

**Human-Ecosystem Interactions in Relation to Holocene Climate Change in Port
Joli Harbour, Southwestern Nova Scotia, Canada**

**A thesis submitted to the Faculty of Graduate and Postdoctoral Studies
in partial fulfillment of the requirements
for the degree of Master of Science in Geography**

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Abstract

A high-resolution pollen record from Path Lake (43°87'00"N, 64°92'42"W, 10m asl) in Port Joli Harbour, Nova Scotia, Canada, was used to provide a paleo-ecological perspective on Holocene climate and vegetation variability within the context of local archaeological research. Pollen assemblages in the early Holocene reflect a post-glacial forest dominated by *Pinus*, *Tsuga*, *Betula* and *Quercus*. Shallow water aquatic and wetland taxa increased after 3400 cal. yr. BP in response to wetter climatic conditions. Increased settlement intensity of native inhabitants coincides with late-Holocene climate change at a regional scale, suggesting that environmental conditions may have influenced prehistoric human activities. European settlement, after 350 cal. yr. BP, was marked by a rise in *Ambrosia*, and peak charcoal accumulation rates after this time showed evidence of human disturbance on the landscape. This study suggests that environmental changes affected human exploitation of the landscape, and that human activity altered forest composition in the late Holocene.

Résumé

Un profil pollinique à haute résolution de Path Lake (43°87'00"N, 64°92'42"W, altitude 10m), dans Port Joli, en Nouvelle-Écosse, Canada, a été utilisé pour fournir un point de vue paléo-écologique sur la variabilité climatique et de la végétation Holocène, dans le cadre de recherche archéologique. Les assemblages polliniques au début de l'Holocène reflètent une forêt postglaciaire dominée par *Pinus*, *Tsuga*, *Betula* et *Quercus*. Les taxons aquatiques (*Isoetes*) et des zones humides (*Alnus* et *Sphagnum*) ont augmenté après 3400 cal. an. BP en réponse à une transition vers des conditions climatiques humides. Une augmentation des habitants autochtones coïncide avec un changement climatique régional de l'Holocène, ce qui suggère que les conditions environnementales peuvent être un facteur déterminant des activités humaines préhistoriques. Suivant la colonisation Européenne vers 350 cal. an. BP, une hausse d'*Ambrosia* et l'élévation des taux d'accumulation de charbon démontrent des perturbations humaines sur le paysage. Cette étude démontre une relation entre l'activité humaine et l'environnement naturel, ce qui suggère que les changements environnementaux affectent l'exploitation humaine sur le paysage, et que l'activité humaine a modifié la composition forestière à la fin de l'Holocène.

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Chapter 1 – Introduction

1.1 Introduction

Understanding the complex structure of human-ecosystem interactions, both in the past and present, is an important aspect of environmental studies (Briggs et al., 2006). Archaeological and historical records provide evidence of cultural activities, while paleo-environmental records provide information about past vegetation and climate regimes through multi-proxy analyses. The combination of these records allows for a better understanding of how ecosystem structure is related to human land-use, and vice-versa, at a decadal- or century-scale temporal resolution (Briggs et al., 2006, Gajewski et al., 2010). This thesis uses a paleo-ecological perspective to investigate Holocene vegetation and climate variability, within the context of archaeological research in Port Joli Harbour, Nova Scotia.

Human culture is limited to or enabled by the possibilities created by the natural environment, which is in turn controlled by climate variability (Sutton and Anderson, 2010; Stephenson, 1990). By understanding local to regional scale changes in vegetation and climate during the late Holocene, inferences can be made regarding cultural development of past human populations (Coe and Flannery, 1964). The adaptation of humans within their natural and structured environment is studied by looking at distribution patterns of human material remains (fields, settlements, houses, artefacts; Trigger, 1971) and historical literature. In southwestern Nova Scotia, the Canadian Museum of Civilization (CMC) has conducted extensive work, specifically in Port Joli Harbour, to determine how the Mi'kmaq interacted with the marine and terrestrial ecosystems along the Atlantic coast of Nova Scotia (Betts, personal communication, 2013). These archaeological excavations of coastal sites have led to the dating of native indigenous populations (the Mi'kmaq) between 3200-500 yr. BP (Betts, personal communication, 2013; Levac, 2001).

Human activities have also had a profound influence on forest dynamics in eastern North America (Gajewski et al., 2011). Clear-cutting or controlled burning of forests for agriculture during

European settlement in Nova Scotia led to major transformations in vegetation distribution and structure (Briggs et al., 2006; NS Museum of Natural History, n.d). Port Mouton, located less than 10km from Port Joli, was cited as being an encampment of De Monts and Champlain around 350 cal. yr. BP , and a settlement for loyalists after 167 cal. yr. BP (Macgregor, 1832). The potential for anthropogenic disturbances therefore has an extended history in Port Joli Harbour and its surrounding region, making it an ideal location for studying human-ecosystem relationships.

In this thesis, a high-resolution pollen record of a sediment core (Path Lake) from coastal Nova Scotia shows how the Acadian Forest Region evolved over the course of the Holocene. A second multi-proxy record from a fen indicates local environmental changes that provide a context within which interpretation of human activities at a particular site can be made. This thesis specifically attempts to answer the following questions;

- (1) Are the Mi'kmaq (3200-500 yr. BP) or European settlements (350-200 cal. yr. BP) associated with any major changes in vegetation composition near Port Joli Harbour, Nova Scotia?
- (2) Are vegetation changes influenced by climatic factors, or are they primarily driven by anthropogenic factors?

Once established through multiple paleoenvironmental proxy records, the paleo-environmental context of Port Joli Harbour will be useful in interpreting archaeological findings at several spatial and temporal scales.

This thesis is in the form of two articles describing the postglacial history of Path Lake and a Fen associated with an archaeological site in the Port Joli area. After a literature review and detailed description of the methods, the study results are written in the format of two separate and complete scientific articles. The first article discusses the regional environmental history based on the Path Lake results and the second discusses the local history of a fen surrounding an active archaeological site. The overall conclusions are summarized at the end of the thesis.

1.2 Study Area

The study area is located in Port Joli Harbour, Southwestern Nova Scotia, Canada (Figure 1). Port Joli is a small town found in a natural harbour along the southern section of Nova Scotia's Atlantic coast. The length of the harbour extends approximately 6.5km inland, and has a maximum width of 2km. The elevation of the landscape immediately surrounding the harbour is relatively low-lying, reaching a maximum elevation of ~30m above sea level.

The Canadian Appalachian orogeny extends from Newfoundland, through Nova Scotia, to Quebec (Goodwin, 2008). The Meguma zone, composed of Cambrian- Ordovician sediments, covers the majority of southwestern Nova Scotia (MacDonald et al., 1992). Port Joli Harbour, however, is located within a small area of younger Devonian-Carboniferous granitoid rocks (MacDonald et al., 1992). Most surficial deposits surrounding Port Joli are fine- to coarse-grained sediments, averaging closer to sand than clay/silt-sized particles (Miller, 2004). These deposits are thought to have been transported from the Scotian Shelf off the Atlantic coast as a result of sea level rise during the Holocene (Miller, 2004).

Cores were collected from several sites, and two were selected for study. Path Lake (43°87'00"N, 64°92'42"W, 10m) is located northwest of Port Joli Harbour, approximately 600m from the shoreline. The lake (~25ha) is easily accessible from the east by E Port L'Herbert Road, south of Nova Scotia Highway 103. A small spring feeds into the lake from the northwest corner, and an exit channel flows towards the ocean from the eastern side of the lake.

The fen site (43°84'87"N, 64°89'02", 5m) is also located on the western side of the harbour, almost halfway between Path Lake and the Atlantic coast. The fen (~2ha) is found within the boundaries of the Thomas H. Raddall Provincial Park, approximately 80m from the shore of the harbour. An archaeology dig site (AIDf-30) is found on a small knoll in the middle of the fen, several hundred meters away from the nearest park trail. A small stream runs around the base of the knoll, and exits to the ocean.

Chapter 2 – Literature Review

2.1 Climate of the Holocene in Southwestern Nova Scotia

Nova Scotia is located near the edge of the former Laurentide ice sheet margin, and deglaciation patterns for the region have been examined closely (Scott, Gayes and Collins, 1995; Mayle and Cwynar, 1995). Mott and Stea (1989) indicate that separation and subsequent deglaciation towards local ice centres (such as South Mountain - SW Nova Scotia) and away from the coast occurred prior to 12000 cal. yr. BP (Mayle and Cwynar, 1995; Mott et al., 2009). During the warming period (late-glacial; 14000-10000 cal. yr. BP) that marks the transition between the last glaciation and the interglacial (Holocene), the Younger Dryas represents a major reversion to cooler conditions between 12900 and 11600 cal. yr. BP (Mayle and Cwynar, 1995; Mott and Stea, 1993).

Another notable climate variation during the generally warming conditions in the early Holocene is the so-called “8200 cal. yr. BP event”, which represents another notable global cooling of 4°C that was also recorded in Nova Scotia (Lennox et al., 2010). It is thought to be related to a large influx of freshwater into the North Atlantic during the collapse of the Laurentide ice sheet (Lennox et al., 2010; Spooner et al., 2002). The period between 8100-3500 cal. yr. BP was the warmest of the Holocene (Lennox et al. 2010). Around 3000 cal. yr. BP, there was a transition to relatively wet and cool conditions in Nova Scotia (Lennox et al., 2010; Railton, 1973). Superimposed on these broad-scale changes are higher frequency climate variations, the latest of which is a cool period termed the Little Ice Age (LIA), which occurred across North America between 600-100 cal. yr. BP (Wanner et al., 2008).

Relative sea level changes in Nova Scotia during the Holocene can be derived from a combination of postglacial isostatic adjustments (Edgecombe et al., 1999), regional crustal subsidence, and local sea level rise (Forbes et al., 2009). Using seismic reflection and foraminiferal analysis, Edgecombe et al. (1999) interpreted an emergence of Halifax Harbour between 8400-7000 cal. yr. BP, followed by submergence between 7000 cal. yr. BP to present. By 6000 cal. yr. BP sea level would have

been 20m below present level in Halifax, Nova Scotia (Ogden, 1986). A period of rapid acceleration (10m) in sea level rise occurred between 4400-3800 cal. yr. BP (Scott et al. 1995). It was suggested by Scott et al. (1995) that this acceleration was caused by a delayed global response in ice melt to mid-Holocene warming. In the last 2500 years, Nova Scotia has had a submergence rate of roughly 30cm/100yr (Scott, Gayes and Collins, 1995) and future projections for Halifax Harbour estimate a sea level rise of 0.73-1.3m between 2000-2100 (Forbes et al., 2009).

The present-day climate in Nova Scotia consists of cool summers (15°C) and mild winters (-3°C) (Webb and Marshall, 1999). The average yearly precipitation ranges from 1400mm to 1500mm, of which 85% falls as rain (Webb and Marshall, 1999; Clayden, 2010).

2.2 Vegetation of the Holocene in Southwestern Nova Scotia

The boundary between forest and tundra was located in the Maritime Provinces during the late-glacial period; thus vegetation near this transition zone was highly responsive to climatic conditions and variability was greater over relatively short distances (Mayle and Cwynar, 1995). The change to a cooler and wetter climate during the Younger Dryas caused the vegetation in Nova Scotia to shift from predominantly boreal/woodland forest (*Picea*, *Pinus*, *Larix*, *Abies* and *Betula*) to shrub-tundra and herbaceous tundra (Levesque et al., 1994; Mott and Stea, 1993). Tree species re-colonized at the end of the Younger Dryas when climatic conditions were similar to present, and Atlantic Canada was then dominated by a spruce-birch forest (Lennox et al., 2010; Mott and Stea, 1993; Anderson, 1985; Serreze and Barry, 2005).

The vegetation of the early Holocene in southwestern Nova Scotia was characterized by a slowly declining *Picea* population, corresponding with an increasing abundance of hardwood taxa, including *Betula*, *Quercus*, *Ulmus* and *Ostrya-Carpinus* (Miller, 2004). This was associated with a slight improvement in climatic conditions (Miller, 2004). At around 8800 cal. yr. BP, *Pinus strobus* (white pine)

increased in abundance. By 7500 cal. yr. BP, white pine had outcompeted spruce to become the dominant species in Atlantic Canada (Anderson, 1985). An increase and subsequent decline in hemlock pollen has been comprehensively studied in Nova Scotia (Green, 1987; Lennox et al., 2010; Mott, 1975; Mott and Stea, 1993; Mott et al., 2009; Ogden, 1986). The decline occurred at approximately 5500 cal. yr. BP, and is thought to be the result of a pathogen attack (Davis, 1981). *Fagus* became established in Nova Scotia after 4,500 cal. yr. BP (Anderson, 1985), but is rarely found along the coast, which could suggest that it is more sensitive than other species to marine climates (Miller, 2004).

During the late Holocene, the abundance of hardwood species diminished as the climate began to cool, allowing *Picea* and *Abies* to comprise a larger percentage of the vegetation (Livingstone, 1968). The transition to a cooler, wetter climate began at around 3000 cal. yr. BP (Railton, 1973). The transition would have increased water levels, thus promoting increased abundance of species associated with a wetland-type development, such as *Isoetes* or *Alnus*. During the Little Ice Age, there was a further intensified cooling, allowing the spruce-fir forests (Loucks, 1962) to spread from the Atlantic coast landwards towards the upland regions (Miller, 2004).

European settlement of Nova Scotia and subsequent clearance of lands occurred between 350 cal. yr BP and 200 cal. yr BP (Levac, 2001). This is indicated by an increase in pollen of Compositae, Poaceae, *Rumex* and *Ambrosia* (Levac, 2001), and a decreasing abundance of *Larix*, *Tsuga* and *Fagus* (Miller, 2004).

Pre-European settlement forests in Nova Scotia are not thought to have had frequent disturbances (natural or anthropogenic), therefore they were classified as late successional (Mosseler et al., 2003). Before European settlement, 60-85% of the forest composition in northeastern North America was represented by these old growth stands (Thurston and Barrett, 2011). Today the forests of Nova Scotia are principally characterized as early successional forests, where trees older than 100 years comprise less than 1-5% of trees in Nova Scotia (Mosseler et al., 2003).

The vegetation that today characterizes the Atlantic Maritime Provinces is classified as the Acadian Forest Region (AFR; Mayle, and Cwynar, 1995). The high abundance of red spruce (*Picea rubens*) is one of the most distinguishing features of the AFR, as this shade-tolerant species thrives in high moisture conditions (Mosseler et al., 2003). Other species associated with this forest type include balsam fir (*Abies balsamea*), eastern hemlock (*Tsuga canadensis*), eastern white pine (*Pinus strobus*), yellow birch (*Betula alleghaniensis*), sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*) (Mosseler et al., 2003).

Port Joli is further categorized within the AFR as part of the Atlantic Shore Ecoregion, as a forest type described as Acadian-Boreal Coastal. *Picea glauca* is a common species here as it is well adapted to survival in coastal regions where salt spray can affect plant growth (Thurston and Barrett, 2011). *Picea glauca* is also an important successional species in tracts of abandoned farmlands (Mosseler et al., 2003). Common wetland environments along the coast include fens, raised or flat bogs, and salt marshes (Webb and Marshall, 1999). *Pinus strobus* is more abundant in areas with sandy outwash soils, and *Thuja occidentalis* and *Acer rubrum* are commonly found in swampy areas (Mott, 1974).

2.3 History of Human Settlement/Activity in Coastal Nova Scotia

The Derbert archaeological site in Nova Scotia provides evidence of the presence of human activity in Atlantic Canada as early as 10600 cal. yr. BP (MacDonald, 1968; McMillan and Yellowhorn, 2004). The 'Great Hiatus' was a period between 10000 and 4000 cal. yr. BP where minimal human activity in the Maritime Provinces is recorded (McMillan and Yellowhorn, 2004). The most commonly accepted reason for this phenomenon is the submergence of land by rising sea levels after deglaciation, which has effectively destroyed many coastal archaeology sites (McMillan and Yellowhorn, 2004).

Researchers from the Canadian Museum of Civilization (CMC) have completed extensive archaeological work, particularly along the coastline of the Port Joli Harbour, in order to understand the

connection between ancient inhabitants and the marine ecosystem (Betts, personal communication, 2013). Excavated shell middens were used to determine that the prehistoric Mi'kmaq occupied the Atlantic coast between 3200-500 yr. BP (Betts, personal communication, 2013; Levac, 2001). Based on the findings consisting of animal bones and shellfish casings, these hunter-gatherers are thought to have hunted moose and caribou during the winter season and subsequently to fish and gather shellfish in the summer months (Dunlop and Scott, 2006; Miller, 2004).

The Middle Maritime Woodland (1630-1380 cal. yr. BP) and the Later Late Maritime Woodland (850-660 cal. yr. BP) seem to be culturally significant periods in Port Joli Harbour (Black, 2002). The frequency of discovered sites and significant archaeological findings are mainly concentrated within these time periods (Betts, personal communication, 2013). There is an absence of sites locally in Port Joli Harbour between 3150±40 cal. yr. BP and the beginning of the Middle Maritime Woodland, though there is no clear indication of what caused this 'absent' period.

European settlers began to arrive and clear land in Nova Scotia between 350-200 cal. yr. BP, however the region only saw a large growth in population after the American Revolution in the 1780s (last 170 years) (Dunlop and Scott, 2006; Miller, 2004; Levac, 2001). Historical records from the region surrounding Port Joli Harbour described it as "rocky, barren and uninviting, with the most meagre agricultural possibilities, its scanty soil among the granite boulders allowing sustenance for nothing but scrubby spruce and the barren loving berries [...] (Jost, 2009)".

Chapter 3 – Methodology

3.1 Site Selection and Field Methods

Several sites were sampled surrounding the western and northern edges of the Port Joli Harbour between July 9-12th, 2012. A modified Livingstone piston corer and a Russian peat corer were used to extract sediment cores from various types of environments (lake, pond, fen, 'floating' bog). Two coring sites were chosen for further analyses.

A 4.16m sediment sequence recovered from Path Lake was chosen to develop a regional-scale paleo-reconstruction of the vegetation and climate. In order to obtain cores from the deepest section of Path Lake, a raft was built using a wooden platform and inflatable kayaks. The first drive was recovered using a clear plastic tube and piston. Unconsolidated sediments near the water-sediment interface of this drive (approximately 7m deep) were extruded at 0.5cm and 1.0cm intervals into separate zip-lock bags. Deeper sediments from the Path Lake cores were collected using an aluminum casing of the modified Livingstone corer and were extruded horizontally and intact in the field.

The selection of a fen site was determined by its close proximity to the actively studied E'se'get Archaeology Project (specifically the AIDf-30 dig site), located in the Thomas H. Raddall Provincial Park (Betts, personal communication, 2013). A 0.91 m core was collected within the immediate vicinity of the archaeological site and was interpreted as a local-scale sedimentary record. Several shorter cores were recovered from the fen site using both a Russian peat corer and the modified Livingstone corer. Recovery from the fen was not complete, and only consisted of the bottom 0.44m of the single 0.91m drive, as the upper sediment was too unconsolidated and waterlogged to recover. However, this 0.91m core apparently contained the complete sequence, as the base of the fen core consisted of a 3cm long section of finely grained, light gray, sandy clay. This layer was found at the base of multiple cores from the site, but core L was chosen as it had the greatest amount of recovered sediment.

All cores were wrapped in plastic-wrap, aluminum foil and split PVC tubing for transport to the University of Ottawa and were stored in refrigerators at 4°C.

3.2 Magnetic Susceptibility

Using a Bartington MS2C Core loop sensor, the magnetic susceptibility of the Path Lake and Fen cores was measured at 1cm intervals. The sensor is used to detect differences in the concentration of magnetic materials, which varies as a result of environmental forcings changing the sediment composition of the cores (Nowaczyk, 2002). Each drive of the Path Lake and Fen sequence was measured three times, and the mean of these values was used to represent the magnetic susceptibility for the core. Values from the top and bottom 4cm of each drive of Path Lake were excluded from analysis as the sensor averages several cm, which includes air at the ends of the cores.

3.3 Loss on Ignition and Carbonate Content

Determination of organic and carbonate content within the sediment cores was done by using the loss-on-ignition (LOI) technique (Dean, 1974). A brass sampler was used to collect 1cc subsamples of sediment, which were placed in pre-weighed, clean ceramic crucibles. Path Lake was subsampled at 4cm intervals, and the Fen at 2cm intervals. To obtain the dry (or constant) weight, the subsamples were placed in an oven for 12-24 hours at 105°C (Heiri et al., 2001). The subsamples were then ignited for four hours at 550°C in a muffle furnace to determine the organic carbon content (Heiri et al., 2001). In the last step of the procedure, the subsamples were again ignited in a muffle furnace for two hours at 950°C to determine the carbonate minerals (Dean, 1974). The carbonate weight (LOI at 950°C) was multiplied by 1.36 to compensate for the molar mass of carbon dioxide and carbonate (Heiri et al., 2001).

3.4 Chronology

Accelerator-mass spectrometry (AMS) dating was used to obtain the ages of six samples for Path Lake and three samples for the Fen at varying depth intervals. Subsamples of sediment from the cores were sieved through a 90 μ m screen using deionized water to separate organic matter from fine-grained material. Organic matter (fibres, wood, charcoal, etc.) was picked under a stereomicroscope and was submitted to Beta Analytic Dating Laboratory for age determination. Resulting ages were calibrated using the IntCal09 calibration curve (See Table 1-2; Reimer et al., 2009). An age-depth model was fit to the Path Lake and Fen radiocarbon data in the R software package BACON to establish the two chronologies (Blauuw and Christen, 2011).

3.5 Pollen Analysis

Standard laboratory procedures (Faegri and Iverson, 1989) and protocols (Gajewski, 2009) were followed in the processing of sediment samples for pollen analysis. Sediment subsamples of 1cc were extracted at semi-regular intervals for Path Lake: 2.0cm intervals between 0-222cm, 2.0-8.0cm intervals between 222-262cm, and 20.0cm intervals between 262-380cm. Intervals were much closer in the upper section of the core in order to obtain a higher-resolution pollen analysis during the time when humans were most likely occupying or settling the region. Subsamples extracted from the Fen core were taken at 2.0cm intervals, though two samples were lost during processing (at 61cm and 75cm), and a rock spanning the entire diameter of the core prevented sediment collection at 85cm.

In order to remove all non-polliniferous materials, subsamples were chemically treated (in sequential order) with 10% hydrochloric acid, 10% potassium hydroxide, hydrofluoric acid, and acetolysis solution. Ethanol (95%) and tertiary butyl alcohol (TBA) were used to dehydrate the residual pollen material before preserving it in vials with silicone oil (Faegri and Iverson, 1989). Two *Lycopodium* spore tablets (batch #938934) were added to each sample before processing to enable the calculation of

fossil pollen concentration and accumulation rates (Faegri and Iverson, 1989). The samples were mounted on microscope slides, where pollen grains were identified and counted.

Pollen grains and spores were counted using a Nikon Eclipse 80i light microscope at 400x magnification, along evenly spaced transects to avoid biasing the counts due to potential differential sorting during the creation of the slides. Reference material and texts helped with identification of all fossil pollen and spores found on the slides (Faegri and Iverson, 1989; McAndrews et al., 1973; Moore, Webb and Collinson, 1991; Roland and Smith, 1969). For Path Lake, an average total pollen sum of 535 pollen grains per slide was counted, with a range between 462-678.5 grains. For the Fen, an average of 533 pollen grains per slide was counted, ranging between 459-683.5 grains. In some levels of the Fen pollen concentrations were too low to reach a sum of 500 grains, and up to four extra slides were counted for those levels. Aquatic species were excluded from the total pollen sum as their pollen curves tend to differ from their plant production and pollen productivity (Van der Knapp and Leeuwen, 2003). The sum for the aquatic pollen included total pollen plus aquatic sums.

3.6 Micro-charcoal Analysis

Micro-charcoal was measured to quantify natural and anthropogenic fire disturbances at a regional scale (Chapin, 2006). Charcoal was identified as any black, angular fragments or any opaque fragments where a linear or rectangular wood-like structure was visible (Clark, 1982). Fragments were classified into four categories according to size; 1: $218.75 \leq x < 437.5 \mu\text{m}^2$, 2: $437.5 \leq x < 875 \mu\text{m}^2$, 3: $875 \leq x < 1750 \mu\text{m}^2$ and 4: $\geq 1750 \mu\text{m}^2$ (Paquette, 2012; Whitlock and Larson, 2001). The total area of charcoal for each depth interval was calculated by summing the geometric mean of each size class (Whitlock and Larson, 2002). Exotic *Lycopodium* was used to compute charcoal concentration and influx.

3.7 Paleoclimate Reconstruction

The Modern Analogue Technique (MAT) (Sawada, 2006) and version 1.8 of the North American Modern Pollen Database (NAMPD) (Whitmore et al., 2005) were used to create temperature and precipitation reconstructions using fossil data. Modern pollen data between 0-100°W longitude and 25-85°N latitude were considered as potential candidates for modern analogues. The climate variables that were reconstructed included mean annual temperature (°C), mean total annual precipitation, and mean total summer (June, July, August) precipitation. These variables were computed by using the average of the three closest analogues and a squared chord distance dissimilarity coefficient (Williams and Shuman, 2008). The reconstructions were based on a pollen sum of 16 pollen taxa, including *Pinus*, *Picea*, *Abies*, *Tsuga*, *Larix*, *Cupressaceae*, *Acer*, *Betula*, *Fagus*, *Fraxinus*, *Populus*, *Quercus*, *Ulmus*, *Alnus*, *Ericaceae* and *Sphagnum*. The criteria used to select these taxa included those with pollen percentages averaging greater than 1% for all sample intervals, or with a maximum pollen percentage greater than 5% for any individual sample interval.

3.8 Data Analysis and Presentation of Results

Numerical analyses can be performed on large stratigraphic datasets to better understand environmental changes over time (Bennett and Willis, 2002). Stratigraphic data from this study was plotted and analyzed using the C2 data analysis program (Juggins, 2010). Pollen diagrams were generated within the program to represent fossil data in terms of percentages (%), concentrations (gr/cm^2) and accumulation rates ($\text{gr}/\text{cm}^2\text{year}$) (Louderback, 2007). A principal component analysis (PCA) ordination was used to explain the variance, or 'ecological difference' (Legendre and Birks, 2012) between the same 16 pollen taxa used in the MAT reconstruction. A scree plot suggested that only the first four components of the analysis were significant; the first four components each also explained more variance than any one of the 16 pollen taxa used in the analysis. The pollen diagram zone

boundaries were therefore delineated based on changes in the first four components of the PCA (Walker and Wilson, 1978).

Chapter 4 – Results

Human-Ecosystem Interactions in Relation to Holocene Climate Change in Port Joli Harbour, southwestern Nova Scotia, Canada

4.1 Introduction

Understanding the complex structure of human-ecosystem interactions, both in the past and present, is an important aspect of environmental studies (Briggs et al., 2006). Archaeological and historical records provide evidence of cultural activities, while paleo-environmental records reconstruct past vegetation and climate regimes through multi-proxy analyses. The combination of these records allows for a better understanding of how ecosystem structure is related to human land-use, and vice-versa, at a decadal- or century-scale temporal resolution (Briggs et al., 2006, Gajewski et al., 2010).

Archaeological excavations of coastal sites along the Atlantic coast of Nova Scotia have led to the dating of native indigenous populations (the Mi'kmaq) between 3200-500 yr. BP (Betts, personal communication, 2013; Levac, 2001). Through the study of local to regional scale changes in vegetation composition and climate during the mid- to late-Holocene, inferences can be made regarding cultural development and adaptation of past human populations (Coe and Flannery, 1964). The Canadian Museum of Civilization (CMC) is currently working on the archaeological perspective of human activity in Port Joli Harbour, more specifically into the interaction of the Mi'kmaq with marine and terrestrial ecosystems (Betts, personal communication, 2013).

Human activities have also had a profound influence on forest dynamics in eastern North America (Gajewski et al., 2011). Clear-cutting or controlled burning of forests for agriculture during European settlement in Nova Scotia between 350-200 cal. yr. BP led to major transformations in vegetation distribution and structure (Briggs et al., 2006; NS Museum of Natural History, n.d). Port Mouton, located less than 10km from Port Joli, was cited as being an encampment of De Monts and Champlain around 350 cal. yr. BP, and a settlement for loyalists after the American Revolution around

170 cal. yr. BP (Dunlop and Scott, 2006; Macgregor, 1832). The potential for anthropogenic disturbances therefore has an extended history in Port Joli Harbour and its surrounding region, making it an ideal location for studying human-ecosystem relationships.

This study uses a paleo-ecological perspective to investigate Holocene vegetation and climate variability, within the context of local archaeological research in Port Joli Harbour, Nova Scotia. A high-resolution record of a sediment core from Path Lake (43°87'00"N, 64°92'42"W, 10m; Figure 1) shows the evolution of the Acadian Forest Region in southwestern Nova Scotia during the Holocene. Path Lake (~25ha) is located northwest of Port Joli Harbour, approximately 600m from the shoreline. A small spring feeds into the lake from the northwest corner, and an exit channel flows towards the ocean from the eastern side of the lake.

4.2 Methodology

A modified Livingstone piston corer was used to extract a 4.16m sediment sequence from Path Lake on July 12th, 2012. The uppermost sediments were collected in a clear plastic tube. Unconsolidated sediments near the water-sediment interface were extruded at 0.5-1.0cm intervals, with individual cross-sections stored in zip-lock bags. The remaining sediments were extruded horizontally and intact in the field, and wrapped in plastic-wrap, aluminum foil and PVC tubing for transport to the University of Ottawa. Cores were stored in a refrigerator at 4°C.

The magnetic susceptibility of Path Lake sediment core was measured at 1.0cm intervals using a Bartington MS2C meter and loop sensor. Values within 4cm of core extremities were excluded from analysis as the sensor averages over several cm.

Determination of organic and carbonate content within the sediment cores was done by using loss-on-ignition (Dean, 1974). The dry weight was obtained after heating subsamples to 105°C for 12-24 hours followed by ignition at 550°C for four hours to determine the organic carbon content (Heiri et al.,

2001). The carbonate content was obtained after igniting the subsamples at 950°C for two hours (Dean, 1974), and resultant values were multiplied by 1.36 to compensate for the molar mass of carbon dioxide and carbonate (Heiri et al., 2001).

Accelerator-mass spectrometry (AMS ^{14}C dating) was used to obtain the ages of six samples at a series of depths in the Path Lake core. The samples of organic matter were submitted to Beta Analytic Dating Laboratory, and resulting ages were calibrated using the IntCal09 calibration curve (Reimer et al., 2009). Using a Bayesian approach, an age-depth model was fit to the data in the R software package BACON to establish a chronology (Blauuw and Christen, 2011).

Sediment subsamples of 1cc were extracted for pollen analysis. Non-polliniferous material was removed through chemical treatment, involving 10% hydrochloric acid, 10% potassium hydroxide, hydrofluoric acid, and acetolysis solution. Residual pollen material was preserved and mounted on microscope slides with silicone oil (Faegri and Iversen, 1989). Two *Lycopodium* spore tablets (batch #938934) were added to each sample before processing to enable the calculation of fossil pollen concentration and accumulation rates (Faegri and Iversen, 1989). Pollen grains and spores were counted using a Nikon Eclipse 80i light microscope at 400x magnification, along evenly spaced transects to avoid potential differential sorting during the creation of the slides. Reference material and texts helped with identification of all fossil pollen and spores found on the slides (Faegri and Iversen, 1989; McAndrews et al., 1973; Moore, Webb and Collinson, 1991; Roland and Smith, 1969). An average total pollen sum of 535 was reached for 121 subsamples, excluding all aquatic species.

Micro-charcoal was identified as any black, angular fragments or any opaque fragments where a linear or rectangular wood-like structure was visible (Clark, 1982). Fragments were classified into four categories according to size; 1: $218.75 \leq x < 437.5 \mu\text{m}^2$, 2: $437.5 \leq x < 875 \mu\text{m}^2$, 3: $875 \leq x < 1750 \mu\text{m}^2$ and 4: $\geq 1750 \mu\text{m}^2$ (Paquette, 2012; Whitlock and Larson, 2001). The total area of charcoal for each depth interval was calculated by summing the geometric mean of each size class (Whitlock and Larson, 2002).

The Modern Analogue Technique (MAT) (Sawada, 2006) and version 1.8 of the North American Modern Pollen Database (NAMPD) (Whitmore et al., 2005) were used to reconstruct mean annual temperature (°C), mean total annual precipitation, and mean total summer (June, July, August) precipitation. These variables were computed using the average of the three closest analogues and a squared chord distance dissimilarity coefficient (Williams and Shuman, 2008). The reconstructions were based on a pollen sum of 16 pollen taxa, including *Pinus*, *Picea*, *Abies*, *Tsuga*, *Larix*, *Cupressaceae*, *Acer*, *Betula*, *Fagus*, *Fraxinus*, *Populus*, *Quercus*, *Ulmus*, *Alnus*, *Ericaceae* and *Sphagnum*.

4.3 Results

4.3.1 Sediment

Organic content (LOI at 550°C) ranged between 24-35%, and the carbonate content (LOI at 950°C) comprised less than 8% of the sediment (Figure 2). Organic content decreased until 9150 cal. yr. BP, and remained stable below 30% before increasing for a short period once at 7200 cal. yr. BP, and again at 3700 cal. yr. BP. At 2400 cal. yr. BP, organic content reached its uppermost range and only began to decrease again at 2000 cal. yr. BP. In the last 1700 years, organic matter has increased by 3%. Other than very large values near the base of the core, magnetic susceptibility showed no significant changes throughout the Holocene, as all values remained within the range of instrumental error.

4.3.2 Chronology

All six ¹⁴C-calibrated dates fit in chronological order as a function of depth (Table 1, Figure 3). Based on the interpolated ages, the basal date of Path Lake was determined to be just over 9200 cal. yr. BP. The age-depth model for Path Lake produces a relatively linear curve with no visible outliers. The mean sediment accumulation rate, assuming a gamma distribution (shape=2), is 21.9 yr cm⁻¹.

4.3.3 Pollen Record

The Path Lake pollen record was dominated by pollen of *Pinus*, *Picea*, *Betula* and several other hardwoods. Zones were delimited based on a principal component analysis (PCA) ordination of the pollen percentages (discussed below).

