unfortunately, only mammal specimens were quantified and bird remains only partially identified to taxa. It is unclear if artifacts of bone or antler are included in the specimen counts. Element counts were not provided, invertebrates were not collected, and fish remains were not analysed.

Cates Park site (DhRr 8)

Although the archaeofaunal assemblage for the Cates Park site may include material from the past 2,400 years (Charlton 1974:15-18; Alexander and Grier 2000:78), I use the results of the faunal analysis for this site due to a lack of archaeological information for Indian Arm (Fig. 1). Dan George, a Tsleil-Waututh elder, described *Whey-Ah-Wichen* (Cates Park) to archaeologist Charles Borden as a "major site before Belcarra" (Alexander and Grier 2000:10). This site is similar in scale to both the Cove Cliff and Belcarra Park sites extending up to 250 m E-W and 100 m inland. Based on the artifact assemblage, the Cates Park site was occupied from the Marpole Phase (2400 B.P.-1200 B.P.) into the Historic era (Charlton 1974:15-18; Alexander and Grier 2000:78). The type of occupation is unclear. Charlton (1974:13) presumed it was a temporary campsite based on the paucity of artifacts, animal taxa, and structural features as well as the relatively shallow ($\leq$ 60 cm) depth of deposits. The results of more recent investigations suggest historic disturbance has destroyed much of the site making it difficult to truly describe the prehistory. Possible uses are as a village, seasonal campsite, burial ground, and/or fortification (Alexander and Grier 2000:43-44, 78). However, the areal extent of the site, recollections that midden deposits were 1.5 m thick in places (Alexander and Grier 2000:44), and oral tradition suggest that at least a portion of the site contained a relatively large settlement at some time. The site was interpreted as being occupied chiefly in the late fall/early winter based on the animal taxa identified and examination of the seasonal growth rings in butter clam and Pacific littleneck clams recovered, but use during other seasons was not excluded (Charlton 1974:18, 14; Williams 1974:52).

Charlton's field crew collected the archaeofaunal assemblage used in this analysis in 1974. Specimens were recovered by screening sediments from twenty-nine 2 m x 2 m excavation units through ¼-inch mesh screen. As mentioned, the archaeofaunal assemblage may reflect up to 2,400 years of occupation. Smaller specimens, such as those from Pacific herring, probably passed through the ¼-inch mesh and were not recovered. The identification of fish remains to taxa was incomplete due to limitations of the reference collection used. It is unclear if artifacts of bone or antler are included in the bird and mammal specimen counts. The faunal analyst noted that specimens attributed to black-tailed deer and wapiti were primarily foot bones (carpals/tarsals, phalanges; Williams 1974:30). In my analysis, I examine whether a similar pattern occurs in the Cove Cliff archaeofaunal assemblage. Only whole to nearly whole mollusc shells were collected and those were quantified by number of identified specimens (Charlton 1974; Williams 1974).

Tsawwassen site (DgRs 2)

I chose the Tsawwassen site to represent a non-inlet environment because the methods of recovering and identifying faunal remains were similar to mine. In this thesis, I used the reported analyses from deposits dated to the Late Phase from Zone A (210 ± 55 B.P., 280 ± 50 B.P., 430 ± 80 B.P.) and Zone G (530 ± 60 B.P.), two of seven areas within the Tsawwassen site excavated by Arcas Consulting Archeologists [*sic*] Ltd. between 1989 and 1990. The ethnographic record, site dimensions, structural features, artifacts, and faunal remains suggest that in the Late Phase Tsawwassen was a village used year-round (Arcas 1999:134-153).

The faunal remains from the Tsawwassen site are described using two collections. One collection includes the remains recovered from fifteen 1 m x 1 m excavation units by water-screening sediments over ¼-inch mesh. The other collection contains remains recovered from the heavy fraction (> 2.0 mm) of twelve 1- or 2-litre flotation samples with volumes standardized to 1-litre. Although a relatively large amount of sediment was excavated, the sample of faunal remains is rather small. Again, whether bone artifacts were considered when quantifying these collections is not stated. The invertebrate remains are described by either weight or presence, depending on the analysis (Stryd 1991b:49-51,56-57; Kusmer 1994a, 1994b, 1994c).

Research Objectives

I have three major objectives for this research. My first objective is to reconstruct how the Late Phase occupants generally used the Cove Cliff site, as reflected in the faunal remains. In particular, I aim to determine which animal resources were used, how and when they were collected, from which ecosystems, and how they were processed, used, and disposed of. My second objective is to investigate whether different activities were being conducted inside and outside the small structure. My final objective is to compare the Cove Cliff archaeofaunal assemblage to other sites' assemblages to gain a broader understanding of how Burrard Inlet and Indian Arm were used by ancient peoples during the Late Phase. Specifically, I investigate whether any patterning in these combined datasets reflect differential use of local ecosystems, assuming other parameters are held equal (e.g., season of occupation, settlement type). To address my second and third objectives, I developed expectations about the patterning that should be visible in the archaeofaunal assemblage from Cove Cliff (Table 4).

Table 4. Research assumptions, expectations, and methods.

Objective 2. Comparison of interior and exterior deposits		
Assumptions[1]	Expectations	Methods
Some food will be consumed inside the structure; the large remains of any foods eaten will be discarded outside or moved to the interior edges of the structure.	Food remains inside the structure will be small sized and the result of incidental discard.	Fragmentation analysis.
Much of the inside of structures, particularly small structures, will be intensively used for a range of activities.	Faunal remains inside will be fragmented due to trampling.	Fragmentation analysis.
Initial processing of animals will occur outside the structure.	Evidence of butchering and cooking of resources.	Specimen modifications. Review of features and field notes.
	Discard of unwanted animal parts (e.g., shells, bones, and animals inadvertently brought to the site) outside the structure.	Density of shell from primary food taxa. Density of "inadvertents." Density of vertebrate remains.
Valued items will be stored inside the structure. These include tools, tool preforms, and items that are decorative, symbolic, and/or used in ritual.	Higher proportion of valued items within the interior deposit as compared to the exterior deposit.	Density of culturally modified bone and antler remains.

Table 4. Research assumptions, expectations, and methods (cont'd).

Objective 2. Comparison of interior and exterior deposits		
Assumptions[1]	Expectations	Methods
A variety of tasks occurred inside and outside the structure.	Interior and exterior deposits may not differ much in overall number of taxa represented, but should differ in kinds of taxa.	Richness. Taxa represented. Skeletal part frequency.
Inside surfaces will be periodically cleaned, resulting in larger remains being removed entirely or moved to the interior edges of the structure.	Spatial patterning of faunal remains inside the structure will not be distinct.	Spatial distribution of faunal remains.
	Faunal remains inside the structure will tend to be smaller than those found outside the structure.	Fragmentation analysis.
	Larger remains inside the structure will tend to be located along the interior edges of the structure.	Not tested because boundaries of structure were not located and sampling not fine-grained enough.
Large amounts of shellfish and fish were being processed outside the structure and refuse from these tasks were discarded outside.	Discrete concentration(s) of a shellfish taxon, whose shell is relatively unfragmented, in the exterior deposit.	Spatial distribution of faunal remains. Fragmentation analysis.
	Discrete concentration(s) of a fish taxon in the deposit.	Spatial distribution of faunal remains.

Table 4. Research assumptions, expectations, and methods (cont'd).

Objective 3. Comparison of sites		
Assumptions	Expectations	Methods
All site types are similar (i.e. large settlements occupied throughout the year).	Seasonality use is the same. Resource specialisation is similar.	Seasonality. Resource specialisation.
People will tend to harvest resources closer to home, all other social factors being equal.	Faunal remains at sites will tend to reflect local fauna. Inlet sites will tend to be more similar to each other than those outside the inlet.	Ecosystems utilised as represented by taxa recovered and identified.

[1]Assumptions and expectations based on the following sources: Barnett 1955; Coupland *et al.* 2003; Hayden 2000; Huelsbeck 1994:32-44; LaMotta and Schiffer 1999; Lepofsky and Lyons 2003; Matson 2003; Matthews 1955; Samuels 1991a, 1991b, 1994; Smith 1947; Suttles 1974; Wessen 1994:168-171.

CHAPTER TWO
METHODS

Sample selection

The faunal specimens I analysed from the Cove Cliff site Late Phase deposits were selected to obtain a cross-site distribution enabling spatial patterns to emerge. I identified all the specimens recovered from the heavy fraction (> 1 mm) of 30 flotation samples (approximately 38 litres of matrix; Fig. 8; Appendix B) and specimens recovered in the field from the ¼-inch screen (Appendices C-G). I followed the same methods used in 2000 to float matrix samples and was fortunate to have a student, who helped with flotation in 2000, available to check for consistency in methods. I selected the flotation samples using the following criteria. I wanted to have equal representation of the interior and exterior deposits so chose 15 samples from each context. Samples from within these contexts were selected to cover the range of strata, with an emphasis on the surface (layer 8) within the interior deposit, and to attempt to discern intra-context patterning. Also, I tried to use samples from areas of minimum historic disturbance. The shell analysed came from the heavy fraction except for a collection of frilled dogwinkle hand-gathered from a feature within the structure (Fig. 6-F21).

To conduct my analysis of the archaeofauna from the Cove Cliff site, I first subdivided the assemblage into smaller collections because different methods were used to recover and quantify specimens. For most analyses, my collections are the fish specimens from the heavy fraction, the invertebrate specimens from the heavy fraction, and all the bird and mammal specimens combined, minus the selectively collected sample of faunal remains from the upper 20 cm of the trenches and upper 30 cm around

OEU-2. I chose to combine bird and mammal specimens from the screens and heavy fraction into one collection to increase my sample size and because it is unlikely a specimen < ¼-inch in size was identified as bird or mammal in the heavy fraction. Specimens that small were more likely considered "unidentified." As needed, the bird and mammal collection was further subdivided into sub-collections by taxonomic class. I included the specimens selectively collected in analyses only to determine presence of taxa and types of bone modifications.

After initial sample selection, I decided to exclude the faunal remains recovered from the upper 10 cm of sediment in the northern unit because 155 historic artifacts and five sawn specimens that were probably domestic cow were identified. This historic disturbance disappeared less than 10 cm dbs (Fig. 6-F13). As mentioned, although historic artifacts were found in other areas of the excavation (n=173), excavators felt the faunal remains were associated with the prehistoric occupation of the site.

Identification and description

Categorisation of specimens followed standard biological taxonomy with some customisation, discussed below. Only specimens identifiable to element were classified to a taxonomic category more specific than fish, bird/mammal, invertebrate, or unidentified. The category "unidentified" consists of specimens that could not be identified, usually due to breakage, and those that may be identifiable but were not identified. The latter primarily occurs with the fish specimens as only a subset of elements—the articular, basioccipital, dentary, dorsal spines (spiny dogfish only), hyomandibular, palatine, pharyngeal plate (perch, suckerfish only), premaxilla, maxilla, quadrate, scutes, teeth, vertebra, and vomer, were selected for identification from the outset. These elements were chosen for their distinctiveness across species or because they were the only element in the collection representing certain taxa (following Leach

1997:6-8). Prior to identification, a list of species found in the region was developed (Appendix A). This list was the basis for the zoological reference collection I used during identification.

Vertebrates

To facilitate vertebrate specimen identification, the heavy fraction and screened material were re-screened over 1 mm or ¼-inch mesh, respectively, to remove any residual dust. The sorting and initial identification of the heavy fraction was then accomplished with the aid of a magnifying lamp (10x). Final identification was done using an American Optical model Forty microscope (7x – 30x) and made based on morphological similarity to specimens in reference collections housed in Simon Fraser University's Department of Archaeology, University of Victoria's Department of Anthropology, and the University of Washington's Burke Museum. I also visited the Royal British Columbia Museum in Victoria to view their mountain goat skeleton.

A small sample of salmon vertebrae (n=11) was identified to species using ancient DNA analysis. The selection of vertebrae to be analysed was partially based on Cannon's (1991:51-54, 1998) radiographic technique for identifying salmon species. I judgementally selected specimens based on the number of annuli visible in x-rays. My assumption was that vertebrae with different numbers of annuli were less likely to be from the same species of salmon. The x-rays were taken with a Fischer model FP200 machine using the following settings: 60 cm focus distance, 1.5 seconds exposure, 80 kV/15 mA power. I submitted for analysis four sets of vertebrae each representing different annuli counts. Three of the sets contained three vertebrae; these sets had vertebrae with one annulus, two annuli or three annuli. The fourth set contained only two vertebrae, which had an indeterminate number of annuli, either three or four. The ancient DNA sequencing was completed in Simon Fraser University's Ancient DNA Laboratory (see Yang *et al.* 2004 for methods).

I also used a potentially new approach to identify salmon vertebrae to species. This approach is based on the initial results of a study combining ancient DNA identifications with vertebra measurements. In this approach, the width of the salmon vertebra is measured and size categories used to determine species. Salmon vertebrae < 8 mm wide are either sockeye salmon or pink salmon and vertebrae > 10.5 mm wide are either chum or chinook (Aubrey Cannon, personal communications 2004). One hundred vertebrae recovered from the ¼-inch screen were randomly selected and measured by Liza Grotrian, a Simon Fraser University undergraduate. Salmon vertebrae in the heavy fraction were generally too fragmented for this analysis or ancient DNA analysis.

Several decisions needed to be made regarding the identification of fish remains. Because I used the heavy fraction to quantify fish remains, most fish specimens recovered in the ¼-inch mesh screen were identified only to taxonomic class. If I encountered a unique specimen, such as a sturgeon scute, or an element from a taxon not found in the flotation samples, I identified the specimen. I also identified and recorded any specimens that were salmon cranial elements in case I decided to use the ratio of salmon cranial elements to axial elements to better understand the natural and cultural processes acting on the faunal remains (Butler and Chatters 1994). Because of the morphological similarity between elements across family or genus, vertebrae from the Embiotocidae and Pleuronectidae families were identified only to family and vertebrae attributed to the genera *Sebastes*, *Oncorhynchus* and *Hexagrammos* were identified only to genus. To reduce bias in the quantification of fish vertebrae resulting from differences in the ease with which certain taxon are identifiable, I identified fish vertebrae to a taxon only if the vertebral specimen consisted of both an anterior and/or posterior surface and at least part of the centrum (following Butler and Chatters 1994:417). Because of this conservative approach, some specimens that would typically be categorised as salmon or herring are categorised as "Osteichthyes-Undifferentiated."

Custom taxonomic categories based on size of animals were useful for characterising mammalian and avian remains that could not be identified to genus. Under the order Artiodactyla, the following categories were used: *small artiodactyl* – deer-size or smaller, and *large artiodactyl* – wapiti (elk)/cow-size. Some specimens could only be identified to very general size categories: *small mammal* – smaller than a wolf, *medium mammal* – wolf-sized to deer-sized, and *large mammal* – larger than a deer. Elements that were definitely bird but could not be attributed to a family were characterised based on their size: *small bird* – smaller than Common Goldeneye, *medium bird* – as large as Common Goldeneye but smaller than a goose, and *large bird* – goose-size or larger. A special circumstance arose regarding specimens attributed to the family Anseriformes. Of the ducks, only specimens from the *Bucephala* sp. were positively identified to genus. Thus, within the family Anseriformes, the categories-*duck-sized*, *duck/goose-sized* and *goose/swan-sized*, are used. The *duck/goose-sized* category is specific to the coracoid. In general, I did not attempt to identify passerines due to the difficulty in narrowing the list of possible species to a manageable number.

Six attributes were used to describe a specimen (Table 5). Partial and complete elements were recorded using standard biological nomenclature, e.g., "humerus, distal + shaft" means the distal end and a portion of the shaft of the humerus is present. Since many long bones were fractured longitudinally, I used the categories "shaft" (the circumference of the bone is intact) and "shaft fragment" (the circumference is

Table 5. Physical attributes used to describe specimens.

Attribute	Archaeofaunal collection described	Comments
Element name	Bird, mammal, fish	See above for list of fish elements identified
Element part	Bird, mammal	
Length	Bird, mammal, bird/mammal	Long bones and unidentified specimens
Age-related characteristic	Bird, mammal	Inconsistently recorded for fish
Breakage	Bird, mammal	Long bones only
Modifications	All	

incomplete) to better describe them. Breakage patterns, based on Reitz and Wing (1999:158) were recorded, but due to the small size of most specimens, these descriptions are considered medium confidence at best and thus were not analysed further. The length of long bones, and unidentified specimens likely part of a long bone, were measured to the nearest centimetre to collect data on bone fragmentation. Age-related characteristics consist of deciduous teeth, epiphyseal fusion, and overall bone morphology. The terms used to describe modifications are discussed in the section How did Late Phase people at the Cove Cliff site use animals?, below.

Invertebrates

Identifying and describing the invertebrate specimens was more straightforward than for vertebrate remains. Shell was sieved through nested screens (22.4 mm, 11.2 mm, 5.6 mm, 2.8 mm, and 1.0 mm) to assist in identification and collect size data to be used in the fragmentation analysis. The archaeological collection was primarily identified to taxonomic categories based on visual comparison to the reference collection at Simon Fraser University's Department of Archaeology and a collection of mollusc shells gathered in the vicinity of DhRr 18 during the summer 2000. Reference books (McConnaughey and McConnaughey 1985; Abbott 1968; Snively 1980; Morris 1966) were used to identify three taxa—bent-nose macoma, *Macoma* sp., and frilled dogwinkle. My description of shell was limited to amount of shell by weight in the size categories noted above and modification of the shell. A common bias encountered when analysing shell is that for some taxa, due to the colouration and/or the texture of the outer shell, small fragments are identifiable to genus or species. I found this was the case for blue mussel, Pacific littleneck clam and Nuttall's cockle. I was usually only able to identify other bivalves when the hinge was intact.

Laura Nielson and Rosie Nathoo, Simon Fraser University undergraduates, assisted with the identification of the invertebrate remains. I reviewed the entirety of half the samples and portions of the other samples to ensure we were consistent in our identifications. Because the shell was recovered from just under the sod, all littleneck clam was double-checked for presence of the introduced Japanese littleneck clam. Any inconsistencies in identification that may remain are minimal and do not affect my results.

Quantification

Number of identified specimens (NISP) has been commonly used to describe faunal remains from Late Phase sites in the Gulf of Georgia (Hanson 1991) and was the method used to characterise the faunal collections from my three other study sites. Although NISP has its drawbacks (Grayson 1984:17-26, 93-115; Ringrose 1993:124-126, 132-135; O'Connor 2000:54-57), to have results comparable with other Late Phase sites I used NISP for my quantification. In order to minimize errors, I limited my interpretations of differences in frequencies of abundance to when there is a large spread between NISP counts. Specimens, whose identification to taxa I rated as low confidence, are included in my quantification of the assemblage.

The quantification of vertebrate specimens that could be refit was case dependent. In general, when breaks not caused by excavation or subsequent curation could be refitted, each individual fragment was counted and the refit noted in the comments field of my database. In the case of artifacts, I followed the procedure for refitting specimens used by the 2000 field school. Fragments of culturally modified bone/antler that could be refitted were considered one specimen. I also counted refitted fragments, where the break was caused during excavation or curation, as one specimen. Teeth were counted individually when loose. Teeth still rooted in or refitted to a jawbone element were not counted individually; only the element was counted. The only exceptions are two salmon bones containing teeth where the jawbone could not be identified; these specimens are recorded as "teeth."

I quantified shell by weight as this measure was required for my fragmentation analysis (Claassen 1998:114-115; Ford 1992) and it is the most common method used by Northwest Coast archaeologists (Hanson 1991:33). The shell was sorted into size categories using the sieves noted previously. After sorting into taxon, weight was recorded to the nearest 0.1 gram. Material caught in the 1.0 mm screen was weighed but not always sorted for shell; thus, the shell weight may be inflated by the inclusion of some rock and bone. The presence of bone is explained below.

I sub-sampled the unidentifiable vertebrate remains from the heavy fraction since an exact number for these specimens was not required for this research. I counted the specimens within ¼ of a sample (by weight or volume) and then multiplied the results by four to derive an estimated total count (Appendix B). I also sub-sampled the invertebrate collection. Samples 9, 22, 45, 46, 66, 83, 92, and 106 were largely shell. These samples were halved by weight and sorted by sieve size. I then identified and quantified the remains. I estimated total weight for these samples by multiplying the weights by two. Identification of the shell < 5.6 mm was very time-consuming, often taking four to eight hours, with few specimens being identified to genus or species. Thus, for most samples, I quantified only ¼ of the specimens in the smaller sieve sizes (2.8 mm and 1.0 mm; Appendix B). Again, I estimated total weights by using a multiplier of four.

Analytical methods

In order to address my research objectives, I used the methods described in detail below. Prior to addressing my research questions, I determined whether my sample size was sufficient to characterise the archaeofaunal assemblage. To do this, I plotted the relationship between number of mutually exclusive identified taxa (NIT) and sample size. When the plotted line levels off, the assemblage has been sampled to redundancy (i.e., all taxa present are identified). Sample size is the cumulative number of specimens (NSP) or weight of specimens (grams) for the collection, prior to adjusting the numbers to reflect sub-sampling as described above. I plotted the relation between NIT and NSP for three collections, the vertebrate and invertebrate collections from the heavy fraction and the bird and mammal collection from the ¼-inch screen. These collections were further sub-divided into the interior and exterior deposits. The NSP by level bag or, NSP or weight by flotation sample, were summed and plotted in random order. These plots indicate whether I captured the taxonomic richness of the faunal assemblage and could answer my research questions regarding what animals were used and when and where they were harvested.

How did Late Phase people use the Cove Cliff site?

I addressed my research question regarding the general use of the site, as reflected in the archaeofauna, by evaluating taxonomic richness, assessing resource specialisation, examining cultural modifications of remains, and determining if certain parts of animals were selected for.

Richness

Richness is simply the number of mutually exclusive taxa identified within a collection and is a result that begins to answer the question, what animals did people use? To refine this answer, I examined the amount of specialisation reflected in the collections.

Resource specialisation

Specialisation measures whether people focused on a few, or a wide array, of animals. I calculated the degree of specialisation by combining the relative frequencies of the three most common taxa within the collections of fish, mammals, birds, and invertebrates. Relative frequency was calculated by dividing the NISP of a specific taxon by the NISP for the entire collection. If the sum of the frequencies of the three most commonly found taxa was $\geq$ 80%, I considered the archaeofaunal collection to be specialised. When the sum was 60-79%, the collection was considered to show a weak specialisation on the three most common taxa. If the sum of the frequencies was < 60%, the collection was not specialised (*c.f.* Lepofsky and Lyons 2003:1361).

