Featuring Wetlands: A Feature Analysis of Wetland Resource Use at DhRp-52, British Columbia

by

Annique-Elise Goode

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Name: **Annique-Elise Goode**

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Examining Committee: **Chair:** Dana Lepofsky, Professor

George Nicholas
Senior Supervisor
Professor

Dana Lepofsky
Supervisor
Professor

Dale Croes
External Examiner
Professor
Washington State University

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Abstract

This study explores wetland resource use at DhRp-52 to develop a better understanding of the inhabitants' interactions with their wetland environment. A feature analysis of selected feature contents using multiple sources of evidence (i.e., archaeobotany, charcoal analysis, and zooarchaeology) was employed to (a) taxonomically identify seed, bone, and charcoal as indicators of wetland resource use, and (b) assess feature function in relation to resource use. This provides a means to evaluate the suitability of feature analyses for future use at archaeological sites in the region, particularly in wetland contexts. The results of the feature analysis contribute to a more general discussion of regional hunter-gatherer interactions with wetland ecosystems. While many aspects of human landscapes and resource use in the Northwest Coast have been extensively discussed, wetlands have seldom been considered as a specific environmental zone. This study helps to broaden that discussion by presenting new data on the topic, by demonstrating the utility of a feature analysis-based approach, and highlighting the archaeological and ethnographic importance of regional wetlands and their use.

Keywords: Wetland archaeology, resource use, feature analysis, Northwest Coast, DhRp-52, archaeology, charcoal analysis, archaeobotany, zooarchaeology

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Chapter 1: Wetlands and Past Human Landscapes

Human populations have always had an intimate relationship with their environment, and this is particularly true of hunter-gatherers and other small-scale societies. People interact with local and regional environmental conditions in different ways and at different spatial and temporal scales. Such interactions can manifest in resource use patterns and cultural behaviours oriented to specific ecological landscapes. Understanding the nature of those interactions, whether in terms of cultural stability or adaptation to changing climate, can yield greater understanding of hunter-gatherer societies regarding their subsistence preferences, settlement patterns, technological innovations, and landscape use.

Much research has been conducted in the context of coastal and riverine-adapted hunter-gatherers in North America, Europe, and beyond (see Kelly 2013; Lee and Daly 2004). However, one often-overlooked avenue, particularly in North America, has been archaeological and paleoecological research in the context of hunter-gatherers in wetlands-rich settings (Croes 2013; Nicholas 2013; Menotti 2012; Menotti and O'Sullivan 2013; Nicholas 1998a, b). Wetlands are an important ecological component of many different environments, and once had a much greater presence on the landscape than they generally do today. They are also particularly relevant to the study of prehistoric hunter-gatherer lifeways for three primary reasons: 1) they are often dynamic ecosystems with relatively high resource diversity, productivity and availability, and thus attractive locations for human beings (Nicholas 1998b: 33-36); 2) this attraction is documented archaeologically and ethnographically through settlement patterns, wetland resource exploitation, and the use of wetlands for social and ritual purposes (e.g., Barnett 1955; Lourandos 1980; Matsui 1991; Menotti 2012: 27-99); and 3) wetlands often have high archaeological value by preserving organic material in the archaeological record, rarely recovered from other locales, including archaeobotanical remains and material culture (e.g, wood, bone, antler) (Croes 1992: 101-102; 2003: 51; Menotti 2012: 14-15). Therefore, studying how ancient peoples exploited a specific wetland or used wetland-rich areas can help archaeologists to better understand hunter-gatherer processes of adaptation and patterns of resource use, and to explore human landscapes as a whole (Nicholas 1998b: 31-32, 2013; Van de Noort and O'Sullivan 2006: 29, 34).

There are, however, problems in studying the documented or presumed relationship between hunter-gatherers and wetlands or any other ecozone. The proximity of archaeological sites to wetlands may strongly suggest wetland use, but is proximity alone a land-use indicator, since that association can be fortuitous? Conversely, some wetlands existed in the past but not in present-day landscapes, either through natural ecological succession or man-made destruction; their disappearance makes it difficult to use landscape analysis to recreate ancient wetland use patterns. Ethnographic data may document seasonal harvesting of wetland plants or birds, and place-names, stories, and rituals can indicate the cultural values of such settings. However, do those activities extend to earlier times and if so, how are they expressed in the archaeological record?

Addressing these questions requires a more direct means of evaluating land use and resource extraction, such as the study of archaeobotanical and faunal remains recovered from archaeological sites and, in particular, features possibly associated with resource extraction, processing, and use (e.g., hearths, processing pits). It is beneficial to use multiple lines of evidence to evaluate different datasets in regards to their association with wetland areas, specific wetland resources, and their use by hunter-gatherers.

The Pacific Northwest Coast provides opportunities to study hunter-gatherer use of landscapes and resources in the context of regional wetlands. There is a long and well-documented record of human occupation in the region extending to at least ca. 12,000 BP (Ames and Maschner 1999: 66, 71-72; Fedje and Mackie 2005: 154), and considerable evidence of ancestral and more recent fisher-hunter-gatherers using wetlands. That relationship may be exemplified by the Coast Salish peoples who historically occupied coastal British Columbia and Washington. Extensive archaeological, ethnographic, and historical sources reveal their: 1) use of wetland-associated resources for food, shelter, transportation, and technology; 2) naming of specific wetland areas, often for particular uses or traits; and 3) spiritual rituals involving wetland locations or resources, and cultural stories that emphasize the importance of wetlands (e.g., James 1998; Jenness 1955; Spurgeon 2001; Suttles 1955, 1987).

Given that wetlands were a significant part of the precontact Coast Salish landscape, there are research opportunities to survey wetland areas for archaeological sites, study them for evidence of wetland resource use (e.g., plant and faunal remains of wetland taxa), and discuss the archaeological evidence for human relationships with regional wetland environments.

In this thesis, I explore the nature of hunter-gatherer use of wetland resources through a feature analysis of one wetland-margin archaeological site in southwestern British Columbia. This site, DhRp-52, is located in the Pitt Polder region of the lower Fraser Valley (Fig. 1), in the Katzie First Nation’s traditional territory. Ethnographic and historic information on Katzie land use reveals that they traditionally used a wide variety of resources from different ecosystems within their territory, including wetlands.

DhRp-52 itself is an important and unique site for three reasons: 1) it is located in an area that was wetlands-rich in precontact times; 2) excavation yielded a large and diverse assemblage containing lithic and wood artifacts, as well as waterlogged organic

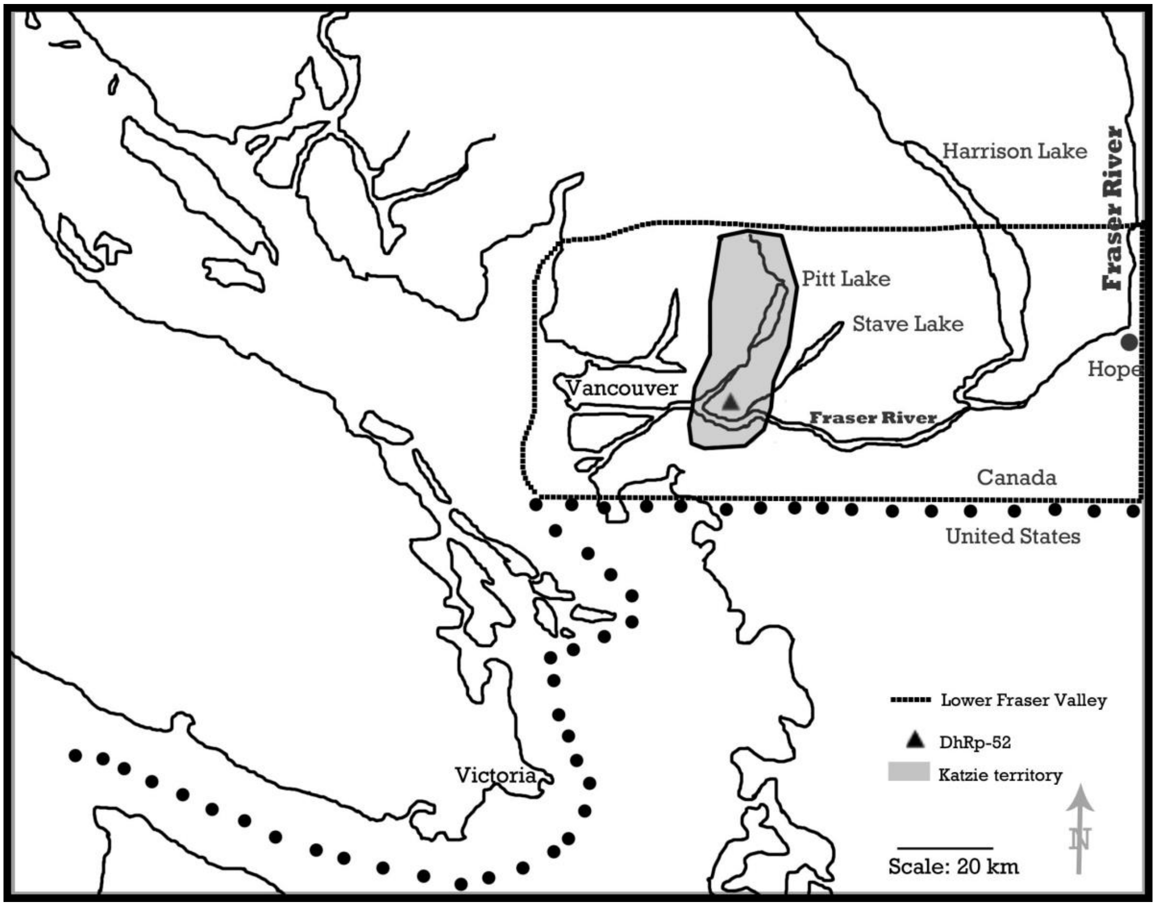

Figure 1: Location of DhRp-52 within approximate location of Katzie traditional territory in the lower Fraser Valley, British Columbia.

remains; and 3) site excavators found the first documented wapato (*Sagittaria latifolia*) tubers in an archaeological context on the Northwest Coast (Hoffmann and Huddlestan 2010: 232); and possible evidence for wapato cultivation of patches. This wapato discovery is significant because regional archaeological studies have historically considered the indigenous societies of the Northwest Coast as not engaging in either cultivation or agriculture (Bernick 2013: 78; KDC 2010; Deur and Turner 2005a: 3).[1]

A feature analysis of DhRp-52 provides a means to investigate direct evidence of resource extraction, processing, and use at this site, which can provide information about past subsistence practices and hunter-gatherer relationships with wetlands. Such an approach can corroborate or challenge interpretations of site use provided by other data sets. Feature analysis can recover archaeobotanical and faunal remains as indicators of resource use and interpret feature functions in the same vein. In wetland contexts, integrated feature analyses that draw on multiple lines of evidence can maximize the recovery of rare perishable organic remains, assess land use, and provide archaeological links to ethnographic data.

Research Objectives

The location of DhRp-52 within the traditional territory of the Katzie First Nation provides an opportunity to use both archaeological and ethnographic data to research wetland exploitation, hunter-gatherer adaptation, and resource use on the Pacific Northwest Coast. I address this through four primary research objectives:

[1] This narrative focused on maritime-riverine fishing is now being reconsidered by archaeologists in favour of a broader interpretation of resource use (Smith 2005: 37-38; Lepofsky 2004: 373-374; Deur and Turner 2005; Turner et al. 2013).

1. To explore wetland resource use at DhRp-52 to develop a better understanding of the inhabitants' interactions with their wetland environment;

2. To analyze selected feature contents for multiple sources of evidence (i.e., archaeobotany, charcoal analysis, zooarchaeology) to (a) taxonomically identify seed, bone, and charcoal as indicators of wetland resource use, and (b) assess feature function in relation to resource use;

3. To evaluate the suitability of feature analysis for future use at archaeological sites in the region, particularly in wetland contexts; and finally,

4. To relate feature analysis results and interpretation to a more general discussion of regional hunter-gatherer interactions with wetland ecosystems.

These objectives are relevant to a larger discussion of hunter-gatherer interactions with their environment and the role that wetlands played in human history. While many aspects of human landscapes and resource use in the Northwest Coast have been extensively discussed, wetlands have seldom been considered as a specific factor. This study helps to broaden that discussion by presenting new data on the topic, by demonstrating the utility of a feature analysis-based approach, and highlighting the archaeological and ethnographic importance of regional wetlands and their resources. It is hoped that this thesis will contribute to filling the research gaps between the ethnography and the archaeology highlighted in this chapter.

The reason for conducting a feature analysis is that it can help confirm feature classification, especially where a feature presents vague or inconclusive typological characteristics. It can also provide information about human resource use patterns at a particular site. In a wetland context, using a feature analysis approach that includes multiple sources of evidence can maximize the potential information gained from preserved organic material, which is rarely found in drier archaeological sites.

There are four different approaches to feature analysis. *Descriptive analysis* describes a feature's observed characteristics and classifies them according to typology. *Spatial analysis* uses quantitative and statistical tools to study feature spatial patterning in a given area. *Single dataset analysis* focuses on a single type of evidence sampled from features, such as archaeobotanical or faunal remains. Finally, *multiple dataset analysis* integrates different types of data recovered from features.

I employed a multiple dataset analysis since this offered the best opportunity to construct the most complete picture possible concerning wetland use at DhRp-52. In my integrated feature analysis, three hearths and one probable processing pit were analyzed for seeds, bone, and charcoal, and the results were used to interpret feature function. In addition, charcoal analysis of these features and four additional features was used to assess fuelwood selection and use, particularly of tree species associated with wetlands and moist soils. When considered together, the results of this analysis, along with other evidence drawn from site assemblages and post-excavation analyses, offer new insights into wetland resource use at DhRp-52.

Thesis Organization

This thesis is organized into five chapters. This first chapter introduces my research topic and methods of feature analysis at DhRp-52, provides a general introduction to wetlands and the nature of human use of wetland ecosystems, and offers a general description of the study area. I also present information about ethnographic Katzie lifeways and regional archaeology, plus briefly discuss gaps between the ethnographic and archaeological records.

Chapter 2 provides a background to DhRp-52, including a description of the artifact assemblages and features recovered, along with a summary of the results of pertinent post-excavation analyses of archaeobotanical and faunal remains, wooden artifacts, pollen, phytoliths, and diatoms.

In Chapter 3, I describe the methods of feature analysis used to study selected site features from DhRp-52.

The results of this analysis are presented and discussed in Chapter 4. I conclude the chapter with an assessment of the feature analysis method's potential for future use in local archaeology.

In Chapter 5, I discuss what the results suggest about wetland use, link the interpretation and implications of these results to a larger discussion of regional wetland use, and identify research gaps and potential areas for future work.

The Importance of Wetlands

Wetlands are generally defined as transitional areas between dry land and aquatic environments, where the water table is at or near the land surface or the land is covered by up to six feet of water (Maltby 1991: 8-9; Niering 1985: 19-21). However, wetland definitions vary broadly across countries and by organization, are sometimes controversial, and often reflect the purpose for which they are defined[2] (e.g., environmental conservation or agricultural development) (Braddock 2007: 7; Mitsch and Gosselink 2007: 25; Tiner 1996: 114-117). There are also many different types of wetlands, including swamp, bog, fen, marsh, peatland, and mangrove (Maltby 1991: 9-17; Mitsch and Gosselink 2007: 26; NWWG 1988: 9-11; 13). In fact, scientific wetland classification includes over 70 different wetland forms within the five major classes of "bog, fen, marsh, swamp and shallow water" (Tarnocai et al. 1988: 416).

Generally speaking, all wetlands share three unique characteristics: 1) standing water or waterlogged soils (at least seasonally); 2) anoxic conditions; and 3) plants and animals adapted to flooded conditions (Braddock 2007: 3; Mitsch and Gosselink 2007: 27-28). Using these criteria, wetlands are found in every continent except Antarctica and in every climatic zone from tropical to tundra regions (Mitsch and Gosselink 2007: 43).

Wetlands are ecologically and socio-economically important environments (Maltby 1991: 8; Mitsch and Gosselink 2007: 4; Nicholas 1998b: 720). Ecologically, they

[2] For a detailed discussion of wetland definitions, refer to Mitsch and Gosselink (2007).

support a wide range of flora and fauna, fish, insects, and birds (Mitsch and Gosselink 2007: 4). Moreover, if trees are the lungs of the world, then wetlands are the kidneys, acting as water cleansers and important carbon, nutrient, pollutant, and sediment sinks (Braddock 2007: 20; Mitsch and Gosselink 2007: 4).

For millennia, humans have valued wetlands for providing food and technological resources, habitation sites, and transportation routes, as well as spiritual foci and burial places (Doran 1992: 128-129; Mitsch and Gosselink 2007: 5-15; Nicholas 1998a: 724-725; 2001: 262). Wetlands tend to be high in resource availability, diversity, productivity and stability, making them especially attractive to hunter-gatherers (Nicholas 1998a: 722-723, 2007a: 48). However, Western views of wetlands tend to be negative, often treating them as obstacles and wastelands, and seeing their drainage and conversion to farmland as improvements (Braddock 2007: 6; Coles 1998: 7; Driver 1998a: 5; Spurgeon 1998: 63).

There is robust ethnographic, historical, and archaeological evidence for diverse wetland use by people (e.g., Barnett 1955; Lourandos 1980; Matsui 1991; Nicholas 1990; Spurgeon 2001; Suttles 1955; Turner 1995, 2001 [1998]). For example, there are settlements on wetland margins, with optimal access to both wetlands and other ecozones (Bottoms and Painter 1979; Coles 1998: 7, 13; Lourandos 1980: 250; Nicholas 1990: 14-15). Trails and transportation routes go both around and through these in some locales; Britain’s oldest known road, the Neolithic Sweet Track, cuts through Somerset Levels’ marshy wetlands (Van de Noort and O’Sullivan 2006: 14-15).

Wetlands are recognized by archaeologists for their preservation of fragile organic remains by the wet and anaerobic conditions, making them important sources of information about aspects of human societies not associated with or preserved at dry sites (Bernick 1998a: xi-xii; 1998b: 139; Croes 1992: 101-102; Nicholas 2001: 266-267). This is especially true where the material culture is predominantly wood, bone, and fibre, which otherwise do not preserve well over time (Croes 1992: 102, 2003: 51). Such wet contexts may also preserve a range of other plant remains that can be used to infer past human diets (Pearsall 2010: 499).

In summary, wetlands thus have considerable value to archaeology and should be considered an important part of the landscape of environmental zones used by hunter-gatherers in different ways at different times and places. This is especially true where wetlands formed significant elements of a geographic region. Therefore, it seems logical to routinely seek out wetlands in conducting archaeological surveys. However, while wetland archaeology is rather robust in Europe and Japan (Matsui 1991; Van de Noort and O'Sullivan 2005), it remains somewhat marginal in North American archaeology (Bernick 2013: 72-73; Menotti 2012: 82, 85; Purdy 2013: 68). This has begun to change over the last 20 years. There has also been increased attention and interest paid to wet or waterlogged sites, particularly on the Northwest Coast (Bernick 2013: 71, 73). However, identified waterlogged sites tend to be described and studied as wet sites rather than wetland sites (Bernick 2013: 71, 72-80; Menotti 2012: 88-91).[3]

Wetlands of the Lower Fraser Valley

This section introduces the study area, the Pitt Polder, which is part of the lower Fraser Valley. I provide an overview of the area's environmental history and the relevant ecological aspects of local wetlands that were a significant element of the regional landscape.

Environmental History

Originating in the Rocky Mountains, the Fraser River ends its journey in the westernmost lower Fraser Valley, a region called the Fraser Valley lowlands (Fig. 1). While the lower Fraser River lacks the awe-inspiring roar and crash of the upper Fraser's Hell's Gate, it still earned the title of *Skookumchuck* or "mighty waters" in Chinook

[3] I follow Nicholas (2001) in distinguishing between wetland sites and wet sites, terms that tend to be used interchangeably in the literature. Nicholas states that wetland sites are defined by a *relationship* between people and the wetland environment, studied through the archaeological record that relationship produces, while wet sites are defined by the *association* between artifacts and the preservation context. Thus, an artifact found at a wetland site may have been created and/or used in the context of that contemporary wetland environment, while an artifact recovered from a wet site does not have that cultural association.

jargon[4]. One of the largest river systems in North America, the Fraser watershed includes approximately 180 kilometres of the Fraser River from the town of Yale to the Fraser delta at the Pacific Ocean (McPhail and Carveth 1993: 28).

The river mouth's present location and form is very different from past conditions and continues to change incrementally over time. River deltas form through the buildup of silty river sediment at the river mouth and tend to spread outwards, changing the coastline and creating new land (Barrie and Currie 2000: 748; Hebda 1977: 3-4). Over the course of the Holocene, the Fraser delta has moved westward (Fig. 2) from its original drainage into a maritime bay near Pitt Meadows to the landscape we know today (Clague et al. 1991: 1392).

The lower Fraser Valley is arguably the Northwest Coast's epicenter for ecological productivity and diversity. The Coastal Western Hemlock (CWH) zone is the most productive forest region in Canada, while the Fraser watershed is one of the most productive salmon rivers worldwide and includes estuaries, tidal and freshwater marshes, and sloughs (Northcote 1974: 39; Pojar et al. 1991: 110). Today, there are approximately 40,554 ha of wetlands in the Fraser lowlands (Buffett et al. 2011). Nearly two-thirds of these are classified as "shallow water," which includes large tidal flats, sloughs, and areas

[4] This was a trade language developed to facilitate communication between the diverse linguistic populations of indigenous peoples living on the Northwest Coast and, post-contact, with European traders and settlers (Lang 2008: 3-4; Suttles 1998: 164).

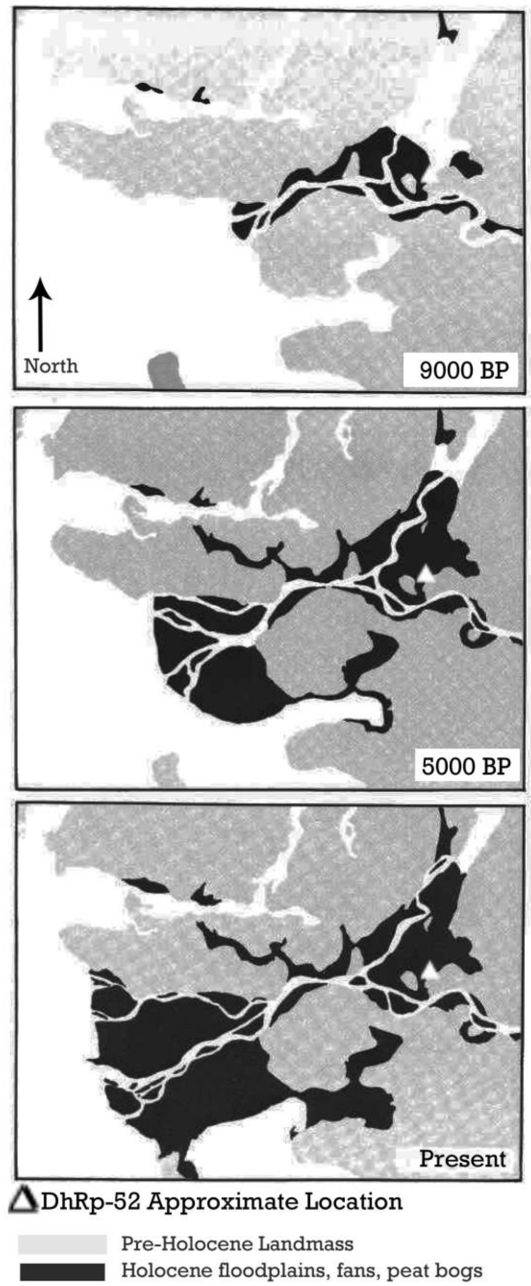

Figure 2: Fraser Delta formation (modified from Clague et al. (1991: 1392).

alongside riverbanks, streams, and ponds. The rest are classified as marshes, gravel bars, fens, bogs (including domed *sphagnum* peat bogs), and swamp (Banner et al. 1988: 327-330; Ward 1992 [1989]: 9). Regional wetlands are considered ecologically productive, especially estuaries and marshes (Pojar and McKinnon 1994: 18-19; Ward 1992 [1989]).

Estimated past and present wetland distributions in the Fraser lowlands are shown in Fig. 3a and 3b. Land development between 1827[5] and 1930 removed 80% of freshwater wetlands and wetland distribution continues to decrease, mirroring global trends (Boyle et al. 1997; Buffett et al. 2011; Mitsch and Gosselink 2007: 48-49). However, there still remain a few regional wetland systems with healthy ecological communities, including the Pitt Polder wetlands (Ward 1992 [1989]: 9, 13).

[5] This is the date of the first European settlement in the Fraser lowlands, near Fort Langley (Boyle et al 1997: 186).

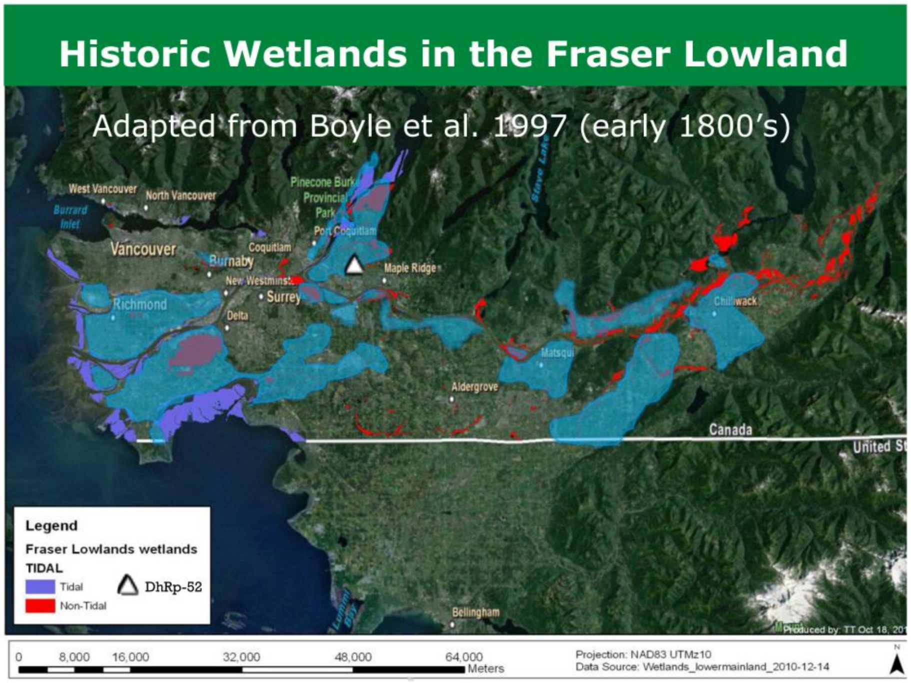

Fig. 3a

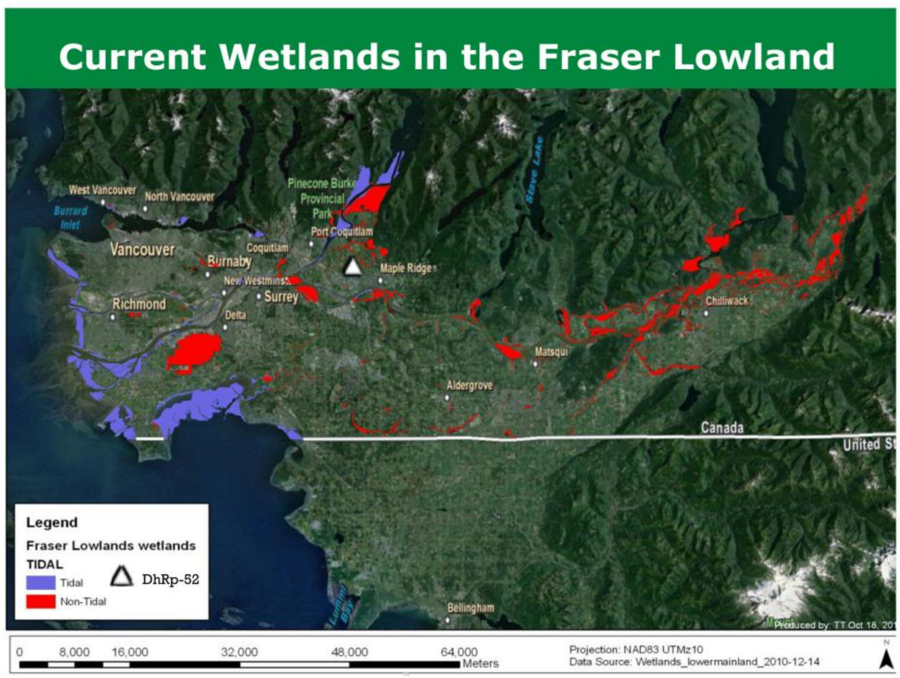

Fig. 3b

Figure 3: (3a) Estimated Fraser lowlands wetland distribution in early 1800s; (3b) Estimated Fraser lowlands wetland distribution, 2010. Adapted from Ducks Unlimited, with permission. Metadata from Major et al. 2011.

The Pitt Polder Wetlands

The Pitt Polder, also called the Pitt Lowlands, lies a few meters above sea level at the approximate midway point of the lower Fraser River (Fig. 4). *Polder* is an imported Dutch term meaning an area of low land reclaimed from the sea (Merriam-Webster Inc. 1997: 566). The Pitt Polder today holds some of the few regional wetland areas left in the lower Fraser Valley, particularly tidal freshwater marshes, fens, and peat bogs (Ward 1992 [1989]: 11, 13-14). After Burns Bog, the Pitt Polder has the second largest area of peat bogs in the region and it has over 70% of regional fens (Ward 1992 [1989]: Appendix D).

The polder was created approximately 4700 BP as a result of delta formation (Clague et al. 1991: 1392; Driver 1998b: 20). While its formation history is not well understood, it appears that at the start of the post-glacial deltaic shift the area was part of a large estuary near a marine bay (Diaz and Hoffmann 2010: 43). Delta sedimentation slowly moved the marine shoreline westward (Fig. 2). As relative sea levels reached present-day conditions by approximately 5000 BP and river sediment built up over time, dry land emerged just a few metres above sea level and formed the polder (Diaz and Hoffmann2010: 44; Driver 1998b: 20).

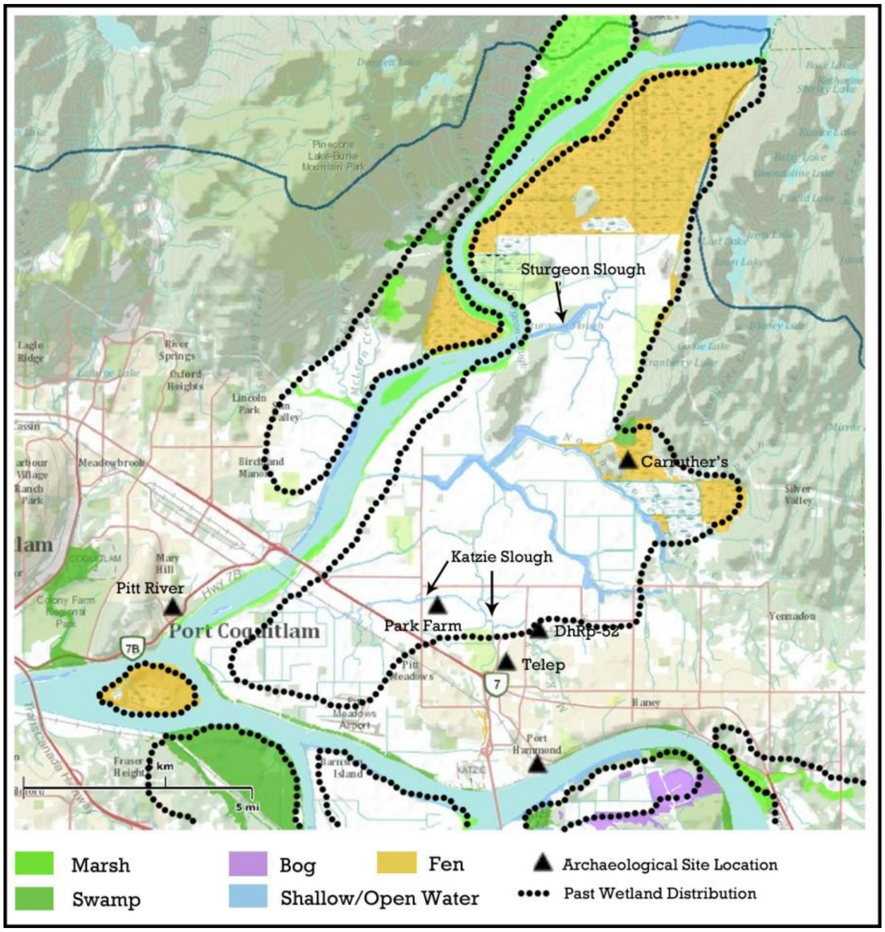

Figure 4: Pitt Polder with past and current wetland distribution, and locations of archaeological sites mentioned in text (Canadian Wetlands Inventory database, Ducks Unlimited Canada. Based on 1989 inventory metadata).

In precontact times, the Pitt Polder was an extensive wetland environment flooded annually by the Fraser River, with interconnected sloughs, streams, and rivers, and occasional patches of dry land and hillocks (Diaz and Hoffmann 2010: 46; Spurgeon 2001: 19). Most of the polder was a seasonally inundated marsh (Driver 1998b: 22). Prior to diking by European settlers in the 1890s, the area was influenced by the tides, the level of the Fraser and Pitt Rivers, and the Alouette River’s discharge (Driver 1998b: 12-14). Today, there are still daily water level fluctuations and when tides are high, tidal waters can back up the Fraser and Pitt Rivers and reverse flow into Pitt Lake (Driver 1998b: 20; Spurgeon 2001: 19).

Since the 1880s, the Pitt Polder wetlands have been significantly altered by European settlers for agriculture, including drainage, diking, infilling, and land levelling (Driver 1998b: 23; Ward 1992 [1989]). Drainage and diking have had a particularly significant effect by drying land and limiting flooding, which has impacted wetland communities and species distribution (Driver 1998b: 23; Spurgeon 1998: 78, 2001: 69-70). Although some sloughs remain, including the Katzie and Sturgeon sloughs (Fig. 4), it is difficult to determine the polder's original slough system through historic records or field observation (Driver 1998b: 12).

Based on the sources reviewed above, it is evident that wetlands were significant elements of the Fraser watershed, and that the Pitt Polder remains one of the few wetland-rich areas in the watershed today.

Archaeology of the Lower Fraser Valley

The Northwest Coast is anthropologically divided into three parts: the North, Central, and South regions[6], with regional cultural sub-areas (Ames 1994: 209, 2003: 19; Matson and Coupland 1995: 39). The lower Fraser Valley falls within the Gulf of Georgia cultural sub-area of the Central coast, with the following culture phase

[6] Some scholars make further subdivisions (e.g., Deur 1999: 131) or exclude the southernmost coast (e.g., Mitchell and Donald 1988: 294).

chronology: Old Cordilleran (9000-4500 BP); St. Mungo (4500–3500/3300 BP); Locarno Beach (3500/3200–2400 BP); Marpole (2400-1500/1100 BP); and Gulf of Georgia (1500 BP-contact).[7] There are some identified wet sites in the region, from which rare perishables (e.g., basketry; wood artifacts) have been recovered (Bernick 2013: 71; Menotti 2012: 88-91). However, there are few identified wetland sites per se and survey bias appears to favour dry land.

Archaeological Sites of the Pitt Polder

The archaeology of the Pitt Polder is not well known. While more than 50 sites are recorded in the polder, few have been excavated and those often as salvage archaeology (BC Archaeology Branch, RAAD 2012; Spurgeon 2001: 43-44). Apart from early 20th-century work by Harlan Smith, there have been no major village excavations (Driver and Spurgeon 1998b: 92). The polder, the Alouette drainage, and the mountains of Katzie territory have not been extensively surveyed (Driver and Spurgeon 1998b: 92). Known site distributions are concentrated north of Sturgeon Slough, but this may be influenced by survey bias (BC Archaeology Branch, RAAD 2012; Driver and Spurgeon 1998b: 92). It is very likely that more sites exist within the Pitt Polder.

[7] For further information, refer to Ames and Maschner 1999, Matson and Coupland 1995.

Recorded sites include lithic scatters, mounds, middens, settlement sites, resource collection sites, historic sites, and burial grounds (BC Archaeology Branch, RAAD 2012). Apart from DhRp-52, I draw archaeological knowledge about wetland resource use in the Pitt Polder from five sites (described below) that suggest use of the wetlands and associated sloughs (Fig. 4): Carruther's (DhRp-11), Port Hammond (DhRp-17), Telep (DhRp-35), and Park Farm (DhRq-22). While not within the polder, I also include the nearby Pitt River site (DhRl-21) because (a) it is located within Katzie territory close to the Pitt Polder, (b) it contains wetland contexts, and (c) site investigation produced potential evidence for wetland resource use.

The Carruther's Site (DhRp-11)

This site is located near the confluence of the North and South Alouette Rivers and contains seven large earthen mounds in a crescent across over approximately .8 hectares (Crowe-Swords 1974: 14). Several sloughs formerly ran through the area and are now filled in; one slough forms the site's southern boundary. David B. Crowe-Swords (1974: 15, 146) suggested that, prior to agricultural activity, the mounds were surrounded by low marshy lands. He interpreted these mounds as natural features with some cultural association between them (Crowe-Swords 1974: 40). In 1973, Crowe-Swords directed excavations at the site, with the objectives of: 1) describing and analyzing archaeological materials for Katzie territory that, until that point, were primarily known from surface collections; 2) comparing ethnographic and archaeological data for the Katzie; and 3) determining if coast and interior relationships could be detected in material culture at the site (Crowe-Swords 1974: 148-149).

The large artifact assemblage recovered was attributed to the late Marpole period (1600-1200 BP). The assemblage included flaked and ground stone, bone projectile points, knives, abraders, pendants, beads, and sharpened wood stakes along with postholes, stake holes, and hearths (Crowe-Swords 1974: 44-147). In addition, several clay-lined pits were found in two mounds with associated stake moulds (Crowe-Swords: 46-47; 50). No charcoal, ash, paleobotanical, or faunal remains were recovered from pit contents. Four of the clay-lined pits were found in direct association with a hearth. Crowe-Swords (1974: 54) suggested the clay-lined pits were used for processing wapato by steaming, with the small post moulds along the rims inferred to be the remnants of a small structure to retain steam.

The archaeological results corroborated some ethnographic information such as seasonal movement and woodworking technology, but linking artifacts or features to wapato processing proved more difficult (Crowe-Swords 1974: 149-153). Crowe-Swords (1974: 155, 158-159) concluded from lithic and feature analysis that the site was primarily used for plant gathering/processing and fishing, and speculated that the location may have been especially linked to wapato. He further suggested that the mounds provided high dry ground to camp on and from which to access the nearby wetland areas (1974: 146). The site and surrounding areas, including nearby former sloughs, were disturbed in historic and modern times by agriculture and land reclamation (Crowe-Swords 1974: 14).

Port Hammond Site (DhRp-17)

The Port Hammond site is located in the polder's south side, on the Fraser River's north bank. It is one of the earliest systematically excavated archaeological sites in the lower Fraser Valley, investigated by Charles Hill-Tout and Harlan Smith in the 1890s (Rousseau et al. 2003: 87; Smith 1903). More recent investigations by Michael Rousseau and colleagues produced a similar artifact assemblage to the earlier excavations, including bifaces, ground stone points, drills, mauls, stone bowls, and celts (Rousseau et al. 2003: 91-100).

A large faunal assemblage was recovered, representing a diversity of mammal (land and marine), bird, fish, and shellfish taxa (Rousseau et al. 2003: 100-102). The only slough-associated faunal taxa recovered was sturgeon (*Acipenser* sp.) (NISP=54; MNI=1), although the fish can be caught in the open river as well (McPhail and Carveth 1993: 35; Wooding 1997: 211-214). Flotation samples from hearth, column, and possible houses produced 67 seeds (charred and uncharred), including sedge (*Carex*), goosefoot (*Chenopodium*), strawberry (*Fragaria*), Raspberry (*Rubus* sp.), elderberry (*Sambucus*), bulrush (*Scirpus*), and possibly spike-rush (*Eleocharis*) and knotweed (*Polygonum*) (Rousseau et al. 2003: 104-105). However, the hearth sample only produced a single charred elderberry seed (Antiquus 2001: 50, 84-86). With the exception of strawberry, the recovered species are common in local wetlands.

While compact clay matrices were observed, no clay-lined pits were recorded at the site. Five radiocarbon dates for Port Hammond ranged from about 2000 to 1500 years BP, which falls within the Marpole Period (2400-1500/1200 BP) (Rousseau et al. 2003: 107). The site has been interpreted as a large, permanent shell midden and village site where diverse resource hunting/gathering and processing, woodworking, and other manufacturing activities took place (Rousseau et al. 2003: 103-104, 107-108).