Zone P1 (9280-5250 cal. yr. BP) was dominated by arboreal taxa, which represented over 90% of the total pollen sum. *Pinus haploxylon* and *Betula* had relatively high pollen percentages, whereas *Picea* was at its lowest abundance. *Pinus diploxylon* was at its maximum abundance (20%) at 8600 cal. yr. BP, and decreased to between 1-15% in the most recent four zones. In this zone, *Tsuga* began to rise at 6650 cal. yr. BP, reached maximum abundance (27%), and subsequently declined between 5350-5250 cal. yr. BP. As *Tsuga* increased, there was a corresponding decline in both *Betula* and *Quercus*. *Alnus* represented less than 4% of the total pollen sum in this zone. Pollen percentages of herbaceous taxa, spores and aquatics were also minimal in this zone.

Zone P2 (5250-3400 cal. yr. BP) was characterized by a maximum abundance of *Pinus (haploxylon)*, which lasted for 220 years, at the beginning of the zone. Throughout the zone, *Pinus (haploxylon)* pollen percentages remained relatively high, ranging between 30-40% of the total pollen sum. The rapid decline of *Tsuga* within the previous zone had stabilized by around 5000 cal. yr. BP, before beginning a more gradual increase. *Picea* and *Abies* pollen percentages steadily increased, and those of the herbaceous taxa, spores and aquatics remained very low.

In Zone P3 (3400-2100 cal. yr. BP) *Pinus haploxylon*, as well as *Quercus* gradually decreased, although the latter decrease was far less pronounced. At the beginning of this zone, pollen percentages of shrub taxa (*Alnus*, *Corylus* and *Ericaceae*) began to increase, representing up to 15% of the total pollen sum once they had reached peak abundance at 180 cal. yr. BP. *Isoetes*, an aquatic plant, also began to increase around 2450 cal. yr. BP.

In Zone P4 (2100-600-cal. yr. BP) pollen percentages of *Pinus haploxylon* stabilized at a range between 15-25% of the total pollen sum. *Isoetes* gradually increased and reached a peak at around 1700 cal. yr. BP before declining again. A similar increase was seen in *Sphagnum*, though this taxon peaked later at 1200 cal. yr. BP. These two taxa have a negative relation with *Picea*, which decreased slightly in abundance midway through the zone before increasing again. Shrub pollen percentages again continued to steadily increase. Pollen of the shrub *Ilex* increased from minimal percentages at 1700 cal. yr. BP, and declined abruptly at 900 cal. yr. BP.

In Zone P5 (600 cal. yr. BP-Present) there was a significant increase in non-arboreal pollen, beginning around 350 cal. yr. BP (1600AD). The main taxa contributing to this change were *Ambrosia*, *Poaceae* and *Rumex*. Another peak in *Isoetes* was also seen at this time. *Alnus rugosa*, *Ericaceae*, *Picea* and *Abies* reached peak abundance in this zone, while the pollen percentages of hardwood taxa and *Tsuga* gradually decreased until the present date. The pollen percentage of *Betula* remained fairly constant throughout the entire sequence.

Pollen accumulation rates (PAR) were low in Zone P1, with the exception of high PAR values of *Tsuga* pollen during its maximum abundance at 6000 ca. yr. BP. Arboreal PAR increased in zone P2, while shrub, non-arboreal, spore and aquatic taxa remained low. In Zone P4, *Ilex*, *Sphagnum* and *Isoetes* had small increases in PAR. All major taxa showed large PAR around 250 cal. yr. BP (or 1700AD), around the time of European settlement.

4.3.4 Micro-charcoal

Charcoal accumulation rates (CAR) were relatively low in Zones P1 and P2 (Figure 6). Charcoal fragments greater than $1750 \mu\text{m}^2$ contributed to three peaks above background values across these two zones. Charcoal accumulation rates generally increased at the beginning of Zone P3 with more frequent peaks, though estimates of fire reoccurrence could not be determined due to non-continuous sampling

depths. In Zone P4 there were two large periods of charcoal influx at 1700 and 1100 cal. yr. BP. Charcoal accumulation rates reached a maximum in Zone P5, and were mainly represented by a single large peak between 160-180 cal. yr. BP, which was over 13 times greater than the average CAR of the entire sequence.

4.3.5 Numerical Analysis

A principal component analysis (PCA) ordination illustrates the relation among the pollen taxa (Kindt and Coe, 2005). The first four components of the ordination explained 56% of the variance. Major changes in the PCA components were used to delineate the zone boundaries of the pollen diagram (Walker and Wilson, 1978).

The first component of the PCA had negative scores in Zones P1 and P2, entered a period of transition in Zone P3, and generally remained positive with fluctuating scores from 1900 Cal yr. BP (Zone P4) until the present. *Pinus haploxylon* was one of the few pollen types that was negatively correlated with this component, while *Abies*, *Larix* and non-arboreal pollen (*Alnus* and *Ericaceae*) were all very positively correlated.

The second component showed a similar, but reversed, trend to the first component. There was an overall decrease in scores, although the transition zone was more variable in terms of both positive and negative scores, and only reached a constant state of negative scores around 1200 cal. yr. BP. Many hardwood taxa, including *Juniper*, *Acer*, *Fagus*, and *Fraxinus*, were positively correlated with this component. The correlation between this component and *Sphagnum* was highly negative.

In Zones P1, P2, and P4 the scores for the third component were mostly small and negative, while Zones P3 and P5 consisted of positive scores. *Picea* and *Abies* were both positively correlated with component three, and hardwood taxa were negatively correlated. Component four had positive scores in Zone P1, negative scores in Zone P2, and fluctuated just above and below zero in the three most

recent zones. It was highly correlated with *Pinus (diploxylon)*, *Tsuga* and *Ulmus*, and had a negative correlation with *Quercus*.

4.3.6 Paleoclimate Reconstruction

The reconstructed mean annual temperature of Path Lake averaged 4.3°C for the past 9000 years of the Holocene. Annual temperature fluctuated within a range of 1°C below average, and up to 2°C above average in Zones P1, P2, and P3. In Zone P4, mean annual temperature became more variable, exceeding a 2°C range both above and below average. Around 250 cal. yr. BP (zone P5) there was a significant decrease in mean annual temperature to 1.5°C, which was 2.8°C below average.

The Path Lake record had an average total annual precipitation of 984mm. In Zones P1 and P2 annual precipitation was below average. At the end of Zone P2, at 3400 cal. yr. BP, total annual precipitation began to increase. Between 3400-1600 cal. yr. BP was a period of variability where precipitation oscillated around the average, although the overall trend still was increasing. At 1400 cal. yr. BP, total annual precipitation reached its maximum, and gradually declined until present. Total summer precipitation (June, July, August) had a similar trend of increasing values, although the increase began at 3000 cal. yr. BP and only declined slightly at 180 cal. yr. BP.

4.4 Discussion

The high-resolution regional pollen record for Path Lake shows the postglacial evolution of what is now classified as the Acadian-Boreal Coastal forest of southwestern Nova Scotia. Based on a principal component analysis of Holocene pollen assemblages, five major zones were delineated, but only three zones could be distinguished in the paleoclimate reconstruction. Forests with a significant component of white pine, accompanied by hemlock, birch and oak trees characterize the early Holocene in Path Lake. Forest succession in response to changes in climate in the later Holocene favoured an increase of

species perhaps found in more moist ecosystems, as well as an increase in boreal species (spruce and fir).

The sediment sequence obtained from Path Lake has a basal date of 9650±30 cal. yr. BP (Figure 3); this overlaid 20cm of sandy sediment. Other lake sediment sequences from Nova Scotia have basal dates ranging between 10800-12700 yr. BP (Green, 1986; Mott and Stea, 1993). In many of these lakes, Mott and Stea (1993) found organic deposits related to the Wisconsinan late-glacial period, buried under a layer of minerogenic deposits. This inorganic layer was interpreted as a product of mass-wasting and solifluction associated with climatic cooling during the Younger Dryas around 11700 cal. yr. BP (Mott and Stea, 1993; Walker et al., 2009). Sediment accumulation in Path Lake therefore began at a later date in comparison to the regional record. The main purpose of the study was to provide a high resolution paleo-environmental record in the context of archaeological findings dating roughly 3000 cal. yr. BP, thus the formation of Path Lake was not studied further.

4.4.1 Holocene Vegetation and Climate Variability

In Nova Scotia, the Younger Dryas cooling event marked a shift in vegetation from predominately boreal/woodland forest (*Picea*, *Pinus*, *Larix*, *Abies* and *Betula*) to shrub-tundra and herbaceous tundra (Levesque et al., 1994; Mott and Stea, 1993). After the Younger Dryas, warming climatic conditions favoured the return of a mixed forest rather than the previously dominant spruce-fir forests (Green, 1981). The early pollen record for Path Lake (Zone P1), which dated to this latter period, therefore had very low abundances of *Picea* and *Abies* (Figure 4). The post-glacial forest was instead comprised primarily of *Pinus haploxylon* and *Pinus diploxylon*, with abundant percentages of *Tsuga*, *Betula* and *Quercus* (Figure 4). The combination of hardwood and mixed stands would have limited the frequency and intensity of fire disturbances (Green, 1987), as shown by relatively low charcoal influx rates in Zone P1.

An increased abundance of *Tsuga* in Path Lake at 6500 cal. yr. BP, followed by its subsequent decline at 5500 cal. yr. BP, is also seen in records from other lakes in Nova Scotia (Green, 1987; Lennox et al., 2010; Mott, 1975; Mott and Stea, 1993; Mott et al., 2009; Ogden, 1986). The decline in *Tsuga*, and to a lesser extent hardwood taxa, led to the gradual re-colonization of *Picea* and *Abies*. This resurgence of boreal species is interpreted as due to a gradual shift to moister conditions (Green 1987). Hardwoods and mixed stands are less flammable than conifers (Green, 1987), thus accumulated charcoal in the Zone P1 was at its minimum. Alternatively, low-frequency fire disturbances may have helped to promote the eventual succession of *Pinus haploxylon* stands to spruce-fir forests (Carleton et al., 1996).

The closed-canopy mixed forest persisted until 3400 cal. yr. BP at Path Lake. After this time, reconstructed total annual precipitation shows a transition towards a wetter regime between 3400-1500 (Zone P3; Figure 8), as do other multi-proxy records from the region (Lennox et al., 2012; Railton, 1973). Increased abundance of quillwort (*Isoetes*) after 3400 cal. yr. BP also indicates rising water tables, as this species colonizes early in shallow water (Railton, 1973). Aquatic species were excluded from the paleoclimate reconstruction, meaning that the increase seen in the reconstructed total annual precipitation was not influenced by the corresponding rise in *Isoetes* at the same point in time. Increased shallow water environments also favour the development of wetlands (Lennox, 2010). An increase in pollen percentages of *Alnus* and *Sphagnum* at 3400 and 2100 cal. yr. BP, and a general decline in *Pinus haploxylon* and hardwood taxa reflect this ecological response to cooler and moister climatic conditions (Green, 1987).

At around 900 cal. yr. BP, the pollen assemblages showed an increase in boreal species (spruce and fir) that reached their maximum abundances by 260 cal. yr. BP (Figure 4). This could potentially indicate climatic cooling associated during the Little Ice Age (600-100 cal. yr. BP; Wanner et al., 2008), where reconstructed annual temperatures reach up to 2.75°C cooler than the Holocene average. However, temperature does not seem to show any significant change associated with known climatic

shifts during the Holocene in the region before this time. For this reason, it is more reasonable to believe that the pollen assemblages of Path Lake are reflective of an ecosystem driven by moisture rather than temperature.

4.4.2 Human-Ecosystem Dynamics

Excavated shell middens from archaeological sites in Port Joli show that native inhabitants (the Mi'kmaq) who occupied the Atlantic coast between 2500-500 cal. yr. BP had an important connection to the marine ecosystem (Betts, personal communication, 2013; Levac, 2001). Their main diet consisted of fish and shellfish during the summer months (Dunlop and Scott, 2006; Miller 2004), thus proximity of dwellings to the Atlantic coastline would have been essential.

Studies often use temporal frequency of archaeological radiocarbon dates to infer prehistoric settlement intensity or cultural activity, as larger populations in theory produce larger amounts of cultural carbon (Peros et al., 2010; Munoz and Gajewski, 2010; Rick, 1987; Wendland and Bryson, 1974). The frequency of archaeological radiocarbon dates before 3400 cal. yr. BP was limited across Nova Scotia, and absent in Port Joli Harbour until 3150 cal. yr. BP where only one site was found (Figure 9). Submergence of land by rising sea levels after deglaciation destroyed many coastal archaeology sites, which is thought to be the main cause of this prolonged 'hiatus' (McMillian and Yellowhorn, 2004). Records show that sea level between 7000-3400 cal. yr. BP rose by 19m (Edgecombe et al., 1999; Ogden, 1986; Scott et al., 1995; Scott, Gayes and Collins, 1995; Forbes et al., 2009). Archaeological sites that were once concentrated along past coastlines were most likely inundated with water, and may presently be located underwater in the basin of Port Joli Harbour.

The transition to moister climatic conditions after 3400 cal. yr. BP was associated with increased settlement intensity in Nova Scotia at a regional scale (14C Nova Scotia; Figure 9). In Port Joli Harbour, settlement intensity was highest during the Middle Maritime Woodland Period (1630-1380 cal. yr. BP)

and the later Late Maritime Woodland period (850-660 cal. yr. BP; Betts, personal communication, 2013). These culturally significant periods coincide with the largest above-average reconstructed total annual precipitation values for the Holocene in the Path Lake paleoclimate reconstruction. The increased precipitation at these times, or perhaps effective soil moisture in this particular coastal environment, may have led to changes in the ecosystem that would have favoured cultural development. The climatic influence on vegetation may therefore be indicative of optimal conditions for prehistoric settlement. At the beginning of the time of increased cultural activity in Port Joli Harbour (1600 cal. yr. BP), sea level was less than 6.5m lower than present day (Figure 9). This shows a relative stabilization of coastal submergence in comparison to the earlier sea level rise, thus archaeological sites along what is now the present coastline were preserved.

The shrub gallberry (*Ilex glabra*) is generally found along the Atlantic and Gulf coastal plains, in swamps, bogs and sandy pinelands (Burrows and Tyrl, 2013); Nova Scotia represents this taxon's northeastern range limit (USDA, 2013). Gallberry is a common understory shrub of frequently burned forests as it responds quickly and prolifically to fire disturbances (Miller and Miller, 2005). Figure 4 shows that increased *Ilex* abundance does coincide with peaks in charcoal influx at 1700 and 1100 cal. yr. BP. Gallberry was also used by native inhabitants of North and Central America as an emetic and a mild ceremonial stimulant in herbal teas (Burrows and Tyrl, 2013; Odenwald and Turner, 2006). The maximum prehistoric settlement intensity in Nova Scotia and Port Joli occurred around 1600-600 cal. yr. BP, when *Ilex* first appeared. This indicates that plant ecology may have been related to local cultural activities.

Records of traditional plant knowledge describe the cultural significance of certain plant taxa for the Mi'kmaq people in relation to several uses, including spiritual, medicinal, construction and consumption (MacDonald, 2000). Sweet grass and cedar were often used in smudging ceremonies (Hunt and Paul, 2012), though these taxa were not highly represented in the Path Lake pollen record. White

spruce and alder were commonly used to treat various ailments from colds to migraines to tuberculosis (Cape Breton University, 2013). Once soaked, spruce roots became flexible and sturdy and therefore had a wide range of uses; building structures and canoes, used as an antibiotic and to mend cuts, sewing clothing, and finally making beer (Hunt and Paul, 2013). Both spruce and alder were fairly abundant in the region, and showed a generally increasing trend in pollen percentages as settlement intensity increased.

There is little evidence from an archaeological perspective to suggest that native inhabitants of the northeast were deliberately clearing forests for agricultural use (Mosseler et al., 2003). European settlement in southwestern Nova Scotia is reported to be between 350-200 cal. yr. BP, although the region only saw a large growth in population after the American Revolution at 167 cal. yr. BP (Dunlop and Scott, 2006; Miller, 2004; Levac, 2001). The *Ambrosia* rise in Path Lake dates to 350 cal. yr. BP (1600 AD), although dating of sediments in the uppermost part of sediment sequences is difficult due to lack of compaction of the sediment. A single peak in charcoal influx (over 13x greater than the Holocene average) between 160-180 cal. yr. BP shows how extensive human activity and land clearance was in the region at this time.

4.4.3 Summary

The pollen assemblages of Path Lake seem to reflect a coastal ecosystem where precipitation, or potentially effective moisture, was the major influencing climate variable on the vegetation. Based solely on the reconstructed total annual precipitation, three distinguishable climate regimes were seen for the Atlantic coastal region during the Holocene. An extended dry period (9280-3400 cal. yr. BP) was characterized by a mixed forest canopy, primarily comprised of pine and hardwood stands. A transitional period of increasing total annual precipitation or effective moisture (3400-1600 cal. yr. BP) is associated with increased wetland-type environments, which led to higher abundances of alder, sphagnum and

quillwort pollen percentages. A relatively wet period (1600 cal. yr. BP to present) followed, where moister climatic conditions promoted the establishment of boreal species (spruce and fir).

The increased settlement intensity of the Mi'kmaq who inhabited Port Joli Harbour coincides with significant changes in vegetation and climate regimes of coastal Nova Scotia. In this case vegetation seems to have had more control over cultural activities than vice-versa, although more research is needed from an archaeological perspective to determine the exact nature of the human-ecosystem relationship in Port Joli Harbour. An increase in herbaceous plants (ragweed, sorrels and grasses) and large charcoal accumulation rates are common indicators of European settlement. Vegetation composition of southwestern Nova Scotia may have had minor influences on human activity during European settlement, but it is more likely that humans during this time had significantly greater impacts that altered the forest from its 'presettlement' natural state.

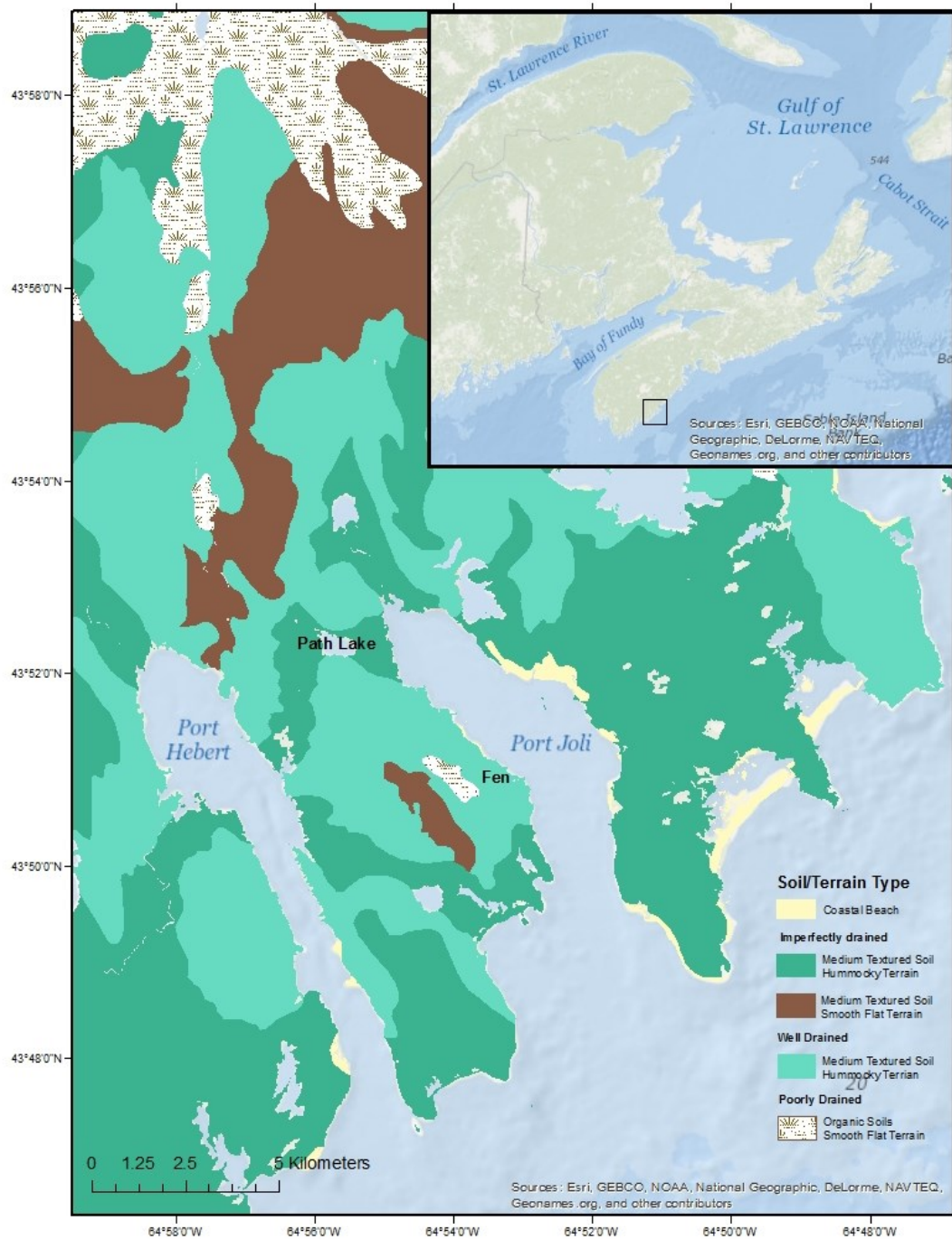


Figure 1: Location of Path Lake and the Fen site in Port Joli, Nova Scotia. Drainage, soil type and terrain are indicated. Source of Soil/Terrain type: *Ecological Land Classification* [ESRI Shapefile], 2003.

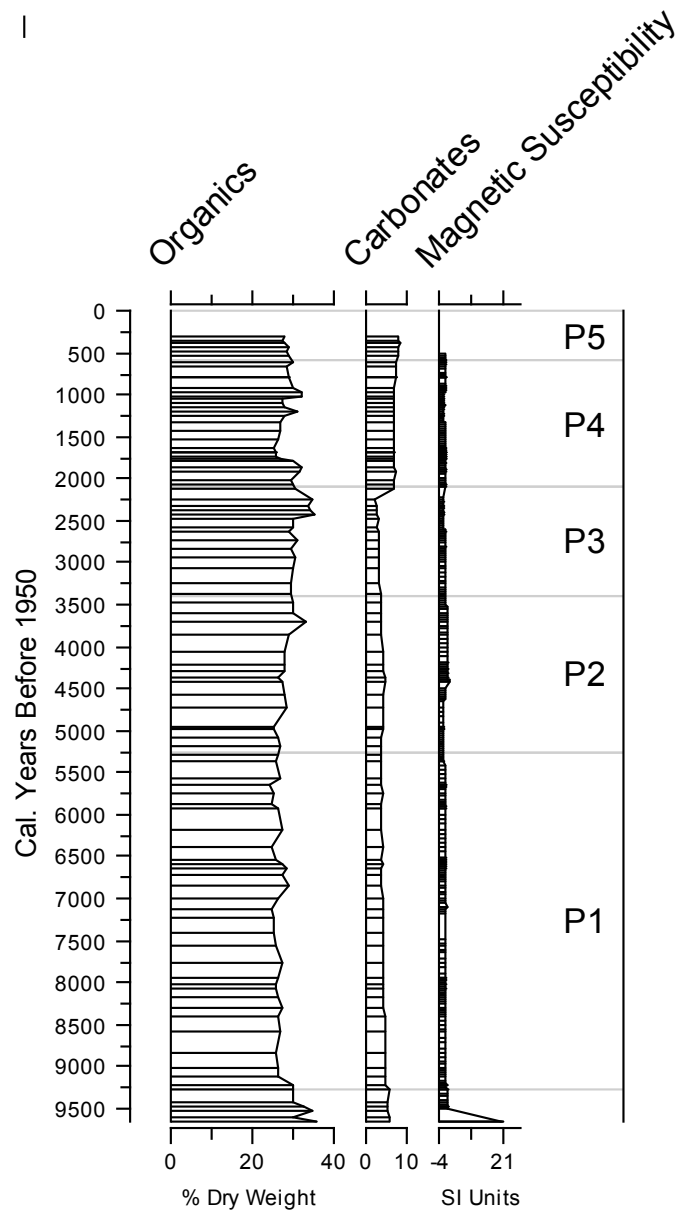


Figure 2: Loss on Ignition and magnetic susceptibility for Path Lake, Port Joli, Nova Scotia.

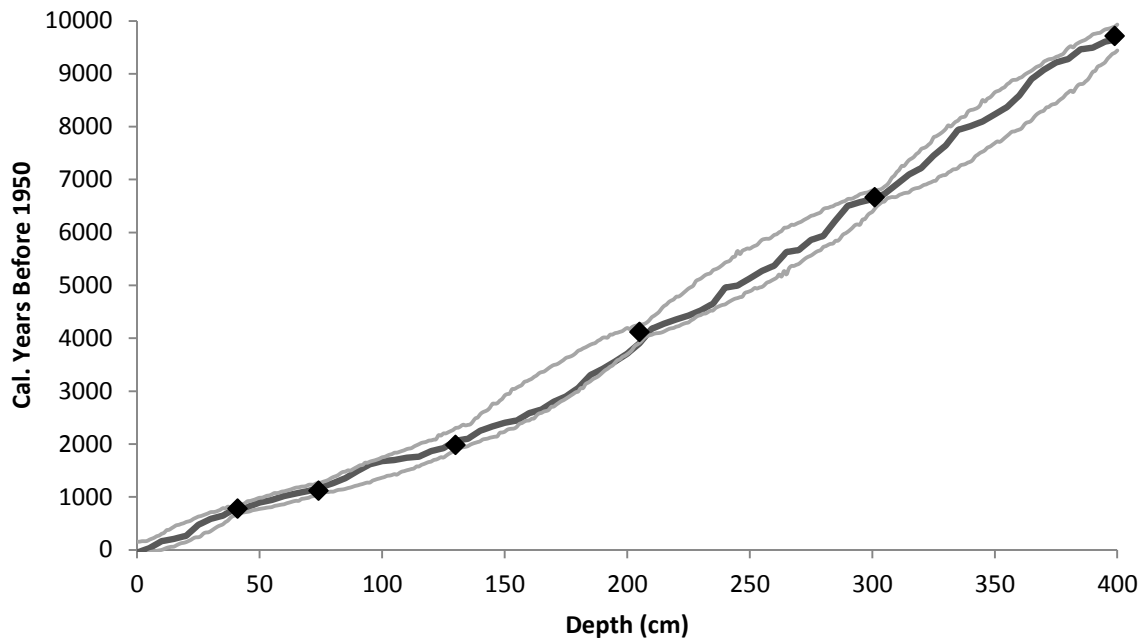


Figure 3: Chronology for the Path Lake sediment core. The black diamonds indicate calibrated ^{14}C dates. The dark grey line is the average estimated age-depth curve using the R software package BACON. The lighter grey lines represent the minimum and maximum values at every 1cm.

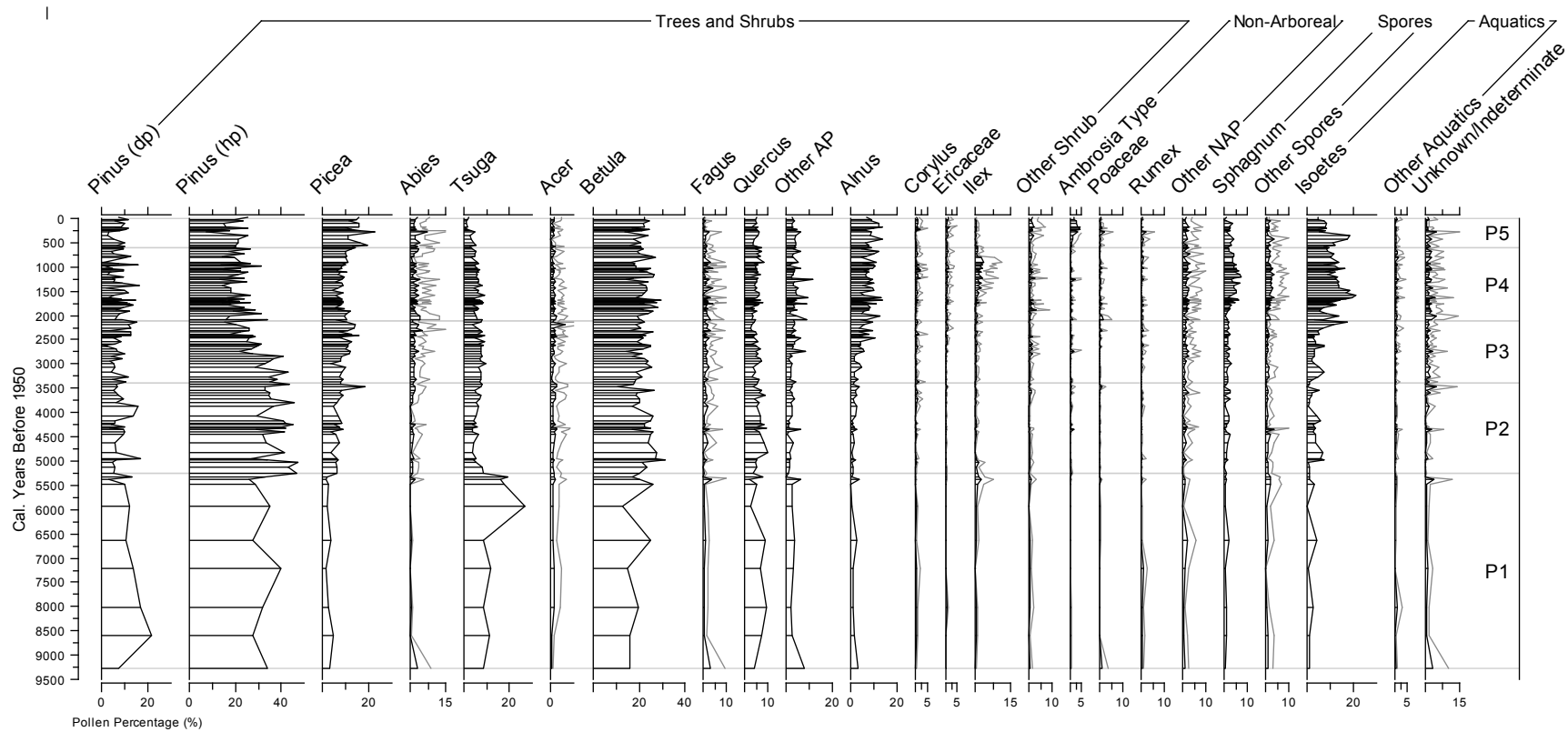


Figure 4: Pollen percentage diagram for Path Lake, Port Joli, Nova Scotia. Only major taxa are shown, and a 3x exaggeration is applied to taxa representing a smaller portion of the total pollen record.

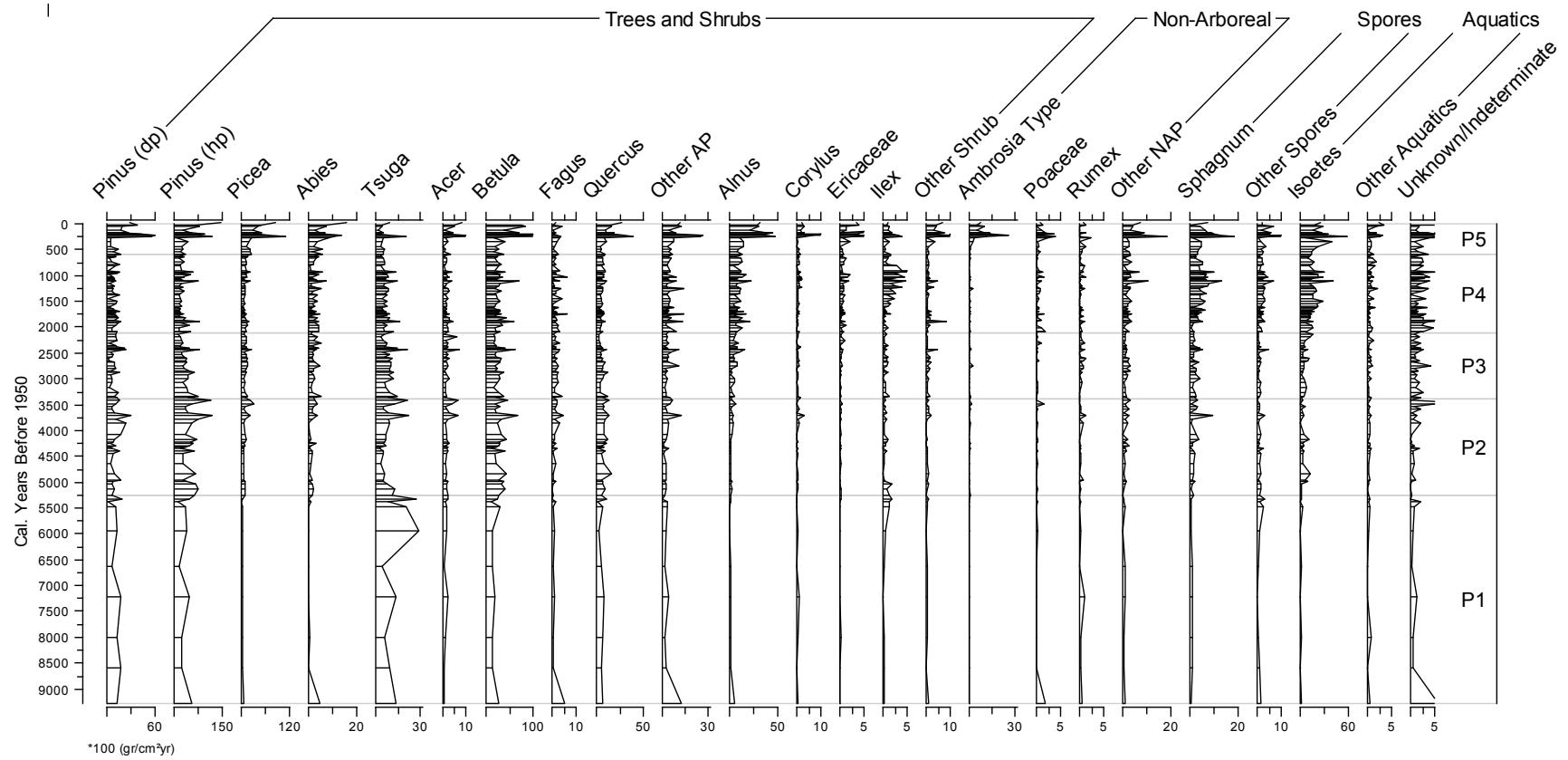


Figure 5: Pollen accumulation rates (PAR) for Path Lake, Port Joli, Nova Scotia. Note changes in scale.