Specimen modification

To understand how animals were being used, processed, and disposed of, I relied heavily on the analysis of specimen modifications and the ethnographic record (see Table 3). I used the magnification lamp and microscope to examine specimens for modifications. Within the vertebrate collection, modifications recorded were burning, carnivore and rodent damage, cutmarks, chopmarks, and saw marks. Cutmarks and chopmarks were not examined to determine if stone or metal tools were used, nor did I address whether these modifications were made to obtain meat for food or bone to be manufactured into an implement. I used another classification for cultural modifications (i.e., specimens that were manufactured or in the process of being made into an implement). Cultural modifications were categorised as finished artifacts, grooved and snapped/polished specimens, or worked bone/antler (e.g., striations or shaping likely to be cultural in origin). Invertebrates were also examined for cultural modifications (e.g., worked edge, drilled hole, cutmarks). Burnt shell was present but I did not quantify it because of the difficulty in differentiating between burnt shell and discolouration due to absorption or colour change caused by leaching. These analyses incorporated all specimens.

Skeletal part frequency

I used analyses of skeletal part frequencies to further understand how ancient peoples used animal resources. For this analysis, I compared expected skeletal part frequencies to the frequencies observed within the archaeological remains. In particular, I examined artiodactyl specimens to evaluate if the over-representation of foot bones described by Williams (1974:30) at Cates Park is present in the Cove Cliff collection. A similar patterning in artidodactyl remains (over-representation of lower limb and foot bones) has been noted at other Late Phase sites in Coast Salish territory (Hanson 1991:226-227; Huelsbeck 1994:47; Kusmer 1994c:203, 2000:121) implying the patterning is not due to sampling bias as posited by Williams (1974:33).

Bird remains are evaluated for an over-representation of wing elements as compared to leg elements to see if the remains from Cove Cliff are similar in character to remains at other Northwest Coast sites. This over-representation of bird wings is seen in the remains of waterbirds recovered from ten Northwest Coast sites and worldwide (Bovy 2002; Schalk 1993). Bovy (2002) proved that differential loss of elements due to bone density is unlikely to be the cause of this patterning and, therefore, other factors (e.g., carnivore activity, procurement methods, processing methods) must be considered. I analyse the entire collection of bird remains including all identified elements and use Bovy's (2002:970, 973) method to analyse the specimens from aquatic birds.

Seasonality and ecosystems utilised

To understand where and when people were procuring animals, I used the identified taxa as proxies for the ecosystems utilised and seasons during which the site was occupied. I categorised the taxa identified based on their current habitat preferences and prime-hunting season(s) for harvesting them to determine if there was any spatial or temporal preference in resource selection (following Bernick and Wigen 1990; Calvert 1980:221-229, 233-234; Coupland 1991; Monks 1981). Prime-hunting season refers to the season in which a taxon aggregates into denser populations, is found in more accessible locations (e.g., black-tailed deer is found at lower elevations during the winter), and/or the fur is better quality. Much of this information comes from general source books on fish, mammals, birds, and invertebrates (e.g., Hart 1973; Nowak and Paradiso 1983; Campbell *et al.* 1990a; Harbo 1997, respectively).

These analyses are somewhat hampered by the fact that there is not always a direct relationship between presence of a taxon and either utilisation of an ecosystem or timing of site occupation by ancient peoples. Juvenile and adult fish within one species may be found in different ecosystems or have different seasonal migrations. Some vertebrae in the Cove Cliff assemblage appeared to be from smaller sized (and therefore possibly younger) fish, but I could not systematically record this age-characteristic as reference skeletons from varying age-ranges were not available. My impression is that most specimens, unless noted, were adult size.

Animal foods or materials that could be dried or curated may have been eaten or used out of season or obtained via trade (Table 6). Because the features at Cove Cliff are indicative of a small, ephemeral structure, I assume people were not storing foods long-term but were procuring and processing animals while there. This implies a direct relationship between presence of a taxon and season of site occupation. Whether or not animals were being processed in large quantities for storage elsewhere is addressed by considering the artifact assemblage, element representation, features, and site location.

The use of migratory animals to represent season of site occupation is enticing. However, Schalk (1993) raised the issue of animals, in particular birds, which could be

Table 6. Storable taxa and seasonal absence of taxa identified in the Late Phase deposits at the Cove Cliff site.

Class	Storable	Seasonal absence[1]
Fish	Probably all but noted in ethnographic sources are: salmon, sturgeon, lingcod, rockfish, herring, smelts, flounder	Adult salmon (winter), eulachon (late summer-winter)
Mammal	Beaver, seal, porpoise, bear, wapiti, deer	
Bird	Waterfowl was typically eaten fresh but could be dried	Common loon (late spring-early summer), horned grebe (late spring-early summer), Oldsquaw (late spring-early fall), Goldeneye (late spring-early fall)
Molluscs	Pacific littleneck, butter clam, gaper clams, cockles	

[1]Season of absence is in parentheses. *Sources*: For storage, Barnett 1955; Matthews 1955; Suttles 1974. For seasonality, Breault and Watts 1996; Campbell *et al.* 1990a, 1990b, 1997, 2001.

scavenged and therefore may have died sometime before the people collected them. Also, many migratory animals are found, albeit it in much reduced numbers, year-round within the Burrard Inlet and Indian Arm (Table 6).

To minimize errors in these analyses, I consider the abundance of a taxon as well as its presence. A stronger argument can be made for utilisation of a particular ecosystem or harvest during a specific time of year if a taxon is abundant and many taxa from the same ecosystem or season are identified. Because the birds and mammals found in the Burrard Inlet and Indian Arm are relatively unconstrained to a specific ecosystem, I primarily used fish and invertebrates to assess what ecosystems were utilised by ancient peoples. For these analyses, I sub-divided the assemblage into the invertebrate and fish collections from the heavy fraction and the combined bird and mammal collection.

Were different activities conducted inside and outside the small structure?

Fragmentation

I tested for a greater frequency of large-sized specimens in the exterior deposit by evaluating fragmentation of bivalve shells and mammal remains. The comparison of bivalve fragmentation required the weight of shell recovered in each of the nested sieves used during sorting. Taxa examined were Pacific littleneck, Nuttall's cockle, blue mussel, and a composite category "other bivalves." Frequency per size category for each taxon was graphed. To analyse fragmentation of mammal remains, I applied a less stringent method of identifying mammal specimens to increase my sample size. For this analysis, specimens that could not be identified to element were categorised as either bird or mammal; previously they were identified to the taxon "bird/mammal." I differentiated between bird and mammal using cortical bone thickness and cancellous bone morphology. This analysis excludes any specimens showing fresh breaks, worked specimens, specimens aged foetal to juvenile, and the specimens selectively collected from the trenches and near OEU-2. Mammalian long bones, metapodials, and specimens unidentified to element, but likely long bone, were measured by 1 cm increments (e.g., 0-1 cm, 1-2 cm), after Serjeantson (1995) and Watson (1972). The specimen counts per measurement interval were than compared for the two deposits.

Density

To assess if the density of vertebrate remains is greater inside, I calculated the densities for fish, mammal, bird, and unidentified vertebrate remains by context and compared the results. I was unable to test statistically for differences in density of remains between the interior and exterior deposits due to the small size of my samples. I considered ratios comparing exterior versus interior deposits $\geq$ 1.5:1 to be meaningful. Fish remains are quantified using the heavy fraction; the other categories are quantified using material from the ¼-inch screen, excluding specimens selectively collected. The same approach for examining the distribution of vertebrate remains was applied to understand patterning in the distribution of artifacts. The one difference is that all artifacts collected were quantified and thus the volume of sediment from which specimens were selectively collected is included in the total excavated volume used to standardize the counts to one cubic-meter.

To test that shell from primary prey and inadvertently procured taxa are more common in the exterior deposit, I used the specimens recovered from the heavy fraction. "Inadvertents" are defined by the ethnographic use of taxa (see Table 3). The primary shellfish prey was defined by my earlier results regarding resource specialisation. As the heavy fraction from the interior and exterior deposits both equate to 15 litres of matrix, I used a direct comparison of the total weight or the NISP of taxa per context to understand their distribution.

Richness

Richness, the number of mutually exclusive taxa identified within a collection, was determined for the collections recovered from the interior and exterior deposits. This analysis of richness by context led me to examine the distribution of bird skeletal parts between the two contexts.

Skeletal part frequency

In this instance, I simply compared the total number of bird elements, standardized to a cubic-metre, per skeletal part by context.

Spatial patterning

Intra-site spatial patterning was observed by plotting the frequency of fish and invertebrate taxa per flotation sample across the site. The sample of bird and mammal remains identified in the heavy fraction was too small to use for this analysis. The frequency of a taxon is calculated by dividing the NISP or weight for that taxon within a sample by the total NISP or weight for the taxon. For example, if a flotation sample contains 10 g of butter clam out of a total 100 g of butter clam recovered in all the flotation samples taken together, the frequency for butter clam in that sample would be 10%. The frequencies of the most common fish and invertebrate taxa, defined by the results from analysing resource specialisation, are also presented in this manner.

How was the Burrard Inlet-Indian Arm locality utilised in the Late Phase?

To assess if the sites I used for my inter-site analysis were utilised in a similar manner by ancient peoples, I re-examined the seasonal use of Belcarra Park, Cates Park, and Tsawwassen and compared resource specialisation at each site. The small samples of specimens from Belcarra Park, Cates Park, and Tsawwassen make it unlikely that the true taxonomic diversities of the site deposits are represented.

Therefore, there is the possibility that some ecosystems that were utilised are not represented. Other limitations of each site's data were described in the Archaeological Context section (Chapter One).

Seasonality

Understanding the seasons in which people were in the Burrard Inlet and Indian Arm is required to recreate how the inlet environment was utilised by ancient peoples. I reassessed the season(s) during which people were at Belcarra Park, Cates Park, and Tsawwassen using my relatively conservative method discussed previously.

Resource specialisation

Due to limitations in the reported data, I compare the relative frequencies of vertebrate taxa by class (fish, mammal, bird) for each site. If people had different focuses, then considerations (e.g., site use), in addition to environmental setting, must be taken into account when comparing the faunal assemblages. I used the specimen collections recovered from ¼-inch mesh screen for this analysis. The other faunal reports did not note specimens unidentifiable to bird, mammal, or fish suggesting they made the distinction between these classes for all specimens, whereas I did not. However, in the context of this analysis, the "unidentifiable" specimens in the Cove Cliff collection comprised an insignificant portion of the remains. One factor that I could not control for is timing of occupation. Occupations at the four sites likely overlap to some extent temporally but not necessarily entirely.

Ecosystems utilised

I looked at ecosystems represented by the taxa present and, in some instances, the relative frequencies of the taxa to determine which ecosystems were used and if there was an emphasis on a specific ecosystem. For these analyses, I used the shellfish, mammalian, and avian remains recovered from flotation samples and ¼-inch mesh screen. Domestic pig and dog are not included in this analysis of mammalian remains as I am concerned with how people used the natural environment, not animal husbandry. I also excluded taxa that died on the site due to natural causes such as mice, voles, and moles.

CHAPTER THREE
RESULTS

The Cove Cliff archaeofauna

The archaeofaunal specimens recovered in 2000 were well preserved, albeit quite fragmented, and included bone, antler, fish scales, shell and other invertebrate specimens. From the Late Phase deposits, 46,421 vertebrate specimens and approximately 15,185.6 g of invertebrates[2] were analysed. The vertebrate specimen count was 52,568 after standardising the flotation samples to 1-litre and accounting for sub-sampling (Appendix K). This includes 13,907 bone and antler specimens recovered from ¼-inch mesh screen and 38,661 specimens from the heavy fraction. Of the total vertebrate specimens recovered in screens, 1,222 (9%) were selectively collected and were therefore excluded from analyses requiring NISP. The invertebrate collection weighed 13,326.0 g after standardising flotation samples to 1-litre (Appendix K). Twelve percent of the fish in the heavy fraction were identifiable to genus (Appendix C). This percentage was low due to the limited number of elements selected for identification. Only 19% of the mammalian specimens were identified to genus primarily due to breakage (Appendix D). Higher percentages of bird and invertebrates were identified to genus 21% and 40%, respectively (Appendices E-G). The small number of identified specimens constrained my interpretations.

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[2]Weight includes estimates for sub-sampled portion of collection.

Specimen identification

Based on patterning within the archaeofaunal assemblage, I felt confident in assigning some portions of the collection to a species or genus, even though I could not do so by visual observation alone. Henceforth, I interpret specimens identified as "small artiodactyl" to be black-tailed deer because these specimens are more similar to deer than the only other small-sized artiodactyl in the region, the mountain goat. Using the same reasoning, I considered "large artiodactyl" to be wapiti and not domestic cow; although, it is harder to distinguish between wapiti and cow when specimens are fragmentary. The canid remains are interpreted as domestic dog because they were too small to be wolf and based on the past distribution of the coyote are not likely to be that species (Ministry of Environment, Fish and Wildlife Branch 1980:2).

For the invertebrate collection, I adopted the following assumptions in my identification. Miscellaneous littleneck clam, cockle, and mussel were attributed to Pacific littleneck clam, Nuttall's cockle, and blue mussel, respectively, because no other species within the genera were identified. Although the taxa barnacle, gastropods, and limpets may be identifiable, limitations in the reference collection prevented a more specific identification.

Taphonomy

The prehistoric deposits analysed in this thesis showed no major signs of disturbance. There was little evidence of bioturbation due to burrowing animals or root action. The small number of specimens that had been gnawed by rodents (n=4) supports excavators' observations about the paucity of natural disturbances. There were localized historic disturbances, such as postholes and small pits, but excavators did not note an association between these features and faunal remains. I did identify domestic cow (NISP=2) and domestic pig (NISP=1) in the archaeofauna and one sawn long bone, whose taxon was not determined. I considered these specimens intrusive and excluded them from my analyses. However, their presence suggests that some historic material may yet be mixed in with the archaeofaunal assemblage. One difficulty encountered was how to handle a sheep/goat metapodial, which was found within 10 cm of the surface. I took a conservative approach and categorised the specimen as an intrusive specimen dating to the Historic era. Attempts to identify the metapodial to species were inconclusive owing to the articular ends being damaged by carnivore action. If any intrusive specimens remain in the assemblage after having taken the above actions, the number is quite small and therefore do not bias my results.

Carnivores influenced the preservation of remains, particularly within the interior deposit. Of the carnivore gnawed specimens, 83% of 35 specimens were recovered from the interior deposit. Sixty-nine percent of these 35 specimens were collected within 10 cm dbs. It is likely that domestic dogs were the cause of most of this damage. Dogs tend to fragment and destroy bones by gnawing, which hinders identification of a specimen to element and, therefore, to taxon. This makes it harder to assess if patterning in the faunal remains is due to cultural practices (e.g., butchery, tool manufacture) or natural processes. The spatial distribution of remains is affected not just by this absence of bones but also by dogs moving bones away from where they were left by humans (Hayden and Cannon 1983:130; Hudson 1993, Yellen 1991).

How did people use the Cove Cliff site during the Late Phase?

Richness

The specimen collections used to represent the vertebrate and invertebrate animals present were of sufficient size to capture the taxonomic richness within the Cove Cliff site's archaeofaunal assemblage (Fig. 9). Twenty-two fish taxa were identified to at least family in the assemblage. Nineteen fish taxa were identified to at least family in the

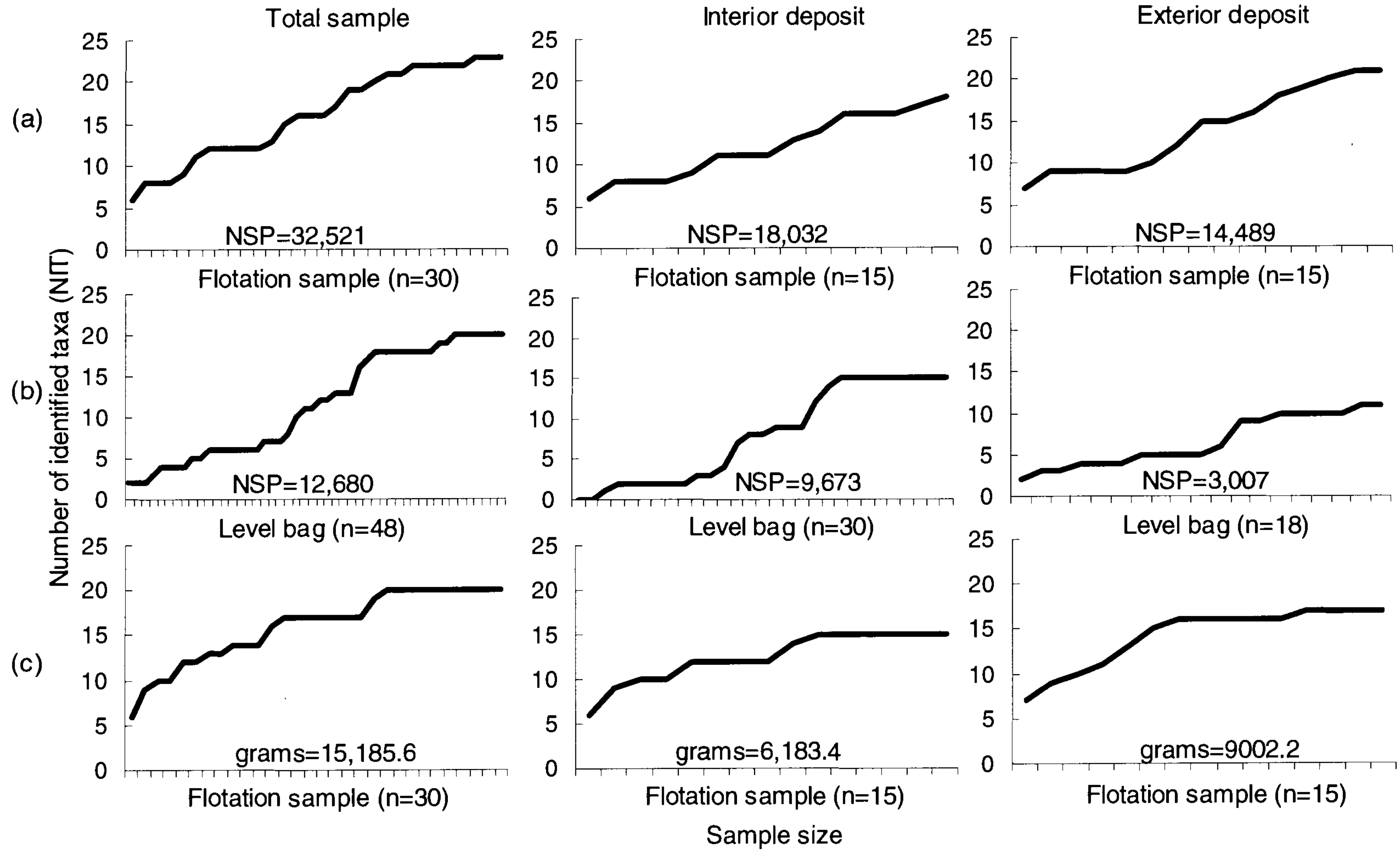


Figure 9. Number of identified taxa in relation to sample size. (a) Vertebrates from the heavy fraction, (b) bird and mammal taxa from ¼-inch screen, (c) invertebrates from the heavy fraction. Note: Specimen counts/weights are not adjusted to reflect sub-sampling. The archaeofaunal assemblage was adequately sampled for richness, except for the vertebrate collection (a) recovered from the interior and exterior deposits.

Table 7. Results of ancient DNA analysis of salmon specimens (n=11).

Specimen id	D-loop	Cyt B	Number of annuli	Unit	Layer	Level
291	Chum	Chum	1	486N 497E	23	2
244	Pink	Pink	1	480N 500E	trench	3
531	Pink	Pink	1	484N 500E	n/a	1
7	Chum	Chum	2	484.75N 496E	8	2
24	Chum	Chum	2	484.75N 496E	8	2
28	Chum	Chum	2	484.75N 496E	8	2
4	Chum	Chum	3	484.75N 496E	8	2
10	Chum	Chum	3	484.75N 496E	8	2
18	Chum	Chum	3	484.75N 496E	8	2
106	Chum	Chum	3 or 4	484.75N 496E	1	2
560	Chum	n/a	3 or 4	482N 498E	1	1

heavy fraction (Appendix C). One taxon, sturgeon, was identified in remains from the ¼-inch screen. Ancient DNA analysis identified the presence of chum and pink salmon (Table 7; Speller 2004). Ten mammalian taxa (excluding historic remains), 11 bird taxa, and 13 invertebrate taxa were identified to at least genus in the Late Phase faunal remains (Appendices D-G). These data allowed me to make interpretations about resource specialisation, ecosystems utilised, and seasonality for the area of the site that was excavated.

Resource specialisation

The vertebrate collection (including remains from the heavy fraction and screens) was overwhelmingly dominated by fish (97%), with bird, mammal and unidentified specimens each comprising no more than 2% of the collection (Table 8). To test that the dominance of fish was not a result of quantifying the numerous spines and rays fish possess as "Fish," I calculated relative frequencies using only specimens identified to family or more specific taxonomic category. Using this conservative approach, fish were

Table 8. Specialisation within the Cove Cliff vertebrate remains by entire assemblage, ¼-inch screen collection, and heavy fraction collection.

	Assemblage		¼-inch screen		Heavy fraction	
Taxon	NSP	%	NSP	%	NSP	%
Fish	49,956	97.31	11,420	90.04	38,536	99.67
Mammal	217	0.42	213	1.68	4	0.01
Bird	145	0.28	139	1.10	6	0.02
Unidentified	1,025	1.99	910	7.18	115	0.30
Totals:	51,343	100.00	12,682	100.00	38,661	100.00

NSP=number of specimens. %=NSP_{taxon}/total NSP.

still dominant comprising 97% of the vertebrate collection (4,732 $NISP_{identified\ fish}$/4,866 NISP). Although vertebrates and invertebrates cannot be directly compared, the amount of shell within the deposits suggest that fish and invertebrates were the predominant animal resources utilised by the Late Phase occupants at Cove Cliff.

