DORSET USE AND SELECTION OF FIREWOOD AT PHILLIP'S GARDEN, NORTHERN PENINSULA, NEWFOUNDLAND

AN APPLICATION OF WOOD IDENTIFICATION ON ARCHAELOGICAL CHARCOAL AND CONTEMPORARY DRIFTWOOD

By

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ABSTRACT

This thesis employs wood identification and spatial analysis of charcoal to examine Dorset Palaeoeskimo firewood use and selection at the Phillip's Garden site (EeBi-1), Northern Peninsula, Newfoundland. Handpicked charcoal fragments (n = 600) from five cold-weather dwellings and one midden were identified. Charcoal identified was predominantly fir (*Abies* sp.; mean = 69%) and spruce (*Picea* sp.; mean = 14%). These genera dominate the modern forest (65% and 27%, respectively) as well as contemporary driftwood accumulations (34% and 32%, respectively) and are present in the prehistoric tree pollen record from a nearby pond. These data suggest that Dorset collected firewood according to the principle of *least effort* from nearby sources. Reduced diversity in minor genera (<1%) in the archaeological charcoal record may be indicative of changing cultural preferences and/or reduced availability as prolonged occupation led to a decline in local wood resources. To evaluate if handpicked charcoal biased genera represented, eight sediment samples were processed from three dwellings tested in the summer of 2013. Few charcoal fragments were recovered from the sediment samples and were either fir or spruce suggesting that handpicked sample did not introduce a source of bias. Maps depicting charcoal distributions within three dwellings indicate that wood was burnt inside despite lacking hearth features. These findings challenge the widespread assumption that marine mammal fat was the only fuel used by the Dorset. This project applies a novel approach to a resource that has received little attention to date in the study of the Dorset people.

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I would like to thank first and foremost my esteemed advisors, Priscilla Renouf, Trevor Bell, and Michael Deal, whose collective efforts made this thesis. I thank Priscilla for making time for me no matter what and coaching me through the ups and downs of research, Trevor for taking me on and teaching me how to be a productive researcher, and Mike who aided with the charcoal identification and editing.

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LATIN AND COMMON NAMES OF SPECIES

Note: In the text species are referred by their common names.

Latin name	**Common name**
SOFTWOODS/GYMNOSPERMS	
Abies	**Fir**
Abies amabilis	Amabilis fir
Abies balsamea	Balsam fir
Chamaecyparis	**Cedar**
Chamaecyparis nootkatensis	Yellow cedar
Juniperus	**Juniper**
Juniperus communis	Common juniper
Juniperus horizontalis	Creeping juniper
Juniperus virginiana	Red juniper
Larix	**Tamarack/Larch**
Larix larcinia	Tamarack
Larix occidentalis	Western larch
Picea	**Spruce**
Picea glauca	White spruce
Picea negra	Black spruce
Picea sitchensis	Sitka spruce
Pinus	**Pine**
Pinus strobes	White pine
Pinus bankisana	Jack pine
Pinus resinosa	Red pine
Pseudotsuga	**Douglas fir**
Pseudotsuga menziesil	Douglas fir
Tsuga	**Hemlock**
HARDWOODS/ANGIOSPERMS	
Acer	**Maple**
Acer rubrum	Red maple
Acer saccharum	Sugar maple
Alnus	**Alder**
Alnus rubra	Red alder
Alnus virdis	Green alder
Betula	**Birch**
Betula alleghaniensis	Yellow birch
Betula pumila	Bog birch
Betula glandulosa	Shrub birch
Betula papyrifera	Paper birch
Betula minor	Glandular birch
Betula cordifolia	Heart leafed birch
Fagus	**Beech**
Fagus grandilfolia	Beech
Fraxinus	**Ash**
Fraxinus negra	Black ash
Populus	**Poplar/Aspen**
Populus sect. *Aigeiros*	Cottownwood
Populus tremuloides	Trembling aspen
Prunus	**Cherry**
Prunus serotina	Black cherry

Latin name	**Common name**
HARDWOODS/ANGIOSPERMS	
Salix	**Willow**
Salix colciocola	Limestone willow
Salix herbacea	Snowbed willow
Salix jejuna	Hairy willow
Salix reticula	Net veined willow
Salix vestita	Hairy willow
Sorbus	**Mountain ash**
Sorbus decora	Showy mountain ash
Quercus	**Oak**
Thuja	**Cedar**
Thuja plicata	Western red cedar
Tilia	**Basswood**
Ulmus	**Elm**

CHAPTER 1

INTRODUCTION

This thesis examines Dorset Palaeoeskimo (referred to as the Dorset throughout the thesis) wood use and selection at the Phillip's Garden site (EeBi-1) at Port au Choix, Northern Peninsula, Newfoundland. The broad aim of this thesis is to understand an Arctic culture's use of firewood in a boreal environment, as revealed through the analysis of charcoal preserved in cultural layers. Two broad themes are examined, firewood selection and firewood use. I apply wood and charcoal identification techniques to examine how the Dorset selected the terrestrial and littoral wood (i.e., driftwood) available at Phillip's Garden. I identified charcoal fragments handpicked from six previously excavated features, five cold-weather dwellings and one midden that span several occupation phases at the site. Specifically, my goal was to understand which genera were targeted and their relative proportions in features and the surrounding environment, and whether genera present varied between feature type and occupation phase. Samples of driftwood collected in the summer of 2013 from three beaches near Phillip's Garden were identified to genus to characterize both the composition of modern trees species stranded at the site and the species assemblage that may have been available on local beaches during Dorset occupation. The percentage of modern tree species within the modern merchantable forest (DFA 1990) served as a baseline for the prehistoric forest at Port au Choix. Although slight variation exists, palaeoenvironmental data from the region suggest that species composition at the time of Dorset occupation was similar to the modern forest (Chapter 2; Macpherson 1995).

I address firewood use through spatial analysis of charcoal distribution from three dwellings. As dwellings at Phillip's Garden lacked hearth features it has been assumed that sea mammal fat burnt within soapstone vessels was the primary fuel. I analysed location of charcoal densities in relation to dwelling features and areas to understand where charcoal was deposited. I then plotted the location of soapstone vessel fragments found within the feature to understand the potential relation between firewood and soapstone.

I conclude that the Dorset adopted wood as a fuel but did not overly specialize in its use, possibly due to environmental constraints. Additionally, sea mammal fat continued to be used in spite of available wood resources.

1.1. Significance of research

This research is significant as it examines Dorset firewood use, a topic that has not been extensively discussed. Past research on Dorset fuel use has concentrated on the exploitation of sea mammal fat (De Laguna 1940; Odgaard 2003). The data presented in this thesis suggest that wood was used as a fuel as well. This research will broaden the view of resource use and acquisition at the site.

Charcoal is the most common botanical remains recovered from archaeological contexts. Despite its abundance it has received little attention in archaeological research beyond its use for radiocarbon dating. This project is the first to intensively use charcoal analysis in Newfoundland and contributes to the growing body of literature on plant use and collection by Arctic cultures. Although there has been numerous studies on the contemporary and past use of plants by indigenous groups in Labrador (Zutter 2009, 2012; Lauzon et al 2012; Roy et al. 2012; Steelandt et al. 2013; Dobrota 2014), plant use has been scarcely discussed in Newfoundland. Thus, this study will add to the regional understanding of paleoethnobotany. Furthermore, the reference charcoal generated by this project remains available at Memorial University, allowing for charcoal identification to continue on provincial archaeological sites.

1.2. Organizational framework

Chapter 2 describes the Dorset culture, their occupation of the Phillip's Garden site, and the available wood resources in the region. Chapter 3 summarizes the cultural use of wood as a raw material in the Arctic and Subarctic using archaeological and ethnographic examples. The research questions specific to wood use at Phillip's Garden are then formulated as a result of this literature review. Chapter 4 describes the three analytical methods used in the thesis: charcoal analysis, driftwood analysis, and spatial analysis. Chapter 5 presents the results, while Chapter 6 uses the results to address the thesis research questions.

CHAPTER 2

CULTURAL AND ENVIRONMENTAL BACKGROUND

The objective of this chapter is to provide a cultural and environmental background to the project. The first half of the chapter discusses the Dorset culture in general and their occupation of the Phillip's Garden site, while the second half describes the contemporary and prehistoric wood resources available in the region.

2.1. Dorset culture

The Dorset were a cold-marine-based culture, who occupied the Canadian Arctic (Maxwell 1985; McGhee 2001), Greenland (Andreasen 2000), Northern Quebec (Fitzhugh 1980), Labrador (Cox 1978; Fitzhugh 1972) and Newfoundland (Harp 1964; Renouf 2011a). Jenness (1925) identified the Dorset as a distinct culture from the archaeological collection of Cape Dorset, Baffin Island. The Dorset originated from the Arctic Small Tool Tradition, possibly around Hudson Strait, and radiated outwards (Maxwell 1985). The Dorset culture is divided into Early (2500-2000 BP (before present)), Middle (2000-1200 BP), and Late (1000-500 BP) phases (Fitzhugh 2002), but only the Middle Dorset are found in Newfoundland (Tuck and Fitzhugh 1986). Dorset were mostly nomadic, travelling in small family bands, but occasionally aggregating in larger groups (Meldgaard 1960; Renouf 2011b).

Dorset material culture is characterized by the use of lithics (chipped stone), such as triangular endblades, thumbnail scrapers, bifacial knives, microblades, and soapstone lamps (Maxwell 1985). Dorset used organic materials such as bone, ivory, and antler as harpoon heads, foreshafts, pendants, sled runners and sewing needles (Lemoine and Darwent 1998; Lemoine 2005; Wells 2012). Wood was also used as a raw material for shafts, boats, ladles, carvings, and masks (Holtved 1944; Mary-Rousselière1970, 1976, 1979, 2002; Erwin 2001; Sutherland 2001; Fitzhugh et al. 2006). Dorset wood use will be further discussed in Chapter 3.

2.2. Dorset in Newfoundland

The Dorset appeared in Newfoundland around 2000 cal BP[1], a period marked by climactic warming (Rosenberg et al. 2005), and they resided there until 1000 cal BP (Renouf 2011b). Sites are typically situated on headlands and coastal areas, which reflected their reliance on marine mammals (Renouf and Bell 2009).

2.3. The Phillip's Garden site

Phillip’s Garden is located at the National Historic Site of Port au Choix, on the Point Riche Peninsula of northwestern Newfoundland (Figure 2.1). In total, 17 Dorset sites were identified in this area, ranging from winter occupations (Renouf 2011b) and warm-weather occupations (Renouf and Bell 1998; Stiwhich 2011) to burials (Harp and Hughes 1968; Brown 1988, 2011).

[1] All calendar dates from Phillip’s Garden were calibrated using Calib 6.0 and are represented by one sigma probability range.

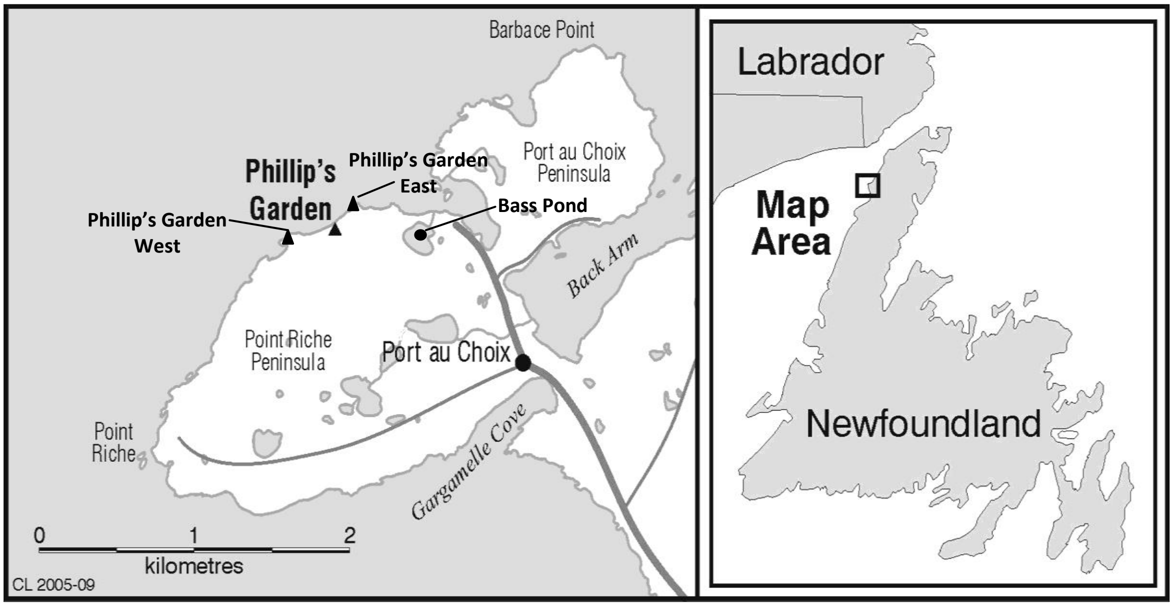

Figure 2.1: Point Riche and Port au Choix Peninsulas situated on the northwestern coast of the Northern Peninsula. The nearest town is Port au Choix. The Phillip's Garden site is found on the Point Riche Peninsula (PACAP 2011).

2.3.1. History of research

The site was discovered through test pits by Wintemberg (1939) and later surveyed by Harp (1964) who identified 36 possible dwellings, excavating 8 and testing 12 (Renouf 2011a). Renouf (1985) continued work in the area under the direction of Parks Canada, with the goal of surveying the region to establish an archaeological inventory. Her later work at Phillip's Garden involved excavating additional dwellings, as well as re-excavating Harp's sites[2] (Renouf 1986, 1987, 1992, 2006, 2009; Wells et al. 2010). Students under her direction have focused on faunal remains (Murray 1992; Hodgetts 2005a), material culture (Knapp 2008; Wells 2011), dwelling architecture (Cogswell

[2] Dwellings excavated by Harp have the prefix "house" (e.g., house 18) while dwelling excavated by Renouf have the prefix "feature" (e.g., feature 55). In this thesis, dwellings identified by Renouf will be referred to as house features to avoid confusion as the term feature may also apply to middens, charcoal stains, bone pits, etc...

2006), site occupation (Erwin 1995; Lavers and Renouf 2012), palaeoenvironment (Bambrick 2009; Wells et al. 2014), and settlement patterns (Anstey 2011; Robinson 2014).

Phillip's Garden is the oldest and largest identified Dorset site in Newfoundland. It was densely populated and focused on seal hunting (Renouf 2011b). The site is a 2 ha meadow with three raised terraces facing the Gulf of St. Lawrence (Figure 2.2; Harp 1964; Renouf 2011b). Continuous human occupation at the site left an imprint on the landscape, causing the soil to be black and organically rich; this is thought to be a product of intensive seal butchering (Harp 1964; Renouf 2011b).

There are three stratigraphic layers identified at the site: 1) top soil; 2) cultural; and 3) subsoil. Because of the intensity of human occupation at the site, the cultural layer consists of dark organically enriched soil and is relatively shallow, 20 to 60 cm deep, and laden with artefacts (Renouf 2011b).

Originally it was thought that there was a total of 68 unexcavated dwellings at Phillip's Garden; however, Robinson's (2014) research has revealed that there may be many more, possibly around 160. Of those, 32 were partially or completely excavated (Figure 2.3; Harp 1964; Renouf 2011a). Dwellings are situated on the two topmost terraces and are absent from the lowest one (Harp 1964).

The large aggregation of people at the site is thought to be a response to the harp seal herds (*Phoca groenlandica)* that migrate through the Strait of Belle Isle in the late winter and early spring (Sergeant 1991). The faunal assemblage dominated by seal remains supports this (Murray 1992, 2011; Hodgetts 2005b). Demographics of seal remains suggest that Dorset hunted during both spring and winter migrations (Hodgetts 2005a).

Figure 2.2: Phillip's Garden outlined in white. The site is bordered by a forest of stunted fir and spruce trees and looks out into the Strait of Belle Isle (PACAP 2011).

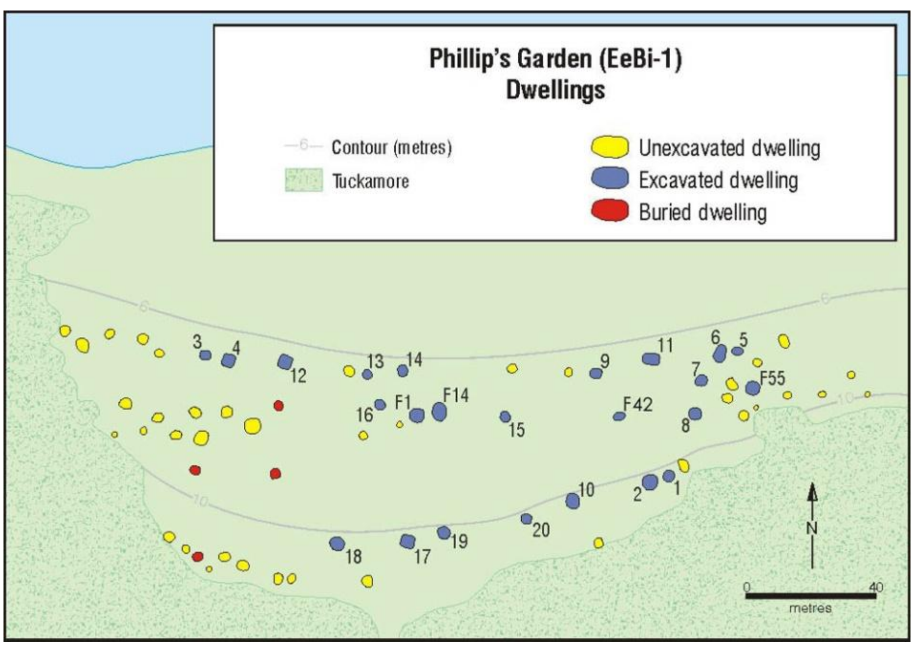

Figure 2.3: Dwellings identified at Phillip's Garden. Additional depressions identified in the 2013 field season by Robinson (2014) are not shown (PACAP 2011).

2.3.2. Material culture

The material culture at Phillip's Garden reflects a focus on seal hunting, with a high proportion of harpoon endblades, harpoon heads, microblades, and slate scrapers (Knapp 2008; Renouf 2011b). The utility of seals at Phillip's Garden extended beyond subsistence, as their fat was used as fuel (this will be further discussed in Chapter 3) and for waterproofing (Renouf 2011b). Seal hides processed on site (Bell et al. 2005; Bambrick 2009; Renouf et al. 2009,) were likely used for clothing, boots, and boat coverings (Knapp 2008).

2.3.3. Dwelling architecture

Dwellings were large, cold-adapted semi-subterranean structures (Renouf 2011b). A few warm-weather dwellings were identified and probably occupied by a smaller population between hunts (Renouf 2009). Dwelling size ranged between 74.7 to 105 m^2, with exception of Feature 55 which was exceptionally small, measuring 28.3 m^2. Based on the size of the dwellings, Renouf (2011b) estimated that these structures accommodated multiple families.

Although variation exists, dwellings typically had a rear platform, a single entrance, a central depression with an axial feature lined by pits and associated middens (Figure 2.4; Renouf 2011b). The axial feature is thought to have been the main cooking area (Renouf 2011). The excavation around the platforms of three dwellings revealed that pits may have been used as postholes for either whale rib or driftwood (Renouf 2006).

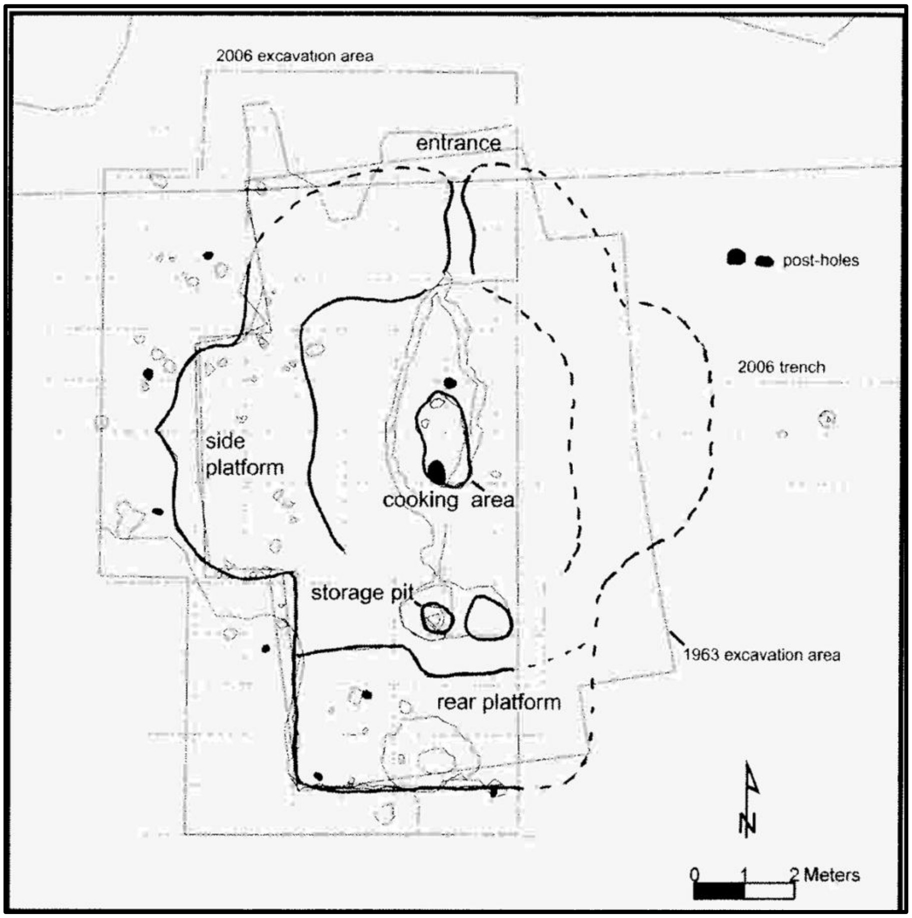

Figure 2.4: Architectural features of house 17. The solid line traces the dwelling outline based on Renouf's 2006 excavation. The dashed line represents the approximate outline based on Harp's 1963 excavation. Two dark ovals in the center are postholes for support posts. The dark ovals along the perimeter are thought to be postholes for whale ribs (from Renouf et al. 2011).

2.3.4. Occupation and chronology

The number and size of dwellings paired with the rich artefact assemblage suggest a low mobility pattern (Eastaugh and Taylor 2011). The population would have reached its peak during the winter and spring seal hunts and been occupied yearlong by a smaller population (Erwin 2011; Renouf 2011b). Overlapping carbon dates from the 25 excavated dwellings indicate that 6-10 of these dwelling were occupied simultaneously (Erwin 2011). This number is potentially much higher as many of the dwelling depressions have yet to be excavated (Robinson 2014).

Bell and Renouf (2009) divided the site into three occupation phases based on charcoal dates from 32 dwellings: the early phase (1990-1550 cal BP), middle phase (1550-1330 cal BP), and late phase (1350 -1180 cal BP). A small population and variable occupation defined the early phase (Renouf and Bell 2009). The middle phase corresponded with a warming period (Bell and Renouf 2011) and was characterized by the highest population and regular occupation. The late phase showed a return to sporadic occupation and a decrease in population. The abandonment of the site is thought to be associated with a marked warming trend around 1100 cal BP (Bell et al. 2005; Rosenberg et al. 2005; Renouf et al. 2009), which may have affected harp seal availability (Hodgetts et al. 2003).

2.3.2. Groswater occupation

Prior to the Dorset, Port au Choix was occupied by the Groswater Palaeoeskimo (2950-1820 cal BP; Renouf 2005). Two culturally distinct Groswater sites were uncovered at either side of Phillip's Garden, Philip's Garden West (EeBi-11) and Phillip's Garden East (EeBi-1; Figure 2.1; Fitzhugh 1987; Ryan 1997, 2005; Renouf 2005). Phillip's Garden West likely extended into Phillip's Garden as Groswater artefacts scattered around the perimeter of numerous Dorset dwellings suggest that the artefacts were displaced when the Dorset removed the topsoil to construct their dwellings (Lavers and Renouf 2012). The Groswater presence may have impacted the vegetation composition in the area prior the Dorset occupation (this is further discussed under *2.4.2. Prehistoric forest*)

2.4. Current and prehistoric wood sources

2.4.1. Modern forests

Newfoundland is part of the Canadian Boreal Forest region (Damman 1983). Boreal forests develop in cold climates with poor soils and are dominated by coniferous cone-bearing species (softwoods) such as spruce, fir, and pine. Deciduous broad leaf species (hardwoods) are also found but to a lesser extent (Thurston 2011). Due to the cold Labrador Current, which encircles the island, the Canadian Boreal Forest attains its southern limits in St. John's, Newfoundland (Thurston 2011). Growing seasons on the island are cool and short, especially near the coast, which results in smaller trees (Boland 2011).

Due to its large longitudinal and latitudinal span, Newfoundland contains a diverse array of forest types (Damman 1983; Boland 2011). Damman (1983) divided the island into nine ecoregions based on climactic conditions (Figure 2.5). Port au Choix straddles two ecoregions: the Strait of Belle Isle Ecoregion and the Northern Peninsula

Forest Ecoregion, giving Port au Choix a blend of coastal barrens and boreal forest (Bell and Renouf 2011).

Coastal barrens mainly occupy limestone terrain and are characterized by open woodlands and heath lands made up of shrubs such as juniper and willow (Bell and Renouf 2011). A wet boreal forest type characterizes the Northern Peninsula Ecoregion (Thompson et al. 2003). Balsam fir thrives in these areas, making up 65% of the commercial forest (DFA 1990), partially due to the lack of fires, which limits the growth of black spruce (Bakuzis and Hanson 1965). Spruce makes up 27% of the forest cover while birch comprises 7%, making it the most common hardwood. Additional tree species in the region include alder, tamarack, mountain ash and willow, but none form any major stands. Pine, yellow birch, red maple, and trembling aspen are absent from the Northern Peninsula Ecoregion, meeting their limits at the northern boundary of the Southwestern Newfoundland Ecoregion (Figure 2.5; Damman 1983).