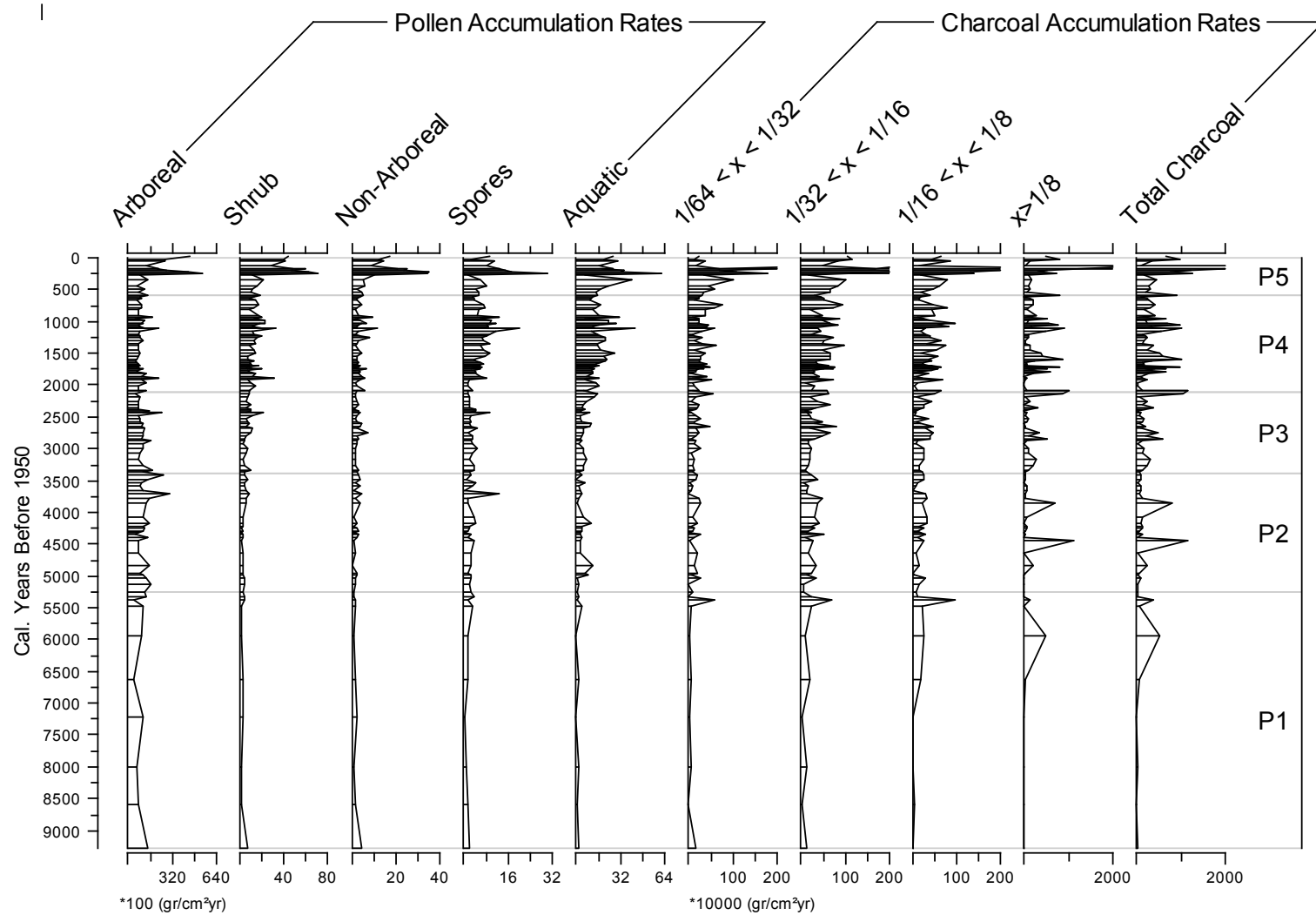


Figure 6: Pollen accumulation rates and charcoal accumulation rates of the measured size classes for Path Lake, Port Joli, Nova Scotia. Note changes in scale. Charcoal accumulation rates in zone P5 between 160-180 cal. yr. BP exceed the upper scale limit by at least 2x.

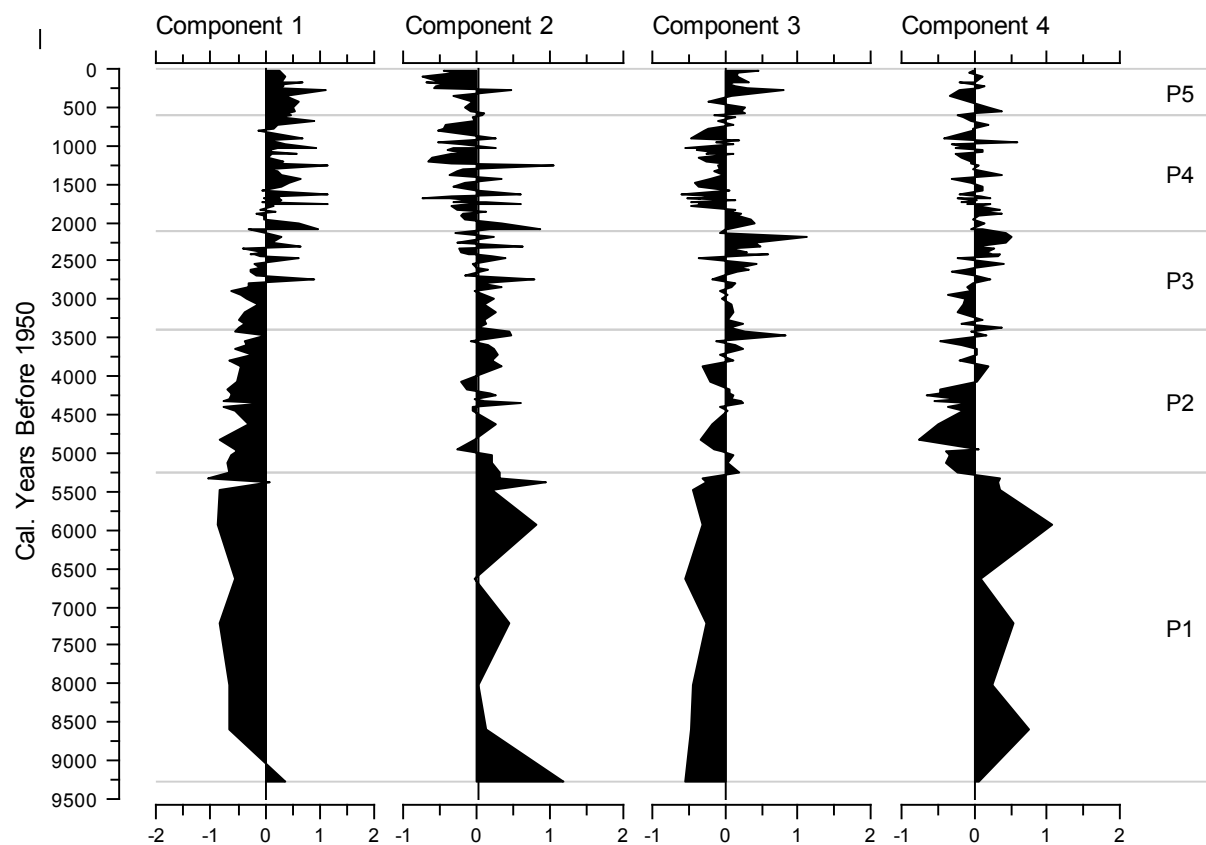


Figure 7: Principal component analysis scores of pollen percentages for Path Lake, Port Joli, Nova Scotia. The PCA analysis is based on a sum of 17 arboreal, non-arboreal and spore taxa.

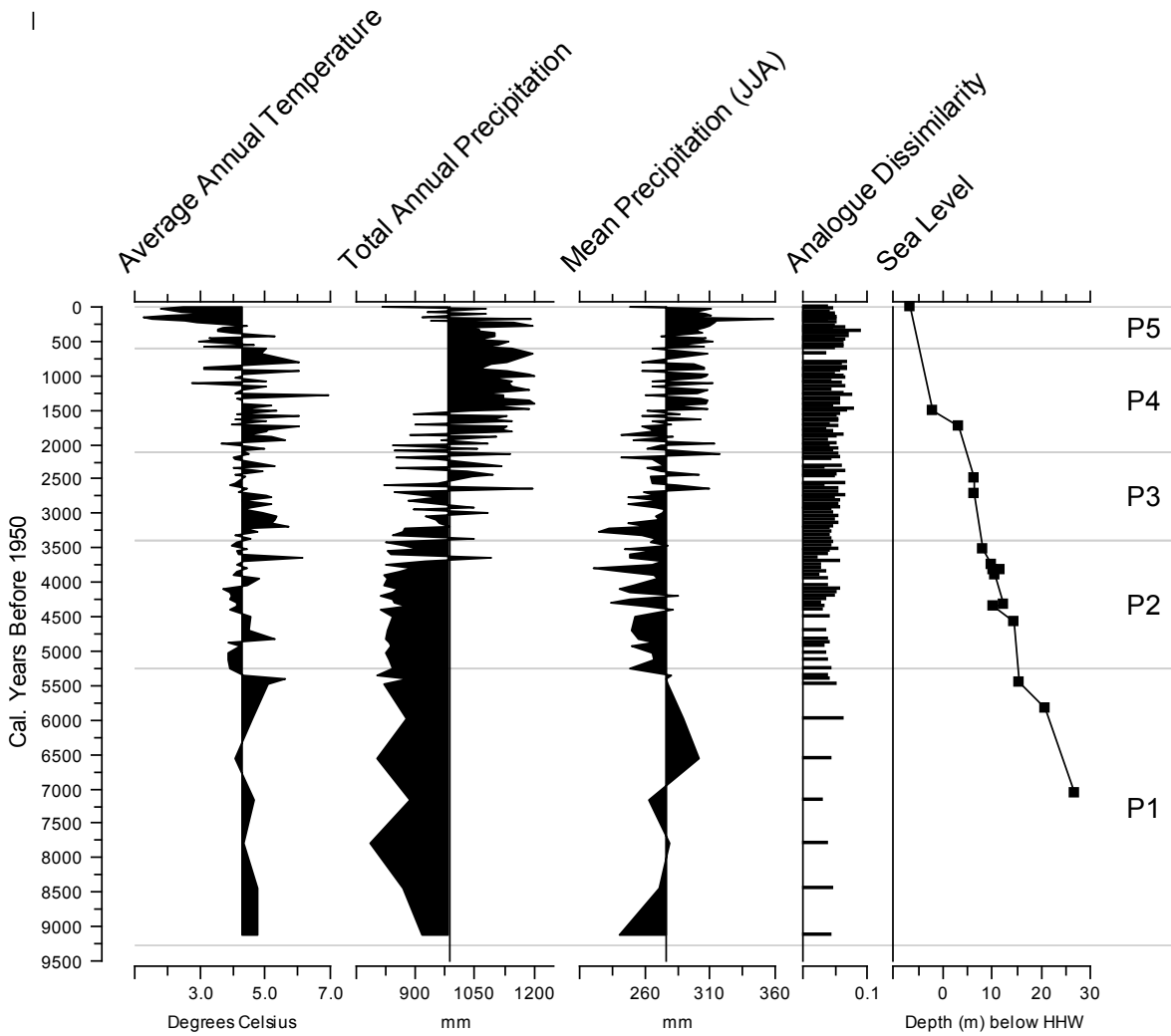


Figure 8: Reconstructed mean average annual temperature ($^{\circ}\text{C}$), total annual precipitation (mm) and total summer precipitation (mm) for Path Lake, based on the Modern Analogue Technique (MAT). Values are represented as either above or below reconstructed average (4.3°C , 983.7mm and 276.1mm , respectively). Sea level data was obtained from multiple sources (Edgecombe et al., 1999; Ogden, 1986; Scott et al., 1995; Scott, Gayes and Collins, 1995; Forbes et al., 2009). HHW refers to Higher High Water, which is the maximum tidal range (up to 2m above sea level along the Atlantic coast).

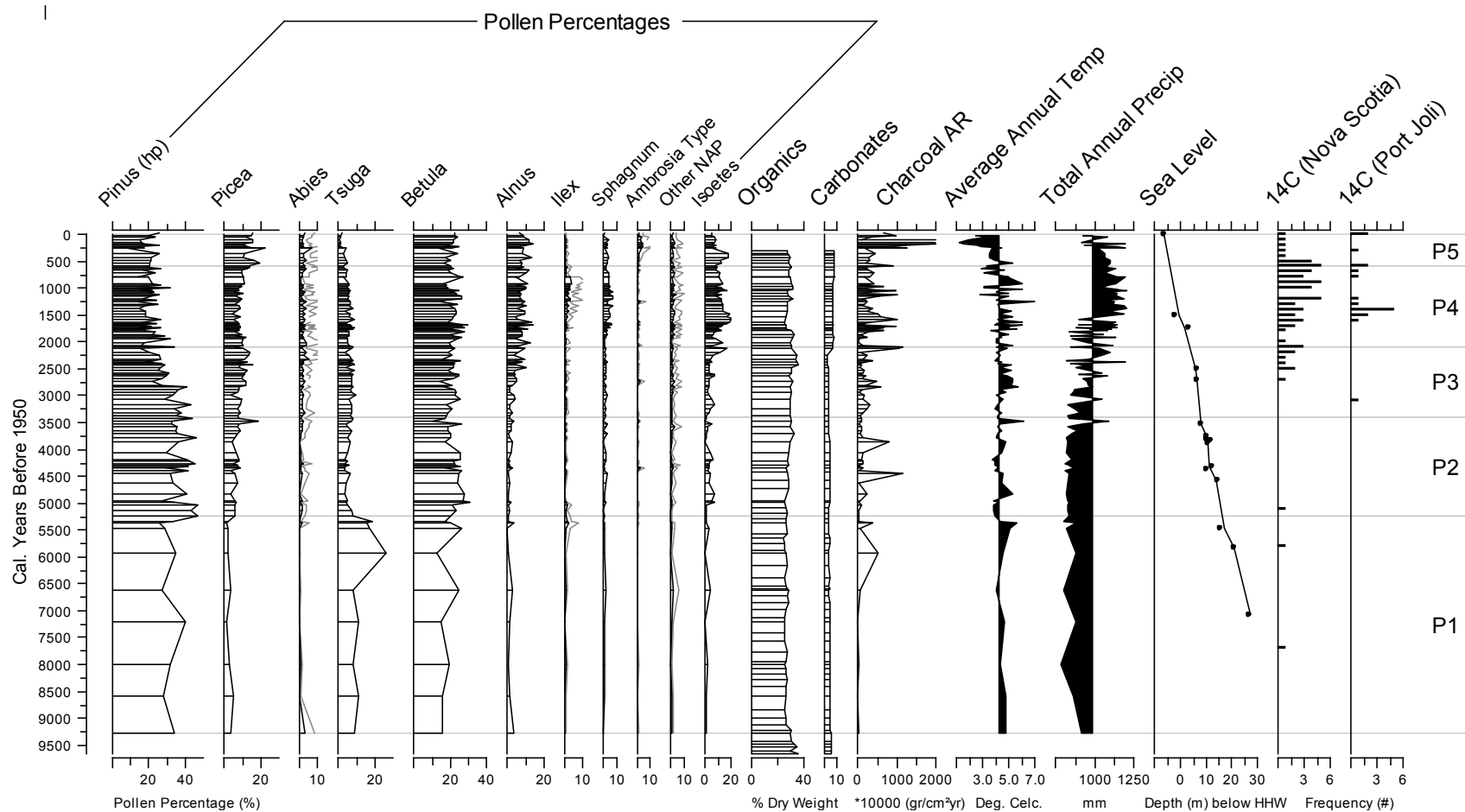


Figure 9: Paleoenvironmental summary for the Port Joli region, Nova Scotia, including Path Lake pollen percentages, organic/carbonate content, charcoal accumulation rates (CAR), paleo-reconstructions, sea level (Edgecombe et al., 1999; Ogden, 1986; Scott et al., 1995; Scott, Gayes and Collins, 1995; Forbes et al., 2009) and archaeological radiocarbon dates. Archaeological frequency distributions of ^{14}C dates are interpreted as representing cultural activity. The ^{14}C dates were obtained from the CARD database (Nova Scotia; <http://www.canadianarchaeology.ca/>; Morlan 2005) and the Canadian Museum of Civilization (Port Joli; Betts, personal communication, 2013).

Table 1

Conventional radiocarbon ages and calibrated age ranges (CALIB 6.0; Stuiver and Reimer, 1993; Reimer et al., 2009) for Path Lake-TR05, Port Joli, Nova Scotia. Samples were comprised of organic material extracted from the sediment core.

Laboratory No. Beta-	Depth (cm)	¹³ C/ ¹² C Ratio	Conventional Radiocarbon Age	Calibrated Age Ranges (probability)	Sigma (σ)
343098	41-43	-26.9 o/oo	870 +/- 30 BP	732-795 (0.963) 887-891 (0.037)	1σ
				698-803 (0.757) 808-831 (0.059) 855-905 (0.184)	2σ
329631	74-75	-29.0 o/oo	1190 +/- 30 BP	1068-1143 (0.873) 1159-1169 (0.127)	1σ
				1006-1029 (0.038) 1053-1180 (0.932) 1209-1230 (0.03)	2σ
329632	130-131	-27.2 o/oo	2030 +/- 30 BP	1932-2004 (0.932) 2027-2036 (0.068)	1σ
				1898-1914 (0.037) 1918-2062 (0.933) 2086-2105 (0.03)	2σ
343099	205-207	-32.8 o/oo	3750 +/- 30 BP	4009-4030 (0.147) 4082-4153 (0.853)	1σ
				3987-4048 (0.222) 4065-4162 (0.674) 4167-4180 (0.021) 4198-4230 (0.082)	2σ
343100	301-302	-26.8 o/oo	5840 +/- 30 BP	6573-6579 (0.042) 6633-6694 (0.811) 6701-6719 (0.147)	1σ
				6562-6593 (0.105) 6597-6737 (0.895)	2σ
329633	399-400	-26.3 o/oo	8740 +/- 40 BP	9601-9777 (0.972) 9853-9857 (0.018) 9879-9882 (0.011)	1σ
				9560-9574 (0.028) 9580-9888 (0.972)	2σ

Table 2

Taxon loadings and the explained variance (eigenvalues) of a principal component analysis performed on the pollen percentages of a core from Path Lake.

Taxon	Component			
	1	2	3	4
<i>Pinus haploxylon</i>	-1.56	0.97	0.45	-1.06
<i>Pinus diploxylon</i>	-0.55	-0.70	-0.62	2.20
<i>Picea (undiff.)</i>	1.00	-0.61	2.13	-0.03
<i>Abies balsamea</i>	1.26	0.45	1.49	-0.05
<i>Tsuga canadensis</i>	-0.83	1.22	-0.79	1.73
<i>Larix</i>	1.21	0.79	-1.08	0.58
<i>Juniper</i>	0.92	1.44	-0.38	-0.19
<i>Acer (undiff.)</i>	0.05	0.73	1.45	0.29
<i>Betula</i>	-0.43	-1.48	-0.73	-1.20
<i>Fagus</i>	1.09	1.46	-0.61	-0.36
<i>Fraxinus (undiff.)</i>	0.84	1.41	-0.78	-0.45
<i>Populus</i>	1.09	-0.21	-1.27	0.20
<i>Quercus</i>	-0.62	-0.25	-1.11	-1.39
<i>Ulmus</i>	-0.22	-0.44	0.37	1.96
<i>Alnus (undiff.)</i>	1.70	-0.76	-0.17	0.14
<i>Ericaceae</i>	1.24	-0.94	0.12	-0.04
<i>Sphagnum</i>	0.75	-1.50	-1.05	-0.05
Eigenvalues	0.25	0.14	0.09	0.08

Chapter 5 – Results

Mid- to Late Holocene Successional Development of a Coastal Fen in Port Joli Harbour, southwestern Nova Scotia

5.1 Introduction

Wetland areas that accumulate more than 40cm of organic sediments are defined as peatlands, and can be further categorized as bogs, fens or swamps (Price et al., 2005). In southwestern Nova Scotia soils tend to be fairly acidic due to podsolization, which is a soil-forming process that is heavily influenced by moist and humid climates (Wilson, 2011). Wetlands and peatlands require slightly acidic to acidic soils to promote peat accumulation, and are therefore abundant along the Atlantic coast of Nova Scotia and upland regions.

Mid-Holocene climate change and sea level rise can impact ecological succession by influencing groundwater levels in southwestern Nova Scotia (Martin et al., 2005). The culmination of vegetation succession into ‘climax’ communities therefore may not follow traditional hydrarch models (Klinger, 1996). The classification of wetlands and their responsiveness to climatic change is important in terms of creating conservation policy and legislation to protect these sensitive ecosystems.

A sedimentary core was collected from a fen environment to provide a paleo-ecological context for the interpretation of human activities associated with a local archaeological dig site in Port Joli Harbour, southwestern Nova Scotia. The purpose of the study was to determine the evolution of Holocene vegetation for this particular site, and to determine if the paleo-environmental record could lend some insight into the human occupation of the site.

5.2 Study Area

Site TR01 (43°84'87"N, 64°89'02", 5m) is located in Thomas Raddall Provincial Park, along the Atlantic coast of southwestern Nova Scotia. The site is in close proximity to an actively studied

archaeological dig site (AIDf-30), located on a knoll in the center of a wetland environment. At site TR01, decomposed peat accumulations and a relatively high water table were overlain by a mat of unconsolidated *Sphagnum* moss. The center of the site was densely covered in tall ferns and small shrubs (red maple), and the outer edge was more forested (spruce, alder, maple). The high plant diversity and productivity, as well as the presence of a small stream surrounding the base of the knoll led to the classification of site TR01-L as a fen-type ecosystem. The primary characteristics of a fen include an accumulation of peat, a water table equal to, above or below the vegetation surface, and a diverse vegetation community comprised of a combination of ferns, sedges, mosses, graminoids and shrubs (Warner and Rubec, 1997).

5.3 Methodology

A modified Livingstone piston corer and a Russian peat corer were used to collect several cores from the fen at site TR01. The core selected for analysis (TR01-L) consisted of the bottom 0.44m of a single 0.91m drive. The upper 0.47m of the drive was not recovered as the sediment was too unconsolidated. Core TR01-L was chosen for further analysis as it contained the full sequence, and had the greatest amount of recovered sediment from the upper section of the core. The base of several cores from the site consisted of finely grained, light gray, sandy clay, indicating a complete record of sediment accumulation. All cores were enclosed in plastic-wrap, aluminum foil and split PVC tubing. They were then transported to the University of Ottawa to be stored in refrigerators at 4°C.

Magnetic susceptibility was measured at 1.0cm intervals using a Bartington MS2C meter and loop sensor. Loss-on-ignition was used to determine organic and carbonate content of the sediment core (Dean, 1974). Four samples of organic matter (fibres, wood, charcoal, etc.) from the TR01-L sediment core were sent to Beta Analytic Dating Laboratory for accelerator-mass spectrometry (AMS

¹⁴C) dating. An age-depth model was fit to the resulting ages in the R software package BACON to establish a chronology (Blauuw and Christen, 2011).

Sediment subsamples were extracted from the TR01-L sediment core for pollen analysis. Non-polliniferous material was removed through chemical treatment, involving 10% hydrochloric acid, 10% potassium hydroxide, hydrofluoric acid, and acetolysis solution. Residual pollen material was preserved and mounted on microscope slides with silicone oil (Faegri and Iverson, 1989). To enable the calculation of fossil pollen concentration (Faegri and Iverson, 1989), two *Lycopodium* spore tablets (batch #938934) were added to each sample before processing. Pollen grains and spores were counted along evenly spaced transects using a Nikon Eclipse 80i light microscope at 400x magnification. Reference material and texts were used for identification of all fossil pollen and spores found on the slides (Faegri and Iverson, 1989; McAndrews et al., 1973; Moore, Webb and Collinson, 1991; Roland and Smith, 1969). An average total pollen sum of 533 pollen grains per slide was counted, excluding aquatic species.

Black, angular fragments or opaque fragments where a linear or rectangular wood-like structure was visible were identified as micro-charcoal (Clark, 1982). Fragments were classified into four categories according to size; 1: $218.75 \leq x < 437.5 \mu\text{m}^2$, 2: $437.5 \leq x < 875 \mu\text{m}^2$, 3: $875 \leq x < 1750 \mu\text{m}^2$ and 4: $\geq 1750 \mu\text{m}^2$ (Paquette, 2012; Whitlock and Larson, 2001). The geometric mean of each size class represented the total area of charcoal at each depth interval (Whitlock and Larson, 2002).

5.4 Results

5.4.1 Sediment

Near the base of the core, organic content (LOI550) represented less than 20% of the dry weight (Fig 10). At 70cm, organic content rose rapidly to 50%, and continued to increase gradually until reaching between 95-100% at the surface. Carbonate content remained minimal and constant throughout the lower portion of the sequence (<2%), and was essentially zero after 52cm. Magnetic

susceptibility was relatively high near the base of the core, and reached its maximum value at 86cm. This is the depth of the core that contained a rock spanning the entire diameter of the core. Magnetic susceptibility decreased gradually until reaching 71cm, where it remained constant until the surface of the core.

5.4.2 Chronology

Accelerator-mass spectrometry (AMS ^{14}C dating) was used to obtain the ages of four samples at a series of depths in the TR01-L sediment core (Fig 11). The age-depth model BACON suggests changes in sedimentation rate associated with the change in sediment type (Fig 10, 11). The date obtained at 55cm was excluded from the age-depth model, as the analyzed material contained more ^{14}C than the modern reference standard (AD 1950). This resulting date was most likely contaminated, possibly by shrub rootlets, fungal remains or foreign material (Piotrowska et al., 2011).

5.4.3 Pollen and Micro-Charcoal Record

Zone F1 (89-71cm) was dominated by *Betula*, which accounted for 20-35% of the total pollen sum. *Sphagnum* and *Dryopteris* reached up to 15% and 30% respectively. Most other pollen taxa ranged between 0-7% of the total pollen sum. *Abies*, *Tsuga*, *Acer* and *Ilex* were particularly low in abundance in this zone. A sudden and large increase in *Isoetes* (to 50%) occurred at 77cm, and it subsequently declined just as rapidly. The pollen concentration in Zone F1 was low for arboreal, shrub, non-arboreal and spore taxa, while maximum for aquatic species. Charcoal concentrations started low at the base of the zone, and gradually increased. The total charcoal concentration was only represented by particles smaller than $1750\mu\text{m}^2$.

In Zone F2 (71-53cm) there was a significant increase in shrub taxa (*Alnus*, *Corylus*, *Myrica*, *Ilex*). *Pinus haploxylon*, *Pinus diploxylon* and *Tsuga* reached their highest pollen percentages for the sequence.

Another spike in *Isoetes* occurred at 65cm, although it was much smaller than that of the previous zone (20%). Pollen of boreal species (*Picea* and *Abies*) were low in abundance, and *Dryopteris* spores gradually decreased until reaching less than 5% of the total sum. Near the upper limit of this zone, *Betula* pollen percentages decreased by 10%. The pollen concentration of arboreal, shrub, non-arboreal and spore taxa had two large peaks in this zone; a small peak occurred at 67cm, and a larger peak occurred at 59cm. Total charcoal concentration mirrored the first peak in pollen concentration at 67cm, though it decreased and remained relatively low in the rest of the zone. Only charcoal particles greater than $437.5 \mu\text{m}^2$ contributed to the peak.

In Zone F3 (53-47cm) there was a large increase of boreal species (*Picea* and *Abies*), as well as *Betula* pollen percentages. *Dryopteris* rapidly increased at 51cm. The pollen percentage of overall shrub taxa decreased, particularly that of *Alnus*. *Isoetes* was absent in this zone, and all pollen taxa were at their lowest concentrations of the sequence. Total charcoal concentration reached its maximum amount at 51cm, and was represented mostly by particles larger than $1750\mu\text{m}^2$.

5.5 Discussion

The early record of site TR01-L shows an abundance of pollen of shallow-water aquatic species, fern and fern allies, and *Sphagnum* mosses. This is indicative of a shallow-lake environment with abundant macrophytes and wetland environments around the shore. After 63 cm of the TR01-L sediment sequence, aquatic species are no longer found, and pollen assemblages were dominated by arboreal and fen taxa. This suggests that the lake had in-filled to become a wooded fen.

Martin et al. (2005) completed a paleo-environmental study of the Pleasant River Fen ecosystem in central southwestern Nova Scotia to determine the effects of climate change on wetlands. The evolution of the Pleasant River Fen was characterized by succession from a productive shallow lake before 8600 cal. yr. BP to an acidic wooded fen after 1700 cal. yr. BP (Martin et al., 2005). This site was

strongly influenced by changes in groundwater levels associated with Holocene climate change (Martin et al., 2005). Although site TR01-L is in a coastal rather than inland region, the pollen and sediment record seems to reflect a similar successional sequence to that of Pleasant River Fen.

Isoetes is an aquatic species that colonizes early in shallow water environments, and is thus indicative of a high water table (Railton, 1973). Site TR01-L had a large concentration of *Isoetes* pollen near the base of the sediment core (77cm). This indicates the presence of a shallow-water environment at the site roughly 4000 cal. yr. BP. Between 4400-3800 cal. yr. BP, there was a rapid acceleration of sea level rise of 10m (Scott et al., 1995). This potentially accounts for the sudden rapid increase in *Isoetes* associated with increased water levels.

At roughly 3000 cal. yr. BP, a transition to cooler and moister climatic conditions (see Chapter 4; Lennox et al., 2010; Railton, 1973) is reflected by increased clastic sediment input and pollen assemblage changes in the Pleasant River Fen sediment cores (Martin et al., 2005). Site TR01-L showed a significant increase in organic content at this time, which is indicative of the succession of open water to peatland (Wojcicki, 2012). Pollen and charcoal concentration also increased rapidly after 3000 cal. yr. BP, further signalling a change in sediment composition.

A minerotrophic 'poor fen' can be characterized by a vegetation community consisting of *Sphagnum*, Ericaceae and Cyperaceae, associated with *Osmunda*, *Nemopanthus*, *Ilex*, *Schoenoplectus tabernaemontani*, and *Viola* (Muller et al., 2003). Before the evolution of the fen-type environment at 3000 cal. yr. BP, Ericaceae and Cyperaceae species were relatively abundant at site TR01-L. Although the fen was not fully established at this point in time, these species may have reflected wetland communities forming around the edges of the shallow-water lake. An increase in *Osmunda* and *Ilex* at 3000 cal. yr. BP reflects the typical vegetation change related to fen succession.

In drier fens where the water table is lower than the vegetation surface, shrubs and small trees tend to be more prominent features (Warner and Rubec, 1997). In Zone 2, there is a greater abundance

of shrub taxa (alder, hazel, sweet gale and gallberry) and white pine, perhaps indicating slightly drier local conditions, although some of these pollen, particularly that of white pine, may have come from upland trees. An increase in *Acer* after 3000 cal. yr. BP may indicate the establishment of red maple stands along the periphery of the fen (Muller et al., 2003).

After 2000 cal. yr. BP most arboreal species had increased pollen percentages, particularly spruce and birch. Wooded or forested fens are generally dominated by a combination of *Picea mariana*, *Larix*, *Betula*, and *Salix* (Fraser and Keddy, 2005), which is mostly consistent with the vegetation composition seen in the uppermost zone (Zone F3; Figure 12), although these pollen could also be coming from the uplands. Total charcoal concentration in Zone F3 consists mainly of larger-sized particles, suggesting a local fire source (Ohlson and Tryterud, 2000). The increased abundance of vegetation, and the somewhat drier conditions of the fen could explain an increase in local fire disturbances (Kuhry, 1994).

The paleo-environmental record of core TR01-L shows a significant change in vegetation composition after 3000 cal. yr. BP, from an open-water environment to that of a wooded fen. Human occupation in Port Joli Harbour was recorded after 1600 cal. yr. BP (see Chapter 4). The transformation of the environment therefore preceded the local archaeological record of human occupation. The uppermost zone of the TR01-L pollen record lacks the temporal resolution to show significant vegetation changes after humans had settled in the region. Despite this limitation, the record provides a paleo-environmental context in terms of ecosystem components that may have led native inhabitants to establish themselves at this particular local site.

5.6 Conclusion

A sediment core from TR01-L fen showed a successional pattern beginning with a shallow water environment, surrounded by wetlands. A transformation of environment around 3000 cal. yr. BP was associated with increased regional moisture, and culminated in a wooded fen.

Archaeological excavations from the shore of Port Joli Harbour record local human occupation much later than the establishment of the fen vegetation community. Mid- to Late-Holocene climatic shifts most likely had minimal to no direct influences for the Mi'kmaq in Port Joli Harbour. Indirectly, climate changes contributed to the increase of wetland environments both inland and along the Atlantic coast. Analysis of the paleo-ecological record for core TR01-L in conjunction with local archaeological records could potentially indicate why the site was chosen by the Mi'kmaq inhabitants, and the type of human activity that took place there.