The Telep Site (DhRp-35)

The Telep site is located near the centre of the polder approximately 1.5 km from DhRp-52, between two small sloughs just east of Katzie Slough. It was excavated in 1981 by William Peacock. The artifact assemblage consisted of debitage and 43 formed tools, including bifaces, flake tools, wedges, a celt, a sandstone saw, an abrader, and bipolar tools (Peacock 1982: 109-142). Residue analysis of 30 flake tools indicated that 10 were used on plants and animals, possibly including cooked meat (Peacock 1982: 139-140 and Appendix 2: 40). A single *Rubus* sp. seed was recovered from a hearth pit feature, although the possible use of other wetland resources by site inhabitants is discussed (Peacock 1982: 153). Based on three radiocarbon dates ranging from 3180+/-340 BP to 2940+/-800 BP, Peacock (1982: 8-9) interpreted Telep as a Locarno Beach phase (3500-2400 BP) late autumn salmon fishing and duck hunting camp site. The site was investigated again in 2000, 2003, and 2005, yielding additional lithic tools, cores, and debitage, an anvil stone, and wood and bone artifacts—all attributed to the Locarno

Beach phase (Rousseau and Hewitt 2006: 1, 15-16). The perishable artifacts were preserved in the compact clay deposits in which they were found (Rousseau and Hewitt 2006: 18). While compact clay matrices were common at Telep, no clay-lined pits were recorded. Rousseau and Hewitt (2006) generally agreed with Peacock's (1982) interpretation.

The Park Farm Site (DhRq-22)

The Park Farm Site is located in the centre of the polder, along a low-lying ridge in the Pitt Highlands. Terry Spurgeon excavated the site in 1984 and recovered stone beads, projectile points, scrapers, abraders, cobble tools, hammerstones, knives, cores, and flakes (Spurgeon 1984: 23-26). He tentatively assigned the site to the St. Mungo (4500-3500/3300 BP), Locarno Beach (3500/3200-2400 BP), and Marpole (2400-1500/1100 BP) phases based on comparative artifact analyses and a radiocarbon date of 4179+/-120 BP for a charcoal sample from a hearth feature immediately above the culturally sterile base (Spurgeon 1984: 21, 29). More recent excavations at Park Farm produced radiocarbon dates, a lithic assemblage, and features associated with St. Mungo period occupation, along with human remains[8] (Kristensen et al. 2009).

[8] A fragment of human cranium was conclusively identified, and five other possible human bone fragments were found; all were calcined, possibly indicating cremation, and found in three locations along an east-west axis approximately 40-50 m apart (Kristensen et al. 2009: 192).

Faunal analysis identified diverse mammals, birds, and fish, while archaeobotanical analysis of 47 samples from hearths, clay-lined pits, and other features produced 26 plant species, including those with known food, medicinal, and technological uses (Kristensen et al. 2009: v, 199-201). Identified taxa associated with wetlands, sloughs, or moist soils included sturgeon, northern pikeminnow (*Ptychoeilus oregonensis*), three-spine stickleback (*Gasterosteus aculeatus*), duck, grebe, salmonberry (*Rubus spectabilis*), red elderberry (*Sambucus racemosa*), Oregon grape (*Mahonia nervosa*), sedges, knotweeds, and mosses (Kristensen et al. 2009: 201).

Six clay-lined pits were identified at Park Farm (Kristensen et al. 2009: 95-100). A cluster of small post moulds are associated with one or two clay-lined pits, and most pits contained fire-altered rock (FAR), charcoal, and bone flecks. Three pits were sampled but produced little to no faunal remains; one pit produced red elderberry, bracken ferns (*Pteridium aquilinum)*, licorice ferns (*Polypodium glycyrrhiza*), horsetails (*Equisetum* sp.), and mosses (Kristensen et al. 2009: 208). The clay-lined pits were interpreted as plant and clam processing and/or steaming pits, and the ferns, horsetail, and mosses as a possible bed for steaming. In addition, large numbers of boiling stones were found on-site, including clusters located within pit features possibly used as boiling or baking pits (Kristensen et al. 2009: 101). Based on the artifacts, features, faunal and floral remains and other variables, the site is now interpreted as a spring-to-fall base camp associated with broad-spectrum resource use (Kristensen et al. 2009: 215-217).

Pitt River Site (DhR1-21)

Although not located within the Pitt Polder, this site is near the confluence of the Pitt and Fraser Rivers, with sloughs surrounding the site area (Patenaude 1985a: 26). The site was excavated from 1978 to 1980 by Valerie Patenaude and colleagues (Patenaude 1985a, 1985b), who recovered evidence for wetland resource gathering, processing, and use.

The artifact assemblage includes projectile points, pebble and cobble tools, knives, scrapers, cores, abraders, stone beads, microflakes of quartz crystal and obsidian, and wooden artifacts[9] (Patenaude 1985a: 114-332). Radiocarbon dates suggest site use from approximately 4400 to 200 BP (Patenaude 1985a: 14-16), placing the site within the St. Mungo, Locarno, and Gulf of Georgia (1500/1200–250 BP) phases. Faunal analysis identified fish, shellfish, birds, and mammals (e.g, salmon [*Oncorhynchus* sp.], bay mussel [*Mytilus edulis*], swan [*Olor* sp.], and wapiti [*Cervus elaphus*]), while archaeobotanical taxa were identified as hemlock, horsetail stems, Indian plum (*Osmaronia cerasiformis*), bitter cherry (*Prunus emarginata*), wild crabapple (*Malus fusca*), and morning glory (*Convolvulus* sp.) (Patenaude 1985a: 354-360). Identified taxa associated with wetlands, sloughs, and moist soils include sturgeon, grebe, swan, duck, bitter cherry, crabapple, and horsetails.

[9] Dated to ca. 2900 BP, they included basketry, worked wood, a perforated stick, and a sharpened stake (Bernick 1981).

Seven earth oven features were excavated and their contents analyzed, with charred deerberry (*Maianthemum dilatatum*) seeds recovered from some features (Patenaude 1985a: 135-142). Seven clay-lined pit features were also found, with rocks pressed into the rim, post holes associated with three pits, and no signs of fire (Patenaude 1985b: 10). The features are interpreted as most likely being steaming pits, perhaps for wapato, based on the site's location near contemporary wetland areas that could have supported wapato (Patenaude 1985b: 13). The Pitt River site was interpreted as a late summer/early fall processing camp for salmon, wapato, berries, and migratory birds and also as a mid-spring camp for eulachon and sturgeon fishing (Patenaude 1985b: 289).

Bridging the Past and Present

In examining past hunter-gatherer interactions with their environment, it is worthwhile to compare the archaeological record with ethnographic records and identify the ways in which they agree or differ. In this section, I first introduce the Katzie First Nation, their traditional territory, and known resource-use patterns as described in the ethnographic and historic records. This ethnographic information is then compared with the archaeological record presented in the previous section. Based on this comparison, I identify and discuss some differences between ethnographic information and the archaeological record.

Traditional Katzie Lifeways

Katzie means "moss" or "people of the moss" in Downriver Halkomelem (Duff 1952: 27). The Katzie today live along the banks of the Fraser and Pitt Rivers, Pitt Lake, the Pitt Polder, and the lower reaches of the Alouette River (Driver 1998a: 5). Their traditional territory (Fig. 1) also includes hills to the east toward Alouette Lake, and the mountain slopes west of Pitt River and surrounding Pitt Lake (Suttles 1955: 15).

The Katzie are downriver Halkomelem (Hun'qumyi'num) speakers of the Central Coast Salish. They traditionally used a broad range of resources from wetland, riverine, forestland, meadow, and alpine ecosystems within their territories. Their annual calendar or seasonal round counted ten months and two supernumerary months, the year starting in August (James 1998: 35; Jenness 1955: 7). Table 1 presents the seasonal round of the primary resources exploited by the Katzie, sourced from ethnographic records.

Katzie resources included anadromous salmon, trout (*Onchoryncthus* sp.), and eulachon *(Thaleichthys pacificus*) spawning runs in the Fraser river and its tributaries; such land animals as deer and elk, mountain goat, bear, beaver, and otter; and plant resources including redcedar, various berries, and other plants used for food, technology, and medicine (James 1998: 35-44; Spurgeon 2001: 19-20; Suttles 1955: 21-27).

Wetland resources were used every month of the year (Table 1), and included many waterfowl (e.g., ducks and swans), fish (e.g., sturgeon), and plants (e.g., cat-tail [*Typha latifolia*] and other rushes for weaving) (Jenness 1955: 7-8; Suttles 1955: 21, 26-27). The Katzie were particularly renowned for their wapato and bog cranberry

(*Vaccinium oxycoccos*) patches (Suttles 1955: 26; Spurgeon 2001: 32). While individual families and tribes had ownership of specific wapato and cranberry patches, outside groups could gain access to these resources through trade, gifts or sometimes simply by acknowledging the ownership and requesting permission (Suttles 1955: 26-27).

Within the larger landscape, the polder wetlands were valued areas known to the Katzie and other peoples. For instance, summer and winter villages were located near or on wetland areas (Suttles 1955: 17-20). The creation of the polder and sloughs are recounted in origin stories (Jenness 1955: 12-13). In recording place-names in Katzie territory, Suttles (1955:17) observed that important features include "berry bogs,"[10] wapato marshes, and the sloughs used as "shortcuts" in crossing the flats (Schaepe 1991: 60; Jenness 1955: 12-13). The sloughs were also valued as sturgeon fishing locations, including the aptly named Sturgeon Slough (Fig. 4; James 1998: 37; Suttles 1955: 21). The sloughs also provided safe, sheltered trade routes for goods, which was especially useful because the wetlands were not only resource-rich but a lucrative trading hub (Patenaude 1981: 18; Suttles 1955: 17).

[10] This most likely refers to cranberry bogs (James 1998: 41).

Table 1: Katzie Traditional Seasonal Round.

Species	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Chum Salmon	■	■	■					■	■	■		
Coho Salmon										■		
Pink Salmon										■		
Sockeye Salmon							■	■	■			
Chinook Salmon					■	■	■					
Trout			■			■						
Steelhead	■	■	■	■						■		
Sturgeon	■	■	■			■		■	■		■	■
Eulachon				■								
Waterfowl					■						■	■
Land mammals	■	■	■			■				■	■	■
Berry plants			■	■		■	■	■	■	■		
Wapato	■	■							■	■	■	■
Crabapples									■	■		
Rushes						■	■					
Fuelwood	■	■	■	■	■	■	■	■	■	■	■	■

Key: Shaded cells indicate the months in which particular resources are traditionally gathered.
Sources: James 1998; Jenness 1955; Spurgeon 2001; Suttles 1955

The Katzie's location proved particularly advantageous for trade among Coast Salish both because they were well situated in between the more coastal groups and those further upriver, and had wetland resources in their territory that other neighbouring groups did not. People from neighbouring Coast Salish territories would congregate at Katzie wetlands during and after fishing season to procure such important resources as wapato, bog cranberries, crabapples, and sphagnum moss (*Sphagnum* sp.) from the Katzie (Duff 1952: 73; James 1998: 34; MacLachlan 1998: 40; Suttles 1955: 26-27). In addition to wetland resources, the Katzie also traded woven mountain goat wool blankets (Suttles 1955: 25). Hunted in the mountains of northern Katzie territory, the mountain goat was a cherished resource with important spiritual significance for the Katzie (James 1998: 43). In exchange for Katzie resources, coastal groups sometimes traded or gifted salt-water clams and mussels, while Interior and Upriver Sto:lo traded items such as dried Saskatoon berries (*Amelanchier alnifolia*) and lithic material not found in the lower Fraser Valley (Spurgeon 2001: 35; Suttles 1955: 27; Turner and Loewen 1998: 52-55).

The ethnographic information and Katzie traditional knowledge presented here indicate that the Pitt Polder wetlands and sloughs have long been a focal point of the Katzie seasonal round, trade, landscape naming, and oral traditions. They also demonstrate that high cultural value has been (and continues to be) placed upon the Pitt Polder wetlands.

Bridging the Gap Between Ethnography and Archaeology

The Pitt Polder's archaeological record appears to echo Katzie ethnography in terms of broad-spectrum resource use from wetlands and other ecozones, as well as trade in obsidian and other materials. Although a full settlement pattern analysis of the Pitt Polder has yet to be done, known sites tend to be associated with small streams, bogs, sloughs, and the main rivers, survey biases notwithstanding (Peacock 1982: 34). Some sites are located along the few highland ridges in the polder or on natural mounds between watercourses, safe from floods but near water and wetlands. However, some gaps remain between the archaeology and ethnography of the Pitt Polder region.

Because a large percentage of prehistoric wetlands have been destroyed, it is difficult to recreate ancient settlement patterns *vis a vis* wetland landscape use. There is also a notable scarcity of identified wetland sites, compounded by lack of distinction between wet and wetland sites in the literature. The sites highlighted in the previous section are rare exceptions, particularly the Carruther's and Pitt River sites, where site investigators discussed site use, identified wetland resources, and any probable associated features (e.g., clay-lined pits) in the context of adjacent wetlands.

In addition, there is as yet no clear and direct archaeological evidence in the region for the wetland plants wapato and cranberries. There is also a lack of archaeological data on fuelwood selection and use, including the use of wetland-associated trees; little charcoal analyses has been done in the lower Fraser Valley to date (e.g., Lepofsky and Lyons 2003 for Scowlitz site; Ormerod 2002 for Xay:tem).

The recovery of such archaeological evidence would demonstrate that the ethnographically documented use of these plant, animal, and fuelwood resources extended into the distant past. It may also indicate the use of resources not mentioned in ethnographic records. In-depth feature analysis is useful to this endeavour, but the approach is not often used in lower Fraser Valley excavations, particularly for focused study of resource use patterns (e.g., Ormerod 2002), which is discussed in Chapter 3. My research objectives can address these archaeological gaps through the analysis of floral and faunal remains from hearth and processing feature contexts, and through using multiple lines of evidence to evaluate different datasets and shed light on wetland resource use at a wetland-margin site.

Summary

Wetlands have considerable value to archaeology and should be considered an important part of the ecological landscape used by hunter-gatherers. In precontact times, wetlands were significant elements of the lower Fraser Valley and the Pitt Polder remains one of the few regional wetland-rich areas today. The Pitt Polder wetlands have long been a focal point of the Katzie First Nation's seasonal round, trade, landscape naming, and oral traditions based on both ethnographic information and traditional knowledge. The presence of archaeological sites within or near the Pitt Polder (e.g., Carruther's, Port Hammond, Telep, Park Farm, and the Pitt River site) suggest long-term and short-term use of the wetlands and associated sloughs. Archaeological feature analysis of archaeological sites provides a means to link ethnographic information with the archaeological record to explore the nature of hunter-gatherer use of wetland resources in this region.

Chapter 2: DhRp-52 Excavation and Summary Results

DhRp-52 is located near the confluence of the Fraser and Pitt Rivers, in the centre of the Pitt Polder within the present-day city of Pitt Meadows (Fig. 1). It was a habitation site situated on a knoll adjacent to wetlands, and used with increasing intensity over a 2,500-year span (Hoffmann et al. 2010a: 204). The site has both dry and wet components and generated considerable interest because of its large, diverse artifact assemblage, which includes rare perishable wooden artifacts, the recovery of archaeologically associated wapato, and possible evidence for cultivation of wapato (Hoffmann and Huddlestan 2010: 225-228; KDC 2010: iv-vi). A total of 991 features were identified, including inferred house structures, clay-lined pits, and activity complexes of post moulds, hearths, and possible processing features.

In this chapter, I describe DhRp-52, present a brief history of the excavation of the site, and summarize reported findings, site assemblages, and features that pertain to the analyses within this thesis.

History of Site Investigation

DhRp-52 was first recorded in 2003 during an Archaeological Impact Assessment (AIA) of the Golden Ears Bridge project and related road development, and subsequent excavations were conducted by the Katzie Development Corporation-Archaeology

(KDC) from May 2007 through March 2008 (KDC 2010: iv, 1)[11]. Excavations focused on site areas directly impacted by planned development, with approximately 11% of the tested (KDC 2010: iv). Assemblage cataloguing and site analyses continued for several years after excavation, and the Final Report was submitted to the British Columbia Archaeology Branch in October 2010 (KDC 2010).

Known site boundaries (Fig. 5) encompass an area approximately 184 m (N-S) by 423 m (E-W) and KDC suggests that the archaeological site extends into surrounding properties, although the exact size is unknown (Hoffmann et al. 2010b: 6). Archaeological investigation concentrated on the proposed Abernathy Connector right-of-way, specifically on an area comprising a small knoll (approximately 4.5 m above sea level) and surrounding grass fields (Fig. 5). Originally, the area was a waterlogged peat bog with the knoll rising above the bog as a small highland (Diaz and Hoffmann 2010: 38). The grass fields formed part of a farm for the past 75 years or more (Hoffmann et al. 2010b: 6). Before excavation, a barn and an outbuilding's cement foundation existed at the top of the knoll. A tributary of McKenny creek flowed near the knoll's western edge, although its course was altered in historic times.

[11] *Heritage Conservation Act*, Section 14 Site Investigation Permit 2007-097

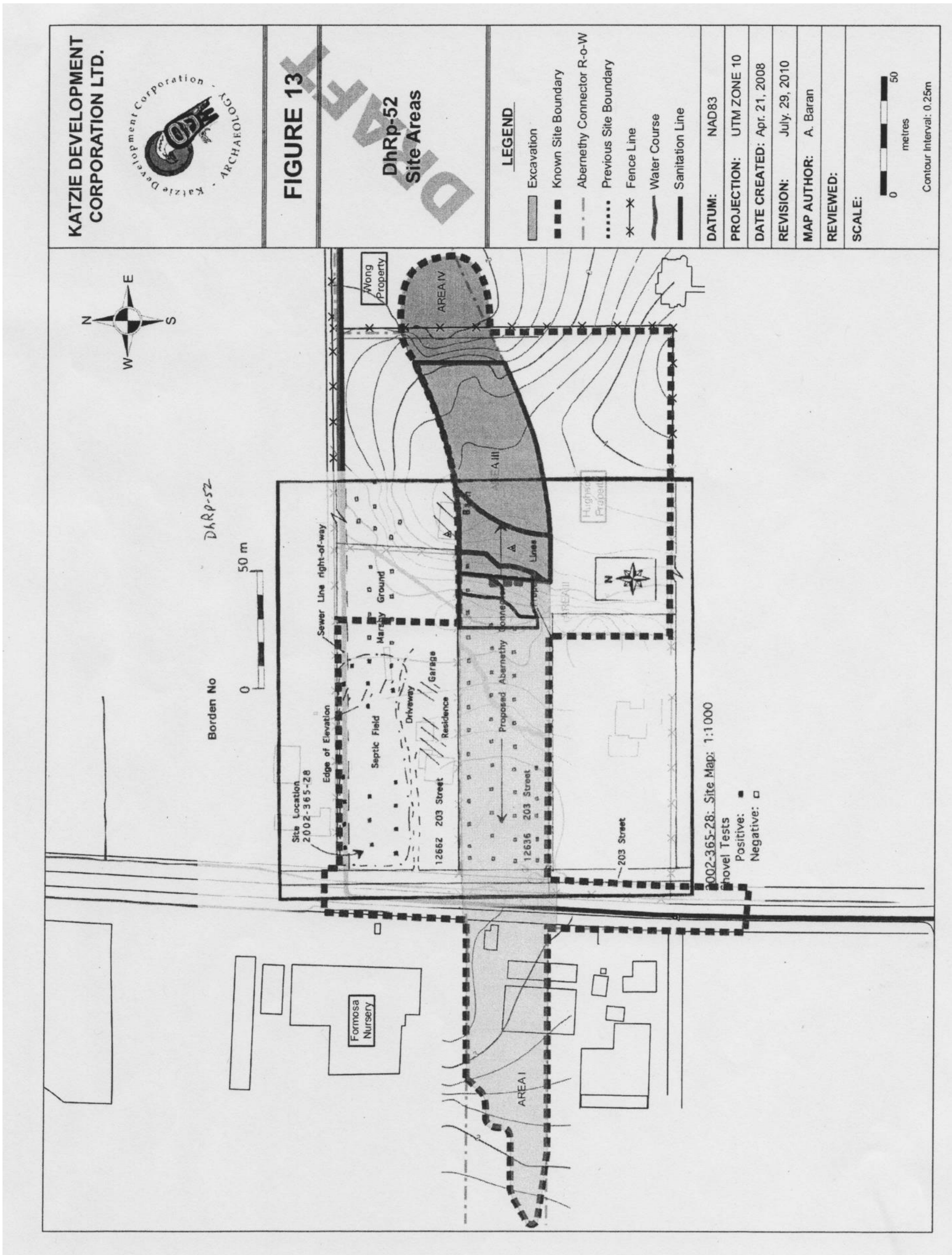

Figure 5: Known DhRp-52 Boundaries and Site Areas (KDC 2010).

Testing and Excavation Methods

Exploratory shovel tests of the site area were completed in May 2007, confirming the presence of cultural deposits. To reflect differences in surface topography and deposit characteristics, the site was divided into four site areas (Areas I–IV; Fig. 5, Table 2), with further subdivisions into numbered $2m^2$ units within each area in order to denote feature or artifact distributions (Hoffmann et al. 2010c: 56). KDC also divided Areas II and III into site zones (Table 3; Fig. 6) to identify known and inferred structural features and associated non-structural locations (KDC 2010; Wilkerson 2010a: 6, 18-20).

Table 2: DhRp-52 Site Areas.

Area	Location	Description	Trenches	Cultural Contexts
I	From western site boundary approx 230 m east to McKenney Creek tributary.	West half contained upland deposits, while in east half, sediments transitioned from dry to low-lying water-saturated deposits	7–9	Water-saturated deposits with perishable artifacts and botanical remains.
II	From east boundary of Area I for approx. 35 m to knoll's hillside edge.	Water-saturated riparian zone along east side of the creek tributary. Eastern edge transitioned into dry-upland sediments of Area III.	4; 11–15	Water-saturated deposits with perishable artifacts and botanical remains; hillside midden area.
III	From east boundary of Area II for approx. 100 m east to toe of slope at knoll's eastern end.	Includes bank and top of knoll and surrounding grassy field. Dry upland sediments that run parallel to eastern bank of McKenney Creek tributary.	1–6	Edge of hillside midden; structural area including lithic artifact concentrations, many features, possible habitation structures, activity areas; FAR pit area containing high densities of FAR.
IV	From east boundary of Area III approx. 50 m east to easternmost site boundary.	None given aside from location.	16	Cultural soil overlain by peat deposits with wapato. Some FAR and perishable artifacts recorded.
Source of information: Hoffmann et al. 2010c: 56-63, 66; Diaz and Connaughton 2010: 104.				

Table 3: DhRp-52 Cultural Components and Site Zones.

Matrix Type	Cultural Component	Site Zone	C^{14} Dates	Description*
Wet Site	Late Component?	Wet Site Zone (WSZ)	~4900–3200 cal BP	Includes entire "wet" portion of site, including peat deposits. Unclear associations with the knoll.
Loam	Late Component (4100-3200 cal BP)	Loam Non-Structural Zone (LNSZ)	3700–3600 cal BP	Light yellow loam deposit. ~ upper 80 cm of knoll deposits except where it drops off downslope. Contains all loam units that do not fall within the other loam zones.
		Loam Structural Zone (LSZ)	~3500 cal BP	Contains 54 units assoc. with structural features in Loam.
		FAR Pit (Feature Zh-q)	~3800–3600 cal BP	Large clay-lined and V-shaped pit containing >12 tonnes of FAR, located in Trench 2.
		Midden Zone (MZ)	~3700 cal BP	Links WSZ to drier knoll, downslope from upper LS and LNSZ. Deposits are yellow loam. Inferred midden due to location and recovered material (e.g., debitage).
Sand	Middle Component (5300-4250 cal BP)	Sand Non-Structural Zone (SNSZ)	~ 5200 cal BP	All non-structural sand deposits contemporaneous but outside of SSZ features. Reddish-yellow sand; ~80-120 cm below surface.
		Sand Structural Zone (SSZ)	~ 5200–5000 cal BP	All sand deposit units assoc. w/ structural features. Dark-grey sand densely packed w/FAR in places, often greasy.
Sub-Structural Sand	Early Component (5700-5300 cal BP)	Sand Sub-Structural Zone (SSSZ)	~ 5200–5000 cal BP	Non-structural reddish-yellow sand deposits below SSZ. ~120-180 cm below surface.

Key: ~ means date is approximate;
*Refer to Site Zone column for meanings of acronyms in Description column.

Information compiled from: KDC 2010; Wilkerson 2010

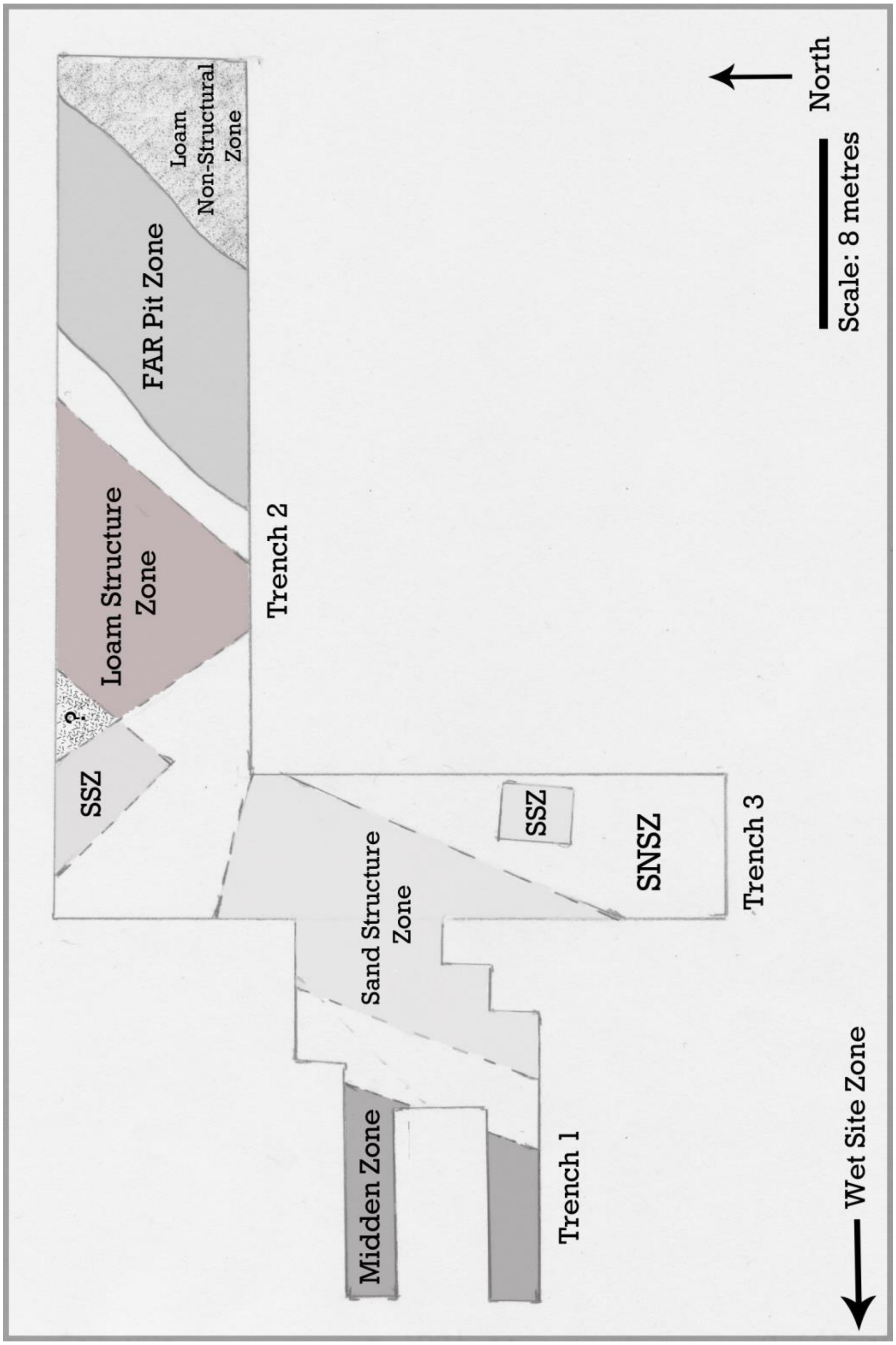

Figure 6: Area III Site Zones (after Wilkerson 2010a).

Based on shovel test results, further exploratory units were opened in each site area and used, along with judgmental sampling, to guide additional unit and trench placement (Hoffmann et al. 2010c: 58). The exploratory excavations revealed two distinct deposit types: 1) waterlogged deposits containing perishable artifacts and botanical remains (Area II, informally called the “wet site”); and 2) the knoll (Area III), an associated dryland area with deep, complex cultural deposits (informally called the “dry site”) (KDC 2010: 9; Fig. 5). A total of 15 trenches were opened. Overall, an estimated 11% of the site was excavated from May 2007 through March 2008 (Hoffmann et al. 2010a: 2, 6).[12] The site was extensively sampled, including wall profiles and features. Not all features were sampled but all feature types were included, particularly hearths and pit features.

Summary of Excavation Results

Radiocarbon results revealed a long occupation at DhRp-52, dating between 5700 cal BP to 3200 cal BP,[13] with a hiatus/absence of radiocarbon dates between ca. 4250 and 4090 cal BP. Given differences between recovered artifacts and those known from the local Gulf of Georgia cultural phases, site investigators proposed a culture chronology

[12] For further details on excavation procedures and methods, refer to KDC 2010.

[13] Based on radiocarbon dating of 109 charcoal samples (Connaughton and Diaz 2010: 78, 81-84).

spanning three cultural components (Table 3) called the Early (5700–5300 cal BP), Middle (5300–4250 cal BP), and Late (4100–3200 cal BP) components (Hoffmann et al. 2010a: 204). These three site-specific components were developed on the basis of (a) spatial analysis of feature distributions and variability, (b) analysis of the perishable artifact assemblage and associated peat sediments, (c) the site's depositional history and physical stratigraphy, (d) the archaeobotanical assemblage, and (e) 109 radiocarbon dates (Hoffmann et al. 2010a: 204). Within each cultural component, KDC identified discrete occupations by the associated cultural group (Hoffmann et al. 2010a: 204). I also use these components in my analyses.

The excavation recovered 165,639 artifacts, including lithics and perishable artifacts, and 6,980 macrobotanical remains (KDC 2010: iv). A total of 991 features were identified on-site, with descriptive and spatial analyses of 747 (75%).[14] In my feature analysis, I examine four of these features. In the following sections, I summarize the recovered assemblages, identified site features, and post-excavation analyses, with particular attention to information pertinent to this analysis; further details are provided in Appendices A and B.

[14] See Appendix B for details.

Artifact Assemblages

This section presents an overview of recovered artifact assemblages (Table 4), highlighting artifact classes of potential relevance to wetland resource extraction, processing and use.

Table 4: Artifact Assemblages.

Artifact Type	Amt.	Description
Lithics (N= 159,660)		
Tools	2,713	Adzes; pestles/hand mauls; mortar stones; grooved stones; abraders; hammer/anvil stones; points/bifaces; specialized chipped stones; scrapers; flake tools; spall tools; wedges; choppers; chipped slate tools; ground slate tools; misc. ground stone items
Cores/Debitage	61,715	**Cores:** Microblade cores; bipolar cores; general cores; **Debitage:** bifacial thinning flake; platform remnant bearing flake; flake shatter; block shatter; microblade
Disc Beads	91,649	Disc beads, primarily mud stone but a few are possibly slate.
Other Lithics	3,583	Status items; quartz crystals; boiling stones; boulder/slabs; unworked cryptocrystalline pebble; oblong stones; unmodified stones
Perishable Artifacts (N= 12,954)*		
Basketry	1	A possible piece of tumpline woven from western redcedar inner bark
Cordage	31	Wood (root or withe) or bark material twisted or braided into cords
Cordage waste	231	Apparent fragments of cordage strands broken on either end
Worked wood	212	Tool tip and shaft fragments, miscellaneous culturally modified wood, and possible stakes
Woodworking debris	12,249	Wood chips and chunks from woodworking activities
Worked bark	235	Curled, pounded or stripped bark; miscellaneous bark fragments (possible waste from bark processing)
*To avoid inflating tool numbers, cordage waste and woodworking debris are classified separately here. In KDC 2010, they are subsumed within the cordage and worked wood categories, respectively.		

Lithic Artifacts (N=159,660)

KDC staff examined recovered lithic artifacts, which were classified, interpreted, and reported by Emily Wilkerson (2010a; Homan et al. 2010: 147). Wilkerson analyzed 1,880 lithic tools but excluded tools from the first 50 cm of deposits because of such issues as problematic or missing data, artifact misclassification, and agricultural disturbance (Wilkerson 2010a: 12). A lithic typology was created based on observed traits and comparison to regional variants[15] (Wilkerson 2010a: 1). Lithic materials were divided into four major lithic classes: 1) lithic tools; 2) cores and debitage; 3) beads; and 4) "other lithics." Each class was further subdivided into grouped artifact classes and tool types (Table 4, Appendix A). No cobbles large enough for lithic tool manufacture (e.g., serving as cores) or for use in food processing technologies occur locally at DhRp-52, leading Wilkerson (2010a: 173) to conclude that all lithic material was imported to the site from elsewhere.

Lithic Tool Classes

The Area III lithic assemblage's diversity, in conjunction with identified features, suggests that this area was likely the focus of site activity (Homan et al. 2010: 153). The

[15] Particular attention was paid to similar lithic assemblages from the Glenrose Cannery (Matson 1976) and Crescent Beach sites (Matson and Coupland 1995).

midden zone and FAR Pit zone (Table 3) contained diverse lithic artifacts, but also abundant broken tools, suggesting possible refuse dumps (Homan et al. 2010: 153). Area II's Wet Site Zone also produced abundant flake tools, points/bifaces, and broken tools, which Homan et al. (2010: 153) suggested may be overflow from midden discards as well as evidence of possible plant harvesting and waterfowl hunting. Finally, Area 1's lithic assemblage (e.g, adzes, wedges) suggested that it was a specialized work area that possibly involved woodworking or plant processing (Homan et al. 2010: 153). For further information on lithic classes, refer to Appendix A.

Perishable Artifacts

Perishable artifacts (N=12,959) consist of basketry, cordage, worked wood, and worked bark. While well preserved, most were fragmentary (Homan et al. 2010: 154, 158). All were found in Middle and Late Component peat matrices, and 96% were recovered in Area II, the most heavily sampled of all waterlogged areas on-site (Homan et al. 2010: 154, 156; Homan and Leon 2010: 1).

Evidence of basketry consists of a piece of flat woven checker-plaited strap (DhRp-52:177) which is 380-mm long and 44-mm wide, and appears broken off at one end (Homan and Leon 2010: 8). The strap was identified as the inner bark of redcedar, and it was interpreted as a piece of tumpline, an item attached to both ends of carrying packs or baskets (Homan et al. 2010: 155; Homan and Leon 2010: 8). The artifact was found in the wapato patch directly on top of and within a submerged rock pavement feature (see Feature section; Homan and Leon 2010: 9, 157). It dates to the Late Component (ca. 4100 to 3200 cal BP).

Recovered cordage (N=31) includes twisted cordage rings, linear cordage of different braiding and twisting techniques, wood fibre knots, and cordage waste (Homan and Leon 2010: 11-19). The highest count of cordage artifacts (N=14) comes from peat deposits directly above, within, and below the rock pavement feature (Homan et al. 2010: 157). However, twisted cordage rings were primarily found in midden matrices (Homan and Leon 2010: 63). A 3-strand, braided bark, linear cordage artifact (DhRp-52:308), 130-mm in length, has been interpreted as a possible tumpline (Homan and Leon 2010: 14). Three cord knots of unknown function and cordage waste (N=231) were also recovered. The latter includes apparent fragments of cordage strands broken on either end, which appear related to basketry (Homan et al. 2010: 19).

Worked wood (N=212) includes tool tip and shaft fragments, 12 unidentified wood artifacts (described below), and possible stakes (Homan and Leon 2010: 20-47). Found in the wapato patch, the tool tip fragments appear to have been broken in use as many exhibited hinge-fracture break patterns (Homan and Leon 2010: 20, 23). Seventy percent are burned at the tip or on the entire fragment, likely a result of fire-hardening (Homan and Leon 2010: 21; Homan et al. 2010: 154). While the shaft fragments showed visible tool marks, their function is unknown (Homan and Leon 2010: 33). For information regarding woodworking debris and worked bark, refer to Appendix A.

Twelve unidentified wood artifacts were recovered and described by Homan and Leon (2010: 35-48; see Appendix A). Four have been tentatively identified as: a composite fishhook (DhRp-52:187) large enough for sturgeon fishing, an ear-spool (DhRp-52:237), a canoe bailer (DhRp-52: 164), and a labret (DhRp-52:15286). In addition, 10 possible stake fragments were found in association with each other in peat matrices (Homan and Leon 2010: 20); they are classified as a "wood stake grouping" feature (see Feature section, below).

Macrobotanical Remains

Uncharred macrobotanical remains from the peat (N=6,980) consisted of 3,767 wapato specimens and 3,213 shells of beaked hazelnut (*Corylus cornuta*) (Homan et al. 2010: 165). Wapato is known ethnographically and through oral tradition as an important food resource among Coast Salish people, especially the Katzie (Spurgeon 2001: 16). Its presence in DhRp-52 is the first confirmed case of archaeologically associated wapato found on the Northwest Coast (Hoffmann and Huddlestan 2010: 232). Wapato tubers were found in growth position within the peat and 80% of 204 examined tubers were largely circular in shape, implying a healthy growing environment (Homan et al. 2010: 166). The wapato tubers were therefore interpreted by KDC as the remains of a wapato patch, which occupies the majority of Area II (Fig. 7).

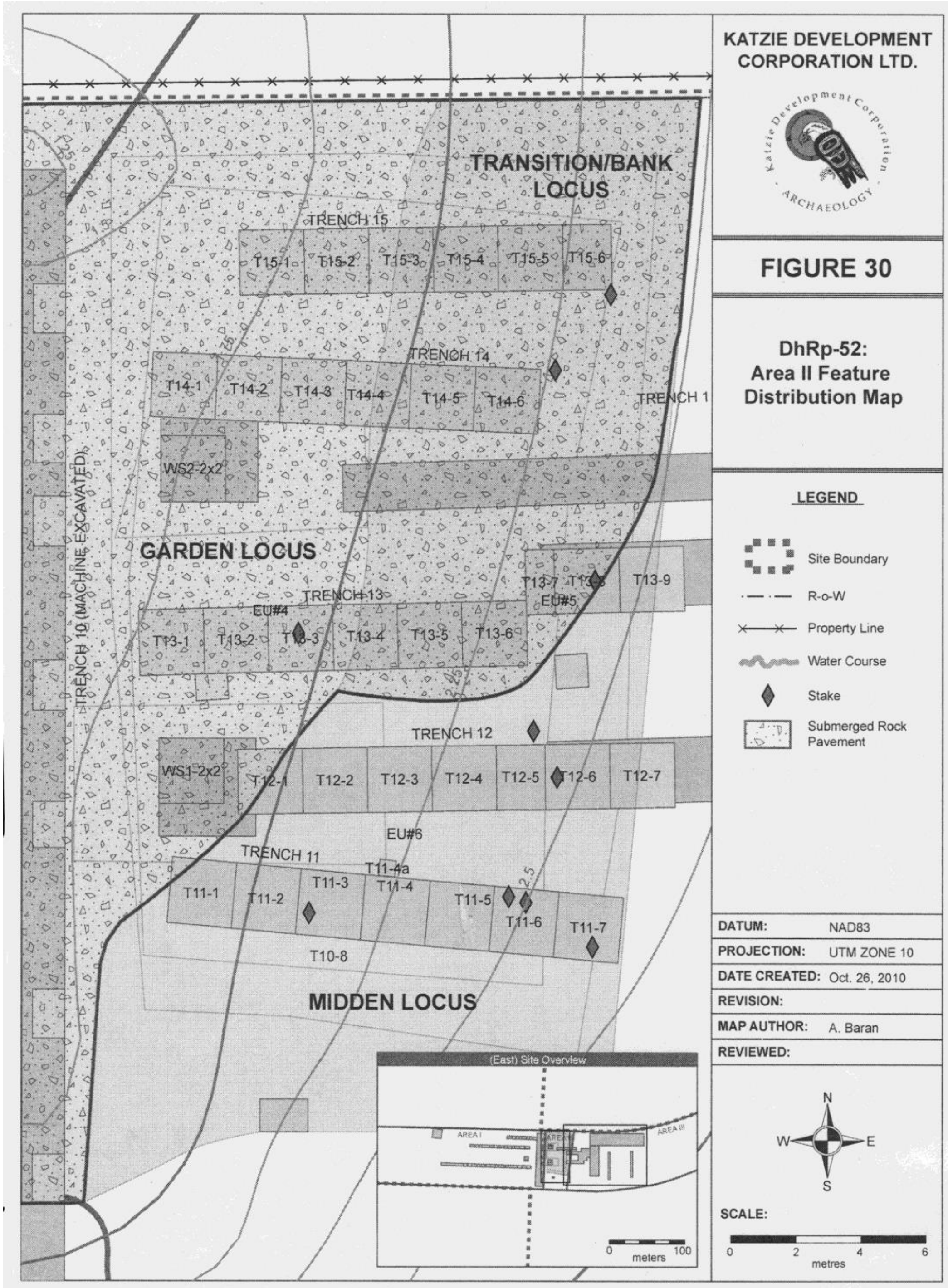

Figure 7: Area II Feature Distribution (KDC 2010).

