Climatic change causes abrupt shifts in forests, inferred from a high-resolution lacustrine record, Southwestern Quebec, Canada.

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ABSTRACT

A pollen profile from varved lake sediments sampled at 10-year intervals and spanning the past 1000 years is analyzed to understand the effects of climate change and anthropogenic activity on forests in southwestern Quebec. The forests responded rapidly to changes in temperature and precipitation during the Medieval Warm Period and Little Ice Age as well as to land-use changes associated with the European Settlement of the area. The transition into the Little Ice Age was abrupt and had significant impact on the pollen production within a couple of decades. A synthesis of this record with other high-resolution and well-dated pollen data from the conifer-hardwood forest of eastern North America shows consistent results across the whole area, indicating that very-high resolution pollen data can provide insight into multi-decadal climate variability and its impact on forest vegetation. Tree-ring records from the region show inter-annual fluctuations not always consistent between sites, while high-resolution pollen data record multi-decadal to century changes which enable us to interpret climatic effects on plant communities.

RÉSUMÉ

Un profil pollinique provenant des sédiments lacustres varvés échantillonné à intervalles de 10 ans et couvrant les derniers 1000 ans est analysé afin de comprendre les effets du changement climatique et de l'activité anthropogénique sur les forêts du sud-ouest du Québec. Les forêts ont réagis rapidement aux changements de températures et de précipitations au cours de la Période Chaude Médiévale et du Petit Âge Glaciaire ainsi qu’à la modification des sols associée à la colonisation Européenne de la région. La transition vers le Petit Âge Glaciaire a été brusque et a eu un impact significatif sur la production pollinique d'ici quelques décennies. Une synthèse de cette étude comparant d'autres données polliniques bien datées à haute résolution de la forêt mixte de l'est de l'Amérique du Nord démontre que les résultats sont cohérents à travers la région. Ainsi, des données polliniques évaluées à haute résolution peuvent donner un aperçu du changement climatique à l’échelle multi-décennale et un aperçu de son impact sur la végétation forestière. Les profiles dendrochronologiques de la région, bien qu’ils dévoilent des fluctuations interannuelles, ne sont pas toujours cohérents entre sites. Par contre, les profiles polliniques à haute résolution enregistrent des données à l’échelle multi-décennale et à l’échelle centenaire, permettant l’interprétation des effets climatiques sur les communautés végétales.

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List of Acronyms

AMS: Accelerator Mass Spectrometry

AP: arboreal pollen

cal yr BP: calibrated years before AD1950

cc: cubic centimeter

DO: Dissolved oxygen

JJA: June, July, August

LIA : Little Ice Age

LN : Lac Noir

LOI: Loss-on-ignition

MAT: modern analogue technique

MWP: Medieval Warm Period

NAP: non arboreal pollen

PAR : Pollen accumulation rate

PCA: Principal Components Analysis

yrs BP: years before present; radiocarbon years before AD1950

Chapter 1

Introduction

An important goal of the study of paleoenvironments is to understand the factors affecting vegetation changes through time, for example climate, fire, pathogens or human activity. Paleoenvironmental studies provide a needed long-term context to understanding the factors influencing forest composition and biological production. Understanding the factors that affect ecosystem composition and production at many scales is needed to address issues of climate change impacts and ecosystem preservation.

Discerning present-day climate impacts on the vegetation is complicated by changes in the forest over the past centuries caused by human activities. For example, in the deciduous forest of eastern North America, as well as elsewhere in the world, processes such as succession after farm abandonment have affected and are affecting the composition of forests and this is confounded by the impacts of past and present climate variability. In order to discover how forests may be affected by present-day and future climate change, a first step would be to study vegetation changes from a time when human influence was small or negligible. The insights gained from this study can then be combined with analyses of vegetation changes since human settlement to understand the combined effects from human activity and climate on modern vegetation across eastern North America.