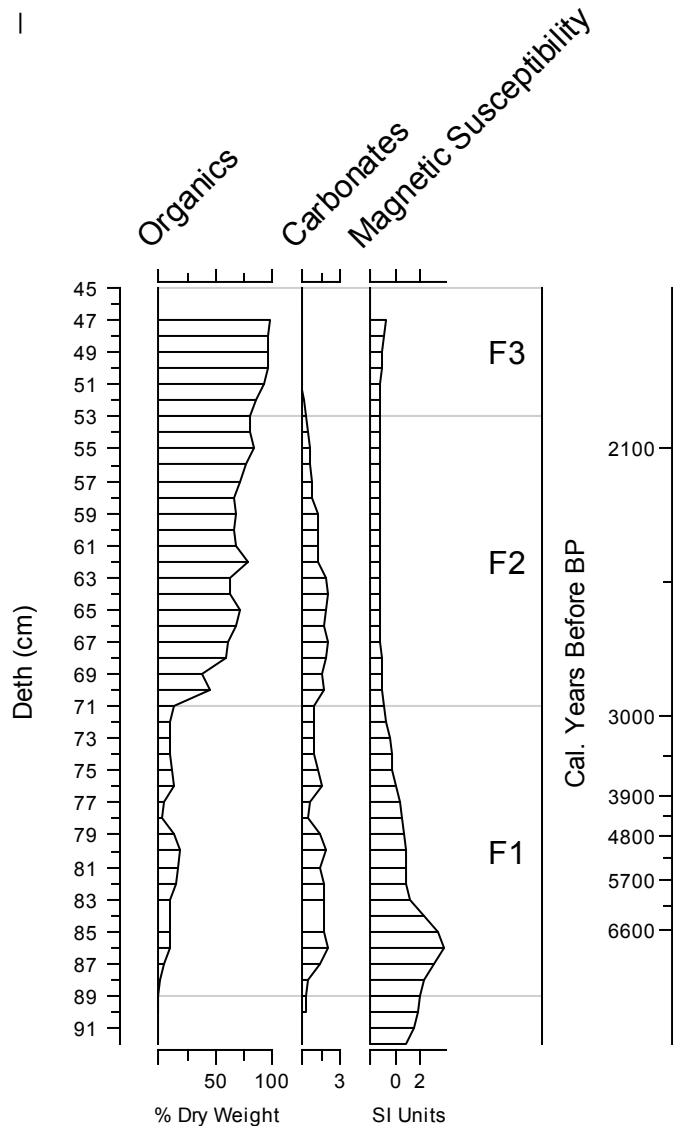


Figure 10: Loss on Ignition and magnetic susceptibility for the Fen, Port Joli, Nova Scotia.

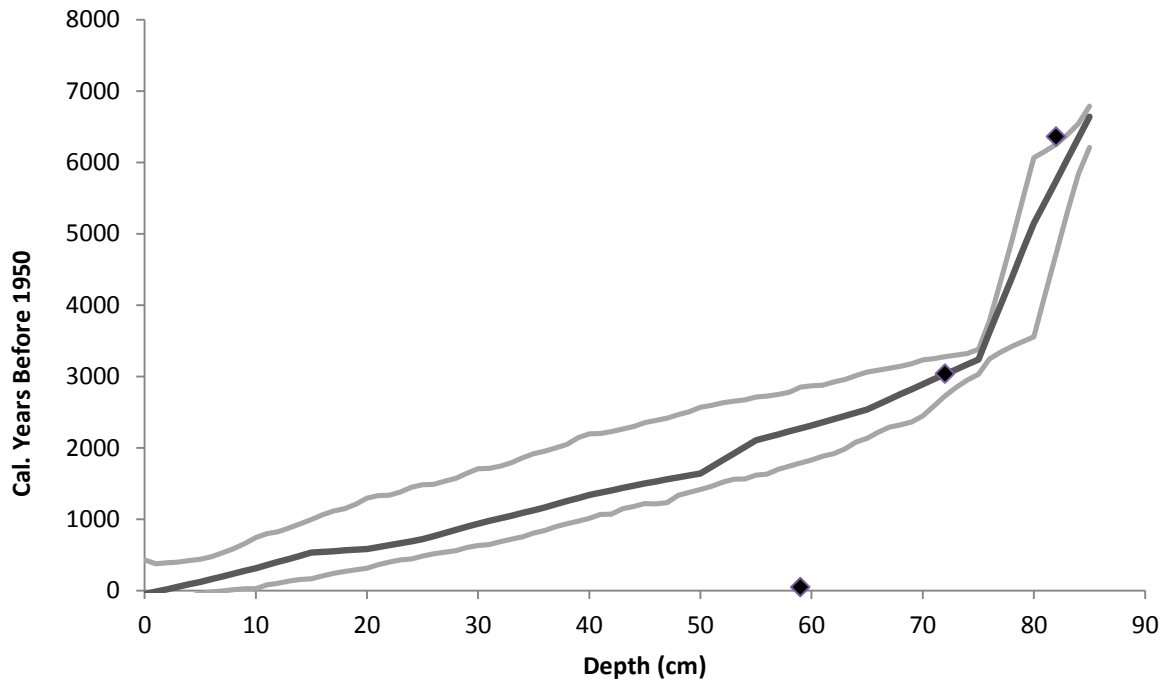


Figure 11: Chronology for the Fen sediment core. The black diamonds indicate calibrated ¹⁴C dates. The dark grey line represents the average estimated age-depth curve using the R software package BACON. The lighter grey lines represent the minimum and maximum values at every 1cm. The date taken at 55cm is excluded from the plot, as the analyzed material contained more ¹⁴C than the modern reference standard (AD 1950).

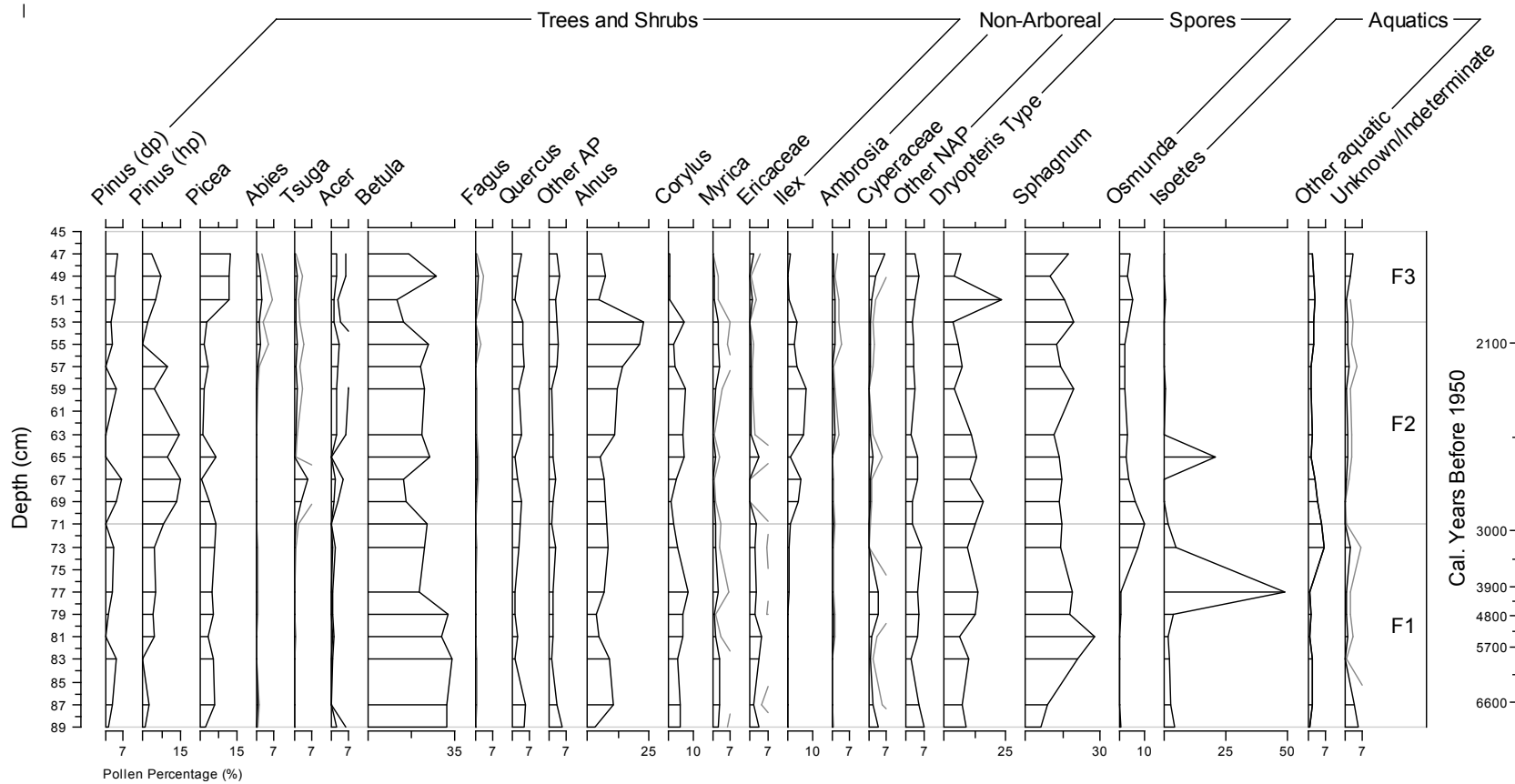


Figure 12: Pollen percentage diagram for the Fen, Port Joli, Nova Scotia. Only major taxa are shown, and a 3x exaggeration is applied to taxa representing a smaller portion of the total pollen record.

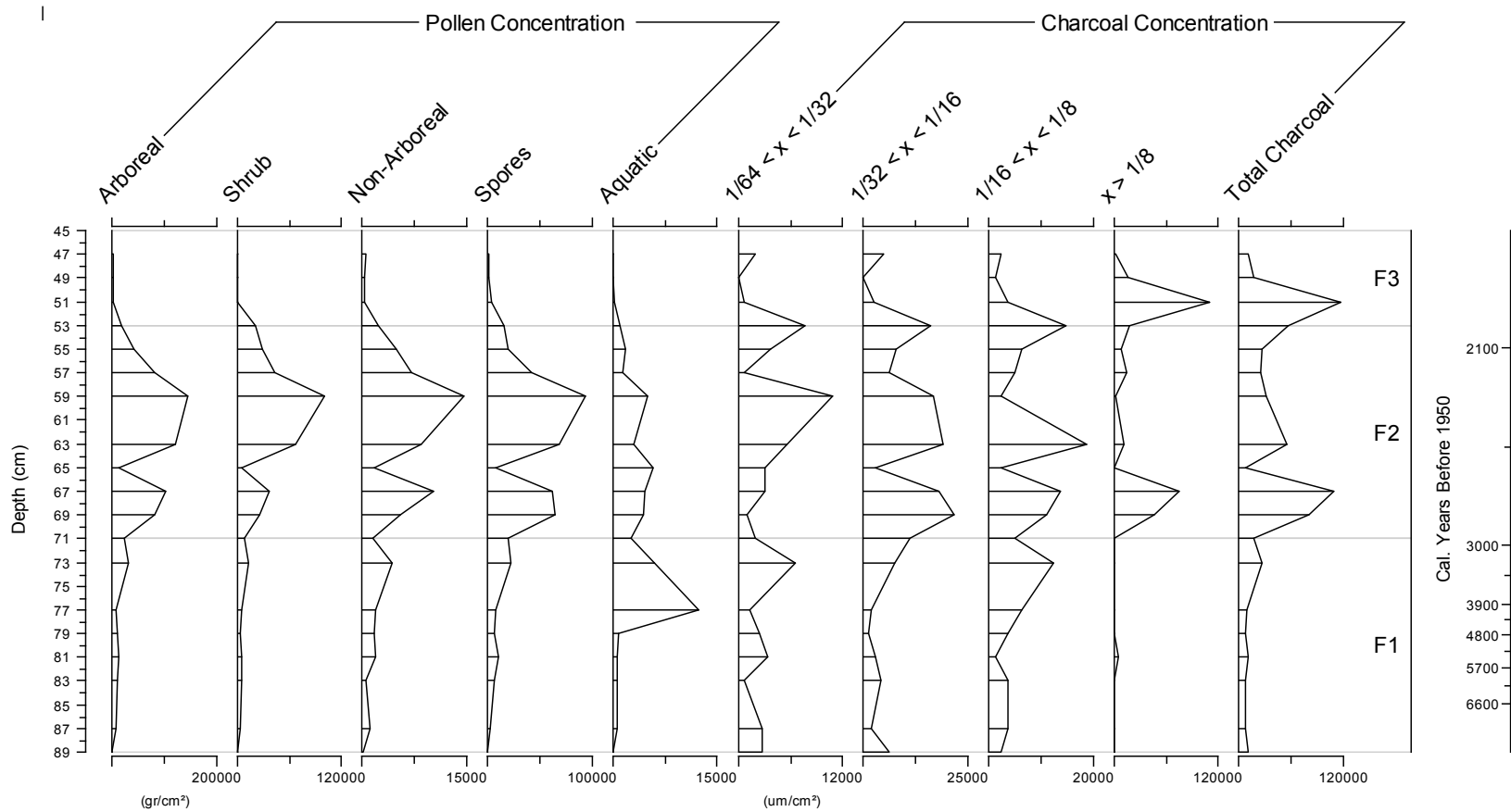


Figure 13: Pollen concentration rates and charcoal concentration rates of the measured size classes for the Fen, Port Joli, Nova Scotia. Note changes in scale.

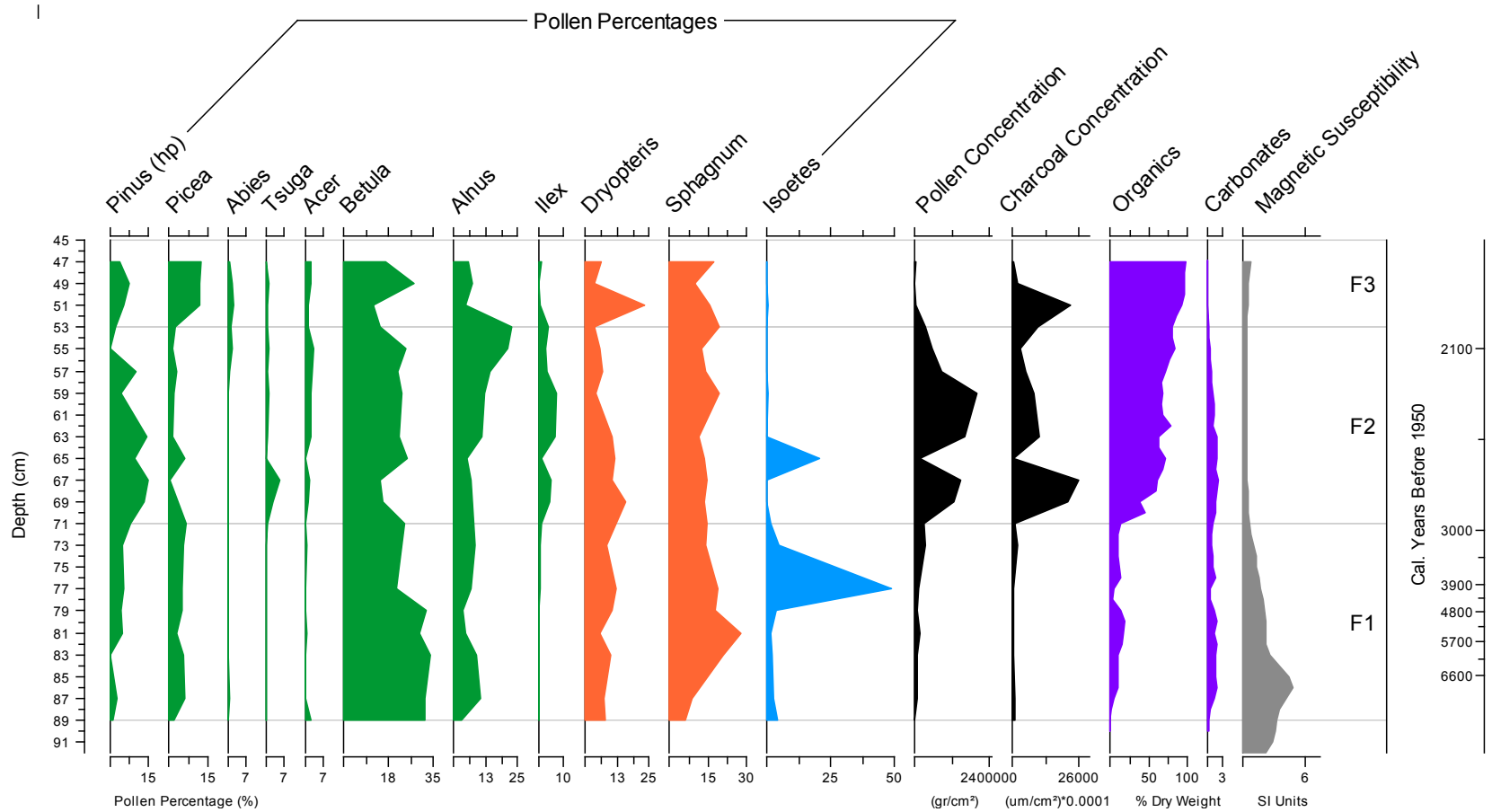


Figure 14: Paleoenvironmental summary for the Port Joli region, Nova Scotia, including Fen pollen percentages, pollen and charcoal concentration, organic/carbonate content and magnetic susceptibility.

Table 3

Conventional radiocarbon ages and calibrated age ranges (CALIB 6.0; Stuiver and Reimer, 1993; Reimer et al., 2009) for the Fen-TR01, Port Joli, Nova Scotia. Samples were comprised of organic material extracted from the sediment core.

Laboratory No. Beta-	Depth (cm)	¹³ C/ ¹² C Ratio	Conventional Radiocarbon Age	Calibrated Age Ranges (probability)	Sigma (σ)
329629	55-56	-28.8 o/oo	110.2 +/- 0.3 pMC	N/A	N/A
343101	59-60	-27.2 o/oo	10 +/- 30 BP	(-5)-(-3) (0.396) 46-56 (0.604)	1σ
				(-5)-(-2) (0.242) 34-71 (0.562) 116-134 (0.077) 228-251 (0.119)	2σ
343097	71-72	-26.5 o/oo	2900 +/- 30 BP	2973-3075 (1.00)	1σ
				2950-3160 (1.00)	2σ
329630	82-83	-26.9 o/oo	5590 +/- 30 BP	6319-6374 (0.802) 6319-6403 (0.198)	1σ
				6303-6413 (0.975) 6425-6436 (0.025)	2σ

Note: Percent modern carbon (pMC) format is used when the analyzed material contains more ¹⁴C than the modern reference standard (AD 1950). This indicates that the environment containing the analyzed sample was respiring carbon after thermo-nuclear bomb testing, which on-set in the 1950s and contributed a major source of 'extra' ¹⁴C into the atmosphere (Beta Analytic, 2012).

Chapter 6 – Conclusions

Paleo-ecological studies use multi-proxy records obtained from sediment cores to provide an environmental perspective of past climate and vegetation variability. A high-resolution pollen record from Path Lake (43°87'00"N, 64°92'42"W, 10m) was used in conjunction with archaeological data to better understand the regional dynamics between humans and the ecosystem in Port Joli Harbour, southwestern Nova Scotia. Focus was placed on the mid- to late-Holocene, as there is clear evidence of human settlement in the region after 3200 cal. yr. BP. A shorter peat core (TR01-L) from a fen (43°84'87"N, 64°89'02", 5m) was analyzed to provide a more localized context within which interpretation of an actively studied archaeological dig site could be made.

Five major vegetation zones were defined for the Path Lake sediment record, based on the results of a principal component analysis of Holocene pollen percentages. The base of the Path Lake pollen record (9280 cal. yr. BP) was dominated by *Pinus haploxylon* and *Pinus diploxylon*, mixed with *Tsuga*, *Betula* and *Quercus*. This combination of hardwood and mixed stands gave way to the gradual colonization of boreal taxa (*Picea* and *Abies*) after 5250 cal. yr. BP. Until 3400 cal. yr. BP, the pollen assemblages reflected extended relatively dry environment, where reconstructed total annual precipitation was below Holocene average.

After 3400 cal. yr. BP, there was a large increase in plant taxa associated with wetland-type environments in the Path Lake record. Higher abundances of *Alnus*, *Sphagnum* and *Isoetes* reflected the transition to a moister climate, which was also comparable with other multi-proxy records from the region (Lennox et al., 2012; Railton, 1973). Reconstructed total annual precipitation showed a long-term trend of increasing values, signalling a gradual rather than abrupt climatic shift. The general decline in *Pinus haploxylon* and hardwood taxa after 3000 cal. yr. BP also indicates an ecological response to cooler and moister climatic conditions (Green, 1987). The sediment core from site TR01-L showed a progressive succession from a shallow-water to wetland ecosystem, consistent with the paleoclimate reconstruction

but potentially showing increasing effective moisture rather than precipitation. In Path Lake, a rapid regional increase in boreal species (*Picea* and *Abies*) after 900 cal. yr. BP could indicate cooling associated with the Little Ice Age, although reconstructed average temperature does not show any significant changes associated with known climatic shifts in the Holocene before this time.

Inferred prehistoric settlement intensity (or cultural activity) does seem to be associated with major changes in vegetation, though the exact nature of the interaction is not certain without a detailed archaeological perspective. Human occupation of Nova Scotia and Port Joli Harbour was inferred by looking at the frequency of archaeological radiocarbon dates. This analysis may not be accurate in determining the correct timing of human occupation, as sea level rise during the Holocene may have destroyed earlier archaeological evidence of coastal sites. The conclusion that human occupation is related to climate and vegetation changes is still valid, however the results of this study only represent one small piece of what is potentially an extensively complicated history.

Historical records show that culturally significant plants for the Mi'kmaq population were present in the Holocene forests, and *Picea* and *Alnus* were of particular importance in every-day life. The increase in abundance of *Ilex* in Path Lake and TR01-L occurs when local and regional archaeological records signal greater settlement intensity. It has been suggested in this thesis that *Ilex* may have been used in a ceremonial capacity by the Mi'kmaq, as it was used by native inhabitants of North and Central America as an emetic and stimulant in herbal teas (Burrows and Tyrl, 2013; Odenwald and Turner, 2006). Vegetation composition was unlikely to have been significantly altered by native inhabitants as there is little evidence suggesting that the Mi'kmaq practiced agriculture (Mosseler et al., 2003). However, European settlement did seem to have large consequences in terms of elevating charcoal accumulation rates through land clearance after 350 cal. yr. BP.

The chronology of the TR01-L core from the fen was a limiting aspect in this study, as radiocarbon-dated samples were most likely contaminated by roots. The top of the TR01-L record was

also missing, so more detail of human-environmental interactions is not possible. For these reasons, the TR01-L record could not be significantly correlated to the Path Lake record. Combining regional and local data into one cohesive record would have strengthened the overall knowledge of human-ecosystem dynamics in Port Joli Harbour. However, the two separate articles still provide significant insights that can be beneficial to future paleoecological and archaeological research in the area.

Using an interdisciplinary approach to understand the influence of human activity on ecosystems and *vice-versa* allows for a more complete understanding of the past. There is a lack of comprehensive ecological studies that relate human land-use to vegetation changes at a time scale longer than 200 years (Briggs et al., 2006). This study analyzed paleoecological sequences from coastal sites within the context of Holocene climate change, aboriginal site occupation, and European settlement. Future work could be done to bridge this gap in knowledge between disciplines by studying regions where perspectives from ecological, biological, archaeological and/or anthropological backgrounds can be connected. This will create not only multi-proxy, but cross-disciplinary records for the Holocene that can be used to advance multiple fields of study.

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Appendix A - Magnetic Susceptibility Data (TR05-Path Lake)

Depth (cm)	Age (cal. yr. BP)	Average Reading		Depth (cm)	Age (cal. yr. BP)	Average Reading
23.00	391.60	x		60.00	1018.90	-1.97
24.00	432.80	x		61.00	1028.90	-1.93
25.00	474.10	x		62.00	1038.90	-1.97
26.00	496.50	x		63.00	1048.90	-1.93
27.00	518.90	-1.33		64.00	1058.90	-1.93
28.00	541.30	-1.43		65.00	1069.00	-2.00
29.00	563.70	-1.43		66.00	1078.30	-1.97
30.00	586.10	-1.53		67.00	1087.70	-1.97
31.00	598.60	-1.53		68.00	1097.10	-1.97
32.00	611.10	-1.63		69.00	1106.50	-1.90
33.00	623.60	-1.63		70.00	1115.90	-1.90
34.00	636.10	-1.67		71.00	1130.00	-1.87
35.00	648.60	-1.67		72.00	1144.10	-1.90
36.00	675.10	-1.70		73.00	1158.20	-1.93
37.00	701.60	-1.67		74.00	1172.30	-1.93
38.00	728.10	-1.73		75.00	1186.40	-1.93
39.00	754.60	-1.67		76.00	1201.70	-1.97
40.00	781.10	-1.67		77.00	1216.90	-1.93
41.00	786.70	-1.60		78.00	1232.20	-1.93
42.00	792.40	-1.63		79.00	1247.40	-1.90
43.00	798.00	-1.57		80.00	1262.70	-1.90
44.00	803.70	-1.57		81.00	1281.60	-1.90
45.00	809.40	x		82.00	1300.50	-1.97
46.00	826.70	x		83.00	1319.40	-1.93
47.00	844.00	x		84.00	1338.30	-1.83
48.00	861.40	x		85.00	1357.20	-1.83
49.00	878.70	-1.53		86.00	1384.50	-1.83
50.00	896.10	-1.63		87.00	1411.90	-1.83
51.00	905.90	-1.70		88.00	1439.30	-1.87
52.00	915.70	-1.73		89.00	1466.60	-1.80
53.00	925.60	-1.80		90.00	1494.00	-1.80
54.00	935.40	-1.80		91.00	1518.90	-1.80
55.00	945.30	-1.87		92.00	1543.80	-1.77
56.00	960.00	-1.87		93.00	1568.80	-1.73
57.00	974.70	-1.90		94.00	1593.70	-1.73
58.00	989.50	-2.00		95.00	1618.60	-1.77
59.00	1004.20	-1.97		96.00	1630.60	-1.77
60.00	1018.90	-1.97		97.00	1642.60	-1.73

Depth (cm)	Age (cal. yr. BP)	Average Reading		Depth (cm)	Age (cal. yr. BP)	Average Reading
98.00	1654.60	-1.63		136.00	2132.20	x
99.00	1666.60	-1.73		137.00	2162.20	x
100.00	1678.50	-1.70		138.00	2192.20	x
101.00	1682.70	-1.70		139.00	2222.20	-2.03
102.00	1687.00	-1.67		140.00	2252.10	-2.17
103.00	1691.20	-1.67		141.00	2268.50	-2.23
104.00	1695.40	-1.53		142.00	2284.90	-2.20
105.00	1699.60	-1.60		143.00	2301.30	-2.23
106.00	1708.20	-1.63		144.00	2317.80	-2.23
107.00	1716.70	-1.67		145.00	2334.20	-2.20
108.00	1725.30	-1.57		146.00	2348.00	-2.27
109.00	1733.90	-1.60		147.00	2361.80	-2.23
110.00	1742.50	-1.53		148.00	2375.60	-2.17
111.00	1746.70	-1.53		149.00	2389.40	-2.23
112.00	1750.90	-1.53		150.00	2403.20	-2.13
113.00	1755.10	-1.47		151.00	2412.20	-2.13
114.00	1759.30	-1.60		152.00	2421.10	-2.07
115.00	1763.60	-1.57		153.00	2430.10	-2.03
116.00	1784.30	-1.50		154.00	2439.10	-2.07
117.00	1805.10	-1.53		155.00	2448.00	-2.03
118.00	1825.90	-1.53		156.00	2475.40	-2.00
119.00	1846.60	-1.50		157.00	2502.80	-2.00
120.00	1867.40	-1.50		158.00	2530.20	-1.93
121.00	1878.90	-1.47		159.00	2557.60	-1.97
122.00	1890.40	-1.53		160.00	2585.00	-1.93
123.00	1901.80	-1.40		161.00	2598.80	-1.90
124.00	1913.30	-1.40		162.00	2612.70	-1.87
125.00	1924.80	-1.43		163.00	2626.50	-1.87
126.00	1952.40	-1.43		164.00	2640.30	-1.87
127.00	1980.00	-1.40		165.00	2654.20	-1.83
128.00	2007.60	-1.37		166.00	2683.30	-1.83
129.00	2035.20	-1.37		167.00	2712.50	-1.83
130.00	2062.80	-1.40		168.00	2741.70	-1.83
131.00	2070.70	-1.33		169.00	2770.90	-1.70
132.00	2078.60	-1.30		170.00	2800.10	-1.77
133.00	2086.50	-1.23		171.00	2820.40	-1.70
134.00	2094.40	-1.13		172.00	2840.80	-1.67
135.00	2102.30	x		173.00	2861.10	-1.67

Depth (cm)	Age (cal. yr. BP)	Average Reading		Depth (cm)	Age (cal. yr. BP)	Average Reading
174.00	2881.50	-1.60		212.00	4217.80	-0.63
175.00	2901.80	-1.63		213.00	4237.20	-0.60
176.00	2933.70	-1.63		214.00	4256.60	-0.60
177.00	2965.70	-1.57		215.00	4275.90	-0.60
178.00	2997.60	-1.53		216.00	4292.10	-0.53
179.00	3029.50	-1.47		217.00	4308.20	-0.53
180.00	3061.40	-1.43		218.00	4324.40	-0.43
181.00	3110.10	-1.40		219.00	4340.50	-0.53
182.00	3158.80	-1.37		220.00	4356.70	-0.50
183.00	3207.50	-1.33		221.00	4371.30	-0.43
184.00	3256.20	-1.40		222.00	4386.00	-0.23
185.00	3304.80	-1.33		223.00	4400.60	-0.10
186.00	3328.30	-1.27		224.00	4415.20	0.13
187.00	3351.80	-1.17		225.00	4429.90	x
188.00	3375.30	-1.20		226.00	4449.10	x
189.00	3398.80	-1.20		227.00	4468.30	x
190.00	3422.30	-1.23		228.00	4487.60	x
191.00	3450.00	-1.20		229.00	4506.80	-1.50
192.00	3477.60	-1.13		230.00	4526.00	-1.60
193.00	3505.20	-1.07		231.00	4552.00	-1.70
194.00	3532.80	-1.00		232.00	4577.90	-1.73
195.00	3560.40	-1.03		233.00	4603.90	-1.80
196.00	3590.20	-1.00		234.00	4629.80	-1.87
197.00	3620.00	-0.97		235.00	4655.80	-1.90
198.00	3649.70	-0.97		236.00	4716.10	-2.00
199.00	3679.50	-0.97		237.00	4776.40	-2.00
200.00	3709.30	-0.93		238.00	4836.80	-2.00
201.00	3748.60	-0.80		239.00	4897.10	-2.00
202.00	3787.80	-0.83		240.00	4957.40	-2.00
203.00	3827.10	-0.80		241.00	4965.40	-2.07
204.00	3866.30	-0.73		242.00	4973.30	-2.03
205.00	3905.60	-0.77		243.00	4981.30	-2.00
206.00	3960.30	-0.77		244.00	4989.30	-1.97
207.00	4015.00	-0.77		245.00	4997.20	-1.97
208.00	4069.70	-0.70		246.00	5024.20	-1.97
209.00	4124.40	-0.67		247.00	5051.10	-1.93
210.00	4179.10	-0.67		248.00	5078.00	-1.93
211.00	4198.50	-0.67		249.00	5104.90	-1.93

Depth (cm)	Age (cal. yr. BP)	Average Reading		Depth (cm)	Age (cal. yr. BP)	Average Reading
250.00	5131.80	-1.97		288.00	6393.20	-1.43
251.00	5160.00	-1.93		289.00	6448.10	-1.47
252.00	5188.30	-1.93		290.00	6503.00	-1.47
253.00	5216.50	-1.93		291.00	6517.20	-1.43
254.00	5244.70	-1.90		292.00	6531.40	-1.10
255.00	5272.90	-1.93		293.00	6545.60	-1.37
256.00	5293.20	-1.97		294.00	6559.90	-1.33
257.00	5313.60	-1.93		295.00	6574.10	-1.33
258.00	5333.90	-1.90		296.00	6585.30	-1.30
259.00	5354.20	-1.90		297.00	6596.50	-1.33
260.00	5374.60	-1.90		298.00	6607.70	-1.33
261.00	5425.50	-1.87		299.00	6618.90	-1.33
262.00	5476.50	-1.83		300.00	6630.10	-1.30
263.00	5527.50	-1.87		301.00	6650.30	-1.10
264.00	5578.50	-1.83		302.00	6670.60	-1.30
265.00	5629.50	-1.80		303.00	6690.80	-1.30
266.00	5637.50	-1.80		304.00	6711.00	-1.30
267.00	5645.40	-1.80		305.00	6731.30	-1.23
268.00	5653.40	-1.80		306.00	6767.50	-1.23
269.00	5661.30	-1.70		307.00	6803.70	-1.20
270.00	5669.30	-1.73		308.00	6839.90	-1.17
271.00	5707.10	-1.73		309.00	6876.10	-1.20
272.00	5745.00	-1.73		310.00	6912.40	-1.17
273.00	5782.90	-1.77		311.00	6949.10	-1.13
274.00	5820.80	-1.70		312.00	6985.80	-1.13
275.00	5858.60	-1.67		313.00	7022.50	-1.13
276.00	5874.10	-1.60		314.00	7059.20	-1.10
277.00	5889.70	-1.63		315.00	7095.90	-1.03
278.00	5905.20	-1.60		316.00	7120.60	-1.13
279.00	5920.70	-1.63		317.00	7145.20	-1.13
280.00	5936.20	-1.47		318.00	7169.80	-1.07
281.00	5994.70	-1.57		319.00	7194.50	x
282.00	6053.10	-1.60		320.00	7219.10	x
283.00	6111.60	-1.53		321.00	7265.80	x
284.00	6170.00	-1.53		322.00	7312.40	x
285.00	6228.50	-1.57		323.00	7359.10	x
286.00	6283.40	-1.40		324.00	7405.80	x
287.00	6338.30	-1.40		325.00	7452.40	x