Further analysis revealed people specialised in the procurement of specific animals. Pacific herring, salmon and northern anchovy account for 88% of identified fish (Fig. 10, Appendix C) suggesting people focused their efforts on procuring these species. However, I propose the presence of northern anchovy is an anomaly and not representative of the typical subsistence practices of the people who lived at Cove Cliff. Northern anchovy is concentrated in two flotation samples (55 and 57) from the same stratum in the exterior deposit suggesting most the anchovy was deposited during one event. Relatively little research has been conducted on anchovy in British Columbia waters, and most references to anchovy in nearshore waters, such as bays and inlets, refer to the west coast of Vancouver Island. The numbers of northern anchovy in British Columbia waters appear to fluctuate considerably over time (Therriault *et al.* 2002). This behaviour suggests that in a year when anchovy was abundant the population may have

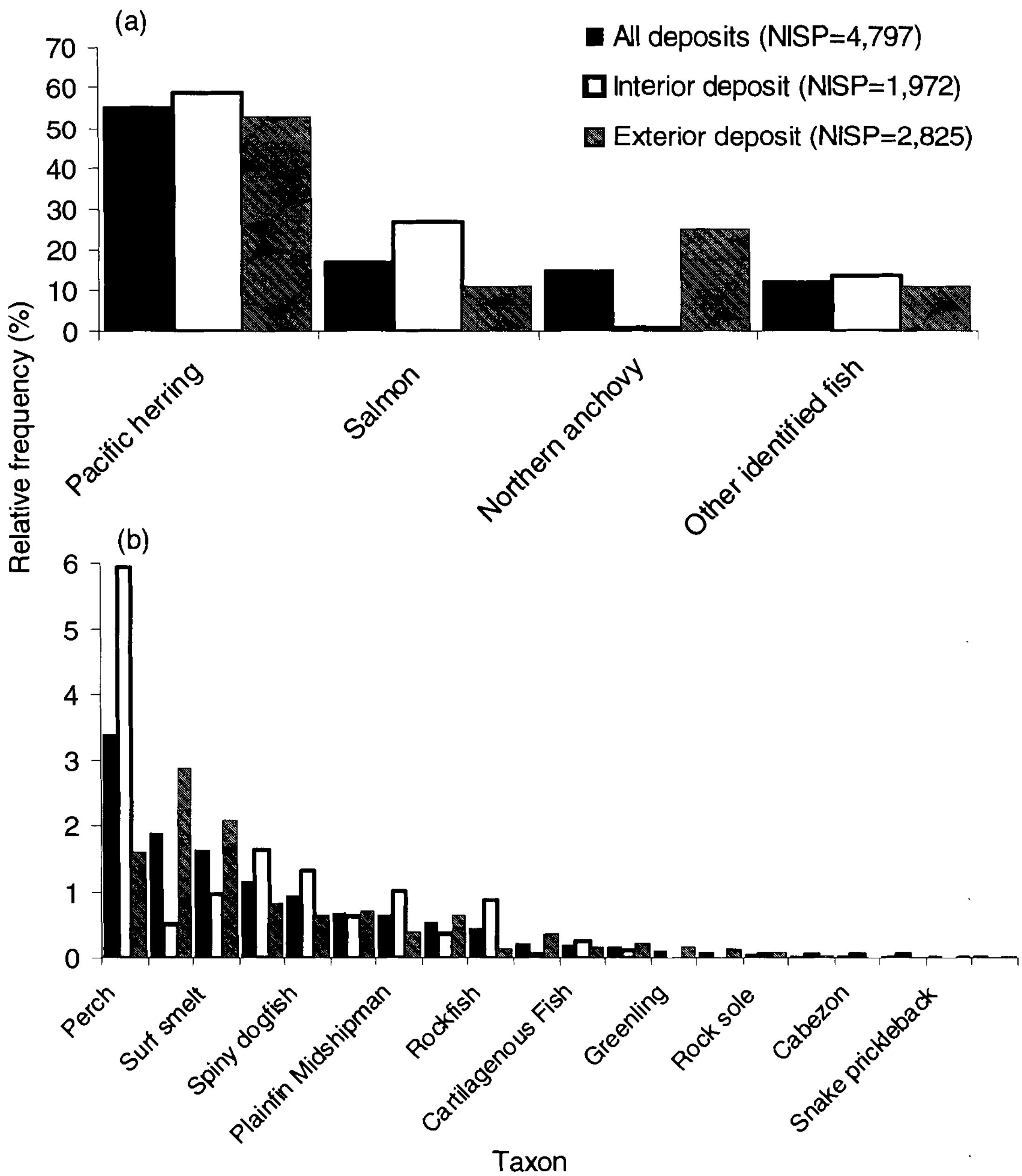


Figure 10. Relative frequency of fish taxa recovered from the heavy fraction in order of abundance. (a) Three most abundant fish taxa, (b) "Other identified fish" by taxon. Relative frequency=$NISP_{taxon}$/total $NISP_{fish}$.

spilled over into the Burrard Inlet in large numbers, where people at Cove Cliff may have caught the schooling anchovy using a net or herring rake.

In addition to the ancient DNA analysis (Table 7), the result of measuring the salmon vertebrae suggests the harvesting of chum salmon (Appendix J). Sixty-four percent of the vertebrae measured were > 10.5 mm wide suggesting they are either chum or chinook salmon and 3% were < 8.0 mm suggesting pink or sockeye salmon. Because chinook and sockeye were not identified by ancient DNA analysis, have small runs or do not run in the Burrard Inlet (respectively), and do not preserve as well as chum or pink salmon (Kennedy and Bouchard 1990:444; Romanoff 1985:120,126,154-155; Suttles 1990:457), I posit it is most likely that these vertebrae are from chum and pink salmon.

The people at Cove Cliff appear to have specialised on hunting artiodactyls and ducks. Domestic dog, black-tailed deer, and artiodactyl comprise 65% of the identified mammalian remains (Fig. 11) indicating a weak focus on these taxa. The importance of deer is probably under-represented as some of the 25 specimens identified to the more generic category "Artiodactyl" are likely deer. People also were not highly specialised in types of birds hunted. Ducks, loons, and gulls comprise 75% of identified bird remains. However, duck is relatively pronounced in the collection constituting 52% of identified bird specimens (Fig. 11) and this is likely an under-representation of the presence of duck. Seventy-four percent of medium bird specimens (n=32) identified to genus are duck suggesting that many specimens identified to the general category "medium bird" are duck. Therefore, the true abundance of duck in the collection is between 52% and 78% (Appendix E). Within the combined bird and mammal collection, domestic dog was most abundant (19%) followed by duck (16%) and black-tailed deer (15%).

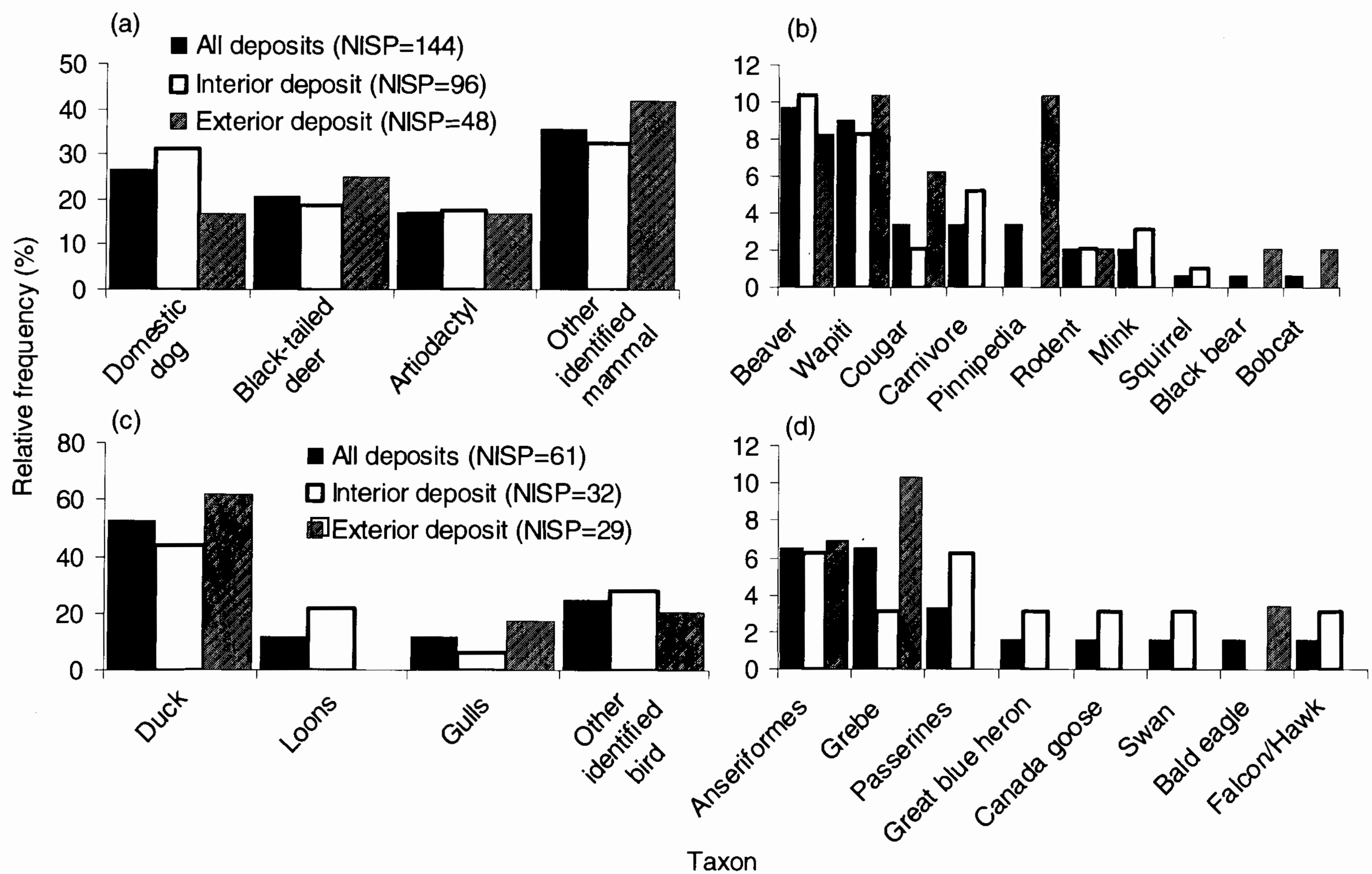


Figure 11. Relative frequency of identified mammalian and avian taxa recovered from ¼-inch screen and heavy fraction in order of abundance; (a) Most abundant mammalian taxa, (b) "other identified mammal" by taxon, (c) most abundant avian taxa, and (d) "other identified bird" by taxon. The following are generic categories containing specimens identified to species: duck, gull, and pinnipedia. Relative frequency=$NISP_{taxon}$/total $NISP_{mammal}$ or $NISP_{taxon}$/total $NISP_{bird}$.

People at Cove Cliff focused on four invertebrate taxa—the butter clam, Pacific littleneck clam, Nuttall's cockle, and blue mussel, which collectively comprise 75% of the identified invertebrate collection (Fig. 12). For this analysis of resource specialisation, the method, as defined previously, was changed to the sum of the relative frequencies of the four (instead of three) most common taxa. I did this because the relative frequency of blue mussel is so close to that of the littleneck clam and cockle I could not justify its exclusion. The results suggest that butter clam was the primary bivalve collected by ancient peoples at the site and the other three taxa were secondary prey.

The importance of butter clam is probably under-represented in this analysis. The butter clam's shell lacks distinctive texturing or colouring; therefore, only hinges of the butter clam were categorised as butter clam. Other butter clam fragments were categorised as "miscellaneous clam." Since fragments of the other three common taxa are easily identified to taxon, much of the "miscellaneous clam," by process of elimination, is likely butter clam. Adding the number of specimens in "miscellaneous clam" and "butter clam" together, the true relative frequency of butter clam is between 27% and 43% of the collection. Taken together, these results show that the Late Phase occupants utilised a variety of animal resources with definite emphases on Pacific herring, salmon (probably chum), duck, black-tailed deer, dog, and butter clam.

Procurement, processing, and use of animals

The bone and antler artifact collection provided some insight into how animals were procured (Tables 9-10). The procurement of salmon is indicated by the recovered pieces of small-size toggling harpoon heads, referred to as salmon harpoons (Barnett 1955:83; Drucker 1955:43; Stewart 1986:109-110). Two channelled valves and a wedge-based point comprised a toggling harpoon head. These objects were found both

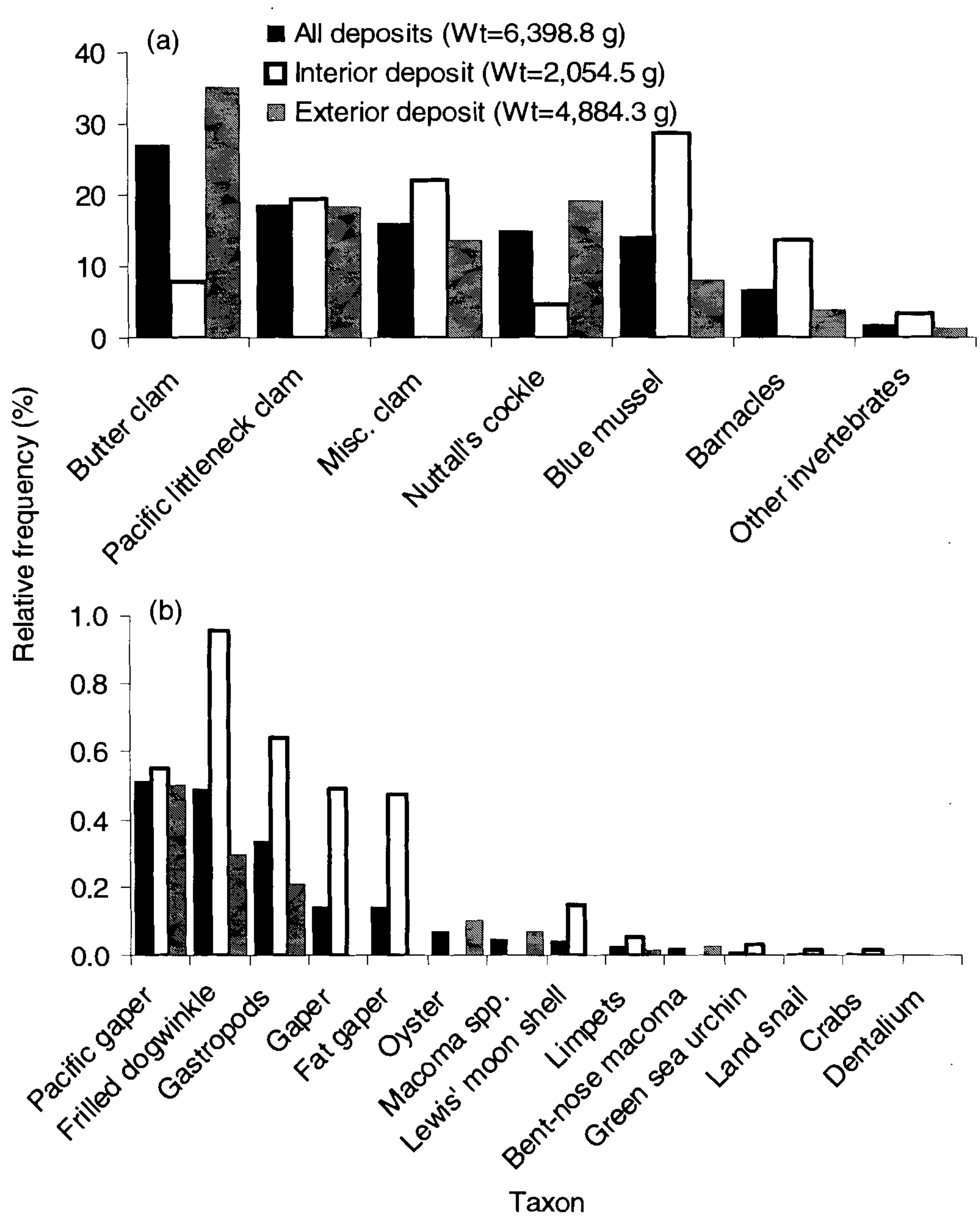


Figure 12. Relative frequency of identified invertebrate taxa recovered from the heavy fraction in order of abundance. (a) Most abundant invertebrates, (b) "Other identified invertebrates" by taxon. To make graph (b) readable due to differences in scale, graph (a) shows more than just the three most abundant taxa.
Relative frequency=$weight_{taxon}$/total $weight_{identified\ invertebrates}$.

Table 9. Prehistoric bone, antler, and shell artifacts recovered at Cove Cliff.

Taxon	Element	Modification	Count	Used for:
Beaver	incisor	split vertically	1	woodworking
Wapiti	antler	wedge	2	woodworking
Black-tailed deer	metapodial	grooved and snapped	2	unknown
Artiodactyl	antler	worked	5	unknown
		wedge-based point	1	fishing
		toggling harpoon valve type A	10	fishing
		toggling harpoon valve type B	1	fishing
Mammal	unidentified	wedge-based point	1	fishing
		arming point	1	fishing/hunting
		worked	1	unknown
Bird or mammal	long bone	wedge-based point	5	fishing
		arming point	2	fishing/hunting
		grooved and polished	1	unknown
		worked	3	unknown
	unidentified	polished to point	3	unknown
		toggling harpoon valve type A	3	fishing
		worked	11	unknown
Dentalia		bead	1	trade/ornamentation
		Total:	54	

in associated groupings and individually. The toggling harpoon valves were consistent in form except one, categorised as toggling harpoon valve type B. Its length was approximately two-thirds the length of the other valves and the carving more detailed. One of the wedge-based points was burnt. Whether these differences mean the tools served a different purpose or were made by a different person or group is unknown. The hunting of bird and mammal with atlatl and bow-and-arrow is indicated by the types of lithic projectile points recovered (Morin 2002).

The sample of vertebrate specimens that were burnt or had cutmarks is too small to make broad interpretations concerning how the animals were processed (Table 10). However, other evidence, in addition to the quantity of fish and shell recovered, suggests that fish and/or shellfish processing occurred at the site. In the southwest corner of the excavation, paired stake hole features (Fig. 6-F28, F31) were found in association with burned matrix. These stake holes may be the remains of a drying rack placed near a fire

Table 10. Specimens showing modifications recovered at Cove Cliff.

Taxon	Element	Burnt	Carnivore damage	Rodent damage	Cutmark
Birds					
Loons	tarsometatarsus	1			
Grebes	coracoid	1			
Duck or goose	coracoid		1		
Duck	humerus	1			
	tarsometatarsus				2
Mammals					
Rodent	rib	1			
Domestic dog	femur		1		
	calcaneous		1		
	metacarpal II		1		
	phalanx		1		
	tibia		1		
	atlas		1		
Bear	metatarsal II		1		
Bobcat	humerus	1			
Carnivore	humerus				1
Harbour seal	tibia		1		
Seals, sea lions	rib		1		
Black-tailed deer	lumbar vertebra		1		
	rib		1		
	humerus				1
	ulna				1
	scaphoid		1		
	phalanx III.2				1
Artiodactyl	antler			1	
Medium mammal	rib		1	1	
	radius	1			
Bird or mammal	long bone	10	7		8
	unidentified	17	13	2	2
Fishes					
Pacific herring	maxilla	1			
	vertebra	6			
Perches	teeth	2			
	vertebra	1			
Northern anchovy	vertebra	2			
Salmonids	vertebra	19			1
Fish misc.	vertebra	7			
	unidentified	56			
Unidentified	unidentified	6	1		2
Total		133	35	4	19

Note: Includes specimens selectively collected from the upper 20 cm of sediments in trenches and sediments east of OEU-2.

to dry or roast meats. In this same southwest corner of the excavation, excavators found a deposit (layer 22) of highly burned and crushed mussel and clam shell 10-20 cm dbs suggesting that the shell, itself, was being processed. Some shell, in particular thin shell, weakens when fired (Currey 1979) so it may be that people were intentionally burning the shell, crushing it, and then using it as building material to create a surface inside the structure.

Based on ethnographic accounts regarding use of animal resources, the majority of the Cove Cliff assemblage probably represents the remains of activities associated with food procurement, processing, and consumption (Table 3). The abundance of fish, duck, and shellfish that are primarily described as food items in ethnographic sources supports this claim. The primary use of mammals identified in the faunal remains is less clear. Although there is no evidence that dogs were butchered (e.g., cutmarks, burnt specimens; Table 10), they could have been a food source or butchered for their skins. Many dog remains were gnawed by a carnivore suggesting people accorded dogs no preferential status since dog remains were disposed of in the same manner as other unwanted animal parts (Table 10; Hanson 1991:188-189). Ethnographic sources suggest that even if used for food, the dogs were probably valued more as hunting dogs and/or for their wool (Jenness 1977:67-68, 348; Hill-Tout 1978:119; Suttles 1974:159). Black-tailed deer was hunted for its antler, meat, hide, bones, sinew, intestines, and hooves.

A multitude of other activities besides those related to food may be represented by taxa identified in the faunal remains (Table 3). However, in most cases the collection gives few clues about which of these activities occurred. In the case of the five articulated wapiti anklebones recovered in the uppermost stratum of the interior deposit, the ethnographic record provides no clues about use. A possible scenario is that they were used ritually, as is ethnographically known for deer feet. Alternatively, they could have been brought back to the site attached to other part(s) of the animal and disposed of when processing the hide or butchering the animal. In this latter scenario, I would not expect the unwanted feet to have been deposited inside the structure. However, the articulated salmon vertebrae excavators recorded throughout the site, including in the interior deposit, suggest some refuse may have been deposited where convenient upon abandonment of the site (Lepofsky and Karpiak 2001:66).

The faunal remains indicate people at Cove Cliff were engaged in woodworking and bone tool manufacturing. Woodworking is indicated by the presence of spiny dogfish (n=44), whose main value was its skin, which was used as a kind of sandpaper (Barnett 1955:111). A halved beaver incisor (n=1) and antler wedges (n=2) were tools also used in woodcarving (Stewart 1986:99; Table 10). These results support the notion, based on the lithic artifacts recovered, that people were woodworking at or near the site (Morin 2002). Three specimens that were grooved-and-snapped or grooved-and-polished may be tool preforms suggesting some bone tool manufacturing occurred on site.