Many studies have shown the impact of European (e.g. Whitney, 1994) or Native American (e.g. McAndrews & Boyko-Diakonow, 1989; Bunting *et al*., 1998; Munoz & Gajewski, 2010) activities on the forest composition over the last 500 years. In addition, some studies (Gajewski, 1993; Gajewski, 1987; Anderson, 1985) have demonstrated that climate variability of the past few millennia has impacted the forests. However, details about vegetation - climate interactions at decadal to century scales are not well understood. For example, Gajewski (1987) and Finkelstein *et al*., (2005) showed that recent changes in the composition of the conifer-hardwood forests of eastern North America, previously attributed to land-use changes associated with agriculture or pollution, were actually initiated centuries before the European settlement of the area, and could be associated with climate variability such as the Little Ice Age (LIA, ~AD 1450-1850) and Medieval Warm Period (MWP, ~AD 800-1200). However, only few studies have had the necessary temporal resolution to provide insight into decadal to century-scale climate variability and its impact on the forests of eastern North America (e.g. Swain 1973, 1978, Gajewski *et al*., 1985, 1987; McAndrews & Boyko-Diakonow, 1989; Fuller, 1997; Booth *et al*. 2012).

The purpose of this study is to investigate the history of climate, vegetation changes and fire occurrence during the last 1000 years using annually-laminated sediments from a small lake in the Gatineau Hills of southwestern Quebec. Several questions are addressed in this project: To what extent have climate variations of the past millennium affected the vegetation in southwestern Quebec? Can we see the impact of the Medieval Warm Period (MWP) and the Little Ice Age (LIA) on the terrestrial ecosystems of this region? If so, how have these climate changes affected the forest composition and primary production, as well as fire occurrence? How has human settlement impacted vegetation communities and fire occurrence in the last 200 years? Can these data provide new insight into climate variability of this the past 1000 years?

The primary method to study historical changes in forests is through the use of fossil pollen extracted from lake sediment cores (Bennett & Willis, 2001). However the temporal resolution at which these studies are done is an important consideration. In order to understand forest dynamics, the pollen record must be sampled at a temporal resolution under or approaching that of the lifetime of the trees from the forest. Most available pollen studies, however, have focused on the entire Holocene with relatively low temporal resolution (Anderson, 1985), making it difficult to examine detailed changes in forest composition in response to climate variability such as the Little Ice Age and Medieval Warm Period, or events such as the European settlement of North America during the past 400 years. In this study, the presence of varved sediments (annual laminations) provides an opportunity to examine changes in vegetation and fire occurrence at continuous intervals, thereby providing multi-decadal to centennial-scale information about the timing of fluctuations in the pollen and charcoal record. The relationship between climate, vegetation and fire is investigated, and climate at multi-decadal scales is quantitatively reconstructed.

In addition to the sample interval, which is under the control of the analyst, one limitation to the temporal resolution of paleoecological studies is the chronology. Radiocarbon, the most common dating method for Holocene studies has an error of at least 40-50 years, which approaches the age of some trees living in the forest. However, if the sediments are *varved* (annually laminated), studies can be performed at higher resolution, as the laminations can be associated with specific years (with some error), providing a more accurate estimate of the timing of changes seen in the paleo-record (O'Sullivan, 1983; Tippett, 1964).

The presence of varves also permits the more accurate estimation of pollen accumulation rates (PAR), as individual pollen samples are accurately and independently dated (O'Sullivan, 1983). Although difficult to interpret, pollen influx may be associated with pollen productivity, which in turn may be related to vegetation production (Hicks & Hyvärinen, 1999). Thus, accurate estimation of pollen influx may provide more detailed indications of ecosystem response to climate variability and human influences.

The study area is located on the boundary between the St-Lawrence Lowlands and the Laurentian Highlands of the Precambrian shield (Braun, 1950; Mott & Camfield, 1969). The Laurentian Highlands are characterized by rolling hills 100 m or more above uneven valleys (Mott & Farley-Gill, 1981). The lake is situated in the Grenville geologic Province containing metamorphic rock: sillimanite, garnet, biotite and gneiss (Baer *et al*. 1977). The mixed forest in south-western Quebec is the transition zone between the boreal forest to the north and the deciduous forest to the south (Braun, 1950; Ritchie, 1987; Burns & Honkala, 1990; Richard, 1993).

Lac Noir (45°46'31.91"N, 75° 8'6.23"W, 176 m a.s.l.) is located 60 km north-east of Ottawa (Figure 4.1). It is a small lake of about 10 ha (Ministère du Québec, 1991), with a maximum depth of 16.2 m. The lake is at the bottom of a valley with a steep hillside (400 m a.s.l) to the west and there is some agricultural land within a kilometer to the east. There are two summer cabins on the lake but otherwise there is no other land use presently on the shore.