The hazelnut remains are primarily fragmented pieces and were concentrated in the midden and transitional bank areas (Homan et al. 2010: 165-166). Homan et al. (2010: 165) suggest that humans may have collected and processed the hazelnut because the fragments resemble those of modern machine-cracked Dutch variety of hazelnut (*Corylus californica*) samples and have no visible marks to suggest gnawing or cracking by animals.

Post-excavation Analyses

In addition to KDC's analyses of recovered assemblages, KDC staff and other researchers analyzed archaeobotanical material, wooden artifacts, pollen, phytoliths, diatoms, and faunal remains. Their methods and results are briefly described below, with particular attention to potential evidence for the presence or use of wetland resources.

Archaeobotanical Analysis

An archaeobotanical analysis project was carried out by Dr. Natasha Lyons and research assistants at DhRp-52, where they processed 41 samples from Site Area III: 21 from four hearth features, one hearth-associated feature, and three possible processing pits, and 20 from four column samples (Lyons and Leon 2010; Appendix C). Their goals were (a) to determine if macroremains were present, (b) to explore ancient plant use at the site, and (c) to make recommendations for future archaeobotanical work at the site

(Lyons and Leon 2010). They studied charred seed specimens to understand ancient plant use (N=210).

The team's sediment samples were processed by manual flotation[16] using a .425 screen[17]. Dried light fractions were then passed through nested sieves of 2.00, 1.00, and .425-mm mesh, and a catch pan. They were sorted using a dissecting microscope (6X to 10X magnification) and macrobotanical remains were identified using standard procedures and comparative references (e.g., BC Eflora 2008; Friedman 1978; Pearsall 2010; USA Plant Database n.d.). Dana Lepofsky's comparative collection at Simon Fraser University's Department of Archaeology was also consulted.

Lyon's archaeobotanical assemblage included 210 charred seeds and 15 identified taxa (Table 5; Appendix C). Charcoal fragments were also recovered, but not analyzed. The diverse assemblage suggests broad-spectrum plant gathering, including wetland taxa and plants found in other ecosystems near the site (Lyons and Leon 2010: 25). Wetland-associated taxa were found in all sampled feature types.

[16] In some cases, these were treated with a deflocculant to help disperse soil and free macrobotanical remains.

[17] All information regarding KDC archaeobotanical procedures is drawn from Lyons and Leon 2010.

Table 5: Archaeobotanical remains recovered from sampled hearths, processing features, and columns at DhRp-52 (KDC 2010).

Taxon	Common name	Ecology**	Feature Type(s)***
Amaranthus sp.*	Amaranth	WL	P
Arctostaphylos uva-ursi	Kinnikinnick	DF	P
Carex sp.	Sedge	WL	P
Chenopodium sp.*	Chenopod	C/D	C, H, P
Cyperaceae*	Sedge family	WL	H, P
Galium sp.*	Bedstraw	WL/MF	C
Gaultheria shallon	Salal	MF	P
Mahonia sp.	Oregon grape	MF	H, P
Polygonum sp.	Knotweed/smartweed	WL	H, P
Portulaca sp.*	Purslane	C/MF/WL	P
Potentilla sp.*	Silverweed	C/WL	H
Rosa sp.	Wild rose	C/DF	P
Rubus sp.	Raspberry genus	MF	C, H, P
Sambucus racemosa	Red elderberry	MF	C, H, P
? Viola sp.	Violet	MF	C

*__Taxon key:__ An asterisk denotes the species is considered a weedy inclusion by KDC (2010: Appendix K), but is not separated out as such in this thesis.
**__Ecology Key:__ Clearings (C), Disturbed Soils (D), Dry Forest (DF), Moist Forest (MF), Wetlands (WL). Ecological contexts from Pojar and MacKinnon 2004, Pojar et al. 1991
***__Feature Types Key:__ Column (C), Hearth (H), Processing (P).
Source: KDC 2010

Cellular Analysis of Wood Artifacts

Kathleen Hawes (South Puget Sound Community College Archaeological Training Wet Site Laboratory) was commissioned for a cellular analysis of 17 wood artifact samples, in order to determine the taxa of the wooden artifacts recovered (Table 6; Homan et al. 2010: 155).

Table 6: Identification of Wood Artifacts

Artifact Type (# analyzed)	Taxon	Plant Part
Implement tip fragments (2)	True fir (*Abies* sp.) or Hemlock	Limb, compression wood
Cordage ring (1)	Conifer	Root or possibly bough
Implement tip fragment (1)	Yew (*Taxus* sp.)	Limb
Implement tip fragment (1)	Yew	Wood
Implement shaft fragment (1)	Yew	Limb, compression wood
Tumpline (1)	Western redcedar	Inner bark fibers
Pounded bark (1)	Western redcedar	Limb, compression wood
Implement tip fragments (4)	Hemlock or true fir	Limb, compression wood
Wood chips (3)	Hemlock or true fir	Limb, compression wood
Implement tip fragment (1)	Hemlock	Limb, compression wood
Implement tip fragments (2)	Possible Hemlock	Limb, compression wood

The identification of compression wood is of particular interest, because such wood forms on the underside of coniferous tree limbs and is much stronger than wood from other parts of the tree (Friedman 2005; Gleeson 2005; Homan and Leon 2010: 21). In addition, hemlock is a moderately heavy and durable wood but fairly easy to carve, while yew is prized for making many tools, including digging sticks (Turner 2001: 98, 100). Therefore, the selection of compressed wood, hemlock, and yew suggests implement use for digging or active work, which supports the suggestion of their use to dig wapato (Homan et al 2010: 58). The use of redcedar for the tumpline and pounded bark is not surprising; redcedar bark and fibre was widely used for cordage throughout the Northwest Coast (Turner 2001: 74).

Pollen Analysis

In order to help reconstruct the local prehistoric environment, Dr. Rolf Mathewes (Department of Biology, SFU) completed pollen analysis on two column samples from the Wet Site Zone (Homan et al. 2010: 167; Mathewes 2009)[18]. Results showed a well-preserved pollen record with abundant charcoal particles. Samples were dominated by tree pollen, especially western hemlock and alder (*Alnus* sp.). Other identified taxa include western redcedar, Douglas fir, spruce (*Picea*), true fir, and pine (*Pinus*) – all typical of modern coastal forests. Identified wetland taxa include pollen of wapato (particularly in the uppermost column samples), *Polygonum* sp. (possibly water smartweed [*Polygonum hydropiperoides*]), water milfoil (*Myriophyllum*), sedges, aquatic algae, water lily (*Nymphaea* sp.), and pond weed (*Potamogeton* sp.) (Homan et al. 2010: 167; Mathewes 2009: 2-3). Results indicate a diverse shallow-water plant community with abundant wapato and other shallow-water and wetland plants during the Middle Component (Mathewes 2009: 3).

Mathewes (2009: 3) also identified *Convulvulus* pollen grains in sampled Wet Site units at basal sand levels (approximately 40 to 45 cm depth below data point). Mathewes notes that this is the first record of fossil *Convulvulus* pollen in British Columbia (2009: 3-4). This plant typically occurs on coastal beach dunes and its presence

[18] For original data and analysis report, refer to KDC 2010: Appendix C.

in Early Component (ca. 5700 to 5300 cal BP) levels suggests a sandy shoreline with a well-drained beach ridge and brackish or saline maritime waters (Mathewes 2009: 3).

Phytolith Analysis

To help reconstruct the ancient site ecology, Calla McNamee of C and H Geoarchaeological Consulting conducted a phytolith analysis[19] of botanical remains from two samples drawn from Wet Site Zone (Area II) units and three samples from the knoll (Area III) (Homan et al. 2010: 168; McNamee 2010). Two Area III samples were from features Zh-q (FAR pit) and KC-n (hearth).[20] Some of the identified phytoliths may be typical of regional plant families, including salal (*Gaultheria shallon*), rose (*Rosa* sp.), blackberry/salmonberry (*Rubus* sp.), willow (*Salix* sp.), aspen/cottonwood (*Populus* sp.), and other plants (McNamee 2010: 8). There were also high numbers of a particular phytolith type that can occur in hazelnut. Results from Area III primarily indicated grass species and phytolith types associated with the heather (*Ericaceae)*, rose (*Rosaceae*), and willow (*Salicaceae*) families (McNamee 2010: 8).

[19] Phytoliths are solid structures produced by some plants after silica absorption from groundwater, which preserve in soil after the plants die (Piperno 2006: 5). Phytolith analysis involves studying their morphology to determine what plant species produced it, and it can be used to investigate past environments, species availability, domestication, and human dietery patterns (Pearsall 2010: 355-356; Piperno 2006: 23, 139).

[20] Both features are included in my analyses.

Diatom Analysis

Diatom analysis[21] was spurred by the recovery of chenopod or amaranth remains from cultural deposits on-site. Some species of that plant family are common elements of brackish and salt marshes, and their presence at DhRp-52 suggested that brackish water extended further upstream in the Fraser River estuary than present times (Huchinson 2009: 1). To test this hypothesis, a diatom analysis was conducted by Dr. Ian Hutchinson (Department of Geography, SFU) (Homan et al. 2010: 169; Hutchinson 2009)[22]. Dr. Hutchinson analyzed diatoms from ten Late Component Wet Site Zone sediment samples (three from the submerged rock pavement context) and classified them as "fresh" or "fresh-brackish" species, which indicated freshwater conditions at DhRp-52 during the Late Component. (Hutchinson 2010: 3).

Faunal Analysis

Although faunal remains were recovered at DhRp-52, they were extremely fragmentary and none could be taxonomically identified (Homan et al. 2010: 169). Homan et al. suggest their paucity and condition may relate to adverse soil chemistry

[21] Diatoms are unicellular photosynthetic microscopic algae with durable and taxonomically diagnostic siliceous shells that live in aquatic and semi-aquatic environments, and diatom taxa presence and abundance can help reconstruct past environments (Hutchinson 2009: 1; Smol and Stoermer 2010: 3).

[22] For original data and analysis report, refer to KDC 2010: Appendix E.

and/or food processing techniques in antiquity. As noted earlier, bone fleck scatters were associated with ochre concentrations and unmodified quartz crystals; these materials were also correlated with structural features and the FAR pit (feature ZH-q). Two concentrations of faunal remains were also found in Area III. However, no further analysis of faunal fragments was undertaken by KDC.

Features

A total of 991 features were recorded and classified during excavation. KDC's field classification typology was based on examples drawn from regional archaeological literature (Figs. 7 and 8; Huddlestan and Homan 2010: 111). Table 7 lists KDC's post-excavation classification of 747 analyzed features[23], which I have further categorized into four general groups: 1) features found in Area II peat matrices, 2) structural features, 3) cooking and processing features, and 4) concentrations of material (Tables 7 and 8) Huddlestan and Homan 2010: 109-112).

[23] A total of 282 features were not analyzed by KDC due to incomplete/problematic data and time constraints (Huddlestan and Homan 2010: 110).

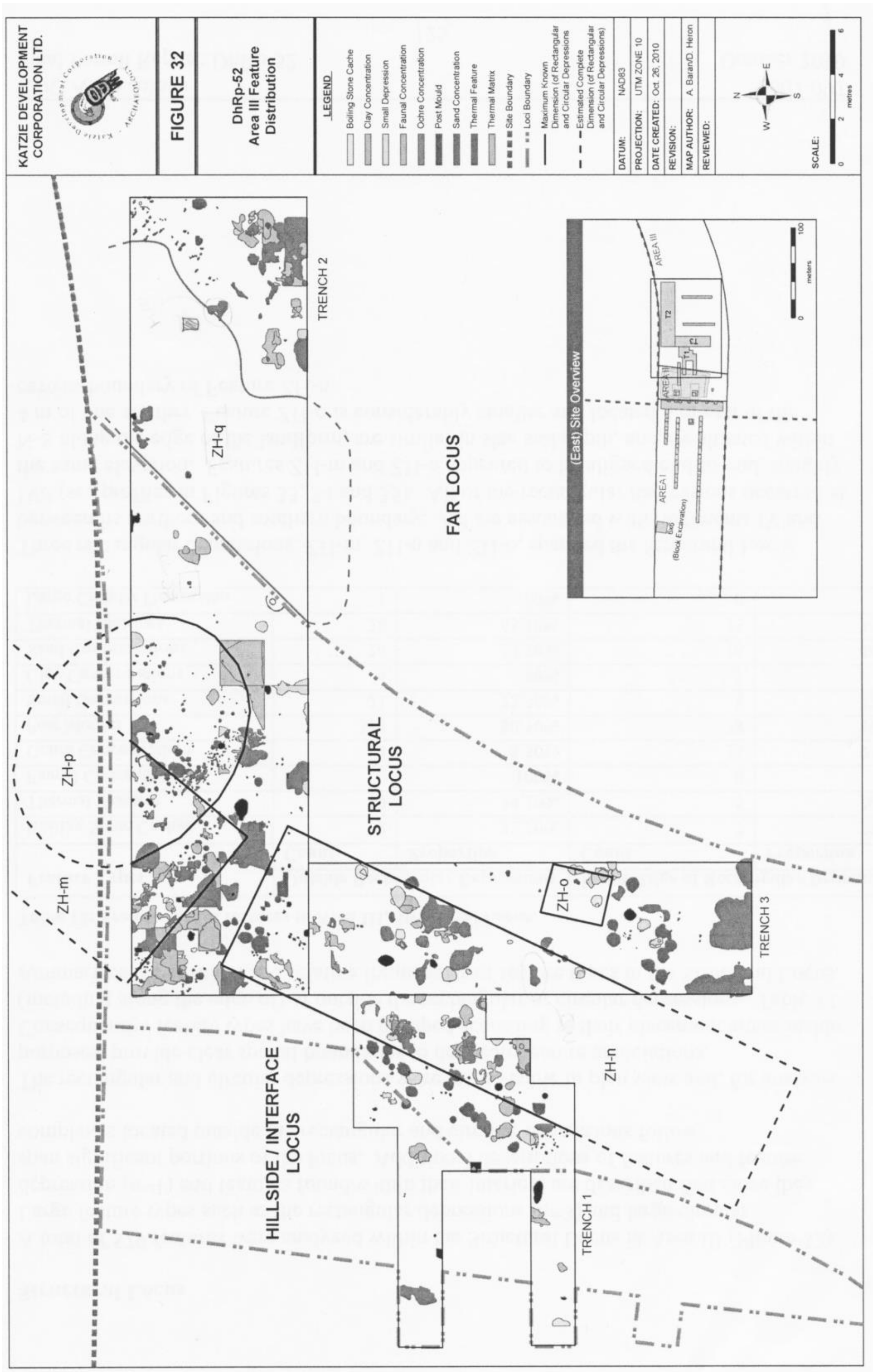

Figure 8:Area III Feature Distribution (KDC 2010).

Table 7: DhRp-52 Analyzed Features (N=747).

Feature Type	Time Period	#	Description
Features found in Area II Peat Matrices			
Submerged Rock Pavement	LC	1	A densely packed layer of FAR and cobbles.
Wood Stake Grouping	LC?	1	A set of 10 wooden posts embedded vertically in peat.
Area III Structural features			
Structural depressions – presumed habitation features	MC & LC	4	Three deep rectangular depressions and one large circular depression
Small Depressions	EC, **MC*** & LC	41	Shallow to deep depressions, round to irregularly shaped in planview.
Post Moulds	MC & LC	485	Circular/oblong stains; angled or vertical in profile, with flat or tapered bottoms.
Area III Cooking and Processing features			
Boiling Stone Caches	**MC** & LC	10	Round pebbles piled together on surfaces or together in pit depressions.
Thermal Features	MC & LC	29	Hearths and earth ovens. Shallow to deep depressions. Contain FAR and sometimes fire reddened sands, charcoal, and calcined bone. Composed of FAR, clay, and/or rock rings.
Thermal Matrices	MC & LC	50	Thermally altered sediments composed of coarse, fire-reddened sands and charcoal, sometimes calcined bone fragments, but no FAR present.
Area III Concentrations of Material			
Clay Concentrations	EC, MC & LC	5	Small lenses and/or concentrations of dense grey clay.
Faunal Concentrations	LC	2	Concentrated, unidentifiable bone fragments mixed with sediment.
Ochre Concentrations	MC & LC	38	Thin patchy lenses of red ochre.
Sand Concentrations	MC & LC	43	Patchy lenses of light-grey to brown or yellow sand.
Key: EC= Early Component, MC=Middle Component, LC=Late Component; *Bold = feature type is primarily associated with that time period.			

Table 8: Feature Presence by Site Zone.

Associated Time Period:	LC				LC?	MC		EC
Site Zones:	**LSZ**	**LNSZ**	**FAR Pit**	**MZ**	**WSZ**	**SSZ**	**SNSZ**	**SSSZ**
Feature Category (classified by KDC 2010)								
Submerged Rock Pavement	-	-	-	-	+	-	-	-
Wood Stake Group	-	-	-	-	+	-	-	-
Boiling Stone Caches	-	-	-	+	-	+	+	-
Thermal Features	+	+	-	+	-	+	+	-
Thermal Matrices	+	+	-	+	-	+	+	-
Structural Depressions	+	-	-	-	-	+	-	-
Small Depressions	+	+	/	-	-	+	+	+
Post Moulds	+	+	/	-	-	+	+	/
Clay Concentrations	+	-	-	-	-	+	-	+
Faunal Concentrations	/	-	/	-	-	-	-	-
Ochre Concentrations	+	-	-	+	-	+	-	-
Sand Concentrations	+	+	-	-	-	+	-	-

Key: + present, - absent, / ambiguous or overlap with other zones;
LC=Late Component, MC=Middle Component, EC=Early Component; LSZ=Loam Structure Zone, LNSZ=Loam Non-Structure Zone, FAR Pit=Feature Zhq, MZ=Midden Zone, WSZ=Wet Site Zone, SSZ=Sand Structure Zone, SNSZ=Sand Non-Structure Zone, SSSZ= Sand Sub-Structure Zone

Features Associated with Area II Peat Matrices (Wet Site Zone)

Only two features were identified in the Wet Site Zone: a rock pavement and a group of wooden stakes. The rock pavement covered a majority of this site zone.

Rock Pavement Feature (N=1)

A densely packed submerged rock layer ("the pavement") was found in the Wet Site Zone (Fig. 7), with wapato and cultural artifacts (e.g., cordage and a possible tumpline) immediately above and below the rock layer (Huddlestan and Homan 2010:

120-121). The pavement's dimensions are approximately 19.5 metres north-south by 15 metres east-west and includes the eastern edge of Area I; it likely extends into adjacent unexcavated areas to the north (Huddlestan and Homan 2010: 115). The pavement's western edge is one rock thick and sits at the interface between the sand deposits below the peat deposit; moving eastward, the pavement rises upwards into the peat and widens to approximately two rocks thick at the knoll's transitional bank (Huddlestan and Homan 2010: 121).

The pavement is associated with the Late Component (ca. 3600–3800 cal BP) (Huddlestan and Homan 2010: 120). It is considered anthropogenic because it consists of 65% FAR and 35% unmodified rounded pebbles and cobbles, the latter possibly size-selected as none exceeds 12 cm in diameter (Huddlestan and Homan 2010: 121). In addition, the wapato growing above it suggested deliberate transplantation and/or cultivation activity. This is further discussed in Chapter 5.

Wooden Stakes Feature (N=1)

This feature consists of a set of wooden stakes, ranging in diameter from 2.07 to 4.57 cm, and found embedded vertically in peat deposits along the eastern boundary of Area II (Huddlestan and Homan 2010: 113; Homan and Leon 2010: 20, 33). Huddlestan and Homan (2010: 124) suggested that this feature may be the remains of small structures (e.g., drying racks, fish weirs) or of markers delineating resource area boundaries. The possible functions of this feature are discussed further in Chapter 5.

Cooking and Processing Features

This category describes three feature types—boiling stone caches, thermal features, and thermal matrices[24]—that may relate to cooking and processing activities.

Boiling Stone Caches (N=10)

Boiling stone caches are clusters of boiling stones piled together or stored in pit depressions (Huddlestan and Homan 2010: 112). At DhRp-52, individual caches contained from five to over 100 stones. Some stones were porous and brittle, sometimes with irregular cracking–traits that may be due to decomposition and/or heat alteration (Huddlestan and Homan (2010: 112). Undamaged stones may have been cached for later use (Huddlestan and Homan 2010: 112-113). All ten caches were found in Area III. The majority were located within the rectangular structural features ZH-m (N=2), ZH-o (N=1), and ZH-n (N=5), and are associated with the Middle Component. Two Late Component caches were located outside the structural features: one near circular depression ZH-p; the other at the edge of the Midden Zone, adjacent to the Wet Site Zone.

[24] "Thermal features" and "thermal matrices" are terms used by KDC to classify these feature types.

Thermal Features (N=29)

Thermal features, including hearths and earth ovens, consist of shallow to deep depressions containing FAR (Huddlestan and Homan 2010: 113-114). The features sometimes contain fire-reddened sands, charcoal, or calcined bone. Some thermal features are lined with clay and others outlined by rock rings. Of 29 thermal features identified at DhRp-52, 15 are associated with the Middle Component, three with Middle to Late Component deposits, and ten with the Late Component. Approximately 79% of thermal features were located outside of habitation structures (see Structural Features, below). Dense clusters of thermal features were found in several areas of the knoll (Area III), including the FAR pit zone (Fig. 8). The "FAR pit," formally known as feature Zh-q, is the largest thermal feature on-site, further discussed in Chapters 4 and 5 (Huddlestan and Homan 2010: 135).

Thermal Matrices (N=50)

Thermal matrices may contain burned sediments, calcined bone, charcoal, and FAR (Huddlestan and Homan 2010: 112). Those identified at DhRp-52 were either small, thin discontinuous lenses or thick and large concentrations (Huddlestan and Homan 2010: 119). The presence of coarse fire-reddened sand and charcoal indicated heat alteration, but no FAR were present. Thermal matrices are associated with both Middle and Late Components and the majority (N=26) are found within the rectangular structural features. There are several dense concentrations of thermal matrices in Area III (Fig. 8).

Structural Features

This category includes depressions inferred to be structural features (Appendix B). Three Middle Component rectangular depressions were identified, two of which (Features ZH-m and ZH-n) were interpreted as large permanent structures (Huddlestan and Homan 2010: 131-133). The third rectangular depression (ZH-o) was much smaller in size, lacked associated post moulds, and was interpreted as a possible storage pit (Huddlestan and Homan 2010: 133). One Late Component large circular depression (feature ZH-p) was inferred to be the remains of an in-ground house (i.e., pit house). In addition, 36 small depressions were found in Area III deposits, the majority being Middle Component. A total of 485 post moulds were also identified, the majority of which were Late Component (62%) and located in trench 2 (78%; Fig. 8). There were 67 post moulds (80% of small size) associated with the FAR pit zone (east of feature Zh-q), clustered with thermal features and matrices, small depressions and sand concentrations.

Material Concentration Features

Four types of material concentrations were observed and documented by the KDC team: clay, faunal material, ochre, and sand.

Clay Concentrations (N=5)

These are typically clay patches or piles present within surrounding matrices of other soil types (Huddlestan and Homan 2010: 112). At DhRp-52, they appear as small lenses or concentrations of dense grey clay (Huddlestan and Homan 2010 117). The source is unclear; the clay may have been deliberately brought on-site (e.g., for use in clay-lined pits) or naturally deposited in shallow water-saturated areas of the knoll. The concentrations are all Late Component, range in size from 34 to 71 cm length and >5 cm to 30 cm depth, and are located within structural features ZH-m and ZH-p. The lone exception in size and association is a large concentration (feature ZH-k) of indeterminate temporal association located in the Sand Sub-Structural Zone or basal deposits of structural feature ZH-n (Huddlestan and Homan 2010: 133). Feature ZH-k's minimum length is 105.2 cm and maximum length is 189.6 cm.

Faunal Concentrations (N=2)

Two concentrations of fragmented and complete bones or shellfish remains, all of unidentifiable taxa, were located between the FAR pit and the Loam Structure Zone at roughly the same depth (Huddlestan and Homan 2010: 11). One (feature KB-d) contained ochre. The faunal concentrations do not appear associated with any other features.

Ochre Concentrations (N=38)

At DhRp-52, ochre were recovered in concentrations a few centimetres thick or mixed with surrounding matrices[25] (Huddlestan and Homan 2010: 115). The majority of ochre concentrations were associated with the Middle Component and located within the rectangular structural features ZH-m and ZH-n, primarily along interior walls (Huddlestan and Homan 2010: 132-134, 137). Five concentrations were associated with Late Component deposits outside of structural features—two within the Midden Zone and three in the Loam Structure Zone. Ochre concentrations were also correlated with bone fleck scatters and unmodified quartz crystals (Hoffmann et al. 2010a: 209).

Sand Concentrations (N=43)

This category includes thin lenses or concentrations of sand up to 10 cm in thickness and ranging from 12.2 cm to 310.4 cm wide (Huddlestan and Homan 2010: 112). The sand colour ranges from light grey to brown or yellow, while the texture is fine to coarse (Huddlestan and Homan 2010: 118). Some lenses contain small charcoal fragments. The concentrations were found in Middle and Late Component deposits, while

[25] These concentrations are separate from individual pieces of ochre recovered at the site, which were treated as artifacts.

one was associated with Early to Middle Component deposits and five had indeterminate temporal associations.

Fire-Altered Rock (FAR)

Fire-altered rocks (FAR) were classified separately from artifacts and features. Substantial amounts of FAR were found in all site areas and all components (Homan et al. 2010: 159). FAR was quantified by count and weight, and tracked by trench unit and each 10-cm level to allow spatial and density analysis (Homan et al. 2010: 159). FAR concentrations were widely distributed on the knoll, often in direct association with large features, including feature Zh-q, which produced >12 tonnes of FAR. The FAR density increased significantly over time in Area III, particularly within feature Zh-q (Homan et al. 2010: 160).

Summary

DhRp-52 is a habitation site situated on a knoll adjacent to wetlands, and used with increasing intensity over a 2,500-year span (ca. 5700 to 3200 cal BP). The site generated considerable interest because of its large, diverse artifact assemblage, including rare perishable wooden artifacts, archaeologically associated wapato, and possible evidence for cultivation of wapato. The site chronology includes Early (5700–5300 cal BP), Middle (5300–4250), and Late (4100–3200 cal BP) components.

The excavation recovered 165,639 artifacts, including lithics and perishable artifacts, and 6,980 macrobotanical remains. Substantial amounts of FAR were found in all site areas and all components, and a total of 991 features were identified at the site. In addition, KDC staff and other researchers analyzed archaeobotanical material, wooden artifacts, pollen, phytoliths, diatoms, and faunal remains.

Previous study results suggested a diverse range of activities at the site (e.g., cooking, resource processing, woodworking, flintknapping) with site activity primarily focused on the knoll. The adjacent wetland contained abundant and diverse wetland plant taxa. Paleobotanical analysis identified charred wetland seed taxa, including those with ethnographically documented cultural use. Perishable artifacts, the rock pavement feature, and the wapato patch suggest that transplantation and/or cultivation of wapato took place, a topic discussed further in Chapter 5.

Chapter 3: Methods of Feature Analysis

Feature analysis is a technique for inferring human activity and resource use at a site. Features are often found in the archaeological record and represent the residue of cultural activities or natural processes (Carver 2009: 20, 139). Certain feature classes are associated with specific types of resource selection, processing or use, such as hearths, shell middens, hide-processing pits, earth ovens, fish-smoking stations, and fish weirs (Ormerod 2002: 7-12; Patenaude 1985a: 94; Pearsall 2010: 499). Recovered plant, bone, and shell remains from hearth and processing pit feature contents can provide indirect indicators of diet (Pearsall 2010: 499). In addition, because some plants and animals are only seasonally available, their presence in features can indicate when the site was occupied or resources harvested.

In this chapter, I describe the methods used in my feature analysis. I begin with a brief review of the four primary methods used to investigate features, and identify those factors that may affect feature analysis. I then present the integrated data approach used to analyze selected features at DhRp-52, followed by a description of the sampling strategy and laboratory methods that contribute to the analysis.

Four Approaches to Feature Analysis

Feature analysis involves studying feature form, contents (e.g., sediment, charcoal, ash, artifacts) and contexts (e.g., location, association with other features) in order to infer feature function and use. There are four types of feature analysis (Table 9): 1) *descriptive*, which describes a feature's physical characteristics and classifies them into types; 2) *spatial*, which uses quantitative and statistical tools to study feature spatial patterning in a given area; 3) *single dataset*, which focuses on a single type of data sampled from features (e.g., faunal remains); and 4) *multiple dataset*, which integrates different types of data recovered from feature contents and contexts. Each approach is described below, along with its benefits and limitations.

Table 9: Types of Feature Analyses.

Feature Analysis Type	Type of Data	Methods	Information Sought
Descriptive	Observed feature characteristics (e.g., shape, size, colour, depth)	Feature description, used to create a typology of features	Feature type/function, formation processes
Spatial	Quantitative data on feature dimensions and location	Use of quantitative and statistical tools to study feature spatial patterning	Spatial associations and patterning among features, identification of activity areas
Single Dataset	One type of recovered evidence from feature contents/context (e.g., charred seeds or bone)	Use of a single type of evidence sampled from features to interpret feature function and use	Feature function and use; resource use and diet
Multiple Dataset	Different sources of data from feature contents and contexts	Integration of multiple types of evidence recovered from features to interpret feature function and use	Feature function and use; resource use and diet

Descriptive Feature Analysis

Descriptive analysis classifies features by comparing their characteristics to a typology (e.g., Morgan et al. 1999: 12.3-12.5; Huddlestan and Homan 2010: 112-119). A feature typology is based on criteria drawn from past archaeological data, ethnographic records, and ethnoarchaeological observation (e.g., Shortland et al. 2008: 14; Ormerod 2002: 7-12). Recorded characteristics include size, spatial dimensions, soil characteristics, colour, visible contents (e.g., bone and shell fragments, charcoal), and feature provenience.[26] Such descriptive data can provide information about feature type, natural or cultural formation processes, and, if culturally produced, the feature's function (e.g., Gose's [1976] analysis of features at Glenrose Cannery). However, inferences about feature interpretations are strengthened with multiple lines of evidence; descriptive data alone may be insufficient.

Spatial Analysis

Spatial analysis is a quantitative approach that incorporates feature depth, length, width, and provenience (Orton 2004: 299-300; Wandsnider 1996). This approach can identify spatial associations among different features at a site or patterning in feature dimensions (e.g., KDC 2010; Parkington et al. 2009; Lepofsky et al. 2000: 393, 412). For

[26] Unlike in spatial analysis, quantitative data is not further analyzed in descriptive analysis.

example, spatial analysis might show a statistically significant correlation between posthole size and site location, suggesting the partitioning of activity areas. This approach often includes multivariate analysis to identify spatial patterns and feature associations (McCoy and Ladefoged 2009: 272; Ormerod 2002). Computer programs like ArcGIS and SPSS allow complex statistical and multivariate analyses of large datasets. The analysis of feature clustering or scaling patterns can provide information on site use, activity areas, and feature types, particularly post moulds and habitation structures. However, focusing on spatial data without feature content analysis or the use of other kinds of feature data constrains interpretation of feature function and resource use. Therefore, spatial analysis should be integrated with other feature data (e.g., feature contents and descriptive data) whenever possible.

Single Dataset Analysis

What I term "single dataset analysis" refers to the sampling of features for a specific evidence type (e.g., archaeobotanical remains or radiocarbon dates) without integration with other kinds of evidence. Archaeologists may have specific research questions in mind and choose to sample for a specific dataset to the exclusion of others (e.g., Dufraisse 2002). For instance, Froyd et al. (2010) analyzed charcoal fragments from historic hearth features and surrounding campsite locations on the Galapagos Islands in order to examine historic anthropogenic impact on the native vegetation. A benefit of this approach is using specialized expertise (e.g., zooarchaeology) and information from a particular data type to answer specific research questions. A limitation is that feature contents may not always be related to feature function (Schiffer 1987: 218-219); e.g., an old processing pit may have been repurposed into a garbage pit. A significant issue is arguably the potential loss of information through reliance on a single dataset, beholden to its particular preservation issues.

Multiple Dataset Analysis

"Multiple dataset analysis" refers to the integration of different types of evidence (e.g., archaeobotany, zooarchaeology, radiocarbon dates, lithic analysis, feature descriptions). The integration of complementary data (particularly botanical and faunal remains) is considered valuable in the study of ancient human diets, resource use and the reconstruction of prehistoric environments (e.g., Albarella et al. 2002: vii-viii; Kristensen et al. 2009; Patenaude (1985a: 95); Pearsall and Hastorf 2011: 179; VanDerWarker and Peres 2010) (Pearsall 2010: 9, 498). For example, in their study of an anthropogenic prairie on Whidbey Island, Washington, Andrea Weiser and Dana Lepofsky (2009) selected 11 cultural features for analysis of feature dimensions, traits, and contents (plant remains, wood charcoal), and integrated results with other lines of evidence (e.g., descriptions of soil sequences, radiocarbon dates of carbonized plant remains) to make inferences concerning feature function, site activities, and the cultural and ecological history of the study area.

Multiple dataset analysis increases the chances of finding useful evidence, as the taphonomical constraints of one dataset may be balanced out by greater preservation or presence of another. It thus allows finer interpretation of feature function and comparative analyses between features (Adams and Smith 2011: 157; Lepofsky et al. 2001: 56). This approach can also pull together many discrete variables in order to generate patterns, as with Ormerod's (2002) multivariate feature analysis at the Xa:ytem (Hatzic Rock) site in which she analyzed 69 variables of feature morphology, contents, and contexts to identify feature clusters and infer feature functions. Her analysis produced 14 feature clusters that could represent particular feature functions (Ormerod 2002: 18). Ormerod (2002: 19) then compared the characteristics of these feature clusters to expected characteristics derived from the ethnographic record and proposed feature types for each group.

The primary constraints on this approach are time, money, and skill. Laboratory-based analyses (e.g., archaeobotany and zooarchaeology) can be time-consuming and expensive. Specialized knowledge is often required to analyze and interpret evidence types and an interdisciplinary excavation team or outside experts may be required in order to integrate multiple datasets. Faced with logistical, budgetary, and time constraints, archaeologists and project stakeholders may prefer simpler, quicker, and cheaper alternatives, such as descriptive or single dataset analyses.

Factors Affecting Feature Identification and Classification

Features are usually identified in the field using criteria drawn from archaeological studies, ethnographic records, and ethnoarchaeological observation (e.g., KDC 2010; Gose 1976; Larson and Lewarch 1995; Morgan et al. 1999; Ormerod 2002). Criteria can include feature morphology, spatial associations, contents and contexts, and may be linked to specific activities. Since cultural behaviours and feature types vary greatly, there is no single overarching feature typology so archaeologists use regional or site-specific feature typologies (e.g, KDC's DhRp-52 typology [Appendix B]).

However, there are four issues with using feature typologies for in-field feature classification:

1) it is not always clear from observation whether a feature is cultural or natural. It is insufficient to define a feature based only on visually observed characteristics, as natural processes can produce similar features to cultural processes;

2) feature contents may not be directly related to feature function (Schiffer 1987: 218-219). Features may have been repurposed for different functions or its contents removed altogether. It can be difficult to distinguish between *in-situ* deposits and secondary deposits discarded elsewhere (Schiffer 1987: 58-59), which can confound the classifying of features or inferring their function;

3) reliance on macroscopic contents (e.g., visible plant material or bone fragments) may miss microscopic evidence, while feature descriptions include qualitative data (e.g., soil colour or feature shape) that may not immediately indicate feature function (Collis 2001: 131); and

4) archaeologists' expectations about past lifeways can influence the feature typologies they create. Differing behaviours, cultural traditions, and attitudes may translate into patterns of feature use that do not fit a typological norm.

These four issues, singly or in combination, can affect feature classification. This supports the argument for a feature analysis strategy that tests preliminary feature classification and uses meaningful data to achieve more precise feature analysis (Clarke 1972: 3; Ormerod 2002: 14; Schiffer 1987: 4). This is particularly important when using feature interpretations to make inferences about site activities and resource use patterns.

An Integrated Approach to DhRp-52 Feature Analysis

After considering the four approaches described above, I chose the multiple dataset strategy (Table 10) to analyze selected features for indicators of wetland resource use and to assess feature function. To delineate indicators of wetland resource use, this study defines *wetland taxa* as plant or animal species adapted to wetland environments and *wetland-associated taxa* as plant or animal species that can inhabit wetlands but also other ecozones. My integrated approach included (a) typological characteristics recorded in the field; (b) archaeobotanical and (c) faunal evidence recovered from feature sediments; (d) taxa identification of charcoal fragments; and (e) information drawn from KDC's (2010) analyses of lithic and perishable artifact assemblages regarding specific artifacts and features, and activity areas. I also drew upon KDC's (2010) pollen, diatom, and phytolith assemblages, as well as comparative ecological information from the literature, and supplemented my analysis and interpretation with ethnographic

Table 10: Multiple Dataset Feature Analysis Strategy.

Feature Analysis of Contents and Contexts: 3 hearths, 1 processing pit			
Data Type	Source	Evidence	Information Sought
Field data	KDC documents/records	Feature information/descriptions	Feature type and function
Archaeobotany	A. Goode	Charred plant and seed remains	Feature function; resource use
	KDC 2010		
Faunal data	A. Goode; Nova Pierson	Bones; shellfish remains	
Charcoal analysis	A. Goode	Wood taxa	Feature function; fuelwood use
Lithic analysis	KDC 2010; Wilkerson 2010	Tools and debitage	(Indirect) woodworking, plant processing, fishing, hunting activity
Perishable artifacts	KDC 2010	Tools and woodworking debris	Woodworking, taxa selection, (indirect) plant processing, fishing
Fuelwood Selection and Use: 5 hearths, 2 processing pits			
Data Type	Source	Evidence	Information Sought
Charcoal analysis	A. Goode	Wood taxa	Fuelwood selection and use; wetland-associated taxa
Resource Availability: Supplemental Data			
Data Type	Source	Evidence	Information
Pollen analysis	Dr. Rolf W. Mathewes (SFU)	Pollen taxa	Presence of plant taxa
Phytolith analysis	Calla McNamee (C&H Geoarchaeological Consulting	Phytolith taxa	
Diatom analysis	Dr. Ian Hutchinson (SFU)	Diatom taxa with preferences for fresh, brackish or saltwater	Presence of fresh, brackish or saltwater during site history
Literature review	Ecological and botanical literature	CWH zone and wetland zone taxa	Resource availability
Resource Use: Supplemental Data			
Data Type	Source	Evidence	Information Sought
Ethnography	Ethnographic literature	Known taxa use by Katzie and other indigenous groups	Resource selection, processing and use

information concerning Coast Salish and Katzie resource use.

The features I analyzed consisted of three hearths and feature ZH-q, the large possible processing pit mentioned in Chapter 2. The hearth and processing feature types were selected because they are thought to represent resource processing and use. I also focused on the presumed occupation area in Site Area III, where resource processing activities likely occurred, and on the Middle Component time period, which is when the adjacent shoreline had developed into a wetland. I also applied cellular analysis to charcoal pieces from these four features and from five additional Late Component features sampled in KDC's archaeobotanical analysis. Results from the charcoal analysis are used to discuss fuelwood selection and use at DhRp-52.

Datasets Used in Multiple Dataset Feature Analysis Strategy

My multiple dataset feature analysis strategy integrated six datasets: 1) field data; 2) archaeobotanical data; 3) charcoal analysis; 4) faunal analysis; 5) supplemental data regarding DhRp-52; and 6) ethnographic information. Each dataset is described below.

Field data used for this study included excavation level sheets, field notes, feature database, and other written material provided by KDC to supplement DhRp-52's final report and appendices.

Archaeobotanical Analysis

The qualitative and quantitative analysis of archaeobotanical remains from archaeological features can corroborate patterns of resource use, contribute new data, and help to confirm or revise interpretations of feature function. Qualitative analysis documents the patterning and locations of plant taxa, while quantitative approaches include taxa counts and weights, density ratios, and statistical analyses (Pearsall 2010: 191-193). I applied both qualitative and quantitative analysis to recovered archaeobotanical material from selected features. I also incorporated the results of KDC's archaeobotanical analysis of 41 sediment samples from DhRp-52, with permission from the Katzie First Nation and KDC (Lyons and Leon 2010).