The forests at Port au Choix are dominated by balsam fir (Figure 2.6), white spruce (Figure 2.7), and tamarack (Figure 2.8; Bell et al. 2005; Bell and Renouf 2011). The most common deciduous trees are showy mountain ash and bog birch (Damman 1983).

The meadow at Phillip's Garden is surrounded by tuckamore (stunted forest) composed of black spruce, white spruce, and balsam fir (Figure 2.2; Bell and Renouf 2011). Tuckamore is a common aspect of the alpine and coastal vegetative communities in Newfoundland and develops in coastal headlands and open hills (Boland 2011).

Tuckamore is exposed to high winds and harsh climates that stunt and contort tree growth (Figure 2.9; Boland 2011).

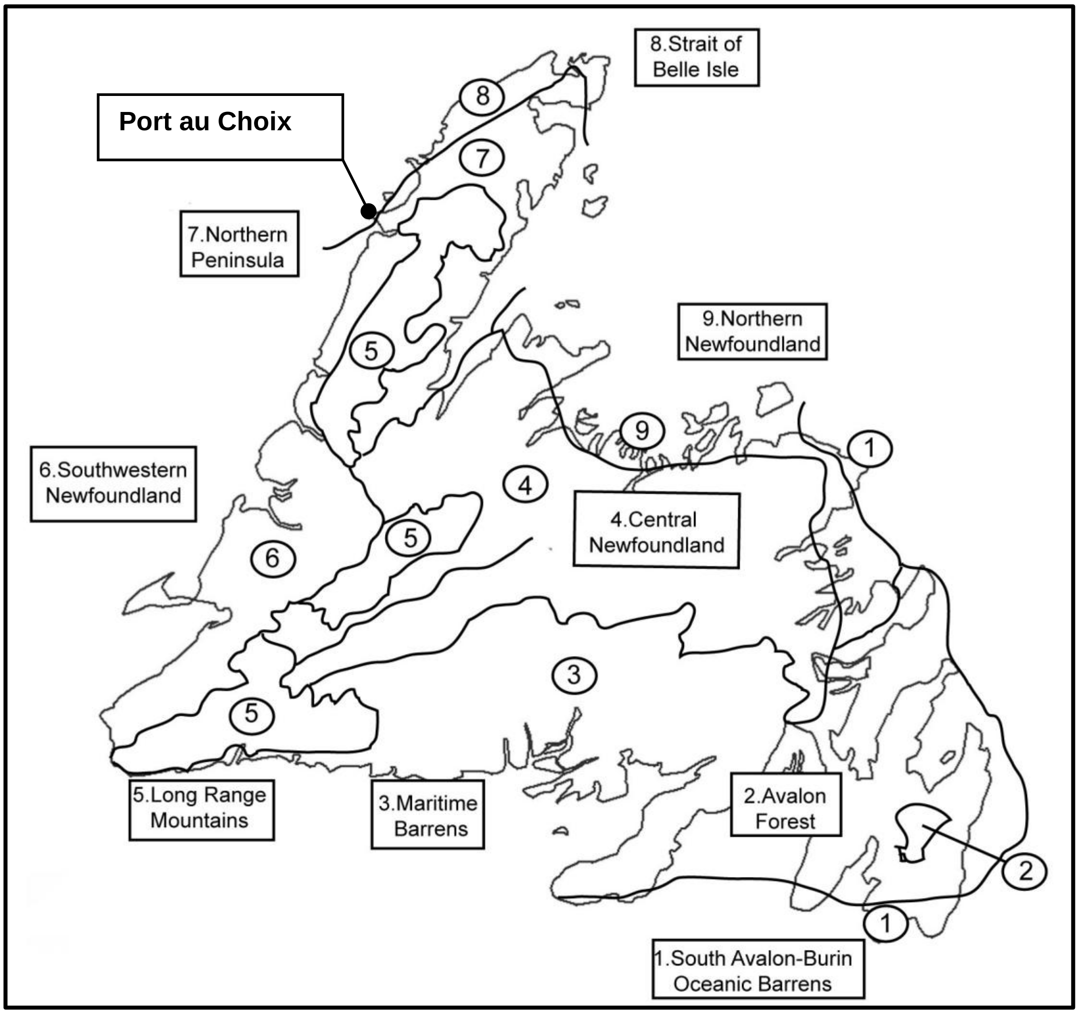

Figure 2.5: Ecoregions of Newfoundland. Port au Choix sits on the border of the Strait of Belle Isle Ecoregion (8) and the Northern Peninsula Ecoregion (7) Adapted from Riche 2002).


Figure 2.6: Balsam fir (Photo: J. Miszaniec).


Figure 2.7: White spruce (Photo: J. Miszaniec).


Figure 2.8: Tamarack (Photo: J. Miszaniec).


Figure 2.9: Tuckamore at Port au Choix (Photo: J. Miszaniec).

2.4.2. Prehistoric forest

Generally, the forest composition in prehistoric times was similar to today, consisting largely of fir, spruce and birch, but also including alder and ash, which are not currently found in the region (Bell et al. 2005; Renouf et al. 2009). A warming period between 1600 and 1100 cal BP marked an increase in spruce, fir, alder, and shrub birch, indicating that warmer growing seasons could have increased the number and diversity of trees in the area (Bell et al. 2005; Figure 2.10). The palaeoenvironment at Port au Choix was reconstructed using pollen grains, charcoal, algae, spores, and fossil midges recovered from sediments in Bass Pond, a small lake 500 metres away from Phillip's Garden (Figure 2.1; Bell et al 2005, 2009; Rosenberg et al. 2005). Spores and pollen samples were also taken at Stove Pond further inland on the peninsula, as a control site to document natural changes only (Macpherson 1997; Bell et al. 2005).

The extent of the forest at the time of Dorset occupation is unknown, as the Groswater Paleoeskimo occupation of the area immediately prior may have impacted tree cover (Bell et al. 2009). A decline in spruce pollen after 3000 cal BP and an increase in charcoal around 2200 cal BP, corresponding with the Groswater occupation, suggest that the area may have been deforested or accidently burnt (Bell et al. 2005; Renouf et al. 2009).

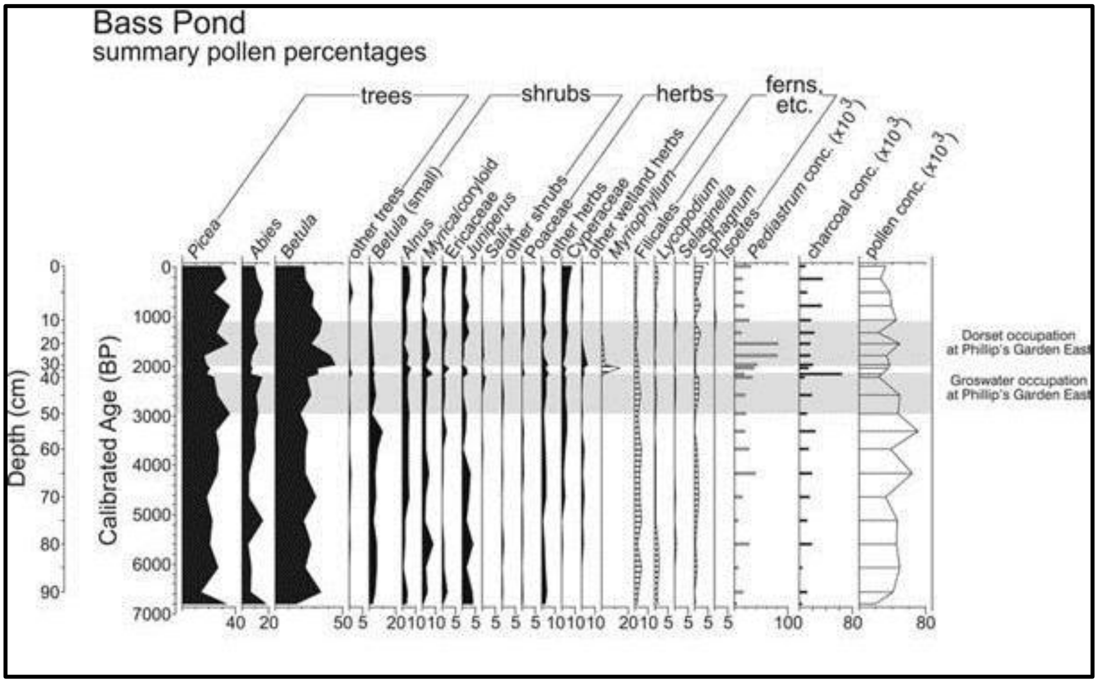

Figure 2.10: Pollen levels from Bass Pond (from Renouf et al. 2009). The principal y-axis shows the age of the sediment for the last 7000 years. The secondary y-axis shows sediment depth. Percentage of pollen is shown in black with types grouped according to taxa. The far right curve shows concentration of pollen per millilitre of sediment. Percentages of spores (ferns) are shown in a striped pattern. Concentrations of *Pediastum* (aquatic algae) and charcoal fragments are shown as histograms (Bell et al. 2005; Renouf et al. 2009).

2.4.3. Driftwood

Wood at Port au Choix is also available as driftwood stranded on local beaches. In this study it is assumed that modern driftwood composition is a close approximation of Dorset-aged driftwood and this assumption relies heavily on both the same processes acting in the formation, transportation and accumulation of driftwood and the sources of driftwood being similar for the region. Driftwood is delivered principally from inland rivers where trees fall into rivers in periods of high flow during the spring snowmelt and in summer (Maser and Sedell 1994; Alix 2005). During the spring thaw, wood is transported out of the river and into the ocean (Maser and Sedell 1994; Alix 2005).

Once in the ocean, distance travelled by driftwood depends on how long it can remain buoyant; it will sink if degraded or waterlogged (Dyke et al. 1997). Driftwood buoyancy depends on species; in general, softwoods remain buoyant longer than hardwoods (Hagglbom 1982).

Surface currents and prevailing winds influence the course of driftwood (Eggertsson 1994; Dyke et al. 1997). For example, areas facing towards prevailing winds are more likely to accumulate driftwood. In the case of Port au Choix and Phillip's Garden, coast-parallel, north-easterly currents and prevailing westerly winds would favour an eastward and north-eastward drift of logs from source regions in south-western Newfoundland and along the coast of the southern Gulf of St. Lawrence (Figure 2.11). The dominant current in the region is the Labrador Current, a branch passes through the Strait of Belle Isle, while another runs southwards down the east coast of Newfoundland. The eastern branch then loops around the island and feeds into the Gulf of St. Lawrence through the Cabot-Straits where it travels northwards along the west coast of Newfoundland and meets up with the western branch (Figure 2.11; Loder et al. 1998; CGC 2013). Based on the currents extra-local genera, such as exotic hardwoods, may be transported to the Northern Peninsula from more southern forests This is suggested from charcoal identified from the Norse site of L'Anse aux Meadows (1000 BP), north of Phillip's Garden, which yielded oak, elm, and basswood, none of which are present on the island (Paulssen 1985). Paulssen hypothesizes that these genera were likely transported as driftwood from the Maritime Provinces, via the Gulf of St. Lawrence and transported in current along the west coast of Newfoundland (Figure 2.11).

Coastal terrain type affects driftwood collection. For instance, rocky coasts are not ideal for driftwood accumulations as they are unsuitable stranding areas (Dyke et al. 1997). Driftwood is typically stranded on beaches during storms. However, storms may also remove driftwood from beaches and strand it in another location.

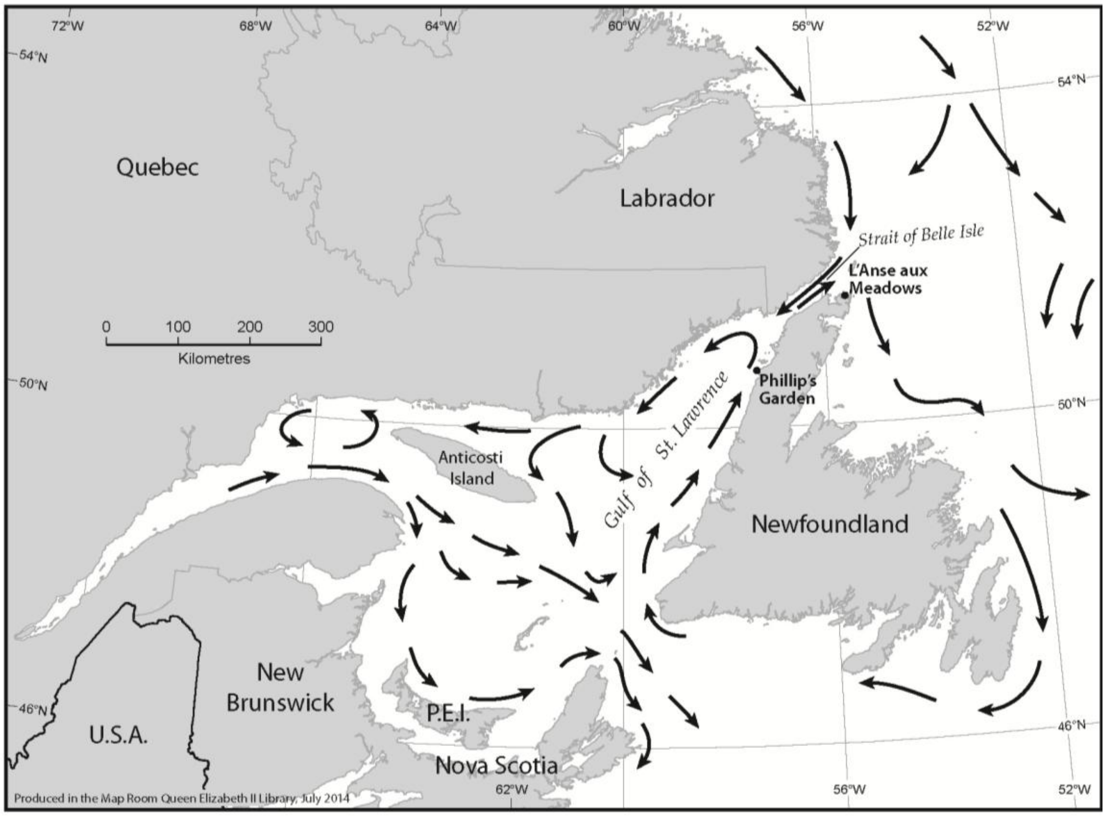

Figure 2.11: The Labrador Current enters the Strait of Belle Isle from the north, running along the coast of Québec, while a separate branch runs southwards along the east coast of Newfoundland where it meets up with currents from the Gulf of St. Lawrence and works its way along the western coast of Newfoundland eventually meeting up with the western branch of the Labrador Current (adapted from CGC 2013).

CHAPTER 3

WOOD USE IN THE (SUB-) ARCTIC

The objective of this chapter is to summarize the use and importance of wood for Arctic and Subarctic cultures by drawing on archaeological and ethnographic examples.
Here I frame the importance of wood for Arctic cultures while emphasizing how its abundance and genera influence its uses. First, I present examples illustrating how Arctic people possess knowledge of the use of trees as a raw material despite living in an area devoid of forests. Second, I discuss how they altered their material culture according to wood availability. Evidence for Dorset wood use in the Arctic and in Newfoundland is presented. Finally, I frame my specific research objectives for Phillip's Garden within the context of our general understanding of Dorset wood use.

3.1. Importance of wood availability

Wood use and selection depend on the trees available in the environment, as each species differs in buoyancy, flammability, strength, hardness and availability, affecting its suitability for specific tasks (Hoadley 2000). For example, the Hesquiat of Vancouver Island preferred alder for smoking salmon as it gives off of a lot smoke when charred (Turner and Efrat 1982; Kuhnlein and Turner 1993). Likewise, the state and shape of wood affect its use. Both the Yup'ik and Athabasca of Alaska prefer long straight pieces of driftwood for constructing cabins, while stumps are used for net floats and containers (Oswalt 1967; Alix and Brewster 2002).

Ethnographies indicate that contemporary Arctic and Subarctic populations are knowledgeable in the use of wood in the form of driftwood and shrubs (Rink 1877; Russell 1991; Jones 2010; Cuerrier et al. 2011a-c; Steelandt et al. 2013). The Inupiat of Alaska have names and uses for each tree; for example, the spruce roots are used for binding, while the birch bark is used to construct containers (Jones 2010). Among the Greenlandic Inuit this knowledge extends to driftwood; for instance *Ikkeq* refers to fine-grained redwood and *Qisuk Qaqrtoq* denotes wood that is exceptionally buoyant (Rink 1877; Petersen 1986). Similarly the Nunavik Inuit of northern Quebec distinguish different driftwood logs based off of texture, shape and colour (Steedlant et al. 2013). In the Arctic and Subarctic regions, wood is a common component of the archaeological record. Excavations revealed that it was used for construction (Arnold 1994; Erwin 2001; Desrosier et al. 2010; Alix 2013), bedding (Bocher and Fredskild 1993; Penney and Clark 2000), tool manufacturing (Holtved 1944; Mary- Rousselière1970, 1976; Gronnow 1996, 2013; Erwin 2001; Alix, 2006; Fitzhugh et al. 2006; Rast 2010; Alix et al. 2011), fuel (Peterson 1986; Fitzhugh 1996; Shaw 2008, 2013; Tennassen 2000), carvings (Lyons 1982; Sutherland 2001), and transportation equipment (Mary-Rousselière1976; Peterson 1986; Walls 2010, 2013).

In the Central Arctic access to driftwood was taken into consideration when selecting campsites (Arnold 1994; Alix, 2005, 2009). When wood was unavailable the Netsilik Inuit of the Central Arctic traded fur for wood (Savelle 1985), a practice carried out by other groups as well (Bennett and Rowley 2004). Stefansson (1914) noted that the Copper Inuit transported driftwood with dogsleds when migrating to areas lacking it.

Regional variations in wood use can be partially attributed to its availability or scarcity, in addition to cultural differences (Arnold 1994; Alix 2009). Driftwood delivery is less consistent in the Eastern Arctic and yields smaller pieces of driftwood (Dyke et al. 2007). As a consequence, groups in the Eastern and Central Arctic used it to a lesser extent than those in the Western Arctic, obtaining it for tool manufacturing but rarely for dwellings or combustion (Alix 2005).

3.1.1. Arctic groups entering boreal environments

The standing forests in Newfoundland would represent an environment with new available wood resources for Arctic cultures moving south along the Labrador coast. Kaplan (2012) notes that the Thule of the Central and Eastern Arctic who settled in Northern Labrador may have regarded the forest as having a wider choice of woods in contrast to their previous region of occupation. Kaplan hypothesizes that the entrance into a boreal forest environment may have had spiritual implications as well, where the tree line was feared as an alien landscape (Kaplan 2012). Likewise the Nunivak Inuit of Northern Quebec describe standing trees as “[...] evil spirits that seem to be standing like erect human beings” (Akirurittuk in Currier et al. 2011b, 63). Kaplan suggests that as a response the Thule deforested areas around residential sites to mimic the treeless environments of the Arctic tundra (Kaplan 2012).

3.1.2. Driftwood use

Ethnographic and archaeological examples have shown that driftwood use is not restricted to non-forested areas (Adams and Hedberg 2002; Alix and Brewster 2002; Lepofsky et al. 2003). Lepofsky et al. (2003) notes that despite having access to forests, groups at the Cape Addington Rockshelter in southeast Alaska supplemented local wood with driftwood. Alix and Brewster (2002) found that contemporary Yup'ik and Athabascan groups along the Yukon and Kuskokwim rivers in Alaska differentiate terrestrial wood and driftwood as separate fuel types based on how they are harvested, their availability, and their uses (Alix and Brewster 2002). Compared to terrestrial wood, driftwood is already felled with its bark removed and is dry unless it has been newly stranded. All that is required for driftwood is for the log to be pulled from the shore and reduced into manageable pieces. Driftwood is easier to transport and can be towed by boat while terrestrial wood must be brought in from the forest (Alix and Brewster 2002). Additionally, genera available as driftwood on a shoreline may not be present in the adjacent forest.

3.2. Dorset wood use

While wood is not preserved in archaeological contexts at Philip's Garden, the presence of wooden artefacts in sites at higher latitudes indicates that wood was used as a raw material by the Dorset (Holtved 1944; Mary-Rousselière 1973; Jordan 1980). As an example, the late Dorset midden of Avayalik-1, Labrador, yielded over 900 wooden artefacts, consisting of shafts, handles, sled fragments, harpoons, lances, and ladles (Cox

1978; Jordan 1980; Fitzhugh et al. 2004). Wood was likely obtained at Avayalik in the form of driftwood as the treeline was 400 km to the south(Fitzhugh et al. 2004). The only wooden artefacts affiliated with the Dorset in Newfoundland were recovered from the soapstone quarry of Fleur de Lys which included 196 spruce timbers interpreted as scaffolding, and a spruce ladle (Erwin 2001).

Charcoal recovered at Phillip's Garden from dwellings and middens suggests that the Dorset were using wood as a fuel (Renouf 1985, 1986, 1987, 1993, 2007; Wells et al. 2012, 2014). The boreal environment of Newfoundland would have provided the Dorset with access to a large variety of wood resources, similar to what the early Thule colonists found in Labrador (Kaplan 2012). Terrestrial wood may have also been supplemented by driftwood stranded along the coast.

3.2.1. Wood use along the Northern Peninsula

Apart from the finds at Fleur de Lys, little archaeological research has considered wood use along the Northern Peninsula. Acidic soils in the region tend not to preserve macrobotanical remains. A notable exception is a Groswater harpoon shaft made of tamarack preserved in a bog from L'Anse aux Meadows is one of the few examples of palaeoeskimo wood use along the Northern Peninsula (Rast 2010). However, when carbonized, wood becomes inert, rendering it resilient to microbial attack and protecting it from decomposition (Smart and Hoffman 1988, Angels 2001); thus wood use can be studied through charcoal analysis. To date two studies have used charcoal analysis to examine wood use along the Northern Peninsula. Hartery (2010) identified a charred log as fir from the Peat Garden North site in Bird Cove. As mentioned in Chapter 2, Paulssen (1985) identified a number of charcoal fragments from the Norse site of L'Anse aux Meadows to establish that Norse settlers were burning a combination of local and extra-local (genera that do not grow in the region) tree species.

3.3. Thesis objectives

1) To understand wood selection at Phillip's Garden

A primary goal of this thesis is to determine which tree genera were selected as firewood at Phillip's Garden. Knowing genera targeted in relation to wood available in the surrounding environment can indicate selection strategies. Charcoal analysis was used to understand wood selection.

Charcoal analysis or anthracology is a sub-discipline of paleoethnobotany, the study of plant use by past groups, focusing on the identification of charred trees and shrubs (Smart and Hoffman 1988; Pearsall 2000). Each tree species has a distinct cellular structure that remains intact after carbonization, allowing for identification (Pearsall 2000; Asouti 2009). Although charcoal identification has been used as a method since the early twentieth century (Badal-Garcia 1992), it has been underutilized in Arctic and Subarctic contexts (Lepofsky et al. 2001), having only been used in a few areas in the Western Arctic (Fitzhugh 1996; Tennassen 2000; Shaw 2008; 2013) and the Eastern Arctic (Paulssen 1985; Layendecker 1981, 1993; Chrystensen 1999; Fitzhugh et al. 2006; Hartery 2010).

This project will address the palaeoeconomy of firewood use at Phillip's Garden, analyzing how wood was selected and managed as a resource. Modern interpretations of firewood selection follow Shackelton and Prins (1992) use of the principle of "least effort" based off of Zipf (1949). The principle of "least effort" postulates that humans will choose tasks that require the least amount of effort to limit energy expenditure. According to Shackelton and Prins, groups harvested tree species that were highest in number and closest in proximity. According to the model, species selected would be proportionate to how prevalent they were in the environment. From this Shackelton and Prins (1992) suggested that archaeological charcoal assemblages should directly reflect the distribution of species in the past environment.

Archaeological and ethnographic research has shown that selection plays a greater role in wood harvesting than Shackelton and Prins had assumed (Alix and Brewster 2002; Marston 2009; Dufraisse 2008; Shaw 2008). It is now acknowledged that wood selection is influenced by both cultural and environmental factors (Dufraisse 2008; Shaw 2008; 2013). Wood was not only harvested according to availability but also selected according to its intended use (Asouti 2003). For instance, the Nunavik Inuit of northern Quebec have a hierarchy of preferred firewood in which alder and willow are favoured (Cuerrier et al. 2011a). In the absence of these preferred fuels, less desirable combustibles such as moss are burnt. In Alaska, the selection of particular species as fuel is related to their properties. For example the contemporary Yupik and Athabasca of Alaska prefer cottonwood for smoking fish because of the fumes it produces when charred (Alix and Brewster 2002). Comparing charcoal from various archaeological features to the prehistoric forest composition (Bell et al. 2005), the contemporary forest, and the available driftwood should reveal Dorset firewood selection strategies, if any.

Evidence of extra-local genera identified in the archaeological charcoal may support driftwood use, providing an indication of what percent of firewood was derived from littoral sources. An inventory of driftwood stranded on beaches at Port au Choix was carried out to establish which genera are available now and potentially during Dorset occupation. Caution, must be observed when projecting contemporary driftwood delivery systems to those in the past, as driftwood delivery has increased due to human activity (Alix 2005). Logging in Eastern Canada (Boucher et al. 2009) and in Newfoundland (Byrne at al. 2003) would have increased driftwood delivered to Port au Choix. Variation in surface currents, wind direction, and ice cover may also have influenced driftwood delivery (Dyke et al. 1997, Eggertsson 1994).