Skeletal part frequencies

The analysis of skeletal part frequencies revealed that representation of skeletal parts in the artiodactyl and avian remains at Cove Cliff are similar to the patterns described at other Gulf of Georgia sites. This analysis was limited to artiodactyl and avian collections since only they had relatively large samples. At both Cove Cliff and Cates Park, the skull, foot, and lower limb of artiodactyls are over-represented (Fig. 13). A possible reason for this patterning is the axial skeleton was left at the kill site while

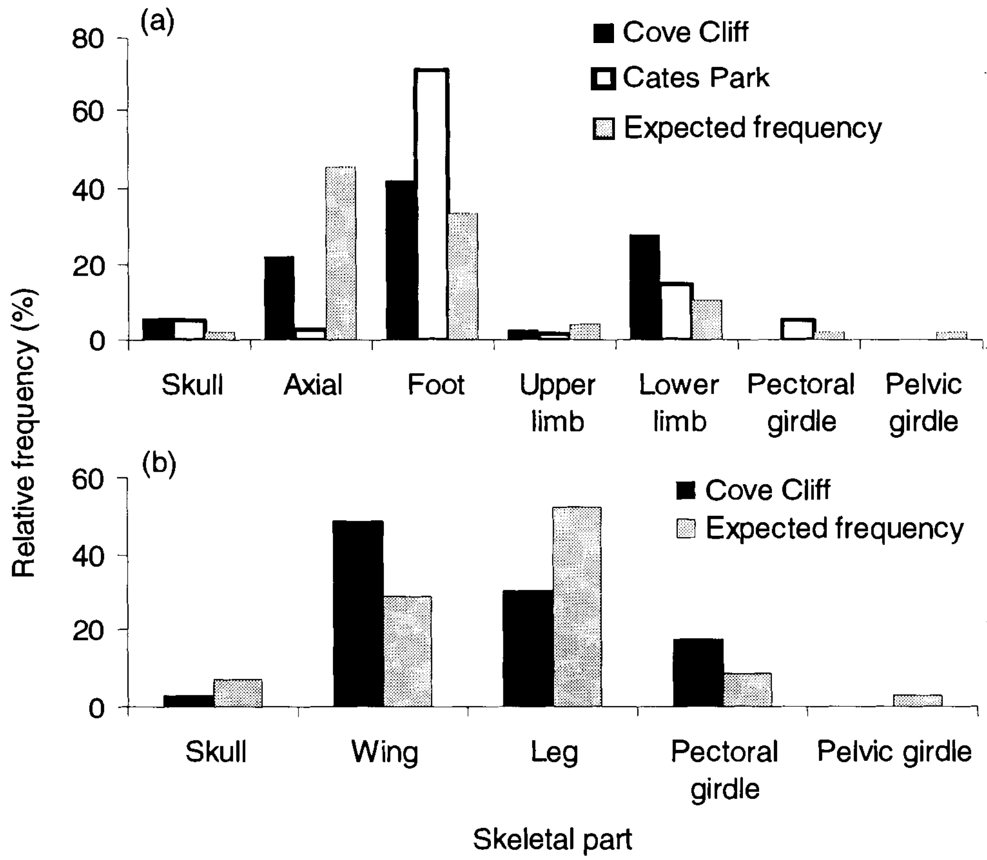


Figure 13. Artiodactyl and avian skeletal part frequencies. (a) Artiodactyl. Skeletal parts represented are: skull [cranium, mandible], axial [43 vertebrae], foot [8 carpals/tarsals, 24 phalanges], upper limb [2 humerii, 2 femora], lower limb [2 ulnae, 2 radii, 2 tibiae-fibulae, 4 metapodials], pectoral girdle [2 scapulae], pelvic girdle [2 innominates]. (b) Bird. Skeletal parts represented are: skull [basi-sphenoidal rostrum, 2 frontal bones, 2 quadrates], wing [2 humerii, 2 radii, 2 ulnae, 2 carpometacarpii, 2 ulnar articulations, 2 carpals, 2 radiale, 6 phalanges], leg [2 femora, 2 fibulae, 2 tarsometatarsii, 2 tibiotarsii, 28 phlanges], pectoral girdle [2 coracoids, furculum, 2 scapulae, sternum], pelvic girdle [2 innominates]. Only elements identified in the archaeological remains are used for this analysis. Foetal/juvenile specimens not included.

lower limb bones (e.g., metapodials) and skull with antlers attached were curated as raw materials (Huelsbeck 1994:47; Hanson 1991:226-227; Hodgetts and Rahemtulla 2001). Alternatively, the differential representation of skeletal parts could be due to denser elements, such as foot bones, better withstanding trampling, carnivore damage, and other natural taphonomic processes (Hanson 1991:222-228; Kusmer 2000:121; Lam *et al.* 1999:351-352). As discussed previously, carnivores impacted the assemblage and

Table 11. Ratio of bird skeletal parts by density per context.

Skeletal part	Interior deposit (NISP per m^3)	Exterior deposit (NISP per m^3)	Ratio of skeletal parts (Interior : Exterior)
Cranial	7	24	0.3:1
Axial	59	63	0.9:1
Wing	103	198	0.5:1
Leg	103	87	1.2:1
Pectoral	45	48	0.9:1

Density=(NISP/excavated volume)*10

two of three tool preforms are artiodactyl metapodials suggesting both human and non-human agents influenced which skeletal elements were recovered and are identifiable.

As at other Northwest Coast sites (see Bovy 2002), bird wing elements are over-represented in the Cove Cliff collection with over twice as many wing elements (1.6:1 wing-to-leg ratio) than is expected if only complete skeletons were present (0.56:1.0 wing-to-leg ratio; Fig. 13; Table 11). Using Bovy's method (2002:970, 973), wings are over-represented in the collection of aquatic bird remains (Table 12). Some possible reasons for these patterns are procurement methods, loss of identifiable elements due to intensive processing by humans, curation of wing bones as raw materials, or gnawing by carnivores (Bovy 2002; Crockford *et al.* 1997; DePuydt 1994:221-224; Schalk 1993). Based on my previous analyses, there is a distinct possibility carnivores caused some of the attrition at Cove Cliff, although only one specimen identified as bird showed signs of carnivore gnawing.

Table 12. Skeletal part distribution for aquatic birds.

	Expected	Cove Cliff
Wing elements (NISP)	8	23
Leg elements (NISP)	6	8
Wing-to-leg ratio	1.3:1	2.9:1

Following Bovy (2002:973): wing [2 humerii, 2 radii, 2 ulnae, 2 carpometacarpii], leg [2 femora, 2 tibiotarsii, 2 tarsometatarsii]."

Seasonality

My data suggest that Cove Cliff was occupied either continuously throughout the year or at various times during the year, by at least some portion of the community. This result expands the seasonality of occupation (mid-summer into fall) suggested by previous archaeobotanical and shell-ring analyses (Ng and Ryan 2001; Ormond 2001). Based on the assumption that there is a direct correspondence between presence of a taxon and season of use, my primary seasonal indicators are those taxa with limited prime-hunting seasons and relatively high abundance within the assemblage—the frilled dogwinkle (winter), Pacific herring (late winter-spring), northern anchovy and surf smelt (summer), and pink and chum salmon (fall; Table 13). Additional evidence for springtime and summertime occupation is the number of taxa whose prime-hunting season encompasses spring (spiny dogfish, sturgeon, Pacific herring, eulachon, plainfin midshipman, English sole, and starry flounder). Although the presence of any one of these taxa on its own is weak evidence, as a whole, they make a strong argument for a springtime occupation.

Ecosystems utilised

The fauna identified in the Cove Cliff assemblage reflects the use of the wide-range of ecosystems located in the Burrard Inlet and Indian Arm (Table 14). Based on modern and historic distributions of fish, people at Cove Cliff had to travel at least one day to obtain some fish. Pacific herring, along with smelt and sturgeon, seem to have been concentrated in the Burrard Inlet west of Lynn Creek (Fig. 3). The few accounts of herring and smelt spawning east of Lynn Creek in the inner Inlet suggest such events are small and sporadic (DFO n.d.; Eric Olsen, personal communication 2004). Eulachon could have either been caught at the mouth of Indian River or on the Fraser River, both

Table 13. Prime-hunting season for taxa[1] identified in the archaeofaunal assemblage from Cove Cliff.

Taxon	NISP/ Wt (g)[2]	Winter D	J	F	Spring M	A	M	Summer J	J	A	Fall S	O	N
Bufflehead/Goldeneye	7	—	—	—	—								—
Bald eagle	1	—	—	—	—							—	—
Mew gull[2]	1	—	—	—	—	—	—			—	—	—	—
Glaucous-winged gull[2]	1	—	—	—	—	—	—				—	—	—
Beaver	14	—	—					—	—	—			
Black bear	1	—	—	—	—			—	—	—	—	—	—
Bobcat	1	—	—	—				—	—	—			
Black-tailed deer	30	—	—	—									
Spiny dogfish	44				—	—	—						
Sturgeon	15				—	—	—						
Pacific herring	2656			—	—	—							
Northern anchovy	724								—	—			
Pink salmon	2										—	—	
Chum salmon	9											—	—
Surf smelt	78							—	—	—			
Eulachon	91				—	—	—						
Plainfin midshipman	31						—	—					
Snake prickleback	1							—	—	—			
English sole	2				—	—	—						
Starry flounder	32			—	—	—							
Sucker fish	1				—	—	—						
Frilled dogwinkle	428.2 g	—	—	—									
Green sea urchin	0.8 g	—	—	—									
Maximum # of taxa per season:			12			14			11			10	

Italicised taxa can be stored. See Methods for definition of prime-hunting season.
[1]Prime-hunting season not determined for the following: loons, grebes, great blue heron, Canada goose, swans, Steller's jay, falcon/hawks, squirrels, dog, mink, cougar, wapiti, harbour seal, perches, rockfishes, greenlings, walleye pollock, buffalo sculpin, Pacific staghorn sculpin, cabezon, rock sole, and invertebrates except ones shown. Distribution of Canada goose may once have been limited to summer (Campbell *et al.* 1990a:276).
[2]Some gulls may have been less common in the past (Campbell *et al.* 1990b; VNHS 1995:26). *Sources*: For bird, Breault and Watts 1996; Campbell *et al.* 1990a, 1990b, 1997, 2001; VNHS 1995. For mammals, Banfield 1974; Dahlquest 1948. For fish, Barnett 1955; Clemens and Wilby 1961; Hart 1973; Lamb and Edgell 1986; Matthews 1955; McPhail and Lindsey 1970; Therriault *et al.* 2002:7; Quamme *et al.* 1998; Eric Olsen, personal communication 2004; Matt Foye, personal communication 2003. For invertebrates, Harbo 1997:211; Matson *et al.* 1999:164-168; Paine 1992:106.

Table 14. Ecozones and ecosystems represented by the fish and invertebrate taxa identified in the Cove Cliff archaeofaunal assemblage, ordered by biological taxonomy. Ecosystems not shown for the general taxa: codfishes, perches, rockfishes, greenlings, land snails, and crabs. [1]Found in ecosystems where their prey—eulachon, herring, and surf smelt are located. [2]The ecosystems which sockeye prefer are not shown as the fish only occasionally strays into the Burrard Inlet. [3]The primary ecosystem is best described as a soft substrate. [4]Prefers a higher ratio of sand to mud. [5]Prefers a higher ratio of mud to sand. *Sources*: Clemens and Wilby 1961; Harbo 1997; Hart 1973; Lamb and Edgell 1986; Snively 1980.

	NISP/ Weight (g)	Coastal Douglas-fir Lakes	Coastal Douglas-fir Streams	Coastal Western Hemlock Lakes	Coastal Western Hemlock Streams	Coast Intertidal Rocky	Coast Intertidal Sand	Coast Intertidal Mudflats	Coast Intertidal Cobble-stone	Coast Intertidal Seagrass/kelp beds	Coast Subtidal Open waters	Coast Subtidal Rocks	Coast Subtidal Sand	Coast Subtidal Mud	Coast Subtidal Cobble-stone	Coast Subtidal Seagrass/kelp beds
Spiny dogfish[1]	44		X							X	X					X
Sturgeon	16		X		X						X					
Pacific herring	2656									X	X					X
Northern anchovy	724										X					
Salmon[2]	831		X		X						X					
Surf smelt	78					X			X		X					
Eulachon	91		X		X						X					
Plainfin Midshipman	31					X							X	X		
Walleye pollock[3]	4						X	X					X	X		
Snake prickleback[3]	1						X	X					X	X		
Buffalo sculpin	11					X				X		X				
P. staghorn sculpin	8							X						X		
Cabezon (juvenile)	1									X		X				
Rock sole[3]	3												X	X		
English sole[3]	2												X			
Starry flounder	32		X		X					X			X	X		
Sucker fish	1	X	X	X	X											
Dentalia	< 0.1 g												X	X	X	
Limpets	1.9 g					X										
Frilled dogwinkle	34.2 g					X										
Blue mussel	993.7 g					X			X							
Nuttall's cockle[5]	1039.0 g							X	X							
Macoma sp.	3.4 g						X	X								
Pacific littleneck clam	1294.9 g								X							
Butter clam	1888.7 g								X							
Bent-nose macoma[3]	1.4 g						X	X								
Fat gaper[4]	9.8 g						X		X							
Pacific horse clam[4]	35.8 g						X		X							
Lewis' moon shell	3.1 g						X									
Green sea urchin	0.8 g					X										
# of taxa per habitat:		1	6	1	5	7	7	6	7	5	7	2	7	7	1	2

at least a day's travel from the site (Bouchard and Kennedy 1986). Although the hunting seasons for Pacific herring and eulachon are staggered, people probably split into at least two groups with one group going to the outer Burrard Inlet for herring and the other to the Indian River or the Fraser River for eulachon in order to control for variation in the timing of either fish's spawning run. As mentioned, the distribution of northern anchovy in British Columbia waters is not well understood; but the fish has been identified in the Port Moody arm of Burrard Inlet (Port Moody Ecological Society 2001).

Contrary to the ethnographic record for other Coast Salish groups (Barnett 1955:68; Suttles 1990:457), there is no evidence that the people of Indian Arm traveled to the Fraser River to obtain their winter supply of salmon. The two salmon species identified, pink and chum, have spawning runs in the Burrard Inlet and Indian Arm. As mentioned, the pink salmon run in the Indian River is quite large, although occurring only in odd-years (Matt Foye, personal communication 2003). The presence of salmon cranial elements (n=12) indicates that at least occasionally salmon were processed at the site. However, the harvesting of salmon in large quantities at Cove Cliff is questionable because the stream to the west of the site is quite small (Fig. 5). If the stream once had suitable salmon spawning habitat, the run of fish would have been too small to support a village. Therefore, people had to travel to larger streams to accumulate enough salmon to last the winter. A few of the salmon bearing streams within the local environment (a one-day round trip) are Noons Creek in Port Moody, Seymour River, and Lynn Creek (Fig. 1). If it takes 72 hours for caught salmon to begin to spoil (Ames and Maschner 1999:26), there would have been time for Cove Cliff inhabitants to return home and process the fish there.

The remainder of the fish were likely obtained in the waters near Cove Cliff. Only one fish taxon, the snake prickleback (n=1), may not be found in the Burrard Inlet or

Indian Arm (Hanrahan 1994; Levings and Ong 2003:118-119; Port Moody Ecological Society 2001; Quamme *et al.* 1998:9-11). Pricklebacks are common in British Columbia waters and young snake prickleback are found at the mouth of the Fraser River (Hart 1973:337). The adult snake prickleback "...migrates into shallow coves and inlets during summer and early autumn" (Lamb and Edgell 1986:82). It may be that the survey results I used to define local taxa missed the presence of this prickleback.

The land mammals identified in the archaeofaunal collection reflect use of almost all the ecosystems found within the Mountain Hemlock and Coastal Western Hemlock biogeoclimatic zones (Appendix D). Absent are taxa found at higher elevations such as the mountain goat and snowshoe hare, which are rare at other Late Phase sites throughout the Gulf of Georgia (Hanson 1991). Since only a small portion of the Cove Cliff midden was excavated, the absence of these taxa may be due to sampling. This absence will be explored further in my inter-site comparison.

The emphasis on waterfowl and presence of loons, grebes, gulls, heron, and eagle strongly supports that the Late Phase occupants focused much of their activity on the shoreline (Appendix E). Birds congregate on the water where Indian Arm flows into Burrard Inlet as well as at Lynn Creek, Seymour River, and Port Moody, which implies people did not need to travel far to obtain birds. All the invertebrates could have been collected from the nearby shore fronting the Cove Cliff site except *Dentalium* (Appendix F-G). The one *Dentalium* specimen was likely obtained via long distance trade, as its distribution in British Columbia is limited to the west coast of Vancouver Island and the north coast (Barton 1994).

Summary

I can make a few statements regarding the procurement of animals by people at Cove Cliff. The artifacts suggest salmon were caught using toggling harpoons. The high number of fish taxa identified that are represented by few specimens suggests that nets or tidal weirs may have been used as they are rather indiscriminate means of collecting fish. The use of hook-and-line and spears to obtain fish is suggested by the presence of such taxa as rockfish and flatfish, respectively. People would have used rakes or digging sticks to collect burrowing shellfish from the intertidal zone. Prying sticks would have been used to collect mussel, limpets, and other gastropods. Mammal and bird were likely collected using many of the techniques described in ethnographic sources (see Table 3).

The faunal remains indicate the site was visited, if not occupied, year-round and that resources were obtained from a variety of ecosystems. A wide range of animal resources were utilised by people during the Late Phase, with a focus on herring and butter clam. Salmon, domestic dog, black-tailed deer, ducks, Pacific littleneck clam, Nuttall's cockle, and blue mussel were also used to a high degree. Many of the animals could have been obtained without travelling far from the site while others, such as Pacific herring, smelt, and eulachon probably required travel to the Burrard Inlet west of Lynn Creek or the head of Indian Arm. People were involved in trade based on the presence of *Dentalium*. The archaeology indicates people were involved in woodworking, shellfish processing, tool manufacturing, and probably fish processing.

Were different activities conducted inside and outside the small structure?

In the Introduction, my expectations for patterning within the archaeofaunal assemblage were presented. In most instances, I was able to assess if my expectations were met (Table 15) but small samples hindered some of my analyses.

Table 15. Results from the comparison of the interior and exterior deposits.

Objective 2. Comparison of interior and exterior deposits		
Expectations	Methods	Results
Food remains inside the structure will be small-sized and the result of incidental discard.	Fragmentation analysis.	Expectation partially met. Fragmentation of mammalian remains inconclusive. For some shellfish taxa, larger remains outside. Other shellfish taxa showed no distinct difference. Concentration of sea urchin and frilled dogwinkle suggests incidental discard.
Faunal remains inside will be fragmented due to trampling.	Fragmentation analysis.	See above.
Evidence of butchering and cooking of resources outside.	Specimen modifications.	Inconclusive.
	Review of features and field notes.	Indication of fish/shellfish processing.
Discard of unwanted animal parts (e.g., shells, bones, and animals inadvertently brought to the site) outside the structure.	Density of shell from primary food taxa.	Expectation was met.
	Density of “inadvertents.”	Inconclusive.
	Density of vertebrate remains.	Distribution of unidentified bird/mammal specimens met expectation.
Higher proportion of valued items within the interior deposit as compared to the exterior deposit.	Density of culturally modified bone and antler remains.	Inconclusive.

Table 15. Results from the comparison of the interior and exterior deposits (cont'd).

Objective 2. Comparison of interior and exterior deposits		
Expectations	Methods	Results
Interior and exterior deposits may not differ much in overall number of taxa represented, but should differ in kinds of taxa.	Richness.	Expectation met except for NIT_{bird}.
	Taxa represented.	Expectation was met. Taxa differ.
	Skeletal part frequency.	Major meat bearing elements of bird are emphasised inside the structure.
Spatial patterning of faunal remains inside the structure will not be distinct.	Spatial distribution of faunal remains.	Expectations were partially met. Excavators observed distinct groupings of faunal remains.
Faunal remains inside the structure will tend to be smaller than those found outside the structure.	Fragmentation analysis.	See above.
Larger remains inside the structure will tend to be located along the interior edges of the structure.	Not tested because boundaries of structure were not located and sampling not fine-grained enough.	
Discrete concentration(s) of a shellfish taxon, whose shell is relatively unfragmented, in the exterior deposit.	Spatial distribution of faunal remains.	Expectation was met. Concentrations identified.
	Fragmentation analysis.	Expectation was met except for cockle shell.
Discrete concentration(s) of a fish taxon in the exterior deposit.	Spatial distribution of faunal remains.	Expectation met.

Fragmentation

My analysis of the fragmentation of remains does not suggest that people regularly redeposited large refuse outside the structure. Instead, I found only a weak tendency towards this pattern in the bivalve specimens. Of the four bivalve taxa examined, a relatively pronounced difference in shell fragmentation between the two deposits is evident only when comparing Pacific littleneck clam and "other bivalves" (Fig. 14). The fragmentation of these taxa supports the expectation that shell will be more fragmented inside a structure due to trampling (Table 15). Equal fragmentation of mammalian specimens between contexts (Fig. 14) may be because I used remains from more than one taxon to increase my sample size (NSP=658). Thus, the variability in density and strength of bones across taxa may obscure any patterning. Another factor at play here is that the remains, in general, were small-sized (93% $\leq$ 3 cm).

Density

The distribution of faunal remains suggests that unwanted animal parts were being disposed of outside the structure. Unidentified vertebrate specimens are almost twice as dense per cubic-metre in the exterior deposit (Table 16). The small sample of specimens that are modified (Tables 9-10) makes it impossible to definitively say humans processed bone and antler and disposed of the associated refuse outside the structure. However, the only other agents of specimen modification identified, carnivores and rodents, are unlikely to have created this pattern. The majority of specimens with signs of carnivore action were recovered inside, not outside, the structure, and too few specimens (n=4) showed evidence of rodent gnawing to influence the patterning. Densities of fish, mammal, and bird remains within each deposit suggest there is no difference between contexts (Table 16). As is consistent with my expectations (Table 15), shell from primary prey species, and invertebrates in general, were more concentrated in the exterior deposit (Tables 16-17). This supports excavators' observations that shellfish processing occurred outside the structure.

The densities of "inadvertent" taxa and artifacts between contexts, which were expected to reflect refuse disposal and curation of valued items, respectively, were

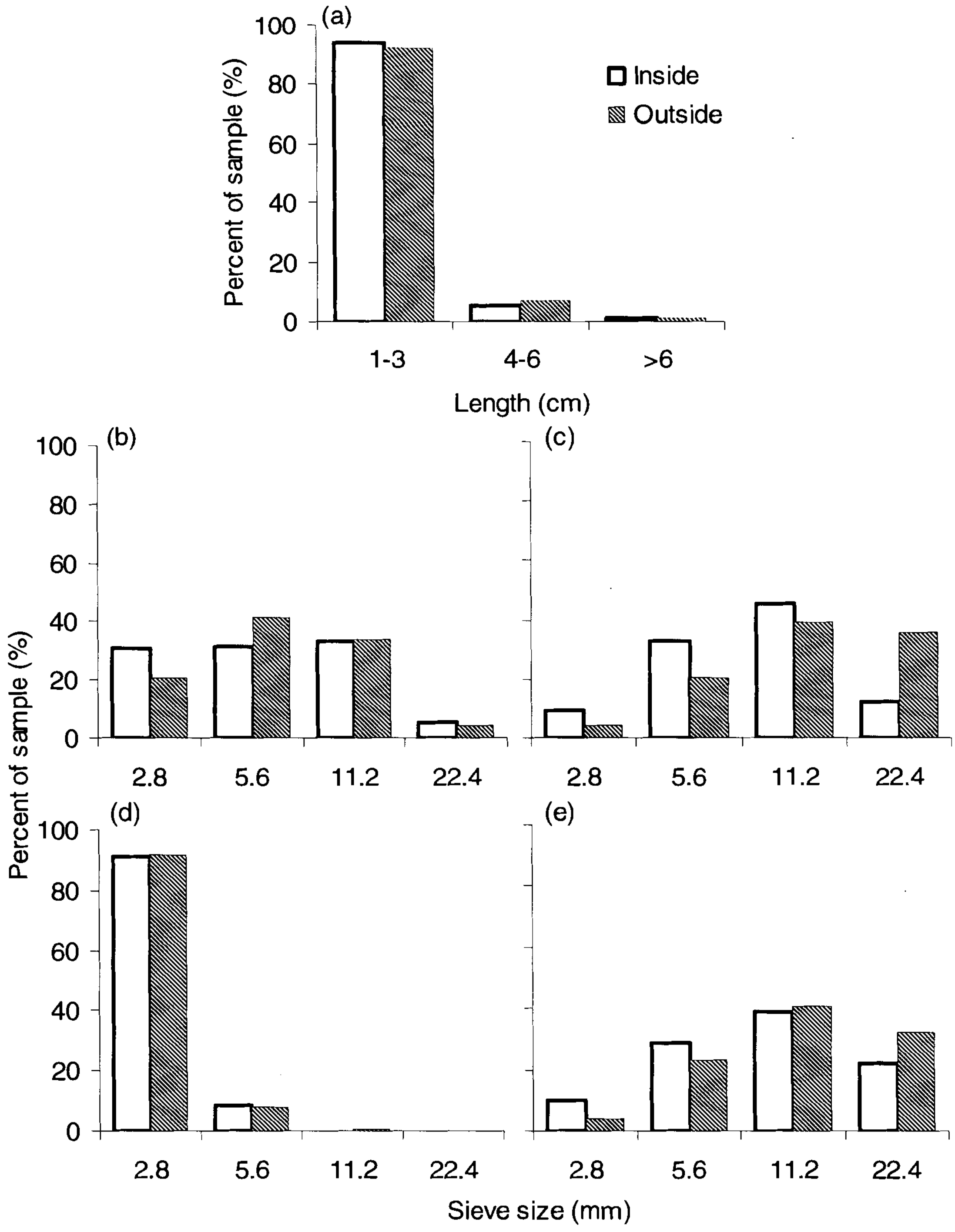


Figure 14. Comparison of specimen fragmentation in interior and exterior deposits. (a) mammal, (b) Nuttall's cockle, (c) Pacific littleneck clam, (d) blue mussel, (e) other bivalves. Mammal remains quantified by NSP. Bivalves quantified by weight. Pacific littleneck clam and "other bivalves" more fragmented inside. The other categories are inconclusive. For mammals, relative frequency=$NSP_{size\_category}/NSP$. For bivalves, $weight_{taxon}$ per sieve size/$weight_{taxon}$.