The organization of this thesis follows: Chapter 1 introduces the subject and defines the problem, Chapter 2 reviews the literature pertaining to the subject, Chapter 3 addresses the methods used in the field and laboratory, Chapter 4 presents the results in the format of a scientific article, and Chapter 5 summarizes the findings and the conclusions of the study.

When dealing with historical data the chronology is critically important in high-resolution studies. The term “yrs BP”, is used to denote radiocarbon years before AD 1950. The year AD1950 is used as the base by convention. Because radiocarbon ages are not the same as calendar years, they must be calibrated, and are then denoted as cal yr BP (calibrated years before AD1950). These will be used when reviewing the literature, for example. As the chronology is based on varves in this study, and these correspond to calendar years, we will use “yr BP” to indicate years before AD2010, the year of sample collection. The common “yr AD” will also be used.

Chapter 2

Literature Review

2.1 Holocene Fossil Pollen Record of eastern North America

Many pollen records from eastern North America (Anderson, 1985; Ritchie, 1987) span the early to late Holocene (~12,000 yrs BP - present) and provide a relatively comprehensive description of long-term vegetation change. Holocene pollen records from southern Quebec (Richard, 1993) and eastern and southern Ontario (Mott & Farley-Gill, 1981; Bennett, 1987; McAndrews & Boyko-Dyakonow, 1989; Fuller, 1997) have been used to analyze the postglacial migration of the major tree taxa in eastern North America by mapping the percentages of the various tree pollen taxa through time (Bernabo & Webb, 1977; Williams *et al*. 2004). Higher-resolution late-Holocene records have been prepared from several areas of north-eastern United States (Gajewski, 1987, 1988).

The oldest pollen assemblages in southern Quebec and Ontario show evidence of tundra and boreal phases. By the mid-Holocene *Pinus* species, firstly *P*. *banksiana/resinosa* and then *P*. *strobus* became dominant, indicating a shift in vegetation communities (Ritchie, 1987). *Pinus strobus* then decreased while *Tsuga* and *Fagus* increased (Anderson, 1985; Mott & Farley-Gill, 1981, Fuller, 1997). Other tree taxa, such as *Fraxinus*, *Quercus*, *Ulmus*, *Ostrya-Carpinus*, *Corylus* and *Acer* were also important components of the mid-to late-Holocene forests, although the pollen is in some cases less abundant. *Betula* pollen increased around 5000 years ago and has been dominant in the mixed forest of northeastern United States and southeastern Canada ever since. *Tsuga* increased around 5000 years ago (the exact time depending on the study site), subsequently decreased and finally increased again, around 3000 years ago; this is recorded in most pollen diagrams in eastern North America (Anderson, 1985; Mott & Farley-Gill, 1981, Fuller 1997). This decrease is attributed to an epidemic attacking the species (Fuller, 1998; Bennett, 1987). A late-Holocene increase in boreal taxa toward the northern part of the deciduous forest is a result of cooler conditions. *Fagus* pollen began decreasing 1000 years ago, while other hardwoods such as *Acer saccharum*, *Ostrya-Carpinus*, *Fraxinus* and *Ulmus* increased (McAndrews & Boyko-Diakonow, 1989), marking the influence of the Medieval Warm Period on climate changes in the region. Coniferous species such as *Pinus* increased around 1500 AD, along with *Picea* and *Abies*, while hardwoods decreased, marking the Little Ice Age. *Tsuga* and *Fagus* both decreased together in other parts of eastern North America during the Little Ice Age (Gajewski, 1987). An increase in herbaceous pollen taxa such as *Ambrosia*, *Artemisia*, Poaceae, Asteraceae and *Rumex*-type marked the influence of the European settlement starting around 1850 AD in most parts of eastern North America.

2.2 Holocene Climate Variability in North America

An extensive literature has documented past climate variability during the Holocene in North America (Viau & Gajewski, 2009; Viau & Gajewski, 2007; Viau *et al*. 2006; Willard *et al*. 2005) and during the late-Holocene in eastern North America (Booth *et al*. 2012; Viau *et al*. 2012; Oswald & Foster, 2011; Shuman *et al*. 2009; Finkelstein & Davis, 2006; Jackson & Booth, 2002; Prentice *et al.* 1991; Gajewski, 1987, 1988).