2) To determine whether temporal variation exists in firewood selection

Phillip's Garden was occupied for approximately 700 years (Renouf 2011b). Through its occupation it experienced variations in population size and climactic conditions, which may have influenced wood selection and availability. The dwellings and feature selected for charcoal analysis represent the three occupation phases at Phillip's Garden (Chapter 2; Renouf and Bell 2009). A comparison of charcoal assemblages spanning these periods will demonstrate if there were changes in firewood selection during the Dorset occupation of the site.

3) To evaluate whether tree genera selected differ between features

A midden was selected for sampling to investigate charcoal composition from a designated dumpsite (Binford 1983; Pearsall 2000; Asouti 2009). Generally, middens show greater diversity in genera as they are deposits that accumulate over extended periods of time and hence represent numerous fires and, potentially, multiple dwellings. (Smart and Hoffman 1988; Thompson 1994; Pearsall 2000; Asouti 2009). In contrast, charcoal from single dwellings may only represent one burning event as dwellings were typically cleaned after use (Binford 1983, Asouti 2009).

4) To analyse the spatial distribution of charcoal within dwellings

Although charcoal was recovered from within dwellings, it is unknown how the wood was burnt, as dwellings from Phillip's Garden lacked hearth features. Binford (1983) noted that indoor cooking activities required a barrier to prevent charcoal from spreading throughout the house. It is also accepted that Dorset used steatite lamps to burn sea mammal fat, for heat and light (De Laguna 1940; Odgaard 2003; Figure 3.1). Due to the prevalence of these vessels and charred sea mammal fat at Phillip’s Garden it was assumed that hearths were not needed (Renouf 2011b). Renouf (2011b) argued that seal fat was the most readily available fuel source due to the high proportion of seal remains at the site(Hodgetts 2005b; Renouf 2011b), but notes that whale fat may have also been available and used, as whalebone was commonly used as a raw material (Wells 2012). The presence of charcoal within dwellings therefore is perplexing.

It has been suggested that lamps in the Arctic were a cultural adaptation to areas scarce in wood (Hough 1896; Mobjerg 1999; Lee and Reinhardt 2003). Mobjerg (1999) suggests that this is why the Saqqaq, the Greenlandic predecessors to the Dorset, ceased to use box hearths and began using soapstone vessels. Renouf (2011) interpreted the charred residue typically observed coating steatite vessel fragments from Philip's Garden as being sea mammal fat; however, analyses conducted on the charred residues to identify whether they were plant or animal in origin were inconclusive, possibly due to post-depositional contamination (Deal 1990; Farrell 2012)

Binford (1983) notes that the distribution of debris around hearths provides clues as to where activities took place. Thus the location of charcoal within dwellings may elucidate where and how wood was burnt. Charcoal distribution maps were produced for three dwellings to illustrate the location and quantity of charcoal. A comparison of charcoal density and architectural features may indicate where wood was burnt and deposited.

5) To determine whether handpicked charcoal samples biased the genera identified

The bulk of the charcoal analysed for this study originated from handpicked samples previously collected by the Port au Choix Archaeology Project between 1986 and 2012. Though the excavators collected charcoal with scrutiny due to its value for dating, handpicked samples are generally discouraged for anthracology (Smart and Hoffman 1988; Thompson 1994; Pearsall 2000; Asouti 2009). Charcoal for identification is usually obtained through bulk sediment samples to ensure that smaller fragments, which may be missed by handpicking, are not excluded (Smart and Hoffman 1998; Asouti 2009). Genera that are physically smaller are more likely to fragment into smaller pieces, introducing bias towards larger genera in handpicked samples.

To evaluate the potential bias introduced by handpicked samples, bulk sediment samples from cultural layers that had charcoal handpicked from them during the 2013 field season were analyzed for charcoal remains (Wells et al. 2014). The analysis of these bulk samples should reveal no charcoal if the handpicking was particularly efficient or a charcoal sample similar in genera composition to the handpicked sample if no size or other bias was introduced.

Figure 3.1: Rectangular soapstone vessel from Phillip's Garden (Photo: J. Miszaniec).

CHAPTER 4

METHODS

The objective of this chapter is to present the methods used in this thesis. First the anatomical features required for wood identification are described along with the reference material used to identify archaeological charcoal. I then summarize sampling strategies and laboratory procedures for each of the three methods: 1) charcoal analysis; 2) driftwood identification and collection; and 3) spatial analysis.

4.1. Wood Identification

The following section discusses how to identify tree genera, as wood identification was used on both archaeological charcoal and modern driftwood. Wood identification is carried out by observing the xylem, an active part of the tree that lies between the heartwood (pith) and the bark (Figure 4.1; Hoadley 2000). Xylem is found in the trunk, branches, and twigs and is responsible for transporting liquid throughout the tree (Barefoot and Hankins 1982; Hoadley 2000). Wood parts that do not contain xylem such as the bark, the pith, and the roots cannot be identified when charred.

Three planes of the xylem are used for identification: (1) the transversal; (2) the tangential; and (3) the radial (Figure 4.2). Due to constraints in microscopy, this research only used the transversal and tangential planes, which are sufficient for genus identification. The transverse plane is typically sufficient for identification, while tangential and radial planes are used only when the specimen is damaged.

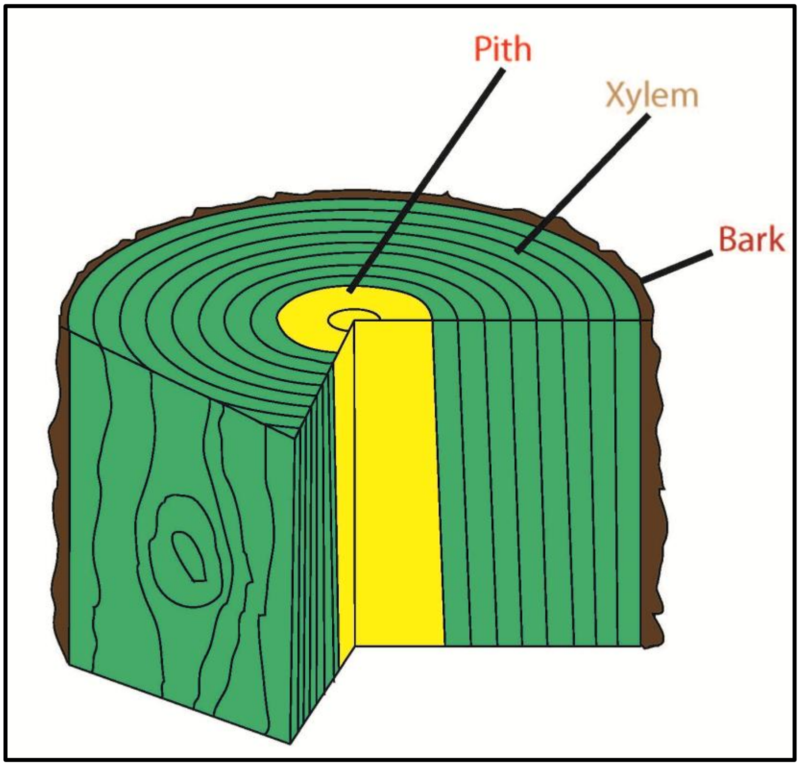

Figure 4.1: The xylem, situated between the pith and the bark (adapted from Schloch et al. 2004).

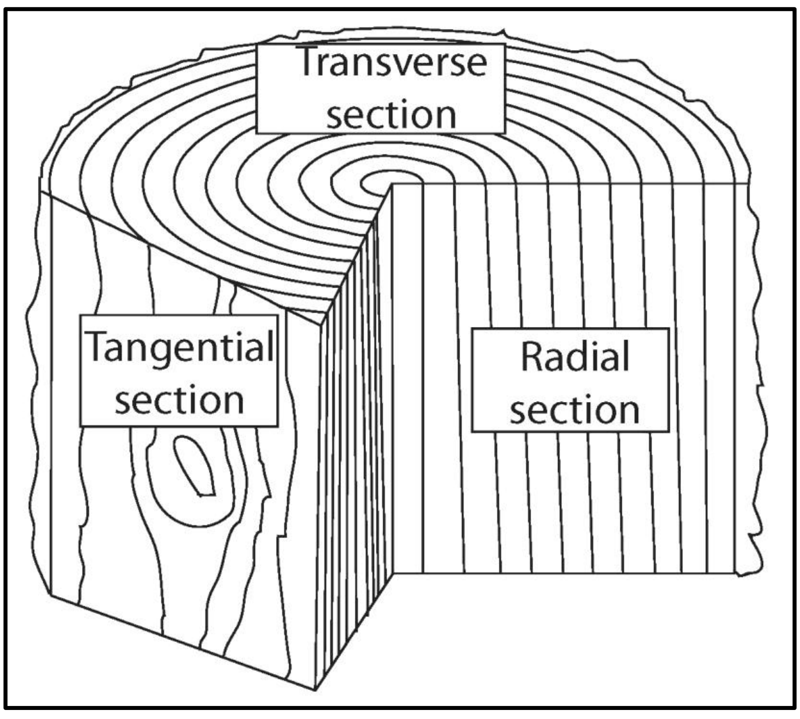

Figure 4.2: Three planes used for wood identification (adapted from Schloch et al. 2004).

4.1.1. Hardwood versus softwood

The primary wood distinction is made between gymnosperms (softwood) and angiosperm (hardwood; Barefoot and Hankins 1982). Softwoods are cone-bearing trees while hardwoods are broadleaves. Softwoods are made up of long narrow cells called tracheids (Figures 4.3 and 4.4). The tracheids of softwoods have thick walls that permit them to withstand cold temperatures (Raven et al. 1999). On the other hand, hardwoods have a more intricate cellular structure and have three types of cells: tracheids (as in softwoods), pores and companion cells (Barefoot and Hankins 1982).

Hardwoods and softwoods are differentiated by the presence or absence of pores. Pores permit hardwoods to transport additional water, allowing them to attain larger sizes on average than softwoods (Raven et al. 1999). As a consequence, water loss is greater within hardwoods since cells are not as thickly walled as softwoods, causing hardwoods to fare less well in cold climates (Raven et al. 1999). In the transverse plane, pores resemble large ovals. On the radial and tangential planes, pores are elongated and run through the tree end to end (Figures 4.5 and 4.6; Barefoot and Hankins 1982).

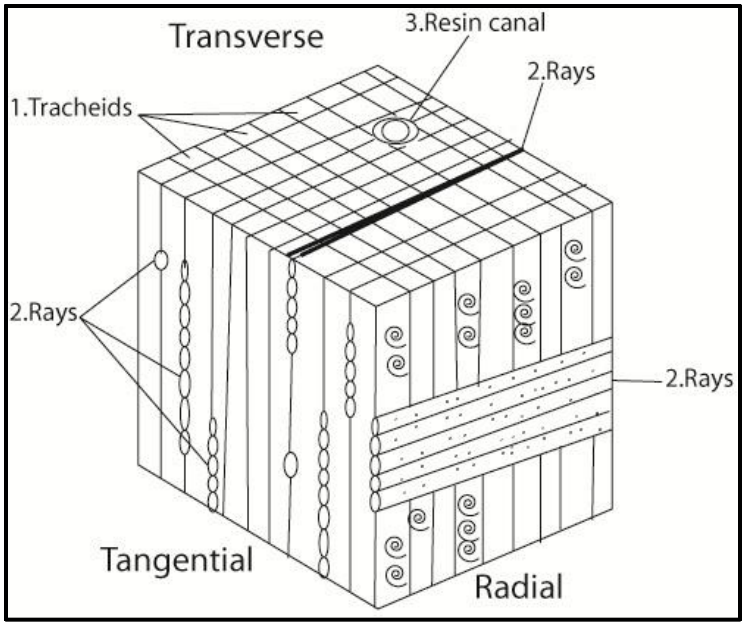

Figure 4.3: Schematic representation of anatomical features of softwoods as mentioned in the text. 1) Tracheids are the building blocks of the xylem structure. They resemble small square cavities on the transverse plane and are elongated in the tangential and radial planes. 2) Rays are fine tissues found on all three planes. On the transverse plane rays resemble long lines that intersect growth rings, while on the tangential they resemble ovals that can be grouped vertically depending on species. Rays resemble elongate horizontal rectangles on the radial plane. 3) Resin canals are circular cavities found in the transversal plane (adapted from Charles et al. 2009).

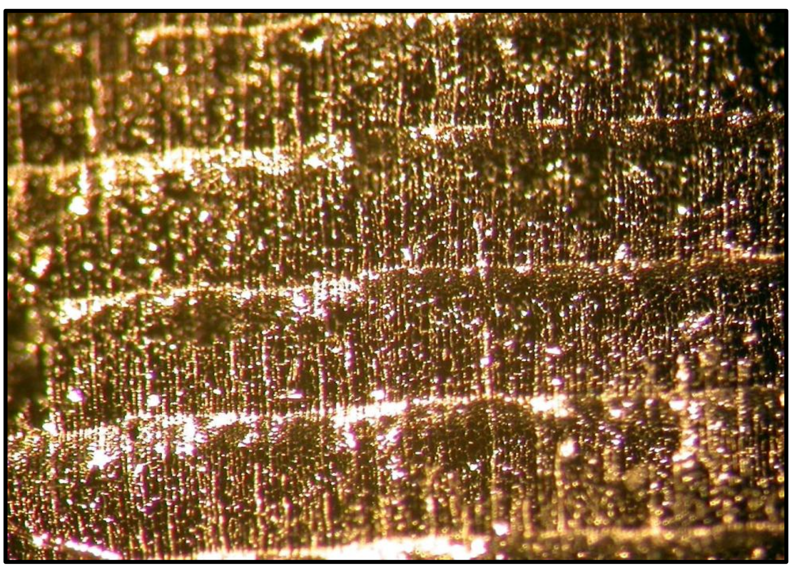

Figure 4.4: Tracheids on the transversal plane in charred tamarack (100X; Photo: J. Miszaniec).

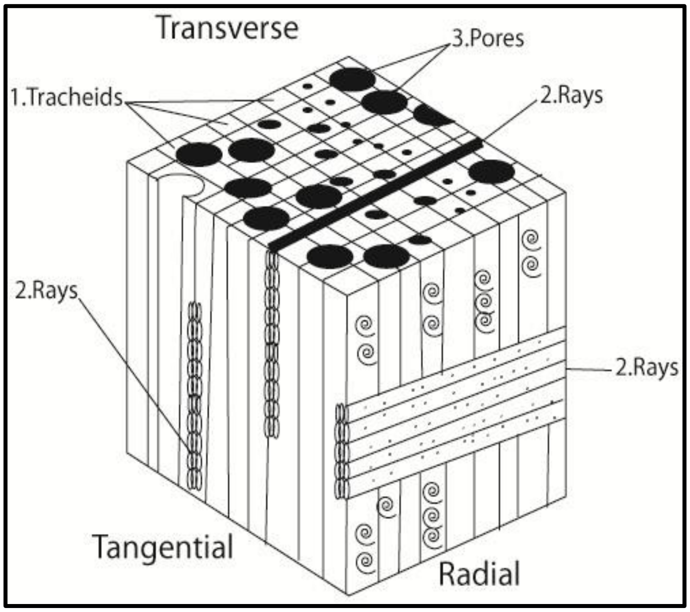

Figure 4.5: Schematic representation of anatomical traits of hardwood as mentioned in the text. 1) Tracheids, as for softwoods. 2) Rays, as in softwoods. 3) Pores resemble large cavities and are numerous on the transverse plane. On the tangential and radial planes they form large cylindrical cavities that extend throughout the tree (adapted from Charles et al. 2009).

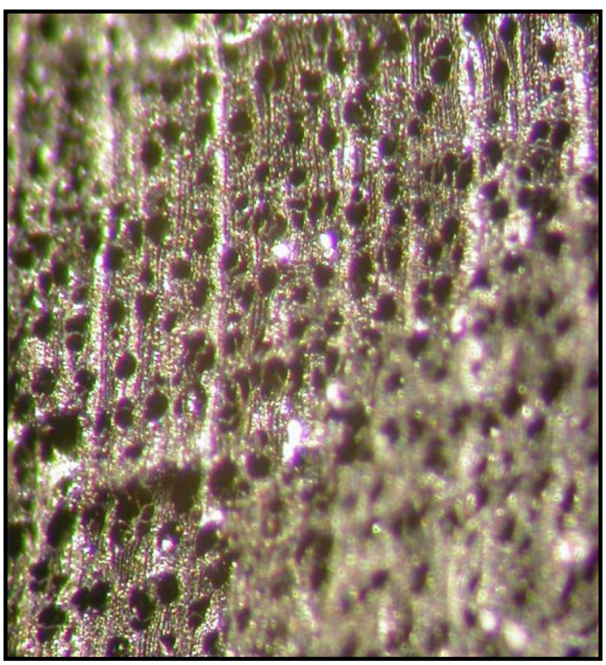
Figure 4.6: Tracheids and pores in charred birch (100X) shown on the transverse plane (Photo: J. Miszaniec).

4.1.2. Identification between genera

Charcoal can only be identified to genus as charring removes species-specific features such as colour and smell (MacGinnes et al. 1971; Hather 2000). Additionally, charcoal identification is accomplished by observing a fragment of the entire specimen, thus species-specific traits may be absent from the fragment. Carbonization can also obliterate traits, causing the fragment to be unidentifiable (MacGinnes et al. 1971; McParland et al. 2010).

Traits used for assigning genera depend on whether the specimen is a hardwood or softwood. Features used for identifying softwoods include growth rings and resin canals (Hather 2000), while those for hardwoods include growth rings, pore arrangement and ray thickness (Barefoot and Hankins 1982; Hather 2000; Pearsall 2000).

4.1.3. Growth rings

Growth rings are created when trees add new layers of xylem (Hoadley 2000). Trees add more xylem in warmer periods than in cooler periods (Hoadley 2000). Wood grown in warm periods is called early wood while wood grown during colder periods is called late wood (Hoadley 2000). As a result rings are wider in early wood than in late wood (Figure 4.7; Hoadley 2000). The transition between early and late wood distinguishes softwood genera from one another. For instance, in tamarack the division between late and early wood is well defined, while in pine there is no noticeable transition (Greguss 1995).

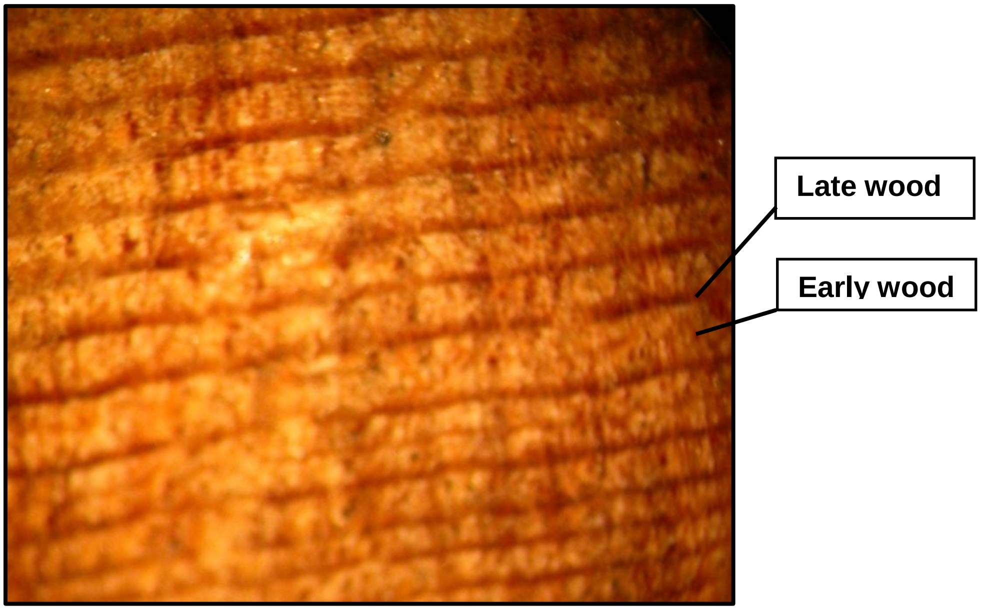

Figure 4.7: Late wood and early wood shown in Tamarack (50X). Late wood in softwoods is typically darker and not as wide as early wood (Photo: J. Miszaniec).

4.1.4. Pores

Similar to softwoods, the transition from late to early wood determines genus in hardwoods. In hardwoods, the transition is marked by pore patterns that form during growth periods. Pore clusters along early and late wood are arranged in one of three patterns: 1) ring porous (Figure 4.8); 2) semi-ring porous (Figure 4.9); and 3) diffuse porous (Figure 4.10). In ring-porous wood there is a clear division in size and number between pores from early and late wood. In semi-ring porous wood, pores gradually change in size between early and late wood. In diffuse-porous wood, pores are constant in number and size across growth periods with no clear change (Barefoot and Hankins 1982; Hoadley 2000).

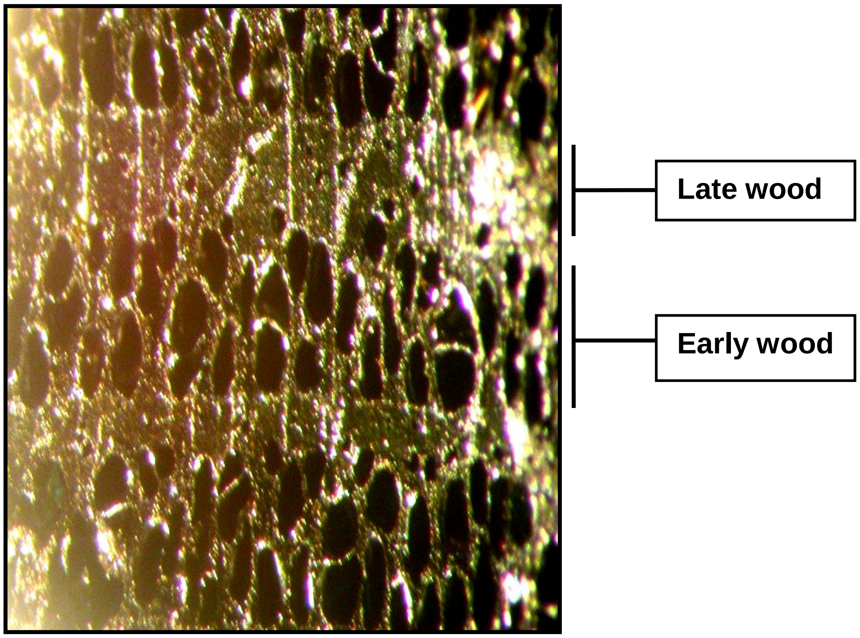

Figure 4.8: In ring-porous wood, the transition between early and late wood is marked by an abrupt change in pore size and density. Pores in early wood are larger and more numerous (Ash; 100X; Photo: J. Miszaniec).

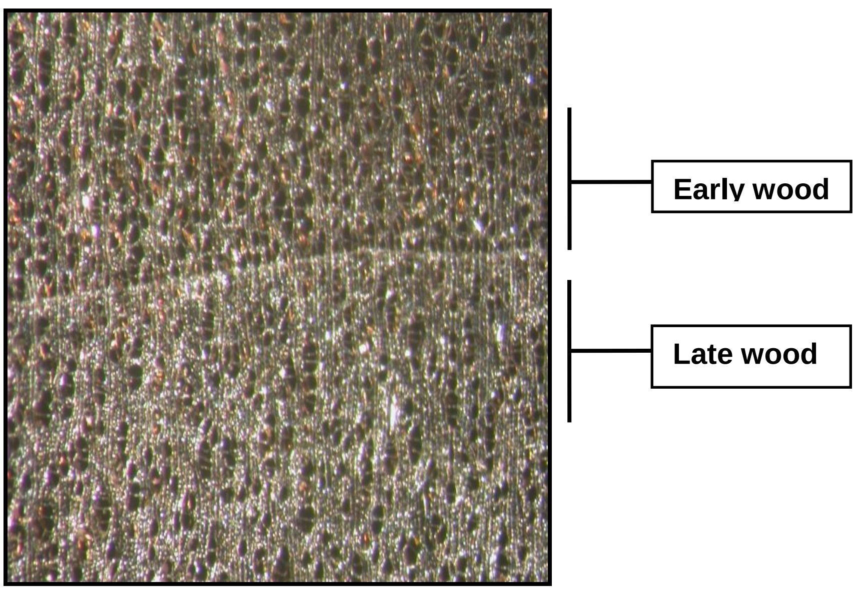

Figure 4.9: In semi-ring-porous wood pores are more numerous in early wood and less common in late wood. In contrast to ring-porous wood, there is a gradual change in number of pores between early and late wood while pore size remains consistent (Alder; 100X; Photo: J. Miszaniec).

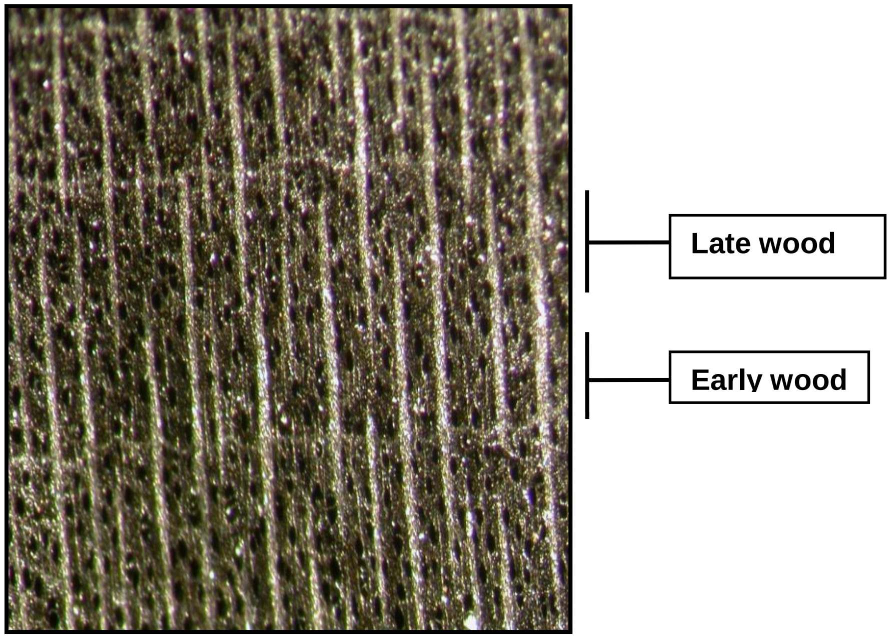

Figure 4.10: In diffuse porous wood there is not visible change in pore size or number between early and late wood (Maple; 100X; Photo: J. Miszaniec).