Charcoal Analysis

A subfield of archaeobotany, charcoal analysis (or anthracology) is the microscopic analysis of charcoal fragments for wood taxa identification (Esterhuysen and Smith 2003: 3; Pearsall 2010: 144-153). It can provide insight into fuelwood and tool material selection, or demonstrate changes in resource use over time (Pearsall 2010: 144; e.g., Adams and Smith 2011: 163; Cartright and Parkington 1997; Lepofsky et al. 2005: 276).

I used charcoal analysis to determine if wetland-associated trees or shrubs were selected for fuelwood. Taxa identification can also potentially suggest particular feature functions. For example, some softwood (conifers) burn hotter than hardwood (deciduous trees); rotting hardwood and certain tree species produce a smoky fire; some woods have a sweet scent; and some are so dense with pitch that they may be a fuel of last resort (Ormerod 2002: 8, 11; Turner 2001 [1998]: 80, 81, 152). Such traits influence cultural, practical, and individual preferences in fuel selection, and are thus informative to my study.

Faunal Analysis

Faunal analysis is most often used to explore ancient food resource use (Cannon 2000: 49), such as determining the relative abundance of different species to infer human dietary patterns (Pearsall 2010: 509). In addition, some species of fish and shellfish can be sensitive indicators of past environmental conditions (Driver 1993: 84), while others are useful seasonal indicators (Butler and Campbell 2004: 334; Cannon and Yang 1996: 123, 126-127). In this study, faunal analysis was used to explore the collection, processing and consumption of wetlands-associated birds, fish, and animals at DhRp-52.

Supplemental Data From DhRp-52

In Chapter 2, I presented the supplemental data drawn from KDC's published report on DhRp-52 (KDC 2010) and Emily Wilkerson's MA thesis (2010a). The lithic and perishable artifact analyses (Homan et al. 2010; Wilkerson 2010a, 2010b) provide insight into site use, activity areas, specific features, resource processing, and tool use. The pollen, phytolith, and diatom assemblages (Hutchinson 2009; Mathewes 2009; McNamee

2010), in conjunction with archaeobotanical and faunal assemblages, can build a clearer picture of the ancient site environment and local resource availability (Adams and Smith 2011: 151; Pearsall and Hastorf 2011: 174, 179). I also make use of ecological information on plants and animals found in local wetlands and the Coastal Western Hemlock biogeoclimatic zone in order to consider resource availability at DhRp-52.

Ethnographic Information

The ethnographic record concerning traditional resource use by the Katzie and other Coast Salish groups, includes information on their seasonal round (Table 1), fuelwood preferences, plant and animal resources, tool-making, and resource processing techniques (e.g., Barnett 1955; Jenness 1955; Kuhnlein and Turner 1991; Suttles 1955; Turner 1995). These data can supplement wetland resource-use models, and can be used to indirectly infer feature function and site inhabitants' relationships with local wetlands. As in Lyons and Leon (2010), my paleoethnobotanical interpretation also draws on ethnography to model prehistoric plant use (Pearsall 2010: 245).

Sampling Strategy

For my study of the archaeobotanical, faunal, and wood charcoal assemblages in feature contexts, three sets of samples were used: 1) Sample Set A, which is comprised of four features selected for analysis of feature contents (Table 11); 2) Sample Set B, consisting of KDC's archaeobotanical results of 41 sediment samples taken from nine hearth and processing features and four columns (Appendix C); and 3) Sample Set C, which consists of recovered charcoal fragments from all Sample Set A features and from selected Sample Set B features (Table 12). I describe each sample set and provide rationale for their selection, below. Figure 9 shows the locations of all sampled features in this thesis.

Table 11: Description of Sample Set A.

Sample#	Feature Type	Feature Name	Description	RC dates (cal)	Time Period	Sediment Volume*	Sample Prov.
A1	H	HP	Charcoal-rich matrix ringed by FAR.	4829-4569 BP	MC	1 litre	Trench 2 Unit D6 150-160 cm
A2	H/P	KC-N	Hearth/sand. Assoc. cobble tools, FAR & orange silty clay.	5285-4978 BP	MC	600 ml	Trench 2 Unit C18 160-170 cm
A3	H/P	MJ	Pile of yellow sand w/ small bone flecks & FAR. Inside structure ZH-n	4415-4250 BP	MC	900 ml	Trench 3 Unit M11 70-80 cm
A4	P	ZH-q	Large pit w/ +12 tonnes FAR. Beads & smaller thermal features & matrices along edges.	5585-5471 BP (bottom of feature) and 3827-3569 BP	MC to LC	850 ml	Trench 2 Unit C6 90-100 cm

Key: H=Hearth; H/P= Hearth / Processing; P = proposed processing pit; MC=Middle Component; LC=Late Component; Prov.=provenience

*Although measured out as 1 litre at KDC headquarters, lower volumes were recorded when re-measured at SFU Archaeology Department laboratories. This is likely due to sediment settling.

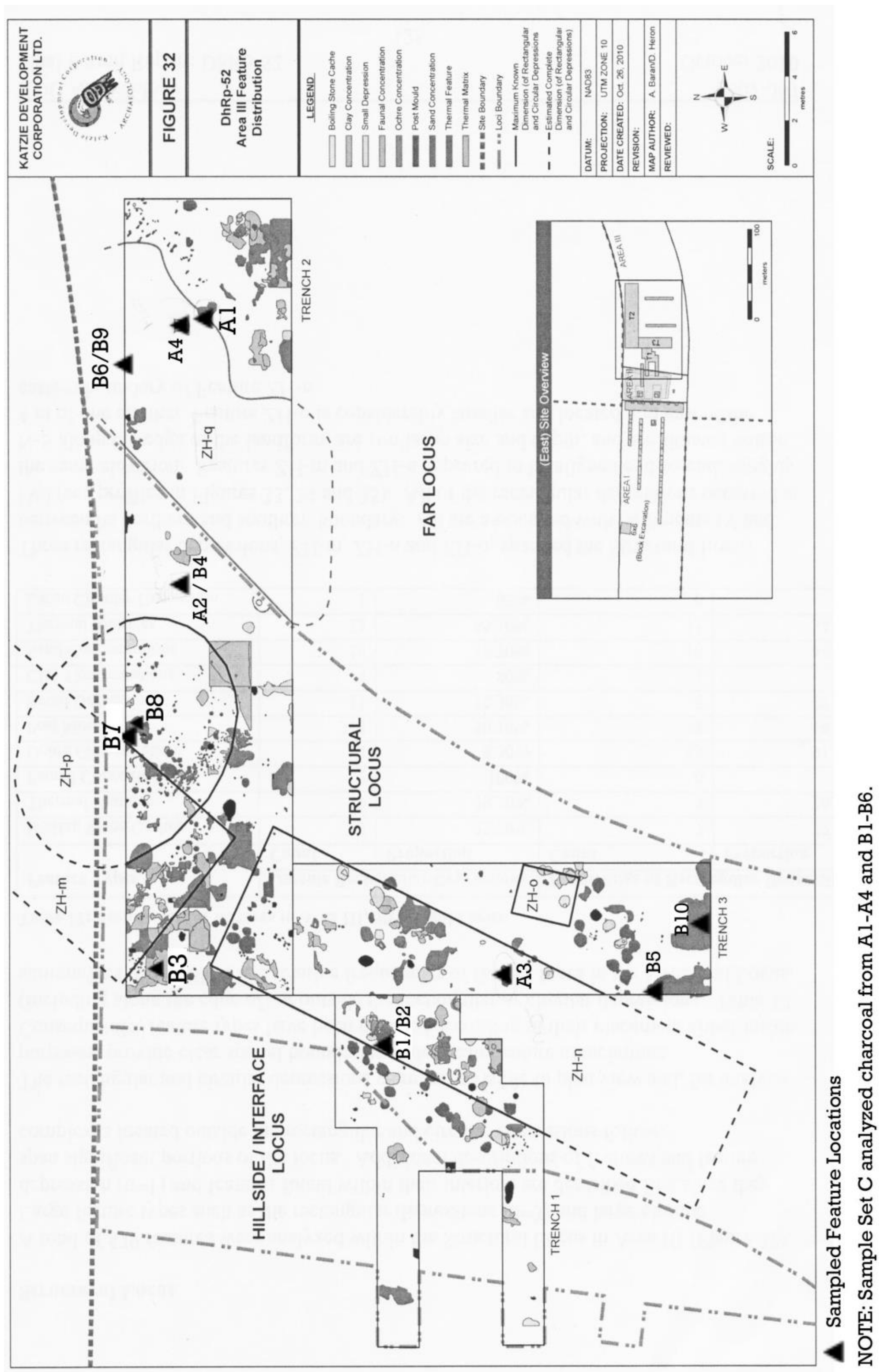

Figure 9: Locations of all sampled features (After KDC 2010).

Sample Set A

For this first set of features, I focused on Site Area III, the Middle Component occupation period, and the "thermal features" category (see Table 3). My selection was based on the following reasons:

1) This appears to be an occupation area, where people were likely to have processed, used, or consumed a variety of resources, according to Huddlestan and Homan (2010: 131-134);

2) During Middle Component times (5300-4250 cal BP), the site's environment had changed from shoreline sand dunes into vegetated upland surrounded by a young freshwater marsh (Hoffmann et al. 2010b: 206). The perishable artifact assemblage suggests that Middle Component site occupants were using wetland resources, but the picture is less clear than for the Late Component (Hoffmann and Huddlestan 2010: 225; Huddlestan and Homan 2010: 206). Sampling Middle Component features would thus help clarify wetland resource use during that time period; and

3) The thermal features category includes hearths and earth ovens, feature types with particular relevance to resource use (Pearsall 2010: 499).

I subsequently reviewed Area III thermal features and consulted with KDC Senior Archaeologist Stephanie Huddlestan as to those most suitable for analysis. We looked for features that had (a) unambiguous characteristics and descriptions, (b) available sediment samples, and (c) evidence of bone flecks, charcoal and/or the remains of fire-altered rocks (FAR). Based on these criteria, I selected the four features that comprise Sample

Set A (Table 11; Fig. 9**;** Appendix D). To minimize confusion, these features have been assigned individual sample numbers for this study.

Description of Sample Set A Features

This section provides the essential details of the four selected features. Additional details are provided in Appendix D.

A1: Hearth Feature HP. This circular to ovoid feature is a dense charcoal layer irregularly ringed by FAR (Appendix D: Fig. 1), and is approximately 3 cm deep, 82 cm wide, and 88 cm long. It is located in Trench 2 on the western edge of feature ZH-q, approximately 150 to 160 cm below surface. Its association with feature ZH-q is unclear and it appears set apart from the thermal feature complex southeast of feature ZH-q. Feature HP was radiocarbon dated to 4692 +/- 79 cal BP (Diaz et al. 2010: 10).

A2: Hearth/Processing Feature KC-n. This feature is an irregularly shaped concentration of sand, orange silty clay, charcoal, and FAR, approximately 7 cm deep, 17 cm wide, and 31 cm long (Appendix D: Fig. 2). It is located in Trench 2, approximately 160-167 cm below surface between Feature Zh-q and proposed pit house feature ZH-p. The feature was within waterlogged deposits, which prevented it being thoroughly recorded. Feature KC-n was radiocarbon dated to 5182 +/- 87 cal BP (Diaz et al. 2010: 2).

A3: Hearth/Processing Feature MJ. This feature is irregularly shaped and consists of a dense FAR cover, coarse yellow sand, and charcoal (Appendix D: Fig. 3). It is approximately 20 cm deep, 44 cm wide, and 97 cm long. It is located in Trench 3 within the proposed structural feature ZH-n, near the eastern wall's estimated mid-point (Fig. 9). No radiocarbon samples were taken. Feature MJ is considered contemporary with Middle Component matrices.

A4: Processing Pit Feature Zh-q. Feature Zh-q is a large bowl-shaped pit or trench >2 m deep, 10.5 m wide, and 11.5 m long. It occupies much of Trench 2's eastern half and forms the core of the "FAR Pit Zone" (Figs. 6, 9). Clay-rich sediment lines the bottom of the feature and associated charcoal dates to 5584-5471 cal BP (Huddlestan and Homan 2010: 135). Other radiocarbon-dated charcoal samples from feature contexts range from 3827 cal BP to 3569 cal BP (Huddlestan and Homan 2010: 135).

Feature A4 contains >12 tonnes of FAR, with discrete concentrations that over time expand and form a single dense FAR concentration (Huddlestan and Homan 2010: 135, 160). The feature contains associated quartz crystals, ochre, and faunal scatters, while dense concentrations of disc beads line the feature's margins (KDC 2010: Fig. 44; Hoffmann and Huddlestan 2010: 237; Hoffmann et al. 2010b: 209; Wilkerson 2010: 19, 185). Although the association with feature A4 is unclear, there are two groups of features adjacent to feature A4: 1) post moulds along its northeastern rim, and 2) a set of sand concentrations, small pits, and thermal features and matrices along its southeastern edge (Huddlestan and Homan 2010: 135). Feature A4 is associated with the Middle and Late Components. Wilkerson (2010a: 32) suggests it may even post-date site abandonment as a habitation area at the end of the Late Component.

Feature Sediment Sample Selection

After I determined which features to analyze, sediment sample logs were reviewed to select one 1-litre sediment sample per feature[27] (see Table 11). These 1-litre samples was taken from the selected sediment sample bags and bagged with label cards noting pertinent tracking data. For feature sample A2, two small bags of sediment with the same provenience were combined to make a single sample of approximately 1 litre.

Sample Set B: KDC's Archaeobotanical Analysis

KDC's archaeobotanical results were incorporated into my analysis with permission as Sample Set B[28] (Table 5; Fig. 9; Appendix C), in order to increase the sample size and contribute to the discussion of wetland resource use at DhRp-52. In addition, KDC had sampled hearth feature KC-n and processing feature Zh-q. I compared their archaeobotanical results (Sample Set B) with results from Sample Set A. Their archaeobotanical sampling strategy, methods, and research design are presented in Chapter 2. KDC used a similar rationale in their archaeobotanical sampling design, in which they selected three hearths, one possible hearth, two possible processing pit features, and four Area III column samples.

[27] Multiple sediment samples were taken from many features during excavation.

[28] Their archaeobotanical sampling strategy, methods, and research design were presented in Chapter 2.

Sample Set C: Charcoal Analysis

In order to consider fuelwood selection in relation to feature function and wetland resource use, my integrated dataset includes charcoal analysis. Sample Set C included charcoal from all Sample Set A features, as well as charcoal recovered from four selected Sample Set B features and one associated column. The latter were selected after I reviewed KDC's feature descriptions and the archaeobotanical results for Sample Set B Middle to Late Component thermal features and column samples.

In total, Sample Set C included five hearths, two possible processing pits, and one column sample associated with Feature ZH-q (Table 12; Fig. 9). Four features are associated with the Middle Component, two with both Middle and Late Components, and two with the Late Component.

Laboratory Methods

Sample Set A sediment samples were processed, sorted, and analyzed in the Archaeology Department laboratories at Simon Fraser University (SFU). Archaeobotanical remains were identified to taxa when possible; Nova Pierson (SFU) completed identification of all sorted faunal material. For Sample Set C's fuelwood analysis, I selected, analyzed, and identified to taxa (where possible) charcoal samples for each feature. Laboratory procedures for each stage are described below.

Table 12: Features Selected for Fuelwood Analysis (Sample Set C).

Analysis Sample#	Feature Name	Feature Type	Description	Time period	Sample #
A1	HP	H	Charcoal rich matrix ringed by FAR	MC	126
B1	PA-i	IH	Rock-lined hearth inside ZH-n; within cobbles	MC	122B
B2			Sampled just outside hearth ring		115B
B3	JO	H	Fire-reddened sands & charcoal in large compressed midden-like matrix lined with clay	LC	258
A2	KC-n	H / P	Hearth/sand feature w/ assoc. cobble tools, FAR & orange silty clay	MC	346/ 348
B4			Hearth-like matrix in basal deposits assoc. w/ cobble tools	MC	345/ 349
A3	MJ	IH / P	Patch/pile of yellow sand w/ small bone flecks, dense FAR. Inside structural feature ZH-n.	MC	8A
B5	MA	P	Pit/trench of w/ dark grey silty sand/clay, FAR, charcoal. Bands of light grey clay. Large cobbles/boulders.	LC	1A
A4	Zh-q	P	Large, FAR-dense, smaller thermal features & matrices along edges. Basal layers of clay.	MC/LC	101
B6	Column 3 (assoc. w/ A4)	P	Within northern boundary of Zh-q	MC/LC	657
Key: Feature Type: IH= interior hearth of structural feature, H = hearth, H/P=hearth/processing, P=processing; Time Period: MC = Middle Component, LC = Late Component					

Sediment Processing

All Sample Set A sediment samples were processed by manual bucket flotation at Simon Fraser University’s Archaeology Department, using standard methods described by Pearsall (2010: 14-59). For each sample, I filled the plastic 10-L bucket with lukewarm water and carefully poured in the sediment. Where necessary, I used gentle hand agitation to disperse material; hard clumps were allowed to sit in the water a few minutes to soften. Care was taken not to over-agitate the water and damage remains or to over-saturate charcoal by leaving clumps too long in the water, which would lead to fragmentation during flotation or air-drying (Pearsall 2010: 42; Wagner 1988: 23).

When the *light fraction*, consisting of plant remains, charcoal particles, and similar material, floated to the surface, I then tilted the bucket to slowly pour the water and light fraction into stacked 1.00 and .250 screen meshes. This process was repeated until no more light material floated to the surface. The light fraction was then removed for air-drying on newspaper-covered racks. Once dry, each sample's weight was recorded (Appendix E), before I sifted them through a series of stacked sieves (4.00, 2.00, 1.00, .425, and .250 mm) and a catch pan. When the light fraction sample was small, I sifted the material through 2.00-mm and .250-mm sieves and a catch pan. Each sieve's contents were then weighed and placed into labeled tin containers for storage.

The *heavy fraction* comprised the remaining material in the flotation bucket, primarily lithic fragments, pebbles, bone fragments, and shell. I sieved the heavy fraction using the 1.00-mm mesh screen before placing the material onto drying racks. Once dry, the heavy fraction samples were put into labeled plastic sample bags.

Sediment Sorting

Using a 10x–50x dissecting microscope, I sorted the light fractions in order from the largest (4.00 mm) to the smallest (.250 mm) screen samples. The 4.00-mm and 2.00-mm fractions were sorted for wood charcoal, seeds, plant parts, possible vascular plant tissue, bone, shell, and unidentified organic material[29]. Typically, wood charcoal is not sorted in <2.00-mm splits as the sizes are too small for species or genus identification (Pearsall 2010: 102, 107-109). I scanned the 1.00-mm fraction for bone, shell, seeds, plant parts, and any unusual material; this fraction was the cut-off point for sorting bone because identification is very difficult under 1.00 mm (Stewart et al. 2003: 57-58). The .425-mm and .250-mm fractions were too small to effectively differentiate possible charred vascular tissue using a standard laboratory microscope (Naoko Endo, Pers. Comm. 2011) so these fractions were simply scanned for plant remains, seeds, and unidentified organic material.

I weighed and recorded the heavy fraction, which was then sifted through a series of stacked sieves (4.00, 2.00, 1.00, .425, and .250-mm) and a catch pan. Only the 4.00, 2.00, and 1.00-mm pans were sorted. Under the microscope, I sorted the 4.00 and 2.00-mm fractions for wood charcoal, charred vascular tissue, plant remains, bone, lithic artifacts, and shell. The 1.00-mm fractions were sorted for organic material (e.g., seeds, needles, and plant parts), bone, and shell. As with the light fraction, the cut-offs were 2.00 mm for reliable wood charcoal identification and 1.00 mm for faunal identification.

Taxonomic Identification of Sorted Assemblages

[29] Archaeobotanical materials were stored in tins or small gel capsules and appropriately labelled.

After sorting was complete, I analyzed the archaeobotanical and charcoal remains and identified them to taxa where possible. Nova Pierson analyzed the faunal assemblage and identified them to taxa where possible (Appendix F). The identification methods used for each kind of assemblage are described below.

Archaeobotanical identification

I used standard identification procedures for archaeobotanical analysis, along with reference material (e.g., Jones et al. 2004; Martin and Berkeley 1961; Montgomery 1977; Pearsall 2010) and comparative seed collections compiled by Dr. Dana Lepofsky and Dr. Cathy D'Andrea at Simon Fraser University. KDC also loaned identified archaeobotanical samples[30] from Sample Set B for comparative reference. When I was uncertain of an identification, I consulted my colleagues Naoko Endo, Molly Capper, and Pamela Wadge in the SFU Archaeology Department.

Only charred seeds were considered anthropogenic. If a charred seed had no identifying features or internal characteristics allowing identification, often a result of taxonomic wear and damage, it was deemed unidentifiable. Charred and uncharred seed coats (outer seed coverings) were sorted but given their frequently fragmented state, I made no attempt to identify them. Possible tuberous vascular tissues were sorted and

[30] References for KDC identification included comparative samples, online/published photos, seed catalogues, and other resources (Lyons and Leon 2010: 6).

weighed in grams before storage and labeling. The majority of specimens were too small for further analysis but two were further examined and are discussed in Chapter 4.

Naoko Endo verified all culturally significant seeds and also checked most of the other seed specimens upon request. I noted identified seeds on a standard paleoethnobotanical data sheet form (Appendix G). Where identification was reasonably confident but not 100% certain, "*c.f.*" ("compare") was used before the taxon name. Insect parts, spores, seed coats, and unidentified uncharred plant fibres were noted, but not individually counted.

Faunal identification

Nova Pierson used standard procedures to analyze sorted faunal remains, with reference to the SFU Archaeology Department's zooarchaeological comparative collection and relevant literature. Results are presented in Chapter 4 and Pierson's report (Appendix F).

Fuelwood Analysis: Wood Charcoal Identification of Sample Set C

I analyzed charcoal using established procedures and reference materials (e.g., Friedman 1978; Hoadley 1990; Pearsall 2010; Panshin and de Zeeuw 1980), as well as Dana Lepofsky's comparative charcoal reference collection. Naoko Endo trained me in charcoal identification and assisted in checking my work.

Only ≥ 2.00-mm charcoal fragments were selected. Each specimen was sectioned into tangential, transverse, and radial sides and analyzed under a light reflective microscope at 10X–50X magnification.[31] Identification features included: a) vessels, their arrangement, and presence or absence; b) ray size and arrangement; abundance and nature of parenchyma; c) presence/absence of tracheids; d) presence/absence of spiral thickening; and e) other identifying micro-anatomical features where possible (Friedman 1978; Hoadley 1990; Pearsall 2010: 144-153). Each piece was identified as hardwood, softwood, or unidentified wood, and then further identified to taxa where possible. For each feature sample, I aimed for a minimum of 10 to a maximum of 20 charcoal subsamples from >2.00-mm light fraction sorts, depending on the number and quality of charcoal pieces available for sectioning. If there were few pieces to work with in a light fraction assemblage, I added heavy fraction charcoal (if available) to the sample set to bring the total as close as possible to a minimum of 10 charcoal pieces per feature.

Charcoal identifications were noted on corresponding feature data sheets (Appendix G). I also noted observed characteristics that led to a particular genus and where possible, species identification for each sample (Appendix H). Naoko Endo checked my identifications of the first 20 subsamples and thereafter checked each new species I identified, as well as any specimens I was unsure of.

[31] Some specimens were too fragile to section, breaking apart when touched.

Summary

In order to answer the research questions posed in Chapter 1, I chose the multiple dataset feature analysis strategy to analyze selected features. This integrated approach included (1) typological characteristics recorded in the field; (2) archaeobotanical (seeds and charcoal fragments) and (3) faunal evidence recovered from feature sediments; (4) taxa identification of the charcoal fragments; and (5) pertinent information drawn from KDC’s (2010) analyses of lithic and perishable artifact assemblages. Analysis was supplemented with ethnographic information about Coast Salish and Katzie resource use.

For the study, three Middle Component hearths and one Middle-to-Late Component possible processing pit feature (Sample Set A) were selected for complete analysis of feature sediment sample contents for bone, seeds, and charcoal remains. KDC’s archaeobotanical data (drawn from six features and four columns) was incorporated with permission as Sample Set B, increasing the study’s sample size. For charcoal analysis, I selected three hearth features and two processing features from Sample Set B, and included them with the Sample Set A features to form Sample Set C. Sorting and identification of recovered material was conducted in the SFU Archaeology Department’s archaeobotanical and charcoal analysis laboratories using standard methods and equipment.

Chapter 4: Laboratory Results

The purpose of this thesis is to explore wetland resource use at DhRp-52 in order to develop a better understanding of how site inhabitants interacted with their wetland environment. To that end, the goals of my integrated feature analysis approach are to (1) taxonomically identify seed, bone, and charcoal to species as indicators of wetland resource use and (2) assess feature function in relation to resource use.

In this chapter, I present and discuss (in order) the results of the archaeobotanical, faunal, and charcoal analyses.[32] From charcoal analysis results, I interpret and discuss fuelwood use at DhRp-52. I then offer a brief summary of discussed assemblages, before turning to feature interpretation. I integrate recovered assemblages with other datasets to infer the function and use of Sample Set A features (A1–A4). Finally, I discuss my feature analysis approach and whether it achieved my research goals.

Archaeobotanical Results

Two sets of samples described in the previous chapter, Set A and Set B, were analyzed. Here I present the results of seed and other material identification, followed by

[32] Appendix K provides inventories of identified taxa, with ecological/ethnographic information.

a discussion of archaeobotanical results. I consider the two sample sets individually and altogether in terms of richness, relative abundance, interpreting results, and wetland resource use.

In total, 145 charred seeds were recovered for Sample Set A (Table 13). Due to damage and wear, 108 seeds (75%) were unidentifiable. One unidentified seed labeled "UNID A" was also found, and is described here. A total of 36 seeds were identified to taxa, with an average of nine seeds per feature. Eight seed taxa were confidently identified, while seven are probable identifications. In addition, possible *Liliaceae* (lily family) tissue, tuberous vascular tissues, nutshell fragments, and needle parts were identified.

Sample Set A Unidentified Seed Types

A total of 108 charred seeds were unidentifiable due to damage and wear. Over 50% of recovered seeds in each feature were unidentified. The highest charred seed count (N=65) and percentage (93%) came from interior hearth A3 (MJ).

Unidentified A

One unidentified seed type, "UNID A" (Appendix I: Fig. 1) was recovered from interior hearth A3. UNID A is 1 mm x 0.5 mm in size and oblong to ovoid in shape, with stippled rows of circular punctuations. The proximal end is rounded with a slightly tapered neck, while the distal end is damaged and partially broken off. A seam runs along the seed's ventral side from end to end and the dorsal side is moderately curved.

Table 13: Archaeobotanical Assemblage from Sample Set A.

Identified Taxa		Resource Data		Features Sampled				
Scientific Name	**Common Name**	**Ecology (a)**	**Ethnobot-anical Use (b)**	**A1: HP**	**A2: KC-N**	**A3: MJ**	**A4: ZH-Q**	**Total**
Charred Seeds								
c.f. *Brassica* sp.	Mustard	W/MF/C/Ma	f			1		**1**
Chenopodium sp.	Goosefoot	C	f		2	1	3	**6**
Cheno/amaranth	Goosefoot/ amaranth	C	f		1			**1**
Crataegus sp.	Hawthorn	**W**/MF	F/M/T		1			**1**
c.f. *Cyperaceae*	Sedge	**W**/MF	T		1			**1**
c.f. *Eragrostis* sp.	Stinkgrass	MF/DF/C/M	Unknown		1			**1**
c.f. *Galium* sp.	Bedstraw	**W**/MF/C/Ma	t/d/c		1			**1**
Gaultheria shallon	Salal	W/MF	F/L		1		1	**2**
Liliaceae sp.	Lily family	W/MF/DF/C	F/M/T		1			**1**
Mahonia nervosa	Oregon grape	W/MF/C	F/M/D		2			**2**
Polygonum sp.	Knotweed	**W**/MF	Unknown	4	2			**6**
Polygonum c.f. *hydropiperoides*	Water-pepper	**W**/MF	M/R	1				**1**
Poaceae sp.	Grass family	W/MF/DF/C/ M	f/T/L		2	2		**4**
c.f. *Potentilla* sp.	Cinquefoil	W/C/Ma	F		1			**1**
c.f. *Suaeda maritima*	Seablite	Ma	Unknown				1	**1**
Rubus sp.	Raspberry genus	**W**/MF	F/H/M	5			1	**6**
			Total :	**10**	**16**	**4**	**6**	**36**
UNID A	N/A	Unknown	Unknown			1		1
Unidentifiable	N/A	Unknown	Unknown	17	20	64	7	108
			Total:	**27**	**36**	**69**	**13**	**145**
Other Charred Plant Remains								
UNID fragments	N/A	Unknown	Unknown	5	27	16	14	62
UNID plant node		Unknown	Unknown		1			1
c.f. *Liliaceae* tissue	Lily family	W	F	1				1
c.f. nutshell fragments	Nut	Unknown	F	8				8
c.f. needle parts	Tree needle	Unknown	Unknown				3	3
c.f. vascular tissue (g)		Unknown	Unknown		0.016	0.021		0.037

(a) Wetland (W), moist forest (MF), dry forest (DF), clearings (C), Montane (M), Marine/shorelines (Ma). **Bold** = indicator plant or strongly associated with that zone.
(b) Food (F), technology (T), lining/bedding (L), herbal tea (H), medicinal (M), dye (D), cosmetics (C), ritual (R). Uncapitalized letters mean the use is not regionally specific.

Sources: Ethnobotanical data–James 1998, Kuhnlein and Turner 1991, Turner 1995, Turner and Gustafson 2006; Ecological data–Cronk and Fennessy 2001, Little 2009 [1980], Meidinger and Pojar 1991, Pojar and MacKinnon 2004, Turner and Gustafson 2006.

Other Plant Material

Other plant material was recovered during the sorting stage. Uncharred plant fibres and parts were recovered but not identified or further analyzed because they are considered modern inclusions. One unidentifiable charred plant node approximately 0.8 mm x 0.5 mm in size was recovered from feature A2 (Appendix I: Fig. 2). While the stem itself is largely intact, the tissue around the attachment point is irregularly broken off. Three possible tree needle fragments were recovered from feature A4 (Zh-q), but could not be identified to taxa (Appendix I: Fig. 3). Of greater interest was the recovery of possible vascular tissue, *c.f. Liliaceae* tissue, and possible nutshell fragments, all described below.

Possible vascular tissue

Small amounts of possible vascular tissue were recovered from features A2 and A3. Scanning electron micrograph (SEM) photographs were taken of the tissue recovered from feature A2 and comparative wapato tissue from Dana Lepofsky's collection, but results were inconclusive (Appendix I: Fig. 4a-d). Although the recovered material appears to be vascular tissue, there is no clear identification of characteristics indicating that it is wapato. Further examination with SEM cross-sectioning may help identify the tissues to at least family level, which would be of significant value because there is no clear evidence of wapato in archaeological cooking or processing feature contexts to date.

C.f. Liliaceae tissue

One piece of vascular tissue was recovered from feature A1 and identified as likely belonging to the *Liliaceae* family (Appendix I: Fig. 5). Further analysis using SEM technology may confirm this identification.

C.f. nutshell fragments

Eight charred probable nutshell fragments were recovered from feature A1. The fragments have worn, damaged edges. It is possible that they are beaked hazelnut; as mentioned in Chapter 1, KDC recovered large quantities of beaked hazelnut fragments during the excavation of Area 1 peat and midden matrices.

Sample Set B Assemblage

KDC's earlier archaobotanical project recovered 210 charred seeds from 41 samples representing eight features and four columns, from which a total of 15 plant taxa were identified (Table 14). Three identified taxa are wetland plants (sedges, knotweed, and the raspberry genus) and four taxa can be found in wetland environments (cinquefoil, Oregon grape, red elderberry, and salal). Other identified species in the assemblage are associated with other ecological zones.

Many analyzed seeds were worn and damaged[33], making identification challenging (Lyons and Leon 2010: 15). A total of 44 seeds were unidentifiable. Two unknown seed types were also observed, labelled "T" and "V." Each is described here.

A single seed was labelled "Unidentified T" and described as having an ovate to circular shape, a dull black colour, and spiral grooves encircling the seed (Lyons and Leon 2010: 14). The dimensions are approximately 1 x 1 x 1 mm. The "Unidentified T" seed was located in feature KC-n (A2), while similar seeds were abundant in sampled Area 1 peat. This seed type (T) is similar to that described by Musil (1978 [1963]: 95) of a seed in the *Brassicaceae* family.

In addition, eleven unidentified seeds were labelled "Unidentified V." These are elliptical to ovoid in shape (one end rounded and wide; the other almost straight and tapered), light brown in colour, and with a finely reticulated surface (Lyons and Leon

[33] KDC suggested foot traffic/trampling in the soil was a significant cause.

Table 14: Archaeobotanical Assemblage from Sample Set B (KDC 2010).

Identified Taxa		Resource Data		Hearth Features				Processing Features			Sand Feature	Column Samples	
Scientific Name	**Common Name**	**Ecology (a)**	**Ethnobotanical Use (b)**	**PA-i**	**FO**	**KCn**	**JO**	**Zhq**	**MA**	**HS**	**FO-i***	**N=20**	**Totals**
Charred Seeds													
Amaranthus	Amaranth	C	f						13	1			14
Arctostaphylos sp.	Kinnikinnick	C/DF	T/M					1/?1					1/?1
Carex sp.	Sedge	**W**/MF/C	T					1					1
Chenopodium sp.	Goosefoot	C	F	?2		9			29	2	1/?1	22	63/?3
Cyperaceae	Sedge family	**W**/MF	T						2	1	?2		3/?2
Galium sp.	Bedstraw	**W**/MF/C/Ma	t/d/c									?3	?3
Gaultheria shallon	Salal	W/MF	F/L					1					1
Mahonia nervosa	Oregon grape	W/MF/C	F/M/D	?1				6					6/?1
Polygonum sp.	Knotweed	**W**/MF	Unknown				1	3	11	1			16
Portulaca sp.	Purslane	C	Unknown					2					2

Potentilla sp.	Cinquefoil	W/C/Ma	F			1							1
Sambucus racemosa	Red elderberry	W/MF	F	?2				2/?1				2	4/?3
Rosa sp.	Wild rose	C/DF/MF	F/H/M					15					15
Rubus sp.	Raspberry genus	**W**/MF	F/H/M	?1				6			?1	5	11/?2
cf *Viola* sp.	Violet	MF	Unknown									?1	?1
Total Number of Identified Charred Seeds per Feature				**?6**	**0**	**10**	**1**	**37/?2**	**55**	**5**	**1/?4**	**29/?4**	**138/?16**
UNID T	N/A	Unknown	Unknown			1							1
UNID V	N/A	Unknown	Unknown		11								11
UNID seeds	N/A	Unknown	Unknown			2	7	4	8	7	5	11	44
Total Number of Charred Seeds per Feature				**6**	**11**	**13**	**8**	**43**	**63**	**12**	**10**	**44**	**210**

*Associated with hearth feature FO.

A: Wetland (W), moist forest (MF), dry forest (DF), clearings (C), Montane (M), Marine/shorelines (Ma). **Bolded means indicator plant or strongly associated with that zone.**

B: Ethnobotanical Use: Food (F), technology (T), lining/bedding (L), herbal tea (H), medicinal (M), dye (D), cosmetics (C), ritual (R). **Uncapitalized letters mean the use is not regionally specific**

Sources: Lyons and Leon 2010: Appendix 2; Ethnobotanical data–James 1998, Kuhnlein and Turner 1991, Turner 1995, Turner and Gustafson 2006; Ecological data–Cronk and Fennessy 2001, Little 2009 [1980], Meidinger and Pojar 1991, Pojar and MacKinnon 2004, Turner and Gustafson 2006.

2010: 14). The dimensions are approximately 1.5 x 1 x 1 mm. This seed type was found in abundance in the Wet Site Zone (Lyons and Leon 2010: 14).

Discussion of Archaeobotanical Results

Archaeobotanical richness of Sample Set A was negatively correlated with sample volume (Table 15). Despite having the lowest sediment sample volume, feature A2 was the richest of all sampled features with seven definite and five probable taxa. However, relative abundance for all identified taxa in Sample Set A was low (Table 16). A total of 70% of the recovered plant remains were unidentified and predominantly came from hearth feature A3 (MJ). The four most commonly identified taxa to family or species were goosefoot, knotweed, raspberry genus, and the grass family.

Sample Set B sediment samples were all 1-L in volume. Processing feature Zh-q produced the highest NIT (Table 17) with nine identified taxa, seven of which are ethnographically known traditional Coast Salish resources. The most common seeds in Sample Set B were goosefoot (N=66; 21%) and unidentified seeds (N=44; 16%).

The 20 column samples in Sample Set B were taken by KDC to reveal strata changes in particular site areas, and it is useful to compare column sample results against those of the cultural features from both Sets (Tables 16, 17; Fig. 10 and 11). Such a comparison indicates that the abundance of goosefoot most likely represents accidental inclusion. This is because if goosefoot was cultural in origin, it would be present in smaller amounts or not at all within non-cultural column samples. The lone exception

Table 15: Archaeobotanical Richness of Sample Set A Features.

Feature	Feature Type	Sample Vol. (ml)	NIT
A1 (HP)	Hearth	1000	3
A3 (MJ)	Hearth/Processing	900	3
A4 (ZH-q)	Processing	850	4
A2 (KCn)	Hearth/Processing	600	11

Table 16: Relative Abundance of Seed Taxa from Sample Set A (4 features).

Charred Seed Taxa (N=145)	Number of Charred Seeds	Relative Abundance (%)
UNID Seeds	108	74.48
Goosefoot	6	4.14
Knotweed	6	4.14
Raspberry genus	6	4.14
Grass family	4	2.76
Salal	2	1.38
Oregon grape	2	1.38
c.f. Mustard	1	0.69
Goosefoot/ amaranth	1	0.69
Hawthorn	1	0.69
c.f. Sedge	1	0.69
c.f. Stinkgrass	1	0.69
c.f. Bedstraw	1	0.69
Lily family	1	0.69
cf Water-pepper	1	0.69
cf Cinquefoil	1	0.69
cf Seablite	1	0.69
UNID A	1	0.69

Table 17: Archaeobotanical Richness of Sample Set B Features and Columns.

Feature	Feature Type	# of 1-liter sample bags	Seed NIT
ZHq	Processing	4	9
4 Columns	Column	20	5
PAi	Hearth	2	4
MA	Processing	4	4
HS	Processing	2	4
Foi	Sand	1	3
KCn	Hearth/Processing	1	2
JO	Hearth	4	1
FO	Hearth	2	0

may be the clay-lined processing feature MA, from which 29 charred goosefoot seeds were recovered. That abundance is much higher than the average of three goosefoot seeds recovered from other features in Sample Sets A and B. Although not regionally known as a culturally significant plant, the goosefoot found in feature MA may possibly be either a food source or vegetable lining (Ormerod 2002: 34).

The origin of the single recovered seablite seed from feature A4 is more certain. Seablite grows in saltwater marshes, tidal flats, and beaches (Pojar and MacKinnon 1994: 310). The polder was originally marine shoreline before the delta's westward drift and pollen analysis confirmed the presence of a beach plant (*Convulvus* sp.) in peat samples coinciding with early site soils (Mathewes 2009: 3). I have found no ethnographic mention of seablite as a traditional food resource for indigenous peoples. If non-cultural, the seablite seed was likely deposited by wind, water, or foot traffic onto the upland area during the Early Component and then added to Middle to Late Component cultural matrices through soil disturbance during the feature's creation and use.

Of the plant taxa identified in Sample Sets A and B (Tables 13, 14), 12 identified taxa (three to family) and one probable taxa have known regional traditional use for food, medicine, technology or ritual purposes. Of these, six are wetland plants (i.e., bedstraw, hawthorn, knotweed, raspberry genus, sedge, and the probable water-pepper) and four are wetland-associated (i.e., cinquefoil, Oregon grape, red elderberry, and salal). Oregon grape, the raspberry genus, red elderberry, and salal are considered important cultural resources for Coast Salish, including the Katzie. Their presence in analyzed features is likely cultural in origin. Water-pepper, which strongly co-occurs with wapato on site

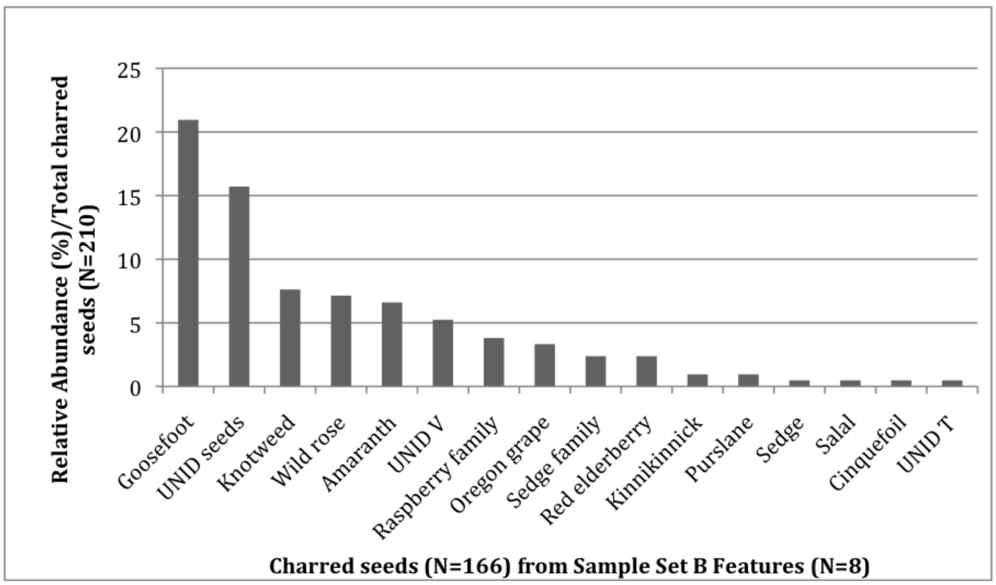

Figure 10: Relative abundance (%) of charred seeds (N=166) from Sample Set B features (N=8; 21 one-litre samples), excluding column samples.