Between 9000-5000 yrs BP was a period of relative warmth, ultimately caused by higher summer insolation in the northern hemisphere (Grove, 2004; Wanner, 2008). From ~4000-5000 yr BP to the present was a period referred to as the "Neoglacial" period, when multiple glacier advances occurred in northern mountain regions. This was ultimately caused by a decrease in summer insolation in the northern hemisphere (Grove, 2004; Wanner, 2008). At a millennial scale, the period between 3500-3000 BP was relatively cool in many places, and this was followed by the Medieval Warm Period (MWP; 900-1250 AD) and the Little Ice Age (LIA; 1280-1850 AD).

Summer temperatures have been reconstructed for the past 2000 years using a dataset of pollen records in all of North America (Viau *et al*. 2012) and the results showed that both the MWP and LIA were cooler than present, and that the MWP was warmer than the LIA across the majority of North America. In the region of the conifer-hardwood forest, temperature anomalies were about 0°C around 1000 years ago and -0.2°C 500 years ago; similar values were found in reconstructions based on pollen records from the deciduous forest to the south and in the boreal forest to the North (see Figure 3 in Viau *et al*. 2012; Viau and Gajewski, 2009). The cause of these temperature changes can be attributed to a northward shift in high pressure systems of the Atlantic during the summer during the Medieval Warm Period and southward shift during the LIA (Gajewski, 1998).

2.3 Resolution of paleoenvironmental records

The spatial and temporal resolution chosen to study fossil pollen records is of importance as it determines the questions that can be asked of the data, the dynamics recorded by the record and the variability recorded in the data (Gajewski, 1993). If a sediment core is sampled at non-continuous intervals, for example, a sample extracted every 2 or 4 cm, many sections are not analyzed, thus creating gaps in the record. The resulting pollen diagram may therefore not contain sufficient information to record high frequency changes in the vegetation or climate.

Although many studies have analyzed vegetation changes and climate variability at a low temporal resolution (millennial scale) (Anderson, 1985), there are relatively few studies from eastern North America that have been conducted at high resolution (decadal to century; Swain 1973, 1978, Gajewski *et al*., 1985, 1987; McAndrews & Boyko-Diakonow, 1989; Fuller, 1997; St-Jacques & Smol, 2008; Booth *et al*. 2012). Although sampled at relatively high resolution, most of these studies did not analyze the sediment continuously and the majority of these samples were analyzed at 40 year intervals. Recent exceptions are St-Jacques *et al*. (2008) , who analyzed sediments from Lake Mina in west-central Minnesota at continuous sub-decadal scale (4-year resolution) and two studies where fossil pollen were analyzed at continuous 10-year intervals (McAndrews & Boykow-Dyakonow, 1989; Swain, 1973).

2.4 Varve formation

Lac Noir, the object of study in this thesis, contains varved sediments and therefore it is important to discuss what varves are and how they are formed. Varved sediments are defined as annually layered sediments (O'Sullivan, 1983) that you can see with the naked eye (Figure 2.1).

Figure 2.1: Varves from Lac Noir, Core #2, 52.5 cm; photo no. DSC09842.

Annually laminated sediments have consecutive layers deposited at the bottom of the lake by precipitation and flocculation of autochthonous (iron, manganese, carbonates, biogenic substances) and allochthonous materials (clastic particles, vegetation, pollen and charcoal) (Anderson & Dean 1988). The couplets can be annual or seasonal (Tippett, 1964; O'Sullivan, 1983) and the layering can be chemical (calcareous, ferrogenic), mechanical (clastic), or organic (biogenic) (O'Sullivan, 1983). Ferrogenic laminae have been identified in Hell's Kitchen Lake, Wisconsin USA, Green Leaf Lake, Ontario and Lake of the Clouds, Minnesota USA. Usually, there are four separate laminae each representing a seasonal deposition, where iron oxides precipitate during overturn. Calcareous laminae have been found in Little Round and McKay Lakes in eastern Ontario; diatoms are the cause of these laminae. Biogenic laminae have been discovered in Crawford Lake, Ontario, Fayettville Green Lake, New York, and in Finland. Organic material, including dead organisms create these layers, leaving alternations between white silty layers, grey layers and dark black layers of humus (O'Sullivan, 1983). Clastic laminae have been found in Lake Erie and other European lakes. They usually occur from particles being brought into the lake, thereby affecting sediment influx (O'Sullivan, 1983). Particles sizes differ from coarse to fine depending on the season.