4.1.5. Rays

Rays are fine tissues composed of parenchyma tissue and tracheids and are found in all three planes in both softwoods and hardwoods (Figures 4.3 and 4.4; Barefoot and Hankins 1982). In the transverse plane, rays radiate from the heartwood to the bark, intersecting the growth ring (Barefoot and Hankins 1982). In the tangential plane they resemble columns made up of oval cells. The thickness and length of the rays are genus dependent (Barefoot and Hankins 1982; Hoadley 2000). In softwoods, rays are thin and one-cell thick (uniseries), while hardwoods have more variation in ray thickness, ranging from two (bi-series), three (tri-series), five (tri-five-series) or more (multi series) cells thick.

4.1.6. Resin canals

Resin canals are tubular inter cellular spaces found in select softwoods (Figure 4.11; Barefoot and Hankins 1982). Resin canals transport pith through the tree (Barefoot and Hankins 1982). They are normally vertical and found throughout the transversal planes scattered across the growth rings (Barefoot and Hankins 1982). Tangential resin canals occur in rays and are horizontally oriented, causing the ray to be spindle-shaped, referred to as a fusiform ray (Figure 4.12; Barefoot and Hankins 1982). The presence of resin canals as well as canal size and density are genus specific.

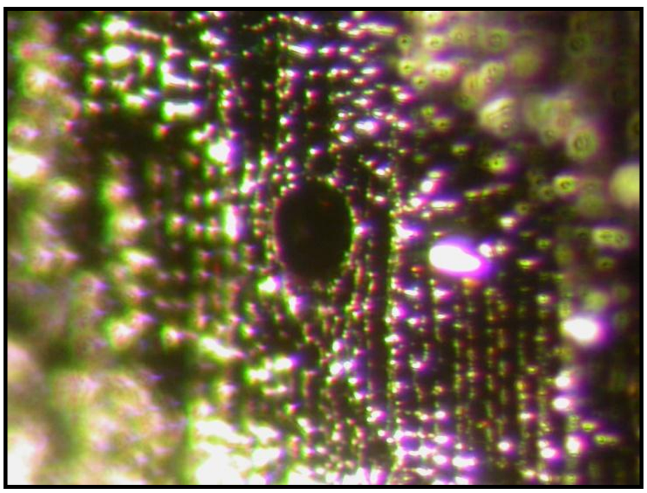

Figure 4.11: Resin canal on the transversal plane (Pinus; 150X; Photo: J. Miszaniec).

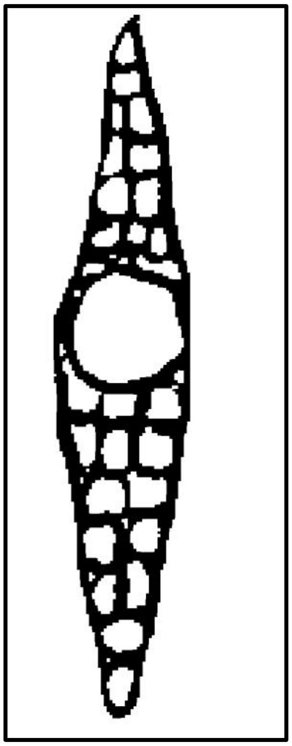

Figure 4.12: Drawing of a resin canal on tangential plane also referred to as fusiform ray (adapted from Charles et al. 2009).

4.1.7. Identification summary

The first step for wood identification is to determine whether the specimen is a hardwood or softwood from the presence or absence of pores. If the specimen is hardwood then the pore clusters are examined. The specimen is then identified as either ring porous, semi-ring porous, or diffuse porous. The thickness of rays on the transverse or tangential planes is determined by counting the number of cells. Once these steps are completed the genus of hardwood can be assigned. If the specimen is softwood, the transition from early to late wood is verified on the transversal plane. The tangential and transversal planes are then examined for resin canals. If resin canals are present, their size, position and frequency are noted. After these steps the genus of softwood can be assigned (Hather 2000; Pearsall 2000).

4.2. Comparative collection

A comparative collection of charred wood is needed for charcoal identification as wood shrinks by 35% when burnt due to moisture loss (MacGinnes et al. 1971; Beall et al. 1974). Since wood identification manuals are designed for uncharred specimens they cannot be used with confidence when identifying charcoal.

In the winter of 2013, under the supervision of Michael Deal (Department of Archaeology, Memorial University), I produced a reference collection of charred wood. The collection consists of 28 species representing 19 genera found in Canada (Table A.1). To complement the collection, I designed a laboratory manual outlining the steps and procedures for charcoal analysis with a focus on species from Newfoundland and Labrador (Miszaniec 2013). Along with wood identification manuals (Barefoot and Hankins 1982; Greguss 1995; Hather 2000; Hoadley 2000; Schloch et al. 2004; Halden 2009) the comparative collection and lab manual served as my reference material.

4.2.1. Laboratory procedure

Wood used for the charcoal collection came from an assortment of identified wood from the Eastern Forest Product Laboratory, Lyndeborough, New Hampshire, USA. Selected specimens were cut into 5 x 5 x 2 cm tablets. Wood was charred in a muffle furnace following the procedures established by Pearsall (2000). Wood tablets were individually wrapped in aluminum foil and placed in the furnace at 400ºC. Softwoods and hardwoods were charred separately since they burn at different rates (Dimbley 1978; Natural Resources Canada 2002). Wood was charred for 10-15 minutes or until the furnace ceased to produce smoke. Samples were then labeled and stored (for examples of charred wood see Appendix B).

4.3. Charcoal analysis

Here I present how charcoal analysis was applied to samples from Phillip's Garden. This section is divided between methods used for charcoal samples that were handpicked and those that were obtained from bulk sediment samples. Unfortunately, bulk sediment samples were not available to test the representativeness of the handpicked charcoal samples used in this study and therefore a separate set of analysis was undertaken on another set of dwellings to specifically address this important question on sample quality.

4.3.1. Handpicked charcoal sample sites

Handpicked charcoal came from sample bags collected from past excavations at Phillip's Garden. Selected samples originated from five dwellings: house feature 1 (Renouf 1986) house feature 14 (Renouf 1987), house 17 (Harp 1964; Renouf 2007), house 18 (Harp 1964; Cogswell 2006), house feature 55 (Renouf 1993), and midden feature 386 associated with house 10 (Harp 1964; Renouf et al. 2012; Figure 4.13). Unfortunately, house 10 was not able to be sampled since Harp did not collect charcoal during his excavation and due to time constraints, no middens belonging to house 17 or house 18 were analysed.

Of the selected features, house features 1 and 14 were from the early phase occupation of the site, houses 17 and 18 and feature 386 (house 10) were from the middle phase, and house feature 55 was from the late phase (Renouf and Bell 2009). The features selected for analyses were either completely excavated by Renouf or partially excavated by Harp and subsequently re-excavated by Renouf. Features completely excavated by Harp (1964) were not included since he did not collect or record charcoal.

House feature 14 (1990-1870 cal BP) was an oval dwelling from the early phase excavated by Renouf (1987). It is the oldest dated dwelling from the site (Renouf 2006). House feature 14 has a raised platform at the rear, with a narrow depression facing southeast, interpreted as a cold trap (Renouf 2003). Because of its cold trap, house feature 14 was interpreted as a winter dwelling (Renouf 1987:17).

House feature 1 (1920-1620 cal BP) was a small oval-shaped, early phase dwelling excavated by Renouf (1986). It has an east-west axial feature and two stone-lined pits in the rear (Renouf 2003). Stacked limestone shingles lined the perimeter of the dwelling (Renouf 2003). A break in the northeast perimeter was interpreted as the primary entrance, while a secondary entrance was identified to the southeast (Renouf 2003; Renouf and Murray 1999). It is interpreted as being a winter dwelling based on its faunal remains (Renouf and Murray 1999).

House 18 (1590-1460 cal BP) was a large rectangular middle-phase dwelling partially excavated by Harp (1964) and re-excavated by Renouf (Cogswell 2006). Its architectural features included a north-facing entrance, a north-south axial feature, elevated platforms and several storage pits (Cogswell 2006). Due to its size and complex construction it was interpreted as a winter dwelling (Cogswell 2006). There is a smaller tent-like structure built onto it, indicative of possible downsizing or warm-weather reoccupation (Cogswell 2006: 63,65)

House 17 (1660-1340 cal BP; Renouf 2006) is trilobate in shape. It was partially excavated by Harp (1964) and re-excavated by Renouf (2006). It has a centrally located entrance tunnel in the northern wall, a north-south axial feature with two central postholes, a large well defined perimeter platform, two rear storage pits and numerous post holes outlining the perimeter of the platform (Renouf 2009). Its structural complexity suggests that it was a permanent dwelling occupied year-round (Renouf 2009).

Midden feature 386 was found in association with house 10 (1480-1630 cal BP) and was excavated by Renouf et al. (2012). It is located outside the dwelling, its dimension were approximately 1.7 m north south and 1.5 m southwest (Renouf et al. 2012). The midden consists of dark stained soil containing bone, several flakes, and charcoal (Renouf et al. 2012).

House feature 55 (1410-1180 cal BP) was a late phase dwelling excavated by Renouf (1993). It is the smallest excavated dwelling and has cobble lined axial features running east to west, with central postholes at either end (Renouf 2006). The central depression is lined with a limestone perimeter. Breaks in the perimeter suggest that there was a main northeast entrance and a secondary southeast entrance (Renouf 2006:123).

Faunal remains recovered from its associated midden (Hodgetts et al 2003: 116) suggest that it was occupied in the winter, late spring, and possibly early summer.

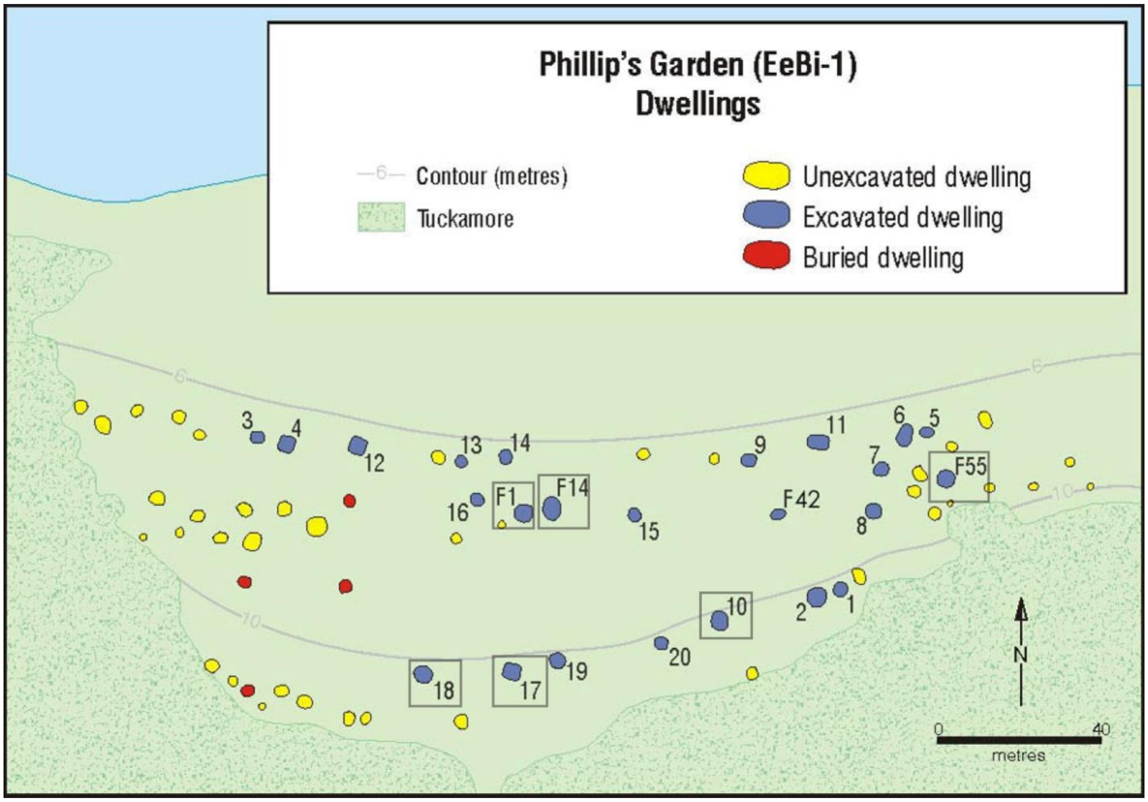

Figure 4.13: Map of dwellings at Phillip's Garden. Sampled features are outlined in rectangles. F1= house feature 1, F14=house feature 14, 10=house 10, 17=house 17, 18=house 18, F55=house feature 55. Note that house 10 was not sampled but its associated midden, Feature 386, was (PACAP 2013).

4.3.2. Handpicked charcoal sampling

When charred, wood can fragment into hundreds of pieces (Dufraisse 2008). To reduce the likelihood that all fragments analysed originated from one piece of wood, charcoal specimens were systematically sampled by sub-operation within the dwelling to ensure that all areas were represented[3]. Three rules were employed for sampling:

Rule 1: A minimum of 25 charcoal fragments was identified per sub-operation.

This rule is based on Thompson's (1994: 17) assertion that 20 fragments make up a representative sample size for charcoal sampling per context. Where a sub-operation did not have 25 fragments, all fragments within the sub-operation were analysed. In some cases sub-operations did not have any charcoal.

Rule 2: Sub-operation sampling was ended when no new genus was identified from previous ten fragments.

When identifying charcoal, the number of newly recorded genera initially increases rapidly but eventually becomes constant as more fragments are analysed (Keepax 1988: 44; Smart and Hoffman 1988; Chabal et al. 1999: 67). A representative sample will achieve a constant number of genera irrespective of new fragment identified. For this study, if no new genus was identified in the previous 10 fragments then the sample was deemed representative and the analysis was stopped for that sub-operation.

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[3]Renouf (1985) set up the excavation grid at Phillip's Garden. It consists of 98 squares known as operations, each one covering 100 m^2. The squares run east to west across the datum line of the site. Operations are labeled numerically from 201 to 299 in accordance with the Parks Canada provenience system. Each operation is divided into four equal sub-operations designated as A, B, C and D in a clockwise direction from the northwest.

Rule 3: All fragments from a specimen bag were analysed.

When recovered in the field, charcoal specimens were assigned a catalogue number and placed in a bag. Charcoal clusters or scatters were collected together as one specimen and placed in one bag (Renouf, pers. comm. 2014). As a consequence, the number of fragments varied between specimen bags. Since each bag was considered its own sample all fragments within a bag had to be identified for a true representation of its contents. If the quantity of charcoal examined reached 25 fragments and there were still charcoal left in a bag, the remaining specimens were analyzed.

For each sub-operation, specimen bags were selected for sampling using a random number chart containing the catalogue numbers. New specimen bags continued to be selected until 25 fragments were analysed or until the number of identified genera was constant for a sub-operation.

4.3.3. Procedures for analysis of handpicked charcoal

As samples may need to be used in the future for radiocarbon dating strict measures to prevent contamination were implemented. When handling charcoal, latex gloves or tweezers were used and equipment was washed between samples. Before analysis, the sample number, excavation date, provenience, level and associated feature (if applicable) were recorded for each sample bag (Appendix C). Samples were passed through a 4 mm mesh sieve as only charcoal larger or equal to 4 mm could be identified. Fragments smaller than 4 mm were wrapped in aluminum foil and returned to their sample bag for possible future radiocarbon analysis.

4.3.4. Bulk sediment samples

Sediment samples were collected from three unexcavated dwelling features that were tested during the 2013 field season (Wells et al. 2014). Test pits 50 x 50 cm in size. A single test pit was excavated within the central depression of each of the three dwellings, toward the rear of the structures. Charcoal was picked for radiocarbon dating from cultural layers in each test pit and then a bulk sample was taken. Of the thirty features tested, twenty-one were dated. The bulk samples selected for this study came from three dwelling features that had radiocarbon dates similar to the dwellings selected for the handpicked charcoal analysis (Table 4.1). The dwelling features selected were depression 1, depression 100 and feature 368 (Figure 4.14).

Since charcoal is produced by both cultural and natural causes (e.g., forest fire; Smart and Hoffman 1988; Pearsall 2000), a 1 L control sample was taken directly below the topsoil near Bass Pond away from the site in order to assess natural charcoal levels.

Feature 368 was identified in the 2011 field season (Wells et al. 2012) and dated in 2013 to 1730-1620 cal BP, placing it in the early phase of site occupancy (Wells et al. 2014). Charcoal, flakes, tools, and bones were recovered from the test unit (PACAP 2013). Four sediment samples were recovered from this unit, two from level 2 and two from level 3 (PACAP 2013).

Depression 1 was identified in the 2012 field season (Renouf et al. 2013) and dated in 2013 to 1560-1420 cal BP, placing it in the middle phase (Wells et al. 2014). A midden, feature 420, was tested; as a consequence the test pit contained charcoal, bone, flakes, and tools. Two sediment samples analysed from this unit came from level 2 (PACAP 2013).

Depression 100, situated in the tuckamore at the edge of the site, was identified in the 2012 field season (Renouf et al. 2013; Wells et al. 2014). It was dated in 2013 to 1360-1310 cal BP, placing it in the late phase of occupation. The test pit contained flakes and faunal remains, as well as charcoal. There were two sediment samples collected from this test pit one each from levels 2 and 3 (PACAP 2013).

Table 4.1: Dates of selected features where sediment samples were taken compared to dates of the features where the handpicked samples originated. The features are grouped according to occupation phase.

Phase	Feature (bulk)	Dates in cal BP	Feature (handpicked)	Dates in cal BP
Early	Feature 368	1730-1620	House feature 14	1990-1639
			House feature 1	1920-1630
Middle	Depression 1	1560-1420	House 17	1710-1310
			House 18	1690-1410
			Feature 386	1690-1420
Late	Depression 100	1360-1310	House feature 55	1400-1180

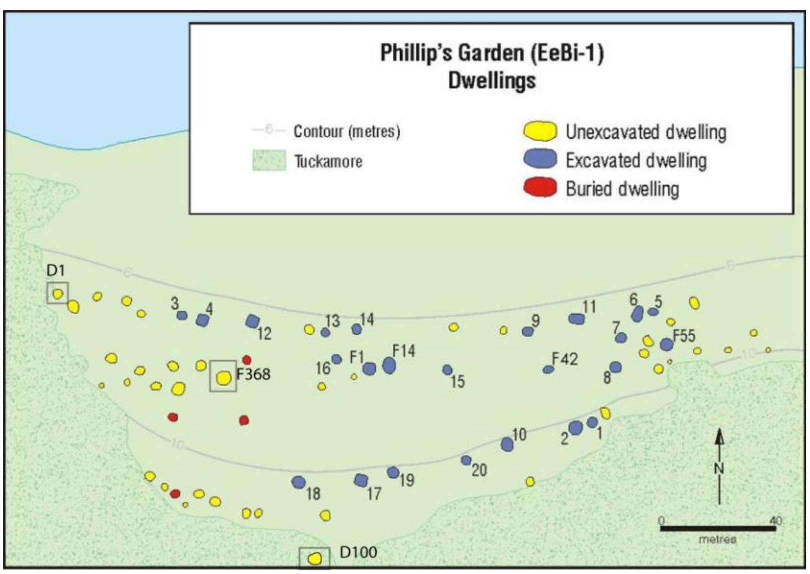

Figure 4.14: Map of dwellings at Phillip's Garden. Features where sediment samples originated from are encased in rectangles. D1=depression 1, F368=feature 368, D100=depression 100 (PACAP 2014).

4.3.5. Bulk sediment sample laboratory procedures

Soil samples were measured and notes were taken on texture (Appendix D; Pearsall 2000). All sediment samples were processed using simple floatation, in which samples were placed in a container of water and agitated (Pearsall 2000). The resulting flot (material which floats on the surface during the flotation) was passed through two sieve trays: 4 mm and 250 µm mesh size. Only charcoal 4 mm or larger can be analysed for wood identification, thus only the 4 mm flot was used for this study. The 250 µm flot was placed in ethanol and stored for future research.

The 4 mm flot was placed in a closed cloth and suspended to air dry for 1-2 days. Once dry, the flot was re-sieved in the 4 mm sieve tray, since materials could have been entangled with one another when wet. Material was visually analysed for charcoal. Non-charcoal material was placed with its associated finer fraction and stored for future research.

4.3.6. Charcoal Identification

Fragments were fractured by hand or with a single-edged razor to expose the transversal and tangential planes (Hather 2000). The specimen was then prepared for microscopic analysis and placed in a container of salt to be supported and easily manipulated during identification.

Charcoal fragments were examined with a Nikon stereoscopic microscope. The transversal plane was examined under a magnification of 10-45X. Observation of the tangential plane was carried out under a magnification of 100X (Hather 2000; Pearsall 2000: 145).

In most cases genus-level identification was possible. None of the specimens analysed could be specified to species level. In some cases, genus-level identification was not possible due to damage that occurred during charring. In some cases fragments were assigned a dual genus category because of limited distinguishing traits; for example, fir-spruce which are both members of the *Pinacea* family; aspen-willow which are both members of *Salicaeae* family; or fir-juniper which are similar due to their lack of resin canals.

Three types of unidentified classes were assigned to fragments that could not be assigned to genus level: 1) bark, root or pith; 2) unidentified hardwood or unidentified softwood; and 3) unidentified charcoal. Bark, roots and pith do not contain any xylem tissue, thus could not be identified to genus. "Unidentified softwood" or "unidentified hardwood" refers to charcoal that could not be assigned to a genus but could be identified as either hardwood or softwood. "Unidentified charcoal" refers to a sample that could neither be distinguished as hardwood or softwood.

Once charcoal was isolated and identified for each sediment sample or sub-operation, it was grouped according to genus. Unidentified charcoal was grouped by their respective categories. Each genus/group was then weighed with a digital scale. Weight was chosen over counting individual fragments since fragments can vary in size and would not represent proportions (Thompson 1994). Additionally, charcoal could have fractured after its removal from the field. Thus, weight provides the most accurate representation of charcoal proportions. All weights were added to give a total weight for the entire sample (Appendix E). Once all individual charcoal samples were weighed, their weights were added to give the total weight for the respective features.

4.4. Driftwood collection and identification.

4.4.1. Driftwood survey

Before driftwood could be collected a foot-survey was completed to identify beaches that had abundant driftwood for sampling. The survey route was 20-km-long starting at Sandy Point, approximately 4 km south of the town of Port au Choix. The route followed the coast along the Point Riche and Port au Choix peninsulas ending at the isthmus between Back Arm and Gargamelle Cove (Figure 4.15). Each beach surveyed was assigned an informal name if it did not already have an official one. GPS coordinates were taken at the start and the end of each beach and driftwood accumulations were recorded (Appendix F). Relative driftwood concentration was judged by observing size and density of driftwood build-up along a beach. Beaches were subjectively designated as low, medium or high in relation to one another (Figures 4.16-4.18).

In total 22 beaches were surveyed. Of these beaches, four had high driftwood accumulations, seven had medium accumulations, and eleven had low accumulations (Table 4.2; Figure 4.19). The majority of beaches on the Point Riche Peninsula with high accumulations faced southwest into the Gulf of St. Lawrence.The findings from the survey informed decisions on where to collect driftwood. Beaches favoured for sample collection were those with high driftwood accumulation.

Driftwood accumulation was influenced by human activity on the surveyed beaches in two ways: by removing and contributing to driftwood. Areas that were close to human occupation were not selected for sampling as inhabitants use and burn driftwood (Figure 4.20; e.g., Gargamelle Cove and House beach). Humans also increase levels of driftwood accumulation (Alix 2005). Much of the driftwood found along the survey route was derived from anthropogenic sources (Figures 4.21 and 4.22). As visual assessment of driftwood alone may not be sufficient to confirm an anthropogenic source, an independent test of the driftwood sampling approach was carried out using unambiguous natural driftwood (see below under *Systematic Sampling*).

Table 4.2: Driftwood abundance per surveyed beach. Abundance was subjectively determined through observation of driftwood accumulations. Map of beach location is provided in Figure 4.19.

	Driftwood Abundance		
Beach	**Low**	**Medium**	**High**
Phillip's Garden beach		X	
Little beach		X	
Rocky beach	X		
No Access beach	X		
Old Port au Choix cove		X	
Urchin beach	X		
Barbace Cove		X	
Cliff beach			X
Fortress beach		X	
Sunshine beach	X		
Pebble beach	X		
Trap beach	X		
Sandy Point			
Whale beach		X	
Gargamelle Cove	X		
Little Gargamelle beach	X		
Visitors beach			X
Point Riche beach			X
House beach	X		
Quiet beach	X		
End beach		X	
Valley beach	X		

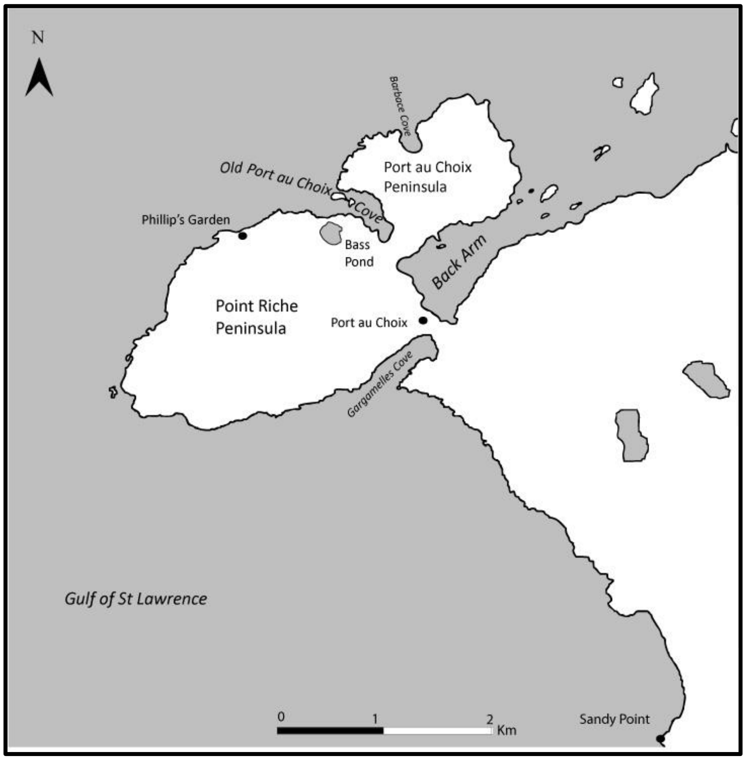

Figure 4.15: Driftwood survey area.