Table 16. Density of faunal remains and bone, antler, and shell artifacts within the interior and exterior deposits.

	All vertebrates (NSP)[a]	Unidentified Vertebrates (NSP)[a]	Invertebrates (grams)[c]	Fish (NSP)[c]	Mammal (NSP)[a]	Bird (NSP)[a]	Artifacts (NSP)[b]
Exterior deposit	3,008	409	7925.2	17,147	77	48	20
Interior deposit	9,674	501	5400.8	21,389	136	91	34
Density exterior (NISP/m^3)	2,387	325	-	-	63	42	7
Density interior (NISP/m^3)	3,336	173	-	-	48	32	8
Ratio exterior to interior	0.7:1	1.9:1	1.5:1	0.8:1	1.3:1	1.3:1	0.9:1

A ratio $\geq$1.5 is considered significant. Density rounded to nearest whole number. [a]Specimens from ¼-inch screen; excavated volume exterior deposit=1.26 m^3; excavated volume interior deposit=2.90 m^3. [b]Includes artifacts recovered from deposits in which remains were selectively collected thus excavated volume exterior deposit=2.70 m^3; excavated volume interior deposit=4.10 m^3. [c]Specimens from heavy fraction.

inconclusive (Tables 16-17). The density of fish inadvertently brought to the site is greater in the exterior deposit, but the sample is too small to be conclusive (Table 16). Contrary to my expectations (Table 15), inadvertent invertebrates (i.e., barnacle) were denser per litre of sediment in the interior deposit (Table 16). However, much of the barnacle was probably brought to the area attached to mussel shell. Therefore, its distribution is dependent on the distribution of mussel, which is more abundant in the interior deposit (Appendix F-G).

Table 17. Density of shell from primary prey and “inadvertents” in the interior and exterior deposits.

Context	Primary prey[1] (grams)	Inadvertent fish[2] (NISP)	Inadvertent invertebrates[2] (grams)
Exterior deposit	3964.8	34	193.7
Interior deposit	1251.5	11	281.1
Ratio exterior to interior	3.2:1	3.1:1	0.7:1

[1]Butter clam, Pacific littleneck clam, Nuttall's cockle, and blue mussel combined.
[2]Taxa categorised as “Inadvertents” are sculpins and barnacles.

Richness and skeletal part frequency

Contrary to the expectation that there would be no difference in taxonomic richness between the interior and exterior deposits (Table 15), the collection of bird remains suggests there is a difference in richness. Combining remains from the heavy fraction and screen, over twice as many bird taxa are represented in the interior deposit ($NIT_{interior}$=9; $NIT_{exterior}$=4; Table 18); there is no difference in richness based on the identified mammalian taxa. The vertebrate collections from the heavy fraction, which characterise the fish in the assemblage, had insufficient sample sizes to capture the taxonomic richness of the interior and exterior deposits. However, even though the graphs have not leveled off, the asymptote of the lines are similar implying little difference between the number of identified fish taxa in the two deposits (Fig., 9, Table 18). The comparison of the invertebrate collections for the interior and exterior deposits recovered from the heavy fraction also show no difference in taxonomic richness (Table 18).

To better understand why there is this diversity of bird taxa in the interior deposit, I examined which avian taxa are represented and the distribution of avian skeletal parts. Bald eagle and mew gull are taxa found exclusively in the exterior deposit and were desired more for their feathers and bones than their meat (Table 3, Appendix E). By comparison, the majority of bird specimens from the interior deposit were waterfowl,

Table 18. Taxonomic richness within the interior and exterior deposits (NIT).

Taxa (collection)	Expected	Interior deposit	Exterior deposit
Fish (heavy fraction)[1]	20	13	15
Mammal (screen and heavy fraction)	10	9	8
Bird (screen and heavy fraction)	11	9	4
Invertebrates (heavy fraction)	13	9	10
Total NIT:	54	40	37

[1]Sample size is insufficient to characterise richness of vertebrate collection.

which were used for their meat, bones, and feathers.

Elements from the axial, leg, and pectoral skeleton are emphasised in the interior deposit suggesting that the primary meat-bearing unit of a bird was commonly deposited inside the structure (Table 19). This patterning does not fit my assumption that the structure was occasionally cleaned and thus larger bird bones (e.g., tibiotarsus, tarsometatarsus, femur) would eventually be deposited outside. However, several factors may have obscured such behaviour—processing of the bones resulting in no large specimens as evidenced by the fragmentary nature of the assemblage in general, curation of long bones as raw materials, and/or trampling of specimens causing breakage. Based on the avian skeletal part representation, it is plausible that people were eating roasted or steamed bird inside the structure. The fragments resulting from processing could easily have been incidentally discarded inside the structure and, due to their small size, left undisturbed during cleaning events.

Table 19. Ratio of bird skeletal parts by density per context.

Skeletal part	Interior deposit (NISP per m^3)	Exterior deposit (NISP per m^3)	Ratio of skeletal parts (Interior : Exterior)
Cranial	7	24	0.3:1
Axial	59	63	0.9:1
Wing	103	198	0.5:1
Leg	103	87	1.2:1
Pectoral	45	48	0.9:1

Density=(NISP/excavated volume)*10

Spatial patterning

The spatial distribution of fauna tends to support excavators' observations that there are three activity areas: the interior space, an outside resource processing area, and an outside refuse midden. Hampering these analyses is that few contiguous 50 cm x 50 cm sampling grid squares were either sampled or had flotation samples analysed. Within the exterior deposit, the density of fish drops off slightly (45% NSP per 15 litres; Table 16; Fig. 15). Strikingly, salmon is most abundant inside the structure (64% inside) and is relatively abundant in the three flotation samples taken near the structure's southern boundary (Fig. 16). Why the interior deposit contains a greater density of fish, and as mentioned previously more canid remains, is not known. People walking and sitting on the surface may have compressed the deposits resulting in a greater density of certain small-sized remains inside the structure. Or, as suggested previously, people may have disposed of waste in the structure between occupations.

The spatial distribution of shell supports the notion that the extramural area contained a shellfish processing area and associated refuse midden. Basic evidence of this is that a greater amount of shell is found outside the structure (Fig. 15; Tables 16-17). In addition, my expectation that there would be patterning indicative of shellfish processing was met (Table 15). Three samples from the same stratum (layer 14) had an abundance of shell that was relatively unfragmented (i.e., > 11.2 mm; Fig. 17; Table 20). Layer 14 occurs as a 15-25 cm thick band in all walls of OEU-2 and was internally divided by a possible surface suggesting that shellfish processing occurred during more than one occupation. This result, in combination with fewer invertebrates and burnt matrix in the southwest unit of the excavation (Lepofsky and Karpiak 2001), suggest that people processed shellfish in the southwest area and then disposed of the shell to the southeast (Fig. 17). Blue mussel is an exception to the general patterning of shell being more abundant outside. I suggest that blue mussel is more abundant inside the structure because it is easier to fragment than either butter clam or Pacific littleneck clam

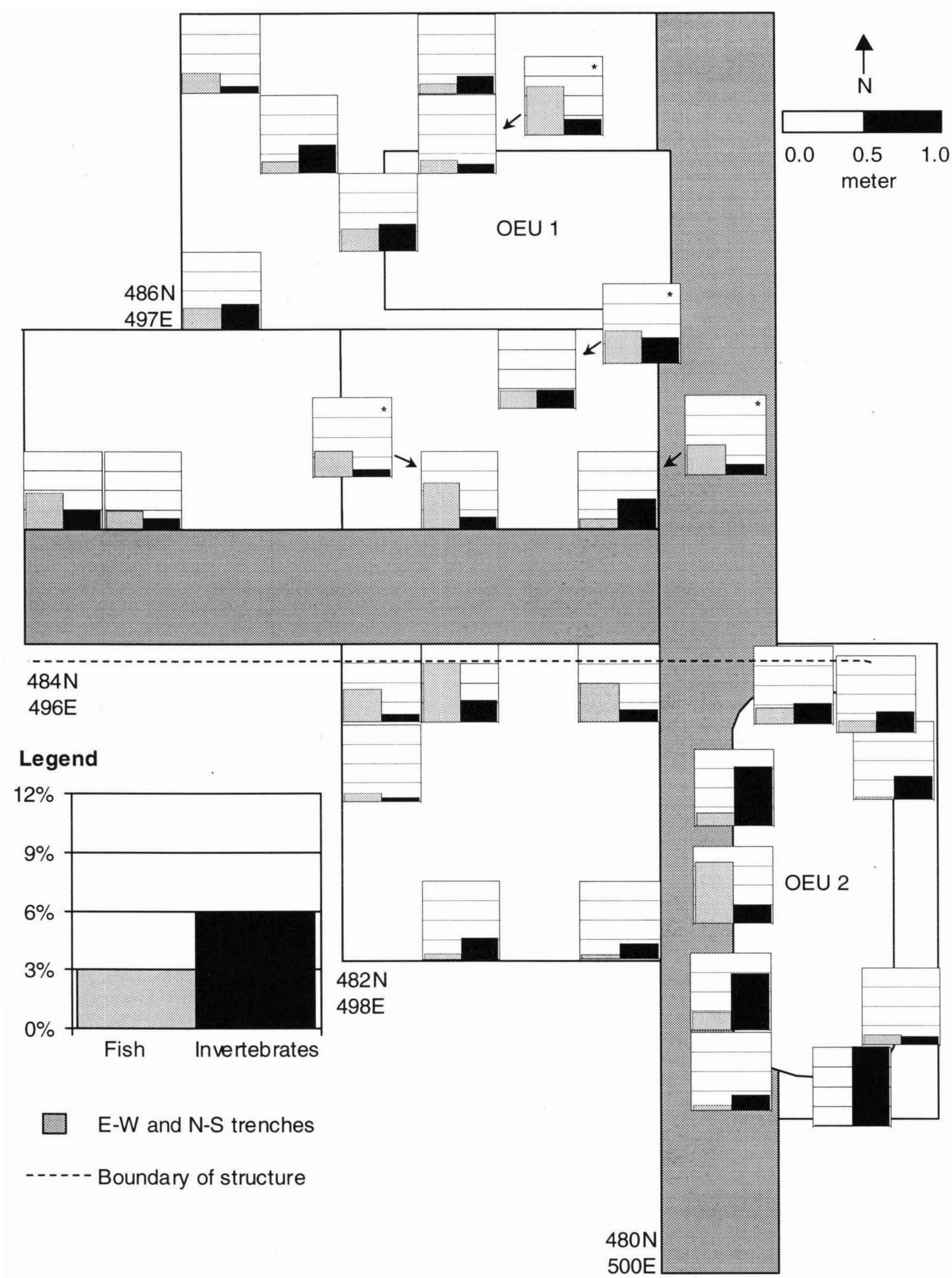


Figure 15. Frequency of fish and invertebrates as represented by 30 flotation samples. * means the sample is from 10-20 cm dbs; refer to Fig. 8 for depth of other samples. The arrows point to the sampling grid-square from which the sample was taken. Frequency=NSP_{taxon} or $weight_{taxon}$ in sample/total NSP_{taxon} or total $weight_{taxon}$ in the 30 samples.

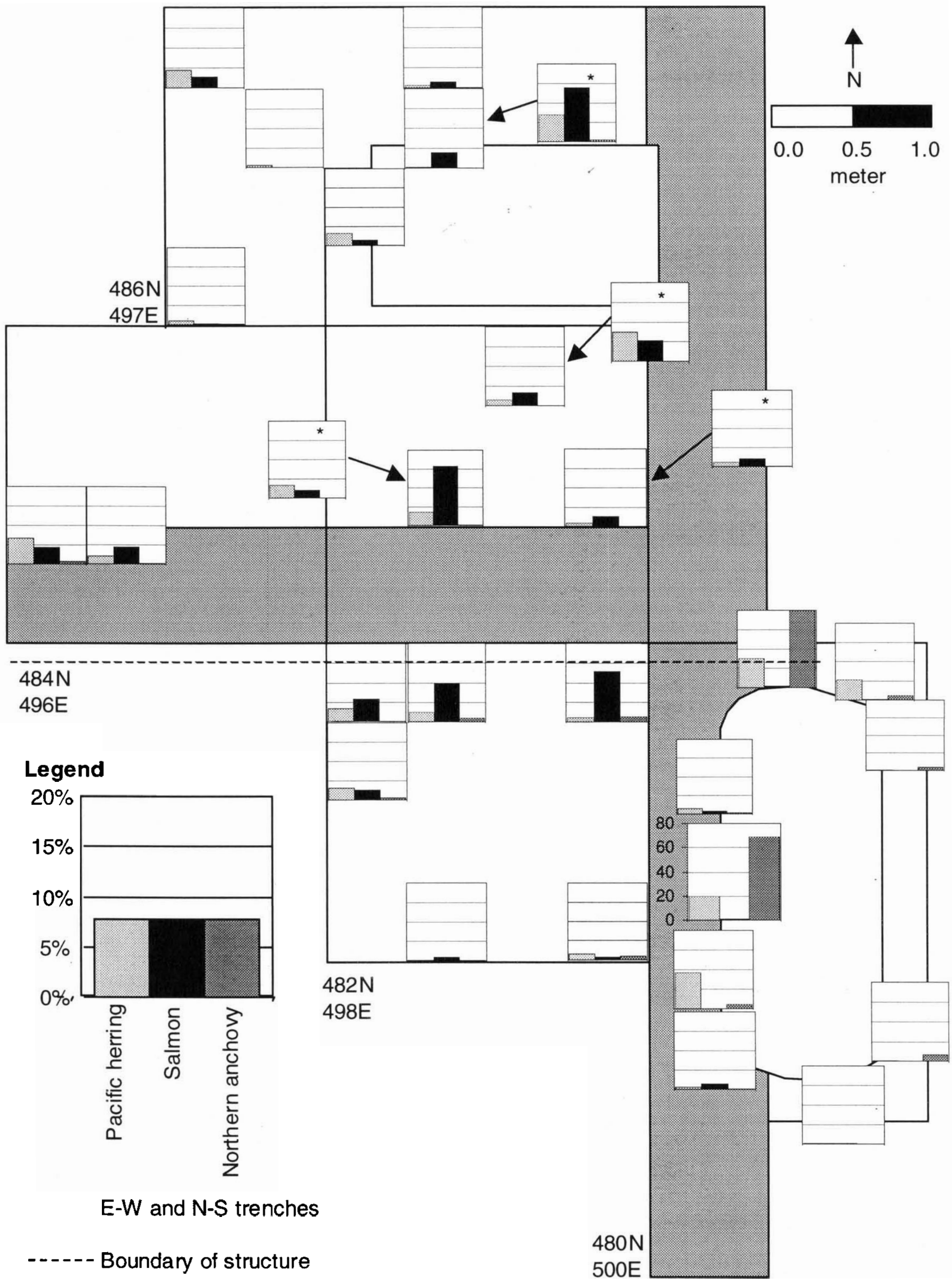


Figure 16. Frequency of most common fish taxa as represented by 30 flotation samples. * means the sample is from 10-20 cm dbs; see Fig. 8 for depth of other samples. The arrows indicate the sampling grid-square from which the sample was taken. Frequency=$NISP_{taxon}$ in sample/total $NISP_{taxon}$ in the 30 samples. Note: Different scale used for sample 57.

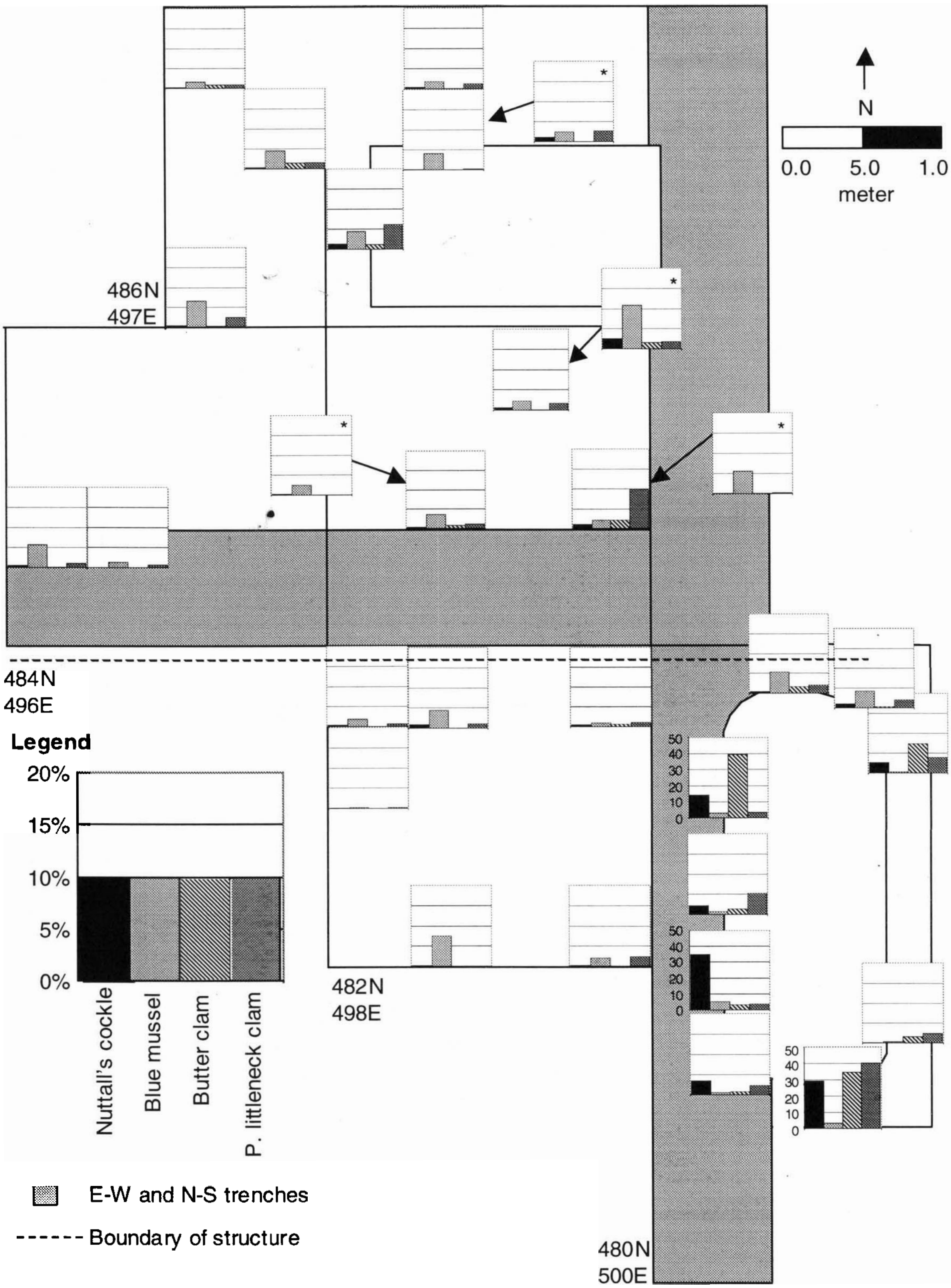


Figure 17. Frequency of most common invertebrate taxa as represented by 30 flotation samples. * means the sample is from 10-20 cm dbs; see Fig. 8 for depth of other samples. The arrows indicate the sampling grid-square from which the sample was taken. Frequency=weight$_{taxon}$ in sample/total weight$_{taxon}$ in the 30 samples. Note: Different scale used for samples 40, 43, and 45.

Table 20. Relative frequency of primary shellfish prey specimens > 11.2 mm recovered from flotation samples 40, 43, and 45.

	% specimens > 11.2 mm		
Taxon	Sample 40	Sample 43	Sample 45
Nuttall's cockle	41	28	41
Butter clam	79	84	(97)
Pacific littleneck clam	86	(50)	(71)

Refer to Fig. 8 for the provenience of samples. Numbers in () indicate the taxon is not abundant within the sample.

(Muckle 1985:69-72) and therefore is a good local material with which to create a clean, drained surface (Fig. 17).

In addition to these analyses, excavators documented three concentrations of faunal remains inside the structure. Two concentrations of frilled dogwinkle shells that seem to be associated with the edge of the structure were uncovered during excavation (Fig. 6-F21, -F30). One of these features (F21) contained 63 whole to nearly whole shells (394.0 g); unfortunately, the other feature was not collected. The frilled dogwinkle were large enough (averaging 4.5 cm x 2.7 cm) that after eating people would want to move the shell out of the way of traffic. A concentration of sea urchin specimens was also recorded (Fig. 6). The urchin is broken open to obtain the gonads and the remnant pieces of exoskeleton, being small and fragile, would tend to be tramped into the ground forming concentrations where they fell, versus being moved off to the side. I suggest the urchin and dogwinkle features were the remains of snacks or meals eaten within the structure on a winter day, the season when these taxa are more available or more desirable, respectively.

Summary

Although not all expected differences between the inside and outside of the structure were discerned (Table 15), three discrete activity areas were suggested by the spatial patterning of the faunal remains. The reported features and distribution of shell support the intrepretation that the southwest section of the excavated area was used to process shellfish, and possibly fish, and the southeast section was a refuse midden. The distribution of the mussel shell, the expansive area of finely-crushed shell lenses (layer 8), and evidence of shell itself being processed, suggests a surface was purposefully engineered using blue mussel shell.