Depth (cm)	Age (cal. yr. BP)	Average Reading		Depth (cm)	Age (cal. yr. BP)	Average Reading
326.00	7491.20	-1.47		364.00	8837.50	-1.40
327.00	7530.00	-1.53		365.00	8899.50	-1.30
328.00	7568.80	-1.57		366.00	8934.40	-1.30
329.00	7607.60	-1.63		367.00	8969.30	-1.23
330.00	7646.40	-1.63		368.00	9004.20	-1.27
331.00	7704.80	-1.67		369.00	9039.10	-1.30
332.00	7763.20	-1.63		370.00	9074.00	-1.27
333.00	7821.60	-1.67		371.00	9101.80	-1.23
334.00	7880.00	-1.67		372.00	9129.50	-1.23
335.00	7938.40	-1.63		373.00	9157.20	-1.20
336.00	7952.60	-1.67		374.00	9185.00	-1.13
337.00	7966.80	-1.60		375.00	9212.70	-1.03
338.00	7980.90	-1.67		376.00	9226.30	-1.17
339.00	7995.10	-1.67		377.00	9239.80	-1.10
340.00	8009.30	-1.67		378.00	9253.40	-1.07
341.00	8027.00	-1.67		379.00	9266.90	-1.00
342.00	8044.70	-1.63		380.00	9280.50	-0.93
343.00	8062.50	-1.63		381.00	9316.60	-1.00
344.00	8080.20	-1.67		382.00	9352.70	-0.97
345.00	8097.90	-1.63		383.00	9388.90	-0.93
346.00	8125.00	-1.63		384.00	9425.00	-1.03
347.00	8152.10	-1.60		385.00	9461.10	-0.97
348.00	8179.20	-1.67		386.00	9467.80	-1.03
349.00	8206.30	-1.60		387.00	9474.50	-1.03
350.00	8233.40	-1.67		388.00	9481.20	-1.00
351.00	8261.00	-1.63		389.00	9487.80	-0.93
352.00	8288.60	-1.57		390.00	9494.50	-0.97
353.00	8316.30	-1.53		391.00	9517.00	x
354.00	8343.90	-1.53		392.00	9539.40	x
355.00	8371.50	-1.50		393.00	9561.90	x
356.00	8415.10	-1.53		394.00	9584.30	x
357.00	8458.70	-1.50		395.00	9606.70	x
358.00	8502.30	-1.50		396.00	9616.30	x
359.00	8545.80	-1.43		397.00	9625.90	x
360.00	8589.40	-1.40		398.00	9635.50	x
361.00	8651.40	-1.43		399.00	9645.10	20.03
362.00	8713.50	-1.40		400.00	9654.70	21.47
363.00	8775.50	-1.37				

Appendix AA – Magnetic Susceptibility (TR01-Fen)

Depth (cm)	Meter Reading 1	Meter Reading 2	Meter Reading 3	Average Reading		Depth (cm)	Meter Reading 1	Meter Reading 2	Meter Reading 3	Average Reading
47	-1.2	-0.7	-0.8	-0.90		84	2.6	2.7	2.7	2.67
48	-1.5	-0.9	-0.9	-1.10		85	4.1	4	3.8	3.97
49	-1.5	-1.1	-1.1	-1.23		86	4.5	4.5	4.6	4.53
50	-1.7	-1.1	-1.1	-1.30		87	3.6	3.7	3.6	3.63
51	-1.7	-1.2	-1.2	-1.37		88	2.6	2.8	2.8	2.73
52	-1.8	-1.2	-1.2	-1.40		89	2.3	2.5	2.4	2.40
53	-1.9	-1.3	-1.2	-1.47		90	2.2	2.2	2.3	2.23
54	-1.9	-1.3	-1.3	-1.50		91	1.8	1.8	1.9	1.83
55	-1.9	-1.3	-1.3	-1.50		92	0.7	1.1	1.2	1.00
56	-1.9	-1.3	-1.3	-1.50						
57	-1.9	-1.3	-1.3	-1.50						
58	-1.8	-1.3	-1.3	-1.47						
59	-1.8	-1.3	-1.4	-1.50						
60	-1.8	-1.3	-1.4	-1.50						
61	-1.8	-1.3	-1.4	-1.50						
62	-1.7	-1.3	-1.4	-1.47						
63	-1.8	-1.3	-1.3	-1.47						
64	-1.7	-1.2	-1.4	-1.43						
65	-1.7	-1.2	-1.4	-1.43						
66	-1.7	-1.2	-1.3	-1.40						
67	-1.7	-1.3	-1.4	-1.47						
68	-1.6	-1.2	-1.2	-1.33						
69	-1.5	-1.2	-1.2	-1.30						
70	-1.5	-1.1	-1.2	-1.27						
71	-1.2	-1	-1	-1.07						
72	-1	-0.8	-0.8	-0.87						
73	-0.8	-0.5	-0.5	-0.60						
74	-0.5	-0.3	-0.2	-0.33						
75	-0.4	-0.2	-0.1	-0.23						
76	-0.1	0.1	0.2	0.07						
77	0.2	0.4	0.5	0.37						
78	0.5	0.6	0.7	0.60						
79	0.7	0.9	0.9	0.83						
80	0.9	1	1	0.97						
81	0.9	1	0.9	0.93						
82	0.9	1	1	0.97						
83	1.4	1.5	1.4	1.43						

Appendix B - LOI Data (TR05-Path Lake)

Sample Depth (cm)	Age (cal. yr. BP)	Crucible Weight (g)	105° Dry Weight (g)	550° Ignition Weight (g)	950° Ignition Weight (g)	Organics Weight (g)	Carbonate Weight (g)	Organics as % Dry Weight	Carbonates as % Dry Weight
21	309.2	8.5731	8.7247	8.6828	8.6741	0.1097	0.1010	27.6385	7.8047
22	350.4	7.4174	7.5659	7.5249	7.5164	0.1075	0.0990	27.6094	7.7845
23	391.6	8.5136	8.6509	8.6124	8.6041	0.0988	0.0905	28.0408	8.2214
24	432.8	8.1104	8.2611	8.2173	8.2086	0.1069	0.0982	29.0644	7.8514
25	474.1	8.2455	8.3971	8.3540	8.3450	0.1085	0.0995	28.4301	8.0739
28	541.3	8.3788	8.5352	8.4902	8.4813	0.1114	0.1025	28.7724	7.7391
32	611.1	9.1043	9.2600	9.2129	9.2043	0.1086	0.1000	30.2505	7.5119
36	675.1	9.1360	9.2877	9.2443	9.2360	0.1083	0.1000	28.6091	7.4410
40	781.1	9.8028	9.9604	9.9148	9.9063	0.1120	0.1035	28.9340	7.3350
44	803.7	10.2589	10.4170	10.3710	10.3626	0.1121	0.1037	29.0955	7.2258
52	915.7	9.1026	9.2821	9.2281	9.2191	0.1255	0.1165	30.0836	6.8189
56	960	9.3569	9.5241	9.4706	9.4624	0.1137	0.1055	31.9976	6.6699
60	1018.9	10.6496	10.8110	10.7595	10.7515	0.1099	0.1019	31.9083	6.7410
64	1058.9	9.8177	9.9804	9.9356	9.9271	0.1179	0.1094	27.5353	7.1051
68	1097.1	9.5676	9.7423	9.6941	9.6854	0.1265	0.1178	27.5902	6.7728
72	1144.1	9.3588	9.5249	9.4783	9.4699	0.1195	0.1111	28.0554	6.8778
76	1201.7	9.2534	9.4181	9.3667	9.3586	0.1133	0.1052	31.2083	6.6885
80	1262.7	8.9257	9.0900	9.0444	9.0359	0.1187	0.1102	27.7541	7.0359
84	1338.3	9.4129	9.5915	9.5434	9.5345	0.1305	0.1216	26.9317	6.7772
88	1439.3	9.7244	9.8940	9.8484	9.8398	0.1240	0.1154	26.8868	6.8962
92	1543.8	9.4833	9.6659	9.6181	9.6090	0.1348	0.1257	26.1774	6.7777
96	1630.6	9.8657	10.0449	9.9995	9.9903	0.1338	0.1246	25.3348	6.9821
100	1678.5	9.5419	9.7122	9.6683	9.6595	0.1264	0.1176	25.7780	7.0276
104	1695.4	8.7521	8.9180	8.8748	8.8662	0.1227	0.1141	26.0398	7.0500
108	1725.3	10.4029	10.5696	10.5262	10.5177	0.1233	0.1148	26.0348	6.9346
112	1750.9	9.1263	9.3059	9.2579	9.2488	0.1316	0.1225	26.7261	6.8909
116	1784.3	9.2415	9.4064	9.3568	9.3485	0.1153	0.1070	30.0788	6.8454
120	1867.4	9.7247	9.8807	9.8306	9.8227	0.1059	0.0980	32.1154	6.8872
124	1913.3	9.2049	9.3543	9.3069	9.2989	0.1020	0.0940	31.7269	7.2825
128	2007.6	9.5399	9.7008	9.6533	9.6450	0.1134	0.1051	29.5214	7.0155
132	2078.6	9.3546	9.4986	9.4552	9.4477	0.1006	0.0931	30.1389	7.0833

Sample Depth (cm)	Age (cal. yr. BP)	Crucible Weight (g)	105° Dry Weight (g)	550° Ignition Weight (g)	950° Ignition Weight (g)	Organics Weight (g)	Carbonate Weight (g)	Organics as % Dry Weight	Carbonates as % Dry Weight
136	2132.2	9.3761	9.5240	9.4787	9.4710	0.1026	0.0949	30.6288	7.0805
140	2252.1	10.5599	10.7104	10.6580	10.6555	0.0981	0.0956	34.8173	2.2591
144	2317.8	9.7786	9.9230	9.8745	9.8719	0.0959	0.0933	33.5873	2.4488
148	2375.6	9.4874	9.6518	9.5955	9.5925	0.1081	0.1051	34.2457	2.4818
152	2421.1	10.0239	10.1864	10.1290	10.1259	0.1051	0.1020	35.3231	2.5945
156	2475.4	9.0770	9.2519	9.1990	9.1951	0.1220	0.1181	30.2459	3.0326
160	2585	8.8538	9.0281	8.9756	8.9719	0.1218	0.1181	30.1205	2.8870
164	2640.3	8.3873	8.5566	8.5076	8.5039	0.1203	0.1166	28.9427	2.9722
168	2741.7	9.6768	9.8597	9.8028	9.7988	0.1260	0.1220	31.1099	2.9743
172	2840.8	9.0393	9.2238	9.1691	9.1649	0.1298	0.1256	29.6477	3.0959
176	2933.7	8.6744	8.8472	8.7944	8.7905	0.1200	0.1161	30.5556	3.0694
180	3061.4	9.4749	9.6406	9.5912	9.5871	0.1163	0.1122	29.8129	3.3651
184	3256.2	9.3456	9.5241	9.4719	9.4675	0.1263	0.1219	29.2437	3.3524
188	3375.3	9.2482	9.4406	9.3836	9.3785	0.1354	0.1303	29.6258	3.6050
192	3477.6	9.0827	9.2567	9.2043	9.1996	0.1216	0.1169	30.1149	3.6736
196	3590.2	9.1623	9.3390	9.2864	9.2816	0.1241	0.1193	29.7680	3.6944
200	3709.3	9.2173	9.3885	9.3321	9.3273	0.1148	0.1100	32.9439	3.8131
204	3866.3	8.5108	8.6880	8.6364	8.6313	0.1256	0.1205	29.1196	3.9142
208	4069.7	9.8205	9.9970	9.9475	9.9422	0.1270	0.1217	28.0453	4.0839
212	4217.8	8.8381	9.0095	8.9621	8.9566	0.1240	0.1185	27.6546	4.3641
216	4292.1	11.0423	11.2128	11.1651	11.1595	0.1228	0.1172	27.9765	4.4669
220	4356.7	9.6294	9.8076	9.7611	9.7551	0.1317	0.1257	26.0943	4.5791
224	4415.2	9.9891	10.1683	10.1193	10.1133	0.1302	0.1242	27.3437	4.5536
232	4577.9	8.5732	8.7599	8.7078	8.7021	0.1346	0.1289	27.9057	4.1521
236	4716.1	7.4175	7.6030	7.5501	7.5446	0.1326	0.1271	28.5175	4.0323
240	4957.4	8.5136	8.6962	8.6504	8.6451	0.1368	0.1315	25.0821	3.9474
244	4989.3	8.1104	8.2915	8.2457	8.2404	0.1353	0.1300	25.2899	3.9801
248	5078	8.2454	8.4288	8.3808	8.3757	0.1354	0.1303	26.1723	3.7819
252	5188.3	8.3788	8.5621	8.5128	8.5080	0.1340	0.1292	26.8958	3.5614
256	5293.2	9.1041	9.2866	9.2381	9.2335	0.1340	0.1294	26.5753	3.4279
260	5374.6	9.1360	9.3188	9.2716	9.2667	0.1356	0.1307	25.8206	3.6455
264	5578.5	9.8029	9.9758	9.9290	9.9242	0.1261	0.1213	27.0677	3.7756
268	5653.4	10.2590	10.4442	10.3997	10.3944	0.1407	0.1354	24.0281	3.8920

Sample Depth (cm)	Age (cal. yr. BP)	Crucible Weight (g)	105° Dry Weight (g)	550° Ignition Weight (g)	950° Ignition Weight (g)	Organics Weight (g)	Carbonate Weight (g)	Organics as % Dry Weight	Carbonates as % Dry Weight
272	5745	9.1025	9.2868	9.2405	9.2350	0.1380	0.1325	25.1221	4.0586
276	5874.1	9.3569	9.5414	9.4954	9.4902	0.1385	0.1333	24.9322	3.8331
280	5936.2	10.6496	10.8283	10.7812	10.7763	0.1316	0.1267	26.3570	3.7292
284	6170	9.8177	9.9874	9.9408	9.9360	0.1231	0.1183	27.4602	3.8468
288	6393.2	9.5677	9.7458	9.7013	9.6961	0.1336	0.1284	24.9860	3.9708
292	6531.4	9.3585	9.5567	9.5054	9.4999	0.1469	0.1414	25.8829	3.7740
296	6585.3	9.2534	9.4320	9.3833	9.3781	0.1299	0.1247	27.2676	3.9597
300	6630.1	8.9256	9.0927	9.0454	9.0407	0.1198	0.1151	28.3064	3.8253
304	6711	9.4128	9.5810	9.5346	9.5298	0.1218	0.1170	27.5862	3.8811
308	6839.9	9.7244	9.8922	9.8438	9.8390	0.1194	0.1146	28.8439	3.8903
312	6985.8	9.4831	9.6523	9.6078	9.6026	0.1247	0.1195	26.3002	4.1797
316	7120.6	9.8657	10.0478	10.0023	9.9969	0.1366	0.1312	24.9863	4.0329
320	7219.1	9.5419	9.7391	9.6898	9.6839	0.1479	0.1420	25.0000	4.0690
324	7405.8	8.7522	8.9292	8.8848	8.8794	0.1326	0.1272	25.0847	4.1492
328	7568.8	10.4030	10.5876	10.5403	10.5346	0.1373	0.1316	25.6230	4.1993
332	7763.2	9.1263	9.3008	9.2534	9.2478	0.1271	0.1215	27.1633	4.3645
336	7952.6	10.5601	10.7316	10.6861	10.6807	0.1260	0.1206	26.5306	4.2822
340	8009.3	9.2417	9.4270	9.3796	9.3736	0.1379	0.1319	25.5801	4.4037
344	8080.2	9.7248	9.9117	9.8632	9.8573	0.1384	0.1325	25.9497	4.2932
348	8179.2	9.2049	9.3852	9.3373	9.3315	0.1324	0.1266	26.5668	4.3749
352	8288.6	9.5400	9.7212	9.6718	9.6659	0.1318	0.1259	27.2627	4.4283
356	8415.1	9.3545	9.5305	9.4844	9.4785	0.1299	0.1240	26.1932	4.5591
360	8589.4	9.3762	9.5519	9.5051	9.4987	0.1289	0.1225	26.6363	4.9539
364	8837.5	9.7787	9.9521	9.9076	9.9013	0.1289	0.1226	25.6632	4.9412
368	9004.2	9.4873	9.6609	9.6148	9.6086	0.1275	0.1213	26.5553	4.8571
372	9129.5	10.0238	10.2043	10.1571	10.1508	0.1333	0.1270	26.1496	4.7468
376	9226.3	9.0770	9.2480	9.1966	9.1906	0.1196	0.1136	30.0585	4.7719
380	9280.5	8.8538	9.0132	8.9654	8.9589	0.1116	0.1051	29.9875	5.5458
384	9425	8.3874	8.5496	8.5006	8.4944	0.1132	0.1070	30.2096	5.1985
388	9481.2	9.6768	9.8341	9.7829	9.7770	0.1061	0.1002	32.5493	5.1011
392	9539.4	9.0394	9.1866	9.1357	9.1299	0.0963	0.0905	34.5788	5.3587
396	9616.3	8.6742	8.8302	8.7838	8.7774	0.1096	0.1032	29.7436	5.5795
400	9654.7	9.4747	9.6132	9.5639	9.5582	0.0892	0.0835	35.5957	5.5971

Appendix BB - LOI Data (TR01-Fen)

Sample Depth (cm)	Crucible Weight (g)	105° Dry Weight (g)	550° Ignition Weight (g)	950° Ignition Weight (g)	Organics Weight (g)	Carbonate Weight (g)	Organics as % Dry Weight	Carbonates as % Dry Weight
47	8.5108	8.5683	8.5119	8.5128	0.0011	0.0020	98.0870	-2.1287
48	8.4336	8.5026	8.4365	8.4372	0.0029	0.0036	95.7971	-1.3797
49	8.3110	8.4034	8.3143	8.3145	0.0033	0.0035	96.4286	-0.2944
50	8.1863	8.2888	8.1899	8.1901	0.0036	0.0038	96.4878	-0.2654
51	8.2571	8.3750	8.2653	8.2654	0.0082	0.0083	93.0450	-0.1154
52	8.6179	8.7352	8.6342	8.6340	0.0163	0.0161	86.1040	0.2319
53	8.4195	8.5510	8.4450	8.4447	0.0255	0.0252	80.6084	0.3103
54	7.7644	7.8988	7.7902	7.7898	0.0258	0.0254	80.8036	0.4048
55	7.8495	8.0041	7.8742	7.8735	0.0247	0.0240	84.0233	0.6158
56	7.9073	8.0587	7.9427	7.9420	0.0354	0.0347	76.6182	0.6288
57	9.6411	9.8324	9.6941	9.6930	0.0530	0.0519	72.2948	0.7820
58	9.4700	9.6912	9.5440	9.5427	0.0740	0.0727	66.5461	0.7993
59	9.9055	10.1287	9.9778	9.9758	0.0723	0.0703	67.6075	1.2186
60	8.5705	8.8042	8.6492	8.6470	0.0787	0.0765	66.3243	1.2803
61	9.7402	9.9569	9.8093	9.8072	0.0691	0.0670	68.1126	1.3180
62	10.3902	10.5718	10.4288	10.4272	0.0386	0.0370	78.7445	1.1982
63	9.1323	9.3176	9.2020	9.1995	0.0697	0.0672	62.3853	1.8349
64	9.3193	9.5305	9.3982	9.3951	0.0789	0.0758	62.6420	1.9962
65	10.2245	10.4267	10.2801	10.2774	0.0556	0.0529	72.5025	1.8160
66	9.6758	9.9074	9.7482	9.7453	0.0724	0.0695	68.7392	1.7029
67	9.0099	9.2522	9.1039	9.1002	0.0940	0.0903	61.2051	2.0768
68	9.7600	10.0222	9.8638	9.8600	0.1038	0.1000	60.4119	1.9710
69	9.3107	9.6421	9.5132	9.5093	0.2025	0.1986	38.8956	1.6005
70	9.2821	9.5974	9.4546	9.4505	0.1725	0.1684	45.2902	1.7685
71	9.3843	10.0635	9.9716	9.9665	0.5873	0.5822	13.5306	1.0212
72	9.1132	9.8376	9.7621	9.7574	0.6489	0.6442	10.4224	0.8824
73	9.1188	9.8502	9.7744	9.7695	0.6556	0.6507	10.3637	0.9111
74	9.2704	10.0125	9.9326	9.9271	0.6622	0.6567	10.7667	1.0080
75	9.0027	9.7317	9.6463	9.6399	0.6436	0.6372	11.7147	1.1940
76	8.6475	9.2376	9.1570	9.1500	0.5095	0.5025	13.6587	1.6133
77	9.0557	10.2355	10.1808	10.1751	1.1251	1.1194	4.6364	0.6571
78	9.3079	10.6172	10.5706	10.5655	1.2627	1.2576	3.5592	0.5297
79	9.1233	9.8118	9.7186	9.7112	0.5953	0.5879	13.5367	1.4617
80	9.0784	9.6252	9.5208	9.5132	0.4424	0.4348	19.0929	1.8903
81	9.2323	9.8489	9.7451	9.7383	0.5128	0.5060	16.8343	1.4999
82	9.2255	9.8339	9.7431	9.7350	0.5176	0.5095	14.9244	1.8107

Sample Depth (cm)	Crucible Weight (g)	105° Dry Weight (g)	550° Ignition Weight (g)	950 ° Ignition Weight (g)	Organics Weight (g)	Carbonate Weight (g)	Organics as % Dry Weight	Carbonates as % Dry Weight
83	9.2908	10.0210	9.9449	9.9359	0.6541	0.6451	10.4218	1.6763
84	Rock	Rock	Rock	Rock	Rock	Rock	Rock	Rock
85	9.2583	9.9799	9.9085	9.8991	0.6502	0.6408	9.8947	1.7716
86	10.1905	10.8725	10.8031	10.7929	0.6126	0.6024	10.1760	2.0340
87	9.9595	10.8734	10.8180	10.8085	0.8585	0.8490	6.0619	1.4137
88	9.5804	11.0714	11.0455	11.0404	1.4651	1.4600	1.7371	0.4652
89	10.0903	11.6165	11.6057	11.6029	1.5154	1.5126	0.7076	0.2495
90	10.0358	11.6422	11.6320	11.6283	1.5962	1.5925	0.6350	0.3132

Appendix C - Pollen Data (TR05-Path Lake)

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Pinus (dp)	Pinus (hp)	Picea (1/1)	Abies (1/1)	Tsuga	Larix	Juniper	Acer r.	Acer s.	Acer n.	Acer	Betula
0.5	-50.1	68.9	119.6	69	3	5	2	4	4	2	0	0	109
2.5	-16.7	13.4	162.6	86	17.5	11	0	0	7	1	0	0	114
4.5	16.8	58.4	100.1	75	11	7	0	0	7	1	0	0	113
6.5	59.8	30.2	128.3	64.5	12	7	2	1	5	1	0	2	133
8.5	112.3	52.4	78.6	83.5	7	5	1	1	1	0	0	1	115
10.5	164.8	42.4	80.6	81.5	7.5	8	1	1	5	1	0	1	113
12.5	182.3	30.1	90.4	53	11.5	6	2	0	4	2	0	0	108
14.5	199.7	69.2	153.8	68	10.5	3	2	0	3	0	0	0	103
16.5	220.3	57.8	74.3	66.5	13	9	4	0	8	1	0	0	133
18.5	244.2	42.0	91.0	84	8	16	0	0	6	1	1	0	112
20.5	268	16.9	38.1	114.5	36	23	3	7	4	1	0	0	70
22.5	350.4	13.5	135.0	59.5	11	14	0	1	5	2	0	0	126
24.5	432.8	26.8	111.7	56.5	11	18	8	1	0	1	0	0	91
26.5	496.5	52.9	110.1	85	21.5	23	4	2	3	1	0	0	107
28.5	541.3	35.3	105.8	100.5	7	27	6	2	0	3	0	1	84
30.5	586.1	52.8	109.2	71.5	16.5	15	5	3	6	0	3	1	111
32.5	611.1	48.6	102.9	76.5	12.5	17	5	0	3	1	0	0	112
34.5	636.1	53.2	148.8	70.5	19.5	21	5	0	4	0	0	0	124
36.5	675.1	21.6	88.9	53	17	27	4	3	4	6	0	0	101
38.5	728.1	26.5	119.5	50.5	9	23	1	2	6	1	0	0	101
40.5	781.1	68.6	78.9	57	9.5	26	3	2	4	1	0	0	140
44.5	803.7	60.4	110.6	57.5	3	19	2	1	1	0	0	1	154
52.5	915.7	5.7	119.3	60	5	31	6	1	3	3	0	0	90
54.5	935.4	38.8	145.7	50	14	34	1	1	8	2	0	0	98
56.5	960	86.1	75.9	54	7	28	2	1	2	1	1	0	98
58.5	989.5	8.3	173.3	46	13.5	27	3	1	3	3	0	0	102
60.5	1018.9	23.4	74.6	37	4.5	28	6	5	5	2	0	0	90
62.5	1038.9	11.3	117.2	45	5	26	2	3	7	3	0	1	132
64.5	1058.9	49.6	79.4	36.5	7	36	6	0	3	2	0	0	124
66.5	1078.3	54.3	131.2	36.5	16.5	33	4	1	7	0	0	1	118
68.5	1097.1	18.6	104.4	54.5	11.5	32	4	0	4	2	0	0	122
70.5	1115.9	19.6	129.4	39.5	13	26	0	1	4	2	0	1	120
72.5	1144.1	14.3	114.7	36.5	5	31	4	1	4	3	0	0	144

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Pinus (dp)	Pinus (hp)	Picea (1/1)	Abies (1/1)	Tsuga	Larix	Juniper	Acer r.	Acer s.	Acer n.	Acer	Betula
76.5	1201.7	52.4	91.6	52.5	7	30	0	1	5	0	0	0	144
78.5	1232.2	26.8	133.8	50	11.5	32	0	1	2	1	0	0	98
80.5	1262.7	27.6	64.4	40.5	20	32	5	24	3	5	0	0	69
82.5	1300.5	27.1	128.9	30.5	9	34	2	0	5	3	0	2	125
84.5	1338.3	51.0	102.0	47.5	7	32	1	2	4	5	0	0	109
86.5	1384.5	91.3	79.2	50.5	20	46	2	0	4	2	0	1	127
88.5	1439.3	10.9	89.1	33.5	9	20	4	4	3	7	0	1	117
90.5	1494	53.2	95.8	22	16	34	1	0	4	2	0	0	124
92.5	1543.8	60.3	94.7	48	9.5	30	5	4	6	2	0	0	117
94.5	1593.7	27.7	146.3	30.5	18.5	49	5	1	8	3	0	0	116
96.5	1630.6	16.3	84.2	36.5	10	28	5	9	5	3	0	0	96
98.5	1654.6	42.7	123.8	43.5	7	23	3	1	1	6	0	2	119
100.5	1678.5	50.8	81.2	47	7	28	4	2	5	2	0	0	163
102.5	1687	81.5	74.0	21.5	15	31	3	1	3	4	0	0	160
104.5	1695.4	26.6	79.9	27	2	34	1	0	4	1	0	0	132
106.5	1708.2	32.3	113.2	46.5	15	41	2	1	5	2	1	2	137
108.5	1725.3	60.9	79.1	50	9.5	34	6	1	5	2	0	0	155
110.5	1742.5	43.0	143.5	35	13	47	2	0	5	1	0	0	119
112.5	1750.9	10.1	85.9	36	14	20	5	10	4	5	0	0	100
114.5	1759.3	68.1	96.4	46.5	9.5	45	3	2	3	3	0	0	113
116.5	1784.3	73.5	90.5	43	4	19	3	1	1	5	0	0	134
118.5	1825.9	51.0	131.0	33	12.5	33	2	0	8	2	0	0	155
120.5	1867.4	40.1	114.9	50.5	9	33	4	4	9	2	0	1	107
122.5	1890.4	31.9	149.1	35.5	8.5	32	0	0	7	1	0	0	115
124.5	1913.3	67.1	104.9	66	12.5	23	1	1	7	1	0	2	143
126.5	1952.4	39.8	159.2	54	13.5	25	1	1	3	2	0	0	121
128.5	2007.6	34.7	91.8	49.5	21.5	29	2	7	8	5	0	0	100
132.5	2078.6	28.1	80.4	53.5	21	29	9	10	6	4	0	0	101
134.5	2094.4	48.5	187.0	32.5	6.5	44	2	0	5	2	0	1	115
136.5	2132.2	79.3	79.3	54.5	6.5	39	3	0	2	2	0	1	115
138.5	2192.2	61.8	109.3	77.5	19.5	21	2	0	13	19	0	1	101
140.5	2252.1	67.6	138.4	73	13	30	3	0	2	4	0	0	112
144.5	2317.8	17.9	125.6	52.5	25.5	36	2	3	6	4	0	0	77
146.5	2348	69.4	124.1	42	9.5	45	0	1	8	1	0	1	143
148.5	2375.6	71.7	100.3	71.5	12	34	1	0	6	5	0	0	121

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Pinus (dp)	Pinus (hp)	Picea (1/1)	Abies (1/1)	Tsuga	Larix	Juniper	Acer r.	Acer s.	Acer n.	Acer	Betula
150.5	2403.2	72.2	156.3	42	13.5	49	1	0	3	1	0	0	130
152.5	2421.1	34.8	146.7	85.5	10	50	2	0	5	6	1	0	111
154.5	2439.1	45.9	158.6	48.5	6	43	6	1	10	4	0	0	120
156.5	2475.4	27.9	145.1	44.5	9.5	26	5	2	2	3	0	0	120
158.5	2530.2	44.3	132.8	67.5	12	49	0	1	6	4	1	0	101
160.5	2585	30.2	166.3	59.5	8	33	6	0	6	0	0	0	113
162.5	2612.7	5.2	167.8	61.5	7	46	1	0	8	3	0	0	137
164.5	2640.3	13.6	149.4	55	10	39	1	1	3	1	0	1	127
166.5	2683.3	33.2	143.8	53	9.5	39	3	0	2	4	0	0	115
168.5	2741.7	32.0	102.5	56	16	36	8	7	5	3	0	0	68
170.5	2800.1	50.8	143.2	61	8.5	40	1	0	4	2	0	1	111
172.5	2840.8	22.9	226.6	47	11	46	2	1	1	2	0	0	94
174.5	2881.5	49.1	200.4	44	4	39	1	0	3	1	0	0	123
176.5	2933.7	23.3	213.7	47	10.5	46	0	1	6	2	0	0	145
178.5	2997.6	28.5	177.5	21	11.5	51	0	1	9	3	0	0	122
180.5	3061.4	35.9	174.6	61	9.5	38	2	0	5	2	0	0	155
182.5	3158.8	21.4	225.1	45	7	38	1	4	6	0	0	0	96
184.5	3256.2	60.1	174.4	38	7	38	1	1	2	2	0	0	109
186.5	3328.3	25.7	205.3	48	15	41	0	0	1	1	0	2	102
188.5	3375.3	56.5	185.5	41	9.5	36	2	0	4	2	0	0	96
190.5	3422.3	33.1	234.9	43.5	5.5	44	0	2	13	0	0	0	94
192.5	3477.6	35.8	177.2	99	12	40	2	1	10	3	0	0	58
194.5	3532.8	26.3	169.7	43	9.5	25	2	0	2	2	0	0	137
196.5	3590.2	39.6	223.4	47	11	34	1	1	6	5	1	0	120
198.5	3649.7	38.8	179.2	47	6	38	0	0	8	4	0	0	96
200.5	3709.3	45.3	174.7	35	5.5	33	1	0	6	4	0	0	100
202.5	3787.8	37.0	272.5	37	6	32	1	2	4	3	0	0	120
204.5	3866.3	95.7	222.3	28.5	0	40	3	3	2	3	0	0	104
208.5	4069.7	77.1	163.9	38	2.5	31	0	4	4	2	0	1	144
210.5	4179.1	31.5	220.5	43.5	4	22	0	3	3	1	0	2	137
212.5	4217.8	31.0	217.0	44	1	27	0	2	6	3	0	0	114
214.5	4256.6	21.6	244.4	27.5	12	21	0	0	5	4	0	2	121
216.5	4292.1	52.7	215.8	39	5.5	31	0	1	2	2	0	0	120
218.5	4324.4	19.8	237.2	41.5	3.5	21	0	3	8	6	0	2	143
220.5	4356.7	43.2	135.3	42.5	5	17	2	8	2	9	1	0	79

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Pinus (dp)	Pinus (hp)	Picea (1/1)	Abies (1/1)	Tsuga	Larix	Juniper	Acer r.	Acer s.	Acer n.	Acer	Betula
222.5	4386	54.3	220.7	19	6	19	1	3	7	1	0	0	140
226.5	4449.1	48.9	166.1	31	9	34	1	1	6	5	0	1	129
234.5	4629.8	29.0	168.5	36.5	5.5	22	0	2	6	2	0	0	121
238.5	4836.8	32.9	219.6	20.5	1.5	21	0	4	4	2	0	0	149
240.5	4957.4	89.6	143.4	32.5	7.5	27	0	0	2	3	0	0	145
242.5	4973.3	30.9	172.1	36	1.5	23	2	1	7	2	0	0	159
246.5	5024.2	24.0	252.5	32	6.5	30	3	0	5	2	0	0	114
250.5	5131.8	34.1	251.9	37	7.5	46	0	0	5	0	0	0	139
254.5	5244.7	26.9	244.6	32.5	5.5	44	0	0	5	3	0	0	106
258.5	5333.9	80.7	201.8	11.5	1	116	0	0	6	3	0	0	104
260.5	5374.6	15.3	125.2	8	9	77	4	3	8	3	0	0	97
262.5	5476.5	52.0	152.0	13	0	93	0	2	6	1	0	0	139
280.5	5936.2	64.9	189.1	12	0	143	2	1	4	3	0	0	70
300.5	6630.1	59.2	151.8	20	1.5	46	3	0	3	2	0	0	137
320.5	7219.1	84.3	242.2	8	0	70	3	3	7	3	0	0	92
340.5	8009.3	87.4	164.1	14	2	43	3	0	2	5	0	0	103
360.5	8589.4	147.6	189.4	33.5	1	78	5	1	2	2	0	0	108
380.5	9280.5	36.5	169.0	17	14.5	43	7	6	1	1	0	0	79