Figure 4.16: Photograph facing east along Sunshine beach situated on the northeast coast of the Port au Choix Peninsula. Sunshine beach is an example of a beach with low driftwood accumulation. Note several logs in middle foreground and one near right middleground (Photo: J. Miszaniec).

Figure 4.17: Photograph facing east along Fortress beach situated on the northwest coast of the Port au Choix Peninsula. Fortress beach is an example of a beach with medium driftwood accumulation. Note the moderate size driftwood scatter starting in the left foreground and extending to the right middleground (Photo: J. Miszaniec).

Figure 4.18: Photograph facing east along Visitors beach situated on the south coast of the Point Riche Peninsula. Visitors beach is an example of a beach with high driftwood accumulation. Note the dense driftwood build up in the left middleground extending to the right foreground (Photo: J. Miszaniec).

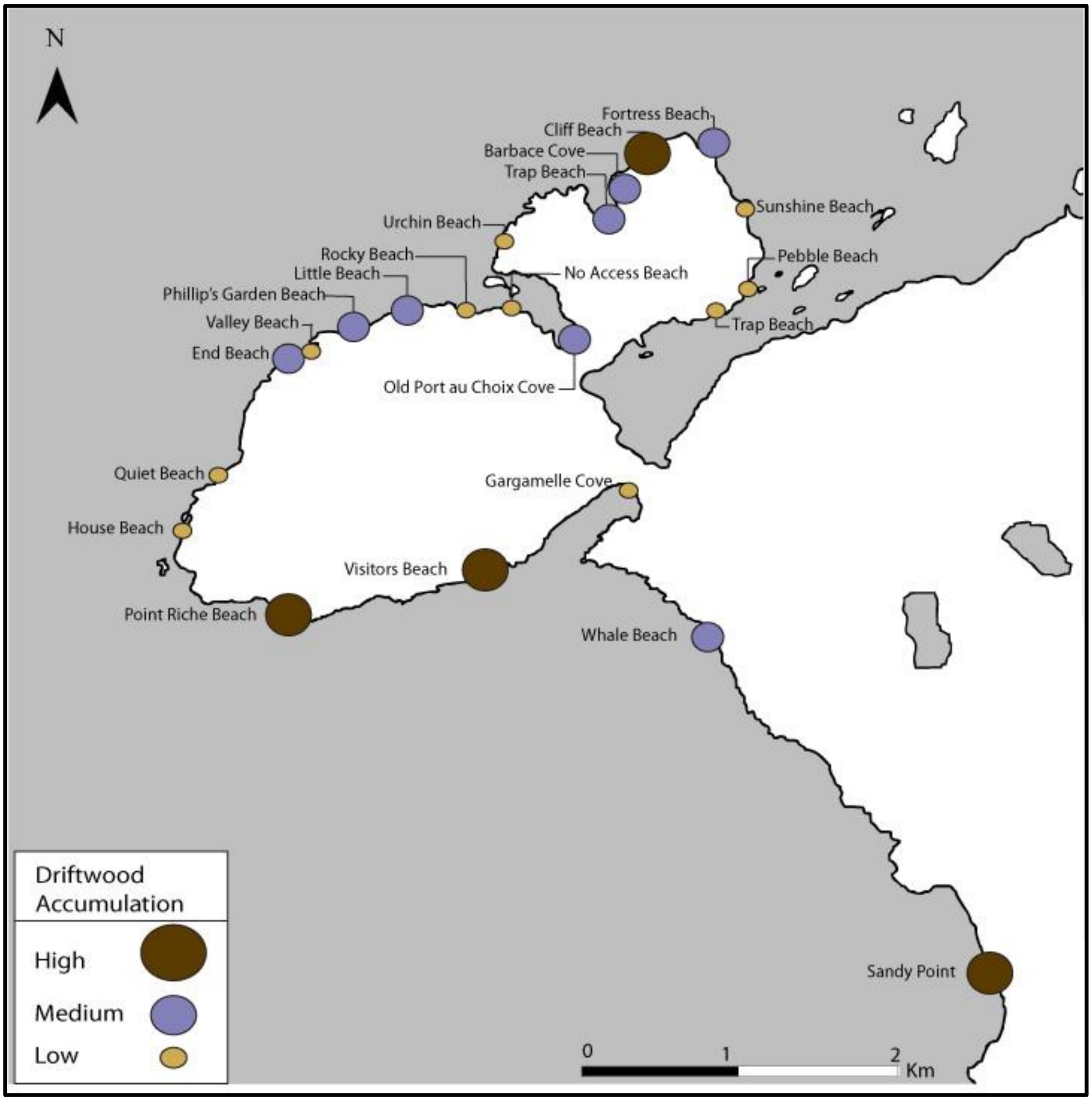

Figure 4.19: Driftwood accumulation on surveyed beaches in Port au Choix study area.

Figure 4.20: Example of driftwood being used for bonfires on Gargamelle Cove. View is seaward from upper beach (Photo: J. Miszaniec).

Figure 4.21: Remains of a boat found on Sunshine beach on the north coast of the Port au Choix Peninsula. Photographer is facing east (Photo: J. Miszaniec).

Figure 4.22: Example of driftwood produced by logging, found at Sandy Point (Photo: J. Miszaniec).

4.4.2. Driftwood collection

From the 22 beaches surveyed, 3 beaches were selected for driftwood collection: 1) Visitors beach; 2) Point Riche beach; and 3) Phillip's Garden beach (Figure 4.19). Visitors beach and Point Riche beach were selected due to their high driftwood accumulation. Phillip’s Garden beach had only medium driftwood accumulation but was selected because of its proximity (500 m) to the adjacent archaeological site (Figure 4.23). It is composed of coarse gravelly sand. Visitors beach is a 200-m-long beach located near the Port au Choix Visitors Centre. It is composed of shattered limestone bedrock backed by a moderate slope (Figure 4.24). Point Riche beach is a 1.5-km-long beach beginning at the Port au Choix Visitors Centre and ending roughly at the lighthouse near the archaeological site of Point Riche (Figure 4.25). It is a gravelly beach dotted with limestone outcrop. The driftwood accumulation was consistently high along the beach.

Figure 4.23: Driftwood accumulation at Phillip’s Garden beach. Photographer is facing east (Photo: J. Miszaniec).

Figure 4.24: Driftwood accumulation at Visitors beach (Photo: J. Miszaniec).

Figure 4.25: Driftwood accumulation at Point Riche beach (Photo: J. Miszaniec).

4.4.3. Collection methods

4.4.3.1. Transects

Driftwood collection methods were adapted from Alix (2005). Two-metre-wide belt transects were placed in areas representative of driftwood concentration at each of the three beaches, but areas of excessive driftwood build-up were avoided for reasons of sampling logistics (Figure 4.26). It seemed reasonable to collect only those samples for which there would be sufficient time to process and identify. For similar reasons, only pieces with a circumference of 15 cm or larger were sampled.

The belt transect was set up perpendicular to the coastline running from the highest piece of driftwood to the active shoreline. Driftwood pieces that were more than half inside the transect were sampled, whereas pieces that were mostly (>50%) outside the transect were excluded. If a piece of driftwood passed completely through the transect it was included (Figure 4.27). Driftwood pieces were also excluded (but counted) if they showed signs of an anthropogenic source such as cut/saw marks or presence of spikes or nails. Pieces that were substantially decomposed were also excluded.

For each piece selected, its length, circumference and location were recorded (Appendix G; Figure 4.28). The anatomical source of the driftwood sample was assigned to one of four classes: 1) root; 2) branch; 3) trunk; or 4) unidentified. The presence of bark and/or root systems was also noted (Alix 2005). A handsaw was used to saw off a sample (4 cm wide) that exposed a view of the growth rings (transverse plane) for use in the wood identification. The 4-cm-thick samples (or cookie) varied in circumference above 15 cm.

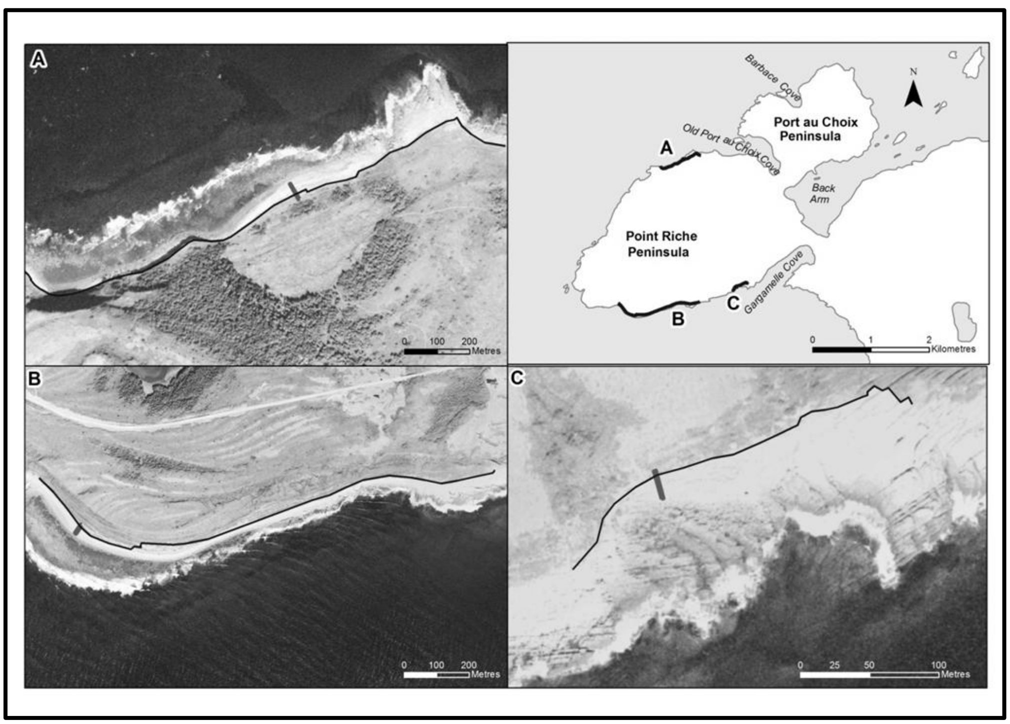

Figure 4.26: Location of beaches selected for driftwood sampling on the Point Riche peninsula. The line represents where the grass meets the beach. The short grey line is where the belt transect was placed on each beach: A) Phillip's Garden beach, B) Point Riche beach, C) Visitors beach.

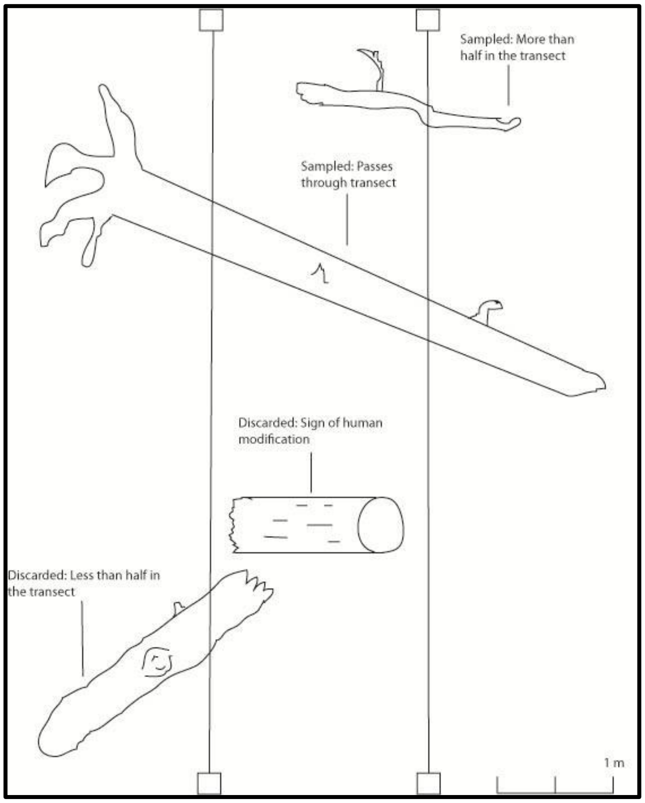

Figure 4.27: Examples of driftwood logs included in or excluded from the sampling protocol.

Figure 4.28: Driftwood specimens at Visitors beach (Photo: J. Miszaniec).

4.4.3.2. Systematic sampling

A systematic survey was conducted along Point Riche beach. The systematic sample targeted driftwood with root systems intact. The goal of this survey was to identify whether driftwood sampled by the transect method unintentionally incorporated anthropogenic wood by comparing the species composition of both transect and systematically collected samples. Even though sample collection in the transects excluded pieces obviously modified by humans, many of the samples observed were broken off at both ends and therefore it was impossible to know if every piece was unambiguously naturally sourced.

The entirety of Point Riche beach was walked and every tenth piece of driftwood that had its root system intact was sampled (Figure 4.29). The two criteria for sampling were that the root system was intact and that the piece showed no signs of human modification. The reasoning was that driftwood with an intact root system was less likely to have fallen due to human involvement. The length and circumference of the samples were measured. Presence or absence of bark was also noted. Wood for identification was sampled similar to that collected from the belt transects.

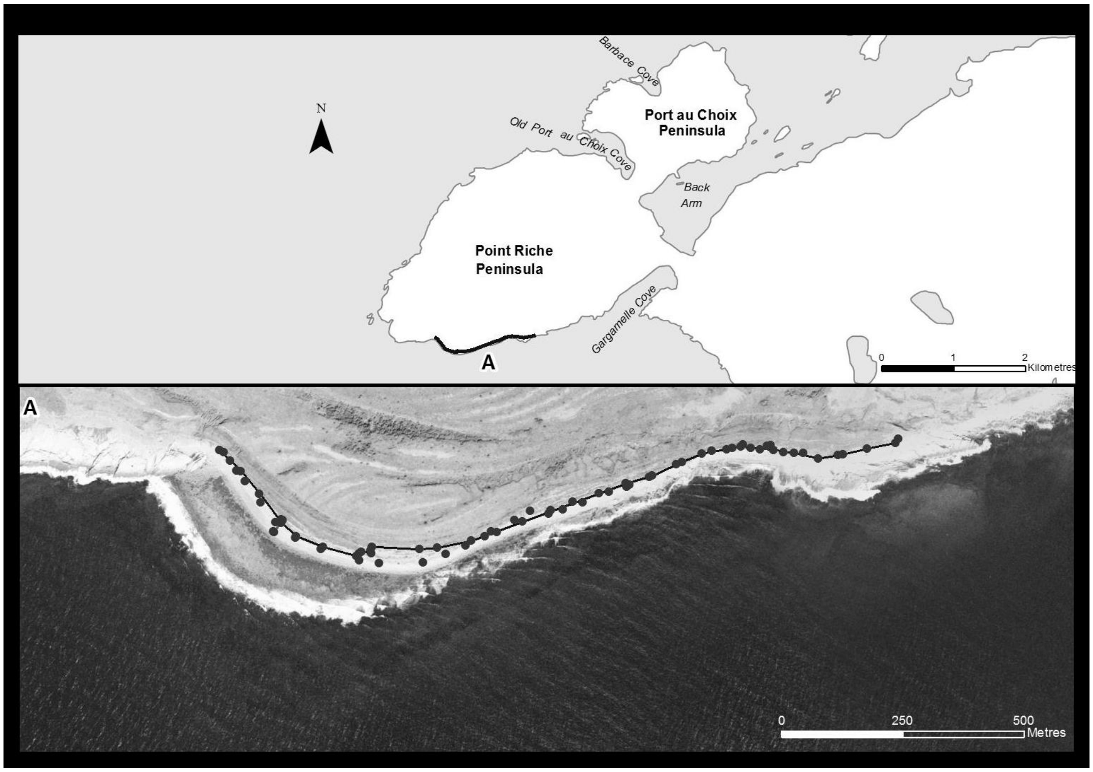

Figure 4.29: Systematic survey of driftwood with root systems on Point Riche beach. Dots indicate where driftwood samples were located.

4.4.4. Driftwood identification

Wood identification was carried out following the methods previously described for charcoal. Since samples were large and complete only the transverse plane was required for identification. A single-edged razor blade was used to remove a sliver of the specimen. The sliver was placed in salt for support, as well as easily manipulation, during microscopic identification.

Waterlogging hindered identification of driftwood. When wood is kept in a moist environment it absorbs water (Menotti 2012). Once removed from a moist environment, water inside evaporates, modifying the cellular structure and making an accurate identification difficult. Similar to the charcoal, a category was assigned for driftwood that was unidentifiable to genus (i.e., rotted or water logged). Two classes were created for these samples: 1) unidentified hardwood or softwood, and 2) unidentified wood.

4.5. Spatial analysis

Charcoal density was mapped in relation to architectural features recorded for three dwellings in order to understand where wood was potentially burnt and charcoal discarded. Dwellings selected were house features 1, 14 and 55. A detailed description of each of these house features is described above. Dwellings selected were completely excavated by Renouf (1986, 1987, 1993) and represent the early and late phases of occupation only. Other dwellings examined for this study were fully or partially excavated by Harp who did not record the location of his charcoal samples and therefore could not be included in this analysis.

4.5.2. Methodology

Total charcoal collected from a dwelling, whether used in genus identification or not, was weighed and tabulated according to the square-metre grid cell or unit in which it was found. More detailed plotting of charcoal was not possible since specific sample locations were not recorded. Weight of charcoal per unit as a percentage of the total weight of charcoal from the dwelling was calculated and plotted on a floor plan of the dwelling.

4.5.3. Error sources

During the charcoal identification process, it was noted that burnt organics were included alongside charcoal in specimen bags. Burnt organics were likely burnt animal fat or burnt bone, as charcoal was typically found in association with faunal material. When weighing charcoal, burnt organics were picked out of samples during the weighing process but in some cases the distinction between burnt organics and charcoal was only possible under magnification. Because not all the charcoal used for the distribution maps was sampled for identification, it is possible that some burnt organics were included. Given that burnt organics are typically heavier than charcoal, their inclusion likely overrepresented the percent charcoal weight of individual units.

Taphonomical processes following dwelling abandonment may also result in misrepresentation of the charcoal distribution. As Phillip's Garden was occupied for over 700 years (Renouf 2011b), areas in and around dwellings may have been disturbed by subsequent activities. For example, Cogswell (2008) noted that a smaller structure may have been built onto house 18. Additionally, Eastaugh and Taylor's (2001) magnetometer survey suggests that abandoned dwellings were re-used as middens. Moreover, natural processes such as wind and rain could have affected charcoal distribution within dwellings (Asouti 2009). If roofs were dismantled it is possible that charcoal within the dwellings could have been contaminated from charcoal transported by the wind from outside fires (Pearsall 2000; Asouti 2009).

CHAPTER 5

RESULTS

This chapter presents the results of the research. It is sub-divided by each method of analysis: 1) charcoal analysis; 2) driftwood analysis; and 3) spatial analysis.

5.1. Charcoal analysis

5.1.1. Data quality

Of the eight sediment samples processed for data quality only three contained charcoal larger than 4 mm: both samples from depression 1 and one of two samples from depression 100. Five fragments of fir weighing in total 0.75 g were recovered from Level 2 in depression 1, while one fragment of spruce weighing 0.01 g was recovered from Level 2 in depression 100. None of the four samples processed from feature 368 yielded any charcoal and the control sample was devoid of charcoal too (Table H.1). These data represent extremely low amounts of charcoal compared to what was recovered in handpicked samples from other features at Phillip's Garden.

5.1.2. Handpicked samples

This section presents the results of handpicked charcoal identification from features at Phillip's Garden. For each feature I present the total number of fragments identified followed by the total weight. The number of genera and percent of each genus are also given. Note that for each paired genera (e.g., fir-spruce), the genus count is two. For instance, in an assemblage that had fir, fir-spruce and willow, the number of identified genera would be three.

House feature 1

In total, 111 charcoal fragments were analysed from 18 units from three sub-operations (Table H.2). The total weight of charcoal from house feature 1 was 9.85 g. Softwoods made up the majority of the total weight. Six genera were identified in total, three hardwoods and three softwoods. Fir by far was the most common genus. Other genera included spruce, birch, alder, fir-juniper, and ash. Charcoal that could not be assigned to a genus consisted of softwoods and bark (Table 5.1; Figure 5.1).

House feature 14

Eighty-seven charcoal fragments were analysed from Feature 14, originating from 13 units in 4 sub-operations (Table H.3). The total weight, for charcoal analysed was 7.66 g. Two softwoods were present, with fir making up the majority of the weight while spruce was only a minor component. Softwood made up the unidentifiable fragments (Table 5.1; Figure 5.1).

House 17

As indicated in Table H.4, 119 charcoal fragments were identified from house 17 in 13 units from 8 sub-operations. The total weight for all charcoal analysed was 14.72 g. The majority of charcoal identified was softwood, while hardwood was rare. Fir made up half of the identified genera, while unidentified softwood and unidentified charcoal made up most of the other half. Other genera identified in very small amounts were spruce, aspen-willow, and aspen (Table 5.1; Figure 5.1).

House 18

In total, 130 charcoal fragments were identified from house 18, originating from 16 units in 5 sub-operations (Table H.5). The total weight of charcoal examined was 24.16 g. Softwoods made up the majority of the charcoal analysed, while hardwoods were rare. Approximately half of the charcoal was identified as fir, while spruce represented almost a third. Other genera included fir-spruce, birch and pine. Unidentified classes included softwood and undifferentiated charcoal (Table 5.1; Figure 5.1).

Midden feature 386

A total of 101 fragments were analysed from feature 386 (Table H.6). The total weight of all charcoal fragments was 17.03 g. Softwoods made up the entire weight where fir made up the majority of the identified charcoal while spruce was a much smaller component. Tamarack was also present but in small amounts (Table 5.1; Figure 5.1).

House feature 55

In all, 52 fragments weighing 3.68 g were identified from house feature 55, from 18 units across 6 sub-operations (Table H.7). Three genera were identified, all softwoods. Fir made up approximately two-thirds of the identified charcoal while other genera included spruce and juniper. Unidentified classes comprised softwood and undifferentiated charcoal (Table 5.1; Figure 5.1).

Summary

Charcoal analysed across all features was overwhelmingly softwood with some hardwood. Five softwood and five hardwood genera were identified. Overall, fir dominated, making up a little over two-thirds of the identified charcoal. Spruce was an important minor component while other genera represented were fir-spruce, birch, pine, juniper, tamarack, aspen-willow, alder, aspen, fir-juniper and ash (Table 5.2).

Table 5.1: Weight and percent of charcoal identified to genus from selected features grouped according to occupation phase at Phillip's Garden.