A number of *in situ* lake conditions have been identified that are needed for varve formation to take place: 1) There cannot be any disturbance (moving water, bioturbation, gas bubbles) at the water-sediment interface or in the sediment which would disrupt and re-suspend particles, 2) The basin should have a relatively flat bottom to prevent slumping and redistribution of sediment and should be deep to prevent the water column from mixing during the change in seasons and storms (because this can activate water movement and bring oxygen down to the sediment surface; this would permit the survival of benthic fauna and lead to the bioturbation of the sediments, 3) Ideally, the water column should be permanently stratified, but varves can form in a seasonal or semi-permanently thermally stratified lake as well (O'Sullivan, 1983).

Three thermal zones can be present in lakes based on different water temperature and therefore density: epilimnion (top and warmer), metalimnion (middle or transition) and hypolimnion (bottom at or near 4°C) (Smol, 2008). Deep lakes have the three zones, but shallow lakes don't necessarily have a hypolimnion; sometimes small lakes have no thermal stratification. When lakes seasonally mix, they can be holomictic, dimictic or polymictic. Lakes that never mix, or mix only once in several years are called meromictic. Varves are often found in meromictic lakes, however, this isn't a necessary requirement for the preservation of varves (Anderson & Dean, 1988) since dimictic or holomictic lakes that have weak mixing can still have anoxic environments in the bottom, discouraging organisms from attaining the bottom and therefore eliminating bioturbation.

Varved sediments are important in paleoclimatology and paleoecology because they provide precise chronology and PAR (pollen accumulation rates), therefore improving the accuracy of the timing of changes seen in pollen diagrams and climate reconstructions (Lamoureux, 2001). For this reason Lac Noir was chosen for this study, which is a high resolution analysis of vegetation and climate dynamics in the Gatineau region of Québec. As the purpose of the project was to study vegetation change in relation to climate variability, the mechanisms of varve formation were not studied; therefore it is difficult at this point to identify the type of varves present in Lac Noir. Nevertheless, evidence will be shown of the annual nature of the varve sedimentation.

Chapter 3

Methods

3.1 Field methods

A 94 cm sediment core was retrieved from the deepest part (16.2 m) of Lac Noir in November 2009, using a modified Livingstone piston corer (Wright, 1967), 5 cm in diameter. Three frozen cores were collected in May 2010 in the same vicinity where the Livingstone core was collected. A freezer corer (Shapiro, 1958) was used to collect the three cores; this consists basically of a hollow aluminum tube which is packed with dry ice, and sunk into the sediments at the bottom for 10 minutes. The sediments stick to the outside of the metal tube and can thereby be retrieved. Cores were wrapped in foil and stored in a foam box packed with dry ice, brought to the Laboratory for Paleoclimatology and Climatology, University of Ottawa and stored in a freezer. Core #1 was 83.5 cm, core #2 was 94 cm and core #3 was 85 cm in length.

Conductivity, temperature and pH were measured on June 27th, 2012 using a multi-meter YSI™ SCT model, and dissolved oxygen was measured using a multi-meter YSI™ 51B model. Percent dissolved oxygen (DO) was calculated based on the YSI meter saturation values (DO (mg/L)/ Saturation DO*100). One pH value was taken in water from the top and bottom of the water column. Conductivity was measured every meter up to a depth of 10 meters (length of the cord), and temperature was measured every 2 meters to 16 meters (Table 1).

3.2 Laboratory methods

3.2.1 Core extrusion

The first 30 cm of the fresh core were sampled at 0.5 cm intervals using an extruding device on a stand. The samples were placed into Ziploc bags for ^{210}Pb dating. The remaining portion of the core (30-94 cm) was firm enough to be horizontally extruded onto cellophane wrap and Aluminum foil and stored in a refrigerator.