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Carpinus	Carya	Fagus	Fraxinus (4)	Fraxinus (3)	Juglans c.	Juglans n.	Populus	Quercus	Tilia	Ulmus	Castanea
0.5	-50.1	0	1	6	0	4	0	0	4	21	0	2	0
2.5	-16.7	0	1	2	3	0	2	0	0	28	0	2	1
4.5	16.8	1	5	1	2	2	1	0	2	23	0	1	1
6.5	59.8	1	1	7	2	1	1	0	5	26	0	4	1
8.5	112.3	0	0	1	2	2	0	0	1	27	1	4	1
10.5	164.8	4	0	2	1	0	0	0	3	17	0	1	2
12.5	182.3	3	2	3	2	0	0	0	2	31	0	1	2
14.5	199.7	1	1	1	4	2	0	0	3	28	0	1	0
16.5	220.3	4	2	2	0	1	0	0	4	29	1	3	3
18.5	244.2	1	2	3	0	1	4	0	4	30	1	3	3
20.5	268	15	0	13	0	6	0	0	0	32	0	0	0
22.5	350.4	2	0	6	1	5	0	0	4	32	2	3	3
24.5	432.8	0	0	5	1	4	0	0	2	21	0	0	3
26.5	496.5	2	2	2	4	1	0	0	4	19	1	2	0
28.5	541.3	0	2	7	1	2	0	0	3	19	0	4	0
30.5	586.1	3	1	8	4	2	0	0	0	27	0	1	2
32.5	611.1	1	0	7	8	4	0	0	2	41	0	1	1
34.5	636.1	2	0	5	3	3	0	0	1	27	2	0	0
36.5	675.1	5	1	9	4	2	0	3	6	38	0	3	3
38.5	728.1	3	0	3	1	0	0	0	3	26	1	5	0
40.5	781.1	0	1	6	3	0	0	0	1	37	1	1	2
44.5	803.7	2	1	4	3	1	0	1	2	30	3	3	0
52.5	915.7	4	3	17	4	4	0	0	4	46	0	0	1
54.5	935.4	4	1	2	1	1	0	0	3	22	0	1	0
56.5	960	0	0	11	1	0	0	0	0	32	0	6	0
58.5	989.5	1	0	5	2	0	1	1	1	26	0	0	1
60.5	1018.9	10	0	21	1	2	0	0	5	22	0	0	2
62.5	1038.9	1	4	6	1	2	0	0	1	29	0	2	2
64.5	1058.9	1	3	2	0	2	0	0	1	29	1	1	4
66.5	1078.3	7	0	7	0	1	1	0	2	32	3	2	1
68.5	1097.1	0	1	11	4	1	1	0	4	31	0	1	1
70.5	1115.9	6	1	0	2	1	3	0	2	19	0	0	0
72.5	1144.1	0	0	3	0	0	0	0	2	37	5	3	1
76.5	1201.7	1	0	6	0	4	1	0	3	15	2	0	0
78.5	1232.2	4	3	3	1	1	0	0	3	31	1	2	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Carpinus	Carya	Fagus	Fraxinus (4)	Fraxinus (3)	Juglans c.	Juglans n.	Populus	Quercus	Tilia	Ulmus	Castanea
80.5	1262.7	14	0	13	5	2	0	0	0	26	0	2	3
82.5	1300.5	3	1	6	2	1	3	0	2	27	0	3	1
84.5	1338.3	1	0	9	2	2	2	0	1	27	0	2	5
86.5	1384.5	3	0	4	1	4	1	0	2	22	1	1	0
88.5	1439.3	7	0	21	8	0	0	0	0	27	0	2	1
90.5	1494	5	0	10	3	5	3	0	4	23	1	0	0
92.5	1543.8	0	1	4	1	0	0	2	5	33	2	1	1
94.5	1593.7	8	1	0	0	1	0	0	2	34	1	3	4
96.5	1630.6	15	0	17	2	7	0	0	9	27	1	0	0
98.5	1654.6	0	4	5	0	2	0	0	3	19	0	2	0
100.5	1678.5	0	0	2	3	1	0	0	3	31	1	6	2
102.5	1687	3	3	2	0	1	0	0	4	36	0	3	1
104.5	1695.4	0	0	9	2	2	1	0	3	35	1	1	3
106.5	1708.2	1	1	11	3	2	2	0	1	15	0	2	1
108.5	1725.3	0	0	12	1	2	0	0	1	45	2	0	0
110.5	1742.5	3	2	9	2	2	2	0	1	24	0	0	0
112.5	1750.9	7	0	20	3	4	0	1	6	23	0	3	4
114.5	1759.3	10	0	7	0	3	1	0	3	36	2	2	1
116.5	1784.3	0	0	8	3	1	0	0	5	32	1	1	1
118.5	1825.9	3	1	5	2	1	3	0	1	15	0	6	1
120.5	1867.4	1	0	10	1	0	0	0	2	23	1	1	1
122.5	1890.4	3	3	2	1	3	5	1	2	17	0	7	0
124.5	1913.3	0	1	8	1	2	0	0	2	28	1	2	0
126.5	1952.4	0	0	8	0	0	1	0	1	17	0	2	1
128.5	2007.6	6	1	10	3	1	0	0	2	19	0	2	1
132.5	2078.6	14	0	15	4	5	0	0	0	17	1	0	2
134.5	2094.4	2	1	8	0	5	2	0	0	27	1	3	0
136.5	2132.2	1	2	4	1	2	0	0	1	22	5	2	3
138.5	2192.2	1	2	10	3	0	1	0	1	16	2	4	1
140.5	2252.1	2	1	7	2	0	0	0	0	15	2	4	0
144.5	2317.8	7	0	15	2	3	0	0	2	16	0	1	0
146.5	2348	2	1	1	2	0	1	0	2	26	0	3	0
148.5	2375.6	0	6	10	0	0	0	0	0	29	3	1	0
150.5	2403.2	2	1	6	1	2	0	0	1	21	1	2	1
152.5	2421.1	1	3	0	1	3	1	0	0	23	2	5	2

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Carpinus	Carya	Fagus	Fraxinus (4)	Fraxinus (3)	Juglans c.	Juglans n.	Populus	Quercus	Tilia	Ulmus	Castanea
154.5	2439.1	0	1	6	5	0	1	1	0	21	2	4	0
156.5	2475.4	8	0	16	5	7	1	0	4	23	0	1	2
158.5	2530.2	2	1	7	1	0	3	0	1	31	1	6	0
160.5	2585	5	4	6	0	0	1	0	0	18	3	1	0
162.5	2612.7	1	1	8	1	4	1	0	0	26	1	4	0
164.5	2640.3	3	2	5	2	2	2	0	0	26	1	1	0
166.5	2683.3	1	3	5	0	1	0	0	2	37	0	3	2
168.5	2741.7	10	0	9	4	3	0	0	7	22	0	1	0
170.5	2800.1	0	1	9	1	2	1	0	0	30	0	1	1
172.5	2840.8	0	1	6	1	5	0	0	0	26	4	2	0
174.5	2881.5	0	0	8	1	0	0	0	1	37	1	3	0
176.5	2933.7	2	0	10	1	3	0	0	0	44	0	2	1
178.5	2997.6	3	0	9	2	3	3	0	1	30	0	2	0
180.5	3061.4	2	0	17	2	2	1	0	0	24	2	2	0
182.5	3158.8	1	0	5	0	0	0	0	3	24	0	0	1
184.5	3256.2	1	0	4	2	2	0	0	0	16	1	1	2
186.5	3328.3	1	3	11	0	0	0	0	0	34	0	2	1
188.5	3375.3	5	0	2	0	3	1	0	2	31	1	6	1
190.5	3422.3	1	3	4	2	3	0	0	1	28	0	2	0
192.5	3477.6	7	0	6	2	2	0	0	0	20	0	1	0
194.5	3532.8	0	0	6	3	1	0	0	0	38	0	1	0
196.5	3590.2	1	1	8	3	1	1	0	1	40	4	2	0
198.5	3649.7	2	3	8	4	0	0	0	0	46	0	5	0
200.5	3709.3	0	1	7	4	4	2	0	3	20	1	2	1
202.5	3787.8	0	1	3	4	0	1	0	0	36	0	3	0
204.5	3866.3	5	0	13	3	0	0	0	2	31	0	1	0
208.5	4069.7	0	1	4	1	1	2	0	2	38	0	3	0
210.5	4179.1	0	2	3	0	0	0	0	0	38	1	1	0
212.5	4217.8	0	0	3	3	2	0	0	0	34	0	0	1
214.5	4256.6	0	0	6	1	3	0	0	1	45	0	0	0
216.5	4292.1	0	1	3	1	0	1	0	0	27	1	0	0
218.5	4324.4	0	0	1	2	1	0	0	0	54	1	3	0
220.5	4356.7	16	0	13	2	0	0	0	0	19	0	0	0
222.5	4386	0	2	1	0	0	0	0	1	35	0	0	0
226.5	4449.1	0	0	5	0	0	0	0	1	35	0	1	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Carpinus	Carya	Fagus	Fraxinus (4)	Fraxinus (3)	Juglans c.	Juglans n.	Populus	Quercus	Tilia	Ulmus	Castanea
234.5	4629.8	2	0	10	7	2	0	0	1	43	0	2	1
238.5	4836.8	0	0	1	0	3	0	0	1	53	0	0	0
240.5	4957.4	4	2	4	1	1	1	0	2	27	0	1	0
242.5	4973.3	1	0	7	1	1	0	0	0	27	0	1	0
246.5	5024.2	1	1	2	0	1	0	0	1	26	0	0	1
250.5	5131.8	1	0	0	2	5	1	0	0	32	0	0	0
254.5	5244.7	0	1	3	2	2	1	0	0	19	0	0	0
258.5	5333.9	0	0	1	0	1	0	0	0	47	0	0	0
260.5	5374.6	12	0	17	2	4	0	0	2	9	0	2	1
262.5	5476.5	2	0	2	2	2	1	0	3	28	0	3	0
280.5	5936.2	0	2	4	2	2	0	0	1	14	0	3	1
300.5	6630.1	0	2	5	3	3	2	0	1	49	1	5	0
320.5	7219.1	0	0	4	2	2	1	0	0	42	0	6	2
340.5	8009.3	0	0	4	1	2	0	0	1	49	1	3	0
360.5	8589.4	0	0	3	1	4	1	0	1	50	0	5	0
380.5	9280.5	7	0	16	9	4	0	0	3	22	0	2	1

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Morus	Nyssa	Celtis	Alnus c.	Alnus r.	Corylus	Myrica	Salix	Shepherdia	Platanus	Ephedra	Viburnum
0.5	-50.1	0	0	0	16	19	1	2	0	0	0	0	1
2.5	-16.7	0	1	0	7	18	1	5	0	0	1	0	1
4.5	16.8	0	0	0	16	28	4	3	2	0	0	0	1
6.5	59.8	0	1	1	14	35	5	2	1	0	0	0	1
8.5	112.3	0	0	0	21	42	4	2	3	0	0	1	3
10.5	164.8	0	0	0	11	50	3	5	1	0	0	2	1
12.5	182.3	0	0	1	26	46	5	3	5	0	0	1	2
14.5	199.7	0	1	1	15	47	2	1	2	0	1	0	0
16.5	220.3	2	2	0	9	26	10	4	0	0	0	2	2
18.5	244.2	0	0	0	5	31	3	4	1	0	0	1	1
20.5	268	0	0	0	3	43	0	0	1	0	0	0	0
22.5	350.4	0	1	3	10	35	1	0	5	0	2	0	1
24.5	432.8	0	0	0	16	55	1	1	1	0	0	1	0
26.5	496.5	0	0	0	9	25	3	2	0	0	0	0	0
28.5	541.3	1	0	1	26	15	2	2	1	0	0	0	0
30.5	586.1	0	0	0	15	25	4	0	1	0	0	1	0
32.5	611.1	1	0	0	19	29	2	2	0	0	0	0	1
34.5	636.1	0	2	1	7	21	4	0	0	0	0	1	0
36.5	675.1	0	0	0	35	29	3	1	1	0	0	1	0
38.5	728.1	0	1	0	18	33	5	1	3	0	1	0	0
40.5	781.1	0	0	0	22	16	4	5	0	0	0	0	0
44.5	803.7	0	0	0	11	15	0	0	1	0	1	2	1
52.5	915.7	0	0	0	31	28	2	0	2	0	0	1	0
54.5	935.4	0	0	0	12	17	4	1	0	0	0	1	0
56.5	960	0	0	0	32	23	8	2	2	0	0	1	2
58.5	989.5	0	0	1	27	30	1	1	0	0	0	0	1
60.5	1018.9	0	0	0	25	20	6	1	0	0	0	0	1
62.5	1038.9	0	1	1	12	27	5	1	1	0	0	0	0
64.5	1058.9	0	0	1	17	24	10	5	1	0	0	1	0
66.5	1078.3	0	0	3	12	23	12	1	0	0	0	0	0
68.5	1097.1	0	0	0	15	25	3	1	4	0	1	0	1
70.5	1115.9	0	0	1	15	23	1	0	3	0	0	2	2
72.5	1144.1	0	0	0	15	20	5	0	0	0	0	0	2
76.5	1201.7	0	0	0	18	21	5	1	1	0	0	0	1
78.5	1232.2	0	0	1	19	25	10	11	0	1	1	0	1

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Morus	Nyssa	Celtis	Alnus c.	Alnus r.	Corylus	Myrica	Salix	Shepherdia	Platanus	Ephedra	Viburnum
80.5	1262.7	0	0	0	41	4	1	1	1	1	0	0	0
82.5	1300.5	0	0	0	18	20	2	0	0	0	0	0	1
84.5	1338.3	0	0	1	30	26	3	4	0	0	0	0	0
86.5	1384.5	0	2	4	11	19	3	0	1	0	0	0	0
88.5	1439.3	0	0	0	24	23	3	0	1	0	0	0	1
90.5	1494	0	0	0	26	26	2	2	1	0	0	0	0
92.5	1543.8	0	0	0	15	8	5	1	1	0	0	0	0
94.5	1593.7	0	1	2	11	20	3	0	0	0	0	1	1
96.5	1630.6	0	0	0	40	28	2	1	0	0	0	0	1
98.5	1654.6	0	0	1	23	21	1	1	0	0	0	0	0
100.5	1678.5	0	0	0	25	19	3	2	1	0	0	0	1
102.5	1687	0	3	3	19	21	2	2	0	0	0	1	0
104.5	1695.4	1	0	0	35	35	5	2	2	0	0	0	2
106.5	1708.2	1	2	0	9	10	3	0	1	0	1	0	0
108.5	1725.3	0	0	0	12	22	2	0	5	0	0	0	0
110.5	1742.5	0	0	0	17	20	4	2	0	0	0	2	0
112.5	1750.9	0	0	0	30	22	1	2	1	0	0	0	1
114.5	1759.3	0	0	4	6	22	1	3	2	0	0	0	0
116.5	1784.3	0	0	0	13	26	4	1	3	0	0	0	0
118.5	1825.9	0	0	0	19	26	0	3	0	0	1	0	0
120.5	1867.4	0	0	0	19	22	2	6	0	0	1	0	0
122.5	1890.4	0	0	6	15	26	0	1	1	0	3	0	0
124.5	1913.3	0	0	0	15	17	2	0	0	0	0	0	0
126.5	1952.4	0	1	0	16	8	1	1	0	0	2	1	0
128.5	2007.6	0	0	0	35	31	1	3	1	0	0	0	0
132.5	2078.6	0	0	0	32	3	0	1	2	0	0	0	0
134.5	2094.4	0	0	0	5	18	3	1	0	0	0	0	0
136.5	2132.2	0	0	0	20	29	4	0	0	0	0	1	0
138.5	2192.2	2	0	0	13	19	2	2	1	1	0	0	0
140.5	2252.1	0	0	0	9	11	1	0	1	0	0	0	1
144.5	2317.8	0	0	0	29	16	0	0	0	0	0	1	1
146.5	2348	0	6	0	12	9	3	1	0	0	0	1	0
148.5	2375.6	0	0	0	15	29	9	0	1	0	0	1	0
150.5	2403.2	0	0	2	12	12	3	0	0	0	0	0	0
152.5	2421.1	0	0	0	7	14	1	0	0	0	0	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Morus	Nyssa	Celtis	Alnus c.	Alnus r.	Corylus	Myrica	Salix	Shepherdia	Platanus	Ephedra	Viburnum
154.5	2439.1	0	0	1	14	16	0	1	2	0	1	1	0
156.5	2475.4	0	0	0	27	31	2	0	0	0	0	0	0
158.5	2530.2	0	4	1	4	19	3	0	2	0	0	0	0
160.5	2585	0	0	1	7	14	3	3	0	0	0	1	1
162.5	2612.7	0	0	0	11	13	3	2	0	0	2	0	0
164.5	2640.3	0	0	2	8	9	5	0	0	0	0	0	0
166.5	2683.3	0	0	0	4	25	2	3	1	0	0	1	0
168.5	2741.7	0	0	0	15	11	3	1	0	0	0	0	0
170.5	2800.1	0	1	4	1	13	1	1	2	0	0	0	1
172.5	2840.8	0	0	0	1	8	0	2	1	0	0	0	0
174.5	2881.5	0	0	0	1	8	1	1	0	0	1	0	0
176.5	2933.7	0	0	0	4	6	4	0	1	0	0	0	0
178.5	2997.6	0	0	1	9	12	2	1	0	0	1	0	0
180.5	3061.4	0	0	0	14	15	0	0	0	0	3	0	0
182.5	3158.8	0	0	1	5	3	3	0	0	0	0	1	0
184.5	3256.2	0	0	2	5	4	2	0	0	0	0	0	0
186.5	3328.3	0	1	1	0	16	1	0	0	0	1	1	0
188.5	3375.3	0	0	0	5	3	7	0	0	0	0	0	0
190.5	3422.3	0	0	1	2	4	1	0	0	0	0	1	0
192.5	3477.6	0	0	0	9	10	0	0	0	0	0	0	0
194.5	3532.8	0	1	0	1	10	2	1	0	0	1	0	0
196.5	3590.2	0	0	0	5	7	5	2	0	0	0	3	1
198.5	3649.7	0	0	0	7	6	1	0	0	0	0	1	0
200.5	3709.3	0	0	1	1	4	5	1	0	0	0	0	0
202.5	3787.8	0	0	0	5	5	2	1	0	0	0	0	0
204.5	3866.3	0	0	0	12	5	4	1	0	0	0	0	0
208.5	4069.7	1	0	0	0	11	0	1	0	0	0	0	0
210.5	4179.1	0	0	0	3	0	0	1	0	0	0	0	0
212.5	4217.8	0	0	0	3	3	2	0	0	0	0	0	0
214.5	4256.6	0	0	0	2	1	1	0	1	0	0	0	0
216.5	4292.1	0	0	0	4	4	0	0	0	0	0	0	0
218.5	4324.4	0	0	1	4	4	0	3	0	0	0	0	0
220.5	4356.7	0	0	0	9	4	3	1	0	0	0	2	0
222.5	4386	0	0	1	0	4	0	0	0	0	0	0	0
226.5	4449.1	0	0	1	0	5	2	0	0	0	0	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Morus	Nyssa	Celtis	Alnus c.	Alnus r.	Corylus	Myrica	Salix	Shepherdia	Platanus	Ephedra	Viburnum
234.5	4629.8	0	0	0	0	9	0	2	0	0	0	0	0
238.5	4836.8	0	0	0	2	2	1	0	1	0	0	0	2
240.5	4957.4	0	0	0	3	2	3	1	0	0	0	1	0
242.5	4973.3	0	0	0	5	5	0	0	2	0	0	0	0
246.5	5024.2	0	0	0	0	4	2	2	0	0	2	0	0
250.5	5131.8	0	0	0	1	6	1	0	0	0	0	1	0
254.5	5244.7	0	0	0	0	5	1	0	0	0	0	0	1
258.5	5333.9	0	0	1	0	4	0	0	1	0	0	0	1
260.5	5374.6	0	0	0	8	10	1	2	2	1	0	0	0
262.5	5476.5	0	0	0	0	0	0	0	0	0	1	1	0
280.5	5936.2	0	0	0	2	1	2	0	0	0	0	0	0
300.5	6630.1	0	0	0	8	7	1	2	1	0	0	0	0
320.5	7219.1	1	0	0	5	2	4	2	0	0	0	0	0
340.5	8009.3	1	0	0	5	0	2	2	0	0	0	0	0
360.5	8589.4	1	0	0	3	9	2	0	0	0	0	0	0
380.5	9280.5	0	0	0	10	7	1	0	3	0	0	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Rhus	Ericaceae	Prunus	Rhamnus	Sambucus	Hamamelidaceae	Ilex	Urtica	Campanulaceae	Tubiflorae	Artemisia	Ambrosia Type
0.5	-50.1	0	3	0	0	0	0	0	2	0	0	3	5
2.5	-16.7	0	2	0	0	0	0	1	1	0	1	0	8
4.5	16.8	0	6	0	0	0	0	1	3	0	0	0	8
6.5	59.8	2	2	0	0	0	0	2	1	0	0	1	16
8.5	112.3	0	4	0	0	0	0	3	0	0	0	0	14
10.5	164.8	1	0	2	0	0	0	3	3	1	0	0	17
12.5	182.3	0	10	0	0	0	0	0	3	0	3	1	22
14.5	199.7	0	6	0	0	0	0	3	2	0	2	2	23
16.5	220.3	0	4	1	0	0	0	3	1	0	2	1	25
18.5	244.2	1	4	0	0	0	1	3	3	0	1	0	9
20.5	268	0	2	0	0	0	0	0	3	0	0	0	16
22.5	350.4	0	6	0	0	0	0	4	0	0	1	1	7
24.5	432.8	0	0	2	0	0	0	1	1	0	1	1	6
26.5	496.5	0	2	0	0	0	0	2	0	0	0	1	4
28.5	541.3	0	2	0	0	0	0	1	0	0	1	1	2
30.5	586.1	1	2	0	0	0	0	5	0	1	0	0	3
32.5	611.1	0	2	0	0	0	0	7	5	0	1	1	1
34.5	636.1	0	3	0	0	0	1	5	0	0	1	0	1
36.5	675.1	0	7	0	0	0	0	6	0	0	0	0	4
38.5	728.1	0	3	0	0	0	0	2	3	0	3	0	1
40.5	781.1	0	3	0	0	0	0	5	2	0	1	1	0
44.5	803.7	0	1	0	0	0	0	16	0	0	0	0	0
52.5	915.7	0	3	0	0	0	0	20	0	0	1	1	1
54.5	935.4	1	1	0	0	0	0	13	3	0	2	0	0
56.5	960	0	4	0	0	0	0	16	2	0	1	1	0
58.5	989.5	0	7	0	0	0	0	11	1	0	2	2	0
60.5	1018.9	0	5	0	0	0	0	15	0	0	0	2	2
62.5	1038.9	1	5	0	0	0	0	12	1	1	1	2	1
64.5	1058.9	0	1	0	0	0	0	10	2	0	3	0	2
66.5	1078.3	0	1	0	0	0	0	7	2	0	1	0	3
68.5	1097.1	0	5	0	0	0	0	13	0	0	1	1	1
70.5	1115.9	0	3	0	0	0	0	8	2	0	1	0	0
72.5	1144.1	0	3	0	0	0	0	8	0	0	2	0	0
76.5	1201.7	0	5	0	0	0	0	15	0	0	0	0	0
78.5	1232.2	0	4	0	0	0	0	18	0	0	3	1	1

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Rhus	Ericaceae	Prunus	Rhamnus	Sambucus	Hamamelidaceae	Ilex	Urtica	Campanulaceae	Tubiflorae	Artemisia	Ambrosia Type
80.5	1262.7	0	3	0	0	0	0	5	0	0	0	0	11
82.5	1300.5	0	3	0	0	0	0	8	2	0	0	0	0
84.5	1338.3	0	1	0	0	0	0	14	5	0	0	0	1
86.5	1384.5	0	6	0	0	0	0	5	2	0	0	0	2
88.5	1439.3	0	3	0	0	0	0	12	2	0	1	0	0
90.5	1494	0	3	0	0	0	0	4	3	0	0	2	2
92.5	1543.8	0	3	0	0	0	0	8	0	0	1	0	0
94.5	1593.7	0	1	0	0	0	0	6	2	0	4	0	1
96.5	1630.6	0	3	0	0	0	0	2	0	0	0	0	3
98.5	1654.6	1	1	0	0	0	0	2	1	0	1	1	1
100.5	1678.5	0	4	0	0	0	0	3	1	0	0	0	1
102.5	1687	2	2	0	2	0	0	3	5	0	0	1	2
104.5	1695.4	1	3	0	0	0	0	4	2	0	0	0	4
106.5	1708.2	1	6	0	0	0	0	3	0	0	1	0	0
108.5	1725.3	0	3	0	0	0	0	2	0	0	0	0	0
110.5	1742.5	1	1	0	0	0	0	8	2	0	1	1	1
112.5	1750.9	0	3	0	0	0	0	1	4	0	0	0	2
114.5	1759.3	0	3	0	1	1	1	1	4	0	1	0	2
116.5	1784.3	0	1	0	0	0	0	4	0	0	1	2	1
118.5	1825.9	1	1	0	0	0	0	0	0	0	0	0	0
120.5	1867.4	0	0	0	0	0	0	1	5	0	1	3	1
122.5	1890.4	3	2	0	2	0	0	1	0	0	0	0	2
124.5	1913.3	0	0	0	0	0	0	0	1	0	0	1	2
126.5	1952.4	1	4	0	0	0	0	2	0	0	0	0	0
128.5	2007.6	0	2	0	0	0	0	5	0	0	0	0	0
132.5	2078.6	0	2	0	0	0	0	0	0	0	0	1	5
134.5	2094.4	1	3	0	0	0	0	1	2	0	0	0	0
136.5	2132.2	0	1	0	0	0	0	5	1	0	0	2	0
138.5	2192.2	0	2	0	0	0	0	1	1	0	0	0	1
140.5	2252.1	0	6	0	0	0	0	1	1	0	0	0	1
144.5	2317.8	0	2	0	0	0	0	1	0	0	0	1	1
146.5	2348	0	0	0	0	0	0	6	1	0	0	0	0
148.5	2375.6	0	0	0	0	0	0	3	2	0	0	0	0
150.5	2403.2	0	1	0	0	0	0	1	1	0	0	1	3
152.5	2421.1	0	2	0	0	0	0	4	2	0	1	0	2

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Rhus	Ericaceae	Prunus	Rhamnus	Sambucus	Hamamelidaceae	Ilex	Urtica	Campanulaceae	Tubiflorae	Artemisia	Ambrosia Type
154.5	2439.1	2	1	0	1	0	0	1	0	1	0	0	2
156.5	2475.4	0	3	0	0	0	0	1	0	0	1	1	2
158.5	2530.2	1	2	0	0	0	0	2	3	0	0	0	1
160.5	2585	1	2	0	0	0	0	5	2	0	0	1	2
162.5	2612.7	0	1	0	2	0	0	3	1	1	1	2	1
164.5	2640.3	0	0	0	0	0	0	3	2	0	0	0	1
166.5	2683.3	1	1	0	0	0	1	4	0	0	1	1	0
168.5	2741.7	0	2	0	0	0	0	3	0	0	0	3	9
170.5	2800.1	0	0	0	0	0	0	0	0	0	0	2	0
172.5	2840.8	1	1	0	0	0	0	3	0	0	0	0	0
174.5	2881.5	0	0	0	0	0	0	3	0	0	0	1	1
176.5	2933.7	0	1	0	0	0	0	2	1	0	0	0	0
178.5	2997.6	0	0	0	1	0	0	0	0	0	0	0	0
180.5	3061.4	0	0	0	0	0	0	3	2	0	0	0	0
182.5	3158.8	0	1	0	0	0	0	3	0	0	0	0	0
184.5	3256.2	0	0	0	0	0	0	2	0	0	0	0	0
186.5	3328.3	1	1	0	0	0	0	4	0	0	0	1	2
188.5	3375.3	0	0	0	0	0	0	1	2	0	0	1	2
190.5	3422.3	0	0	0	0	0	0	1	0	0	0	1	0
192.5	3477.6	0	2	0	0	0	0	0	0	0	0	0	4
194.5	3532.8	3	0	0	0	0	0	2	0	2	0	1	0
196.5	3590.2	0	1	0	0	0	0	2	2	1	0	1	3
198.5	3649.7	0	1	0	3	0	0	3	0	0	0	0	0
200.5	3709.3	1	0	0	0	0	0	0	0	0	0	0	0
202.5	3787.8	1	1	0	0	0	0	3	0	0	0	0	1
204.5	3866.3	0	0	0	0	0	0	1	0	0	0	1	2
208.5	4069.7	0	1	0	0	0	0	1	0	0	0	0	0
210.5	4179.1	0	0	0	0	0	0	3	0	0	0	0	0
212.5	4217.8	0	0	0	0	0	0	3	0	0	0	0	1
214.5	4256.6	0	0	0	0	0	0	2	0	1	0	1	2
216.5	4292.1	0	1	0	0	0	0	2	0	0	0	1	0
218.5	4324.4	0	0	0	0	0	0	0	0	0	0	1	0
220.5	4356.7	0	1	0	0	0	0	0	2	0	0	0	8
222.5	4386	0	0	0	0	0	0	3	0	0	0	0	1
226.5	4449.1	1	0	0	0	0	1	2	0	0	1	1	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Rhus	Ericaceae	Prunus	Rhamnus	Sambucus	Hamamelidaceae	Ilex	Urtica	Campanulaceae	Tubiflorae	Artemisia	Ambrosia Type
234.5	4629.8	0	1	0	0	0	0	1	1	1	0	0	0
238.5	4836.8	0	0	0	0	0	0	0	0	0	0	0	0
240.5	4957.4	0	0	0	0	0	0	2	0	0	2	0	0
242.5	4973.3	1	0	0	0	0	0	2	0	0	1	1	1
246.5	5024.2	0	0	0	0	0	0	7	0	0	0	0	1
250.5	5131.8	1	1	0	0	0	0	3	0	0	0	0	1
254.5	5244.7	0	1	0	0	0	0	5	0	0	0	0	2
258.5	5333.9	1	1	0	0	0	0	8	0	0	0	0	0
260.5	5374.6	0	1	0	0	0	0	12	0	0	1	0	1
262.5	5476.5	0	0	0	0	0	0	6	0	0	0	1	0
280.5	5936.2	0	0	0	0	0	0	2	0	0	0	0	0
300.5	6630.1	0	0	0	0	0	0	3	1	1	1	0	0
320.5	7219.1	0	0	0	0	0	0	0	0	0	2	0	0
340.5	8009.3	0	2	1	1	0	0	2	2	0	0	0	1
360.5	8589.4	0	0	1	0	0	0	2	2	0	0	0	1
380.5	9280.5	0	0	0	0	0	0	1	0	0	1	0	1