		Early Phase				Middle Phase						Late Phase	
	Genus	F1		F14		H18		H17		F386		F55	
		(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)	(g)	(%)
Softwood	Fir	8.51	86	6.72	88	12.67	54	7.42	50	14.68	86	2.6	71
	Spruce	0.49	5	0.37	5	6.9	31	0.29	2	2.25	13	0.51	14
	Pine					0.22	1						
	Tamarack									0.1	0.6		
	Juniper											0.08	2
	Pine												
	Fir-Juniper	0.02	0.3										
	Fir-Spruce					2.1	9						
	Unidentified softwood	0.42	4	0.19	2			4.89	33			0.08	2
Hardwood	Birch	0.2	2			0.56	2						
	Aspen							0.01	<0.1				
	Alder	0.04	0.5										
	Ash	0.01	0.1										
	Aspen-Willow							0.05	0.3				
Undifferentiated	Unidentified charcoal	0.15	2	0.38	5	0.6	3	2.06	14			0.41	11
	Bark	0.01	0.1										
TOTAL		9.85	100	7.66	100	23.35	100	14.72	100	17.03	100	3.68	100

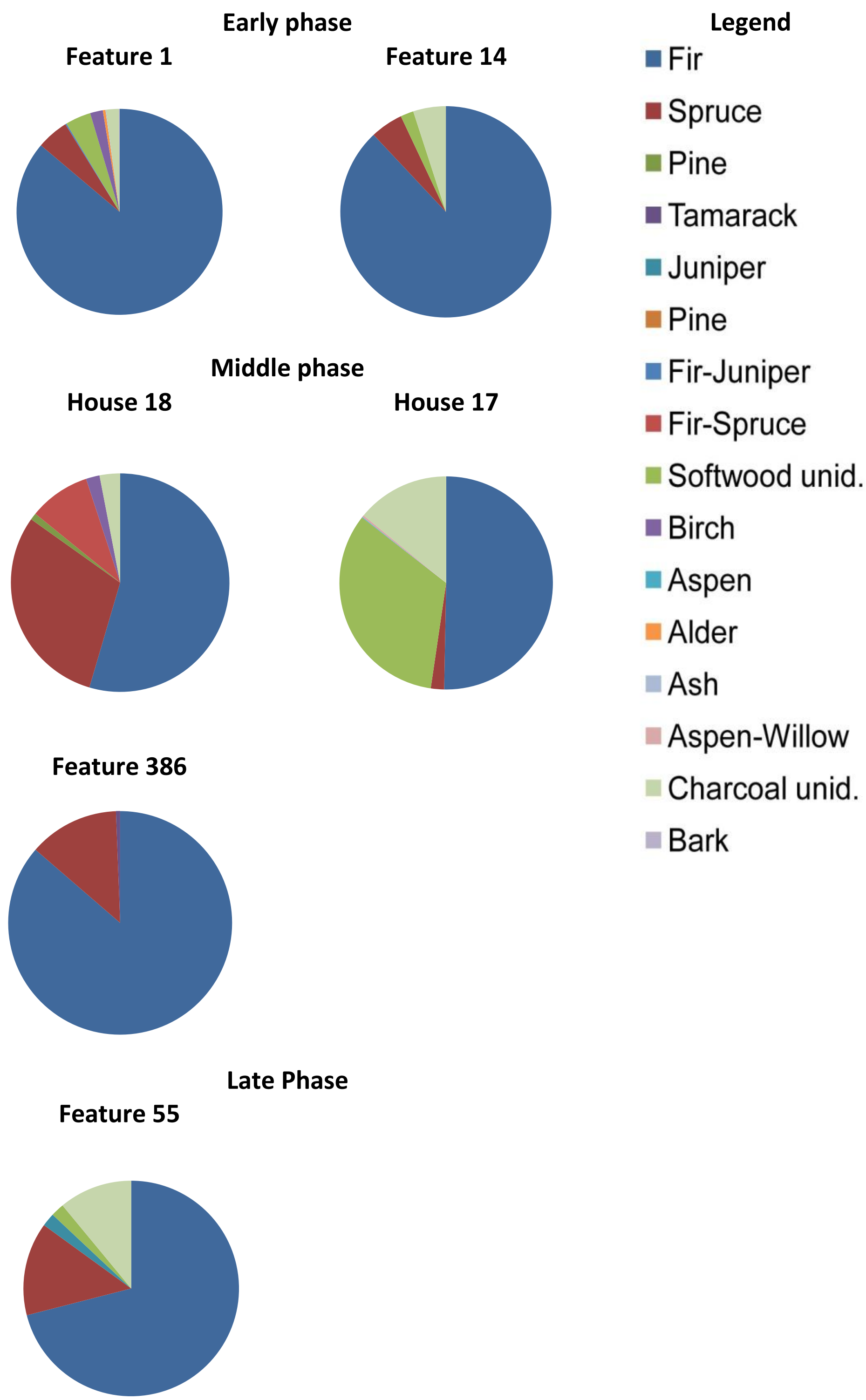

Figure 5.1: Percent occurrence of identified charcoal by weight in selected features at Phillip's Garden.

Table 5.2: Summary of total percent of charcoal by genus from handpicked samples for the six selected features at Phillip'

	Genus	Total (%)
Softwood	**Fir**	69
	Spruce	14
	Pine	<0.1
	Juniper	0.1
	Tamarack	0.1
	Fir-Spruce	3
	Fir-Juniper	<0.1
	Unidentified softwood	8
Hardwood	**Birch**	1
	Aspen-Poplar	<0.1
	Alder	<0.1
	Aspen-Poplar	<0.1
	Ash	<0.1
Undifferentiated	**Unidentified charcoal**	5
	Bark	<0.1

5.2. Driftwood results

For the three sampled beaches, the number of driftwood pieces larger than 15 cm in circumference is presented, and the number of driftwood excluded due to a likely anthropogenic source is given. Proportions of hardwoods and softwoods are identified, followed by a listing of identified genera and their relative abundance.

Phillip's Garden beach

Of the 47 pieces of driftwood sampled from Phillip's Garden beach, 24 showed signs of human modification and 4 were degraded. In total, 23 pieces of driftwood were identified to genus. The majority of pieces were softwoods (n=20, 86%) while hardwoods (n=3, 14%) were much less abundant. Two hardwoods and four softwoods were identified; in decreasing order they were: fir (n=12, 52%), spruce (n=4, 17%), tamarack (n=3, 13%), birch (n=2, 10%), ash (n=1, 4%), and pine (n=1, 4%; Table 5.3).

Visitors beach

One hundred twenty-nine pieces of driftwood larger than 15 cm circumference were collected from the belt transect at Visitors beach. Of these, about half (n=64) were excluded from the analysis due to a probable anthropogenic source. Softwoods (n= 54, 83%) represented the majority of identified pieces, while hardwoods (n=10, 17%) were less common but still well represented. The remaining piece was unidentifiable (2%). Five hardwoods and four softwoods were identified to genus. In decreasing order they were: spruce (n=25, 38%), fir (n=20, 31%), tamarack (n=6, 9%), alder (n=5, 8%), birch (n=2, 3%), pine (n=2, 3%), maple (n=1, 2%), aspen (n=1, 2%) and willow (n=1, 2%). Unidentifiable classes consisted of unidentified softwood (n=1, 2%) and unidentified driftwood (n=1, 2%; Table 5.3).

Point Riche beach (transect)

Forty-seven pieces of driftwood were located in the belt transect on Point Riche beach, 24 of which were excluded for suspected anthropogenic origin (n=22) or degradation (n=2). Softwoods (n=16, 69%) represented the majority of sampled driftwood, while hardwoods (n=7, 29%) made up the remainder. Genera present included in decreasing order: spruce (n=8, 36%), fir (n=7, 31%), alder (n=3, 13%), maple (n=1, 4%), birch (n=1, 4%), ash (n=1, 4%), aspen (n=1, 4%), and tamarack (n=1, 4%; Table 5.3).

Point Riche beach (systematic survey)

The systematic survey along the coast of Point Riche sampled 35 pieces of driftwood with root systems intact. Of the 35, 3 were opportunistically harvested due to their outstanding size. Most of the recovered pieces were softwoods (n=24, 69%) while hardwoods (n=11, 31%) represented almost a third of the samples. There were 10 identified genera, 5 each of softwood and hardwood. In decreasing order they were: fir (n=11, 32%), spruce (n=9, 27%), alder (n=4,11%), tamarack (n=2, 6%), birch (n=2, 6%), ash (n=2, 6%), aspen (n=2, 6%), pine (n=1, 3%), hemlock (n=1, 3%) and cherry (n=1, 3%; Table 5.3).

A comparison of the results between the systematic sample and the transect sample from Point Riche beach reveals very little difference in genus composition (Table 5.3 and Figure 5.2). Both sampling methods recovered mostly fir and spruce with similar proportions of softwoods and hardwoods. Three logs that were opportunistically sampled due to their size were uncommon genera - ash and hemlock - compared to the others driftwood samples on the beach. Overall, the samples collected systematically from Phillip's Garden beach support the use of belt transects to retrieve representative driftwood samples.

Total

In total, 146 pieces of driftwood were collected and sampled from all beaches. Three-quarters of the pieces were softwood (n=114, 78%). Five softwood and 7 hardwood genera were identified. They were in decreasing order: fir (n=50, 34%), spruce (n=46, 32%), alder (n=13, 9%), tamarack (n=12, 8%), birch (n=7, 5%), aspen (n=4, 3%), pine (n=4, 3%), ash (n=3, 2%), maple (n=2, 1%), willow (n=2, 1%), cherry (n=1, 1%), and hemlock (n=1, 1%; Table 5.4)

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Table 5.3: Genera of driftwood identified from selected beaches at Port au Choix. Both number (n) of individual pieces and percent genera are provided.

		Phillips Garden beach		**Visitors beach**		**Point Riche beach (transect)**		**Point Riche beach (systematic)**	
	Genus	**n**	**%**	**n**	**%**	**N**	**%**	**n**	**%**
Softwood	**Spruce**	4	17	25	38	8	36	9	27
	Fir	12	52	20	31	7	31	11	32
	Larch	3	13	6	9	1	4	2	6
	Pine	1	4	2	3			1	3
	Hemlock							1	3
				1	2				
Hardwood	**Alder**	1	4	5	8	3	13	4	11
	Birch	2	10	2	3	1	4	2	6
	Maple			1	2	1	4		
	Aspen			1	2	1	4	2	6
	Ash					1	4	2	6
	Willow			1	2				
	Cherry							1	3
Undifferentiated driftwood				1	2				
TOTAL		23	100	65	100	23	100	35	100

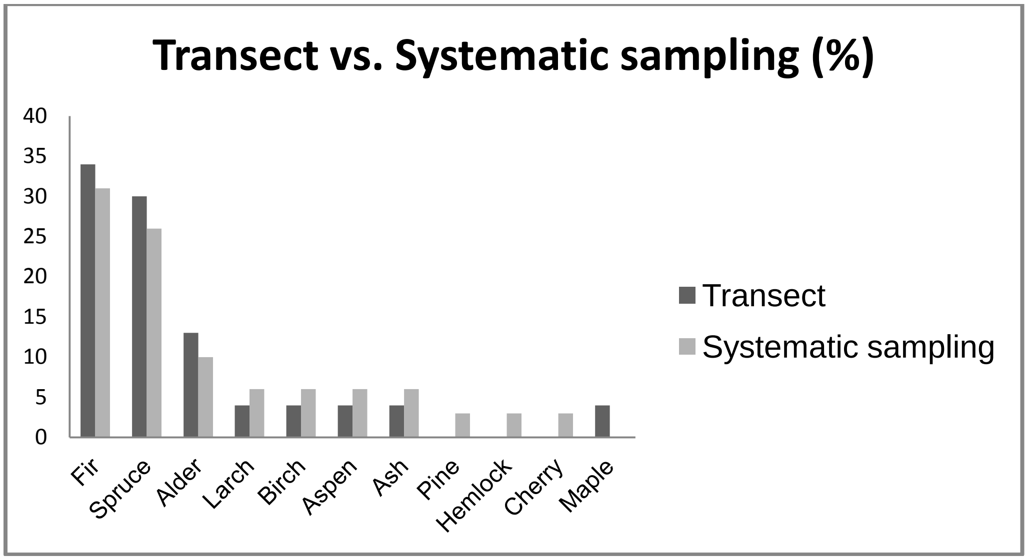

Figure 5.2: A comparison of percent driftwood by genus for belt transect samples and systematically sampled logs with roots from Point Riche beach.

Table 5.4: Frequency distribution of driftwood genera from the three sampled beaches at Port au Choix, including driftwood collected from belt transects and systematic survey. Number of genera is expressed both as individual pieces (n) and percent of total (%).

	Genus	Total (n)	Total (%)
Softwood	**Spruce**	46	32
	Fir	50	34
	Larch	12	8
	Pine	3	2
	Hemlock	1	1
	Unidentified softwood	1	1
Hardwood	**Alder**	13	9
	Birch	7	5
	Aspen	4	3
	Ash	3	2
	Maple	2	1
	Hemlock	1	1
	Cherry	1	1
	Willow	1	1
Undifferentiated driftwood		1	1
TOTAL		**146**	**100**

5.3. Spatial analysis

House feature 1

In house feature 1, 73.2 g of charcoal was collected. Two clusters of charcoal were observed. The first cluster, accounting for 88% of the total charcoal, was found on the southern platform. A second smaller concentration was located near the axial feature (7%; Figure 5.3).

A high concentration of charcoal was located around feature 4 (23%), a charcoal stained area on the east end of the southern platform. Radiocarbon dates from feature 4 suggest that charcoal was deposited post-abandonment of the dwelling as the dates were several centuries younger than the main occupation of the dwelling (Renouf 1986). Thus, charcoal found in the context of feature 4 is not related to activities within the dwelling. Because of the imprecise provenance of charcoal samples, it is unknown whether the charcoal clusters in units around feature 4 were also associated with it.

Other features associated with charcoal clusters included two large bone pits - Feature 5 (5%) and Feature 6 (10%) - near the axial feature. Feature 5 was outlined by large limestone rocks and contained a number of artefacts and faunal remains. Limestone slabs outlined feature 6, within which were a large amount of faunal remains. Charcoal was also clustered around feature 7 (30%), a third bone-filled pit on the southern platform. It was an oval depression surrounded by rocks. The pit contained bone, artefacts, flakes and worked bone (Renouf 1986).

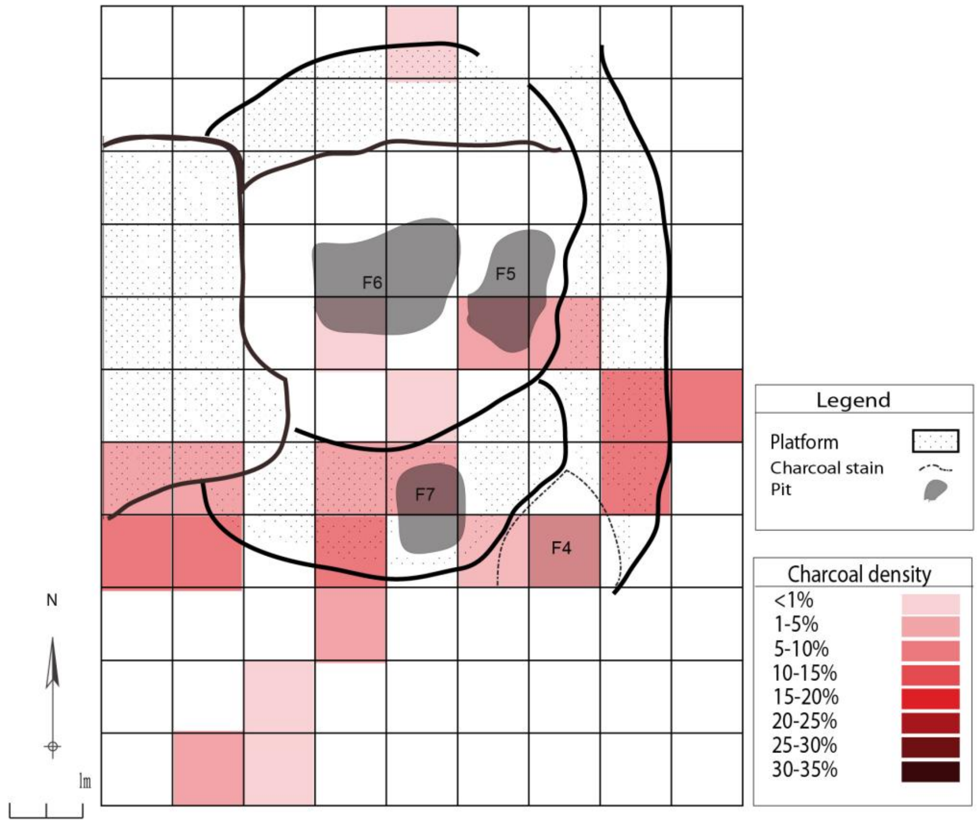

Figure 5.3: Charcoal distribution for dwelling house feature 1.

House feature 14

Total weight of charcoal collected from house feature 14 was 41.47 g. Charcoal was concentrated around the rear platform (45%) and along the eastern platform (49%) and axial feature (2%; Figure 5.4). Because one metre grid plots of charcoal distribution are imprecise, it is not possible to determine if the high charcoal concentrations were located on or off the eastern platform

A large concentration of charcoal on the eastern platform (35%) may be associated with feature 29, a small bone-filled pit surrounded by large limestone slabs, faunal remains, and some soapstone fragments (Renouf 1987). Charcoal was also clustered around feature 16 (16%), a possible stone-lined hearth on the rear platform (Renouf 1987). Renouf interpreted feature 16 as a hearth because the charcoal concentration was confined exclusively within the stone circle. There were no associated faunal material, flakes or artefacts (Renouf 1987). The adjacent unit to the south of feature 16 also contained a moderate charcoal concentration (13%).

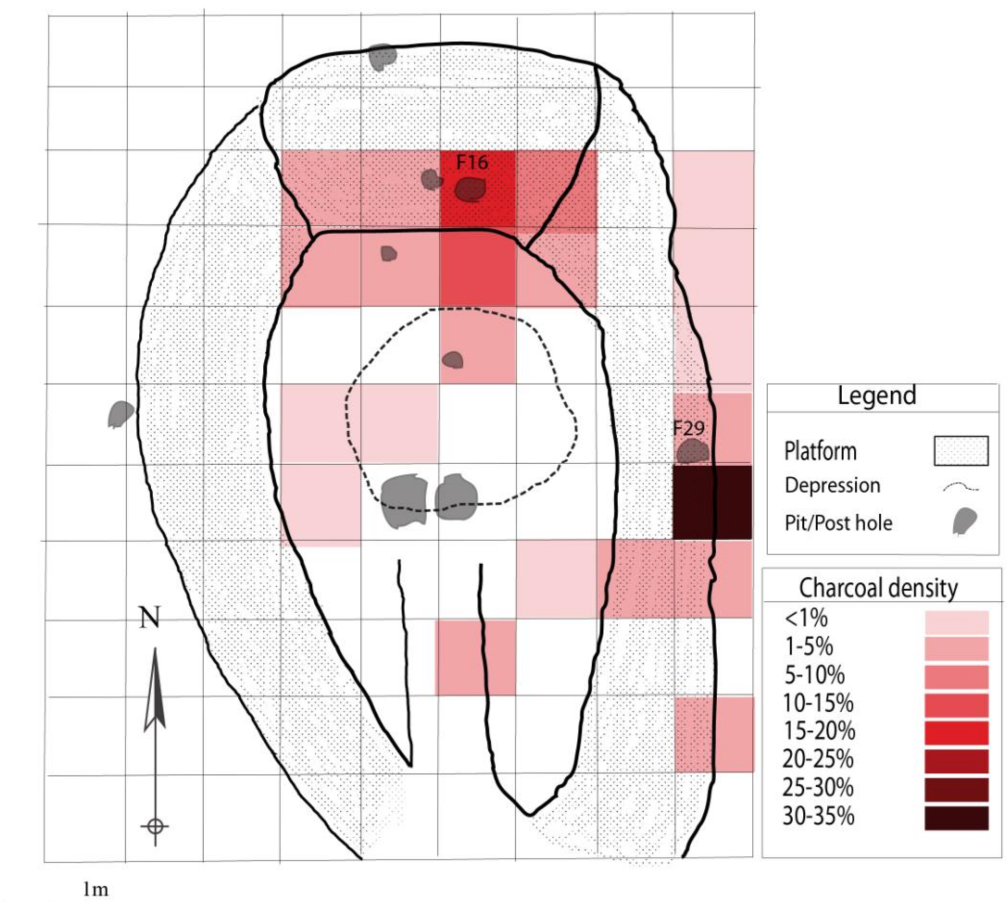

Figure 5.4: Charcoal distribution from house feature 14.

House feature 55

Charcoal from house feature 55 weighed only 3.76 g. Charcoal was concentrated along and around the axial feature (65%; Figure 5.5). The axial feature was lined with cobbles that consisted of rough limestone slabs. The northwest area of the dwelling contained charcoal in low quantities (~8% over six units). A charcoal cluster was found outside the southeast entrance (13%).

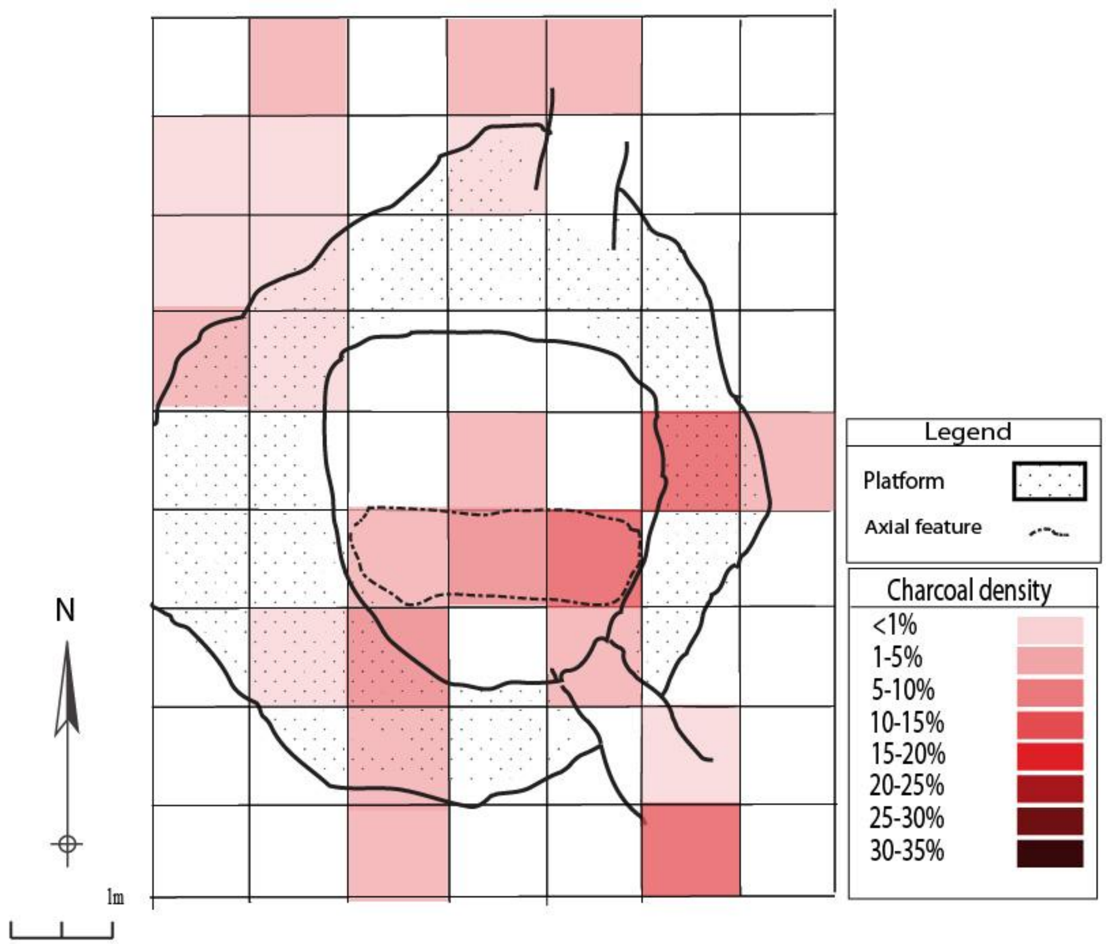

Figure 5.5: Charcoal distribution from house feature 55.

CHAPTER 6

DISCUSSION

The objective of this chapter is to summarize and discuss the findings of the thesis in the context of the specific research goals: 1) to understand wood selection at Phillip's Garden; 2) to determine whether there were temporal variations in firewood selection; 3) to determine whether tree genera differed between feature types; 4) to evaluate whether handpicked charcoal samples biased the results; and 5) to determine the spatial distribution of charcoal within dwellings.

6.1. Quality of handpicked charcoal data

Only small charcoal assemblages were recovered from cultural layers where specimens were collected by handpicking (six fragments out of eight soil samples), with only two genera identified, fir and spruce, which are the dominant genera within the handpicked samples. As the genera of charcoal recovered from the soil samples are similar to what was recovered from the handpicked samples, the handpicked samples do not represent a source of serious bias for the study.

Although only eight sediment samples from three features were processed, the results of this study provide a reason to question contemporary methods for charcoal collection in anthracology. Reliance on sediment samples for charcoal analysis may need to be revaluated when applying this technique to Arctic and Subarctic sites, where handpicking is the preferred method for charcoal collection. In the current study, it appears that handpicked samples were sufficient. However this may be due to relative lack of diversity of woody species in the region, where forests are dominated principally by fir and spruce. In areas with more genera diversity, sediment samples may be required.

Additionally, while handpicked samples may represent a bias, they permit previously collected charcoal to be re-examined. This is pertinent for Arctic and Subarctic contexts where archaeobotany and anthracology is a relative novel approach (Lepofsky et al. 2001) and most collected charcoal has been handpicked. Disregarding previously collected samples because they were handpicked would hinder progress in Arctic archaeological research, by passing over useful available sources of data.

Similar to the cultural sediment samples, the control samples yielded no charcoal. This is not surprising as forest fires are rare in the region, suggesting that there should be little naturally produced charcoal in the surrounding area (Damman 1983; Thompson et al. 2003). However, charcoal spikes registered at Bass Pond suggest that forest fires may have taken place near the pond around 2200 cal BP (Bell et al. 2009). Thus, some trace of charcoal would be expected in the natural environment. An explanation for the absence of charcoal in the control sample may be that the soil had been disturbed, displacing any natural burn layers.

6.2. Dorset wood selection at Phillip's Garden

Here I present how common each genera were in the archaeological charcoal and compare them to their prevalence in the modern vegetation and to local driftwood. This information is synthesized in Table 6.1. I summarize the results from the driftwood survey and then discuss the general trends in wood selection.

The primary objective of applying charcoal analysis to Phillip's Garden was to understand which genera were targeted and from where. Local wood identified from the archeological samples may either be terrestrial or littoral in origin while extra-local genera would suggest that driftwood was collected.

Driftwood specimens identified were mostly the softwoods fir and spruce, while the most common hardwoods were alder and birch (Table 6.1). The genus composition of driftwood is similar to the forests found in the Northern Peninsula Ecoregion (Boland 2011). Six genera identified from the collected driftwood are absent from the Northern Peninsula Ecoregion. Maple, cherry, aspen, pine, and ash reach their northern extent in southwestern Newfoundland, at the northern boundary of the Southern Newfoundland Ecoregion (Figure 2.5; Damman 1983), while hemlock is not found in Newfoundland (Hough 1950; Farjon 1990).

It is unlikely that hardwoods such as cherry, maple, and aspen were transported from the north as the northern boreal forest does not support such genera. Driftwood delivered at Port au Choix likely originated from the south, possibly from the Labrador Current which loops around the island westward and makes its way up the west coast of Newfoundland (Figure 2.11; Loder et al. 1998; CGC 2013). Extra-local genera may have originated from southern Newfoundland or possibly the Maritime Provinces via currents from the Gulf of St. Lawrence that feed into the eastern branch of the Labrador Current. A southern origin is further supported by the prevalence of fir from the collected driftwood, which is the dominant tree along the western coast of Newfoundland (Damman 1995; Thompson et al. 2003).