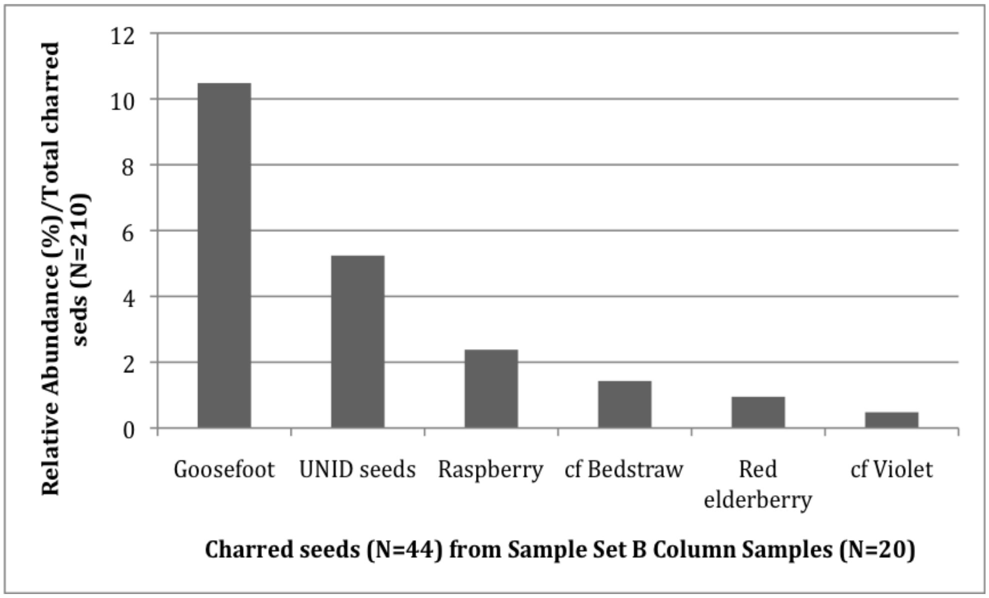

Figure 11: Relative abundance (%) of charred seeds (N=44) from Sample Set B column samples (N=20).

(Mathewes 2009: 3), may have been used for ritual or medicinal purposes (Suttles n.d., cited in Lyons and Leon 2010:12).

Other ethnographic records document the mixing of Oregon grape with other berries[34] such as salal (Kuhnlein and Turner 1991: 136-137), which may explain their co-occurrence in the features analyzed. The presence of berries might suggest site occupation in summer and early autumn (Lyons and Leon 2010: 13). However, dried

[34] Oregon grape contains berberine, a potentially toxic alkaloid drug if taken in large doses (Turner and Szczawinski 1979: 40). It is possible that mixing them with other berries may reduce the drug's potency.

berry cakes were eaten throughout the year so this could also explain seed inclusion, particularly in the context of hearth features within habitation structures.

Faunal Analysis Results

In this section, I present Sample Set A's faunal assemblage, with discussion of identified taxa in terms of ethnographic information, taphonomic factors, and the implications for site activities and resource use. All Sample Set A features yielded faunal remains except for feature A4, the probable processing pit (Table 18).

Table 18: Sample Set A Faunal Assemblage.

Taxa: element type	MNI	Ubiquity (%)	A1: HP	A2: KC-n	A3: MJ	A4: ZHq	NISP/ Taxa
Unidentified Fish elements	1	25			2		2
Dogfish: teeth	2	50		1	5		6
Cartilaginous Fish: cartilage fragments	1	25		9c			9
Three-spine stickleback: scutes	min.15	25			18c		78
Three-spine stickleback: spines	max. 30				60c		
Northern pikeminnow: vertebrae fragments	1	25			8c		8
Salmon: vertebrae fragments	2	50	22c/1b		7c		30
Pacific littleneck: shell fragment	1	25		1			1
Total NISP:			**23**	**11**	**100**	**0**	**134**
Key: MNI= minimum number of individuals; NISP = number of identified specimens; c = calcined; b = burnt							

In March 2011, Nova Pierson analyzed and identified faunal material using standard procedures (Appendix F). To aid identification, Pierson utilized SFU's comparative zooarchaeological reference collection; in the case of three-spine stickleback (*Gasterosteus aculeatus*), which was absent from the collection, she utilized previously identified spines and photographs of scutes (Casteel 1976). Samples were generally delicate and often fragmented, hindering identification. The majority of elements were fragile and calcined.

A total of 134 bone elements were identified, representing dogfish (*Squalus acanthias*), northern pikeminnow (*Ptychoeilus oregonensis*), and three-spine stickleback (to genus), as well as unidentified fish and shellfish fragments. Unidentified calcined fragments and fish elements were observed but not counted in features A1, A2, and A3 (Appendix F). A single invertebrate shell fragment was identified as Pacific littleneck clam (*Leukoma staminea*). As shown in Table 18, feature A3 produced the highest number of identified taxa (NIT=4) and number of identified specimens (NISP=100), comprising 74% of the study's faunal assemblage. In contrast, feature A4 yielded no faunal material at all.

Discussion of Faunal Results

The faunal assemblage represents five aquatic species recovered from three Area III Middle Component features: dogfish, Pacific littleneck clam, northern pikeminnow, salmon, and three-spine stickleback. Although Coast Salish ethnographic information is sparse for dogfish and nonexistent for northern pikeminnow and three-spine stickleback, there is archaeological evidence for past use of these fish in other regional sites (e.g., Kristensen et al. 2009: vii, 188; Casteel 1976: 83; Rousseau et al. 2003: 102). Based on the number of dorsal spines in stickleback (2–4), I calculated a minimum MNI of 15 sticklebacks and a maximum MNI of 30 from the 60 spines recovered from interior hearth feature A3 (MJ).

Both salmon and marine sticklebacks are anadromous and can be seasonal indicators of site use. However, seasonal runs vary with salmon species from May through October and only DNA analysis can identify the exact species for recovered salmon elements (Speller et al. 2005: 1379). Salmon (with or without bone attached) could also have been stored year-round, such as in the inferred storage feature ZH-o (see Chapter 2). While marine sticklebacks arrive in freshwaters between mid-May and late summer, there is also a permanent freshwater variant in the lower Fraser River (Matson and Coupland 1995: 74; McPhail and Carveth 1993: 55)[35]. As with salmon, it is not possible to differentiate between variants in bone elements without DNA analysis. In addition, all stickleback bones and some salmon elements were recovered from an interior hearth, where dried fish could have been eaten in the winter.

Pacific littleneck is a maritime shellfish and possible explanations for its presence include (a) trade with groups living by the ocean, (b) interaction with neighbouring groups with direct maritime access, and (c) site inhabitants travelling to the marine shoreline to gather shellfish themselves. From the present-day Pitt Polder, the nearest marine shellfish habitat is the head of the Burrard Inlet 15 km overland or 32 km downriver at the Fraser river’s mouth (Rousseau et al. 2003: 103). During Middle Component times (5300–4250 cal BP), the site would have been even closer to the river

[35] Citation of stickleback as a seasonal indicator for Fraser Delta sites (e.g., Matson 1976: 93-94) likely stems from reference to large Gulf Islands assemblages, where only the marine variant occurs. In contrast, few stickleback elements have been recovered in Fraser Delta sites to date (e.g., see Butler and Campbell 2004).

mouth, perhaps a half-day by canoe (Fig. 2).

Faunal results contrasted with previous work at DhRp-52, where no identifiable faunal remains had been recovered. It is notable that the majority of recovered elements came from heavy fraction sorting, whereas KDC's archaeobotanical project only sorted the light fraction (Lyons and Leon 2010: 6). The heavier >1.00-mm faunal elements are more easily identified than the <1.00-mm fragments likely to be found in light fraction material (Stewart et al. 2003: 52). In addition, the use of slow manual bucket flotation may have reduced faunal damage in comparison to KDC's adapted bucket system.

The faunal assemblage was similar to comparative assemblages from other Fraser delta sites (e.g., Glenrose Cannery, Port Hammond, Park Farm), although with significantly larger NISP for stickleback and pikeminnow. A total of 92.5% of recovered faunal elements were calcined, not surprising as calcination greatly aids faunal preservation, especially in moist temperate environments where bone can completely decompose (Whyte 2001: 438). Presuming that mammal and/or bird bone had been present at one time, their absence in the samples could be explained by adverse acidic soil and the fragility of bird bones.[36] Likewise, the absence of fish heads or other large fish elements may be a result of preservation differences, hearth cleaning and refuse removal, possible fish preparation in a different area, and/or the consumption of smoked and dried fish parts. Recovered fish remains support Wilkerson's (2010: 43) hypothesis that

[36] Sampling of more hearths is needed to explore this point.

salmon/fish processing occurred on-site, which she based on recovered ground slate knives.[37]

Although the faunal assemblage provided information about fish consumption by site inhabitants and supplemental evidence for feature function and use, it did not contain any wetland resources. While three-spine stickleback and northern pikeminnow can be found in wetland sloughs, their primary habitats are rivers and lakes (McPhail and Carveth 1991: 30-31, 55). The same is true of salmon, which the Katzie fished from the Fraser river and the North and South Alouette rivers (Suttles 1955).

Charcoal Analysis Results

In this section, I present the results of charcoal analysis, which involved all Sample Set A features and four additional features from Sample Set B. I discuss the results in terms of taphonomy, richness, and the identification of wetland taxa. Finally, I consider the assemblage's implications for fuelwood use at DhRp-52, with particular attention to the selection of wetland-associated taxa.

A total of 116 charcoal pieces were analyzed, ranging from five to 27 pieces per feature (an average of 11.6 pieces per sediment sample). From these, eight taxa were positively identified and three were given probable identifications (Table 19). A total of 31 charcoal pieces (26% of the assemblage) were unidentifiable. Raw counts and

[37] At the time Wilkerson wrote her thesis, no identifiable faunal remains had been recovered.

identification notes are listed in Appendix H.

As shown in Table 19, all seven sampled features contained both softwood (conifers) and hardwood (deciduous) charcoal. Pieces identified as “hemlock or true fir” were ubiquitous and may represent either species, since both were positively identified in the assemblage. Maple and cottonwood/aspen pieces were common, while alder, Pacific crabapple, and the probable spruce and Pacific yew are represented by a single charcoal piece each.

Table 19: Sample Set C Charcoal Assemblage.

	Hearths			**Hearths or Proc. pits**		**Processing Pits**		**Total fragments**	**Ubiquity (%)**
Identified Taxa	**PAi**	**HP**	**JO**	**KCn**	**MJ**	**Zhq**	**MA**		
Acer sp. (Maple family)	9	7		13		6	1	**36**	71.4
c.f. *Acer* sp.	1		4				1	**6**	42.5
Alnus sp. (Alder)		1						**1**	14.3
c.f. *Picea sitchensis* (Sitka spruce)					1			**1**	14.3
Populus sp. (Cottonwood or aspen)	2	2	2	3		1		**10**	57.1
c.f. *Populus* sp.						1		**1**	14.3
Pseudotsuga menziesii (Douglas fir)		1		1		1		**3**	42.5
c.f. *Pseudotsuga menziesii*	2							**2**	14.3
Malus fusca (Pacific crabapple)				1				**1**	14.3
c.f. *Taxus brevifolia* (Pacific yew)				1				**1**	14.3
Tsuga/Abies (Hemlock or True fir)	2	5	1	1	1	9	1	**20**	100
c.f. *Tsuga/Abies*					1			**1**	14.3
Tsuga heterophylla (Hemlock)			1			1		**2**	28.6
Unidentifiable Conifer (Softwood)				3	4	4	2	**13**	57.1
Unidentifiable Deciduous (Hardwood)	3		2	4	2	1	3	**15**	85.7
Unidentifiable Wood:	1				1	1		**3**	42.9
Total analyzed fragments:	**20**	**16**	**10**	**27**	**10**	**25**	**8**	**116**	
Softwood (S)/Hardwood (H) Presence:	**S/H**	**S/H**	**S/H**	**S/H**	**S/H**	**S/H**	**S/H**		

Discussion of Charcoal Analysis Results

Only charcoal pieces 2 to 4 mm in size were selected for analysis, which may have skewed results due to size variation among charcoal taxa. However, I was able to identify to genus or species 71 (61%) of the charcoal specimens. Charcoal fragility and in some cases, a lack of ≥ 2.00-mm pieces for analysis, limited the number of specimens selected for some features. Warping and distortion of sectioned charcoal surfaces was frequently observed. As a result, of the total 116 samples examined, three charcoal pieces were unidentified (3%), 14 were only identifiable as conifers (12%), and 15 as deciduous wood (13%). In addition, 12 pieces (10%) were given probable classifications (i.e., "c.f." designation).

In terms of richness, feature KC-n once again produced the highest NIT (Fig. 12). There does not appear to be a distinct correlation between charcoal richness and feature type or whether the feature was located inside a habitation structure or open-air. Individual features were not sampled to redundancy; however the cumulative charcoal analysis curve is starting to level off (Fig. 13), suggesting that the total sample richness is approaching true population richness. Both coniferous and deciduous taxa were found in all sampled features (Table 19).

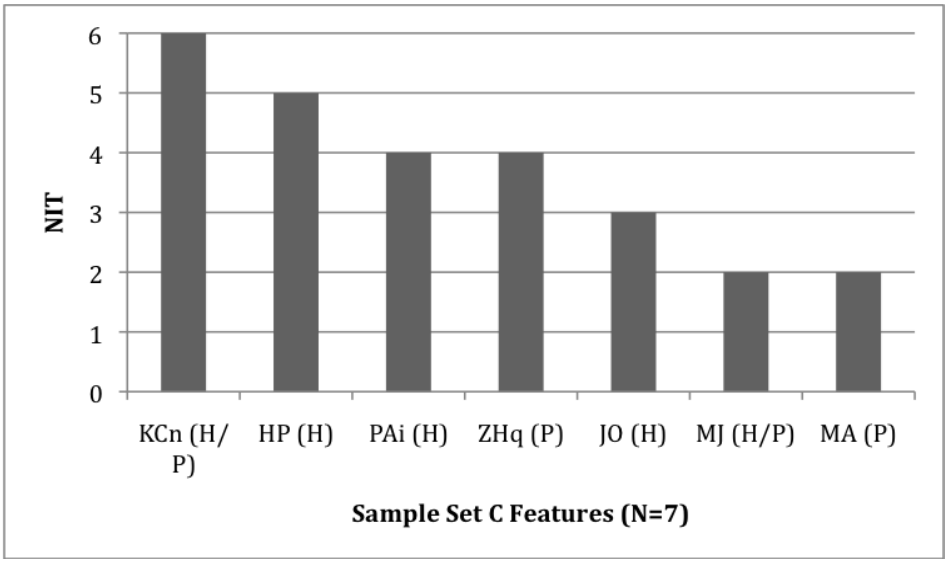

Figure 12: Charcoal Richness by Feature (N=7) for Sample Set C. Feature Types: H/P=hearth/processing, H=hearth, P=processing.

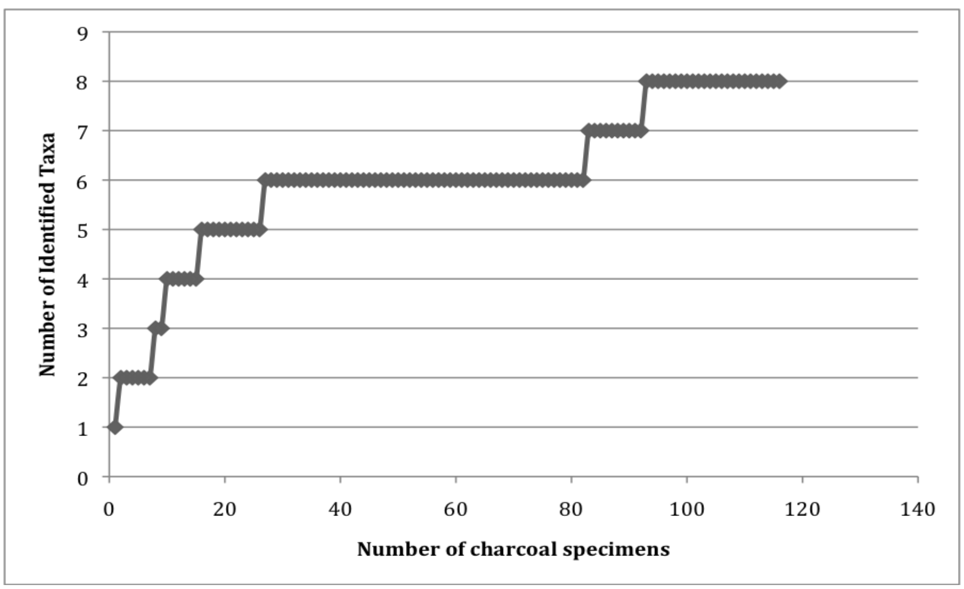

Figure 13: Charcoal assemblage randomized sampling to redundancy curve.

Identified taxa are found regionally; many are commonly found together in mixed stands (e.g., spruce, cottonwood, hemlock, and yew) (Klinka et al. 1989: 66, 181; Pojar and MacKinnon 2004 [1994]: 40). Maple, alder, Pacific crabapple, and Sitka spruce are today found on floodplains and stream banks (Klinka et al. 1989: 68, 75, 165; Pojar et al. 1991: 96); cottonwood, aspen, alder, and Pacific crabapple can be found on nitrogen-rich wetland soils (Cronk and Fennessy 2001: 7, 9, 41). Sitka spruce is therefore a candidate for the *Picea* sp. pieces. Both hemlock and fir are present in pollen samples from DhRp-52, so the absence of confirmed Pacific silver fir in the charcoal assemblage does not rule out its use by site inhabitants for fuelwood or other purposes.

Fuelwood Use at DhRp-52

I cannot infer changes in fuelwood use over time or the absence of specific taxa from the charcoal assemblage due to the variation in number of analyzed fragments per feature, with the majority (63%) representing Middle Component contexts. In addition, fewer Late Component features were sampled. However, results suggest some general selection preferences (Table 20).

All identified wood taxa would have been available near the site, often in mixed stands. Douglas fir, spruce, true fir, and pine were also identified in pollen analysis (Mathewes 2009). The absence of redcedar is not surprising given that it sparks and is

Table 20: Wood Taxa and Ethnographic Fuel Value.

		Feature Type:	Hearths**			Hearths & Ovens		Processing Pits	
		Time Period:	MC	MC	LC	MC	MC	MC/ LC	LC
		Inside structural features (I) or Outside (O):	I	O	O	O	I	O	O
Taxa	Ethnographic Fuel Value*	MBTU per cord	PAi (B1/ B2)	HP (A1)	JO (B3)	KCn (A2/ B4)	MJ (A3)	Zhq (A4)	MA (A3)
Coniferous Taxa (Softwoods)									
c.f. *Picea* sp. (spruce)	Moderate	12-15					X		
Pseudotsuga menziesii (Douglas fir)	Excellent (drops branches, easy fuel collection)	17.4	c.f.	X		X		X	
c.f. *Taxus brevifolia* (Pacific yew)	Unknown	?				X			
Tsuga/Abies (hemlock or True fir)	Unknown	13-15	X	X	X	X	X	X	X
Tsuga heterophylla (hemlock)	Unknown	15.3			X			X	
Deciduous Taxa (Hardwoods)									
Acer sp. (maple)	Excellent (Drops branches, easy fuel collection. Big-leaf maple burns hot w/no smoke)	17.9	X	X	c.f.	X		X	X
Alnus sp. (alder)	Excellent (smoke, low pitch)	14.8		X					
Populus sp. (cottonwood or aspen)	Excellent (smoke)	12.6-13.7	X	X	X	X		c.f.	
Malus fusca (Pacific crabapple)	Unknown	?				X			

*__Source:__ Drawn from ethnobotanical literature (Appendix J); BTU values sourced from https://chimneysweeponline.com/howood.htm.

Key: moderate=known fuel use; Excellent=high preferred; (traits). 1 MBTU= one million British Thermal Units (amount of thermal energy required to raise one lb of water 1 degree F).

generally poor fuelwood. However, smoke-producing fuelwoods (e.g., alder, cottonwood/aspen) were identified in interior feature PA-I, as well as in exterior hearths.

Four of the nine identified taxa are considered excellent fuel (Kuhnlein and Turner 1991; Turner 2001). The probable Sitka spruce is considered moderate fuel quality and the single identified fragment comes from hearth/processing feature A3. There is no ethnographic information concerning fuelwood use of hemlock, yew or Pacific crabapple. Fewer charcoal fragments (N=33; 28.4%) were analyzed for processing pit features, which may have skewed results. Even so, results indicate fairly consistent selection of good quality fuelwood, particularly from deciduous species. In addition, Douglas fir and maple drop their branches (Lepofsky 2004: 406), making them easy to collect and likely increasing the fuelwood value of these tree species.

Given Sample Set C's charcoal richness (N=8 taxa; Fig. 12), as well as the density and quality of charcoal observed in many feature samples at DhRp-52 (KDC 2010), I believe that additional and expanded charcoal analysis of sediment samples from other hearth and processing pit features at the site will shed light on changes in fuelwood use and taxa selection over time. Such work could also reveal additional new taxa and more information about the use of wetland-associated trees.

Summary of Discussed Assemblages

The floral and faunal assemblages suggest the use of plants (Oregon grape, red elderberry, raspberry genus, salal, and wild rose), fish (dogfish, northern pikeminnow, salmon, and three-spine stickleback), and shellfish (Pacific littleneck) for food; six confirmed tree species (alder, cottonwood/aspen, Douglas fir, hemlock, maple, and Pacific crabapple) and two probable tree species (spruce and yew) as possible fuelwood; and sedge, and in the case of feature MA, goosefoot as possible vegetable lining. The probable water-pepper, a species that strongly co-occurred with wapato at DhRp-52, may have been used as medicine. Sedge, water-pepper, and the raspberry taxa are wetland plants, and alder, aspen, cottonwood, and Pacific crabapple are wetland-associated.

Feature Interpretation

As detailed in Chapter 3, four features (Sample Set A: A1–4) were selected for multiple dataset analysis with the two-fold purpose of identifying indicators of wetland resource use and assessing the function of analyzed features. These aims were intended to support the larger research goal of exploring wetland resource use at DhRp-52. As explained in Chapter 3, I chose a multiple dataset feature analysis approach because the integration of different lines of evidence would allow finer interpretation of feature function and wetland resource use. In a wetland site with rare preservation of organic materials, this approach maximizes the data to be gained from features, particularly in regards to resources and human activities that tend leave a light footprint on the landscape.

The data I used for analysis included archaeobotanical, zooarchaeological, and charcoal analyses, information on feature descriptions and characteristics, any artifacts found within or in direct association with analyzed features, and any additional relevant analyses (e.g., pollen analysis). In this section, I integrate these datasets to analyze, discuss, and interpret the functions of each Sample Set A feature (A1-A4).

A1: Feature HP

This feature is a dense charcoal layer irregularly ringed by FAR, which is located on the western edge of feature A4 (Fig. 9). The feature is interpreted as an outdoor hearth used for different purposes (e.g., cooking, debris burning), based upon the dense charcoal layer, the mixture of hardwood and softwoods with different fuel properties (e.g., burning hot or producing smoke), the FAR ring delineating the feature, and the faunal and archaeobotanical assemblages. Feature A1's charcoal assemblage (N=16) is dominated by ethnographically valued fuel (68%). The probable water-pepper present (if identification correct) may have been used for ritual or medicinal purposes (Suttles n.d., cited in Lyons and Leon 2010: 12). The small hearth size, lack of FAR inclusions, and the presence of both salmon remains and smoke-producing hardwood supports a hypothesis that this feature may also have been used to smoke food (Ormerod 2002: 12). The only associated artifacts are a sandstone core and a hammerstone (KDC database). The lithic artifacts may indicate nearby core reduction activity, but their function is uncertain (Wilkerson 2010: 11).

A2: Feature KC-n

Feature A2 is a concentration of sand, orange silty clay, charcoal, and FAR, located west of feature A4 (Fig. 9). The feature contained charred seeds [NIT=11; the highest NIT in Sample Set A] and seafood [NIT=2], including species of ethnographically known economic value (raspberry genus, salal, and Oregon grape). The charcoal assemblage [N=27; NIT=6; the highest NIT in Sample Set A] is dominated by ethnographically valued fuelwood (63%). There is no ethnographic information for the use of Pacific yew and crabapple for fuel. While the lack of ethnographic data does not rule out their use as fuelwood in the distant past, these taxa are small trees that produce limited quantities of wood. In addition, yew is particularly valued for bow-making. In this feature, the source of these taxa may be incidental twigs or woodworking debris. Feature A2 contains a mixture of hardwood and softwood with different fuel properties, which may represent different hearth-use events or cultural preferences. Taken together, the lines of evidence suggest feature A2 was a hearth used for multiple purposes. Two recovered flakes may be accidental inclusions or suggest incidental toolworking near the feature.

Feature A2 may also have been used for small-scale food processing. This possible dual use is suggested by: 1) the diversity of faunal and plant taxa; 2) two recovered boiling stones; 3) recovered possible vascular tissue from a tuberous plant, such as wapato and camas (*Camassia* ssp.) bulbs—which are typically cooked in earth ovens; and 4) high concentrations of grass phytoliths in the feature (McNamee 2010: 9, 16). While it is unclear if the phytolith source is environmental or a by-product of cultural activity, sedges and grasses are ethnographically recorded as lining or wraps for food cooked in earth ovens (Kuhnlein and Turner 1991: 98-99; Turner 2001 [1998]: 113-212).

A3: Feature MJ

Feature A3 is fairly large (44 cm wide by 97 cm long) and is located within presumed structural feature ZH-n (Fig. 11). The feature's charcoal assemblage contains several probable softwood species, all locally available and of moderate fuelwood value. Unidentifiable hardwood pieces were also observed. The absence of taxa that produce smoke or sparks would be practical for an interior hearth, but that inference is hypothetical given the small sample size of analyzed fragments (N=10). Friable charcoal[38], observed in Features A3 and A4, is associated with rapid heating at high temperatures (Forest Products Laboratory 1961: 89). The calcination of faunal elements and high number of unidentifiable seeds (N=64; 92%) also suggest high heat.

Feature A3 produced 100 faunal elements, 98 of which represented four fish taxa, in addition to 64 charred seeds, four of which represented three seed taxa. The few identifiable seeds cannot be conclusively considered cultural. However, given the quantity of recovered charred seeds, it is unlikely that all are accidental inclusions. Unidentified vascular tissue was also recovered, but in amounts too small (0.021 g) for feature interpretation.

A total of 81 artifacts were found within or in direct contact with feature A3, including boiling stones (N=24; 21 heat-treated), flakes (N=11), worked (N=14) and unworked (N=29) raw lithic material[39], and one bead, abrader, and chopper apiece. However, lithics appear to be generally distributed throughout structural feature ZH-n (Wilkerson 2010: 45), therefore feature A3's lithic debitage may have been purposefully

[38] Charcoal that is loose and crumbly.
[39] This is KDC's classification; no further details given in KDC 2010.

or incidentally swept into the hearth. It is unclear what the recovered chopper and abrader were used for. In all, results suggest that feature A3 was a multi-purpose interior hearth used for providing heat and light, cooking seafood and plants, boiling or roasting activity, and as a place of waste disposal.

A4: Feature Zh-q

Feature A4 is a large pit or trench (over 2 m deep, 10.5 m wide, and 11.5 m long) that is lined with clay. It also contains >12 tonnes of FAR. The feature's charcoal assemblage contained a mix of hardwood and softwood taxa, all locally available and three of which are considered excellent fuelwood (Table 20). Both smoke-producing (i.e., cottonwood or aspen) and non-smoking (i.e., maple) taxa were identified. Taxa richness may indicate repeated feature use or a series of superimposed modified pits in the same area[40].

The charred seed assemblage (N=13; unid=7; identified taxa=4) resembled Sample Set B's results for feature A4 (Table 5; Lyons and Leon 2010). The presence of both salal and raspberry taxa mirrors ethnographic documentation of salal mixed with other berries (Turner 1995: 51, 63, 68, 117). The hawthorn seeds may have come from cooked hawthorn berries, traditionally eaten by the Katzie, or the use of hawthorn boughs as pit linings or covers (Suttles 1955: 27). Seablite is associated with sand beaches; the

[40] This feature was heavily disturbed over time, thus its stratigraphy was difficult to interpret.

single recovered seablite seed likely came from Early Component matrices dredged up during feature creation or reuse and it is presumed non-cultural. Phytolith analysis of feature A4 indicated heavy concentrations of grass species, but it is unclear if the source is cultural or natural in origin (McNamee 2010: 8-9). The lack of faunal remains may reflect specialized feature use for plant processing.

Feature A4's FAR distribution and density increase significantly from the Middle to Late Component, with two discrete concentrations of FAR eventually merging into one large concentration (Homan et al. 2010: 160). This pattern suggests increasingly intensive and repeated feature use. The feature is so large and heavily disturbed that it is difficult to draw inferences from artifact distributions. An additional confounding factor is the feature's possible secondary use as a refuse dump, suggested by the high percentage of broken lithic artifacts present (Homan et al. 2010: 153). Given the density and distribution of disc beads across the site, the disc beads lining feature A4's margins are likely the result of soil disturbance rather than deliberate cultural placement (Wilkerson 2010: 46).

Feature A4's shape, size, FAR density, and other characteristics are similar to ethnographically documented earth ovens used to cook large amounts of food for storage, (e.g., camas bulbs, red elderberries or wild onions), particularly root tubers (Barnett 1955; Ormerod 2002: 9). FAR piles are characteristic of dismantled or repeatedly used earth ovens (Ormerod 2002: 9-10). Feature A4 has large quantities of FAR piled on its northeastern end, possibly because used and crumbled-down FAR was pushed there before new rocks were laid down (Peter Locher, pers. comm. 2007; Wilkerson 2010).

The feature is also similar to the clay-lined steaming pits/ovens described by Patenaude (1985a: 13-14), in that it has a clay lining, post moulds along the feature's northeastern margin, and no clear signs of use as a fire pit.

Taken altogether, the evidence suggests feature A4 may represent a heavily used steaming/earth oven or series of ovens within a specialized processing area (Huddlestan and Homan 2010: 136). Large-scale plant processing is one explanation for such a large and heavily-used processing area. It may also have been used as a refuse dump, either intermittently or after feature use as an oven. Wilkerson (2010a: 32) suggested that people may have continued to use feature A4 after site abandonment as a habitation area.

Feature Analysis As a Research Tool

In Chapter 3, I presented the four primary approaches to feature analysis—descriptive, spatial, single dataset, and multiple dataset. A multiple dataset approach was chosen for this study in order to integrate complementary data and overcome the limitations of a single dataset or descriptive approach. My rationale was that a multiple dataset approach would increase the likelihood of finding meaningful data that would allow finer interpretation of feature function and test preliminary classifications of analyzed features. Feature contents, contexts, and inferred functions were then used to infer resource use by site inhabitants, particularly wetland resources. Here, I assess the utility of this feature analysis approach to my research objectives of (a) identifying indicators of wetland resource use in seed, bone, and charcoal assemblages, and (b) assessing feature function in relation to resource use.

In regards to identifying indicators of wetland resource use, the multiple dataset feature analysis of Sample Set A produced some useful data. Of 28 identified taxa recovered from feature contexts, there were five confirmed and two probable wetland indicator species (64%), as well as three confirmed and two probable wetland-associated species (18%). Of these, four are confidently considered cultural taxa (Oregon grape, raspberry, red elderberry, salal), while others (e.g., sedge, water-pepper) have possible cultural uses. However, while analyzed features produced evidence for processing activity, it was not possible to link such activity to specific wetland resources.

In regards to inferring feature function in relation to resource use, the feature analysis approach enabled me to build composite pictures of individual features, including information about fire conditions, feature contents, the nature of feature use (e.g., daily use, feature type, potential changes in function), and resource selection. Where little or no data were recovered for one type of evidence, it tended to be balanced out by recovery of others–as predicted prior to this study. Integrating complementary data helped to infer diet and support feature interpretations, such as multiple indicators of high heat point or of feature use as an earth oven. Analytical results were significantly strengthened by integration with DhRp-52 assemblages–particularly perishable artifacts–and supplemental evidence for wetland resource availability and use (e.g., pollen, phytolith and diatom analyses; ethnographic literature).

The approach did present some challenges, primarily as a result of the small sample size. It was not always clear whether evidence was natural or cultural in origin, particularly for archaeobotanical remains. Feature A4's repeated use, heavy disturbance, and its possible use as a refuse dump precluded interpretation of the large number of artifacts recovered from feature contents. Similarly, it was unclear whether feature A2 functioned simultaneously as a hearth and a processing feature or if these represented feature use at different times. In addition, less evidence for wetland resource use was produced than initially hoped.

The preservation of different data sources (e.g., pollen, phytoliths, seeds) were also affected by ecological and botanical traits. For instance, phytolith presence is impacted by environmental conditions affecting silification and the tendency for some plant families to produce more phytoliths than others (Pearsall and Hastorf 2011: 176). Similarly, certain tree and plant taxa (e.g., conifers and grasses) are heavy pollen producers (Adams and Smith 211: 152). These facts can influence the composition of analyzed paleoenvironmental and archaeological records.

I believe that a more robust sampling strategy involving a greater number of features and charcoal assemblages would mitigate identified issues. For instance, comparing archaeobotanical assemblages from hearth and non-hearth contexts would elucidate whether seeds recovered from hearth contexts are cultural in origin. Multiple samples taken from more features in a larger sampling pool could also potentially produce more wetland resource evidence within any faunal, archaeobotanical, and charcoal assemblages.

Despite the challenges, I believe an integrated dataset feature analysis model is of use to other regional archaeological sites, particularly in wetland contexts where rare perishable evidence may be preserved. Traditional plant use and management often leaves a light footprint in the archaeological record (Lepofsky and Lertzman 2008: 140). Integrated data aids the reconstruction of past environments, resource availability, and dietary models, as well as the interpretation of resource use. As discussed in the next chapter, expanded feature analysis at DhRp-52 or similar wetland sites would strengthen the model and help fill in some research gaps in regional archaeology.

Summary

The archaeobotanical assemblages recovered from Sample Set A (N=145) and Sample Set B (N=210) produced 14 identified wetland and wetland-associated taxa, five of which have ethnographically documented cultural use. Including taxa found in other ecozones, nine identified and three probable taxa have known traditional use for food, medicine, technology or ritual purposes. A total of 75% of Sample Set A seeds and 25% of Sample Set B seeds were unidentifiable, due to damage and wear.

The Sample Set A faunal assemblage included 134 identified bone elements representing five aquatic taxa. Identified fish have no particular association with wetland sloughs. The single Pacific littleneck clam element may suggest trade or gifting from a coastal group. While the faunal assemblage added no evidence regarding wetland use, it provided direct and indirect evidence concerning feature function, type of fire used, fish processing activity, possible trade, and the consumption of aquatic resources.

A total of 116 charcoal pieces were analyzed for Sample Set C. All sampled features contained a mix of hardwood and softwood, regardless of feature type. Identified taxa would have been regionally available and five are associated with floodplains and moist soils. In particular, cottonwood, aspen, alder, and Pacific crabapple can be associated with wetland soils. As with the other assemblages, the charcoal analysis results provided direct and indirect evidence for feature function and use. Results also suggested fairly consistent selection of good quality fuelwood (e.g., alder, cottonwood/aspen, maple, and Douglas fir). In addition, some taxa had specific qualities (e.g., self-pruning, smoke production) that may have been selected for.

Multiple datasets were integrated to analyze Sample Set A features (A1 to A4) and infer their functions. Features A1 and A2 were interpreted as outdoor hearths; the latter may also have been used for food processing. Feature A3 was inferred to be an indoor hearth for cooking and boiling/roasting food. Finally, feature A4 was interpreted as a heavily used steaming or earth oven (or series of ovens) within a specialized processing area as well as a refuse midden. The multiple dataset feature analysis approach succeeded in identifying some indicators of wetland resource use, but failed to link processing features to particular wetland resources (e.g., wapato).

Chapter 5: Wetland Resource Use In Context

There is a relatively strong association between hunter-gatherers and wetlands throughout the world, extending from historic times well into the past, and reflected by both archaeological and ethnographic sources. Within the Pacific Northwest, there is ample evidence that hunter-gatherers utilized wetland resources—in some cases opportunistically, in other cases systematically and intensively. However, it is important to distinguish between *general patterns* of land use from *specific instances* of resource use. That is my challenge for interpreting selected features at DhRp-52. Did the site occupants inhabit this place to take advantage of the adjacent wetland resources? Or was the camp location more for convenience or other reasons, with the activities directed to non-wetland resources?

In this chapter, I consider the utility of a multiple dataset feature analysis for evaluating archaeological evidence of wetland resource use at DhRp-52, one of the primary objectives of this thesis. I begin by evaluating the type and strength of evidence obtained from my feature analysis and other sources to better understand their implications for wetland resource use. I then relate this information to the broader pattern of land use, trade networks, and intergroup relations elsewhere in the Pitt Polder area and beyond. In the second part of the chapter, I turn to a wider discussion of wetland resource use in the lower Fraser Valley as revealed by the archaeological record. Finally, I identify directions for future research relative to wetland resource use and feature analysis.

Considering the Evidence

While DhRp-52's location directly adjacent to a wetland is highly suggestive, it is insufficient to demonstrate that site inhabitants actually used wetland resources. The extensive excavation of the site, and the archaeobotanical, zooarchaeological, and other studies (including my own) on recovered materials have provided a wide array of information reflecting tool manufacture and use, subsistence practices, and other site activities. Do any of these datasets provide evidence indicating direct or indirect use of wetland resources?

A second more general question is how did site use change over time, relative to the local environment's development, as revealed through a comparison of the Middle and Late Components? Based on their analysis of DhRp-52, KDC suggested that wetland use began during the Middle Component (5300–4250 cal BP) and increased in the Late Component (4100–3200 cal BP), primarily focused on the wapato patch in Area II (Hoffmann and Huddlestan 2010: 225-226). However, questions remained regarding the nature of wetland resource use during both time periods, particularly the Middle Component.

To address these two questions, I evaluate the strength of four lines of evidence—macrobotanical remains including charcoal analysis, features, perishable artifacts, and lithic artifacts. Table 21 presents the results of this evaluation for both the Middle and Late Components.

I ranked the strength of each category of evidence as (1) strong/direct, (2) moderate/indirect, and (3) weak/indirect. My ranking criteria were: a) the strength of the contextual association of the data with wetlands/wetland resources; b) for plant and faunal taxa, whether they were indicator species of wetlands or their habitat range included other ecozones; c) whether taxa identification was confident or “c.f.”; and d) the strength of inferred feature or artifact type/function in relation to wetland use, including whether they have probable functions unrelated to wetlands.

A rank of 1 (strong/direct) was given to evidence with clear contextual association with wetlands and their use (e.g., confident identification of an indicator wetland species with ethnographic economic value in hearth contexts). If the Rank 1 evidence was a feature or artifact type, its function was considered directly related to wetland resource procurement, use, and/or processing.

A rank of 2 (moderate/indirect) was given to evidence considered indirectly associated with wetland contexts and use, e.g., a taxon that can inhabit wetland environments but also other ecozones, or a wetland plant that may not be cultural in origin. The taxon may have a “c.f” designation rather than confident identification. If the Rank 2 evidence was a feature or an artifact, its function was considered not directly related to wetland use.

Table 21: Evidence for wetland use during Middle and Late Components.