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Cyperaceae	Poaceae	Ubelliferae	Vitis	Epilobium	Chenopodiaceae	Caryophyllaceae	Cornaceae	Humulus	Cruciferae	Labiatae	Plataginaceae
0.5	-50.1	0	0	0	0	0	0	0	2	0	0	0	0
2.5	-16.7	0	0	0	2	0	0	0	1	0	0	0	0
4.5	16.8	0	2	0	0	0	2	0	0	0	0	0	0
6.5	59.8	0	0	0	0	0	2	0	2	0	0	0	0
8.5	112.3	0	3	0	2	1	1	0	4	0	0	0	1
10.5	164.8	1	3	0	0	0	1	0	4	1	0	0	1
12.5	182.3	2	2	0	0	0	2	0	1	0	0	0	1
14.5	199.7	1	6	0	0	0	0	0	1	0	0	0	0
16.5	220.3	0	0	0	0	0	0	0	3	1	0	0	0
18.5	244.2	1	3	0	0	0	2	0	1	2	1	0	2
20.5	268	0	10	0	0	0	0	0	1	0	0	0	2
22.5	350.4	2	1	0	0	0	0	0	2	0	0	0	0
24.5	432.8	0	3	0	0	0	1	0	0	4	0	0	0
26.5	496.5	0	0	0	0	0	0	0	0	0	0	0	0
28.5	541.3	0	4	0	1	0	0	0	1	6	0	0	0
30.5	586.1	1	1	0	0	0	0	0	1	1	0	0	0
32.5	611.1	2	1	0	0	0	0	0	1	1	0	0	1
34.5	636.1	0	0	0	0	0	1	0	3	0	0	0	0
36.5	675.1	0	1	0	0	0	0	0	1	2	0	0	0
38.5	728.1	0	0	0	1	0	1	0	1	0	1	0	2
40.5	781.1	0	0	0	0	0	1	0	1	0	1	0	0
44.5	803.7	0	0	0	0	0	0	0	0	0	0	0	2
52.5	915.7	2	2	0	0	0	0	0	1	3	0	0	0
54.5	935.4	0	3	0	0	0	0	0	2	4	1	0	0
56.5	960	0	0	0	0	0	0	0	1	2	0	0	0
58.5	989.5	1	0	0	0	0	0	0	0	0	2	0	0
60.5	1018.9	0	5	0	0	0	0	0	0	7	0	0	0
62.5	1038.9	2	2	0	1	0	0	0	1	0	0	0	0
64.5	1058.9	2	1	0	0	0	0	0	0	1	0	0	1
66.5	1078.3	0	0	0	0	0	0	0	0	1	1	0	0
68.5	1097.1	0	1	0	0	0	0	0	1	2	0	0	0
70.5	1115.9	3	2	0	1	0	1	0	1	2	0	0	0
72.5	1144.1	4	1	0	0	0	0	0	1	0	0	0	0
76.5	1201.7	0	0	0	0	0	0	0	1	3	0	0	0
78.5	1232.2	1	1	0	0	1	0	0	3	1	0	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Cyperaceae	Poaceae	Ubelliferae	Vitis	Epilobium	Chenopodiaceae	Caryophyllaceae	Cornaceae	Humulus	Cruciferae	Labiatae	Plataginaceae
80.5	1262.7	0	3	1	0	0	0	0	1	6	0	0	0
82.5	1300.5	3	3	0	0	0	1	0	0	0	1	0	0
84.5	1338.3	1	3	0	0	0	0	0	0	0	0	0	1
86.5	1384.5	1	0	0	0	0	1	0	1	0	0	0	0
88.5	1439.3	0	2	0	0	0	1	0	3	3	1	0	0
90.5	1494	0	1	0	0	0	0	0	0	5	1	0	0
92.5	1543.8	1	0	0	0	0	1	0	1	3	0	0	0
94.5	1593.7	0	0	0	0	0	1	0	2	1	0	0	0
96.5	1630.6	0	4	1	0	0	0	0	1	1	0	0	1
98.5	1654.6	1	3	0	0	0	0	0	0	3	1	0	2
100.5	1678.5	0	0	0	0	0	1	0	1	0	0	0	0
102.5	1687	3	0	0	0	0	1	0	1	0	1	0	0
104.5	1695.4	2	2	0	0	0	0	0	2	2	0	0	0
106.5	1708.2	5	0	0	1	0	1	0	1	2	0	0	0
108.5	1725.3	2	0	0	0	0	0	0	3	0	0	0	0
110.5	1742.5	0	0	0	0	0	0	0	0	2	1	0	1
112.5	1750.9	0	5	0	0	0	2	0	2	4	0	0	0
114.5	1759.3	0	0	0	0	0	0	0	3	1	3	0	0
116.5	1784.3	2	2	0	0	0	1	0	3	0	0	0	0
118.5	1825.9	0	1	0	0	0	0	0	0	4	0	0	1
120.5	1867.4	1	4	0	0	0	0	0	0	4	0	0	0
122.5	1890.4	1	0	0	1	0	0	0	0	0	0	0	3
124.5	1913.3	2	0	0	0	0	0	0	0	1	0	0	0
126.5	1952.4	0	0	0	0	0	0	0	1	2	0	0	0
128.5	2007.6	0	6	0	0	0	0	0	0	1	0	0	0
132.5	2078.6	0	9	0	0	0	0	0	0	4	0	0	0
134.5	2094.4	0	1	0	0	0	1	0	2	0	0	0	0
136.5	2132.2	0	0	0	0	0	0	0	0	1	0	0	0
138.5	2192.2	0	1	0	0	0	0	0	0	1	0	0	1
140.5	2252.1	1	0	0	0	0	0	0	1	0	0	0	0
144.5	2317.8	0	5	0	0	0	0	0	2	0	0	0	0
146.5	2348	2	0	0	0	0	0	0	2	4	0	0	0
148.5	2375.6	0	0	0	0	0	0	0	1	0	0	0	0
150.5	2403.2	0	1	0	0	0	0	0	1	0	0	1	0
152.5	2421.1	0	0	0	0	0	0	0	2	0	0	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Cyperaceae	Poaceae	Ubelliferae	Vitis	Epilobium	Chenopodiaceae	Caryophyllaceae	Cornaceae	Humulus	Cruciferae	Labiatae	Plataginaceae
154.5	2439.1	0	0	0	0	0	0	0	0	0	0	0	0
156.5	2475.4	0	2	0	0	0	0	0	1	5	0	0	0
158.5	2530.2	0	0	0	0	0	0	0	2	0	0	0	0
160.5	2585	0	0	0	0	0	1	0	1	0	1	0	0
162.5	2612.7	0	0	0	0	0	0	0	0	2	0	0	1
164.5	2640.3	1	2	0	0	0	1	0	3	2	0	0	0
166.5	2683.3	1	0	0	0	0	1	0	0	0	1	0	1
168.5	2741.7	0	0	0	0	0	0	0	0	8	0	0	0
170.5	2800.1	0	0	0	0	0	0	0	0	1	1	0	1
172.5	2840.8	1	0	0	3	0	0	0	4	1	0	0	0
174.5	2881.5	0	0	0	0	0	0	0	0	0	1	0	1
176.5	2933.7	0	0	0	1	0	0	1	3	1	0	0	0
178.5	2997.6	0	0	0	0	0	1	0	0	3	0	0	1
180.5	3061.4	0	1	0	0	0	0	0	0	0	0	0	0
182.5	3158.8	1	1	0	0	0	1	0	0	0	1	0	0
184.5	3256.2	0	1	0	2	0	0	0	0	0	0	0	0
186.5	3328.3	0	0	0	0	0	0	0	0	0	0	0	1
188.5	3375.3	1	0	0	1	0	0	0	0	1	0	0	0
190.5	3422.3	1	0	0	0	0	0	0	1	2	0	0	0
192.5	3477.6	0	5	0	0	0	0	0	1	0	0	0	0
194.5	3532.8	0	0	1	0	0	0	0	2	0	0	0	0
196.5	3590.2	0	1	0	0	0	2	0	7	0	0	0	0
198.5	3649.7	1	0	0	0	0	0	0	0	0	0	0	1
200.5	3709.3	1	0	0	0	0	0	0	2	0	0	0	0
202.5	3787.8	1	0	0	0	0	0	0	2	0	0	0	0
204.5	3866.3	0	1	0	0	0	0	0	3	3	0	0	0
208.5	4069.7	0	0	0	0	0	0	0	1	0	0	0	0
210.5	4179.1	0	1	1	0	0	0	0	1	1	0	0	0
212.5	4217.8	1	1	0	0	0	0	0	0	0	0	0	0
214.5	4256.6	0	0	0	0	0	0	0	1	0	0	0	0
216.5	4292.1	1	0	0	0	0	1	0	7	1	0	0	0
218.5	4324.4	1	0	0	0	0	0	0	1	0	0	0	0
220.5	4356.7	0	0	0	0	0	0	0	0	3	0	0	0
222.5	4386	0	1	0	0	0	0	0	2	0	0	0	0
226.5	4449.1	0	0	0	0	0	0	0	1	0	1	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Cyperaceae	Poaceae	Ubelliferae	Vitis	Epilobium	Chenopodiaceae	Caryophyllaceae	Cornaceae	Humulus	Cruciferae	Labiatae	Plataginaceae
234.5	4629.8	2	1	1	0	0	0	0	0	0	0	0	0
238.5	4836.8	0	0	0	0	0	0	0	1	0	0	0	0
240.5	4957.4	0	0	0	0	0	0	0	2	0	0	0	0
242.5	4973.3	2	0	0	0	0	0	0	1	0	0	0	0
246.5	5024.2	0	0	0	0	0	2	0	0	0	0	0	2
250.5	5131.8	0	1	0	0	0	0	0	0	1	0	0	0
254.5	5244.7	0	0	1	0	0	0	0	0	0	0	0	0
258.5	5333.9	0	0	0	0	0	0	0	0	0	0	0	0
260.5	5374.6	0	2	0	0	0	2	0	1	0	0	0	0
262.5	5476.5	0	0	0	0	0	0	0	3	0	0	0	0
280.5	5936.2	0	1	0	0	0	0	0	0	0	0	0	0
300.5	6630.1	0	1	0	0	0	0	0	2	0	1	0	1
320.5	7219.1	0	0	0	0	0	1	0	0	0	0	0	1
340.5	8009.3	0	0	0	0	0	0	0	0	0	0	0	0
360.5	8589.4	1	0	0	0	0	1	0	0	0	0	0	0
380.5	9280.5	0	6	0	1	0	1	0	0	1	0	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Ranunculaceae	Rumex	Mitella	Rubiaceae	Saxifraga	Dryas	Rosaceae	Sanguisorba	Viola	Galium	Arceuthobium	Rorippa
0.5	-50.1	0	0	1	0	0	0	0	0	0	0	0	0
2.5	-16.7	0	0	0	0	1	1	1	0	0	0	0	0
4.5	16.8	0	2	0	0	1	0	0	0	0	0	0	0
6.5	59.8	0	0	0	0	0	1	0	0	0	0	0	0
8.5	112.3	0	0	0	0	0	0	0	0	0	0	0	0
10.5	164.8	1	0	0	0	0	0	0	0	1	0	0	0
12.5	182.3	2	2	0	0	0	0	0	0	0	0	0	0
14.5	199.7	1	0	1	0	0	0	0	0	0	0	0	0
16.5	220.3	0	0	0	0	0	1	0	0	0	0	0	0
18.5	244.2	1	0	0	0	0	0	0	0	0	0	0	0
20.5	268	0	10	0	0	0	0	0	0	0	0	0	0
22.5	350.4	1	0	0	0	0	0	0	0	0	0	0	0
24.5	432.8	2	6	0	0	0	1	0	0	0	0	0	1
26.5	496.5	0	2	0	0	0	0	0	0	0	0	0	0
28.5	541.3	2	3	0	0	0	0	0	0	0	0	0	0
30.5	586.1	3	1	0	0	0	0	0	0	0	0	2	0
32.5	611.1	2	0	0	0	0	0	0	0	0	0	0	0
34.5	636.1	2	0	0	0	0	1	0	0	0	0	0	0
36.5	675.1	0	2	0	0	0	0	1	0	0	0	0	0
38.5	728.1	3	0	0	0	0	0	0	0	0	0	0	0
40.5	781.1	1	2	1	0	0	0	0	0	0	0	0	0
44.5	803.7	1	6	1	0	0	0	0	0	0	0	0	0
52.5	915.7	3	2	0	0	0	0	0	0	0	0	0	0
54.5	935.4	2	2	0	0	0	1	0	1	0	0	1	0
56.5	960	1	0	2	0	0	0	0	0	0	0	1	0
58.5	989.5	1	0	0	0	0	0	0	0	0	0	1	0
60.5	1018.9	2	4	0	0	0	0	0	0	0	0	0	0
62.5	1038.9	2	0	0	0	0	1	0	0	0	0	0	0
64.5	1058.9	2	0	0	0	0	0	0	0	0	0	0	0
66.5	1078.3	2	1	1	0	0	0	0	0	0	0	0	0
68.5	1097.1	1	0	0	0	0	0	0	0	0	0	0	0
70.5	1115.9	5	0	0	0	0	1	0	0	0	0	0	0
72.5	1144.1	1	0	3	0	0	1	0	0	0	0	0	0
76.5	1201.7	1	3	0	0	0	1	0	0	0	0	0	0
78.5	1232.2	2	0	0	0	0	2	0	0	0	0	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Ranunculaceae	Rumex	Mitella	Rubiaceae	Saxifraga	Dryas	Rosaceae	Sanguisorba	Viola	Galium	Arceuthobium	Rorippa
80.5	1262.7	2	4	0	0	0	0	1	0	0	0	0	0
82.5	1300.5	2	0	0	0	0	0	0	0	0	0	0	0
84.5	1338.3	0	1	1	0	0	0	0	0	0	0	0	0
86.5	1384.5	0	1	0	0	0	0	0	0	0	0	0	0
88.5	1439.3	2	0	0	0	0	0	0	0	0	0	0	0
90.5	1494	2	0	1	0	0	1	0	0	0	0	0	0
92.5	1543.8	1	0	2	0	0	0	0	0	0	0	0	0
94.5	1593.7	2	0	0	0	0	0	0	0	0	0	0	0
96.5	1630.6	1	3	0	0	0	0	0	0	0	0	0	0
98.5	1654.6	1	0	1	0	0	0	0	0	0	0	0	0
100.5	1678.5	1	4	1	0	1	0	0	0	0	0	0	0
102.5	1687	1	0	1	0	0	0	0	0	0	0	0	0
104.5	1695.4	3	0	0	0	0	0	0	0	0	0	0	0
106.5	1708.2	1	2	1	1	0	0	0	0	0	0	0	0
108.5	1725.3	0	0	0	0	0	0	0	0	0	0	0	0
110.5	1742.5	0	0	0	0	0	0	0	0	0	0	0	0
112.5	1750.9	0	0	0	0	0	0	0	0	0	0	0	0
114.5	1759.3	1	1	0	0	0	0	0	0	0	0	0	0
116.5	1784.3	2	5	0	0	0	0	0	0	0	0	0	1
118.5	1825.9	3	0	0	0	0	0	0	0	0	0	0	0
120.5	1867.4	0	0	0	0	0	0	0	0	0	0	0	0
122.5	1890.4	1	2	0	0	1	0	0	0	0	0	0	0
124.5	1913.3	4	2	1	0	0	1	0	0	0	0	0	0
126.5	1952.4	1	0	0	0	0	0	0	0	0	0	0	0
128.5	2007.6	0	2	0	0	0	0	1	0	0	0	0	0
132.5	2078.6	7	2	0	0	0	0	0	0	0	0	0	0
134.5	2094.4	1	1	0	0	0	0	0	0	0	0	0	0
136.5	2132.2	4	1	0	0	0	0	0	0	0	0	0	0
138.5	2192.2	0	2	0	0	2	0	0	0	0	0	0	0
140.5	2252.1	3	3	1	0	0	0	0	0	0	0	0	0
144.5	2317.8	0	5	0	0	0	0	0	0	0	0	0	0
146.5	2348	2	0	0	0	0	0	0	0	0	0	0	0
148.5	2375.6	1	1	1	0	0	0	0	0	0	0	0	0
150.5	2403.2	1	0	0	0	0	1	0	0	0	0	0	0
152.5	2421.1	0	4	0	0	0	0	0	0	0	1	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Ranunculaceae	Rumex	Mitella	Rubiaceae	Saxifraga	Dryas	Rosaceae	Sanguisorba	Viola	Galium	Arceuthobium	Rorippa
154.5	2439.1	1	2	0	0	0	0	0	0	0	0	0	0
156.5	2475.4	1	0	0	0	0	0	0	0	0	0	0	0
158.5	2530.2	1	0	1	0	0	0	0	0	0	0	0	0
160.5	2585	0	2	0	0	0	0	0	0	0	0	0	0
162.5	2612.7	3	6	0	0	0	0	0	0	0	0	0	0
164.5	2640.3	0	3	0	0	0	0	0	0	0	0	0	0
166.5	2683.3	1	1	0	0	0	0	0	0	0	0	0	0
168.5	2741.7	0	3	0	0	0	0	1	0	0	0	0	0
170.5	2800.1	1	3	0	0	0	1	0	0	0	0	0	0
172.5	2840.8	4	0	0	0	0	0	0	0	0	0	1	0
174.5	2881.5	0	2	0	0	0	0	0	0	0	0	1	0
176.5	2933.7	2	0	0	0	0	0	0	0	0	0	1	0
178.5	2997.6	1	1	0	0	0	0	0	0	0	0	0	0
180.5	3061.4	1	3	0	0	1	0	0	0	0	0	0	0
182.5	3158.8	1	1	0	0	0	0	0	0	0	0	1	0
184.5	3256.2	1	0	1	0	0	0	0	0	0	0	0	0
186.5	3328.3	1	0	1	0	0	0	0	0	0	0	0	1
188.5	3375.3	0	0	0	0	0	0	0	0	0	0	1	0
190.5	3422.3	0	0	1	0	0	0	0	0	0	0	0	0
192.5	3477.6	0	0	0	0	1	0	1	0	0	0	0	0
194.5	3532.8	0	1	1	0	0	0	0	0	0	0	0	0
196.5	3590.2	2	2	0	0	0	0	0	0	0	0	0	0
198.5	3649.7	1	1	0	0	0	0	0	0	0	0	0	0
200.5	3709.3	1	2	0	0	0	0	0	0	0	0	0	0
202.5	3787.8	0	0	0	0	1	0	0	0	0	0	0	0
204.5	3866.3	1	3	0	0	0	0	0	0	0	0	0	0
208.5	4069.7	0	1	0	0	0	0	0	0	0	0	0	0
210.5	4179.1	0	0	1	0	2	0	0	0	0	0	0	0
212.5	4217.8	0	0	0	0	0	1	0	0	0	0	0	0
214.5	4256.6	2	0	0	0	1	0	0	0	0	0	0	0
216.5	4292.1	1	1	0	0	0	0	0	0	0	0	0	0
218.5	4324.4	0	0	0	0	0	0	0	0	0	0	0	0
220.5	4356.7	1	1	0	0	0	0	2	0	0	0	0	0
222.5	4386	1	0	2	0	0	1	0	0	0	0	0	0
226.5	4449.1	0	1	0	0	0	0	0	0	0	0	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Ranunculaceae	Rumex	Mitella	Rubiaceae	Saxifraga	Dryas	Rosaceae	Sanguisorba	Viola	Galium	Arceuthobium	Rorippa
234.5	4629.8	0	1	1	0	0	0	0	0	0	0	1	0
238.5	4836.8	0	0	0	0	0	0	0	0	0	0	0	0
240.5	4957.4	2	4	0	0	0	0	0	0	0	0	0	0
242.5	4973.3	1	0	0	0	0	1	0	0	0	0	0	0
246.5	5024.2	0	0	0	0	0	0	0	0	0	0	0	0
250.5	5131.8	0	1	0	0	0	0	0	0	0	0	0	0
254.5	5244.7	0	0	0	0	0	0	0	0	0	0	0	0
258.5	5333.9	0	0	2	0	0	0	0	0	0	0	0	0
260.5	5374.6	1	3	0	0	0	0	0	0	0	0	0	0
262.5	5476.5	0	0	0	0	0	1	0	0	0	0	0	0
280.5	5936.2	1	1	0	0	0	0	0	0	0	0	0	0
300.5	6630.1	4	1	0	0	0	0	0	0	0	0	0	0
320.5	7219.1	0	5	0	0	1	0	0	0	0	0	0	0
340.5	8009.3	0	2	0	0	0	0	0	0	0	0	0	0
360.5	8589.4	1	3	0	0	0	0	0	0	0	0	0	0
380.5	9280.5	0	2	0	0	0	0	0	0	0	0	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Robinia	Verbena	Leguminosae	Heteranthera	Cystopteris	Dryopteris	Equisetium	Lycopodium	Polypodiaceae	Pteridium	Sphagnum	Osmunda
0.5	-50.1	0	0	0	1	0	2	0	0	0	1	4	6
2.5	-16.7	0	0	0	0	0	0	0	0	0	0	10	2
4.5	16.8	0	0	0	0	0	1	0	0	0	0	1	2
6.5	59.8	0	0	0	0	0	2	0	0	1	0	7	8
8.5	112.3	0	0	0	0	0	2	0	0	1	0	19	2
10.5	164.8	0	0	0	0	0	2	0	1	1	0	12	5
12.5	182.3	0	0	0	0	0	0	0	0	0	0	15	6
14.5	199.7	0	0	0	0	0	6	0	0	1	0	16	2
16.5	220.3	0	0	0	0	0	1	0	0	0	0	12	4
18.5	244.2	0	0	0	0	0	3	0	0	1	0	14	5
20.5	268	0	0	0	0	0	0	1	1	0	0	5	1
22.5	350.4	0	0	1	0	0	0	0	1	0	1	14	3
24.5	432.8	0	0	0	0	0	4	0	0	0	5	23	10
26.5	496.5	0	0	0	0	0	1	0	0	0	2	13	2
28.5	541.3	0	0	0	0	1	3	1	0	0	3	15	4
30.5	586.1	0	0	0	0	0	1	0	0	1	2	10	3
32.5	611.1	0	0	0	0	0	2	0	0	0	1	9	3
34.5	636.1	0	0	0	0	0	1	0	0	0	0	12	5
36.5	675.1	0	0	0	0	1	1	0	0	2	2	11	5
38.5	728.1	0	0	0	0	0	1	0	0	4	0	21	3
40.5	781.1	0	0	0	0	0	3	0	0	0	2	23	6
44.5	803.7	0	0	0	0	0	1	0	0	1	0	22	7
52.5	915.7	0	0	0	0	0	1	0	0	1	0	20	3
54.5	935.4	0	0	0	0	0	0	0	0	1	0	24	7
56.5	960	0	0	0	0	0	0	0	0	0	1	30	12
58.5	989.5	0	1	0	0	0	2	0	0	0	1	23	8
60.5	1018.9	0	0	0	0	2	1	0	0	2	2	19	6
62.5	1038.9	0	0	0	0	0	7	0	0	3	1	27	5
64.5	1058.9	0	0	0	0	0	4	0	0	0	0	29	10
66.5	1078.3	0	0	0	0	0	3	0	1	0	0	38	7
68.5	1097.1	0	0	0	0	0	0	0	0	0	1	23	7
70.5	1115.9	0	1	0	0	0	1	0	0	0	0	23	11
72.5	1144.1	0	0	0	0	0	4	1	0	0	2	37	12
76.5	1201.7	0	0	0	0	0	3	0	0	0	2	41	7
78.5	1232.2	0	0	0	0	0	5	0	0	0	1	24	9

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Robinia	Verbena	Leguminosae	Heteranthera	Cystopteris	Dryopteris	Equisetium	Lycopodium	Polypodiaceae	Pteridium	Sphagnum	Osmunda
80.5	1262.7	0	0	0	0	0	4	1	0	0	4	14	3
82.5	1300.5	0	0	0	0	0	2	0	0	0	1	18	8
84.5	1338.3	0	0	0	0	0	3	0	0	0	1	38	10
86.5	1384.5	0	0	0	0	0	5	0	0	1	0	23	5
88.5	1439.3	0	0	0	0	2	2	0	0	2	4	20	5
90.5	1494	0	0	0	0	0	4	0	0	0	0	28	9
92.5	1543.8	0	0	0	0	0	3	0	0	0	0	29	9
94.5	1593.7	0	0	0	0	0	2	0	1	0	1	16	6
96.5	1630.6	0	0	0	0	0	3	1	0	5	9	7	1
98.5	1654.6	0	0	0	0	0	1	0	1	1	0	29	4
100.5	1678.5	0	0	0	0	0	2	0	0	0	0	35	4
102.5	1687	0	0	0	0	0	2	0	0	0	1	10	4
104.5	1695.4	0	0	1	0	0	2	0	0	0	3	17	9
106.5	1708.2	0	0	0	0	0	1	0	0	2	0	19	5
108.5	1725.3	0	0	0	0	0	2	0	0	0	0	26	10
110.5	1742.5	0	0	0	0	0	0	0	0	1	0	9	3
112.5	1750.9	0	0	0	0	1	0	0	3	1	1	11	2
114.5	1759.3	0	0	0	0	0	2	0	1	3	1	12	3
116.5	1784.3	0	0	0	0	0	3	0	0	0	4	18	3
118.5	1825.9	0	0	0	0	0	3	0	0	1	0	11	2
120.5	1867.4	0	0	0	0	0	5	2	0	1	0	15	3
122.5	1890.4	0	0	0	0	0	4	0	0	0	0	10	2
124.5	1913.3	1	0	0	0	0	2	0	0	0	0	9	0
126.5	1952.4	0	0	0	0	0	0	0	0	0	0	4	2
128.5	2007.6	0	0	0	0	1	1	3	0	2	0	3	0
132.5	2078.6	0	0	0	0	1	1	5	0	1	1	7	1
134.5	2094.4	0	0	0	0	0	0	0	0	0	0	5	2
136.5	2132.2	0	0	0	0	0	2	0	0	0	0	10	1
138.5	2192.2	0	0	0	0	0	0	1	1	0	0	8	2
140.5	2252.1	0	0	0	0	0	1	0	0	0	0	11	1
144.5	2317.8	0	0	0	0	0	1	0	0	1	2	4	2
146.5	2348	0	0	0	0	0	2	0	0	0	1	9	2
148.5	2375.6	0	0	0	0	0	4	0	1	0	1	15	3
150.5	2403.2	0	0	0	0	0	0	0	1	0	0	13	1
152.5	2421.1	0	0	0	0	0	3	0	0	0	0	7	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Robinia	Verbena	Leguminosae	Heteranthera	Cystopteris	Dryopteris	Equisetium	Lycopodium	Polypodiaceae	Pteridium	Sphagnum	Osmunda
154.5	2439.1	0	1	0	0	1	1	2	1	0	0	10	4
156.5	2475.4	0	0	0	0	0	1	0	0	0	0	9	5
158.5	2530.2	0	0	0	0	0	1	0	1	0	0	9	0
160.5	2585	0	0	0	0	0	3	0	0	0	1	9	2
162.5	2612.7	0	0	0	0	0	1	0	1	0	0	3	4
164.5	2640.3	0	0	0	0	0	1	0	0	0	1	9	2
166.5	2683.3	0	0	0	0	0	3	0	0	0	0	13	2
168.5	2741.7	0	0	0	0	0	3	0	0	0	1	2	0
170.5	2800.1	0	0	0	0	0	1	0	0	0	0	12	2
172.5	2840.8	0	0	0	0	0	1	0	0	1	0	13	2
174.5	2881.5	0	0	0	0	0	0	0	0	0	0	7	1
176.5	2933.7	0	0	0	0	0	3	0	0	0	0	14	1
178.5	2997.6	0	0	0	0	0	1	0	1	0	0	18	0
180.5	3061.4	0	0	0	0	1	3	0	0	1	3	10	3
182.5	3158.8	0	0	0	0	0	1	1	0	1	0	6	3
184.5	3256.2	0	0	0	0	0	1	0	0	0	1	8	5
186.5	3328.3	0	0	0	0	0	0	0	0	0	0	8	3
188.5	3375.3	0	0	0	0	0	0	0	0	0	0	9	2
190.5	3422.3	0	0	0	0	0	0	0	0	0	0	6	0
192.5	3477.6	0	0	0	0	0	2	0	1	0	0	1	0
194.5	3532.8	0	0	0	0	0	1	0	0	0	0	15	4
196.5	3590.2	0	0	1	0	0	3	0	0	0	0	15	2
198.5	3649.7	0	0	0	0	0	1	0	1	0	0	0	1
200.5	3709.3	0	0	0	0	0	3	0	1	0	0	14	1
202.5	3787.8	0	0	0	0	0	0	0	0	0	0	3	4
204.5	3866.3	0	0	0	0	0	1	0	0	0	2	3	0
208.5	4069.7	0	0	0	0	0	0	0	0	1	0	11	6
210.5	4179.1	0	0	0	0	0	0	0	0	0	0	12	3
212.5	4217.8	0	0	0	0	0	0	1	0	0	0	8	2
214.5	4256.6	0	0	0	0	0	1	0	0	0	0	5	3
216.5	4292.1	0	0	0	0	0	0	0	0	0	0	5	2
218.5	4324.4	0	0	0	0	0	0	0	0	1	0	1	0
220.5	4356.7	0	0	0	0	0	0	5	2	2	2	3	5
222.5	4386	0	0	0	0	0	0	0	0	0	0	5	1
226.5	4449.1	0	0	0	0	0	6	0	1	0	0	14	3

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Robinia	Verbena	Leguminosae	Heteranthera	Cystopteris	Dryopteris	Equisetium	Lycopodium	Polypodiaceae	Pteridium	Sphagnum	Osmunda
234.5	4629.8	0	0	0	0	0	2	0	1	1	0	9	2
238.5	4836.8	0	0	0	0	0	3	0	0	1	0	5	1
240.5	4957.4	0	0	0	0	0	1	0	0	0	0	6	1
242.5	4973.3	0	0	0	0	0	1	0	1	0	0	8	2
246.5	5024.2	0	0	0	0	0	0	2	0	0	0	4	4
250.5	5131.8	0	0	0	0	0	1	0	0	0	0	1	5
254.5	5244.7	0	0	0	0	0	1	0	1	1	0	6	2
258.5	5333.9	0	0	0	0	0	5	0	0	0	0	3	8
260.5	5374.6	0	0	0	0	0	2	0	0	0	3	5	4
262.5	5476.5	0	0	0	0	0	5	0	0	1	0	3	6
280.5	5936.2	0	0	0	0	0	3	0	0	0	0	3	1
300.5	6630.1	0	0	0	0	0	2	0	0	0	0	11	5
320.5	7219.1	0	0	0	0	0	0	0	0	0	0	4	0
340.5	8009.3	0	0	0	0	0	0	0	0	0	0	6	3
360.5	8589.4	0	0	0	0	0	4	0	0	0	1	7	3
380.5	9280.5	0	0	0	0	0	3	0	0	0	0	2	2

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Menyanthes	Isoetes	Myriophyllum	Nuphar	Nymphaea	Lemna	Typha (tet)	Typha (mono)	Potamogeton	Sagittaria	Sparganium	Brasenia
0.5	-50.1	1	25	0	0	0	0	0	0	0	0	0	0
2.5	-16.7	0	23	0	1	0	0	0	0	0	0	0	0
4.5	16.8	2	26	0	1	1	0	0	0	0	0	1	0
6.5	59.8	1	45	0	1	0	0	1	0	0	0	0	0
8.5	112.3	0	48	0	0	0	0	0	0	0	0	0	0
10.5	164.8	0	43	0	0	0	0	1	0	0	0	0	0
12.5	182.3	0	29	0	0	1	0	1	0	0	0	1	0
14.5	199.7	0	56	0	2	0	0	0	0	0	0	0	0
16.5	220.3	0	28	3	0	0	0	0	0	0	0	0	0
18.5	244.2	0	45	0	0	0	0	1	0	0	0	0	1
20.5	268	0	28	0	1	0	0	0	0	0	0	0	0
22.5	350.4	1	120	0	0	0	0	0	0	0	0	1	0
24.5	432.8	0	112	0	0	1	1	0	1	0	0	1	0
26.5	496.5	0	66	0	2	0	0	0	0	0	0	0	0
28.5	541.3	0	73	0	1	0	0	0	0	0	0	0	0
30.5	586.1	2	44	0	0	0	0	2	0	0	0	0	0
32.5	611.1	0	58	0	0	1	0	1	0	0	0	0	0
34.5	636.1	0	53	0	0	0	0	1	0	0	0	0	0
36.5	675.1	0	51	1	0	1	0	3	0	0	0	1	0
38.5	728.1	0	66	0	1	0	0	5	0	0	1	0	0
40.5	781.1	0	66	0	1	0	0	0	0	0	0	0	0
44.5	803.7	0	64	0	2	1	1	4	0	0	0	0	1
52.5	915.7	0	86	0	0	1	0	0	0	0	0	0	0
54.5	935.4	0	74	0	0	1	0	0	0	0	0	1	0
56.5	960	0	43	0	1	0	1	2	0	0	0	1	1
58.5	989.5	1	78	0	0	0	0	0	0	0	0	1	0
60.5	1018.9	0	75	0	0	4	0	0	0	0	0	0	0
62.5	1038.9	0	104	0	1	0	0	0	0	0	0	0	0
64.5	1058.9	0	79	2	0	0	0	0	0	0	0	1	0
66.5	1078.3	0	66	0	0	0	0	2	0	0	0	0	0
68.5	1097.1	0	43	0	0	0	0	0	0	0	0	0	1
70.5	1115.9	0	72	0	1	1	0	0	0	0	0	0	0
72.5	1144.1	0	53	0	0	0	1	2	0	0	0	0	0
76.5	1201.7	0	83	1	1	1	0	1	0	0	0	0	0
78.5	1232.2	0	79	0	0	0	0	2	0	0	0	1	1

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Menyanthes	Isoetes	Myriophyllum	Nuphar	Nymphaea	Lemna	Typha (tet)	Typha (mono)	Potamogeton	Sagittaria	Sparganium	Brasenia
80.5	1262.7	0	70	0	0	8	0	0	0	0	0	0	0
82.5	1300.5	0	81	0	1	0	0	1	0	0	0	0	0
84.5	1338.3	0	85	0	0	0	0	2	0	0	0	0	0
86.5	1384.5	0	90	0	0	0	0	0	0	0	0	0	0
88.5	1439.3	0	81	0	0	5	0	0	1	0	0	0	0
90.5	1494	0	122	0	0	0	0	0	0	0	0	0	0
92.5	1543.8	0	107	0	1	0	0	1	0	0	0	1	0
94.5	1593.7	0	147	0	1	0	0	0	0	0	0	0	0
96.5	1630.6	0	125	0	1	5	0	3	0	0	0	0	0
98.5	1654.6	0	105	1	0	0	0	0	0	0	2	0	0
100.5	1678.5	0	82	0	0	0	0	0	0	0	0	1	0
102.5	1687	0	77	1	0	0	0	0	0	0	0	0	0
104.5	1695.4	0	83	0	0	0	0	0	0	0	0	0	0
106.5	1708.2	0	74	0	0	0	1	1	0	0	0	0	1
108.5	1725.3	0	60	1	0	0	0	0	0	0	0	0	0
110.5	1742.5	0	58	2	0	0	0	0	0	0	0	0	0
112.5	1750.9	0	42	0	0	0	0	1	0	0	0	0	0
114.5	1759.3	0	68	0	0	0	0	0	0	0	0	0	0
116.5	1784.3	0	76	0	1	0	0	0	0	0	0	0	0
118.5	1825.9	0	43	2	0	0	0	0	0	0	0	0	0
120.5	1867.4	0	34	0	0	0	0	0	0	0	0	0	0
122.5	1890.4	1	31	0	0	0	0	0	0	0	0	0	0
124.5	1913.3	0	31	0	0	0	1	0	0	0	0	1	0
126.5	1952.4	0	48	0	0	0	0	1	0	0	0	1	0
128.5	2007.6	0	83	0	0	3	0	1	1	0	0	0	0
132.5	2078.6	0	36	2	0	2	0	0	0	0	0	0	0
134.5	2094.4	1	18	0	0	0	0	0	0	0	0	0	1
136.5	2132.2	0	107	0	0	0	1	0	0	0	0	0	0
138.5	2192.2	1	71	0	0	0	0	0	0	0	0	0	0
140.5	2252.1	0	39	0	3	1	0	1	2	0	0	0	0
144.5	2317.8	0	23	0	0	3	0	0	0	0	0	0	0
146.5	2348	0	27	0	1	0	0	0	0	0	0	0	0
148.5	2375.6	0	33	0	0	1	0	0	0	0	0	0	1
150.5	2403.2	0	10	0	0	0	0	0	0	0	0	0	0
152.5	2421.1	0	16	1	0	1	0	0	0	0	0	0	1