Pine, ash, and aspen identified amongst the archaeological charcoal suggest that driftwood at the time of Dorset occupation was delivered from southern Newfoundland or the Maritime Provinces. This coincides with the assumptions made by Paulssen (1985; Chapter 2) who identified extra-local genera from charcoal recovered from the Norse site of L'Anse au Meadows. Information on forest composition in western Newfoundland circa 1000-2000 BP comes from pollen data from Joes Pond and Robinson's Pond (McCarthy et al. 1995), both situated on the southwestern tip of the island. Generally pollen levels were similar to the modern day levels, with the exception of elevated levels of birch pollen between 2000-500 BP relative to modern day levels. Higher levels in birch pollen may have translated to more birch available as driftwood at the time of Dorset occupation.

It is possible that the extra-local genera at Phillip's Garden were traded in or transported manually from another location; however, there is no way to evaluate this. As the driftwood collected in the summer of 2013 also yielded pine, ash, and aspen it is probable that extra-local charcoal originated as driftwood.

The presence of extra-local genera in the archaeological charcoal suggests that driftwood was utilized to some extent. However, as fir is the most prevalent genus both as driftwood and in the local forest it is difficult to determine the relative proportions of archaeological charcoal originating from terrestrial and littoral sources (Table 6.1). At present the only way to observe driftwood use in the archaeological record is through the presence of extra-local genera, which represent only 6% of the modern driftwood, the remainder are genera which are also found in the terrestrial forest.

The Dorset did not select a wide variety of tree genera for firewood as the overwhelming majority of charcoal identified was fir and spruce, the most readily available trees in the local forest region (Table 6.1). Although ten genera were identified, the eight genera that were other than fir or spruce represent <2 % of the total charcoal weight. Firewood studies have examined selection strategies by analysing fuel quality of individual tree species. Generally, hardwoods burn longer producing more intense heat, while softwoods burn rapidly, generating little heat (Natural Resources Canada 2002). In the case of Port au Choix the dominant hardwood is birch. Willow and mountain ash are also common in the region but do not make up any significant stands (Boland 2011; Table 6.1). As fir and spruce are rated low on the fuel utility index (Natural Resources Canada 2002) their presence in the archaeological charcoal may be a product of their abundance in the forest and as driftwood (Table 6.1).

Hardwoods may have been disfavoured as they are scarce in the environment in comparison to softwoods (Table 6.1). Such a selection pattern reflects Shackelton and Prins (1992) principle of *least effort*, which suggests that fuel species are collected following their abundance in the environment. A lack of selection may simply reflect an environment with limited available genera (Heizer 1963), which seems to be the case for Port au Choix where forests consist primarily of fir, spruce, birch and tamarack. Hardwoods, however, represent 23% of the stranded driftwood. Additionally as mentioned above, pollen data from western Newfoundland (McCarthy et al. 1995) suggests that birch-driftwood may have been more present at the time of Dorset occupation. Since hardwoods, particularly birch, degrade more rapidly in damp environments compared to softwoods (Hagglbom1982), rotted wood would have been a poor fuel source and therefore may have been avoided in driftwood (Théry-Parisot 2001). Prevalence of ash and aspen suggests that some stranded hardwoods were selected; however, they comprise <1% of the archaeological charcoal (Table 6.1).

Table 6.1: The first column lists the genera identified from the archaeological charcoal and collected driftwood, followed by the percent of the total weight that each genus made up in archaeological charcoal, the percent of merchantable forest cover for the most common genera on the Northern Peninsula (DFA 1990), percent that each genus made up from the collected driftwood, and whether the genus was identified from the pollen samples taken at Bass Pond. "X" indicates that pollen is present for that genus (Bell et al. 2005). "-" indicates that the genus is absent, while "N/A" indicates that the genus is found in the region but the data are unavailable.

Genus	Archaeological charcoal (%)	Modern forest (%)	Local driftwood (%)	Dorset forest
Fir	69	65	34	X
Spruce	14	27	32	X
Pine	<1	-	2	-
Tamarack	<1	N/A	8	X
Alder	<1	N/A	9	X
Birch	1	7	5	X
Aspen-Poplar	<1	-	2	-
Ash	<1	-	2	X
Willow	<1	N/A	1	X
Juniper	<1	N/A	-	X
Maple	-	-	1	-
Hemlock	-	-	1	-
Cherry	-	-	1	-

6.3. Temporal variation

Here I discuss differences in charcoal composition throughout the occupation of Phillip's Garden by comparing the results of the charcoal analysis between dwellings of different phases. Collections from within dwellings were all dominated by fir and spruce; nevertheless all collections included much undifferentiated softwood and unidentifiable charcoal.

There appears to be a greater diversity in wood genera selected during the earlier occupation of the site (Figure 6.1). House feature 1 from the early phase had five identified genera (Figure 6.1). Of those, ash and alder were possibly only available as driftwood, as they are not currently found in the region. Conversely, they are present in pollen records from Bass pond at time of Dorset occupation which could indicate that they were part of the local forest (Bell et al. 2005; Figure 2.10). However, as pollen is dispersed with the wind, the exact location of ash and alder in relation to Bass Pond is unknown. When the Dorset arrived at Phillip's Garden a greater variety of littoral wood may have been available in the environment. Major forest fires that may have occurred during the earlier period, demonstrated by charcoal spikes in the data from Bass Pond, may have led to lower diversity in local tree species (Figure 2.10). A lack of terrestrial wood may have caused an increased reliance on driftwood, accounting for a greater diversity in genera in the early houses, notably house feature 1. In contrast, house feature 14, also from the early phase, had only two genera present (Figure 6.1). It is unknown how the Groswater people, who previously occupied the region, impacted driftwood caches.

The number of identified genera per dwelling decreases slightly in middle phase features, which may represent a decrease of available wood in the environment. In the middle phase, genera targeted were fir or spruce. An increase in population and increased use of the site in the middle phase may have limited the number of available genera and hence increased demands on fuel resources over the long term, resulting in only the most available woods being used. Driftwood stocks may not have been able to supply sufficient wood for such a large population. Such a trend continues into the late phase, where only three genera were targeted - fir, spruce and juniper - all of which were locally available.

Although the diversity of genera in the archaeological charcoal decreased in the middle phase, there was a corresponding increase in spruce (Table 5.1). Pollen records indicate that when the Dorset arrived at Phillip's Garden there was a decrease in spruce pollen, which may have been caused by the previous Groswater phase occupation of the region (Renouf et al. 2009). As a consequence, spruce represents 5% of the charcoal assemblage for the early phase house features 1 and 14, but is more prevalent in middle (House 18=30%, house 17=2% and feature 386=13%) and late (house feature 55=14%) phase features (Table 5.1). The elevated numbers of spruce in the middle and late phases may correspond to a climate warming phase between 1600 and 1100 cal BP, which may have favoured the growth of spruce trees in the local forest (Bell et al. 2005). Pollen records from Bass Pond indicate an increase in spruce pollen around 1600 cal BP, which corresponds with the beginning of the middle phase occupation of the site around 1550 cal BP.

House 17, a middle phase dwelling, appears to be an anomaly, as spruce makes up only 2% of its charcoal assemblage. The lack of spruce in house 17 may be accounted for by the large amount of unidentifiable charcoal fragments, accounting for nearly half of the charcoal weight and unidentified softwood, which makes up a further one-third of the charcoal sample. In contrast, unidentified genera represent between 0 and 13% of total charcoal weight in all other dwellings (Table 5.1).

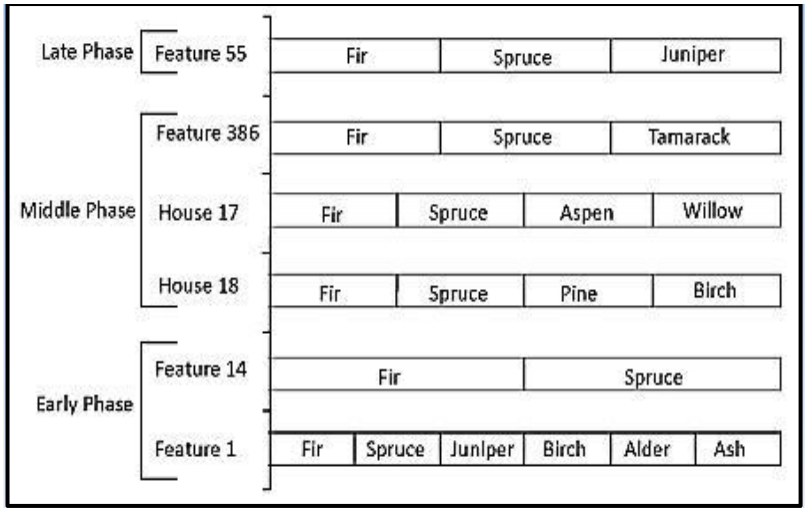

Figure 6.1: The genera present in each feature. Note that this figure does not present the proportion or percentage of each genus, simply whether a genus was identified in the feature.

6.4. Charcoal variation between feature types

Middle phase feature 386, a midden, was sampled to determine if feature type affected charcoal genera present. Charcoal within feature 386 most likely originated from House 10, which it was found next to, but could have been from other dwellings or possibly outdoor fires. It was hypothesized that more genera would be present in a midden as they are "long-term deposits" representing the refuse from multiple fires (Asouti 2009). Wood burned in dwellings may have been dumped in the midden, resulting in greater genera diversity, while dwellings may have been cleaned regularly during use resulting in fewer genera preserved in the charcoal record (Binford 1983; Asouti 2009). Counter to this argument, only three genera were identified from feature 386, fir, spruce, and tamarack. In comparison, middle phase dwellings house 17 and house 18 showed greater diversity. House 17 contained fir, spruce, aspen, and willow, while house 18 had fir spruce, pine and birch (Figure 6.1). Although assemblages from middle phase dwellings have more diversity, the different genera do not represent large proportions of the total charcoal weight. Genera other than fir or spruce genera represent less than 1% and 4% of the charcoal assemblages in house 17 and house 18, respectively.

6.5. Charcoal distribution in Dorset houses

Despite the lack of hearth features within dwellings, the charcoal distribution maps indicate that wood was burnt inside of dwellings because: 1) charcoal is found in higher densities within dwellings compared to outside areas; 2) charcoal is associated with other cultural materials, such as faunal remains and artefacts, which suggests that dwellings were occupied when charcoal was deposited; and 3) charcoal is clustered around features such as axial features, pits and platforms. If charcoal was deposited by post-depositional factors a random distribution would be expected.

It was hypothesized that charcoal would be clustered around the axial feature in the centre of the dwellings, as this feature was interpreted to be the main cooking area (Renouf 2011b). This pattern was observed in house feature 55, a small, late-phase dwelling (Figure 5.5). The axial feature of house feature 55 is lined with fat stained cobbles and charcoal tends to be concentrated around it as well (Figure 5.5; Renouf 1993). However, charcoal weighed for house feature 55 was very low, thus caution must be taken when interpreting these data.

In contrast, charcoal from early phase house features 1 and 14 was concentrated on raised platforms that border the central depression, and was only found in low concentrations around the axial feature (Figure 5.3; 5.4). It is unknown why charcoal was concentrated on the platforms in house features 1 and 14. Charcoal distribution on the platforms is not uniform, but concentrated on the north and east platforms of house feature 14 and on the south and east platforms of house feature 1, which may suggest designated burning or charcoal deposit areas. Only house feature 14 has evidence of a possible hearth like structure (Feature 16; figure 5.4). As the platforms are elevated it is unlikely that charcoal was deposited through natural processes. Thus, charcoal was likely deposited by an anthropogenic source. It is unknown whether wood was burnt on the platform or the charcoal was placed on the platform post-burning. Bone filled pits in house features 1 (Feature 7; figure 5.3; Renouf 1986) and 14 (Feature 29; figure 5.4; Renouf 1987) may indicate dumping areas.

Although distribution maps provide insight into the location of charcoal concentrations, it is difficult to distinguish areas where charcoal was deposited from areas where wood may have been burnt. As Dorset fuel use is associated with soapstone vessels, the location of soapstone vessel fragments may indicate where burning activities took place as it is possible that wood burning occurred in similar areas as burning sea mammal fat. Additionally, it is possible that wood was burnt in soapstone vessels to contain the fire, which may account for a lack of hearth features within dwellings. The presence of soapstone and charcoal in similar units may indicate activity zones associated with wood burning. Locations of soapstone fragments were plotted on the charcoal distribution maps (Figures 6.2-6.4).

Of the soapstone fragments found in house feature 1 none were in squares containing charcoal, though some appear in units adjacent to charcoal concentrations (Figure 6.2). In house feature 14, the majority of soapstone fragments were found in squares containing some charcoal (Figure 6.3). Soapstone fragments found on the eastern platform were in areas with high charcoal concentrations, while few fragments were found in the centre of the house and most of these were not associated with any charcoal. In house feature 55, around two-thirds of soapstone vessel fragments were found in units containing charcoal (Figure 6.4). A little less than a third of fragments were found within the central depression of the house, while another third were located along the raised platforms and the remainder were found outside of the dwelling. Soapstone fragments found along the axial feature were in an area with high charcoal concentration. However, the soapstone vessels outside the dwelling were also situated in units containing charcoal.

The distribution maps for house features 14 and 55 suggest a possible relation between soapstone and charcoal; however, their relation does not appear to indicate where burning took place as soapstone fragments are not concentrated in a specific area but rather are distributed throughout the dwelling. Moreover, soapstone and charcoal are not found in association with each other in house feature 1, weakening any evidence for a relation between soapstone and charcoal.

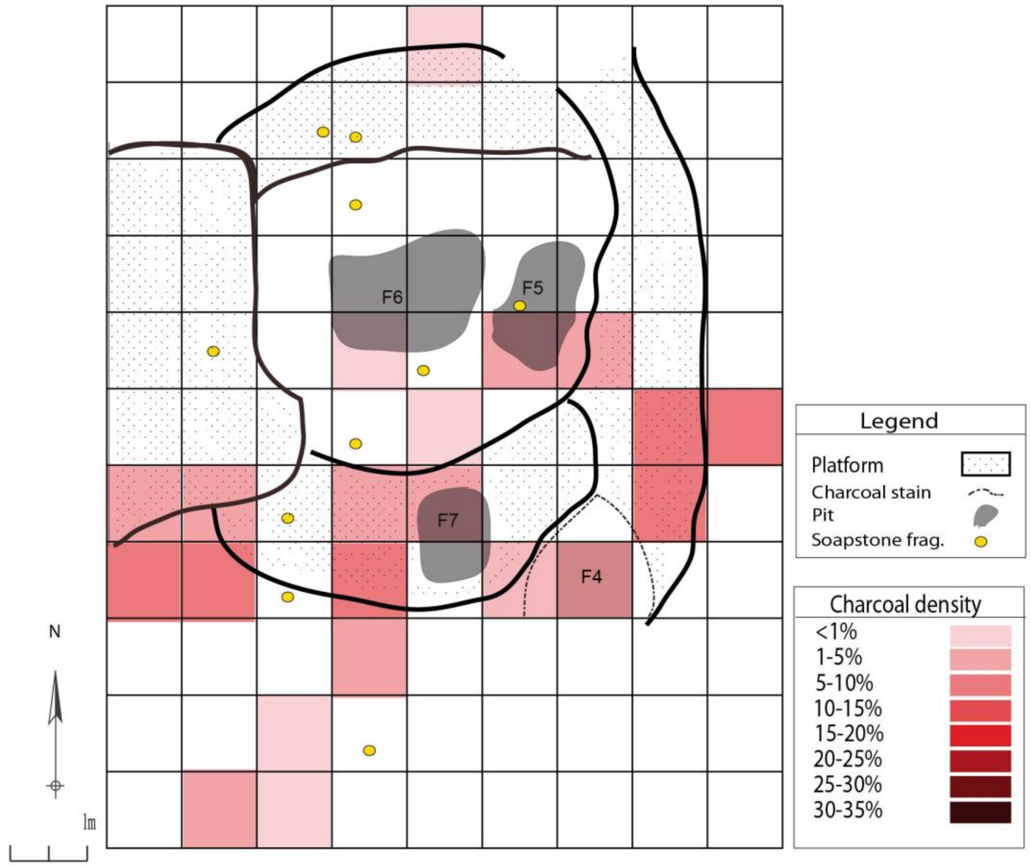

Figure 6.2: Distribution of soapstone lamp fragments (yellow points) in relation to charcoal distribution in house feature 1.

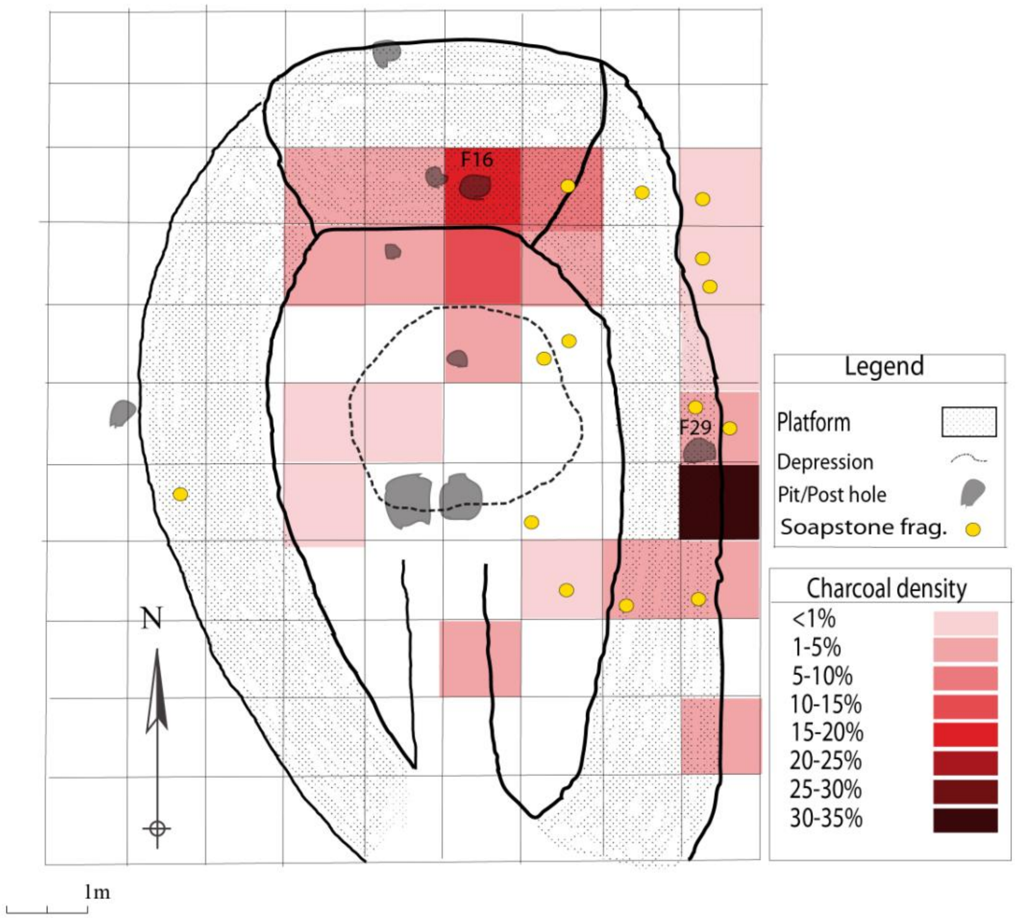

Figure 6.3: Distribution of soapstone lamp fragments (yellow points) in relation to charcoal distribution in house feature 14.

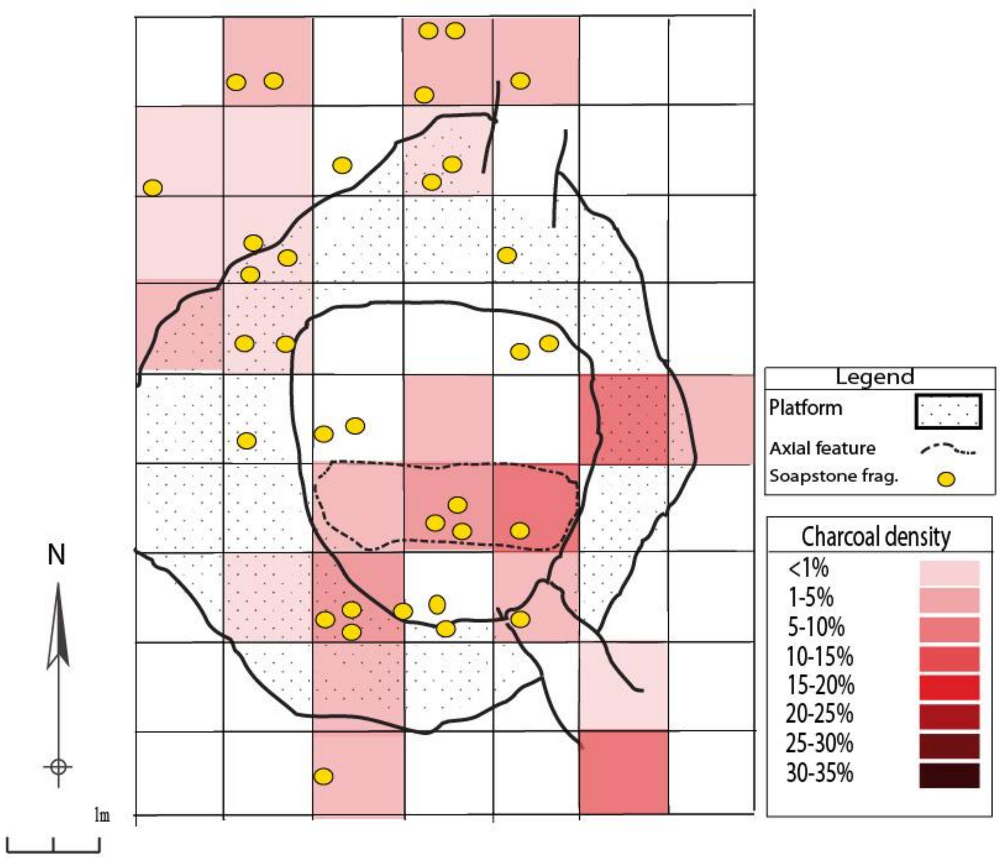

Figure 6.4: Distribution of soapstone lamp fragments (yellow points) in relation to charcoal distribution in house feature 55.

6.6. Implications for fire wood use at Phillip's Garden

Despite having access to harp seal and using soapstone vessels, the Dorset used and selected wood at Phillip's Garden, indicating that the Dorset were not rigid in their fuel use, but adjusted readily to available resources. Despite lacking hearth features, wood was burnt in the dwelling, suggesting that the presence or absence of material culture may not indicate the preferred fuel type. It is unknown how the Dorset regarded the terrestrial forest at Phillip's Garden, but like the Thule who entered Labrador (Kaplan 2012) the Dorset encountered an increase in wood resources of which they took advantage. Although this thesis discusses Dorset wood selection and use, it does not provide an explanation for why wood was adopted and why seal fat was continued to be used as fuel alongside wood. Drawing on the data presented in this thesis as well as archaeological and ethnographic examples, I present five interpretations to account for the use of both seal fat and wood, which should be an interesting topic for future investigation.

1) Wood was favoured, but not sufficient in the environment to be the sole fuel

The use of both seal fat and wood may be explained by a scarcity of wood in the environment. Insufficient wood resources may have necessitated the use of seal fat. Heizer (1963) suggested that wood was the preferred fuel for prehistoric groups. He argued that substitutes such as coal, dung, fat, and bone were only used when wood was unavailable. Similarly, use of sea mammal fat by Arctic cultures in the Central and Eastern Arctic was interpreted as being a product of driftwood shortage (Mobjerg 1999).

Continuous human occupation may have impacted wood availability at Phillip's Garden. Pollen spikes suggest that the Groswater may have impacted the surrounding vegetation prior to the Dorset arrival (Renouf et al. 2009), which may have resulted in reduced availability of terrestrial wood. Additionally, Dorset occupied the area for 700 years, which may have reduced available wood resources in the surrounding forest. Driftwood may also have been depleted by Groswater or early Dorset occupations, which seems to be subtly suggested by charcoal taxonomic diversity data. Dorset may have continued to burn seal fat as wood was insufficient to be the principal fuel. An analysis of firewood use from other Dorset sites in Newfoundland is needed to verify that fuel use at Phillip's Garden was a consequence of the environment.

2) Task-based division of fuels

Charcoal and fat may have been used for different purposes. Fitzhugh (1996) noted a task-based division of fuel types in the western Arctic, in which animal fat was burnt for light, while wood was used for heating and cooking. Such a division may be seen in the distribution map of house feature 14. House feature 14 was the only dwelling with a possible hearth feature (Feature 16). There appears to be two discrete charcoal concentrations, an area on the north platform clustered around the possible hearth feature 16 and a concentration on the east platform associated with soapstone vessel fragments (Figure 6.3). No soapstone vessel fragments seem to be associated with feature 16, possibly indicating a task-based division of fuels. However, soapstone vessel fragments on the eastern platform are still associated with charcoal concentrations. Such patterning is not observed in the other two dwellings.

3) Wood was burnt with sea mammal fat

It is not uncommon for two fuel types to be burnt together. Théry-Parisot (2002) found that burning wood with bone produced fires that lasted longer. Likewise, Odgaard (2003) noted that seal fat and wood burn well with one another. As fir and spruce are considered poor firewood (DFA 1990), combining them with fat may produce more effective fires. McGhee (1996) suggested that in northern Greenland the Independence I culture (4,400-

3000 BP) burnt a combination of muskox bone and driftwood; in this case it seems that this was adopted due to fuel scarcity rather than to improve fuel burning. Thus, wood and seal fat may have been burnt together within soapstone vessels at Phillip's Garden. Since vessels would have been used regardless due to the availability of harp seal oil, it may have been more convenient to burn wood in the vessels rather than construct a hearth. Additionally, charcoal is often found in association with fat at the site (PACAP 2014); however it also possible that they were simply deposited in the same area rather than burnt together.