How was the Burrard Inlet-Indian Arm locality utilised in the Late Phase?

My analyses of the archaeofaunal assemblages from the three inlet sites— Cove Cliff, Belcarra Park, and Cates Park, and these assemblages in comparison to the Tsawwassen assemblage, provide a general picture of how ancient peoples in the Burrard Inlet and Indian Arm utilised their local environment (Table 21). Unfortunately, the incomplete reporting of faunal remains and small sample sizes prevent a more detailed comparison among sites. As mentioned, although Cates Park remains may contain Marpole Phase specimens in addition to Late Phase specimens, the published results are used here due to the paucity of archaeological data for Indian Arm.

Seasonality

My reanalysis of season(s) of occupation was hampered by small sample sizes and the presence of taxa that are not representative of specific seasons. The taxa identified at Belcarra Park do not suggest any particular season of use (Table 22), while only winter (frilled dogwinkle) and possible autumnal use (salmon) are indicated at Cates Park (Table 22). Autumnal use of salmon is based on the timing of the chum salmon and pink salmon spawning runs in the Indian River. At Tsawwassen, winter use is indicated by the presence of frilled dogwinkle, sea urchin, and stored salmon (Arcas 1999:144), late winter is indicated by Pacific herring, and a spring occupation is indicated by the combined presence of spiny dogfish, sturgeon, and Pacific herring (Table 22).

Resource specialisation

Based on the resource specialisation reflected in the archaeofaunal collections recovered in ¼-inch screens from Cates Park, Tsawwassen, and Cove Cliff (Belcarra Park had insufficient data for this analysis), Cates Park seems to be unique with its greater focus on mammals rather than fish (Table 23). Given that Cates Park and Cove Cliff are in close proximity to each other, the data do suggest differential use of local

Table 21. Results from the comparison of sites.

Objective 3. Comparison of sites		
Expectations	Methods	Results
Seasonal use is the same.	Seasonality.	Belcarra Park - inconclusive. Cates Park - winter, maybe fall. Tsawwassen – winter/spring. Other seasons not excluded at any site.
Resource specialisation is similar.	Resource specialisation.	Cove Cliff and Tsawwassen have a focus on fish. Cates Park unique with a focus on mammal, but assemblage may reflect Marpole and Late Phase cultures. Inconclusive for Belcarra Park.
Faunal remains at sites will tend to reflect local fauna.	Ecosystems utilised as represented by taxa recovered and identified.	People at the inlet sites utilised the local and non-local environment.
Inlet sites will tend to be more similar to each other than those outside the inlet.		In general, my expectation was met. Inlet sites are more similar to each other than to Tsawwassen.

Table 22. Prime hunting season of taxa recovered from Belcarra Park (DhRr 6), Cates Park (DhRr 8), and Tsawwassen (DgRs 2), ordered by biological taxonomy.

Taxon	Winter (D J F)	Spring (M A M)	Summer (J J A)	Fall (S O N)	DhRr 6 NISP[1]	DhRr 8 NISP	DgRs 2 NISP[1]
Common loon					-	0	6
Horned grebe					-	1	0
Northern pintail					+	0	0
Northern shoveler					+	3	0
American wigeon					+	1	0
Anas sp.					-	0	1
Aythya sp.					+	0	3
Harlequin					+	0	0
Oldsquaw					-	0	2
Surf scoter					+	0	0
Scoters					-	2	1
Bufflehead/Goldeneye					+	2	5
Bald eagle					+	0	13
Bonaparte's gull					+	0	0
Glaucous-winged gull					-	1	0
Snowshoe hare					1	0	0
Beaver					4	6	3
American marten					1	0	0
Northern sea lion					0	0	1
Black bear					21	6	0
Mountain goat					15	3	0
Black-tailed deer					120	68	12
Pacific herring					na	na	23
Spiny dogfish					na	na	5
Sturgeon					na	na	2
Frilled dogwinkle					na	495	+
Sea urchin					na	na	+
DhRr 6 # of taxa per season:	15	13	4	14			
DhRr 8 # of taxa per season:	10	8	2	9			
DgRs 2 # of taxa per season:	13	12	3	10			

Italicised taxa can be stored. See Methods for definition of prime-hunting season. [1]+ means taxon was present; – means taxon was not recovered. Prime-hunting season not determined for Canada goose, mallard, gadwell, grebes, mergansers, cormorant, northwestern crow, thrushes, and blackbirds, dog, raccoon, mink, dolphin/porpoise, wapiti, harbour seal, salmon, and invertebrates other than ones shown. *Sources*: For bird, Breault and Watts 1996; Campbell *et al.* 1990a, 1990b, 1997, 2001; VNHS 1995. For mammals, Banfield 1974; Dahlquest 1948; Keple 2002. For fish, Clemens and Wilby 1961; Barnett 1955; Hart 1973; Lamb and Edgell 1986; Matthews 1955; McPhail and Lindsey 1970; Therriault *et al.* 2002:7; Quamme *et al.* 1998; Eric Olsen, personal communication 2004; Matt Foye, personal communication 2003. For invertebrates, Harbo 1997:211; Matson *et al.* 1999:164-168; Paine 1992:106.

Table 23. Relative frequency of all vertebrate remains by class from Cove Cliff, Cates Park, and Tsawwassen (% NSP).

Site	Fish	Mammal	Bird	Unidentified
Cove Cliff	90	2	1	7
Cates Park	43	52	5	0
Tsawwassen – Zone A	81	14	5	0
Tsawwassen – Zone G	70	19	11	0

Note: Remains recovered in ¼-inch screen. *Sources*: Kusmer 1994a, 1994b, 1994c; Williams 1974.

resources. This difference in resource specialisation could result from people at Cates Park preferring to hunt artiodactyl (Fig. 18), either due to cultural preference or accessibility of artiodactyls. Alternatively, people there may not have had access to fishing grounds and/or fishing technology (e.g., tidal traps, weirs) that would enable them to harvest the large numbers of fish in evidence at Cove Cliff and Tsawwassen. These results, and the presumption that deer were most accessible during winter, support Charlton's interpretation that the site was a fall/winter special-use camp.

Ecosystems utilised

The taxa recovered and identified suggest people living in the Burrard Inlet and Indian Arm relied on the non-local and local environments as sources of fish (Table 24). As discussed previously, in the spring people from Cove Cliff likely split up with some moving to west of Lynn Creek to obtain Pacific herring, sturgeon, and spiny dogfish and others moving to the Indian River or the Fraser River to fish for eulachon. The presence of surf smelt suggests people also visited English Bay in summer. The remainder of the fish taxa, except possibly snake prickleback, could have been caught in the local waters probably within a short distance of the site. Similarly, the two fish taxa identified at Cates Park (salmon and rockfish) indicate use of the local environment. The diversity of

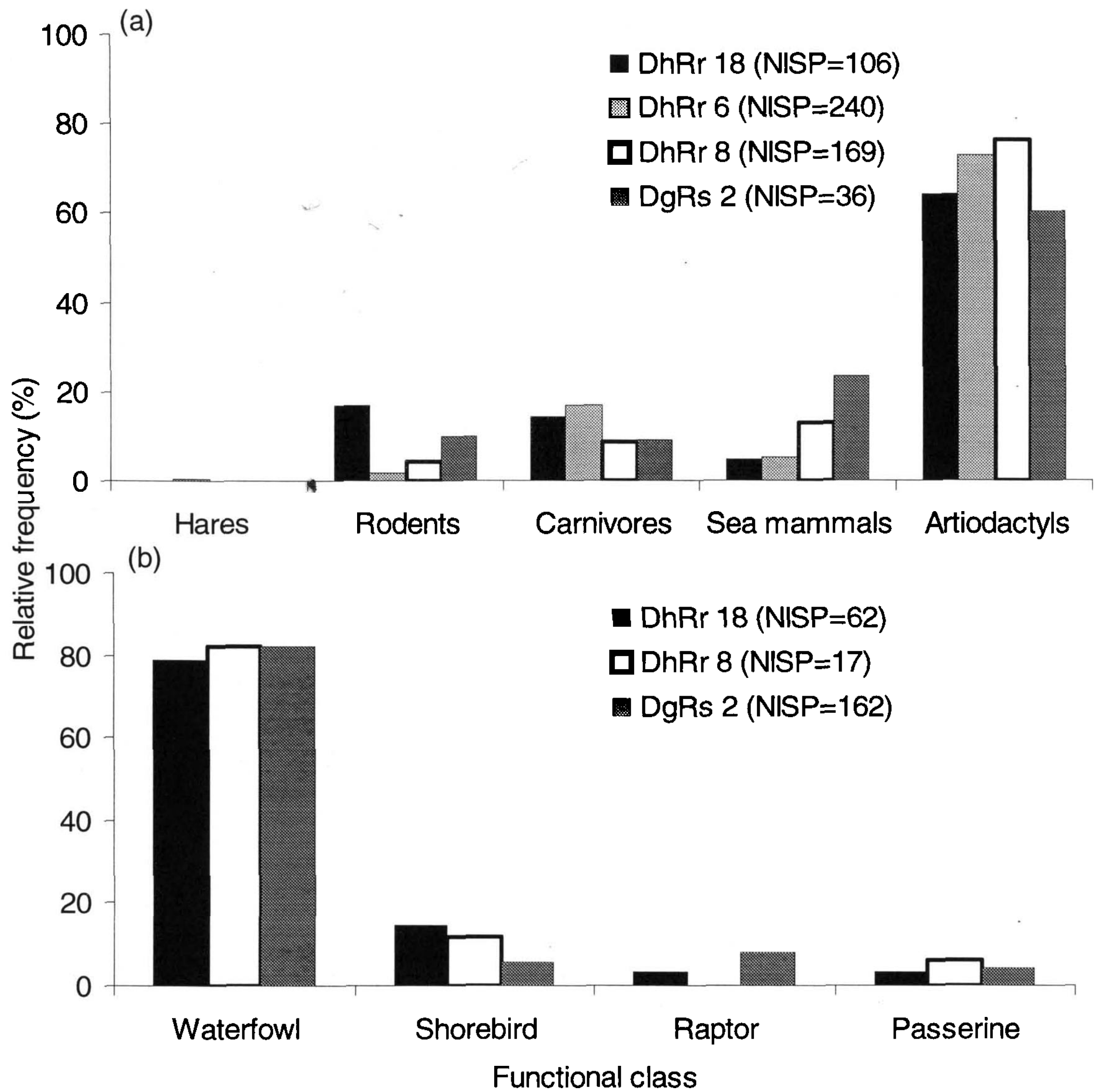


Figure 18. Relative frequency of mammalian and avian taxa in the faunal remains from Cove Cliff (DhRr 18), Belcarra Park (DhRr 8), Cates Park (DhRr 6), and Tsawwassen (DgRs 2-Zones A and G). (a) Mammalian taxa, (b) avian taxa. Includes only specimens recovered in ¼-inch screen. Although the Belcarra Park bird remains were not quantified, nine taxa identified were waterfowl, one was raptor, and one was a shorebird. See appendices H-I.

Table 24. Ecosystems utilised at Cove Cliff (CC), Cates Park (CP), and Tsawwassen (T) based on identified fish taxa (NISP), ordered by biological taxonomy.

	Sites			Coastal Douglas-fir		Coastal Western Hemlock		Coast Intertidal						Coast Subtidal				
	CC[1]	CP[2]	T[3]	Lakes	Streams	Lakes	Steams	Rock	Sand	Mud-flats	Cobble-stone	Seagrass/ kelp beds	Open waters	Rock	Sand	Mud	Cobble-stone	Seagrass/ kelp beds
Spiny dogfish	44	?	5		CC, T							CC, T	CC, T					CC, T
Sturgeon	[16]	?	2		CC, T		CC, T						CC, T					
Pacific herring	[2656]	?	23									CC, T	CC, T					CC, T
Northern anchovy	724	?	-										CC					
Salmon	831	1,149	129		CC,CP,T		CC,CP,T						CC,CP,T					
Surf smelt	[78]	?	-					CC			CC		CC					
Eulachon	[91]	?	-		CC		CC						CC					
Plainfin Midshipman	31	?	+					CC,T							CC,T	CC,T		
Walleye pollock	4	?	-						CC	CC					CC	CC		
Snake prickleback	[1]	?	-						CC	CC					CC	CC		
Rockfish	21	31	2											CC,CP,T				CC,CP,T
Greenling	5	?	-											CC				
Buffalo sculpin	11	?	-					CC				CC		CC				
P. staghorn sculpin	8	?	-							CC						CC		
Cabezon (juvenile)	1	?	-									CC		CC				
Sculpin	25	?	6											CC,T				CC,T
Rock sole	3	?	-												CC	CC		
English sole	2	?	-												CC			
Starry flounder	32	?	-		CC		CC					CC			CC	CC		
Flatfish	55	?	12						CC,T	CC,T								
Sucker fish	1	?	-	CC	CC	CC	CC											

[ ] = taxa not known to be abundant in local environment. + means taxon is present, - means taxon is absent, ? means presence/absence not established. At Cates Park, not all fish considered identifiable were identified further than to class. Fish specimens not identified for Belcarra Park. [1]Specimens from heavy fraction, except sturgeon from ¼-inch screen. [2]Collection from ¼-inch screen. [3]Collection from heavy fraction, except plainfin midshipman from ¼-inch screen.
Sources: Charlton 1977; Clemens and Wilby 1961; Hart 1973; Kusmer 1994a, 1994b, 1994c; Lamb and Edgell 1986; Williams 1974.

taxa recovered at Cove Cliff, in comparison to the diversity of taxa in the Tsawwassen remains, suggests Cove Cliff residents utilised nets, tidepools, and/or tidal traps to collect fish, as these technologies are less specific as to types of fish caught (Table 24).

The Tsawwassen fish remains are, in contrast to Cove Cliff's, all from the local environment and poor in taxa. Although the fish taxa are found within Tsawwassen's local environment, the only taxon found in abundance (seasonally) and in close proximity to Tsawwassen is the Pacific herring. Rockfish were likely obtained from the rocky shore south of the site and the other fish at the mouth of the Fraser River. There are six possibilities for why there are fewer identified fish taxa in the Tsawwassen remains as compared to the number of fish taxa identified in Cove Cliff remains: 1) the sample size of the collection, 2) different identification methods were applied at Cove Cliff and Tsawwassen, 3) fishing technologies used by people at Tsawwassen were more selective of type of fish caught, 4) incidentally or inadvertently caught fish were disposed of at the fishing site, 5) the extensive mudflat that today separates the shore from deeper water was present in the past and impeded casual use of offshore fish, or 6) people at Cove Cliff had insufficient quantities of preferred fish taxa (e.g., salmon) and therefore used a variety of less desired fish to make up the difference. It is unlikely that the identification methods used at Cove Cliff and Tsawwassen are the primary cause because the bulk of analysis was done using the same skeletal reference collection. Unfortunately, larger samples from all sites are required to determine which of the other cause(s) may be a factor.

Mammalian remains also suggest a focus on local ecosystems and a difference between the inlet sites and Tsawwassen. Animals often found at higher elevations, the mountain goat and snowshoe hare were not recovered at the Tsawwassen (Appendix H) or Cove Cliff sites. As mentioned earlier these taxa are rarely found in Gulf of Georgia archaeological sites. The fact that Belcarra Park and Cates Park are two of the three Late Phase sites (as defined by Hanson 1991:219) where mountain goat has been identified suggests that people living within the Burrard Inlet and Indian Arm had greater access to this animal. As mentioned, the absence of mountain goat in the Cove Cliff remains may be due to the small amount of the site excavated. However, the overall paucity of mountain goat specimens recovered from Late Phase sites in the Gulf of Georgia suggests this animal was infrequently acquired.

People at Tsawwassen appear to have focused slightly more effort on sea mammals and less on artiodactyl in comparison to people living in the Burrard Inlet or Indian Arm (Fig. 18). This may be due to Tsawwassen's proximity to the open waters of the Gulf of Georgia where larger size sea mammals occur in greater numbers than in the Burrard Inlet. In addition, within the Burrard Inlet and Indian Arm, deer and mountain goat were probably easier to obtain because during the colder months these animals move down to lower elevations congregating in drainages along the north shore. A general focus on deer in my study area is evidenced by a greater proportion of deer to wapiti in Late Phase mainland sites located between, and including, Tsawwassen and the inlet sites. To the south of Tsawwassen, wapiti specimens outnumber deer (Hanson 1991:218-219). At all the sites, the local environment is reflected in the avian collections by the predominance of waterfowl, but the inlet sites have a slightly greater focus on waterfowl relative to other birds (Fig. 18; Appendix I).

The invertebrate remains strongly suggest that ancient peoples in the Burrard Inlet and Indian Arm relied on shellfish found on the shores abutting their sites (Table 25). The more abundant taxa at Cates Park and Cove Cliff—the Pacific littleneck clam and butter clam, are both important resources based on relative abundance. Those taxa, along with Nuttall's cockle, were also noted as being abundant at Belcarra Park

(Charlton 1977:26). Today, Nuttall's cockle appears to be the most common shellfish at Cates Park based on surface survey of the shore. If people did leave Cates Park to collect butter clam and Pacific littleneck clam, they could have gone to numerous beaches within the local environment including the extensive sand-/mudflats in Port Moody. The rocky shore at Cates Park is strongly represented within that site's shell collection by 495 specimens of frilled dogwinkle. This suggests that perhaps at Cates Park the frilled dogwinkle was a focus species, although probably still a secondary food source, and not taken incidentally when collecting other prey.

In contrast, people at Tsawwassen appear to have dispersed over a greater area to collect invertebrates. The relative distribution of shell in the Tsawwassen remains is 37% mussel, 34% clam, 20% barnacle, and 9% cockle (total weight Zones A and G =2992.8 g; shell was not quantified by species), which suggests minimal use of the sand- and mudflats abutting the site. Cockle is the shellfish most suited to Tsawwassen's beachfront and is the least abundant shell in the collection. The rocky intertidal ecosystem, as represented by barnacle and mussel, is "just south of the site" (Kusmer 1994c:204).

Summary

These results suggest that people extensively utilised the inlet environment. This statement is reflected in the array of animals identified and ecosystems utilised by ancient peoples at Cove Cliff, Cates Park, and Belcarra Park, and also, year-round use of the Cove Cliff site. However, even with the abundance of fauna found in proximity to the inlet sites, people who occupied Cove Cliff must have had relations with people in the outer Burrard Inlet, west of Lynn Creek, and perhaps on the Fraser River to get access to resources at those locations.

Table 25. Ecosystems utilised at Cove Cliff (CC), Belcarra Park (BP), Cates Park (CP), and Tsawwassen (T) based on identified invertebrate taxa, ordered by biological taxonomy.

	Sites				Coast Intertidal				Coast Subtidal			
	CC[1]	BP[2]	CP[3] (NISP)	T[4]	Rock	Sand	Mudflats	Cobblestone	Rock	Sand	Mud	Cobblestone
P. littleneck clam	+	+	653	+				CC,BP,CP,T				CC,BP,CP,T
Nuttall's cockle	+	+	41	+			CC,BP,CP,T	CC,BP,CP,T			CC,BP,CP,T	CC,BP,CP,T
Soft-shell clam	-	?	4	-			CP					
Bent-nose macoma	+	?	0	+		T	T			T	T	
Macoma sp.	+	?	0	+		T	T			T		
Butter clam	+	+	411	+				CC,BP,CP,T				CC,BP,CP,T
Blue mussel	+	?	12	+	CC,CP,T			CC,CP,T	CC,CP,T			CC,CP,T
Shield limpet	?	?	1	+	CP,T							
Pacific oyster***	-	?	1	-					CP			
Native oyster	?	?	0	+					T			
Lurid rocksnail	-	?	0	+	T							
Frilled dogwinkle	+	?	495	+	CC,CP,T							
Striped dogwinkle	-	?	0	+	T							
Misc. dogwinkle	-	?	0	+	T							
Sitka periwinkle	-	?	0	+	T							
Fat gaper	+	?	25	+		CC,CP,T		CC,CP,T		CC,CP,T		CC,CP,T
Pacific horse clam	+	?	0	-								
Weathervane scallop	-	?	2	-						CP		CP
Acorn barnacle	?	?	?	+	T				T			
Horse barnacle	?	?	?	+	T				T			
Misc. barnacle	+	?	?		CC,T				CC,T			
Misc. crab	+	?	?	+	CC,T	CC,T	CC,T	CC,T	CC,T	CC,T	CC,T	CC,T
Misc. sea urchin	+	?	?	+	CC,T				CC,T			

In rows under *Sites*, + means taxon is present, - means taxon is absent, ? means presence/absence not established. [1]Collection from heavy fraction. [2]Presence based on comment in dissertation (Charlton 1977:26). [3]Collection from ¼-inch screen. [4]Collection from heavy fraction and ¼-inch screen. ***Introduced early 1900s. *Sources*: Harbo 1997; Kusmer 1994a, 1994b, 1994c; Snively 1980; Williams 1974.

CHAPTER FOUR
DISCUSSION

This thesis addresses three gaps in our understanding of Gulf of Georgia prehistory—a want of archaeological-based interpretation of Late Phase culture, a paucity of intra-site analyses, and a lack of focus on inlet environments. The archaeofaunal assemblage recovered in 2000 from the Late Phase deposits of the Cove Cliff site, located on the Indian Arm of Burrard Inlet, provided an opportunity to address these shortcomings in our reconstruction of Gulf of Georgia prehistory. Specifically, I looked at how the Late Phase occupants utilised the Cove Cliff site, what activities they engaged in inside and outside a small structure, and how they utilised their inlet environment. I now return to these three main objectives and summarise the results from my analyses combined with the already published reports from Belcarra Park (Charlton 1977, 1980), Cates Park (Charlton, 1974; Williams 1974), and Tsawwassen (Arcas 1991, 1994, 1999; Kusmer 1994a, 1994b, 1994c).

How did the Late Phase occupants utilise the Cove Cliff site?

Based on the archaeological investigations at Cove Cliff, at least in the latter stages of the Late Phase, the site was likely a village. Zooarchaeological analysis of remains from the Late Phase deposits indicates the site was intensively used to procure and process a variety of animal resources and conduct woodworking and tool manufacturing. This broad range of activities is consistent with activities expected at a village site. The inclusion of both local and non-local animal taxa indicates that the Cove Cliff inhabitants used the site as a base camp from which they gathered local resources and either brought back resources collected further afield or received them via trade.

The seasonal use represented by the faunal remains recovered at Cove Cliff implies year-round use by ancient peoples, although not necessarily continuous use. These data suggest that in the Late Phase the Cove Cliff site was likely a village where a range of activities was conducted throughout the year. However, further archaeological investigation is required to determine whether the village was comprised of plank houses, pole-and-mat structures, or a mix of both architectures.