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Menyanthes	Isoetes	Myriophyllum	Nuphar	Nymphaea	Lemna	Typha (tet)	Typha (mono)	Potamogeton	Sagittaria	Sparganium	Brasenia
154.5	2439.1	0	19	0	0	0	0	0	0	0	0	0	0
156.5	2475.4	0	16	0	0	0	0	1	0	0	0	0	0
158.5	2530.2	0	19	0	0	1	0	0	0	0	0	0	0
160.5	2585	1	19	3	0	0	0	0	0	0	0	0	0
162.5	2612.7	2	45	0	0	0	0	0	0	0	0	0	0
164.5	2640.3	1	40	0	0	0	1	0	0	0	0	2	0
166.5	2683.3	0	18	1	0	0	1	0	0	0	0	0	0
168.5	2741.7	0	15	0	0	4	0	0	0	0	0	0	0
170.5	2800.1	0	18	0	0	0	0	0	0	0	0	0	0
172.5	2840.8	0	18	0	0	0	0	0	0	0	0	0	0
174.5	2881.5	1	11	1	0	0	0	0	0	0	0	0	0
176.5	2933.7	0	12	0	0	0	0	0	0	0	0	0	0
178.5	2997.6	1	18	0	0	0	1	0	0	0	0	1	0
180.5	3061.4	0	34	0	0	0	0	0	0	0	0	0	0
182.5	3158.8	1	43	0	0	0	0	1	0	0	0	0	0
184.5	3256.2	0	24	0	0	0	1	0	0	0	0	0	0
186.5	3328.3	1	15	0	0	0	0	0	0	0	0	0	0
188.5	3375.3	1	7	0	1	0	0	0	0	0	0	2	0
190.5	3422.3	0	7	1	0	0	0	0	0	0	0	0	0
192.5	3477.6	0	1	0	0	0	0	0	0	0	0	0	0
194.5	3532.8	0	28	0	0	0	1	0	0	0	0	1	0
196.5	3590.2	0	13	0	0	0	0	0	0	0	0	0	1
198.5	3649.7	0	12	1	0	0	0	0	0	0	0	0	0
200.5	3709.3	0	6	0	0	0	0	1	0	0	0	0	0
202.5	3787.8	0	6	0	0	0	1	0	0	0	0	0	0
204.5	3866.3	0	2	0	1	1	0	0	0	0	0	0	0
208.5	4069.7	0	24	0	0	0	0	1	0	0	0	1	0
210.5	4179.1	0	34	0	0	0	0	0	0	0	0	1	0
212.5	4217.8	0	21	0	0	0	0	0	0	0	0	0	0
214.5	4256.6	0	15	1	1	0	0	0	0	0	0	0	0
216.5	4292.1	0	19	0	0	0	0	0	0	0	1	0	1
218.5	4324.4	0	21			0	0	0	0	0	0	1	0
220.5	4356.7	0	15	1	0	4	0	0	0	0	0	0	0
222.5	4386	1	14	0	0	0	0	1	0	0	0	0	0
226.5	4449.1	0	20	0	2	1	0	0	0	0	0	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Menyanthes	Isoetes	Myriophyllum	Nuphar	Nymphaea	Lemna	Typha (tet)	Typha (mono)	Potamogeton	Sagittaria	Sparganium	Brasenia
234.5	4629.8	0	18	0	1	1	0	0	0	0	0	0	0
238.5	4836.8	0	40	0	0	0	0	0	0	1	0	0	0
240.5	4957.4	1	32	0	1	0	0	0	0	0	0	1	0
242.5	4973.3	0	39	0	0	0	0	0	0	0	0	1	0
246.5	5024.2	0	4	0	0	1	0	0	0	0	0	0	0
250.5	5131.8	0	7	0	0	0	0	0	0	0	0	0	0
254.5	5244.7	1	5	0	0	0	0	0	0	0	0	0	0
259	5333.9	1	7	1	0	0	0	0	0	0	0	0	0
260.5	5374.6	0	6	1	0	0	0	1	0	0	0	0	0
262.5	5476.5	0	16	1	0	1	0	0	0	0	0	0	0
280.5	5936.2	0	1	1	0	0	0	0	0	0	0	0	0
300.5	6630.1	0	23	0	0	1	0	0	0	0	0	0	0
320.5	7219.1	0	2	0	0	0	0	0	0	0	0	0	0
340.5	8009.3	1	13	0	0	0	0	1	0	0	1	0	2
360.5	8589.4	0	6	0	1	0	0	0	0	0	0	0	0
380.5	9280.5	0	4	0	0	1	0	1	0	0	0	0	0

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Other	L. clavatum (Exotic)	Total Sum
0.5	-50.1	14	84	507.5
2.5	-16.7	3	11	519.5
4.5	16.8	9	23	503.5
6.5	59.8	3	24	545
8.5	112.3	3	44	520.5
10.5	164.8	3	24	509
12.5	182.3	6	24	520
14.5	199.7	8	24	604.5
16.5	220.3	5	14	536.5
18.5	244.2	6	11	523
20.5	268	25	61	503.5
22.5	350.4	2	43	530
24.5	432.8	13	71	521
26.5	496.5	3	53	517.5
28.5	541.3	8	68	516.5
30.5	586.1	11	41	538
32.5	611.1	7	65	544.5
34.5	636.1	2	66	563
36.5	675.1	14	76	529.5
38.5	728.1	10	53	503.5
40.5	781.1	8	59	550
44.5	803.7	15	74	563.5
52.5	915.7	4	65	539
54.5	935.4	12	31	543.5
56.5	960	4	86	554
58.5	989.5	9	43	551
60.5	1018.9	13	41	478.5
62.5	1038.9	6	45	530.5
64.5	1058.9	15	62	529.5
66.5	1078.3	4	66	582.5
68.5	1097.1	1	41	516
70.5	1115.9	7	21	509.5
72.5	1144.1	10	58	540.5
76.5	1201.7	6	65	550.5
78.5	1232.2	9	55	560

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Other	L. clavatum (Exotic)	Total Sum
80.5	1262.7	14	44	481.5
82.5	1300.5	10	45	518.5
84.5	1338.3	1	63	556.5
86.5	1384.5	2	65	557
88.5	1439.3	16	57	497.5
90.5	1494	4	50	533
92.5	1543.8	9	61	527.5
94.5	1593.7	5	73	549
96.5	1630.6	21	69	510
98.5	1654.6	7	66	517
100.5	1678.5	6	62	555
102.5	1687	8	57	548
104.5	1695.4	3	55	506.5
106.5	1708.2	8	67	525
108.5	1725.3	3	63	557.5
110.5	1742.5	7	53	537.5
112.5	1750.9	10	33	470
114.5	1759.3	15	62	552.5
116.5	1784.3	9	66	535
118.5	1825.9	9	38	551.5
120.5	1867.4	11	45	521.5
122.5	1890.4	12	20	523
124.5	1913.3	14	51	548.5
126.5	1952.4	8	35	504.5
128.5	2007.6	25	54	516.5
132.5	2078.6	13	49	498
134.5	2094.4	8	38	547.5
136.5	2132.2	6	70	512.5
138.5	2192.2	10	55	540
140.5	2252.1	2	57	532
144.5	2317.8	10	47	479.5
146.5	2348	6	63	551
148.5	2375.6	4	55	563.5
150.5	2403.2	7	32	569
152.5	2421.1	6	43	549

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Other	L. clavatum (Exotic)	Total Sum
154.5	2439.1	5	19	556
156.5	2475.4	9	55	553
158.5	2530.2	4	51	532.5
160.5	2585	6	49	529
162.5	2612.7	3	40	550.5
164.5	2640.3	8	42	508
166.5	2683.3	3	35	528.5
168.5	2741.7	15	33	469.5
170.5	2800.1	4	41	521.5
172.5	2840.8	8	44	554.5
174.5	2881.5	2	29	547.5
176.5	2933.7	7	47	610.5
178.5	2997.6	3	38	534.5
180.5	3061.4	12	56	611
182.5	3158.8	6	53	519.5
184.5	3256.2	11	37	507.5
186.5	3328.3	1	25	539
188.5	3375.3	9	39	529.5
190.5	3422.3	0	18	536
192.5	3477.6	25	28	538
194.5	3532.8	4	40	518.5
196.5	3590.2	13	55	632
198.5	3649.7	1	37	515
200.5	3709.3	2	13	489.5
202.5	3787.8	2	31	594.5
204.5	3866.3	9	35	608.5
208.5	4069.7	1	38	555.5
210.5	4179.1	0	27	541.5
212.5	4217.8	1	37	515
214.5	4256.6	0	35	538.5
216.5	4292.1	3	38	537
218.5	4324.4	1	55	565
220.5	4356.7	12	55	462
222.5	4386	2	29	534
226.5	4449.1	4	53	519

Top Depth on Slide (cm)	Age (Cal. yr. BP)	Other	L. clavatum (Exotic)	Total Sum
234.5	4629.8	4	47	501.5
238.5	4836.8	1	27	532.5
240.5	4957.4	6	42	529
242.5	4973.3	1	34	508.5
246.5	5024.2	0	29	534
250.5	5131.8	0	27	586.5
254.5	5244.7	1	30	523.5
259	5333.9	0	33	608
260.5	5374.6	19	72	479.5
262.5	5476.5	4	34	533
280.5	5936.2	3	36	538
300.5	6630.1	2	71	549.5
320.5	7219.1	6	35	605.5
340.5	8009.3	3	49	517.5
360.5	8589.4	4	54	678.5
380.5	9280.5	17	28	497

Appendix CC - Pollen Data (TR01-Fen)

Depth (cm)	Pinus (dp)	Pinus (hp)	Pinus (1/1)	Picea glauca	Picea (1/1)	Abies (1/1)	Tsuga	Larix	Juniper	Acer rubrum	Acer saccharum	Acer	Betula	Betula (4)
47-48	2	0	5	0	12	1	0	2	0	0	2	0	13	0
47-48 (2)	0	1	9	0	15.5	1	1	0	0	2	0	0	18	0
47-48 (3)	0	1	13.5	0	12.5	0	0	2	1	3	0	0	18	0
47-48 (4)	2	1	6.5	0	18	1	0	2	1	2	0	0	28	0
49-50	3	7	17	5	13.5	6	2	4	0	4	0	0	67	0
49-50 (2)	1	1	10	0	22.5	0.5	0	4	0	3	0	0	36	0
49-50 (3)	0	0	15.5	0	17.5	1	3	0	1	3	0	0	36	0
51-52	6	8	22	16	39	10.5	2	6	3	3	1	0	46	0
51-52 (2)	1	2	5.5	0	5.5	0.5	1	0	0	1	0	0	13	0
53-54	0	0	27	1	15.5	6	4	3	3	6	1	1	86	0
55-56	1	0	14.5	1	9	9.5	7	1	1	17	3	0	141	0
57-58	0	2	48.5	1	15	2	4	1	1	11	3	0	106	1
59-60	1	1	48	0	10.5	1.5	6	1	0	13	0	0	129	0
63-64	0	1	85	0	8	0.5	2	2	0	10	2	0	131	0
65-66	0	1	53.5	0	35.5	0	1	1	0	0	0	0	141	0
67-68	3	7	136.5	0	2.5	0	36	4	1	9	2	0	99	0
69-70	3	9	116	0	27.5	0	19	5	1	5	2	0	109	1
71-72	0	1	43	0	35.5	0	3	1	1	0	0	0	131	0
73-74	2	3	37	2	28.5	0.5	1	7	1	1	1	1	117	0
77-78	1	2	42	0	29	1.5	0	0	1	0	1	0	118	0
79-80	1	5	19.5	1	25.5	1	0	0	1	0	1	0	166	0
81-82	0	3	21	2	14	0	1	0	2	0	1	1	156	0
83-84	1	0	19	0	27	0	0	0	0	0	1	0	164	0
87-88	1	1	20.5	1	27	1.5	0	0	2	0	0	0	146	0
89-90	0	0	1.5	0	1.5	0	0	1	0	2	0	0	20	0
89-90 (2)	0	0	3.5	0	3	0	0	1	1	1	0	0	34	0
89-90 (3)	0	0	1	0	2	0.5	0	0	2	2	0	0	23	0
89-90 (4)	0	0	0.5	0	1.5	0	0	0	1	1	0	0	47	0
89-90 (5)	0	0	1.5	0	1.5	0	0	0	0	3	0	0	25	0

Depth (cm)	Carpinus	Carpinus (4)	Carya	Fagus	Fraxinus (4)	Fraxinus (3)	Juglans cinera	Populus	Quercus	Tilia	Ulmus	Urtica	Alnus crispa	Alnus rugosa
47-48	0	0	0	1	0	0	0	2	0	0	1	0	7	5
47-48 (2)	0	0	1	0	0	0	2	3	1	0	0	1	3	4
47-48 (3)	0	0	0	0	0	0	0	2	10	0	0	1	1	4
47-48 (4)	0	0	0	0	0	0	0	2	6	0	0	0	1	1
49-50	2	0	0	4	0	0	0	0	2	0	1	0	10	14
49-50 (2)	0	0	0	1	0	1	0	3	5	0	0	0	2	6
49-50 (3)	1	0	2	0	0	0	0	0	5	0	0	0	4	2
51-52	0	0	0	4	1	1	1	0	3	0	0	0	13	6
51-52 (2)	0	0	0	0	0	0	0	0	3	0	0	0	0	5
53-54	8	0	0	0	2	1	0	0	26	0	0	0	81	58
55-56	14	0	0	4	3	1	1	0	24	0	0	0	62	59
57-58	7	0	1	0	0	3	0	0	24	0	1	0	30	43
59-60	2	0	0	1	2	0	0	0	15	0	0	2	38	31
63-64	1	1	0	1	3	0	0	0	23	0	2	0	31	37
65-66	1	0	0	2	1	0	0	4	5	0	0	1	11	20
67-68	1	0	0	3	1	6	0	2	16	1	1	3	19	29
69-70	1	1	0	1	1	2	0	1	25	0	0	0	31	22
71-72	0	0	0	0	0	2	0	1	18	0	0	1	20	23
73-74	3	0	0	1	1	1	0	0	13	0	1	3	29	16
77-78	3	0	0	0	0	0	0	3	5	0	0	2	16	22
79-80	3	0	0	0	0	1	0	3	5	0	0	3	8	10
81-82	3	0	1	0	0	1	0	0	11	0	1	7	12	13
83-84	1	0	0	1	1	0	0	2	5	0	0	1	9	35
87-88	5	0	2	1	3	2	0	0	25	0	1	1	27	22
89-90	0	0	0	0	0	2	0	0	10	0	0	1	10	2
89-90 (2)	0	0	0	0	0	1	0	4	4	0	0	0	0	0
89-90 (3)	0	0	0	0	0	1	0	2	6	0	2	1	1	0
89-90 (4)	1	0	0	0	0	0	0	2	0	0	0	4	0	0
89-90 (5)	2	0	0	0	0	0	0	0	2	0	0	10	3	0

Depth (cm)	Corylus	Myrica	Salix	Castanea	Platanus	Ephedra	Viburnum	Tubiflorae	Artemisia	Ambrosia	Cyperaceae	Poaceae	Ubelliferae	Vitis
47-48	1	0	0	0	0	0	0	0	0	2	1	2	0	0
47-48 (2)	1	0	0	0	0	0	0	1	0	0	21	0	0	0
47-48 (3)	1	0	0	0	0	0	0	2	0	1	9	0	0	0
47-48 (4)	0	0	1	0	0	0	0	0	0	0	0	0	0	0
49-50	0	1	1	2	0	1	0	2	0	1	3	2	0	0
49-50 (2)	1	2	2	0	0	0	0	1	0	0	3	1	0	0
49-50 (3)	1	1	1	0	0	0	0	0	0	1	7	3	0	0
51-52	1	4	2	2	0	0	0	1	0	4	2	2	0	1
51-52 (2)	1	0	0	0	0	0	0	1	0	1	3	0	0	0
53-54	39	14	4	2	0	1	1	7	0	6	3	2	0	0
55-56	13	11	4	1	0	0	1	9	1	7	4	4	0	0
57-58	14	14	2	2	0	0	0	7	0	1	3	2	0	0
59-60	38	7	0	0	0	1	0	8	0	2	0	0	1	0
63-64	34	1	5	0	2	0	0	3	0	5	3	1	0	0
65-66	34	5	7	0	1	0	0	7	1	0	10	1	0	0
67-68	20	1	8	1	1	2	3	10	0	1	2	1	1	0
69-70	8	2	5	1	0	5	1	10	0	1	2	0	0	0
71-72	12	6	2	1	2	0	1	3	0	2	1	1	0	0
73-74	18	5	3	1	0	2	0	9	0	1	0	7	1	0
77-78	45	12	9	2	0	0	0	3	1	1	20	1	0	0
79-80	29	2	6	1	0	0	0	3	2	2	18	2	1	0
81-82	31	6	6	0	0	0	0	2	2	2	6	2	0	0
83-84	17	14	3	0	0	0	0	3	0	0	3	4	0	0
87-88	21	12	4	1	0	0	0	5	0	0	8	8	0	0
89-90	4	4	2	2	0	0	0	0	0	0	6	1	0	0
89-90 (2)	3	2	3	0	0	0	0	0	0	0	2	0	0	0
89-90 (3)	6	0	7	0	0	0	0	0	0	0	5	0	0	0
89-90 (4)	5	1	10	0	0	0	0	0	0	0	3	1	0	0
89-90 (5)	5	2	6	0	0	0	0	0	0	1	2	0	0	0

Depth (cm)	Epilobium	Chenopodiaceae	Caryophyllaceae	Cornaceae	Ericaceae	Humulus	Cruciferae	Plantago	Ranunculaceae	Rumex	Saxifraga	Rosaceae	Menyanthes	Morus
47-48	0	0	0	1	1	0	0	0	0	0	0	0	0	0
47-48 (2)	0	0	0	0	2	0	0	1	0	1	0	0	0	0
47-48 (3)	0	0	0	1	1	0	0	0	2	0	0	0	0	0
47-48 (4)	0	0	0	1	2	0	0	1	0	1	0	0	0	0
49-50	0	0	1	5	0	0	0	0	0	0	0	0	0	0
49-50 (2)	0	0	0	5	0	0	0	0	0	0	1	0	0	0
49-50 (3)	0	0	0	3	1	0	0	0	0	0	0	0	1	0
51-52	0	4	0	4	3	2	0	0	2	1	0	0	0	0
51-52 (2)	0	0	0	1	1	0	0	0	0	0	0	0	0	0
53-54	0	0	0	4	0	0	0	0	1	2	0	0	0	0
55-56	0	1	0	1	3	1	0	0	0	1	0	0	0	0
57-58	0	0	0	2	2	4	0	0	1	0	0	0	0	0
59-60	0	0	0	2	2	5	0	0	2	1	0	0	2	0
63-64	0	0	0	1	4	2	0	0	4	0	0	0	0	0
65-66	1	0	0	3	21	9	0	0	0	0	2	0	0	1
67-68	0	0	0	0	0	8	0	0	3	1	3	0	0	0
69-70	0	0	0	2	0	4	0	0	1	1	1	0	0	0
71-72	0	0	0	0	14	7	0	0	1	0	0	0	0	0
73-74	0	0	0	0	11	8	0	0	0	2	0	0	0	0
77-78	0	0	0	0	14	19	0	0	0	0	0	0	0	0
79-80	1	0	0	0	11	12	0	0	0	0	1	0	0	0
81-82	0	0	0	0	23	10	0	0	0	0	0	1	0	0
83-84	0	0	0	0	18	1	0	0	0	0	0	0	0	1
87-88	0	0	0	1	7	6	0	0	1	0	2	0	0	0
89-90	0	0	0	0	5	3	0	0	0	0	0	0	0	0
89-90 (2)	0	0	0	0	4	0	0	0	0	0	0	0	0	1
89-90 (3)	0	0	0	2	2	4	1	0	0	0	0	0	0	0
89-90 (4)	0	0	0	0	3	2	0	0	0	0	0	0	0	0
89-90 (5)	0	1	0	1	2	0	0	0	0	0	0	0	0	0

Depth (cm)	Ilex	Isoetes	Myriophyllum	Nuphar	Nymphaea	Lemna	Typha (tet)	Typha (mono)	Sparganium	Dryopteris	Sphagnum	Osmunda	Lycopodium	Polypodiaceae
47-48	0	0	0	0	0	0	1	0	0	8	17	4	0	0
47-48 (2)	2	0	0	0	0	0	0	1	1	9	24	10	0	0
47-48 (3)	1	0	0	0	1	0	0	0	0	7	18	0	0	0
47-48 (4)	2	0	0	0	1	0	0	0	0	6	21	5	0	0
49-50	0	0	0	6	0	1	0	0	2	9	16	6	0	0
49-50 (2)	1	1	0	0	0	0	0	0	0	5	16	5	0	0
49-50 (3)	0	0	0	0	0	0	0	0	0	6	18	5	0	0
51-52	3	1	0	10	0	0	0	0	0	96	67	23	0	0
51-52 (2)	1	1	0	0	0	1	1	0	0	24	13	5	0	0
53-54	24	0	1	7	0	0	2	0	0	22	119	23	0	0
55-56	15	0	1	8	1	0	0	1	0	33	73	13	0	0
57-58	18	0	0	3	0	0	0	1	0	36	72	11	0	1
59-60	42	3	0	0	1	0	0	1	1	23	110	13	0	0
63-64	39	0	1	4	0	0	1	0	1	65	70	18	0	1
65-66	5	115	0	0	1	0	0	2	0	65	78	16	0	10
67-68	36	1	3	0	7	0	0	1	3	72	103	24	0	1
69-70	30	0	0	0	10	0	5	1	2	112	98	45	0	2
71-72	7	8	0	5	1	0	4	2	5	67	80	53	0	1
73-74	4	24	1	7	0	0	1	4	7	45	73	38	0	3
77-78	2	280	0	0	2	0	0	1	0	69	109	4	0	9
79-80	0	19	1	0	0	0	0	2	0	54	92	2	0	12
81-82	0	8	0	0	0	0	0	0	1	31	147	0	0	2
83-84	0	11	0	1	0	0	0	0	4	49	102	1	0	1
87-88	0	13	1	1	0	0	0	0	3	33	42	0	0	1
89-90	0	1	0	0	0	0	0	1	0	3	6	1	0	0
89-90 (2)	0	3	0	0	0	0	0	0	0	11	5	0	0	2
89-90 (3)	0	5	0	0	0	0	0	0	0	13	9	0	3	0
89-90 (4)	0	6	0	0	0	0	0	0	0	7	3	1	0	3
89-90 (5)	0	4	0	0	0	0	0	0	0	2	6	0	0	0

Depth (cm)	Pteridium	Cystopteris	Amphitrema	Other	L. clavatum (Exotic)	Total Sum
47-48	0	1	0	7	67	106
47-48 (2)	0	0	1	1	148	151.5
47-48 (3)	0	0	0	2	113	125
47-48 (4)	0	0	0	4	93	124.5
49-50	0	1	0	2	222	214.5
49-50 (2)	0	0	0	5	162	143
49-50 (3)	0	0	0	5	141	144
51-52	0	0	0	2	218	414.5
51-52 (2)	0	0	0	2	49	89.5
53-54	0	0	0	7	36	586.5
55-56	1	0	0	5	22	560
57-58	0	0	0	8	12	486.5
59-60	1	0	0	4	6	524
63-64	0	0	0	5	8	564.5
65-66	1	0	0	5	78	556
67-68	1	0	0	4	10	653
69-70	0	0	0	0	12	683.5
71-72	0	1	0	1	39	536.5
73-74	1	1	0	11	30	510
77-78	0	0	0	4	86	568.5
79-80	0	0	0	4	106	509
81-82	0	0	0	6	69	527
83-84	0	0	0	1	103	485
87-88	0	1	0	17	134	459
89-90	0	0	0	12	159	100
89-90 (2)	0	0	0	6	206	91.5
89-90 (3)	0	0	0	2	248	97.5
89-90 (4)	0	0	0	2	226	99
89-90 (5)	0	0	0	2	241	78

Appendix D - Charcoal Data (TR05-Path Lake)

Depth (cm)	Age (Cal. yr. BP)	$1/64 \leq x < 1/32$	$1/32 \leq x < 1/16$	$1/16 \leq x < 1/8$	$1/8 \leq x$	L. clavatum (Exotic)	Total Count
0.5	-50	18	13	4	5	33	40
2.5	-17	10	15	7	5	15	37
4.5	17	4	16	3	6	13	29
6.5	60	21	24	12	8	26	65
8.5	112	9	13	2	2	25	26
10.5	165	9	11	8	13	6	41
12.5	182	102	66	28	15	6	211
14.5	200	20	49	21	11	13	101
16.5	220	46	46	14	12	19	118
18.5	244	36	23	7	5	9	71
20.5	268	23	5	3	4	28	35
22.5	350	42	21	8	2	18	73
24.5	433	30	27	10	5	28	72
26.5	497	31	18	6	3	23	58
28.5	541	24	22	3	8	29	57
30.5	586	17	8	5	3	22	33
32.5	611	16	15	3	0	27	34
34.5	636	14	14	2	3	23	33
36.5	675	13	23	3	8	37	47
38.5	728	26	16	4	3	14	49
40.5	781	47	29	15	6	32	97
44.5	804	22	6	6	3	23	37
52.5	916	22	14	7	8	23	51
54.5	935	12	16	3	2	42	33
56.5	960	18	30	4	11	27	63
58.5	990	18	18	7	6	29	49
60.5	1019	14	18	13	5	21	50
62.5	1039	8	12	7	3	15	30
64.5	1059	13	12	4	6	11	35
66.5	1078	32	20	15	8	28	75
68.5	1097	7	6	1	1	22	15
70.5	1116	16	5	2	3	10	26
72.5	1144	20	14	3	7	23	44
76.5	1202	8	9	5	3	27	25

Depth (cm)	Age (Cal. yr. BP)	$1/64 \leq x < 1/32$	$1/32 \leq x < 1/16$	$1/16 \leq x < 1/8$	$1/8 \leq x$	L. clavatum (Exotic)	Total Count
78.5	1232	10	20	7	8	26	45
80.5	1263	20	23	6	4	23	53
82.5	1301	10	17	10	3	23	40
84.5	1338	29	22	7	4	32	62
86.5	1385	52	41	16	10	30	119
88.5	1439	9	17	9	5	24	40
90.5	1494	18	15	2	9	16	44
92.5	1544	18	21	9	8	22	56
94.5	1594	22	27	7	10	28	66
96.5	1631	20	15	9	8	30	52
98.5	1655	26	17	6	4	33	53
100.5	1679	26	12	3	6	21	47
102.5	1687	8	18	5	4	20	35
104.5	1695	24	12	7	2	23	45
106.5	1708	31	24	10	5	21	70
108.5	1725	26	14	4	4	30	48
110.5	1743	24	27	8	4	24	63
112.5	1751	17	19	10	11	24	57
114.5	1759	14	12	9	5	29	40
116.5	1784	15	13	2	1	27	31
118.5	1826	5	9	6	4	22	24
120.5	1867	20	10	1	0	16	31
122.5	1890	9	8	4	4	24	25
124.5	1913	31	22	10	3	19	66
126.5	1952	4	2	1	0	11	7
128.5	2008	17	20	1	0	41	38
132.5	2079	21	10	2	4	26	37
134.5	2094	4	13	7	17	14	41
136.5	2132	36	20	8	11	20	75
138.5	2192	12	8	1	2	23	23
140.5	2252	6	16	9	2	25	33
144.5	2318	19	27	5	2	25	53
146.5	2348	22	18	6	2	30	48
148.5	2376	19	13	4	10	34	46
150.5	2403	4	5	2	1	32	12
152.5	2421	5	11	1	3	29	20

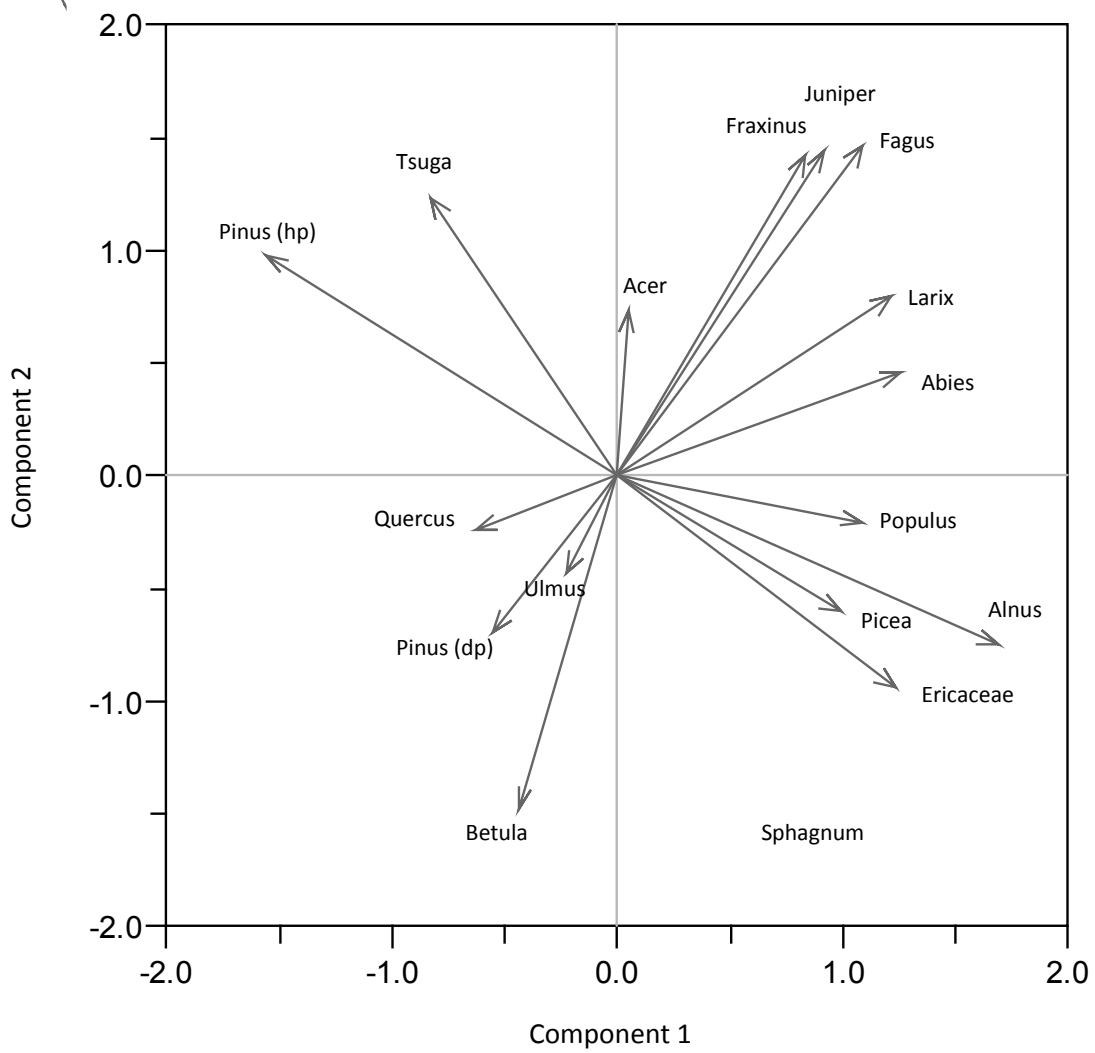
Depth (cm)	Age (Cal. yr. BP)	$1/64 \leq x < 1/32$	$1/32 \leq x < 1/16$	$1/16 \leq x < 1/8$	$1/8 \leq x$	L. clavatum (Exotic)	Total Count
154.5	2439	5	6	2	4	27	17
156.5	2475	25	13	1	2	40	41
158.5	2530	25	10	8	4	26	47
160.5	2585	9	17	1	3	21	30
162.5	2613	10	11	3	0	21	24
164.5	2640	31	25	7	2	18	65
166.5	2683	13	8	5	1	21	27
168.5	2742	13	17	6	5	15	41
170.5	2800	11	17	7	4	20	39
172.5	2841	4	12	7	5	21	28
174.5	2882	14	6	2	2	21	24
176.5	2934	13	8	2	0	27	23
178.5	2998	20	8	4	1	19	33
180.5	3061	6	8	5	1	22	20
182.5	3159	12	8	5	4	22	29
184.5	3256	8	6	3	2	21	19
186.5	3328	8	3	2	2	16	15
188.5	3375	7	4	3	2	16	16
190.5	3422	16	10	5	2	22	33
192.5	3478	13	15	5	2	22	35
194.5	3533	3	3	3	0	28	9
196.5	3590	10	8	2	4	27	24
198.5	3650	5	6	0	3	22	14
200.5	3709	0	1	1	1	4	3
202.5	3788	21	22	7	1	24	51
204.5	3866	10	7	2	4	10	23
208.5	4070	8	12	6	2	20	28
210.5	4179	19	17	7	1	22	44
212.5	4218	5	7	2	4	16	18
214.5	4257	11	12	5	4	20	32
216.5	4292	12	9	3	3	26	27
218.5	4324	3	7	4	1	25	15
220.5	4357	24	22	6	2	21	54
222.5	4386	10	4	2	1	20	17
226.5	4449	3	10	5	7	19	25
234.5	4630	12	5	1	0	14	18

Depth (cm)	Age (Cal. yr. BP)	$1/64 \leq x < 1/32$	$1/32 \leq x < 1/16$	$1/16 \leq x < 1/8$	$1/8 \leq x$	L. clavatum (Exotic)	Total Count
238.5	4837	12	13	3	4	19	32
240.5	4957	21	12	0	3	24	36
242.5	4973	7	7	1	1	22	16
246.5	5024	19	12	5	0	17	36
250.5	5132	0	3	3	0	19	6
254.5	5245	7	2	1	0	16	10
259	5334	1	8	2	0	16	11
260.5	5375	54	33	22	9	22	118
262.5	5477	9	17	7	2	32	35
280.5	5936	3	3	4	9	14	19
300.5	6630	10	13	5	3	27	31
320.5	7219	4	2	0	0	26	6
340.5	8009	7	6	0	1	17	14
360.5	8589	0	2	1	0	42	3
380.5	9281	15	6	0	1	26	22

Appendix DD - Charcoal Data (TR01-Fen)

Depth (cm)	$1/64 \leq x < 1/32$	$1/32 \leq x < 1/16$	$1/16 \leq x < 1/8$	$1/8 \leq x$	L. clavatum (Exotic)	Total Count
47	6	8	2	1	41	17
49	0	0	1	4	15	5
51	2	4	3	6	11	15
53	25	26	12	6	12	69
55	12	13	5	4	17	34
57	2	10	4	5	10	21
59	35	27	2	1	8	65
63	18	31	15	4	11	68
65	10	5	2	0	31	17
67	10	29	11	11	9	61
69	3	35	9	13	8	60
71	6	18	4	0	44	28
73	21	12	10	0	25	43
77	4	3	5	0	38	12
79	8	2	3	0	43	13
81	11	5	1	1	36	18
83	2	7	3	0	57	12
87	9	3	3	0	21	15
89	9	10	2	0	22	21

Appendix F PCA and Graphs (TR05-Path Lake)



Principal component analysis loadings for first to components from Path Lake.