		Wapato	Knotweed	Sedge	Black hawthorn	Pacific crabapple	cf. water-pepper	Bedstraw	Cinquefoil	cf lily family	Oregon grape	Raspberry genus	Red elderberry	Salal	Alder	Cottonwood /Aspen
Dataset	**Evidence**	**Indicator Wetland Taxa**						**Wetland-Associated Taxa**								
Middle Component (5300-4250 cal. BP)																
Archaeobotany	Charred Seeds		3	2	2		3	2	3	3	2	2	2	2		
	Wapato patch	1														
Charcoal Analysis	Wood Taxa					2									2	2
Features	Boiling Stone Caches	3														
	A2 (KC-n)	3		2	2	2								2		
	A3 (MJ)														2	2
	A4 (Zh-q)	3														
Perishable artifacts	Wood tool fragments	2														
Late Component (4100-3200 cal. BP)																
Archaeobotany	Charred Seeds		3	2							2			2		
	Wapato patch	1														
Charcoal Analysis	Wood Taxa															2
Features	Rock pavement	1														
	Boiling stone caches	3														
	A4 (Zh-q)	3														

Key: Evidence Rank: 1=strong/direct; 2=moderate/indirect; 3=weak/indirect.
Source: Cronk and Fennessy 2001; KDC 2010; Lyons and Leon 2010; ethnographic sources listed in Appendix K.

A rank of 3 was given to evidence weakly associated with wetlands and is considered tentative evidence through correlation with higher-ranked evidence (e.g., feature A4).

In this section, I rank and evaluate the evidence for wetland resource use during the Middle and Late Components, respectively. I then compare the two time periods to determine if the evidence indicates changes in site use over time relative to changes in the site's environment.

Middle Component Use of Wetland Resources

Previous research confirmed that site DhRp-52 was first occupied about 5,700 years ago (KDC 2010). By the start of the Middle Component (5300 cal BP), the Fraser's deltaic shift changed the site's environment from shoreline sand dunes to a vegetated knoll surrounded by a young freshwater wetland (Hoffmann et al. 2010d: 206). As plant detritus built up, the wetland changed from a moderate to low-energy riparian wetland into a low-energy peaty marsh where wapato, water smartweed, water milfoil, sedges, water lily and other wetland plants grew. Salal, blackberry/salmonberry, aspen/cottonwood, and other wetland-associated plants grew on the wetland margins, including the knoll's banks.

Previous research suggests Middle Component site occupations were characterized by semi-sedentism, domestic activities, food extraction and processing, woodworking, and possible ritual activities (Hoffmann et al. 2010d). The markedly increased density of FAR over time suggested increasingly intensive processing activity or changes in disposal patterns.

Wetland plant taxa identified in this study with known economic value to the Katzie and other Coast Salish groups include black hawthorn, sedge, and probable water-pepper (Table 21). Pollen analysis indicated that sedge and water-pepper grew abundantly in the site locale (Mathewes 2009: 3); given both the possibility for accidental inclusion and the single water-pepper seed's uncertain (c.f.) identification, the cultural use of these wetland plants is possible but not certain. I consider the identified wetland-associated Oregon grape, raspberry genus, red elderberry, and salal likely cultural in origin and it is possible that they grew on the knoll's bank along the wetland margins. They are considered Rank 2 evidence because their habitat range also includes non-wetland environments.

The presence of a wapato patch adjacent to a habitation site is not evidence of wetland use in and of itself. However, that the patch was associated with the wood tool tip and shaft fragments is strong evidence of wapato harvesting. The Katzie traditionally harvested wapato from September to February, and as Spurgeon (2001: 68) observed, the harvesting season's colder weather could motivate the use of digging sticks instead of the often-reported technique of wading in the water and dislodging the tubers with one's toes (Suttles 1955: 27; Kuhnlein and Turner 1991: 71; Turner 1995: 37). In addition, the rock pavement likely made digging sticks more effective than the wading technique.

I identified one indicator wetland shrub, Pacific crabapple, and three wetland-associated trees, alder, cottonwood or aspen and probable spruce through charcoal analysis. The Pacific crabapple is represented by a single piece found in feature A2 (KC-n) and it is unclear whether the specimen represents fuelwood, an accidental inclusion, or (for instance) woodworking debris that was deliberately swept into the fire. As such, while it is an indicator species, it is considered Rank 2 as possible evidence for wetland resource use (acknowledging that this species habitat is not restricted to wetlands).

The wetland-associated tree taxa identified in Sample Set C are commonly found in floodplains and can be found in nitrogen-rich wetlands. For example, alder is represented by a single piece in feature A1 (HP), while cottonwood/aspen was identified in three out of four Middle Component features. These taxa are ethnographically considered excellent fuel and they likely represent deliberate fuelwood selection.

No analyzed Middle Component features were directly associated with wetland use. Features A2 and A3 are included in Table 5.1 because their contents produced wetland taxa and/or wetland-associated taxa that represent possible (Rank 2) evidence of wetland use. The possible vascular tissue and boiling stones in hearth/processing feature A2 is weak evidence for wapato processing and thus wetland use.

Feature A4 has been interpreted as a large steaming oven and/or earth oven (or series of ovens) located within an intensive processing area (Huddlestan and Homan 2010: 135). The feature's similarity to clay-lined pits posited to be steaming ovens at other sites (Patenaude 1985b: 11-14), the presence of a site-adjacent wapato patch, the ethnographically documented use of similar earth ovens for steaming or baking roots and bulbs (Barnett 1955: 60), and the presence of an inferred storage structure (feature ZH-o) support an hypothesis that wapato were processed at the site. However, in the absence of direct association with wapato, the feature is considered weak evidence of wapato processing (Rank 3).

Late Component Use Of Wetland Resources

By ca. 4000 cal BP, micro-habitats formed on the knoll and surrounding lowlands (Hoffmann e al. 2010b: 211). At that time, wapato, milfoil, and sedges are known to have grown in marsh areas where water levels fluctuated, while aquatic plants such as water lily and pondweed grew in more hydrologically stable parts of the marsh. The bank bordering the knoll was vegetated by shrubs and flowering plants (e.g., goosefoot, pigweed, salal, and *Rubus* sp.), and surrounding areas contained a forest dominated by Douglas fir, red alder, Western hemlock, spruce, and redcedar.

By the Late Component, the knoll was heavily modified by centuries of human activity. The Late Component occupations of the site (over approximately 900 years) were characterized by house pit habitation, continued modification of the knoll surface (e.g., excavation and filling of pits), processing activities, and possible wapato cultivation/enhancement (Hoffmann et al. 2010b: 211-216). There appeared to be processing activity areas on the knoll. At this time there is evidence also of specialized tool kits for manufacturing and processing materials and evidence of subsistence resource extraction, in addition to abundant status items not found in the earlier cultural components (e.g., ear spools, labrets, and the vast quantity of beads on-site [N=91,649]).

There is stronger evidence for wetland use during the Late Component, specifically regarding the wapato patch. Foremost among them is the rock pavement associated with over 3,600 wapato tubers and rhizomes. Hoffmann and Huddlestan (2010: 226) suggest it was constructed to ensure that wapato could be harvested at a consistent depth. It could have also facilitated walking through the bog. Charcoal fragments are abundant in Late Component peat matrices, which KDC tentatively suggested may have been deliberately added as fertilizer (Hoffmann and Huddlestan 2010: 226).[41] The presence of wapato tubers above the rock pavement suggests that wapato was transplanted after construction of the pavement. As in the Middle Component, the inferred digging sticks provide direct evidence of harvesting in the wapato patch.

Fewer wetland and wetland-associated taxa were identified within the Late Component archaeobotanical assemblage compared to the Middle Component. The sedge's cultural use is uncertain. Knotweed seeds are interpreted as probable accidental inclusions, thus the species is Rank 3 evidence. The wetland-associated Oregon grape and salal are considered cultural taxa. Represented by a single specimen of charcoal, cottonwood/aspen (Rank 2) is the only wetland-associated wood charcoal taxon identified from sampled Late Component features. However, cottonwood is not strongly associated with wetlands and aspen does not typically grow in the region (Pojar and MacKinnon

[41] Further study of the wapato remains would determine if wapato above the pavement grew larger or were healthier than those growing below the pavement and charcoal-dense matrices.

1994: 46). As with the Middle Component Pacific crabapple, the cottonwood/aspen specimen may represent fuelwood, accidental inclusion or debris. However, the species is considered excellent fuel, which does increase the likelihood of its use as fuelwood.

Although it is still listed as Rank 3 evidence, feature A4's possible use for wapato processing is more compelling in the Late Component than in the Middle Component. KDC's spatial analysis of FAR density per excavation unit indicated increasing density over time, with two discrete concentrations within the feature eventually merging into one very dense concentration of FAR (Homan et al. 2010: 160). Although further analysis and discussion is needed to determine the feature's function, it is clear that site inhabitants made intensive and sustained use of feature A4. Its dimensions suggest a large volume of food could be processed. Future investigation of the recovered vascular tissue and additional sediment samples from this feature could help test the hypothesis that it was used for large-scale wapato processing.

Finally, a possible fishing hook was recovered among perishable artifacts and it is large enough to have been possibly used for fishing sturgeon, which is strongly associated with wetland sloughs. The artifact's function and association with sturgeon remains hypothetical and it is considered very weak evidence for wetland use. Thus it is not included in Table 21.

Comparing the Middle and Late Components

During the Middle Component, the site's environment changed from a riparian wetland to a marshy bog that supported wapato and diverse other wetland plants. This bog continued to mature through the Late Component, with micro-habitats forming in the adjacents wetlands and on the knoll. Comparison of the Middle and Late Component evidence suggests that Late Component site inhabitants may have responded to these environmental changes by focusing more on wetland resources, particularly the wapato patch. Middle Component wetland use appears to have been broad-spectrum, including wapato, but the evidence is weaker and more indirect.

These observations above are tempered by the present study's small sample size, but the Late Component rock pavement feature and other wapato patch elements offer compelling evidence for wetland use and probably enhancement/cultivation activity. During the Late Component, there was also increased intensity of overall site use, including use of processing areas. Feature A4, the inferred steaming oven/processing pit, was used more intensively than during the Middle Component (Hoffmann et al. 2010b: 207). Although it is unclear if this increased intensity of site and feature use is related to increasingly intensive wetland use, these observed changes present interesting possibilities when considered in conjunction with the evidence for wapato harvesting.

Another observation relevant to wetland resource use concerns the boiling stone caches. On their own, they cannot be considered evidence of wetland use, since the stones can be used to boil a wide range of food. However, a comparison of Middle and Late Component boiling stone caches, in conjunction with other datasets, show changes in the number of caches and their locations that present interesting implications for their use. Eight of ten boiling stone caches were recovered from Middle Component matrices, all but one within structural features. In contrast, the two Late Component boiling stone caches were found outside of structural features. The reduction of boiling stone caches in the Late Component, the shift in location of the caches from within structural features to outdoor areas adjacent to the midden zone, and the increasingly intensive use of feature A4—if used for wapato processing—suggest that Middle Component boiling stone caches may be associated with small-scale wapato processing. An increased focus on large-scale processing during the Late Component may have reduced stone-boiling cooking at the site.

For a number of reasons, the basketry parts (e.g., cordage rings, tumplines), boiling stones, wood stake grouping and faunal assemblage were not included in Table 5.1 for either time period. While basketry may have been used to collect and carry wapato, there are many other possible uses. In addition, the basketry parts recovered from peat matrices may be overflow from the midden on the knoll's bank. Without clear evidence of associated wetland plant parts, boiling stones cannot be considered evidence of wetland use. Similarly, there are a number of possible uses for the wood stake grouping found at the edge of the wapato patch (e.g., boundary markers, tools, fish weirs). Finally, three-spine stickleback and northern pikeminnow can be found in wetland sloughs but also in the open river (McPhail and Carveth 1993: 55; Wooding 1997: 248, 270). They are therefore not considered concrete evidence of wetland use.

DhRP-52 in Context

Wetlands formed a significant part of DhRp-52's landscape, and environmental reconstruction from phytolith, pollen, and diatom analyses indicated that the site-adjacent wetland produced diverse plants in abundance. There is strong evidence for site habitation at least part of the year and consistent site use over long periods of time (KDC 2010). Wetland use by the site inhabitants appears to have included food resource gathering and processing, transportation, wetland enhancement (the rock pavement), and possibly trade of wetland resources.

Based upon the evidence summarized in this thesis, I propose that small-scale wapato gathering and processing occurred during the Middle Component as one part of broad-spectrum resource use, followed by a Late Component shift to more intensive and large-scale wapato gathering and processing. This proposed development agrees with KDC's assertion that wetland use began in the Middle Component and intensified in the Late Component. Later in this chapter, I discuss potential future work that could test these hypotheses.

That is not to say that other ecozones were ignored or minimally used. Recovered assemblages included resources found in forestland, clearings, rivers, lakes, and the sea. The absence of land animal remains at DhRp-52 is likely a result of soil acidity rather than cultural preference. Land mammals, such as deer and mountain goat, would have been available in Katzie territory and are included in the traditional seasonal round (Patenaude 1985: 70; Suttles 1955: 17, 23-24). But as a proximal ecological zone providing a broad range of resources and functions, I believe the Pitt Polder wetlands would have been a prominent source of food resources for site inhabitants.

The diverse wetland resources would have made the Pitt Polder of interest not only to the hunter-gatherers who inhabited it, but other Coast Salish groups as well. For instance, traditional Northwest Coast diets can be protein-rich and carbohydrate-poor in areas that lack access to wapato and camas, which risks protein poisoning (Cannon 1995: 56-57; 2000: 51; Noli and Avery 1988: 396-397). As a starchy tuber, wapato would have been a beneficial source of carbohydrates, especially in lean winter months (Ames 1994: 218; Speth and Spielman 1983; Spurgeon 2001: 29, 32). Ethnographic records indicate that the Katzie were renowned for their wapato and cranberry patches, and that other Coast Salishan groups would travel to Katzie territory in order to access these resources through trade or gifts (Suttles 1955: 26-27).

The Pitt Polder's precontact pattern of interconnected sloughs, streams, and rivers remains unknown. However, recorded and surviving sloughs cut through large sections of the polder (Fig. 4), while ethnographic records document known sloughs as transportation routes and shortcuts across the flats, and canoe shelter from strong winds (Suttles 1955: 11, 17, 19; James 1998). These slough networks would have facilitated transportation, social exchange, and trade, as did the larger river systems[42] (Carlson et al 2001: page?; Grier 2002: 127; Lepofsky et al. 2005: 284). This function is supported by the fact that all lithic artifact materials were sourced from elsewhere (Wilkerson 2010b: 173); such heavy cargo would have been most effectively transported by canoe.

[42] Similarly, Hoffmann et al. (2001) hypothesized trade in maritime shelfish at Port Hammond via slough routes connecting the site to the outer coast.

Recovered obsidian and nephrite artifacts provide additional evidence, as they are known trade materials used in the Northwest Coast trade networks established by 4000 BP (Donald 2003: 316-318; Grier 2002: 127; 2003: 175, 176; Reimer 2003: 53-55).

Given access to extensive slough networks and the presence of other trade materials on-site, trade in wapato during the Middle and Late Components is plausible. The Katzie were traditionally renowned traders in wapato and other wetland resources (Duff 1952: 73; MacLachlan 1998; Suttles 1955: 17, 26). Although speculative, feature A4 may indirectly indicate large-scale wapato processing for trade. The large processing feature was used with increasing intensity over many centuries and its very large size suggests it could process substantial quantities of food.

Past wetland distribution (Fig. 3a) suggests that other Coast Salish groups also had various degrees of direct interaction with wetland environments outside of Katzie traditional territory. This is reflected in Halq'mey'lem names for sloughs, marshes, wapato and cranberry harvesting sites, sturgeon fishing locations, and other wetland sites throughout the lower Fraser Valley (Carlson 2001: 136-153). Some Coast Salish groups have spiritual connections to origin species that dwell in wetlands, such as cattail (Musqueam), bulrush (Hatzic) and sturgeon (Lakahmen, Scowlitz, Si:yita, and Chawathil) (Carlson 2001: 25). Although determining landscape perspectives in the distant past is challenging, it is likely that wetlands were seen as distinct elements of maritime or riverine areas, given their unique characteristics and particular resources.

Reflecting on Research Objectives

This study was designed to address four research objectives relating to the type and degree of wetland exploitation at DhRp-52, as revealed through an analysis of archaeological features at the site. A multiple dataset approach was used. Here, I review each of the four objectives and offer a critical assessment of what was achieved.

Objective 1: To explore wetland resource use at DhRp-52 to develop a better understanding of the inhabitants' interaction with their wetland environment.

The analysis of multiple lines of evidence from DhRp-52 indicated a record of long-term wetland use (e.g., use of wetland plants, possible wetland enhancement). The present study did not produce direct archaeological evidence of wapato or bog cranberries, but the evidence suggests that site inhabitants made use of the surrounding wetlands with increasing intensity and may have focused on large-scale wapato gathering and processing during the Late Component.

My study contributed new information about prehistoric fuelwood selection and wetland resource use through (a) the identification of wetland-associated tree taxa and other wetland-associated resources in feature contents, and (b) the integration, evaluation, and comparison of different lines of evidence for the Middle and Late Components. Results also corroborated KDC's conclusions concerning wetland use at the site. However, there remain questions regarding the extent of wetland use, particularly wapato processing, as well as whether particular features on-site were specialized processing features related to wetland resources. My results may contribute to the discussion of intensification at DhRp-52, but exploring this topic falls outside the scope of this study.

Objective 2: To analyze selected feature contents for multiple sources of evidence (i.e., archaeobotany, charcoal analysis, zooarchaeology) to (a) taxonomically identify seed, bone, and charcoal as indicators of wetland resource use, and (b) assess feature function in relation to resource use.

The first part of this objective was met, while the second was less successful. In terms of taxonomic identification, both wetland taxa and wetland-associated taxa were identified from feature contexts. In some cases, it was unclear whether particular taxa were culturally used or accidentally-introduced. However, four wetland-associated seed taxa are considered likely cultural in origin, while wetland-associated tree taxa may have been selected for fuelwood use.

It was more difficult to assess feature function in relation to resource use, although analyzed datasets were significantly strengthened by integration with DhRp-52 assemblages and previous analyses conducted by KDC and others. Probable functions were proposed for all four analyzed features (A1 to A4) with moderate confidence, but connecting them to particular wetland resources or feature use was challenging. This can be attributed to the study's small sample size, difficulty differentiating between cultural and natural inclusion, and the weakness of particular lines of evidence used to infer feature function. I propose that a larger sample size of features and associated sediment samples would mitigate these issues and strengthen the use of the multiple dataset approach to achieve this objective.

Objective 3: To evaluate the suitability of feature analysis for future use at archaeological sites in the region, particularly in wetland contexts.

In wetland contexts, a multiple dataset feature analysis approach can maximize the potential evidence gained from perishable artifacts and archaeobotanical remains rarely found in drier archaeological sites. Traditional plant use and management, especially of root tubers, tend to leave a light footprint on the archaeological record. At DhRp-52, there were no direct lines of evidence for wapato processing, despite the site's intensive use and processing complexes, including a probable steaming/roasting oven. However, the wetland matrices preserved rare evidence for the presence of a wapato patch, associated perishable artifacts, and a rock pavement feature, all of which suggested wapato management and cultivation took place. DhRp-52 is an example of how wetland sites can shed light on plant use that otherwise may be invisible or very lightly seen in the archaeological record.

In addition, the multiple dataset feature analysis approach can be used to build composite pictures of individual features (e.g., fire traits such as high heat, feature contents, the nature of feature use, taphonomic factors, and resource selection) to assess feature function in relation to wetland resource processing and use. For instance, feature analysis of clay-lined pits may offer a way to infer root tuber processing in the absence of direct archaeobotanical evidence. Given that only 20% of regional wetlands remain, integrated feature analysis may also help to counteract the difficulties of assessing wetland use through landscape archaeology by demonstrating if a site's proximity to wetlands represents actual wetland use.

Objective 4: To relate feature analysis results and interpretation to a more general discussion of regional hunter-gatherer interactions with wetland ecosystems.

Earlier in this chapter, I linked my results and interpretation to a wider discussion of Coast Salish use of the Pitt Polder wetlands. The slough networks and wetland resource patches within the lower Fraser Valley would have influenced how groups interacted with each other and with their landscape, in terms of transportation, trade, and resource use. The presence of ethnographic place-names for specific wetlands areas in other Coast Salish territories indicate that people were aware of and made use of these environments directly, as well as through interaction with the Katzie.

Directions for Future Work

There are significant research gaps that impact the regional study of wetland resource use and archaeological sites. This section identifies several directions for future work at DhRp-52 and other archaeological sites that will shed more light on wetland resource use and regional landscape perspectives in the distant past.

Archaeobotanical analysis continues to be underutilized as an archaeological approach (Lepofsky 2004: 367; Lepofsky and Lertzman 2008: 136, 140). Although there are preliminary models of ancient Northwest Coast plant use based on a variety of sources, archaeobotany is still not commonly conducted during excavation, which limits the interpretation of resource use, including wetland resources (Lepofsky 2004: 367; Lepofsky and Lyons 2013: 42). Without corroboration from archaeobotanical and faunal analyses, among other evidence types, standard lithic analysis tends to produce indirect and speculative indicators of diet.

As a more specific component of paleoethnobotanical analyses, there is an even greater dearth of charcoal analysis in the region, with notable exceptions (e.g., Lepofsky and Lyons 2003; Ormerod 2002; Hawes[43] 2009, 2013), and none in wetland contexts aside from this thesis. As such, there is limited information regarding fuelwood selection and use on a site-specific, regional, or temporal scale. Given that the lower Fraser Valley's environment was considerably changed by the deltaic shift and subsequent creation and maturation of new wetlands and forests, charcoal analysis would contribute both to a regional database concerning fuelwood use and resource selection as well as to the discussion of environmental change and correlated changes in cultural practices.

My use of an expanded multiple dataset feature analysis and charcoal analysis at DhRp-52 has been necessarily limited by the scope of a thesis-length study, and is thus best considered a test of the method. However, I expect that using these methods on a larger sample size across site areas and occupation periods at DhRp-52 will help to (1) clarify cultural use of archaeobotanical taxa, (2) provide more information on fuelwood use over time, (3) increase or refine information derived from the archaeobotanical remains and faunal assemblage[44], and (4) further illuminate wetland use at the site. Future SEM analysis of recovered vascular tissue including the possible lily tissue would also be beneficial.

[43] Hawes published charcoal analyses at Sunken Village (2009) and Qwu?gwes (Hawes and Rowley 2013) in wet site contexts.

[44] Given faunal results in this thesis, I recommend sorting the heavy fraction from Lyon and Leon's (2010) paleobotanical project for faunal remains.

On a regional level, DNA analysis would clarify which stickleback variant (maritime, freshwater, or hybrid) is represented by recovered elements from lower Fraser Valley sites. Despite the availability of all three stickleback variants in the Fraser watershed, archaeologists have assumed recovered elements were maritime and thus seasonal indicators (McPhail and Carveth 1993: 55).[45] DNA results would determine whether these can be considered seasonal indicators, and perhaps reveal something about ancient stickleback fishing.

Closer archaeological study of wetlands as a distinct ecosystem–and the resources they can provide–would benefit regional archaeology. Given the region's ecological productivity and diversity (Northcote 1974: 39; Pojar et al. 1991: 110), studying wetland use in archaeological contexts would generate greater understanding of regional resource and land-use patterns (Hill 2011). For instance, the examination of how the Fraser River deltaic shift (Fig. 2) impacted indigenous peoples should also consider the formation and maturation of associated wetlands (Stevenson 1998: 222). This would build upon previous research on the role of environmental shifts in regional cultural development (Lepofsky et al. 2005: 268).

Understanding the role of wetland sloughs in fishing practices would contribute to a more complete picture of fishing industries in the Lower Fraser watershed, such as the

[45] This assumption likely stems from reference to large Gulf Islands stickleback assemblages, which are the marine variant.

archaeological use of starry flounder and sturgeon (Stevenson 1998: 221-222). In the protohistoric period, people from as far away as Vancouver Island came to Katzie wetlands specifically for wapato and cranberries (Duff 1952: 73; Suttles 1955: 26-27). Examining the ancient role of wetland channels in facilitating trade and social exchanges would contribute to the extensive discussion of regional trade networks and cultural perceptions of landscape, particularly given the issues of projecting ethnographically described exchange systems onto the distant past (Barnett 1955; Lepofsky et al. 2005: 284; Grier 2003: 170-171).

It is clear that regional archaeology would benefit from greater attention to regional wetlands as an ecosystem, as well as areas of potential archaeological sites. I encourage archaeological ground surveys of local wetlands, with attention paid to possible archaeological evidence for signs of cultivation practices or potential resource patches (e.g., stone boundary markers, trenches) (Deur 2005; Lepofsky and Lertzman 2008: 135; Suttles 2005: 185-186). When there is opportunity, wetland-margin sites should be sampled using a multidisciplinary approach. Feature analyses that use an integrated multiple dataset feature analysis approach would help to maximize the recovery of information concerning feature use, particularly in relation to wetland resources.

Conclusions

The location of settlement and activity sites near wetlands and sloughs reflect hunter-gather attraction to these ecozones, while sociocultural adaptations and material culture demonstrate the ways that people formed relationships with their wetland environment. Ethnographically documented relationships with wetland environments can extend into the distant past, as seen at DhRp-52. However, site proximity to wetlands can only be considered evidence of wetland use if there are clear and direct associations through different lines of evidence. Using an integrated feature analysis that draws on various lines of evidences would help to shed light on site-specific wetland use as well as broader patterns of wetland interaction in the larger landscape.

Human relationships with wetlands are complex and nuanced. Human beings respond to wetlands in variable and dynamic ways across time and space, sometimes using them lightly and at other times engaging in intensive wetland management and modification (Crisman et al. 2001: 255-256; Menotti 2012; Nicholas 2007). This makes the study of hunter-gatherer and cultivator interactions with wetlands a challenging task. But archaeologists benefit from turning greater attention towards wetland sites for their potential in preserving the archaeological record and broadening our understanding of hunter-gatherer relationships with their environment.

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Appendices

Appendix A.

DhRp-52 Assemblages

Introduction

This appendix provides additional information concerning DhRp-52 assemblages described in the text. Further details can be found in KDC 2010 and Wilkerson 2010.

Lithic Assemblage

The distribution of lithic tool classes varied by site zone (Table A-1). The site zones associated with structural features (Sand Structure Zone and Loam Structure Zone) produced evidence of domestic tool kits and the range of artifacts, including multifunctional tools, suggest a variety of activities.

Use of Obsidian for Lithic Tools

A total of 265 lithic tools are made from Garibaldi obsidian, which is sourced from the Mount Garibaldi area approximately 15 kilometres northeast of Squamish (Wilkerson 2010c: 3). The use of Garibaldi obsidian tools increases over time and 70% are associated with Late Component deposits (Wilkerson 2010b: 77).

Non-Garibaldi obsidian was found in the Sand Structural Zone and Loam Non-Structural Zone (Wilkerson 2010a: 3, 34). It appeared quite different from Garibaldi obsidian and KDC hypothesized that it was sourced from Oregon, but further sourcing

Table A-1: Presence/Absence of Tool Classes By Site Zone.

Associated Time Period:		**LC**				**LC?**	**MC**		**EC**
Grouped Tool Class	**Function/ Association**	**LSZ**	**LNSZ**	**FAR Pit**	**MZ**	**WSZ**	**SSZ**	**SNSZ**	**SSSZ**
Adzes	Woodworking	+	+	+	+	+	-	-	-
Pestles/ Hand Mauls	Heavy-duty woodworking, food processing	-	-	-	-	+	+	-	+
Mortar Stones	Unknown	+	-	+	+	-	+	-	-
Abraders	Abrading	+	+	+	+	+	+	+	+
Hammerstones	Multipurpose/ stone core reduction, stone tool production	+	+	+	+	+	+	+	+
Anvilstones	Lithic reduction	-	+	+	-	-	+	-	-
Points/Bifaces	Multipurpose/ hunting, (bifaces) ?cutting, fibre processing	+	+	+	+	+	+	+	+
Burins	Chisel tool for bone or woodworking	+	+	+	+	-	-	-	-
Combination Tools	Multipurpose/ drilling, perforation	+	+	+	-	+	+	+	-
Drills	Drilling/perforation of stone, leather, fabric	-	+	-	+	+	-	+	-
Gravers	Bone, woodworking	+	+	-	-	-	+	-	-
Spokeshaves	Smooth/finish a wooden shaft	+	+	+	-	+	+	+	+
Scrapers	Scraping, ?wood or plant processing	+	+	+	+	+	+	+	+
Flake Tools	Expedient, used for short periods of time	+	+	+	+	+	+	+	+
Flake Spalls w/retouch	Unknown, ?food/fibre processing	+	-	+	+	+	+	-	-
Flake Spalls w/o retouch	Lack of usewear = may be for later use	+	+	+	+	+	+	+	+
Wedges	Woodworking, ?split bone/antler	+	+	+	+	+	+	+	-
Choppers	Woodworking	+	+	+	+	+	+	+	+
Ground Slate Knives	Salmon/fish processing	+	+	+	-	-	+	+	-
Chipped Slate Knives	Unknown	+	+	+	-	+	+	+	-

Key: + present; - absent; LC=Late Component, MC=Middle Component, EC=Early Component; LSZ=Loam Structural Zone, LNSZ=Loam Non-Structural Zone, FAR Pit=Feature Zhq, MZ=Midden Zone, WSZ=Wet Site Zone, SSZ=Sand Structural Zone, SNSZ=Sand Non-Structural Zone, SSSZ=Sand Sub-Structural Zone

Source: KDC 2010; Wilkerson 2010

studies are required to confirm this[46] (Wilkerson 2010b: 3). The Middle Component produced more non-Garibaldi obsidian than the Late and Early Components (Wilkerson 2010: 34).

Beads

The bead class (N= 91,649) primarily includes disc beads of a soft mudstone material, but a few may be slate (Homan et al. 2010: 147). Generally considered personal adornment, disc beads have been recovered at other Gulf of Georgia sites of similar antiquity (Ham 1982: 90, 95-96; Lepofsky et al. 2000: 409). Due to the absence of bead blanks or half-finished beads, the recovered beads are thought to have been manufactured elsewhere (Wilkerson 2010b: 189). Nearly all of the beads came from the Late Component and are associated with the structural features and the FAR Pit Zone (Feature Zh-q), which appears to be lined with beads at the margins (Wilkerson 2010a: 46).

Other Lithics

The "other lithics" class (N=3,583) includes items possibly indicating status/rank (e.g., earspools, labrets, ochre/haemetite, pendants, and other decorative items), quartz crystals, boiling stones, boulder/slabs, unworked cryptocrystalline pebble, oblong stones, and unmodified stones (Homan et al. 2010: 149).

[46] X-ray analysis of obsidian from the Park Farm site sourced them to Mt. Garibaldi and central Oregon (Kristensen et al. 2009: 22).

Of this class, quartz crystals and boiling stones are the most relevant to this thesis because of their possible functions and associations with other features. Fifty-eight unmodified quartz crystals were found within the Late Component Loam Structure Zone, Midden Zone, and FAR Pit (Feature Zh-q) (Wilkerson 2010a: 39). They are also correlated with ochre concentrations and faunal scatter (Hoffmann, Huddlestan and Wilkerson 2010: 209). Their function is unknown but their association with ochre suggests possible ritual activities.

Boiling stones are rounded, granitic, pebble-sized stones that can show signs of heat alteration. The majority were recovered from boiling stone cache features and primarily from within structural features. They are typically associated with processing activities such as cooking, steaming or boiling in earth ovens, hearths or processing pits, or woodworking activities (Antiquus 2001: 66, 88-89; Ormerod 2002: 11-12).

Perishable Artifacts

The Midden Zone had the highest number (9,709) and density (197.3/m^3) of perishable artifacts (Homan et al. 2010: 156), followed by the hillside bank with 1737 artifacts (47.4/m^3). The wapato patch area had the lowest numbers, with a total of 652 perishable artifacts at 17.1 artifacts per cubic metre; several were in direct contact with the rock pavement feature.

Cordage Waste

A total of 231 cordage waste artifacts were recovered, including apparent fragments of cordage strands broken on either end (Homan et al. 2010: 19). Approximately 84% were found in the midden area and the remainder from the wapato patch and Area I (Homan et al. 2010: 157).

Woodworking Debris

Woodworking debris (N=12,249) consists of two categories: wood chips and wood chunks. Wood chips were identified by diagnostic features produced by woodworking activity such as adzing and shaving (Homan and Leon 2010: 49, 58). In contrast, wood chunks are blocky, lack diagnostic features, and are associated with such activities as chopping wood or carving (Homan and Leon 2010: 50). Woodworking debris was primarily found in midden matrices, although some were also found further up on the knoll and in the wapato patch.

Worked Bark

Worked bark (N=235) includes curled bark, pounded bark, stripped bark, and miscellaneous bark pieces (Homan and Leon 2010: 51-56). The first three groups are self-explanatory and show diagnostic features (e.g., crease marks and cutting marks) from specific bark preparation activities. The fourth group consists of three miscellaneous bark piece fragments reported as likely waste from bark processing (Homan and Leon 2010: 55-56). Worked bark artifacts were found in wapato patch, midden, and transitional bank matrices, with the highest count (N=122) in the bank area (Homan et al. 2010: 157).

Appendix B.

DhRp-52 Feature Typology and Analysis Methods

This appendix presents and explains the feature typology and documentation methods used during field excavation. The typology and feature data are drawn from Huddlestan and Homan (2010) and Appendix K of the Final Report (KDC 2010).

Methods

KDC's analysis and descriptions of DhRp-52 features are based on field notes, photos, plan views, and profiles (Huddlestan and Homan 2010: 109). Field documentation noted morphological characteristics (e.g., shape and dimensions), briefly described feature contents visible to the human eye, and assigned each feature an alphabetical identifier. Feature analysis included the use of ArcView 9.3 to derive complete dimensions (e.g., length and width in cm)[47]. Once complete feature dimensions and location data were compiled, frequencies and proportions were calculated using the PSAW Statistics 18 statistical program (Huddlestan and Homan 2010: 109).

Feature Typology

The feature typology used at DhRp-52 during excavation uses terminology commonly used in regional archaeology (Huddlestan and Homan 2010: 110). Unique features that did not fit any typological class were classified using descriptive terms. In

[47] See KDC 2010: Appendix J for detailed methods.

addition, identified post moulds were grouped by size categories based on Colin Grier's (2001) functional classification scheme[48]. Finer classification through further analysis was completed post-excavation in the laboratory. Tables B-1 and B-2, below, present the preliminary typology and the post-excavation classification system, respectively.

Table B-1: Preliminary Feature Typology Used during Excavation.

Feature Type	Description
Post/Post-like	Circular to oblong stains that vary in diameter and depth; Differs from "stakes/stake-like" in being larger in size. Subjective assignation in field.
Stakes/Stake-like	Circular to oblong stains that vary in diameter and depth; Differs from "stakes/stake-like" in being smaller in size. Subjective assignation in field
Hearth/Hearth-like	Complete or incomplete features associated with fires, with observable fire-reddened sands and/or charcoal
Pit Feature	Soil depressions, including irregularly shaped shallow depressions
Cache Feature	Refers to what appear to be deliberately placed lithic materials ranging from raw materials to boiling stones
Ochre Feature	Lenses of ochre observed in the soil
Sand Lenses	Thin lenses or concentrated piles of sand
Processing Feature	Includes large rock/charcoal concentrations related to intensive processing.
Faunal Feature	Dense concentrations of faunal remains not related to hearth features
Sources: Huddlestan and Homan 2010; Shortland et al. 2008	

[48] Developed through analysis of post moulds associated with remains of large house structures at Dionisio Point (DgRv-3), a 1500-year-old site on Galiano Island in the Strait of Georgia.

Table B-2: Post-Excavation Feature Classification.

Feature Type	Description
Boiling Stone Cache	Clusters of stones typically associated with (1) processing activities (e.g., cooking, steaming or boiling in earth ovens, hearths or pits or (2) woodworking activities (Antiquus 2001: 66, 88-89).
Submerged Rock Pavement	Self-explanatory. A densely packed layer of FAR and cobbles found within the peat matrices of Area II and considered anthropogenic.
Wood Stake Grouping	Stakes typically ranging in diameter from 3 cm to 6.5 cm and found in various configurations, embedded vertically in peat matrices. This feature class represents activities related to structures and fishing.
Thermal Features	Thermal features vary in depth from surface or shallow concentrations to deep, pit-like depressions. They represent activities related to processing, including hearths and earth ovens.
Faunal Concentrations	Faunal remains in ephemeral scatters or dense concentrations of highly fragmented calcined bone, or as complete elements. In archaeological contexts, these features are typically associated with subsistence, food processing, caching or ceremonial activities.
Ochre Concentrations	Red ochre is pigmented clay, typically found archaeologically in its unprocessed, mineral form and associated with ceremonial activities (Antiquus 2001: 65, 89; Jenness 1955: 38, 44, 79).
Post Moulds	Circular/oblong stains; angled or vertical in profile, with flat or tapered bottoms. These features represent various structure types that may be related to processing activities (e.g., drying racks, smoke houses) or large permanent houses (Grier 2001).
Large Circular Depressions	Large circular bowl-like depressions. With associated evidence of support posts, features in this category are usually interpreted as semi-subterranean pit houses.
Rectangular Depressions	Large and small rectangular depressions. Large features in this category are usually associated with house construction, while small rectangular depressions have been interpreted as related to processing activities or burials.
Small Depressions	Square, bowl- or bell-shaped (in profile) depressions that vary in diameter and depth. They are associated with caching and storage activities.
Clay Concentrations	Ephemeral patches or piles of clay within non-clay matrices.
Sand Concentrations	Thin lenses or concentrations of sand up to 10 cm in thickness. They are typically associated with living floors (Kristensen et al. 2009; Patenaude 1985).
Thermal Matrices	These features contain various contents such as burned sediments, calcined bone, charcoal and FAR. They are typically associatd with hearth dumps.
Sources: Huddlestan and Homan 2010; Grier 2001; Ormerod 2002.	

The Exclusion of Identified Features from Analysis

A total of 991 features were identified at DhRp-52, but 282 were excluded from post-excavation analysis due to (1) inconsistent or incomplete field records, (2) locational and descriptive feature data not corresponding with the 10 cm arbitrary levels in ArcView 9.3, and (3) time constraints precluding finer-scaled analysis (Huddlestan and Homan 2010: 110). Excluded features include one ochre concentration, 55 post moulds, four small depressions, 12 sand concentrations, four thermal matrices and 206 unclassified features with unclear field descriptions. For further information concerning excluded features, see KDC 2010.

Appendix C.

Supplementary Data File: KDC Paleobotanical Assemblage

Description:

The accompanying Excel spreadsheet shows the original data for Lyons and Leon's (2010) paleobotanical assemblage reported in KDC 2010. In each column for identified taxa, "c" represents charred material; "uc" represents uncharred material.

Filename:

AEGOODE_Thesis_2014_Appendix C_KDC_Paleobotanical_Data.xlsx

Appendix D.

Photographs of Analyzed Features

Figure D1: Feature A1 (HP)

Figure D2: Feature A2 (KC-n)

Figure D3: Feature A3 (MJ)

Appendix E.

Flotation Data

Table E-1: Sample Set A Flotation Log.

Flot #	Sample #	Feature	Vol (ml)	Sieve	Feature Type	Trench	Unit/ Depth (cm)	Provenience
1	126	HP	1000	1.00/ 0.25	Hearth	2	D6/150-160	60-100N 0-50E 150-160 dbd
2	8A	MJ	~900ml	1.00/ 0.25	Hearth	3	M11/70-80	10N 85E 74-78 dbd
4	101	ZHq	~850ml	1.00/ 0.25	Proc	2	C6/90-100	60N 60E 95 dbd
5	346-348	KC-n	~600ml	1.00/ 0.25	Hearth	2	C18/160-170	47-86N 27-43E 160-167 dbd

Appendix F.

Faunal Report (Nova Pierson)

Nova Pierson

Department of Archaeology, Simon Fraser University

March 2011

Fauna were identified in March 2011 with the aid of the zooarchaeological comparative collection at Simon Fraser University, with the exception of three-spine stickleback, which is absent from the collection. Identification of this fish was aided by photographs of scutes (Casteel 1976), as well as through previously-identified spines identified with the aid of the comparative collection at Department of Anthropology at the University of Victoria. The confidence level associated with the identification of the spines is for this reason not as high as those identified with the aid of a collection. Individual species of salmon cannot be confidently distinguished osteologically, particularly in this case because of the state of their preservation. The vast majority of the bones had been calcined, meaning they had been burnt at a very high temperature, appearing white or blue in colour (e.g., Reitz and Wing 2008: 132).

Samples were very delicate. Many fell apart before they could be identified.

Table F-1: Fauna Identified from DhRp-52.