The interpretation of the site as a village does not necessarily contradict Tsleil-Waututh oral history, which describes the site as a place where shellfish were gathered and one could wait out bad weather. Over time, possibly due to a reduction in population caused by disease and warfare, the site could have evolved from a village to a short-term use campsite. Also, prior to this proposed change in site use, the Cove Cliff site may have been an outpost connected to the traditional village at Belcarra. This notion is not unrealistic given Cove Cliff is approximately a 45-minute paddle away from Belcarra and that land suitable for settlement in Indian Arm, due to the generally steep terrain, is scarce. As stated previously, the Cove Cliff site is known to have been a place where people at Belcarra obtained water (Lepofsky and Karpiak 2001:9-10). Although physically the site has many characteristics of a village, it may not have been thought of as an autonomous village and therefore is not mentioned as such in Tsleil-Waututh oral history. This notion that the physical location of a village does not equate completely with the social designation of a village appears in the ethnographic and archaeological record (McMillan and St. Claire 2005:178,191; Suttles 1987b:5).

To better resolve the use of the Cove Cliff site requires excavation outside the limits of the small neighbourhood park. Analysis of toggling harpoon valve form and lithic sourcing may also aid in interpreting site use. Excavation beyond park boundaries should determine if the characteristics of faunal remains (e.g., specialisation, seasons represented, taxa present) are consistent throughout the site. Based on cursory examination of toggling harpoon valves recovered from Indian Arm and other sites in the Gulf of Georgia dating to the Late Phase there may be stylistic differences between geographic areas. This suggests that social divisions may be represented stylistically in such implements. The idea of using style of toggling harpoon valves to discern social groups has been suggested for the artifacts recovered from the Ts'ishaa site on the west coast of Vancouver Island (McMillan and St. Claire 2005:193).

Were different activities conducted inside and outside the structure?

The designation of three activity areas by the excavators—interior of a structure, food processing area, and refuse midden, was supported to an extent by patterning in the faunal remains. However, few other intra-site activities were identified (e.g., eating area). In hindsight, the general lack of differentiation between interior and exterior space (Table 13) should have been expected. My expectations for patterns were based on a literature review of household archaeology that was focused on large, enclosed residential spaces (Coupland *et al.* 2003; Hayden 2000; LaMotta and Schiffer 1999; Lepofsky and Lyons 2003; Matson 2003; Samuels 1991a, 1994; Smith 1947). The structure at Cove Cliff may have been of similar construction to that of a temporary structure observed by Stern (1969) in Lummi territory. The structure was "made of poles set in the ground, lower in the rear and higher in the front, to allow the roof to have enough slant to shed rain" and was roofed and walled on three sides with mats (Stern 1969:52). Since the structure at Cove Cliff was probably a small, open-sided shelter, the interior space would have been an extension of exterior space, with some of the same activities occurring in both contexts.

The interpretation that the northern area (i.e., interior deposit) excavated was a series of overlying structural floors formed by shell purposefully lain down was weakly supported. Twenty years ago Blukis Onat (1985) highlighted the need to view shell in prehistoric deposits not just as indicators of subsistence but also the remains of site engineering events. To date, few investigations have referred to the use of shell as a construction material (e.g., Blukis Onat 1985; Ford 1992:321) and few provide a specific interpretation of such construction features (e.g. Arcas 1994:38-42, 1999:147-150). Although similarity in activities between inside and outside blurs the boundary between contexts at the Cove Cliff site, the lack of comparative data from other archaeological sites hinders identification of interior contexts and shell as a construction material.

With the switch to areal excavations and the recognition of activity areas within shell middens, once thought to be homogenous deposits, researchers are beginning to define patterns that can be ascribed to specific cultural practices. Investigations at McNichol Creek suggest a three-part division of village space, with the "backyard" midden being relatively homogenous and used for burials, the village proper, and the shoreside for multi-purpose use (Coupland *et al.* 2003). A similar patterning may exist at the Boardwalk site, also located on Prince Rupert Harbour (Stewart and Stewart 1996:41). At the Ozette site on the Olympic Peninsula, Washington, excavators observed recurring patterning in sediments that distinguished the interior deposit and exterior deposit associated with a plank house (Samuels 1991a:191). The patterning described seems generally applicable (with minor revision) to structures at shell midden sites. Large areas of compacted, finely laminated deposits, with individual lenses showing little internal partitioning, may be evidence of structural floors. Associated exterior middens may be indicated by less compacted sediments with a high degree of internal partitioning, such as concentrations of shell or fish of a specific taxon, with the shell being whole to nearly whole. Horizontal lenses of sediments in the exterior midden are sparse (Ford 1992:321; Mauger 1991:115; Samuels 1991a:191).

How was the Burrard Inlet-Indian Arm locality utilised in the Late Phase?

The results presented in this thesis are a first step to understanding how the lifeways of people in an inlet environment compare to the general descriptions of Coast Salish life represented in the ethnographic sources (see Chapter One-Cultural Context). Pertinent to this discussion are the cultural adaptations of a seasonal round and the exchange of food resources.

The presence of local and non-local taxa in the archaeofauna from the three inlet sites suggests that the system of food exchange described ethnographically was also a part of the culture of the people inhabiting Indian Arm and the Burrard Inlet east of Lynn Creek. People would have had to travel to locales such as the English Bay, Coal Harbour, or the Fraser River to procure large amounts of Pacific herring and smelt. *En route*, and while staying at these locales, it is probable other groups were encountered requiring the establishment of social relations based in part on economic need.

If proximity can be a measure of "land ownership," it is likely the people living in the inner Burrard Inlet had some control over "high elevation" resources found in Indian Arm and the north shore of the Burrard Inlet (Fig. 3). This statement is supported by the fact that Belcarra Park and Cates Park are two of three Late Phase sites (as defined by Hanson 1991:291) in the Gulf of Georgia at which mountain goat has been identified. A strong connection between the people of the Inlet and mountain goats is also suggested by the traditional name, *Selilwettuhl*, for villages known today as Burrard IR 3 and IR 4 (Fig. 1). Such control over high elevation resources would have encouraged social and ecomonic relations between Inlet peoples and non-local groups. The geographic distribution of the taxa identified in the archaeofauna from the three inlet sites suggests relations, such as the one described by Suttles below, did exist between people in Indian Arm and non-local groups. Suttles (1987a:23) wrote,

> If one community had a sudden oversupply of say, herring, its members could take canoeloads to their various co-parents-in-law, receive mountain-goat wool blankets in exchange, with which they might later 'thank' their co-parents-in-law for gifts of camas bulbs or dried sturgeon.

These results (i.e., regional interaction and movement) contrast with those found on the Northwest Coast outside Coast Salish territory where faunal analyses indicate villages were autonomous social and economic units harvesting resources from more culturally and spatially restricted local territories (e.g., Calvert 1980; Coupland *et al.* 1993, but see Stewart and Stewart 1996).

Further analyses of the already collected faunal remains and the collection of new data from sites in the Burrard Inlet and Indian Arm are required to better understand how people living at, and near to, Cove Cliff utilised the inlet environment. The remains recovered in ¼-inch screen at Belcarra Park and Cates Park should be re-analysed in their entirety. In addition, as large-scale excavation is constrained by urban use of the sites, the collection of flotation samples using a 7 cm diameter bucket auger should be done to better discern what fish and shellfish taxa were most sought and perhaps season(s) of site occupation (Cannon 2000). Where urban development has not occurred, the upper portions of drainages should be surveyed for land mammal kill sites to see if the proposed use of such areas, based on ethnographic and historic distributions of animals, occurred. Lepofsky and Karpiak (2001:74) suggest that an attempt should be made to locate local sources of the andesite used for tools recovered from Belcarra Park, Cates Park, Cove Cliff, and the Noons Creek site (located in Port Moody arm of Burrard Inlet). One known source is DhRr 20 (Burrard IR 3) which, if the only local source, supports the idea that people at these inlet sites were tied together economically, if not socially.

Summary

This thesis is a first step towards increasing our understanding of how the inlet environment was utilised by people during the Late Phase in the Gulf of Georgia and adds to our understanding of Coast Salish settlements. More research can be conducted, and needs to be conducted, within the Burrard Inlet and Indian Arm to futher explore settlement patterns and relations between villages and regions on the Northwest Coast. Often because of the non-exotic locale, archaeologists shy away from conducting research in such urban areas as the Burrard Inlet. However, the research at the Cove Cliff site demonstrates that such effort is well rewarded in terms of knowledge. We also need to recognize that life existed outside of the plank house. Additional study of the periphery of large settlements and intra-site spatial analysis needs to become more entrenched in how we approach the analysis of shell middens.

APPENDICES

Appendix A. Fauna present in the Burrard Inlet and Indian Arm based on the historic and archaeological record and fauna identified in the Tsawwassen site archaeofauna.

Fishes by Family

Petromyzonidae	Pacific lamprey (*Lampetra tridentata*), river lamprey (*Lampetra ayresi*)
Squalidae	spiny dogfish* (*Squalus acanthias*)
Rajidae	big skate (*Raja binoculata*)
Acipenseridae	white sturgeon (*Acipenser transmontanus*)
Clupidae	Pacific herring* (*Clupea harengus*)
Engraulidae	northern anchovy* (*Engraulis mordax*)
Salmonidae	pink salmon*, also known as humpback, humpie (*Oncorhynchus gorbuscha*), chum salmon*, also known as dog salmon (*Oncorhynchus keta*), coho salmon, also known as silver, hooknose, blueback(young only) (*Oncorhynchus kisutch*), sockeye salmon (*Oncorhynchus nerka*), Chinook salmon, also known as spring salmon (*Oncorhynchus tshawytscha*), coastal cutthroat trout (*Salmo mykiss*), steelhead/rainbow trout (*Parasalmo gairdneri*)
Osmeridae	surf smelt* (*Hypomesus pretiosus*), night smelt (*Spirinchus starksi*), eulachon* (*Thaleichthys pacificus*)
Gadidae	Pacific cod (*Gadus macrocephalus*), Pacific tomcod (*Microgadus proximus*), walleye pollock* (*Theragra chalcogramma*)
Merluccidae	Pacific hake (*Merluccius productus*)
Batrachoididae	plainfin midshipman* (*Porichthys notatus*)
Embiotocidae	shiner perch (*Cymatogaster aggregata*), striped seaperch (*Embiotoca lateralis*), pile perch (*Rhacochilus vacca*)
Stichaeidae	Pacific snake prickleback** (*Lumpenus sagitta*), black prickleback (*Xiphister atropurpureus*)
Pholidae	penpoint gunnel (*Apodichthys flavidus*)
Ammodytidae	Pacific sand lance (*Ammodytes hexapterus*)
Zoarcidae	blackbelly eelpout (*Lycodes pacifica*)
Gobiidae	bay goby (*Lepidogobius lepidus*)
Scorpaenidae	rougheye rockfish (*Sebastes aleutianus*), copper rockfish (*Sebastes caurinus*), splitnose rockfish (*Sebastes diploprora*), greenstriped rockfish (*Sebastes elongatus*), quillback (*Sebastes maliger*), yelloweye rockfish (*Sebastes ruberrimus*)
Hexigrammidae	kelp greenling (*Hexagrammos decagrammus*)

Cottidae prickly sculpin (*Cottus asper*)· buffalo sculpin* (*Enophrys bison*), Pacific staghorn sculpin* (*Leptocottus armatus*), great sculpin (*Myoxocephalus polyacanthocephalus*), tidepool scuplin (*Oligocottus maculosus*), grunt sculpin (*Rhamphocottus richardsoni*), cabezon* (*Scorpaenichthys marmoratus*)

Liparididae Snailfishes (*Careproctus* spp.)

Bothidae Pacific sanddab (*Citharichthys sordidus*), speckled sanddab *Citharichthys stigmaeus*)

Aulorhynchidae tubesnout (*Aulorhynchus flavidus*)

Gasterosteidae Threespine stickleback (*Gasterosteus aculeatus*)

Pleuronectidae petrale sole (*Eopsetta jordani*), flathead sole (*Hippoglossoides elassodon*), hybrid sole (*Inopsetta ischyra*), butter sole (*Isopsetta isolepis*), rock sole* (*Lepidopsetta bilineata*), slender sole (*Lyopsetta exilis*), dover sole (*Microstomus pacificus*), English sole* (*Parophrys vetulus*), starry flounder* (*Platichthys stellatus*), curlfin sole (*Pleuronichthys decurrens*), sand sole (*Psettichthys melanostictus*)

Catostomidae largescale sucker (*Catostomus macrocheilus*)

Nomenclature from Cannings and Harcombe (1990). *Found in historical and archaeological records. **Found in archaeological record only.

Birds by family

Gaviidae red-throated loon (*Gavia stellata*), Pacific loon (*Gavia pacifica*), common loon* (*Gavia immer*)

Podicipedidae pied-billed grebe (*Podilymbus podiceps*), horned grebe* (*Podiceps auritus*), red-necked grebe (*Podiceps grisegena*), eared grebe (*Podiceps nigricollis*), western grebe (*Aechmophorus occidentalis*)

Phalacrocoracidae double-crested cormorant (*Phalacrocorax auritus*), Brandt's cormorant (*Phalacrocorax penicillatus*), pelagic cormorant (*Phalacrocorax pelagicus*)

Ardeidae great blue heron* (*Ardea herodias*), green-backed heron (*Butorides striatus*)

Anatidae trumpeter swan (*Cygnus buccinator*), mute swan*** (*Cygnus olor*), black swan (*Cygnus atratus*), Canada goose* (*Branta canadensis*), green-winged teal (*Anas crecca*), mallard* (*Anas platyrhnchos*), northern pintail* (*Anas acuta*), northern shoveler* (*Anas clypeata*), gadwell* (*Anas stepera*), Eurasian wigeon (*Anas penelope*), American wigeon* (*Anas americana*), canvasback (*Aythya valisineria*), ring-necked duck (*Aythya collaris*), greater scaup (*Aythya marila*), lesser scaup (*Aythya affinis*), harlequin* (*Histrionicus histrionicus*), oldsquaw* (*Clangula hyemalis*), black scoter (*Melanitta nigra*), surf scoter* (*Melanitta perspicillata*), white-winged scoter (*Melanitta fusca*), common goldeneye (*Bucephala clangula*), Barrow's goldeneye (*Bucephala islandica*), bufflehead (*Bucephala albeola*), hooded merganser (*Lophodytes cucullatus*), common merganser (*Mergus merganser*), red-breasted merganser (*Mergus serrator*)

Cathartidae	turkey vulture (*Cathartes aura*)
Accipitridae	osprey (*Pandion haliaetus*), bald eagle* (*Haliaeetus leucocephalus*), sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*Accipiter cooperii*), red-tailed hawk (*Buteo jamaicensis*)
Rallidae	American coot (*Fulica americana*)
Charadriidae	killdeer (*Charadrius vociferus*)
Haematipodidae	black oystercatcher (*Haematopus bachmani*)
Scolopacidae	greater yellowlegs (*Tringa melanocephala*), black turnstone (*Arenaria melanocephala*) surfbird (*Aphriza virgata*), western sandpiper (*Calidris mauri*), spotted sandpiper (*Actitis macularia*), dunlin (*Calidris* alpina), red-necked phalarope (*Phalaropus lobatus*)
Laridae	Bonaparte's gull* (*Larus philadelphia*), mew gull* (*Larus canus*), ring-billed gull (*Larus delawarensis*), California gull (*Larus californicus*), herring gull (*Larus argentatus*), Thayer's gull (*Larus thayeri*), western gull (*Larus occidentalis*), glaucous-winged gull* (*Larus glaucescens*), common tern (*Sterna hirundo*)
Alcidae	pigeon guillemot (*Cepphus columba*), marbled murrelet (*Brachyrhamphus marmoratus*)
Alcedinidae	belted kingfisher (*Ceryle alcyon*)
Corvidae	Steller's jay* (*Cyanocitta stelleri*), northwestern crow (*Corvus caurinus*)
Icteridae	red-winged blackbird (*Agelaius phoeniceus*), Brewer's blackbird (*Euphagus cyanocephalus*)

Nomenclature from Campbell *et al.* (1990, 1990a, 1997, 2001), except black swan, black oystercatcher, and spotted sandpiper from Breault and Watts (1996). *Found in historical and archaeological records. ***Introduced (Campbell *et al.* 1990a:260).

Mammals by family

Soricidae	shrews* (*Sorex* spp.)
Talpidae	Coast mole* (*Scapanus orarius*)
Leporidae	Snowshoe hare* (*Lepus americanus*)
Arvicolidae	voles* (*Microtus* spp.), muskrat (*Ondatra zibethicus*)
Castoridae	beaver* (*Castor canadensis*)
Cricetidae	mice* (*Peromyscus* spp.)
Erethizontidae	porcupine (*Erethizon dorsatum*)
Sciuridae	Douglas' squirrel (*Tamiasciurus douglassi*), red squirrel (*Tamiasciurus hudsonicus*)
Canidae	coyote (*Canis latrans*)***, gray wolf (*Canis lupus*)
Felidae	cougar* (*Felis concolor*), bobcat* (*Lynx rufus*)
Mustelidae	river otter* (*Lontra canadensis*), American marten* (*Martes americana*), fisher (*Martes pennanti*), striped skunk (*Mephitis mephitis*), short-tailed weasel (*Mustela erminea*), long-tailed weasel (*Mustela frenata*), mink* (*Mustela vison*), spotted skunk (*Spilogale putorius*)

Otariidae	northern fur seal (*Callorhinus ursinus*), northern sea lion* (*Eumetopias jubatus*)
Phocidae	harbour seal* (*Phoca vitulina*)
Procyonidae	raccoon (*Procyon lotor*)
Ursidae	black bear* (*Ursus americanus*), grizzly bear (*Ursus arctos*)
Delphinidae	killer whale (*Orcinus orcas*)
Phocoenidae	harbour porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*)
Bovidae	mountain goat* (*Oreamnos americanus*)
Cervidae	wapiti/elk* (*Cervus elaphus*), black-tailed deer* (*Odocoileus hemionus*)

Domestic and commensal taxa

Muridae	house mouse (*Mus musculus*)
Canidae	domestic dog* (*Canis familiaris*)
Suidae	domestic pig* (*Sus scrofa*)
Bovidae	domestic cow* (*Bos taurus*)

Nomenclature from Cannings and Harcombe (1990). *Found in historical and archaeological records. ***Introduced (Ministry of Environment, Fish and Wildlife Branch 1980:2).

Invertebrates by order

Mytiloida	blue mussel* (*Mytilus edulis*), Californian mussel (*Mytilus californianus*)
Ostreoida	pink scallop (*Chlamys hastata*), giant rock scallop (*Crassodoma gigantea*), weathervane scallop (*Patinopecten caurinus*), green false jingle (*Pododesmus macrochisma*), Pacific oyster (*Crassostrea gigas*), native oyster (*Ostrea lurida*[1])
Veneroida	Nuttall's cockle* (*Clinocardium nuttallii*), bent-nose macoma* (*Macoma nasuta*), fat gaper* (*Tresus capax*), Pacific horse clam* (*Tresus nuttallii*), Pacific littleneck* (*Protothaca staminea*), thin-shell littleneck clam (*Protothaca tenerrima*), Japanese littleneck*/*** (*Venerupis philippinarum*), butter clam* (*Saxidomus gigantea*), Pacific geoduck (*Panopea abrupta*)
Myoida	mud clam (*Mya arenaria*)
Dentaliida	dentalia* (*Dentalium* spp.)
Archeogastropoda	northern abalone (*Haliotis kamtschatkana*), rough keyhole limpet (*Diodora aspera*), whitecap limpet (*Acmaea mitra*), shield limpet (*Lottia pelta*), plate limpet (*Tectura scutum*), ribbed limpet (*Lottia digitalis*), mask limpet (*Tectura persona*), black turban snail (*Tegula* funebralis), brown turban (*Tegula pulligo*), blue topsnail (*Calliostoma ligatum*), pearly topsnail (*Lirularia lirulata*), purple-ring topsnail (*Calliostoma annulatum*)
Mesogastropoda	variable lacuna (*Lacuna variegata*), checkered periwinkle (*Littorina scutulata*), Sitka periwinkle (*Littorina sitkana*), threaded bittium (*Bittium eschrichtii*), hooked slippersnail (*Crepidula adunca*), wrinkled slippersnail (*Crepipatella dorsata*), western white slippersnail (*Crepidula nummaria*),

Lewis's moonsnail (*Polinices lewisii*), Oregon triton (*Fusitriton oregonensis*)

Neogastropoda leafy hornmouth (*Ceratostoma foliatum*), frilled dogwinkle/wrinkled whelk* (*Thais lamellosa*), channeled dogwinkle (*Nucella canaliculata*), striped dogwinkle (*Nucella emarginata*), wrinkled amphissa (*Amphissa columbiana*), dire whelk (*Searlesia dira*)

Neoloricata lined (red) chiton (*Tonicella lineata*), hairy chiton (*Mopalia ciliata*), black katy chiton (*Katharina tunicate*), mossy chiton (*Mopalia muscosa*), giant Pacific chiton (*Cryptochiton stelleri*)

Thoracia common acorn barnacle (*Balanus glandula*), small acorn barnacle (*Chthamalus dalli*), thatched acorn barnacle (*Balanus* cariosus), goose neck barnacle (*Pollicipes polymerus*), giant acorn barnacle (*Balanus nubilus*), acorn-type barnacle (*Balanus rostratus alaskensis*), little brown barnacle (*Chthalamus dalli*)

Decapoda[1] hermit crabs (*Pagurus* spp.), red rock crab (*Cancer productus*), dungeness crab (*Cancer magister*), shore crabs (*Hemigrapsus* spp.), orange spider crab (*Chorilia longipes*), decorator crab (*Oregonia gracilis*), kelp crab (*Pugettia producta*)

Echinoida[1] green sea urchin (*Strongylocentrotus droebachiensis*), red sea urchin (*Strongylocentrotus franciscanus*), purple sea urchin (*Strongylocentrotus purpuratus*)

Nomenclature from Harbo (1997) except [1]Snively. Species not often recovered archaeologically (e.g., octupus, squid) are not listed. ***Introduced (Harbo 1997:139, 165, 169).

Sources: For fish, Hart 1973; Lamb and Edgell 1986; Port Moody Ecological Society 2001; School of Resource and Environmental Management 1996. For mammals, Cannings and Harcombe 1990; Cowan and Guiguet 1956; Nowak and Paradiso 1983. For birds, Campbell *et al.* 1990a, 1990b, 1997, 2001; Breault and Watts 1996. For invertebrates, Abbott 1968; Paine 1992; Quayle 1974; Snively 1980. For all fauna, Cannings and Harcombe 1990; Hanrahan 1994; Hanson 1991. Archaeological sources: Charlton 1977; Galdikas-Brindamour 1972; Kusmer 1994a, 1994b, 1994c; Williams 1974.

Appendix B. Description of flotation samples analysed.