4) Fuels were used seasonally

Seal and wood availability would have fluctuated seasonally. Abundance of sea mammal fat would have depended on the return of the spring and winter seal herds. It is possible that wood replaced seal fat between hunts when stored seal fat began to dwindle. However, such an interpretation cannot be reliably tested in the archaeological record to date.

5) Cultural preferences

Cultural preferences may have favoured the continued use of seal fat. Erwin (2001) suggested that the Dorset retained the use of soapstone vessels as a form of cultural expression. Stefansson (1914) recorded that the Copper Inuit had taboos against burning wood inside of winter dwellings. Some Inuit burnt heather as fuel while other groups cite it as a degrading fuel choice (Stefansson 1914). As Erwin suggested, soapstone and seal fat may have continued to be used in a forested environment due to cultural preferences. Analysis of fuel use from other sites in Newfoundland is required.

It is unknown which, if any, of these interpretations is correct. It is also possible that a combination of these interpretations explains the presence of both fuel types at Phillip's Garden. Additionally, the reasons may have varied through time and between households.

6.7. Summary

To summarize, the Dorset harvested primarily fir and to a lesser extent spruce, two softwood genera found both as driftwood and as terrestrial wood. Due to the similarities between the forest composition and driftwood accumulation, preference for terrestrial or littoral wood could not be inferred. However, the prevalence of genera foreign to the ecoregion indicates that driftwood was used to an extent. Wood seems to have been selected based on availability and not fuel quality, suggesting a generalized harvesting pattern. Selection seems to have varied slightly through time, either due to availability or cultural preferences. Handpicked samples do not appear to have introduced any source of bias. Dorset burned wood within dwellings despite lacking hearth features; however, the distribution maps failed to clarify how wood was being burnt. The relation between wood use and soapstone vessels remains unclear.

6.8. Conclusions

When the Dorset entered the forested areas of Port au Choix they adopted firewood, but retained the use of soapstone vessels and continued to burn sea mammal fat. Their use of wood may be in response to its abundance in the environment. They used wood genera that were most abundant for firewood rather than selecting those of the highest quality. Wood selected was either derived from the surrounding forest or collected along the coast as driftwood. It is unclear why the Dorset burned wood and why it did not replace seal fat as a fuel. To answer these questions, additional Dorset sites in wooded areas must be examined.

This project forces a reconsideration of Dorset fuel use and selection and adds to a growing body of literature on plant use by Arctic peoples. Further wood and firewood studies applied to the Arctic will provide deeper insight into how Arctic groups harvested and used wood resources and how different fuel types were managed.

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Appendix A: Memorial University's reference collection of charred wood

Table A.1: Genus and species (if known) of tree samples in MUN's comparative collection of charred wood.

Genera	Species (if known)
Fir	Amabilis fir Balsam fir
Maple	Red maple Sugar maple
Alder	Red alder
Birch	Yellow birch White birch
Cedar	Yellow cedar
Beech	Beech
Ash	Black ash
Juniper	Red juniper
Larch	Western larch Tamarack
Spruce	Sitka spruce White spruce
Pine	Jack pine White pine Red Pine
Poplar/Aspen	Trembling aspen
Cherry	Black cherry
Douglas fir	Douglas fir
Oak	White oak Red oak
Willow	Willow
Cedar	Western red cedar
Hemlock	Western hemlock
Elm	Elm

Appendix B: Photographs of charcoal genera

All photographs from the Memorial University comparative collection of charred wood
(Photos by: J. Miszaniec)

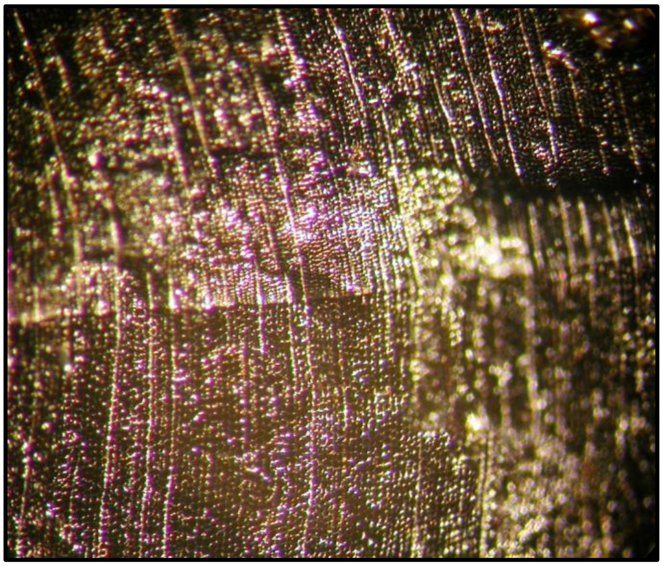

Figure B.1: Charred fir (120X), characterized by its abrupt growth ring transition, uniseriate rays and lack of resin canals.

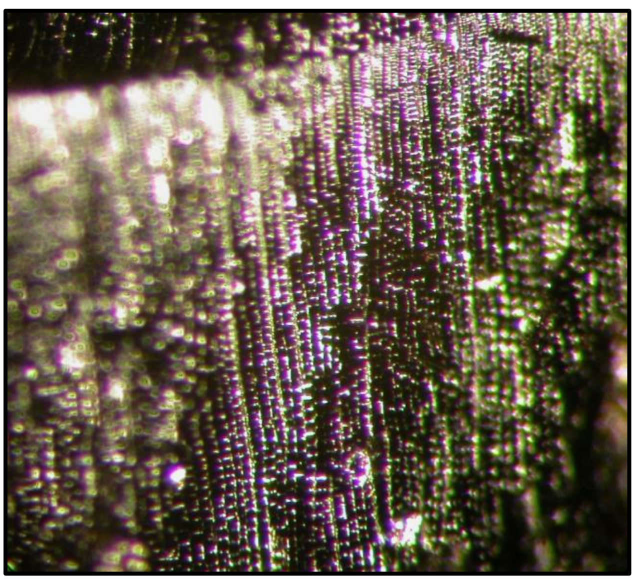

Figure B.2: Charred spruce (100X) characterized by its gradual growth ring transition, uniserate rays and small walled resin canals.

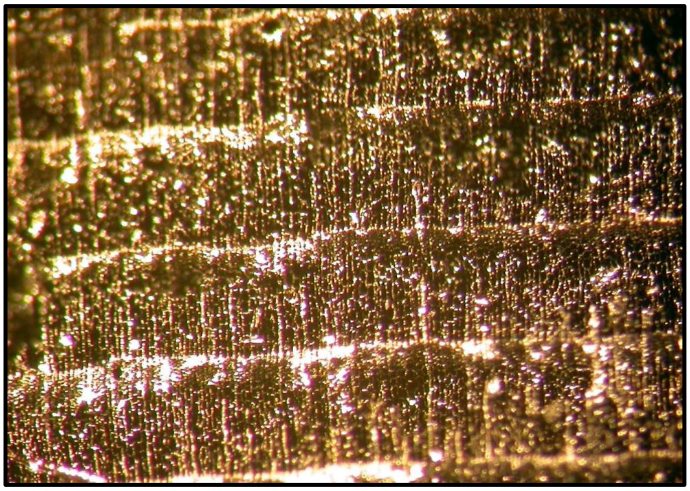
Figure B.3: Charred tamarack (120X) characterized by its abrupt growth ring transition, uniseriate rays and lack of resin canals.

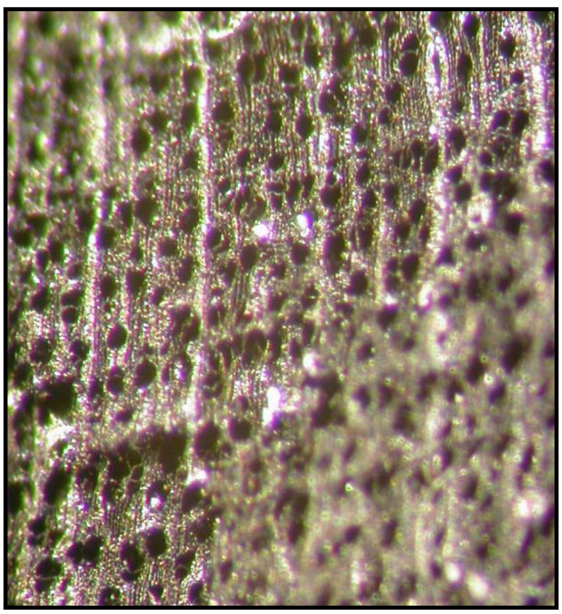
Figure B.4: Charred birch (100X) characterized by its diffuse pores that form in clusters between 1-4 pores. Rays are bi-tri series.

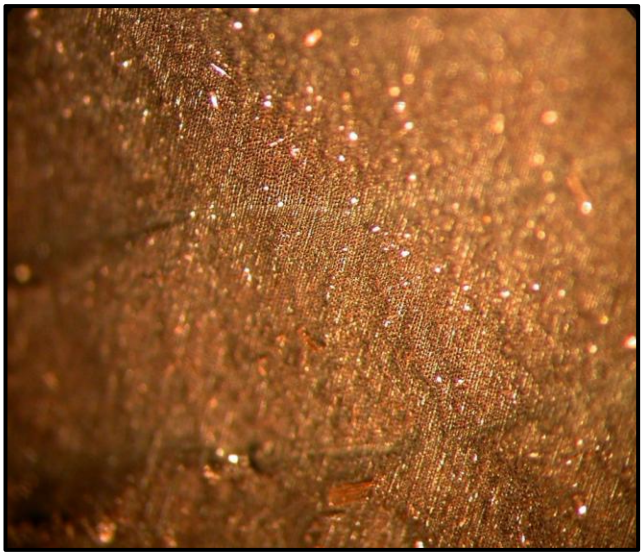
Figure B.5: Charred juniper (100X) showing distinct growth ring boundaries, with a gradual transition from earlywood to latewood.

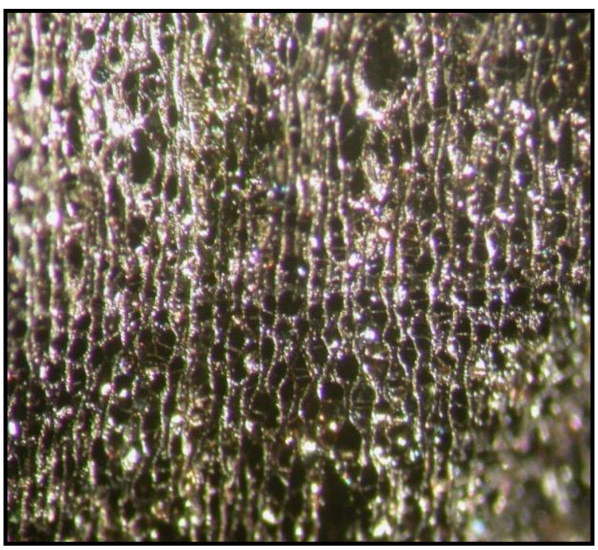
Figure B.6: Charred willow (100X) characterized as diffuse porous, with solitary pores. Rays are uniseriated and clustered close together.

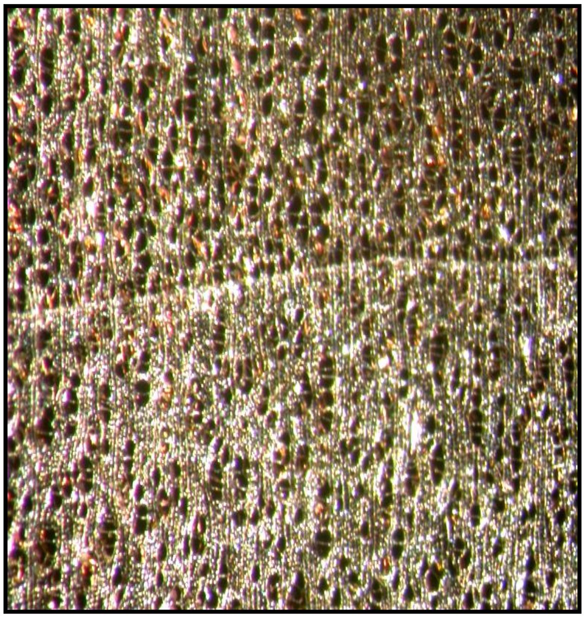

Figure B.7: Charred alder (100X) characterized as semi-ring porous, with pores densely packed in early wood. Rays are bi-tri-seriated.

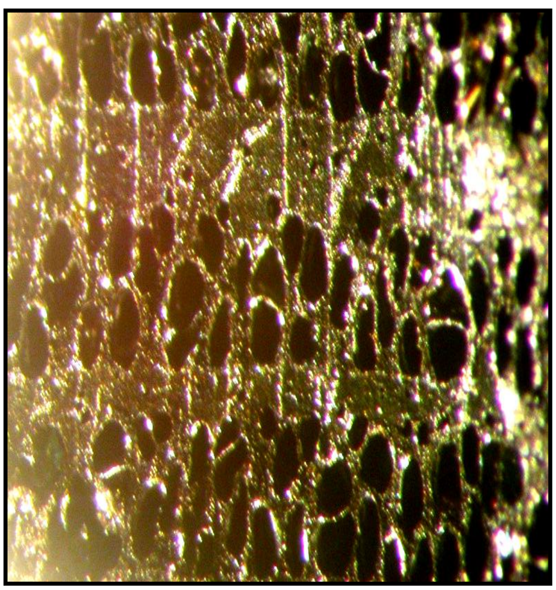

Figure B.8: Charred black ash (100X), characterized as ring porous wood. Rays are biseriate or tri-seriate.

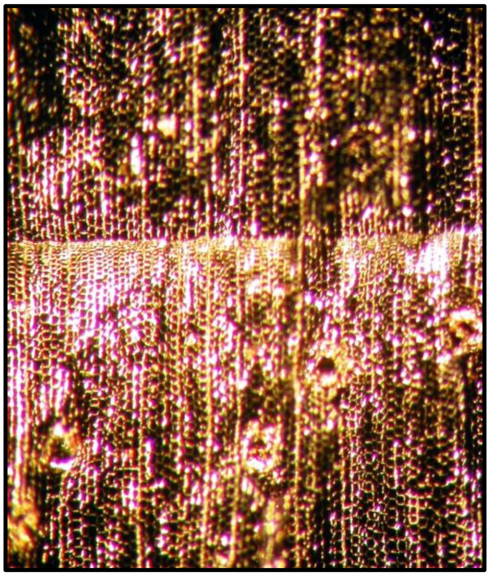

Figure B.9: Charred pine (100X) is distinguished by its lack of transition between late and early wood and numerous resin canals.

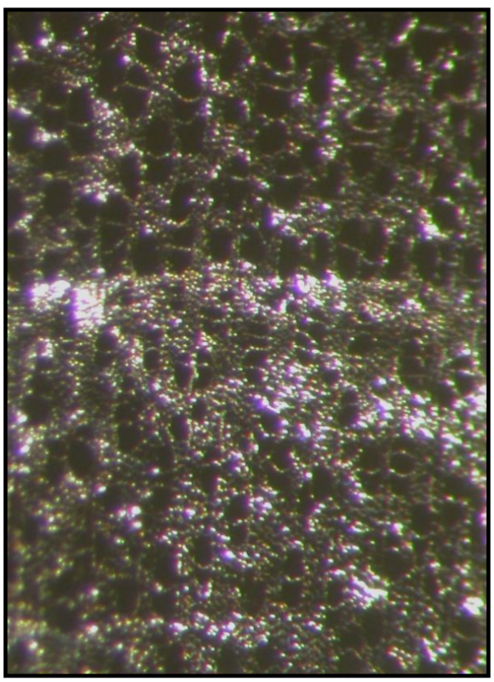

Figure B.10: Charred aspen (120 X) with diffuse to semi-ring porous. Pores commonly align at transitional lines between late and early wood. Pores are in radial groups of 2-3. Rays are uniseriate and are closely grouped to one another.

Appendix C: Charcoal identification form

Site	Sub-operation	Sample	Excavation	Details	Unit	Feature	Level	Genus	Common	Timb./RW	Rings	Comments
7A	284B	189	2009	Found near bone cluster	N45E05	178	2	*Abies*	Fir	Timb	6	Damaged and very ashy

The Charcoal identification form was used when identifying sampled charcoal. The form provides spatial information on the sample as well as descriptive data such as genus, for which both Latin (Genus) and common names (Common) are provided. Other information on the form includes curvature of the growth rings (timber (Timb.) refers to growth rings which are straight while round wood (RW) refers to growth rings that are curved) and number of visible growth rings (Rings). Additional observations are written under “Comments”.

Appendix D: Sediment sample form (Bain 1995)

FICHE DE PRÉLÈVEMENT

Site:	Opération:	Contexte:	Échantillon:
Poids: (gr)	Volume: (l)	Volume après traitement:	Volume de la fraction lourde:
Date:	Traité par:	Trié par:	Nb pétri:

Commentaires avant le traitement: (sol, inclusions, humidité)

Observations pendant le traitement:

Flore	Métal
	Verre
Faune	Mortier
	Charbon
Bois	Pierre
Céramique	Brique
	Autre

Commentaires (état de la conservation)	Diptères Mites Vers

* RENSEIGNEMENTS SUPPLÉMENTAIRES AU VERSO

Appendix E: Charcoal record form

Site	7A
Unit	N45E05
Sub-operation	284B
Feature	178
Level	2
Sample #	189
Common Names	**Weight (g)**
Fir	0.56
Alder	0.04
Birch	0.1
Spruce	0.32
Ash	0.01
Fir-Juniper	0.04
Softwood undetermined	0.1
Charcoal undetermined	0.08
Bark	0.04
Total weight (g)	1.69

Appendix F: Beach recording form

Beach #:_____
Date: ________
Beach type: sandy gravel
Coordinates: Start:______________________ Finish:_________________________
Accessibility:____
____
____
____
____
____
____
Driftwood accumulation: Low Medium High None
Number of drift lines:_____________
Description of drift lines:
Drift line 1:____
____
____
____
Drift line 2:____
____
____
____
Drift line 3:____
____
____
____
Drift line 4:____
____
____
____

Number of Photographs: ____
Comments:____
____
____
____

Appendix G: Driftwood sampling form (adapted from Alix 2005)

Date:
Sampling: Systematic __ Transect __

Transect Coordinates:

Number excluded due to human involvement:

Total collected:

Total Photographs:

Sample number:

Part of the tree: __ trunk __branch __ root __ system

Presence of: bark root system

Circumference:

Length:

Drift line #:

Photographs #:

Appendix H: Charcoal analysis results

Table H.1: Provenience of the selected sediment samples, notes on texture, amount, if charcoal was present, how many charcoal fragments were found and the identified genera.

Feature	Sub-operation	Provenience	Level	Texture	Volume (L)	Charcoal	Fir	Spruce	Weight (g)
Depression 1	192B	N84E24	2	Black loose soil with lots of organic few rocks.	3	Yes	4		0.5
	192B	N84E24	2	Black loose soils with lots of organic few rocks.	1.5	Yes	1		0.23
Depression 100	N/A*	N65E65	2	Clay like soils, lots of organic with few rocks.	3	No			
	N/A*	N65E65	2	Clay like soil, high in organics.	3	Yes		1	0.01
Feature 368	232A	N1E34	3	Black loose soil.	2.5	No			
	232A	N1E34	2	Black loose soil with few rocks	3.5	No			
	232A	N1E34	3	Black loose soil. Lots of organic material. Presence of micro flakes.		No			
	232A	N1E34	2	Black loose soil, organic material present with few rocks.	3	No			
Control sample	N/A	N/A	N/A	Black loose soil	1	No			

***Depression 100 is located within the tuckamore and as a consequence falls outside Parks Canada's operation grid.

Table H.2: Charcoal analysed from house feature 1. Each row represents an individual sample bag and includes the provenience of the sample (sub-operation, unit, associated feature and level). The northing and easting of the unit is provided. "Feature" refers to specific areas that charcoal may have been associated with, such as a midden, bone filled pit, a charcoal stain etc.. The number of fragments per sample bag are grouped by identification either by genera or unidentified class. Total number of fragments per bag and per identified genera is provided. This table format is used for all sampled features.

Sub-operation	Sample	Unit	Level	Fir	Alder	Birch	Spruce	Ash	Fir- Juniper	Softwood unid.	Charcoal unid.	Bark	Total
284A	133	E84N7	3	3									3
284D	254	E20N60	3						3				3
284D	155	E80N0	2	20					1	1			22
284D	248	E42N31	2	1									1
284D	332	E84N01	2	8			1	1			2		12
284C	77	E86N03	2	6			2						8
284C	49	E90N03	2	11									11
283A	77	E86N03	2	1									1
283A	47	E82S03	2	6									6
283A	376	E84S01	2	1									1
283A	453	E83S01	2	1									1
283A	16	E82S02	2			1							1
283A	127	E81S03	2	5	1								6
283A	443	E82S01	2	4									4
284D	255	E13N93	2	1			2						3
284D	247	E81N01	2	4			1						5
284D	186	E81N31	2	4	1								5
284D	184	E46N25	2	2									2
284D	297	E40N50	2	2									2
284D	244	E20N425	2	1									1
284D	89	E83N0	2	10									10
284C	30	E42N55	2				2					1	3
TOTAL				**91**	**2**	**1**	**8**	**1**	**4**	**1**	**2**	**1**	**111**

Table H.3: Charcoal analysed from house feature 14.

Sub-operation	Sample	Unit	Feature	Level	Fir	Spruce	Softwood unid	Charcoal unid.	Total
294A	138	E90N06		3-4	5			1	6
294A	100	E92N06		2	2			2	4
294A	72	E92N07		2	1				1
294A	163	E92N06		3-4	13				13
294B	190	E99N005		2	1				1
294B	51	E95EN05		2	5				5
294B	64	E95 N07		3	1	1			2
294B	35	E95N06		2	3				3
294B	65	E95E95	31	3	27				27
294C	90	E97N065		3	4				4
294C	94	E98N02	26	3	1	1		3	5
294C	145	E95N01		?	10	2	2	1	15
294D	136	E89N06	3	3-4	1				1
TOTAL					**74**	**4**	**2**	**7**	**87**

Table H.4: Charcoal analysed from house 17.

Sub-operation	Sample	Unit	Feature	Level	Fir	Spruce	Aspen	Aspen-Willow	Softwood unid.	Charcoal unid.	Total
270C	704	N40E75		2	10						10
270C	339	N38E75		2	12	3			1	4	20
270C	653	N40E76		2	2					1	3
280A	118	N31E83	164	2	4	1					5
270B	609	N33E75		2		1					1
289D	41	N36E82		4	1						1
280D	73	N36E81	159	4	4						4
280D	76	N36E81	154	2	2						2
280D	79	N36E81		4	5						5
271C	96	N24E75		2	3						3
271C	98	N29E75		2						3	3
279A	19	N43E82		2	1						1
279A	181	N82N43	167	2	9					2	11
269B	611	N41E76		2	4						4
269B	752	N41E75		2	26		2	1	1		30
269B	603	N43E75		2	15	1					16
TOTAL					**98**	**6**	**2**	**1**	**2**	**10**	**119**

Table H.5: Charcoal analysed from house 18.

Sub-operation	Sample	Unit	Feature	Level	Fir	Spruce	Birch	Fir-Spruce	Pine	Softwood unid.	Charcoal unid.	Total
249B	463	N35 E57	125	2	1	6			1			8
249B	560	N35E57	127	2	4						1	5
249B	645	N35E57		2	4					1		5
249C	345	N38E58		2	4							4
249C	801	N38E57		2	4							4
259D	905	N38E62		2	27	1						28
249C	566	N37E57		2	10			2				12
259D	905	N38E62		2	25	1						26
259D	1053	N38E62		3	7	1						8
259D	1051	N38E62		?	1							1
259B	288	?		2	1	1	7					9
259B	264	N34E66		3	7	5						12
259B	229	N34E68		2	3							3
259A	778	N31E61		2	1	1						2
259A	408	?	129	2	1	1						2
259A	401	?	108	2	1							1
TOTAL					**101**	**17**	**7**	**2**	**1**	**1**	**1**	**130**

Table H.6: Charcoal analysed from feature 386 showing provenience of sample bags and genera identified in each bag.

Sub-operation	Sample	Unit	Feature	Level	Fir	Spruce	Tamarack	Total
328B	56	N-31E134	386	2	91	9	1	101

Table H.7: Charcoal analysed from house feature 55.

Sub-operation	Sample	Unit	Feature	Level	Fir	Spruce	Juniper	Softwood unid.	Charcoal unid.	Total
368C	318	N11E018		2	6					6
368C	285	N12E018		2	3					3
368C	459	N10E012		2	3					3
368C	498	E187N011		2	1					1
368C	586	E187N010		2					1	1
368C	80	E185N010		2					1	1
368C	499	E187N011		2	2					2
368C	325	E185N014		2	1					1
368C	177	E185N013		2						1
368C	254	E189N013		2	2					2
368C	1030	E185N013		2	1					1
368B	357	E188N017		2	2					2
368B	276	E188N017		2	1					1
368B	216	E189N016		2	1					1
368B	147	E186N015		2	1					1
371A	31	E190N009		2	1					1
371A	65	E190N008		2		3				3
372D	180	E191N012		2	1					1
372D	222	E190N012		2	3					3
372D	179	E191N012		2	1					1
372D	91	E190N011		2	1					1
372D	54	E190N010		2	2					2
367D	161	E187N08		2	2					2
367B	196	E187N009		2			1			1
367B	192	E187N009		2	1					1
367B	163	E187N08		2	2					2
367B	166	E187N008	60	2	5					5
367B	129	E186N008		2	1					1
367B	165	E187N008		2	1			1		1
TOTAL					**45**	**3**	**1**	**1**	**2**	**52**