Context	Number	Element	Taxon	Comment
S8A F-2 H/F	1	Unidentified	Fish	
S8A F2 H/F	1	Unidentified	Fish	
S8A F2 H/F	6	Scutes	Three-spine stickleback	Calcined
S8A F2 H/F	3	Spines	Three-spine stickleback	Calcined
S8A F2 H/F	2	Vertebrae fragments	Salmon	Calcined
S8A F2 H/F	Not counted	Shell fragments		
S346-348	1	Shell fragment	Pacific littleneck	
S346-348	1	Tooth	Dogfish	
S126 F1 H/F	Not counted	Unidentified	Fish	Calcined
S126 F1 H/F	22	Vertebrae fragments	Salmon	Calcined
S126 F1 H/F	1	Vertebrae fragment	Salmon	Burnt
S346-348 F5 H/F	9	Cartilage fragments	Cartilaginous fish	Calcined
S346-348 F5 H/F	Not counted	Unidentified	Unidentified	Calcined
S126 L/F	Not counted	Unidentified	Fish	Calcined
S8A F2 H/F	Not counted	Unidentified	Fish	Calcined
S8A F2 H/F	57	Spines	Three-spine stickleback	Calcined
S8A F2 H/F	12	Scutes	Three-spine stickleback	Calcined
S8A F2 H/F	5	Vertebrae fragments	Salmon	Calcined
S8A F2 H/F	8	Vertebrae/fragments	Northern pikeminnow	Calcined
S8A F2 H/F	5	Teeth	Dogfish	

Four fish taxa, and one invertebrate species were identified. Three-spine stickleback were the most commonly occuring taxa (*Gasterosteus aculeatus*; NISP 78). Fragmented portions of salmon vertebrae were also common (Family Salmonidae; NISP 30). Northern pikeminnow (*Ptychoeilus oregonensis*; NISP 8) and dogfish (*Squalus* *acanthias*; NISP 6) were also represented. Unidentified fragments of cartilage from a cartilaginous fish (possibly dogfish, but other possibilities exist) were also present.

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Appendix G.

Laboratory Data Form

Paleoethnobotanical Data Sheet -

Provenience		Date:	Sorted by:
House:		Unit:	Layer:
Exact Provenience:			
Feat. No.:		Feat. Description:	
Flot Sample No.		Volume (l):	
Subsample No:		Volume (l):	

	Charcoal	Total (g)		**Seeds**	N	**Needles**	N
	Species			Total		Total	
1		4.0+2.0(g)				Abies	
2		1.0+.425(g)		Amelanchier		Chamaecyparus	
3		catch (g)		Arctostaphylos		Picea	
4				Berberis		Pinus	
5		*Conifers*	N	Brassica		Psuedotsuga	
6		Abies		Carex		Taxus	
7		Chamaecyparus		Chenopodium		T. plicata	
8		Picea		C. canadensis		Tsuga	
9		Pinus		C. stonolonifera		Unided	
10		Psuedotsuga		Corylus		**Cone Parts**	N
11		Taxus		Crataegus		Abies	
12		T. plicata		Fragaria		Chamaecyparus	
13		Tsuga		Gaultheria		Picea	
14		Unided		"Grass"		Pinus	
15				Juncus		Psuedotsuga	
16		*Decidious*	N	M. dilatatum		Taxus	
17		Acer		Oemleria		T. plicata	
18		Alnus		Phacelia		Tsuga	
19		Amelanchier		Prunus		**"Root"**	N
20		Betula		Rhamnus			
21		Cornus nuttallii		Ribes			
22		Gaultheria		R. gymnocarpa			
23		Oemleria		R. nutkana			
24		Physocarpus		Rubus			
25		Populus		Sambucus			
26		Prunus		Scirpus			
27		Rosa		Smilacina			
28		Rubus		Symphoricarpos			
29		Quercus		Trifolium		**Other**	
30		Rhamnus		Vaccinium		Unided fruit (N))	
31		Sambucus		Viburnum		Unided tissue (g)	
32		Salix				conifer bud (N)	
33		Sorbus sitchensis				decid bud (N)	
34		Symphoricarpos				decid leaf (N)	
35		Vaccinium				modern (g)	
36		Unided		Unided A		insect parts (N)	
37				Unided B			
38				Unided C			
39							
40				* Comments on back			

Appendix H.
Paleobotanical Specimens

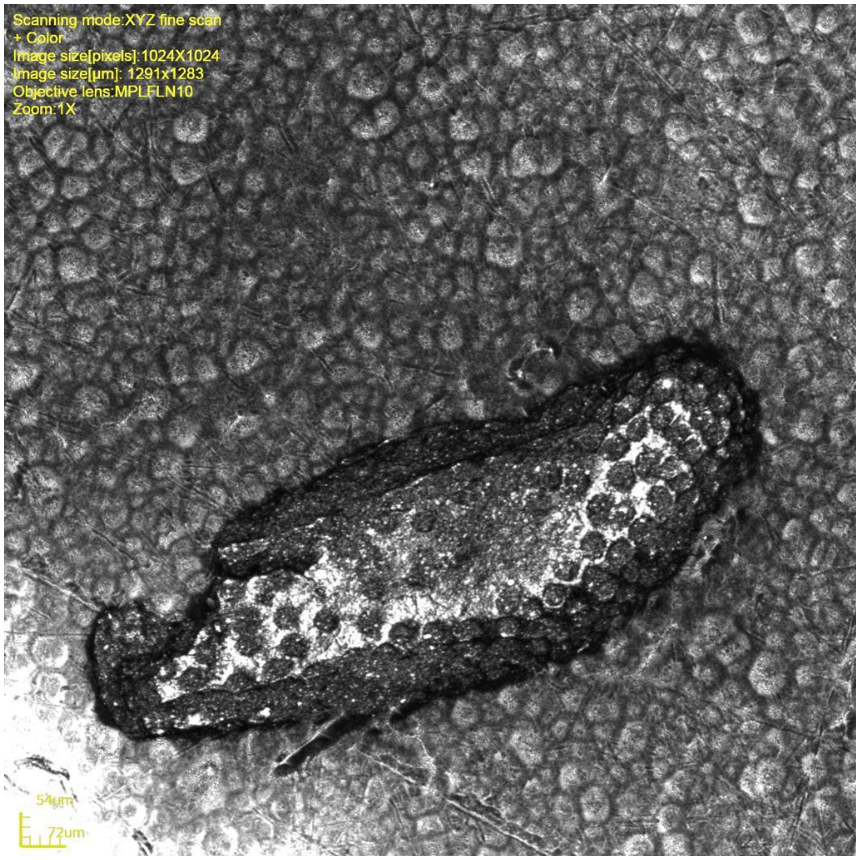

Figure H1: UNID A (Laser, scale is 54 um by 72 um)

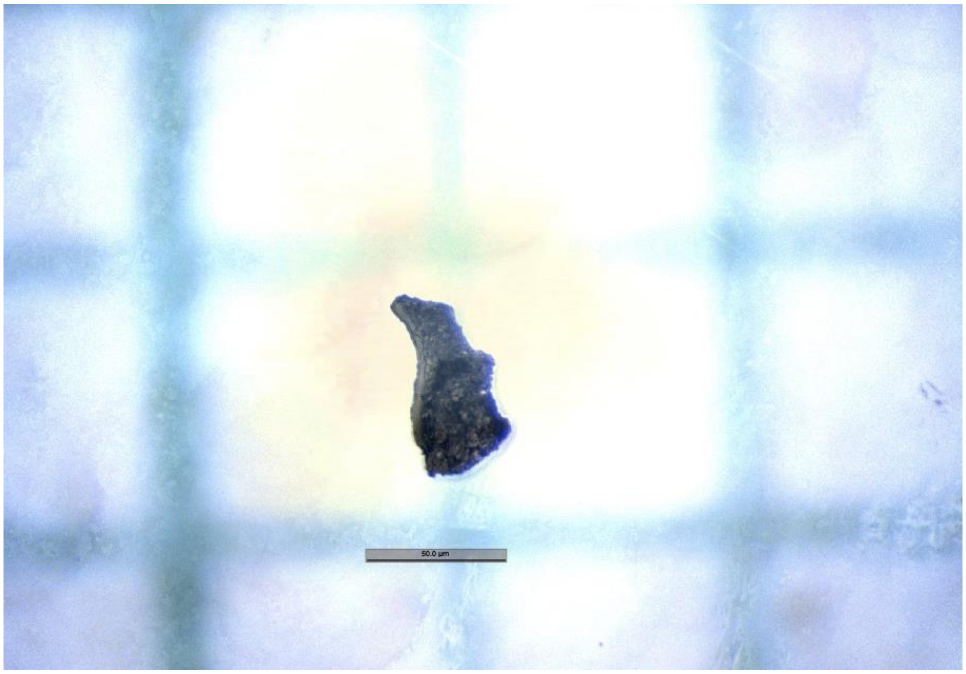

Figure H2: Unidentified plant node (4X magnification, scale is 50 um)

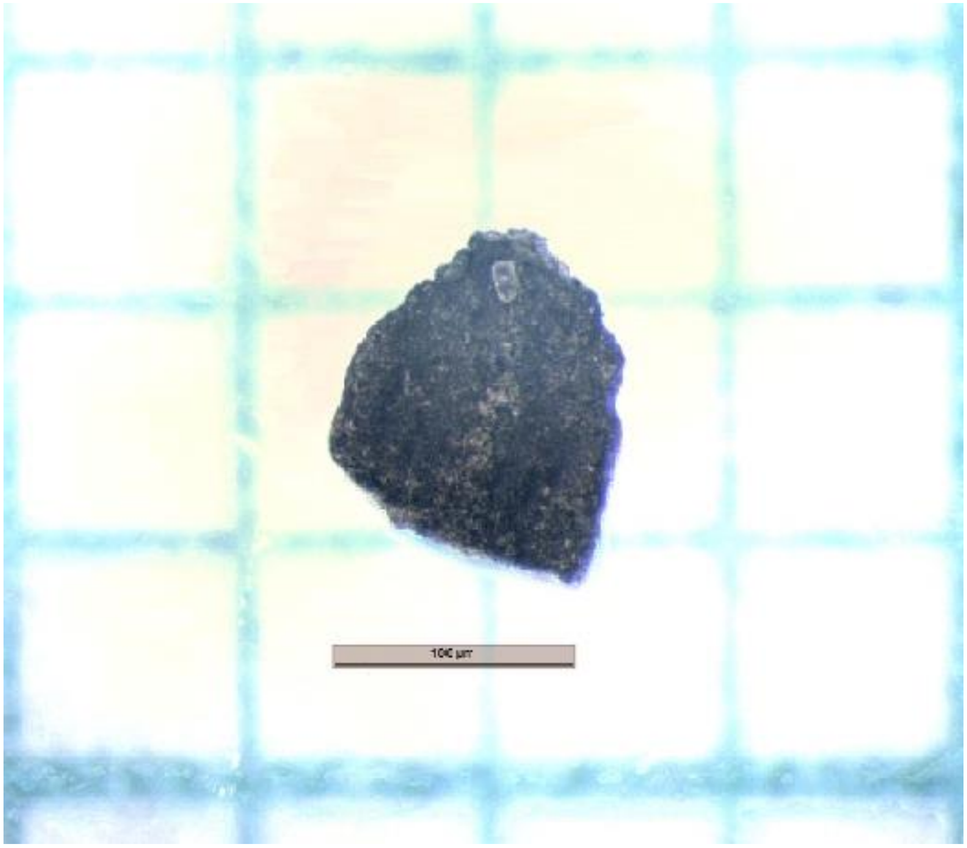

Figure H3: Unidentified needle fragment (2X magnification, scale is 100 um)

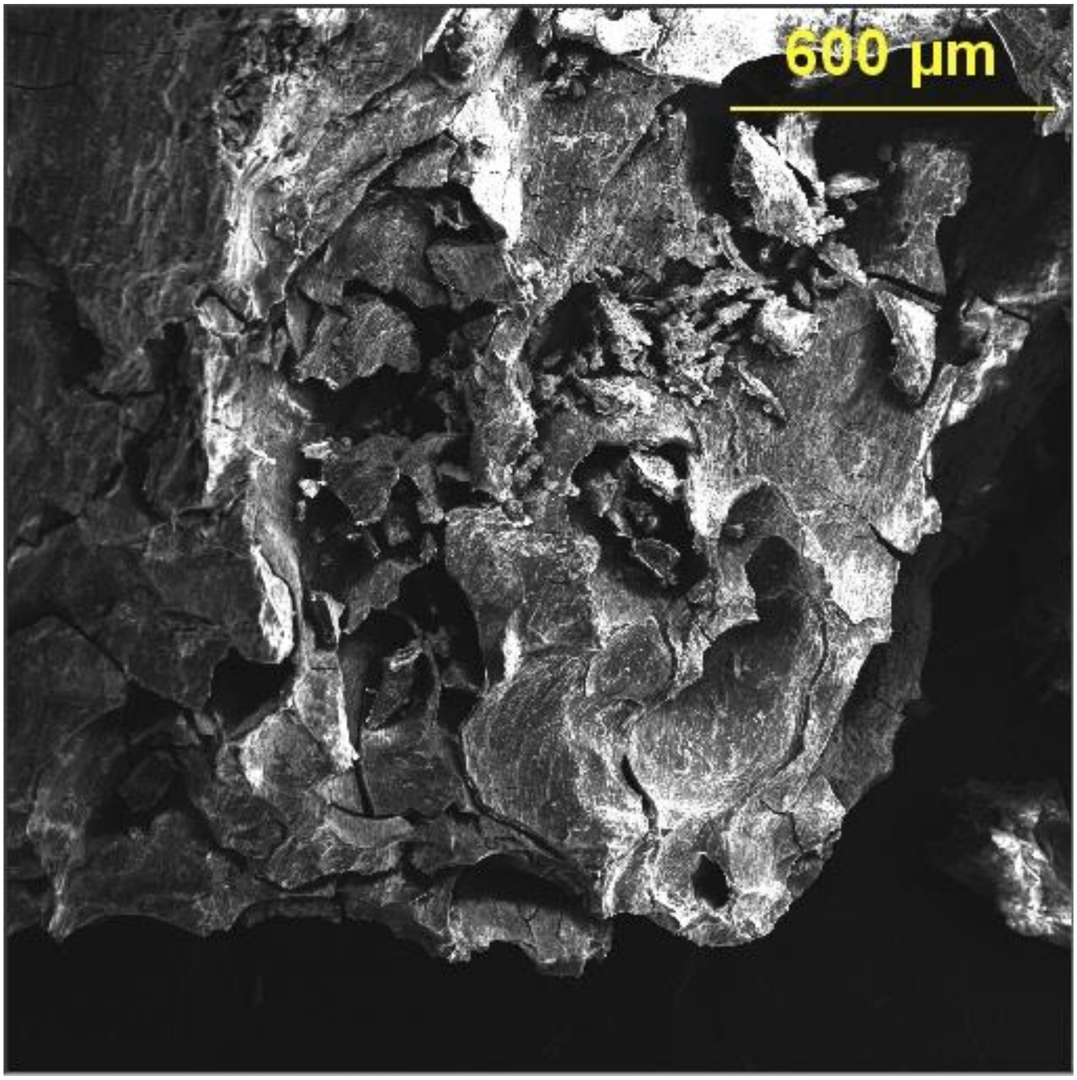

Figure H4a: Unidentified vascular tissue (side 1; SEM)

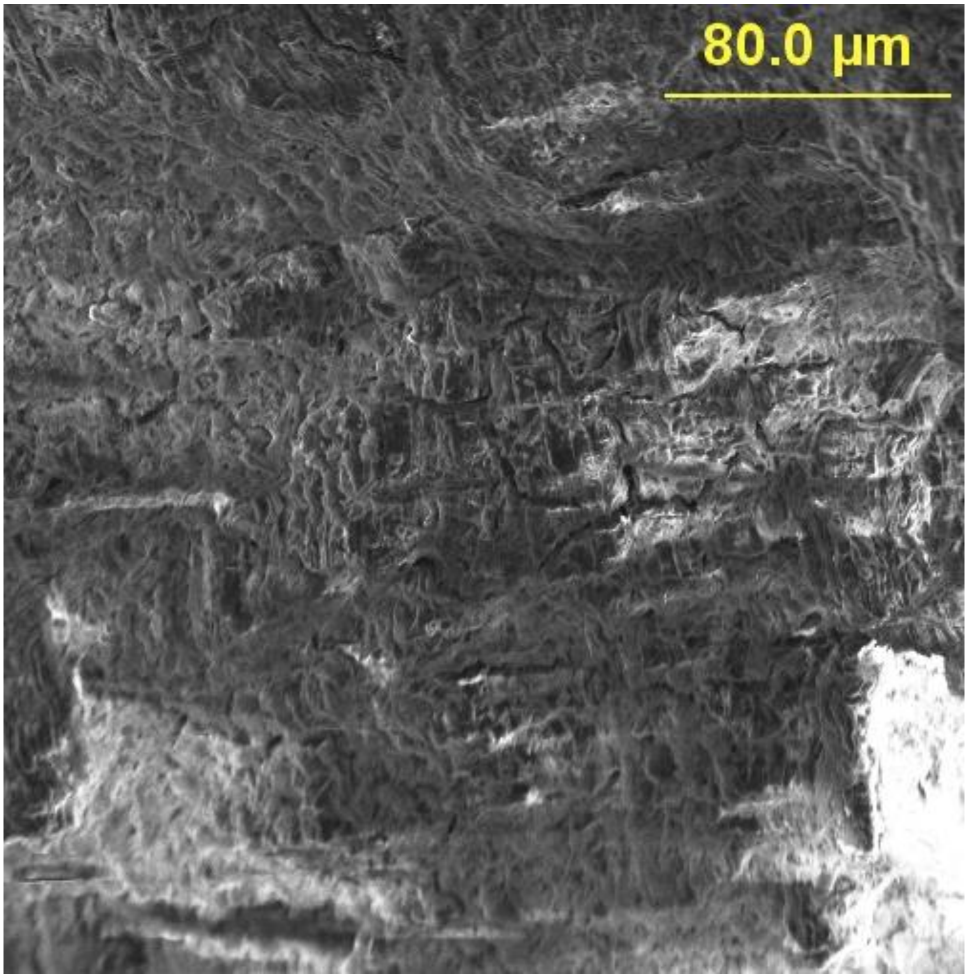

Figure H4b: Unidentified vascular tissue (side 2; SEM)

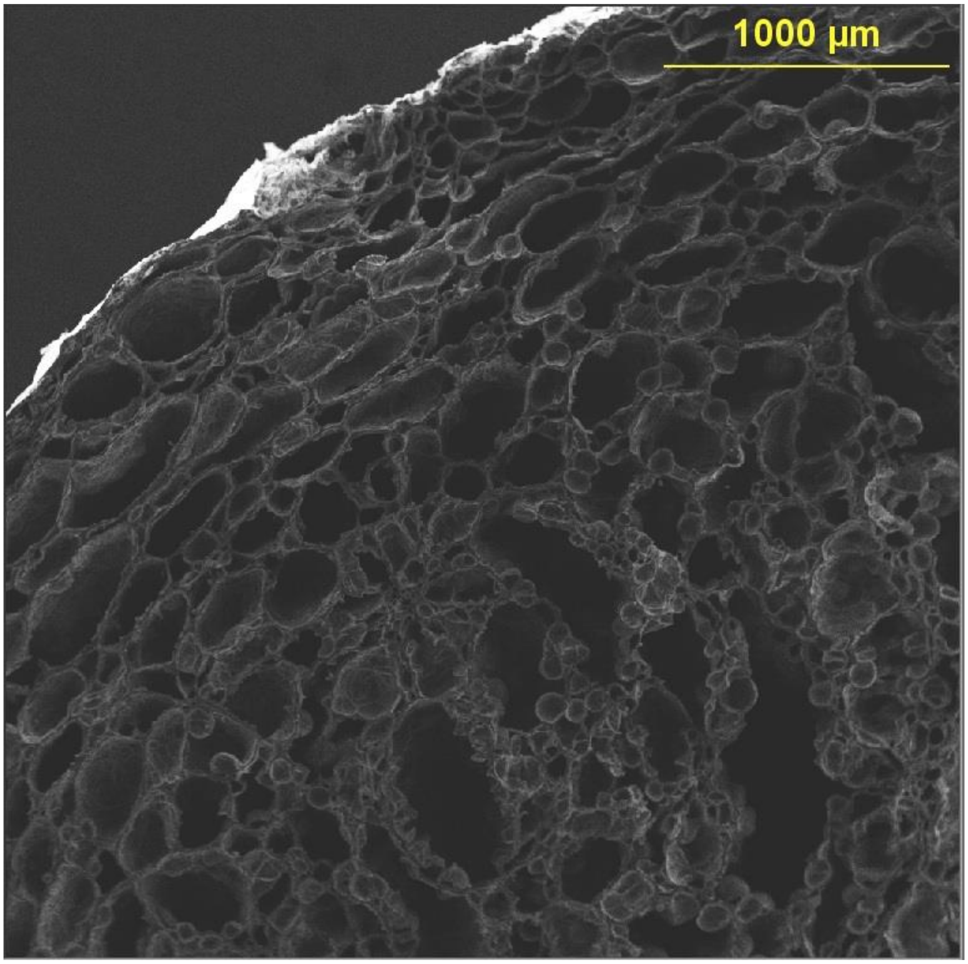

Figure H4c: Comparative Charred Wapato Tuber (SEM)

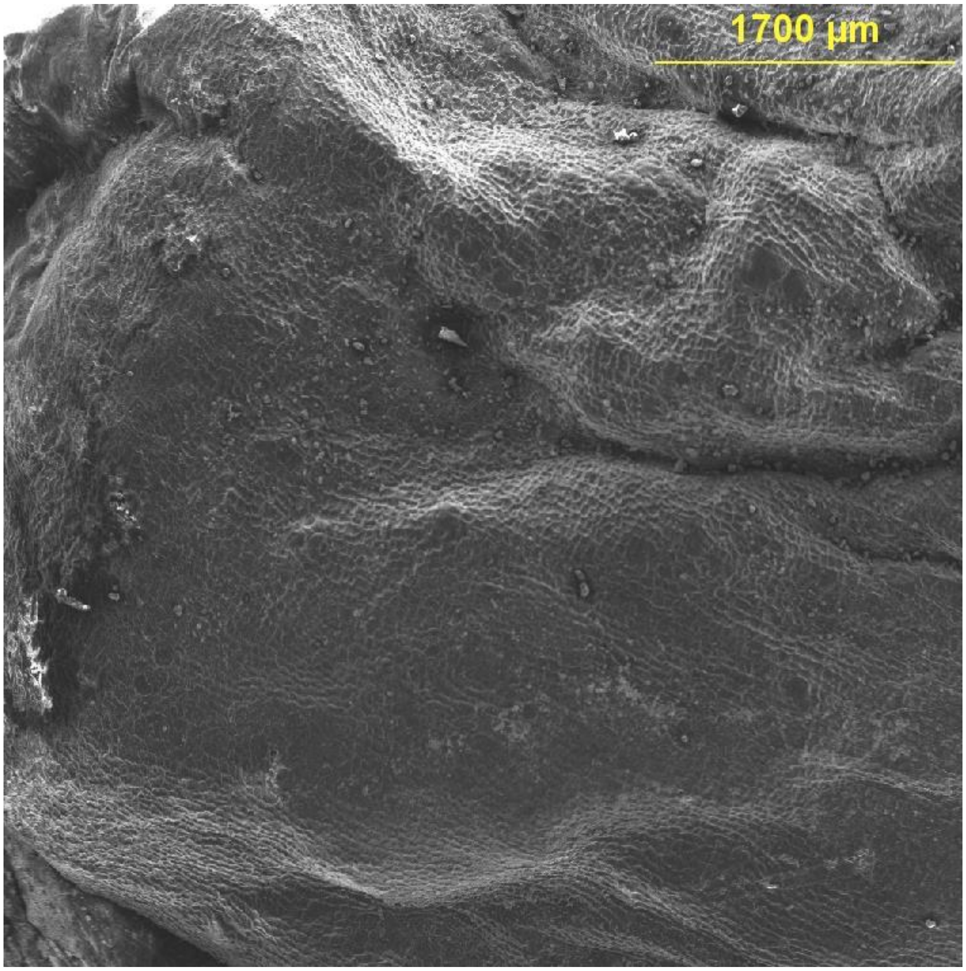

Figure H4d: Comparative dried wapato tuber (SEM)

Figure H5: cf. liliaceae tissue (4X magnification, scale is 50 um)

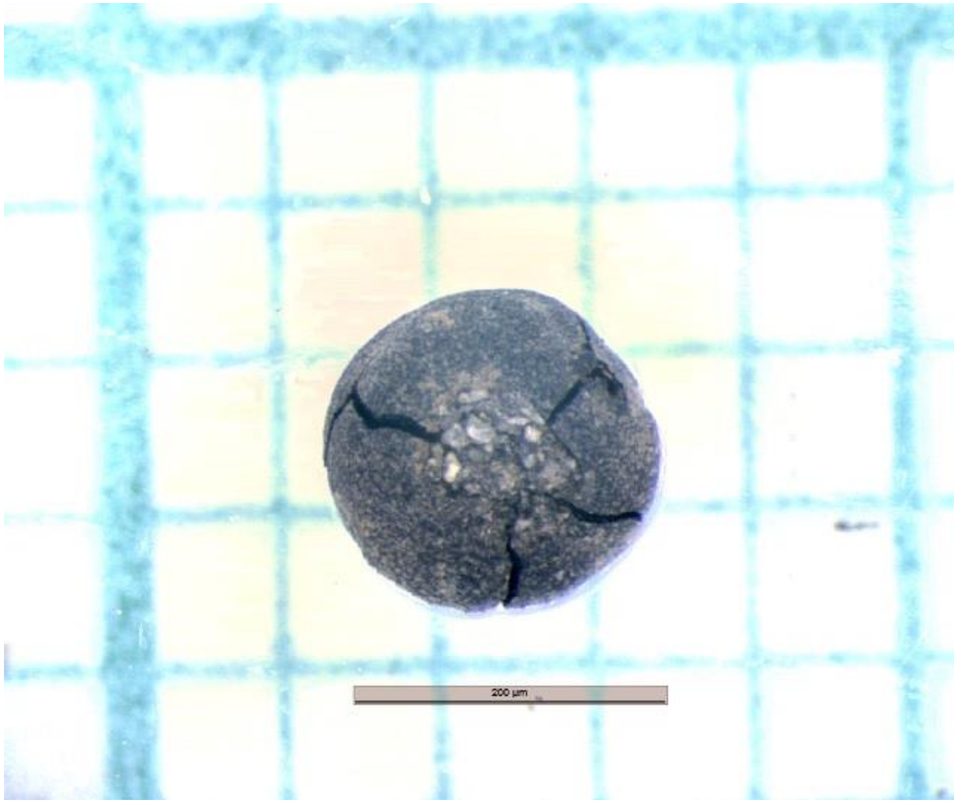

Figure H6: Liliaceae seed (1.6X magnification, scale is 200 um)

Figure H7: Oregon grape seed (Laser, scale is 303 um by 399 um)

Figure H8: Salal seed (Laser, scale is 54 um by 72 um)

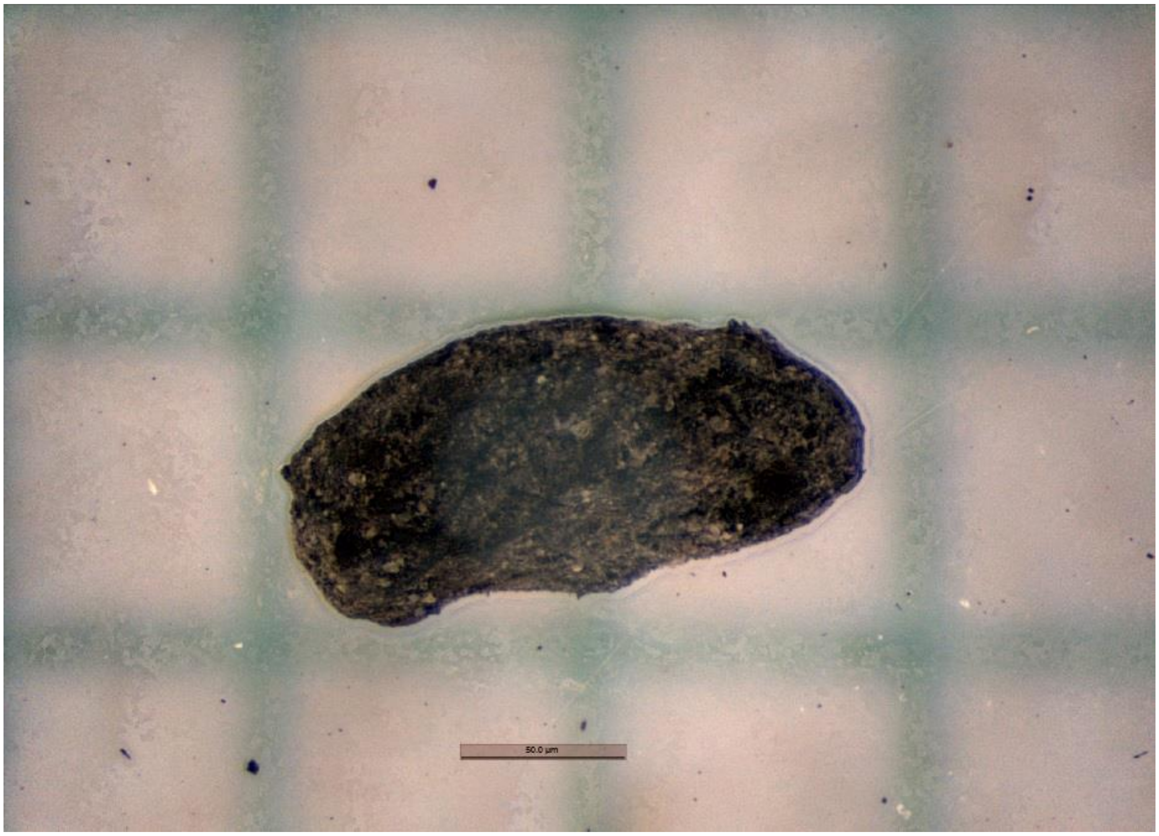

Figure H9: Raspberry genus seed (4X magnification, scale is 50 um)

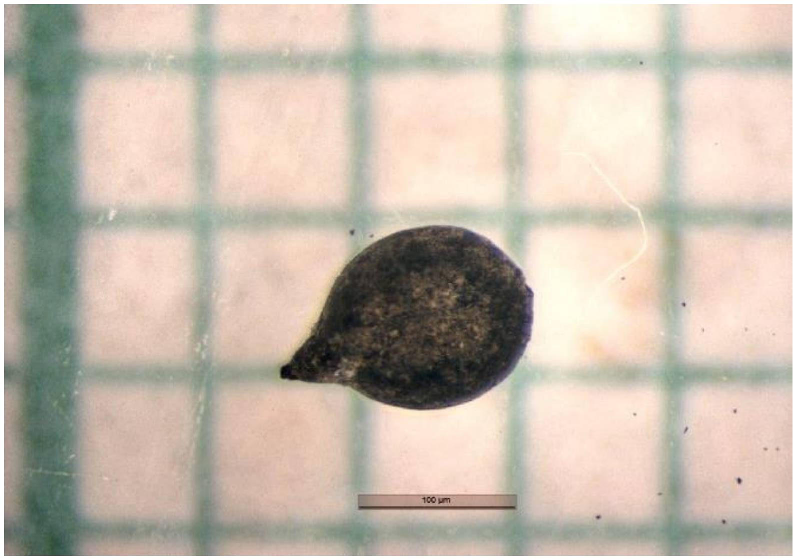

Figure H10: Polygonum sp. seed (2X magnification, scale is 100 um)

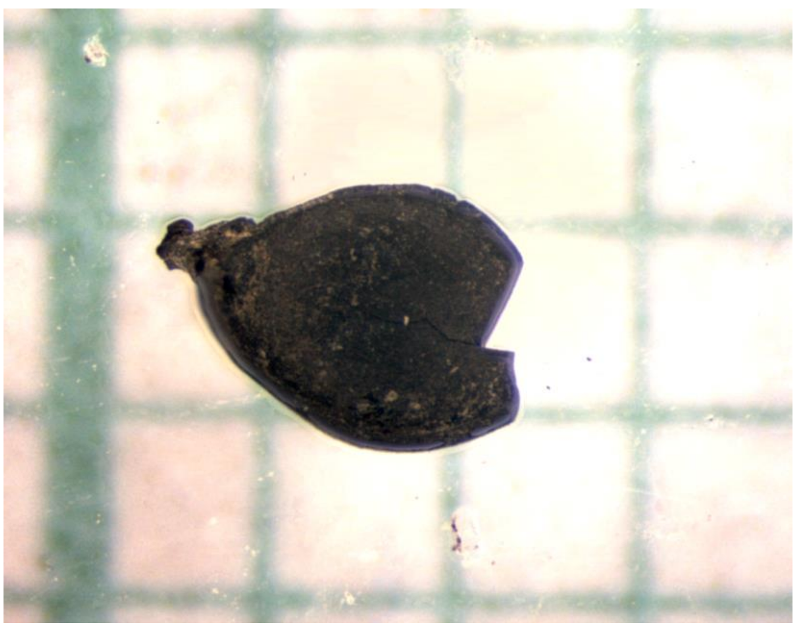

Figure H11: Polygonum sp. seed, cf. water-pepper

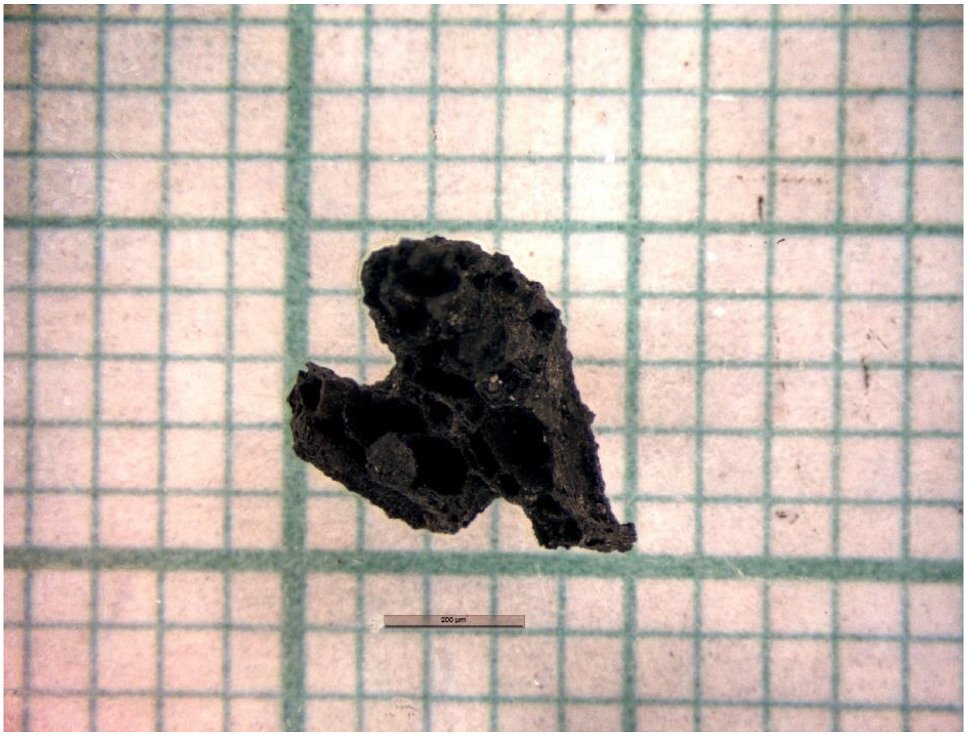

Figure H12: Unidentified vascular tissue (1X magnification, scale is 200 um)

Figure H12b: Unidentified vascular tissue (Laser, scale is 400 um)

Appendix I:

Charcoal Analysis Identification Data

Description:

The accompanying Excel spreadsheet shows the original raw data for this thesis' charcoal analysis. Noted information include sample data, columns for taxa identification traits, preliminary and final taxa identification, whether the charcoal fragment was checked by Naoko Endo, and additional notes as needed. In the "Growth Rings" column, EW refers to earlywood and the number of + symbols indicates the thickness of observed earlywood rings.

Filename:

AEGOODE_Thesis_2014_Appendix J_Charcoal_Lab_Data Sheet.xlsx

Appendix J.

Inventories of Identified Taxa

Inventory of Archaeobotanical Taxa

Identified taxa are presented alphabetically with relevant botanical and ethnobotanical information on taxa characteristics and known uses by the Katzie, other Coast Salishan groups and/or other indigenous peoples. Information on taxa-specific cultural significance is drawn from ethnographic sources, including Barnett (1955), Jenness (1955), Kuhnlein and Turner (1991), Suttles (1955), and Turner (1995, 1998).

Amaranthaceae* sp. *(Amaranth)

Amaranths are herbs and shrubs associated with agriculture and considered a widespread weed of cultivated land and disturbed soil (Kuhnlein and Turner 1991: 109-110). I have found no ethnographic or ethnobotanical reference citing traditional use by Northwest Coast groups. Redroot pigweed (*Amaranthus retroflexus*) and related species have been used as a potherb by Indigenous peoples in the American Southwest and domesticated by the Aztec (Kuhnlein and Turner 1991: 109-110).

Berberidaceae – Mahonia nervosa (barberry family, Oregon grape)

Oregon grape is a low evergreen shrub found in light to shaded areas with well-drained to open conditions (BC Eflora 2008; Kuhnlein and Turner 1991: 136-137; Turner 1995: 63). It forms part of the CWH shrub layer and produces purple berries in late summer (Horn 1994: 68; Pojar et al. 1991: 98).

Halkomelem and other Northwest Coast peoples ate the berries (Kuhnlein and Turner 1991: 136-137; Turner 1995: 64). They were generally harvested in August and eaten raw or mashed, boiled, and mixed with other berries such as salal (*Gaultheria shallon*) for drying into cakes (Kuhnlein and Turner 1991: 136-137; Turner 1995: 64). The stem, bark, and roots can be used to make a bright yellow dye for basketry, while bark and berries have medicinal uses (Pojar and McKinnon 1994: 95; Turner 2001 [1998]: 148-149).

C.f. Brassicaceae* sp. *(Mustard)

The mustard family contains three distinct groups: rapes, cabbages (or coles), and mustards (Musil 1978 [1963]: 94). The large family is found in many habitats globally. Wild *Brassica* seeds (especially mustard seeds) are difficult to identify to species, since they tend to be very small (<250 microns), round and a uniform black colour (Molly Capper, pers. comm. 2011). Domesticated *Brassica* seeds are larger, with more discernable characteristics for identification (Musil 1978 [1963]: 96).

I have found no ethnographic mention of native *Brassica* plants being eaten by any Coast Salishan peoples. Other Indigenous peoples in Canada did not widely or intensively harvest *Brassica* and present-day communities primarily use introduced species recently added to traditional diets (Kuhnlein and Turner 1991: 141-143).

Chenopodiaceae* sp. *(Goosefoot family)

Ranging from herbs to fairly large shrubs, this family is considered common weeds of cultivated and disturbed soils (Hitchcock and Cronquist 1973: 93; Kuhnlein and Turner 1991: 152). However, red goosefoot (*C. rubrum*) is also found in salt marshes and moist saline meadows (Pojar and MacKinnon 2004 [1994]: 311).

There is no record of *Chenopodium* sp. cultivation by the Katzie or other peoples of the Northwest Coast, where it is commonly found in archaeobotanical assemblages and typically interpreted as weedy inclusions (Lyons and Leon 2010: 11). However, Patricia Ormerod (2002: 34) has suggested that *Chenopodium* may have been used as a food resource or a vegetable layer in mound ovens at the Xay:tem (Hatzic Rock) site in the Fraser Valley. Some species have been cultivated or even domesticated in the Americas, including lambsquarters, pigweed or goosefoot (*Chenopodium album* sp.) and quinoa (*C. quinoa Wiilld*) (Bruno and Whitehead 2003: 342; Kuhnlein and Turner 1991: 151-152).

Crataegus* sp. *(Hawthorn)

The hawthorn tree is a large deciduous shrub bearing clustered white flowers and edible black fruits. There are many hawthorn species but the most widespread on the Northwest Coast is black hawthorn (*Crataegus douglasii*), an indicator plant of nutrient-rich wetlands (Klinka et al. 1989; Little 2009 [1980]: 451-452).

"Black haw" is listed among the many berries the Katzie traditionally gathered, and they used hawthorn twigs to make eulachon rakes (Suttles 1955: 23, 27). Katzie use of the thorns is not mentioned. Other Indigenous groups in British Columbia have used the wood and thorns for toolmaking, while the berries were eaten (fresh and dried) and used for medicine (Kuhnlein and Turner 1991: 236-237; Turner 1995: 111-112; 1998: 180-181; Turner and Szczawinski 1979: 140-141).

Cyperaceae (Sedge family)

Sedges resemble grasses but are a separate family altogether, one of the largest of the Plant Kingdom (Pojar and MacKinnon 2004 [1994]: 388; Taylor 1983: 1). Typically found in moist or wet places, *Cyperaceae* are one of the most common emergent species[49] of freshwater and saltwater marshes (Cronk and Fennessy 2001: 7, 41; Taylor 1983: 1).