Deposit Type	Sample Number	Unit	Excavation Level (cm dbs)	Stratigrahic Layer	Floated Vol. (litre)	Multiplier to normalize to 1 litre	Fish sub-sampled	Shell sub-sampled 2.8 mm	Shell sub-sampled 1.0 mm	Archaeo-botanical analysis	Floated by
Interior	9	484.75N 498E	0-10	8	1	1	-	yes	yes	-	Trost
Interior	18	486N 497E	0-10	8	1	1	-	yes	-	yes	Ng & Ryan
Interior	19	486N 497E	0-10	8	1	1	-	yes	-	-	Trost
Interior	20	486N 497E	0-10	8	1	1	-	yes	-	-	Trost
Interior	22	484.75N 498E	0-10	8	1	1	-	-	yes	-	Ng & Ryan
Interior	42	484.75N 498E	0-10	8	1	1	-	yes	-	-	Trost
Interior	52	486N 497E	0-10	8	2	0.5	-	yes	-	-	Ng & Ryan
Interior	58	484.75N 498E	10-20	8	2	0.5	-	yes	-	-	Trost
Interior	59	484.75N 498E	10-20	8	2	0.5	yes[1]	yes	-	-	Trost
Interior	63	486N 497E	10-20	8	1	1	yes	-	yes	-	Trost
Interior	65	484.75N 496E	10-20	18	1.4	0.71	yes	yes	-	-	Trost
Interior	68	486N 497E	10-20	8	1	1	yes	-	yes	-	Trost
Interior	83	484.75N 498E	10-20	8	1	1	yes	yes	-	-	Trost
Interior	84	486N 497E	10-20	23	2	0.5	yes[1]	-	-	-	Trost
Interior	92	484.75N 496E	10-20	8	1	1	yes	yes	yes	-	Trost
Exterior	28	482N 498E	10-20	12	1	1	-	yes	-	-	Trost
Exterior	30	480N 500E	20-30	11	0.25	4	-	-	-	yes	Ng & Ryan
Exterior	31	480N 500E	10-20	11	0.3	3.33	-	-	-	-	Trost
Exterior	40	480N 500E	20-30	14	1	1	yes	-	-	yes	Ng & Ryan
Exterior	43	480N 500E	10-20	14	1	1	yes	-	-	yes	Ng & Ryan

[1]Sample divided by volume versus weight.

Appendix B. Description of flotation samples analysed. (cont'd)

Deposit Type	Sample Number	Unit	Excavation Level (cm dbs)	Stratigrahic Layer	Floated Vol. (litre)	Multiplier to normalize to 1 litre	Fish sub-sampled	Shell sub-sampled		Archaeo-botanical analysis	Floated by
								2.8 mm	1.0 mm		
Exterior	45	480N 500E	20-30	14	1	1	yes	-	-	yes	Ng & Ryan
Exterior	46	480N 500E	20-30	11	2	0.5	-	yes	yes	yes	Ng & Ryan
Exterior	47	482N 498E	10-20	16	2	0.5	-	-	-	-	Trost
Exterior	53	480N 500E	30-40	17	1	1	yes	yes	-	yes	Ng & Ryan
Exterior	55	480N 500E	30-40	17	1	1	yes	yes	-	yes	Ng & Ryan
Exterior	57	480N 500E	30-40	17	1	1	yes	-	-	yes	Ng & Ryan
Exterior	66	482N 498E	0-10	16	1	1	yes	-	-	-	Trost
Exterior	78	482N 498E	10-20	22	2	0.5	yes	yes	yes	-	Trost
Exterior	88	482N 498E	10-20	20	2	0.5	yes	-	yes	-	Trost
Exterior	106	482N 498E	10-20	20	2	0.5	yes	yes	yes	-	Ng & Ryan

Appendix C. Identified fish remains from the heavy fraction (NISP) per sample, ordered by biological taxonomy.

Sturgeon, pink salmon, chum salmon were identified in the ¼-inch screen and by ancient DNA analysis.

	Flotation Sample	Spiny dogfish	Cartilag-enous fish	Pacific herring	Northern anchovy	Salmon	Surf smelt	Eulachon	Plainfin Midshipman	Walleye pollock	Codfish (not pollock)	Perch	Snake prickleback	Rockfish	Greenling	Buffalo sculpin	P. staghorn sculpin	Cabezon	Sculpin	Rock sole	English sole	Starry flounder	Flatfish	Sucker fish	Fish	NISP
Interior deposit	9	1	1	24	-	21	2	-	-	-	-	5	-	2	-	-	-	-	-	-	-	-	-	-	504	560
	18	1	-	16	1	12	-	-	-	-	-	1	-	2	-	-	-	-	1	-	-	-	1	-	563	598
	19	1	-	14	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	655	673
	20	5	-	26	1	2	1	-	-	-	-	34	-	-	-	-	-	-	-	-	-	-	2	-	1187	1258
	22	-	-	40	-	28	2	-	2	-	-	5	-	1	-	-	-	-	-	-	-	-	-	-	957	1035
	42	3	-	93	1	131	-	1	1	-	-	3	-	1	-	-	-	-	-	-	-	1	1	-	2509	2745
	52	-	-	5	-	32	1	-	1	-	-	-	-	2	-	-	-	-	2	-	-	1	2	-	747	793
	58	1	-	89	-	17	1	-	1	-	-	9	-	3	-	-	-	-	1	-	-	-	3	-	1370	1495
	59	3	1	31	1	17	1	1	2	-	1	8	-	1	-	-	-	-	-	-	-	-	1	-	1674	1742
	63	-	-	84	1	12	-	-	6	-	-	19	-	-	-	-	-	1	-	-	-	-	6	-	1194	1323
	65	1	-	55	1	37	4	1	-	-	-	5	-	-	-	1	1	-	-	-	-	-	2	-	963	1071
	68	5	3	184	4	116	-	6	-	-	-	15	-	1	-	-	-	-	2	-	-	6	5	-	2529	2876
	83	1	-	200	-	44	1	-	-	-	-	2	-	1	-	-	-	-	-	-	-	2	1	-	1652	1904
	84	1	-	119	-	23	-	1	6	-	-	3	-	2	-	-	1	-	1	-	1	2	3	-	1017	1180
	92	3	-	177	5	36	6	-	1	-	-	5	-	1	-	-	-	-	-	1	-	-	5	-	1896	2136
Exterior deposit	28	2	2	40	7	6	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-	1	-	-	168	229
	30	-	-	4	12	-	4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	568	592
	31	-	-	3	7	-	3	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	120	136
	40	-	-	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	64	68
	43	2	-	38	2	6	2	68	-	-	-	3	-	-	-	-	1	-	1	-	-	1	-	-	644	768
	45	-	-	245	8	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	5	5	-	818	1082
	46	-	-	16	1	12	-	1	-	1	-	1	-	-	2	-	-	-	-	-	-	1	-	-	270	305
	47	4	-	83	4	21	10	2	3	-	-	4	-	2	-	1	-	-	1	-	-	-	1	-	383	519
	53	-	-	141	8	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	569	722
	55	-	-	199	144	4	-	1	-	2	-	2	-	-	-	-	-	-	1	-	1	-	4	-	615	973
	57	-	-	535	498	5	-	2	3	1	-	8	1	-	3	-	2	-	12	-	-	10	1	1	2604	3686
	66	3	1	89	-	48	19	1	3	-	-	7	-	-	-	4	-	-	-	1	-	2	6	-	1744	1928
	78	1	-	7	1	8	2	-	1	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	301	323
	88	3	1	29	10	107	6	1	1	-	-	8	-	-	-	1	1	-	1	1	-	-	1	-	2130	2301
	106	3	1	67	7	83	13	-	-	-	-	7	-	1	-	4	-	-	1	-	-	-	4	-	3324	3515
	NISP:	44	10	2656	724	831	78	91	31	4	1	162	1	21	5	11	8	1	25	3	2	32	55	1	33739	38536

Appendix D. Identified mammalian remains from ¼-inch screen and heavy fraction (NISP) per excavation unit, ordered by biological taxonomy.

Deposit	Unit	Squirrel	Beaver	Rodent	Domestic dog	Canid	Black bear	Bear	Mink	Cougar	Bobcat	Carnivore	Harbour seal	Pinnipeds	Domestic pig	Domestic cow	Sheep/goat	Wapiti	Black-tailed deer	Small artiodactyl	Large artiodactyl	Artiodactyl	Small mammal	Medium mammal	Large Mammal	Mammal	NISP	Selectively collected
Exterior deposit	480N 500E	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	4	-		-	3	-	1	10	Yes
	480N 500E	-	2	-	-	-	-	-	-	-	1	-	2	-	-	-	-	-	1	4	-	2	1	11	-	1	25	
	481N 500.75E	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	2	Yes
	482N 498E	-	2	1	-	8	1	-	-	3	-	-	1	2	-	-	-	1	-	7	4	6	-	15	-	3	54	
	482N 500.75E	-	-	1	-	2	-	-	-	-	-	-	1	1	-	-	-	-	1	-	-	-	-	2	-	-	8	Yes
Interior deposit	484.75N 496E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2	Yes
	484.75N 496E	-	2	1	3	15	-	-	2	2	-	2	-	-	-	-	-	5	1	6	3	2	-	8	1	-	53	
	484.75N 498E	-	-	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	2	-	3	-	1	14	
	484.75N 500E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	
	484N 496E	-	2	-	-	2	-	1	-	-	-	-	2	-	-	-	1	-	-	4	-	4	-	5	1	-	22	Yes
	484N 496E	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	8	-	-	15	
	484N 498E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	Yes
	484N 500E	-	2	-	-	2	-	-	-	-	-	-	-	-	1	-	-	2	-	7	-	-	-	9	-	-	23	Yes
	484N 500E	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	4	-	2	-	2	12	
	485.9N 498.1E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	
	486N 497E	1	8	-	-	3	-	-	1	-	-	3	-	-	-	-	-	-	-	2	-	9	-	13	-	3	43	
	NISP:	1	18	4	3	42	1	1	3	5	1	6	7	3	1	2	1	9	3	43	7	29	1	82	2	10	285	

Appendix E. Identified bird remains from ¼-inch screen and heavy fraction (NISP) per excavation unit, ordered by biological taxonomy.

	Unit	Loons	Grebe	Great blue heron	Canada goose	Bufflehead/Goldeneye	Duck	Swan	Anseriformes	Bald Eagle	Falcon/Hawk	Mew gull	Glaucous-winged Gull	Gull	Steller's Jay	Passerines	Small bird	Medium bird	Large bird	NISP	Selectively collected
Exterior depsoit	480N 500E	-	-	-	-	2	-	-	1	1	-	-	-	-	-	-	-	1	-	5	Yes
	480N 500E	-	2	-	-	-	5	-	-	1	-	-	-	2	-	-	-	12	-	22	
	481N 500.75E	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	Yes
	482N 498E	-	1	-	-	2	7	-	2	-	-	1	-	2	-	-	2	13	1	31	
	482N 500.75E	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	-	3	Yes
Interior deposit	484.75N 496E	-	-	-	-	3	2	-	1	-	-	-	1	-	-	-	2	17	1	27	
	484.75N 498E	1	-	1	-	-	2	1	1	-	-	-	-	-	-	1	-	2	2	11	
	484.75N 500E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	
	484N 496E	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	1	-	4	Yes
	484N 496E	1	-	-	-	-	5	-	-	-	-	-	-	1	-	-	-	6	-	13	
	484N 500E	-	-	-	-	1	6	-	1	-	-	-	-	1	1	-	-	3	1	14	Yes
	484N 500E	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	-	3	
	485.9N 498.1E	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	
	486N 497E	5	1	-	1	2	3	-	-	-	1	-	-	-	-	1	1	18	5	38	
	NISP:	7	4	1	1	10	31	1	7	3	1	1	2	8	1	2	5	77	10	172	

Appendix F. Identified invertebrate remains in the heavy fraction from the interior deposit per sample, ordered by biological taxonomy.

Sample #	9	18	19	20	22	42	52	58	59	63	65	68	83	84	92	Weight (g)
Dentalia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Limpets	-	0.1	0.1	0.1	0.1	-	-	0.1	0.1	0.3	-	-	0.2	+	-	1.1
Lewis' moon shell	-	-	-	-	-	-	-	-	-	3.1	-	-	-	-	-	3.1
Frilled dogwinkle	-	3.0	0.8	-	2.6	-	0.1	-	5.7	-	-	6.6	-	-	0.8	19.6
Land snails	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	0.3
Gastropods	-	1.2	0.6	2.8	1.4	1.5	-	-	2.8	-	2.4	-	0.1	+	0.4	13.2
Blue mussel	21.6	18.9	44.0	65.5	22.3	36.2	40.5	24.7	55.5	44.2	12.8	24.2	107.4	16.2	56.8	590.8
Oysters	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nuttall's cockle	-	-	-	-	-	5.1	-	0.7	-	13.7	-	-	-	2.5	-	22.0
Cockle	12.2	4.3	3.8	3.8	6.9	-	0.9	2.1	0.9	-	0.2	9.2	26.0	0.2	6.1	76.6
Pacific littleneck clam	127.6	-	-	29.1	-	13.3	2.9	0.4	-	79.7	-	33.2	19.6	10.4	-	316.2
Littleneck clam	-	15.7	23.0	-	22.0	-	-	-	2.5	0.3	7.4	-	-	-	13.8	84.7
Butter clam	40.0	1.5	23.1	4.7	1.7	15.4	-	-	2.0	23.1	0.8	1.8	28.6	15.5	3.0	161.2
Bent-nose clam	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fat gaper	9.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.8
Pacific horse clam	-	-	3.0	-	-	-	-	-	0.7	-	-	-	7.6	-	-	11.3
Gaper	-	0.3		1.5	-	-	0.7	-	-	-	-	7.6	-	-	-	10.1
Macoma spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Clam	114.4	14.6	45.3	12.4	31.0	32.3	5.1	14.8	3.5	13.6	6.1	55.0	66.0	10.1	28.2	452.4
Barnacle	4.5	6.8	37.7	20.3	17.2	12.1	5.4	4.6	27.9	74.6	3.9	14.0	33.2	5.1	13.8	281.1
Crabs	-	-	-	-	-	-	-		0.3	-	-	-	-	-	-	0.3
Green sea urchin	+	+	-	+	+	+	0.2	0.2	+	0.2	+	+	+	+	+	0.6
Sea urchins	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	0.1
Total weight (g):	330.1	66.4	181.4	140.2	105.6	115.9	55.8	47.6	101.9	252.8	33.6	151.6	288.7	60.0	122.9	2054.5

Interior deposit total weight:	2054.6 g
Exterior deposit total weight:	4884.4 g
Total weight of identified specimens:	6939.0 g

+ means taxa was present but weight was < 0.1 g. – means taxa was not present.

Appendix G. Identified invertebrate remains in the heavy fraction from the exterior deposit per sample, ordered by biological taxonomy.

Sample #	28	30	31	40	43	45	46	47	53	55	57	66	78	88	106	Weight (g)
Dentalia	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	0.0
Limpets	-	0.4	-	+	+	0.3	+	-	0.1	-	-	-	-	-	-	0.8
Lewis' moon shell	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Frilled dogwinkle	-	-	-	-	0.3	6.7	-	-	-	-	-	2.6	-	0.3	4.7	14.6
Land snails	-	-	-	-	-	-	-	+	-	-	-	0.1	-	-	-	0.1
Gastropods	0.3	-	-	+	0.8	7.3	0.2	-	0.1	0.3	-	1.0	-	-	0.2	10.2
Blue mussel	20.4	3.6	3.0	33.8	29.3	54.1	5.0	1.9	42.2	53.1	8.1	18.8	75.0	10.0	44.6	402.9
Oysters	-	3.6	-	-	0.1	0.1	-	0.2	-	0.7	-	-	-	0.4	-	5.1
Nuttall's cockle	-	1.6	28.7	268.6	122.2	-	-	1.3	12.2	4.6	1.5	-	-	6.0	-	446.7
Cockle	2.8	-	-	35.0	23.4	360.8	35.7	-	-	-	22.3	3.2	2.3	-	8.9	494.4
Pacific littleneck clam	26.1	29.6	47.3	517.0	42.4	-	28.1	2.2	23.6	25.4	62.3	-	1.0	13.1	13.9	832
Littleneck clam	-	-	-	4.4	0.9	47.3	-	-	0.9	0.1	-	8.4	-	-	-	62
Butter clam	1.6	32.0	139.2	655.5	744.8	62.7	13.5	-	7.1	30.2	27.8	0.4	-	12.0	-	1726.8
Bent-nose clam	-	-	-	-	-	0.1	-	-	-	1.3	-	-	-	-	-	1.4
Fat gaper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pacific horse clam	-	-	-	-	1.0	1.9	20.6	-	-	-	1.0	-	-	-	-	24.5
Gaper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Macoma spp.	-	-	-	-	-	1.5	-	-	0.5	1.4	-	-	-	-	-	3.4
Clam	26.0	30.4	144.9	9.9	27.7	132.7	109.9	5.1	38.0	35.7	49.6	22.6	4.1	9.7	19.3	665.6
Barnacle	7.8	6.0	2.0	11.9	15.0	60.6	1.5	2.2	31.8	18.6	0.9	8.4	8.0	8.3	10.7	193.7
Crabs	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
Green sea urchin	+	-	0.1	-	-	-	-	+	-	-	-	+	+	+	+	0.1
Sea urchins	-	-	-	+	+	+	-	-	+	-	+	-	-	-	-	0.0
Total weight (g):	85.0	107.2	365.2	1536.1	1007.9	736.1	214.6	12.9	156.5	171.4	173.5	65.5	90.4	59.8	102.3	4884.4

Interior deposit total weight: 2054.6 g
Exterior deposit total weight: 4884.4 g
Total weight of identified specimens: 6939.0 g
+ means taxa was present but weight was < 0.1 g. – means taxa was not present.

Appendix H. Mammal remains from Belcarra Park (DhRr 6), Cates Park (DhRr8), and Tsawwassen (DgRs 2), ordered by biological taxonomy.

Taxon	DhRr 6[1]	DhRr 8[1]	DgRs 2
Coast mole	0	0	8
Voles	0	0	21
Snowshoe hare	1	0	0
Squirrels, chipmunks, and marmots	0	1	0
Beaver	4	6	3
Deer mice (*Peromyscus* sp.)	0	0	1
Domestic dog	49	87	137
River otter	0	2	0
American marten	1	0	0
Mink	17[2]	0	1
Northern sea lion	0	0	1
Harbour seal	10	14	6
Raccoon	9	3	0
Black bear	21	6	0
Bears	0	0	1
Dolphin or porpoise	2	8	0
Domestic pig	1	0	0
Wapiti	24	58	6
Black-tailed deer	120	68	12
Mountain goat	15	3	0
Artiodactyl	16	0	6
Large mammal	197	11	66
Medium mammal	22	6	17
Small land mammal	2	0	4
Sea mammal	4	0	9
Unidentified	2538	2687	360
Total NSP:	3053	2960	659
NIT:	11	10	8

All remains recovered from ¼-inch mesh screen. [1]NISP includes specimens for which identification to taxa was of low confidence. [2]One nearly complete mink skeleton was recovered, estimated at 200 elements. These specimens are not included due to the resulting bias in the dataset. *Sources*: Compiled from Charlton 1977:226; Kusmer 1994a, 1994b, 1994c; Williams 1974.

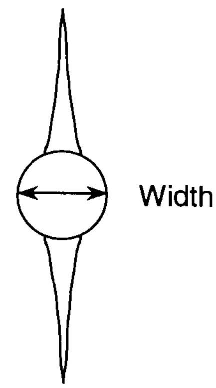
Appendix I. Bird remains from Belcarra Park (DhRr 6), Cates Park (DhRr8), and Tsawwassen (DgRs 2), ordered by biological taxonomy.

Taxon	DhRr 6	DhRr 8[1]	DgRs 2
Common loon	-	0	6
Horned grebe	-	1	0
Grebes (Podicipedidae)	-	1	3
Cormorants (*Phalacrocorax* spp.)	-	0	2
Canada goose	+	0	0
Misc. geese (Anserinae)	-	0	9
Mallard	+	2	4
Northern pintail	+	0	0
Northern shoveler	+	3	0
Gadwell	+	0	0
American wigeon	+	1	0
Teals (*Anas* spp.)	-	0	1
Bay ducks (*Aythya* spp.)	+	0	3
Harlequin duck	+	0	0
Oldsquaw	-	0	2
Surf scoter	+	0	0
Scoters (*Melanitta* spp.)	-	2	1
Bufflehead	+	2	0
Goldeneye/bufflehead (*Bucephala* spp.)	-	0	5
Mergansers (*Mergus* spp.)	-	0	7
Misc. duck	-	0	90
Waterfowl (Anatidae)	-	2	0
Bald eagle	+	0	13
Rails/coots	-	0	2
Bonaparte's gull	+	0	0
Glaucous-winged gull	-	1	0
Gulls and terns (Laridae)	-	1	4
Shorebirds (Charadriiformes)	-	0	3
Northwestern crow	-	1	0
Misc. crow	-	0	1
Blackbirds	-	0	3
Passerines	-	0	3
Unidentified	-	276	449
Total NSP:	270	293	611
NIT:	12	8	16

+ means taxon is present, - means taxon is absent. All remains recovered from ¼-inch mesh screen. [1]NISP includes specimens for which identification to taxa was of low confidence. *Sources*: Compiled from Charlton 1977:223-224; Kusmer 1994a, 1994b, 1994c; Williams 1974.

Appendix J. Salmon vertebrae widths.

ID #	Width (mm)	ID #	Width (mm)	ID #	Width (mm)
162	6.50	537	10.45	70	11.42
264	7.83	323	10.46	177	11.43
499	7.95	415	10.55	541	11.53
30	8.03	232	10.57	488	11.54
130	8.18	501	10.60	462	11.56
388	8.41	523	10.62	351	11.61
348	8.50	52	10.63	15	11.64
98	8.95	639	10.70	467	11.64
236	9.06	68	10.71	468	11.68
552	9.17	576	10.85	463	11.73
275	9.37	73	10.86	548	11.76
575	9.38	104	10.88	337	11.88
582	9.44	5	10.89	293	11.92
72	9.47	445	10.90	35	12.01
271	9.47	489	10.91	476	12.04
561	9.49	88	10.93	214	12.05
29	9.52	187	10.93	384	12.06
83	9.57	426	10.95	599	12.06
521	9.57	145	10.96	290	12.11
430	9.69	565	11.00	225	12.16
530	9.84	1	11.01	496	12.21
422	9.87	75	11.03	435	12.22
117	9.91	140	11.04	389	12.26
604	9.98	394	11.09	212	12.3
301	10.04	360	11.13	441	12.32
251	10.06	538	11.13	266	12.33
570	10.10	204	11.16	149	12.35
175	10.11	361	11.18	84	12.55
51	10.19	99	11.19	478	12.81
112	10.29	324	11.20	179	12.99
154	10.30	390	11.25	353	13.16
262	10.30	346	11.26	405	13.45
473	10.30	129	11.33		
245	10.35	62	11.39		



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