3.2.2 Magnetic susceptibility and LOI

Magnetic susceptibility can be used to correlate multiple cores taken from the same lake (Dearing, 1986) but it also acts as complementary information to other analyses. It is fast and non-destructive and it informs us on the magnetic properties (Fe-bearing minerals from bedrock) of the sediments which may be interpreted as indicating erosion at some point in time (Sandgren and Snowball, 2001). Whole core magnetic susceptibility (Sandgren and Snowball, 2001) of the fresh core (30-94cm) was measured three separate times at 1 cm intervals using a Bartington™ MS2C meter and Loop Sensor with a 6-cm internal diameter (Appendix A) and the average computed.

Weight-loss-on-ignition is a widely-used method of approximating the organic and carbonate content (percentages) of sediment samples (Heiri *et al*., 2001). Loss-on-ignition (LOI) was conducted on frozen core LN #2 at 10-year intervals using the varves as the sampling intervals (Appendix B).

3.2.3 Radiocarbon dating

The radiocarbon dating method requires organic matter for dating. Macro-fossils were hand-picked from the sediment and used for dating.

Two subsamples were chosen from the Livingstone core for macro-fossil extraction. A half diameter, 1 cm thick slice of the core was removed at 41-42 cm and 77-78 cm. Each sample was sieved through a 90 µm Nitex ® mesh into a beaker using a squeeze bottle with deionised water. Organic matter (seeds, vegetation strands, pods) and chironomids were picked from the sample under a 20 x stereomicroscope.

3.2.4 Varve counting and cross-dating

The laminations were first assumed to be varves and counted accordingly in the freezer on the cleaned frozen core surfaces. Subsequent analysis of the varves confirmed the annual nature of the laminations, and so the term “varve” is used throughout this thesis.

Varves were analyzed on the frozen cores. Each core was carefully cleaned using an Exacto blade until the laminations were distinctive enough to count with the naked eye. Once the scraping was done, a dry cloth was used to wipe off any residue left on the core. The top 10 cm of each core could not be scraped much because it was too thin and little sediment remained. However, varves could be estimated on the section, discussed below.

Each couplet (a dark and light lamination) was assumed to comprise the deposition of one year (Boyko-Diakonow, 1979). In addition, all of the cores had nine distinct “marker beds” which were used to cross-date the cores (Figure 3.1). Marker bed A consisted of two thin grey layers, marker bed B consisted of a thicker grey layer 2mm thick, marker bed C had a yellow tint with thickness of 1mm and marker bed D consisted of a distinctive pattern of layers where a thick yellow layer was accompanied by dark brown and reddish layers on either side. Marker bed E also consisted of a distinctive pattern of layers where a pale layer was accompanied by thick pale zones 2 mm thick on either side with a distinctive 4 mm thick layered section bellow. Marker bed F consisted of a pale yellow layer 1 mm thick, marker bed G consisted of a yellowish layer 0.5 mm thick, and marker bed H consisted of a pale grey layer 1.5 mm thick and marker bed I consisted of a group of yellow tinted layers above a thick yellowish layer 2 mm thick.