While I can find no mention of Katzie use of sedges, slough sedge (*Carex obnupta*) is the most widely used by Northwest Coast peoples for basketry and mat-making (Turner 2001 [1998]: 106-107). Coast Salishans also used tule stems and the spongy leaves of *Scirpus* sp. (along with the *Typhaceae* or Cat-tail family) for many purposes (Turner 1979: 149-152). Sedge could also be used to make twine, baskets, bags, capes, hats and headdresses (Barnett 1955: 123; Turner 1979: 152). In ethnographic observations, lining or food mats was used in earth ovens (Ormerod 2002: 12); such material could plausibly be made from sedges.

[49] "Emergent" plants are rooted in underwater soil with leaves, stems and reproductive organs above water.

c.f. Eragrostis* sp. *(Lovegrass, Poaceae [Grass] family)

Lovegrass belongs to the very large and prevalent *Poaceae* family. It is considered a post-contact introduced plant in southwestern British Columbia, where it grows in moist to dry soils and clearings in lowland, steppe and montane zones (BC EFlora 2008; Peterson 2001 [1998]: 144). Because the grass family is so large and the *Eragrostis* sp. identification is not completely certain, the single seed–which appears charred–is tentatively considered a modern inclusion.

I have found no mention of the use of *Eragrostis* sp. by the Katzie or other indigenous groups. For information on indigenous use of the Grass family (*Poaceae*), see below.

Gaultheria c.f. shallon (Salal, Ericaceae [heather] family)

Salal is a small to large shrub characteristic of the CWH shrub layer in wetter maritime areas, sometimes forming thickets (Pojar and MacKinnon 2004 [1994]: 53; Pojar et al. 1991: 98). It also thrives in regional basin bogs[50] (National Wetlands Working Group 1988: 312).

Arguably one of the most important traditional foods of the Northwest Coast, salal bushes produce many berries that can be cooked and dried into cakes (Horn 1994: 120; Kuhnlein and Turner 1991: 168; Turner 1995: 77-78). In the Katzie seasonal round,

[50] Bogs built up to the water level with horizontal or gently sloping surface.

salal berries were harvested from August through September and eaten or dried for the winter (James 1998: 41; Suttles 1955: 27). Halkomelem and other coastal groups often mixed salal with other berries (e.g., oregon grape, wild lily of the valley, red elderberry), and crabapple (*Malus fusca*) (Turner 1995: 51, 63, 68, 117). Some Vancouver Island Salish peoples used salal branches as lining and covers in cooking pits or to give flavour to cooked and smoked foods (Turner 2001 [1998]: 212).

C.f. Galium* sp. *(Bedstraw, Rubiaceae [Madder] family)

Common in British Columbia, bedstraws are herbaceous plants that prefer moist soils, coastal bogs and wetlands, although they can grow in meadows (Lyons and Leon 2010: 14; Pojar and McKinnon 1991: 330-331). Varieties common to the Lower Fraser Valley include *G. aparine* (goose grass), *G. boreale* (Northern bedstraw), *G. trifidum* (Small bedstraw), *G. trifidum* var. *pacificum* and *Galium triflorum* (Sweet-scented bedstraw) (Lyons and Leon 2010: 14; Pojar and McKinnon 1991: 330-332; Turner and Gustafson 2006: 90-92). *Galium triflorum* is strongly associated with nutrient-rich wetlands, including those found in the CWHdm1 (dry maritime) subzone (Pojar et al. 1991: 104).

There are no known uses of *Galium* sp. by the Katzie or other Coast Salishan communities, but the Cowichans of Vancouver Island used goose grass to remove pitch from their hands and some Athabaskan peoples used bedstraw for dye, perfume and hair rinses (Pojar and McKinnon 1991: 330; Turner 2001: 219-220). *Galium* is common in regional archaeological sites and typically interpreted as weedy inclusions (Lyons and Leon 2010: 14).

Liliaceae* sp. *(Lily family)

The lily family contains edible foods, including lily bulbs, wild onions, wild chives, and blue camas bulbs (Kuhnlein and Turner 1991: 78-97). In British Columbia, their habitat ranges from open meadows and shaded woodlands to marshes and moist soils, although many species favour wetlands (Pojar and MacKinnon 1994: 113). The lily family also contains highly poisonous plants, including death camas (*Camassia quamash*), which inexperienced gatherers can confuse with edible lilies such as blue camas (below) or wild onions (Turner and Kuhnlein 1991: 81, 87).

Only one lily is ethnographically mentioned as used by the Katzie – the *Fritillaria* sp. (Suttles 1955: 27). Published Katzie traditional knowledge cites the collection and consumption of black lily (*Fritallaria camschatcensis*) and chocolate lily (*Fritillaria lanceolata*) (James 1998: 41). The *Fritillaria* bulbs can be either boiled or steamed in pits, or dried for winter use (Kuhnlein and Turner 1991: 91). More broadly on the Northwest Coast, *Liliaceae* corms, roots, and tubers were often cooked in steaming or cooking pits, sometimes interspersed with tree boughs or other foods, while bulbs were boiled and dried or eaten raw (Turner 1995: 40-52). The blue camas (*Camassia* sp.) is considered one of the most important Northwest Coast traditional indigenous "root" foods and trade items (Harrington 1967: 20; Kuhnlein and Turner 1991: 84).

Other lilies with known regional use as food and medicine include False Solomon's Seal (*Smilacina racemosa*), False Lily-of-the-Valley (*Maianthemum dilatum*), Pink Fawn Lily (*Erythronium revolutum*), Nodding Onion (*Allium cernuum*), Hooker's Onion (*Allium acuminatum*), Tiger Lily (*Lilium columbianum*), and Indian Hellebore

(*Veratrum viride*)[51] (Kuhnlein and Turner 1991: 78-97; Pojar and MacKinnon 1994: 100-113). Vancouver Island Coast Salishans and other coastal groups still use the tough, dye-friendly bear-grass (*Xerophyllum tenax*) leaves for basketry (Turner 2001 [1998]: 111-112).

Polygonum* sp. *(knotweed and smartweed, Polygonaceae [Buckwheat] family)

Knotweeds are common herbaceous wetland plants characteristically found in freshwater and saltwater marshes and hundreds of *Polygonum* species (many introduced) grow in the Lower Fraser Valley (Cronk and Fennessy 2001: 7, 41; Lyons and Leon 2010: 12; Pojar and McKinnon 1991: 127). Pollen analysis confirmed abundant presence of *Polygonum* sp. in DhRp-52 peat samples (Mathewes 2009: 3).

Many knotweed species have a rhubarb-like flavour (Kuhnlein and Turner 1991: 220). The Katzie used *P. hydropiperoides* (water-pepper, listed below) and *P. amphibium* (water smartweed) for medicine and ritual purposes (Suttles n.d., cited in Lyons and Leon 2010: 12). Alpine knotweed (*P. alpinum*), alpine bistort (*P. viviparum*), mountain bistort (*P. bistorta*), and smokeweed bistort (*P. bistortoides*) were eaten by Indigenous peoples in British Columbia and elsewhere in Canada, and in Alaska (Kuhnlein and Turner 1991: 220-224).

***Polygonum c.f.* hydropiperoides (Buckwheat family, Water-pepper)**

[51] Extremely poisonous, used in small amounts as medicine (Kuhnlein and Turner 1991: 97).

Water-pepper is a weedy stemmed plant found on low-lying moist to wet land (Pojar and MacKinnon 1994: 127). Dr. Mathewes' pollen study indicated strong co-occurrence of water-pepper with wapato in the site's peat bog (Mathewes 2009: 3). The Katzie used it for medicine and rituals, including poulticed leaves for pain relief (Suttles n.d., cited in Lyons and Leon 2010: 12).

Poaceae* sp. *(Grasses family)

The grass family is notoriously large and complex, with over 200 species found locally (Pojar and MacKinnon 2004: 356). Most are native, but approximately 100 introduced species grow wild in Canada (Kuhnlein and Turner 1991: 98). The grass family (also called *Gramineae*) includes wheat, barley, oats, rye, corn and rice. This family is also one of three that contain the majority of common emergent plants found in freshwater marshes (Cronk and Fennessy 2001: 41).

Indigenous peoples have used many *Poaceae* species for different purposes (e.g., game lures, dyes, lining material, floor matting, and bedding), but not extensively for food (Pojar and MacKinnon 2004: 356). On the Northwest Coast, grasses were most commonly used in food preparation, such as lining steam-cooking pits, wiping fish, covering, mixing or whipping berries, and for stringing clams, eulachon and roots for drying (Kuhnlein and Turner 1991: 98-99; Pojar and MacKinnon 2004: 356; Turner 2001 [1998]: 113).

C.f. *Potentilla* sp. *(Cinquefoil, Rosaceae [Rose] family)*

Cinquefoils are perennial herbs that grow on wetlands, slopes, meadows and open areas, and southern British Columbian species include *Potentilla pacifica*[52] (silverweed or Pacific cinquefoil), *P. villosa* (Villous cinquefoil), and *P. flabellifolia* (Fan-leaved cinquefoil) (Pojar and Mackinnon 1994: 186-187).

I found no reference to Katzie use of cinquefoil. However, the roots of *P. pacifica,* which grows in wetlands, were harvested by almost all Northwest Coast peoples for steam-cooking (Deur 1999: 142-144; Turner 1995: 116; Turner and Gustafson 2006: 230). It appears to have greater importance among northern coastal groups, although it was also used as survival food among southern coastal peoples (Turner 1995: 116; Turner and Davis 1993: 182).

Rubus sp. (raspberry, Rose family)

The *Rubus* family has trailing or erect shrubs bearing aggregate berries (Horn 1994: 136). *Rubus* habitats range from wetlands and moist sites to dry forests, open clearings or disturbed soil at low to alpine elevations (Pojar and MacKinnon 2004 [1994]: 78-80). Salmonberry (*Rubus spectabilis*) is notably associated with moist and swampy areas (Kuhnlein and Turner 1991: 258). *Rubus* species (e.g., wild raspberries, blackberries, and salmonberries) are very common on the Pacific Northwest Coast.

Regional culturally significant *Rubus* species include wild raspberry (*Rubus idaeus*), salmonberry, black raspberry (*Rubus leucodermis*), thimbleberry (*Rubus*

[52] Sometimes called *P. anserina spp. pacifica*; not to be confused with *P. anserina*, which grows east of the Coast mountains (Turner 1995: 115).

parviflorus), and trailing wild blackberry (*Rubus ursinus*) (Turner 1995: 122-124, 126-127; Suttles 1955: 27). The Katzie preserved blackberries for winter use (Suttles 1955: 27). They also ate the green shoots of thimbleberry and salmonberry, while black raspberry and trailing blackberry were (and still are) used medicinally for stomach ailments and as a tea for women (James 1998: 41-42; Lyons and Leon 2010: 13). More broadly on the coast, *Rubus* berries are typically eaten raw, mixed with other food or made into dried berry cakes, and the shoots and sprouts of several species are eaten as springtime vegetables (Kuhnlein and Turner 1991: 250-259). Berry harvesting times vary by species from late spring to autumn (Turner 1995: 121-128).

Rubus seeds are commonly found in regional archaeobotanical assemblages and considered an excellent indicator of summer occupation (Lyons and Leon 2010: 13), although recovered seeds from berry cakes eaten in the winter could confound that interpretation.

C.f. *Suaeda maritima* (Seablite, Chenopod family)

Seablite is a taprooted, branched annual that grows in saltwater marshes, tidal flats and beaches (Pojar and MacKinnon 1994: 310; Turner and Gustafson 2006: 470). Sometimes sold in seafood stores today, I have found no ethnographic mention of seablite as a traditional food resource for indigenous peoples (Pojar and MacKinnon 2004: 310).

Inventory of Faunal Taxa

This section presents pertinent information on identified faunal taxa, drawn from ecological literature (e.g., Berra 2001; Castro 2011; Östlund et al. 2007; McPhail and Carveth 1993) and ethnographic texts (e.g., Barnett 1955; James 1998; Jenness 1955; Suttles 1955).

In faunal assemblages, the minimum number of individuals (MNI) represented for a taxon may be measured based on key elements present in a fixed number for a particular species (Grayson 1984: 27-28). For example, MNI based on left and right femurs in ungulates or the left and right jaws of some fish (Grayson 1984: 27; Colley 1990: 217). NISP counts the number of identified specimens (faunal elements) recovered.

Spiny Dogfish (Squalus acanthias) **(NISP=6 [teeth]; MNI=2)**

One of the most abundant sharks, spiny dogfish is about 110 to 130-cm long and between 4 and 7 kg (Castro 2011: 57). It inhabits temperate and sub-polar latitudes of the North Atlantic and North Pacific oceans; off the Pacific Coast, they range from the Bering Sea to Baja California (Castro 2011: 56-57; Musick et al. 2004: 57). Dogfish form very large schools of hundreds or thousands of individuals (Castro 2011: 56). They are found from the ocean surface to >700 m depth (Castro 2011: 56; Musick et al. 2004: 63). Dogfish is fairly abundant in the Strait of Georgia and are reported to congregate at the Fraser River's mouth to feed on eulachon (Castro 2011: 56-57; Hart 1973: 45).

Historic records and traditional knowledge suggest that Katzie fishing resources in the late Gulf of Georgia phase (1500 BP to contact) did not include dogfish (James 1998: 36-38; Suttles 1955: 21-23). Barnett describes dogfish fat rendered for use by Coast Salishans, although he does not name specific groups and also mentions dogfish among items "absolutely not eaten" (1955: 61, 63). Dogfish remains are often found in regional archaeological sites, such as Marpole and Crescent Beach (Altamira Consulting Ltd. 2006: B-1; Altamira Consulting Ltd. 2012: 110; Matson et al. 1991). This suggests possible cultural changes in the use of dogfish over time or a gap in the ethnographic record.

Northern Pikeminnow (Ptychoeilus oregonensis) (NISP= 8 [vertebrae frags]; MNI=1)

Once called "Northern Squawfish," it is now more appropriately named Northern Pikeminnow (Berra 2001: 92; Nelson et al. 1998: 37). A large minnow, the adults reach a length of 45 cm in Canadian waters (McPhail and Carveth 1993: 37; Wooding 1997: 248). While primarily a lake-dweller and absent from peripheral river drainages, it is commonly found from the Lower to Upper Fraser River (McPhail and Carveth 1993: 30, 37; Wooding 1997: 248). Regionally, it is considered an important predator of juvenile salmonids (Berra 2001: 92).

I have found no reference to ethnographic use of this species. However, two pikeminnow elements were recovered from Port Hammond and a possible pikeminnow tooth was found at Park Farm (Kristensen et al. 2009: 186; Rousseau et al. 2003: 102). As with dogfish, it is possible that cultural preferences for the species changed over time.

Salmon (Salmonidae) (NISP=30 [vertebrae frags]; MNI=2)

Salmon is arguably the most famous fish on the Pacific coast. There are five Pacific salmon species: Sockeye (*Oncorynchus nerka*), Chinook (*O. tshawytscha*), Coho (*O. kisutch*), Pink (*O. gorbuscha*), and Chum (*O. keta*) (McPhail and Carveth 1993: 44-

46). Average sizes and weights range from 50 cm and 3 kg for Pink salmon to 91 cm and 9 to 23 kg for Chinook salmon (Busch 2000: 29-39). All five species are anadromous, migrating upriver to spawn in (nearly always natal) freshwater streams, although spawning season varies by species and population (Wooding 1997: 42-43; Quinn 2005: 5). Identification of recovered elements to exact salmon species requires DNA analysis.

There is a large body of literature on the importance of salmon to Northwest Coast peoples, including the Coast Salish and the Katzie (e.g., Barnett 1995; Jenness 1955; Suttles 1955). The Katzie left the first salmon run of the summer alone and then fished or netted sockeye on the Fraser river until the season ended, before dispersing to autumn camps at the North and South Alouette rivers (James 1998: 37-38). They fished for coho, chum, and steelhead trout on the North Alouette River, and sockeye salmon and pink salmon on the South Alouette River (James 1998: 38). Fish weirs and traps were also set close to salmon spawning grounds (James 1998: 38). The salmon was often eaten fresh in the summer or smoked and dried, and the Katzie used these and other fish for ceremonial purposes (James 1998: 36).

Three-spine Stickleback (Gasterosteus aculeatus) (NISP=78[scutes/spines]; MNI=15)

A small fish, the stickleback is 5 to 10 cm in length (Wooding 1997: 267). The name refers to its characteristic fin spines, particularly the number of spines on the first dorsal fin (Wooding 1997: 267). However, the name is misleading because the adaptive and variable fish can have between two and four dorsal spines (Boughman 2007: 92-94; Mattern 2007: 2; McPhail 1994: 402-403). Based on this range, I calculated a minimum

MNI of 15 sticklebacks and a maximum MNI of 30 from the 60 spines recovered from A3 (MJ).

The fish is present in the lower Fraser River but absent from the upper Fraser (McPhail and Carveth 1993: 31, 55). Abundant in lakes and low gradient streams, three-spine stickleback has two subspecies, which often hybridize in the lower Fraser: a permanent freshwater resident and an anadromous form that migrates to freshwater streams to spawn (Mattern 2007: 14-15; McPhail and Carveth 1993: 55). Unfortunately it is not possible to differentiate between them from recovered elements without DNA analysis.

While I have found no ethnographic reference to Katzie or other coastal groups fishing this species, it has been recovered from other regional archaeological sites, including Park Farm, Glenrose Cannery, and St. Mungo's Cannery (Casteel 1976: 83; Eldridge and Fisher 1997: 81; Kristensen et al. 2009: vii, 188).

Pacific Littleneck (Leukoma staminea)(NISP=1[shell fragment]; MNI=1)

The small Littleneck clam is found in coarse, sandy mud in bays or open coast from the Aleutian Islands to Baja California (Rehder 1981: 808). It ranges from 3 to 6 cm in length.

Ethnographic information indicates the Katzie did not gather shellfish, lacking access to the seashore, but that visitors from marine shoreline areas brought them clams and other shellfish as gifts or trade items (Barnett 1955: 68; Suttles 1955: 27). Barnett (1955:

68) suggests that clams were prized and eagerly traded for by Fraser River groups. Coast Salishans with shoreline access often used digging sticks to gather clams, and steamed them open or cooked them on grass or twine strings (Barnett 1955: 61, 63; Turner 2001 [1998]: 113). Clamshells could also be used as oil-dipping containers (Barnett 1955: 60).

Inventory of Charcoal Taxa

This section presents pertinent information on identified taxa, drawn from ecological literature (e.g., Klinka et al. 1989; Little 2009 [1980]; Pojar and MacKinnon 1994) and ethnographic texts (e.g., Barnett 1955; Duff 1952; Suttles 1955; Turner 1995, 2001 [1998]).

Conifers (Softwoods)

Conifers, also called softwoods, are usually evergreen, have narrow needle-like or scale-like leaves and bear cones (Little 2009 [1980]: 25). Excepting Pacific yew, all conifers listed below are Pinaceae species.

Abies amabilis (Pacific Silver Fir)

Pacific silver fir is notoriously difficult to distinguish from Western hemlock under the microscope (Hawes 2010: 145; Naoko Endo, pers. comm. 2011). Thus, a number of charcoal pieces are classified as *Tsuga/Abies* (see Tsuga/Abies section, below). Because some or all of these pieces may be *Abies* sp., I include this species in the inventory.

This extremely shade-tolerant large fir has foliage that is silvery-coloured on the underside, hence its name (Little 2009 [1980]: 249). It prefers submontane, wet and cool sites up to 305 m in elevation and regionally occurs in mixed stands, usually with hemlock, sitka spruce and red cedar (Klinka et al. 1989: 66; Little 2009 [1980]: 249; Pojar and MacKinnon 1994: 33). It is considered characteristic of wet maritime forests (Klinka et al. 1989: 66). However, it is more abundant in British Columbia's northern coastal forests than in the southern range, where Douglas-fir takes its place (Pojar and Meidinger (1991: 45).

The wood is soft and brittle, making it more suitable for fuelwood than as building material (Pojar and MacKinnon 1994: 33; Turner 2001: 80). I have found no mention of Katzie use of this tree. However, the boughs have a pleasant, spicy fragrance and were used by the Nuu-chah-nulth and Nlaka'pamux as bedding and flooring coverings, and to cover berry baskets (Pojar and MacKinnon 1994: 33). It is plausible for other groups to do the same in *Amabilis*-rich areas.

Picea sp. (Spruce family)

This family includes the world's largest spruce, sitka spruce (*Picea sitchensis*), which has stiff, sharp needles and reaches 49 m in height (Little 2009 [1980]: 268). Native to the Pacific coast from southern Alaska to Northwest California, it prefers coastal forests in the fog belt (a narrow strip of high rainfall and cool climate) up to 900 m elevation (Little 2009 [1980]: 268). On the south coast, it is largely restricted to specialized habitats such as floodplains and exposed beaches (Pojar et al. 1991: 96). It is usually associated with black cottonwood (*Populus balsamifera*), western hemlock or western red cedar (Klinka et al. 1989: 181). Other spruce species in British Columbia include Engelmann spruce (*P. engelmannii*), White spruce (*P. glauca*), and Black spruce (*P. mariana*), but only Sitka spruce is definitively found in low-lying coastal forests (BC Eflora 2008).

The wood is light and strong (Turner 2001 [1998]: 87). I have found no reference to Katzie use. However, indigenous peoples often used spruce to make cedar box pegs (Turner 2001 [1998]: 87). The indigenous peoples of Vancouver Island sometimes used it for making tools, while the Haida used the wood and bark for fuel. Sitka spruce roots were a regionally important basket material and also used for rope and fishing lines, netmaking and wood-sewing[53] (Turner 2001 [1998]: 88). The inner bark can be eaten fresh or dried into cakes and eaten with berries (Pojar and MacKinnon 2004: 37; Turner 1995: 32-33). The pitch was chewed for enjoyment, used as topical medicine for skin irritations or eaten as a remedy for illnesses, and used as caulking glue or joint cement (Pojar and MacKinnon 2004: 37; Turner 1995: 32-33; 2001 [1998]: 88).

Pseudotsuga menziesii (Douglas Fir)

Douglas fir has two distinct varieties: Coast (*P. menziesii)* and Rocky Mountain or Interior (*P. glauca*) (Little 2009 [1980]: 294; Turner 2001 [1998]: 95). A large tree, the

[53] Commonly used to make bentwood boxes; wood pieces are sewn together using roots or twine through holes in the wood.

coastal variant can grow up to 70 to 90 m tall (Little 2009 [1980]: 295). It is ubiquitous to the central and southern British Columbian coast, forming vast forests (often pure stands) from sea level to 1,500 m elevation (Pojar and MacKinnon 2004: 32; Pojar and Meidinger 1991: 45; Turner 2001: 95). However, it is more abundant in drier parts of the CWH zone (Pojar and Meidinger 1991:96). Douglas fir self-prunes, dropping dead branches to the forest floor (Lepofsky 2004: 406).

A heavy, strong, fine-grained and durable wood that seasons well and is easy to work, Douglas fir is valued by many coastal peoples (Turner 2004: 95). The Katzie and other Coast Salish groups made harpoon shafts from the branches, and the Coast Salish often used the wood to make spoons, spear shafts, dipnet poles, herring and eulachon rakes, harpoon barbs, fire tongs, and salmon weirs (Turner 2004: 95). Both the wood and bark are considered excellent fuel (Pojar and MacKinnon 2004: 32; Turner 2001 [1998]: 95). The boughs are fragrant and were used by indigenous groups as flooring, sitting mats, bedding, outside covers for shelters, and to shade fish and berries on drying racks (Turner 2001 [1998]: 95). The small seeds can be eaten (Kuhnlein and Turner 1991: 66). The pitch can be used as sealant, caulking, and a medicinal salve (Pojar and MacKinnon 2004: 32; Turner 2001 [1998]: 95).

Tsuga heterophylla (Western Hemlock)

One of the most common trees on the Northwest Coast, western hemlock has a long slender trunk and can grow up to 60 m tall (Little 2009 [1980]: 296; Pojar and MacKinnon 2004: 30). Very shade-tolerant, it grows in cool temperate climates up to 610 m elevation and is common in wet nitrogen-poor sites (Klinka et al., 1989: 235). It only grows in organic-rich soils (Pojar and MacKinnon 2004: 30).

The wood is moderately heavy and works fairly easily (Turner 2001: 98). I have found no reference to Katzie use of this tree. However, other coastal peoples have used it to carve tools (e.g., spoons, roasting spits, dipnet poles, digging sticks, elderberry-picking poles) (Turner 2001: 98). The bark has a high tannin content and was used as a tanning agent, pigment and cleaning solution, while the inner bark could be processed to make a red paint and wood preservative (Turner 2001: 98-99). The inner bark was also an important food eaten freshly cooked or dried (Kuhnlein and Turner 1991: 67). Coastal groups commonly used the boughs as lining and to collect herring spawn, while Mainland Comox threaded eulachon and herring on hemlock boughs to dry and used the branches to line steaming pits (Kuhnlein and Turner 1991: 67; Turner 1995: 35, 2001: 99).

"Tsuga/Abies" (Hemlock or Pacific Silver Fir) identification

It is notoriously difficult to differentiate between hemlock and pacific silver fir at the cellular level, as they have many similar microscopic characteristics (Hawes 2010: 145; Naoko Endo, pers. comm. 2011). Both species grow in Katzie traditional territory. Unless clear indications such as cross-field pitting or ray tracheids were visible, I labeled charcoal specimens with characteristics shared by both species as "Tsuga/Abies."

Taxus brevifolia (Pacific Yew, "Western yew")

A member of the Taxaceae (Yew) family of Conifers, pacific yew is a non-resinous evergreen tree (Little 2009 [1980]: 245). Much smaller than other conifers discussed so far, it reaches a maximum height of 15 m and can sometimes be a shrubby two m tall (Pojar and MacKinnon 2004: 40; Little 2009 [1980]: 245). Its coastal range runs from Alaska to central California (up to 2,134 m elevation in the south) and it prefers moist soils of stream banks and canyons (Little 2009 [1980]: 246; Klinka et al. 1989: 228). In southwestern British Columbia, it also grows as a small shade-tolerant, understory tree beneath douglas fir and western hemlock at low to middle elevations in moist mature forests (Pojar and MacKinnon 2004: 40). However, it is not listed as an indicator species of the CWH zone (Pojar et al. 1991: 95-111).

Most parts of pacific yew, including seeds and foliage, are poisonous and can be fatal if ingested (Little 2009 [1980]: 246). Even so, the Straits Salish used the leaves in potent smoking mixtures (Kuhnlein and Turner 1991: 69). The Masset Haida of Haida Gwaii and the Upper Lillooet of interior British Columbia ate small amounts of the fruit's fleshy outer part, apparently the least toxic part (Kuhnlein and Turner 1991: 69).

Although poisonous to eat, the tree yields strong, heavy, close-grained wood that carves fairly easily and takes a high polish; Indigenous peoples within its range prized these traits and it was often traded to the Interior (Little 2009 [1980]: 246; Pojar and MacKinnon 2004: 40; Turner 2001: 100). Yew is called "bow plant or "bow" in Halkomelem and the Katzie used the tree for bow-making (Suttles 1955: 24; Turner 2001: 100-101). Coastal peoples used yew to make tools for hunting (e.g., clubs, fish hooks and spears), gathering (e.g., digging sticks, boxes, prying sticks) and building or carving (e.g., adze handles, awls, dowels and pegs) (Turner 2001: 100-102). However, the tree's limited supply and small size restrict its use as a material resource (Little 2009 [1980]: 246).

Unidentified Conifer

This label was assigned to any charcoal samples that were clearly conifers in cross-section examination but not identifiable to genus or taxa.

Deciduous (Hardwoods)

Deciduous trees (also called hardwoods) are trees that shed their leaves annually.

Acer sp. (Maple family)

Three variants of maple are found regionally: big-leaf maple (*Acer macrophyllum*), vine maple (*Acer circinatum*) and douglas maple (*Acer glabrum*) (Pojar and MacKinnon 2004: 45, 93). Big-leaf maple is the largest, between 9 and 21 m tall (Little 2009 [1980]: 532). Shade-intolerant, it inhabits stream banks and moist canyon soils up to 305 m above sea level (Klinka et al. 1989: 68; Little 2009 [1980]: 532). It is common in pure or mixed stands, usually with red alder (*Alnus rubra*) or black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) (Klinka et al. 1989: 68). Vine maple is more shrubby and prefers moist to wet places, especially along shaded streambanks (Little 2009 [1980]: 530; Pojar and MacKinnon 2004: 93). Douglas maple is also shrubby or a small tree and prefers dry to moist but well-drained sites (Pojar and MacKinnon 2004: 93).

The Katzie used vine maple for bowmaking (Suttles 1955: 24). Coast Salish people carved spindle whorls and paddles from the wood, and its name in many Coast Salish languages means "paddle-tree" (Turner 2001: 131). Other carved maple tools include dishes, spoons, fishnet measures, fish lures, cattail mat creasers, cedar-bark shredders, and adze handles (Turner 2001: 131).

All variants self-prune and drop their dead branches, which people could then easily collect for fuelwood (Lepofsky 2004: 406). Big-leaf maple is considered an excellent fuel, for it burns hot without smoke (Turner 2001: 131). The Straits and Halkomelem Salish used the leaves to line cooking pits and other groups used them in steaming pits to flavour cooking meat (Turner 1995: 55; 2001: 131). The tree was not widely used for food, but the young tree shoots can be eaten raw in springtime, the Sechelt ate the winged one-seeded fruits, and Barnett (1955: 63) recorded the inner bark being eaten by Vancouver Island Salish (Turner 1995: 55-56).

Alnus rubra (Red Alder, Birch Family)

The shade-intolerant red alder is 12 to 30 m tall and inhabits nitrogen-rich, moist soils along streams and lower slopes up to 762 m in elevation (Klinka et al. 1989: 75; Little 2009 [1980]: 377-378). A fast-growing tree, it tends to form dense stands and may hinder the growth of conifers (Klinka et al. 1989: 75). It is a very common deciduous tree in the CWH zone and frequently associated with freshwater marshes (Cronk and Fennessy 2001: 41; Pojar et al. 1991: 96; National Wetlands Working Group 1988: 311).

There is no ethnographic record of Katzie use of alder. However, indigenous peoples of British Columbia extensively used alder for dyeing basketry, fishing tools, wooden articles, mountain goat wool and other items, as well as for carving (Turner 2001

[1998]: 150). Alder wood makes excellent fuel because of its low pitch content and lack of unpleasant flavour, especially for smoking salmon and cooking deer meat (Kuhnlein and Turner 1991: 138; Turner 2001: 152). Seasoned or partially rotten wood was preferred over green fresh wood for smoking (Turner 2001: 152). The Upper Sto:lo used eulachon drying racks over alder fire (Duff 1952: 71). The absence of pitchy flavour and the wood's smooth, even-grained texture also makes it ideal for carving tools and regalia (Turner 2001: 152). Some Salishan peoples ate the inner bark in the spring (Kuhnlein and Turner 1991: 137; Turner 1995: 65). Alder bark was also used medicinally for respiratory and skin problems, and it is known to have strong antibiotic properties (Pojar and MacKinnon 2004: 44).

Populus* sp. *(Cottonwood and Aspen, Willow family)

Cottonwood and Aspen are difficult to differentiate in charcoal analysis, often limiting identification to genus (Naoko Endo, pers. comm. 2011). Black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) is ubiquitous on the southern British Columbian coast (Pojar and MacKinnon 2004: 46). Quaking aspen also grows in the region, but more sporadically (Little 2009 [1980]: 346; Pojar and MacKinnon 1994: 46). Both are considered possible sources of *Populus* sp. charcoal.

Populus trees are frequently found in freshwater and saltwater marshes (Cronk and Fennessy 2001: 7, 9). Black cottonwood is the tallest native western hardwood at 50 m tall or more and has resinous, sweet-smelling spring buds and leaves (Klinka et al. 1989: 191; Little 2009 [1980]: 334-345; Turner 2001: 194). It grows on fresh to very moist nitrogen-rich soils, tolerating a fluctuating water table, up to 610 m elevation

(Klinka et al. 1989: 191; Little 2009 [1980]: 345-346). It usually occurs along large rivers with extensive floodplains (Pojar et al. 1991: 96). Quaking aspen is a smaller tree (up to 25 m) that usually forms pure stands and tolerates moist soils and floodplains (Klinka et al. 1989: 191; Pojar and MacKinnon 1994: 46).

I have found no ethnographic reference to Katzie use of this tree. Turner (2001:195) notes that Northwest Coast peoples seldom distinguished between black cottonwood and balsam poplar (*Populus balsamifera*), and Turner discusses their use together as “Cottonwood.” The wood is soft, moderately strong, straight-grained and uniformly textured, and easy to work, but not very durable (Turner 2001: 195). Many coastal peoples made cottonwood canoes, which were smaller and lighter than red cedar canoes (Turner 2001: 195).

Cottonwood was considered an excellent fuel, used for smoking hides or fish, while the Upper Sto:lo and other groups used dried cottonwood roots to make drills and hearths for friction fires (Turner 2001: 195). Some Coast Salish groups made rectangular containers out of cottonwood bark and Halkomelem ate the inner bark in the spring and early summer (Kuhnlein and Turner 1991: 260; Turner 2001: 195-196). However, it sours or ferments rapidly, preventing winter storage (Turner 1995: 130). Interior groups used the ashes to make soap for washing and laundering (Turner 2001: 195).

Malus fusca (Pacific crabapple, Rose family)

Pacific crabapple is a shade-intolerant and small shrubby tree approximately 2 to 12 m tall (Little 2009 [1980]: 460). Commonly found in the CWH zone, it is characteristic of nutrient-rich wetlands and often occurs in brackish-water marshes and ocean-spray areas (BC EFlora 2008; Klinka et al. 1989: 165; Pojar and MacKinnon 2004: 48). Submontane to montane, pacific crabapple's maximum elevation is 305 m above sea level (Klinka et al. 1989: 165; Little 2009 [1980]: 461).

It is the only Western species of crabapple, with small, clustered tart apples (Little 2009 [1980]: 461; Pojar and MacKinnon 2004: 48). The fruits are still an important food for nearly all Indigenous peoples in the tree's range (Kuhnlein and Turner 1991: 246; Turner 1995: 118). The Katzie gathered crab apples in the fall and preserved them for winter (James 1998: 48). Halq'emeylem and other coastal peoples often hung crabapples in cattail bags until ripe (Turner 1995: 117). The apples could be eaten fresh, preserved for the winter in bentwood cedar boxes, or mixed with sweeter fruits like salal (Kuhnlein and Turner 1991: 246-247; Turner 1995: 117).

Pacific crabapple wood is hard and resilient (Turner 2001: 183). The Halkomelem and others used it to make tool handles, bows, wedges, and digging sticks, as well as smaller items as spoons and halibut hooks (Turner 2001: 183).

Unidentified Deciduous

This label was assigned to any charcoal samples that were clearly deciduous but not identifiable to genus or taxa.

Appendix K.

List of Scientific Names Mentioned in Text

Scientific Name	Common Name
Abies sp.	True fir
Abies amabilis	Amabilis fir or Pacific silver fir
Acer sp.	Maple
Acer circinatum	Vine maple
Acer macrophyllum	Big-leaf maple
Acipenser sp.	Sturgeon
Allium acuminatum	Hooker's Onion
Allium cernuum	Nodding Onion
Alnus sp.	Alder
Alnus rubra	Red alder
Amaranthus sp.	Amaranth
Amaranthus retroflexus	Redroot pigweed
Amelanchier alnifolia	Saskatoon berries
Arctostaphylus uva-ursi	Kinnikinnick
Brassica sp.	Mustard
Castor canadensis	Beaver

Carex sp.	Sedge
Calystegia soldanella[54]	Beach morning-glory
Camassia ssp.	Blue camas
Camassia quamash	Death camas
Carex obnupta	Slough sedge
Cervus elaphus	Wapiti
Chamaecyparis nootkatensis	Yellow cedar
Chenopodium sp.	Goosefoot
Chenopodium album	Goosefoot subspecies
Chenopodium rubrum	Red goosefoot
Chenopodium quinoa Wiilld	Quinoa
Convolvulus sp.	Morning glory
Convolvulus soldanella	Beach morning-glory
Corylus californica	Western hazelnut (aka Dutch hazelnut)
Corylus cornuta	Beaked hazelnut
Crataegus douglasii	Black hawthorn
Eliocharis	Spike-rush
Erythronium revolutum	Pink Fawn Lily
Equisetum sp.	Horsetails
Eragrostis sp.	Lovegrass
Fragaria	Strawberry

[54] Alternative name. *C. soldanella* primarily used.

Fritillaria sp.	Fritillaria/Lily sub-family
Fritillaria camschatcensis	Black lily
Fritillaria lanceolata	Chocolate lily
Galium sp.	Bedstraw
Galium aparine	Goose grass
Galium boreale	Northern bedstraw
Galium trifidum	Small bedstraw
Galium trifidum var. *pacificum*	Small bedstraw variant
Galium triflorum	Sweet-scented bedstraw
Gasterosteus aculeatus	Three-Spine Stickleback
Gaultheria shallon	Salal
Leukoma staminea	Pacific littleneck
Lilium columbianum	Tiger Lily
Mahonia nervosa	Oregon grape
Maianthemum dilatum	False Lily-of-the-Valley
Malus fusca	Pacific crabapple
Myriophyllum	Water milfoil
Mytilus edulis	Bay mussel
Nymphaea sp.	Water lily
Olor sp.	Swan
Oncorynchus sp	anadromous salmon
Oncorynchus gorbuscha	Pink salmon
Oncorynchus keta	Chum salmon
Oncorynchus nerka	Sockeye salmon

Oncorynchus tshawytscha	Chinook salmon
Onchoryncthus sp.	Trout
Oreamnos americanus	Mountain goats
Osmaronia cerasiformis	Indian plum
Oxycoccos oxycoccos	Bog cranberry
Picea sp.	Spruce
Picea sitchensis	Sitka spruce
Picea engelmanii	Engelmann spruce
Picea glauca	White spruce
Picea mariana	Black spruce
Pinus sp.	Pine
Polygonum sp.	Knotweed/Smartweed
Polygonum amphibium	Water Smartweed
Polygonum alpinum	Alpine knotweed
Polygonum bistorta	Mountain bistort
Polygonum bistortoides	Smokeweed bistort
Polygonum hydropiperoides	Water-pepper
Polygonum viviparum	Alpine bistort
Polypodium glycyrrhiza	Licorice fern
Populus sp.	Cottonwood and Aspen
Populus balsamifera	Balsam poplar
Populus balsamifera ssp. *trichocarpa*	Black cottonwood
Populus tremuloides	Quaking aspen
Portulaca sp.	Purslane

Potamogeton sp.	Pond weed
Potentilla sp.	Cinquefoil
Potentilla pacifica	Silverweed or Pacific cinquefoil
Potentilla flabellifolia	Fan-leaved cinquefoil
Potentilla villosa	Villous cinquefoil
Prunus emarginata	Bitter cherry
Pseudotsuga menziesii	Douglas fir – Coast variant
Pseudotsuga glauca	Douglas fir – Interior variant
Pteridium aquilinium	Bracken fern
Ptychoeilus oregonensis	Northern pikeminnow
Rosa sp.	Rose
Rubus sp.	Raspberry family
Rubus idaeus	Wild raspberry
Rubus leucodermis	Black raspberry
Rubus parviflorus	Thimbleberry
Rubus spectabilis	Salmonberry
Rubus ursinus	Pacific blackberry/Trailing wild blackberry
Rumex sp.	Dock
Sagittaria latifolia	Wapato
Salix sp.	Willow
Sambucus racemosa	Red elderberry
Scirpus	Bulrush
Smilacina racemosa	Solomon’s Seal
Sphagnum sp.	Sphagnum Moss

Squalus acanthias	Dogfish
Suaeda maritima	Seablite
Taxus sp.	Yew
Taxus brevifolia	Pacific Yew
Thaleichthys pacificus	Eulachon
Thuja plicata	Western red cedar
Tsuga heterophylla	Western hemlock
Typhas angustifolia	Cat-tail rush
Vaccinium oxycoccos	Bog cranberry
Veratrum viride	Indian Hellebore
Viola sp.	Violet
Xerophyllum tenax	Bear-grass

Scientific Family Name	**Species mentioned in text**
Berberidaceae	Barberry family
Brassicaceae	Mustard family
Cervidae	Deer and Elk
Chenopodiaceae	Goosefoot family
Cyperaceae	Sedge family
Ericaceae	Heather
Liliaceae	Lily family
Mustelidae	Otters
Pinaceae	Fir family
Poaceae	Grass family

Rubus sp.	Raspberry (Rose family)
Rosaceae	Rose
Rubiaceae	Madder family
Salicaceae	Willow
Salmonidae	Salmon family
Taxaceae	Yew family
Typhaceae	Cat-tail family
Ursidae	Bears