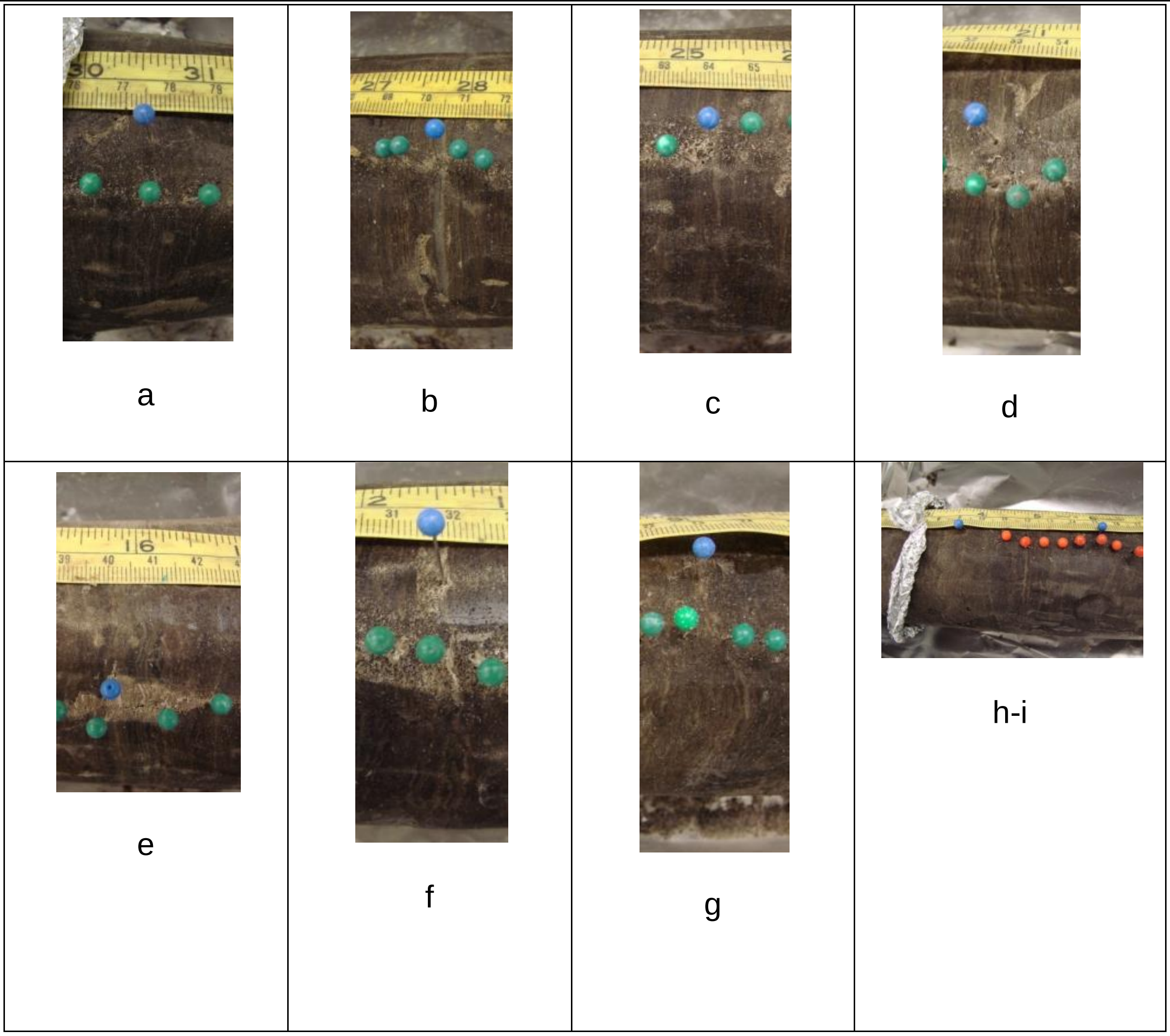

Figure 3.1: Marker beds in core #1 from Lac Noir. a) 78 cm (photo no. DSC09922), b) 71 cm (DSC09923), c) 64 cm (DSC09925), d) 53 cm (DSC09927), e) 41 cm (DSC09931), f) 32 cm (DSC09935), g) 23 cm (DSC09937), h-i) 15 and 9 cm (DSC09941), marked by a blue pin.

The same distinctive marker beds were observed in each of the three cores (Figure 3.2), and a coloured pin was inserted at each marker bed in each core. A pin was then inserted in the sediments at every 10 couplets (i.e. 10 years) for the three frozen cores independently and subsequently cross-dated among each other (Fritts, 1976).

Cross-dating is a standard dendrochronological method that is the basis of tree-ring dating (Fritts, 1976) and the idea is easily transferred to varves. The number of varves between the markers in each core is counted. If there are differences, the cores are studied, using patterns in the varves and distinctive layers, recounted multiple times, until they are resolved. Missing or double varves in any one core can be identified and this is accounted for when determining the final chronology. If there was a difference (missing varves or too many varves), then the counts were reconciled by: 1) visually inspecting all cores, around the circumference, to see if varves were missed or counted more than once and 2) recounting the varves in those sections on the other cores based on the core(s) that had the clearest laminations in each section. All three cores had distinctive marker beds easily seen in all three cores therefore the cores matched well visually and were resolved easily when recounting the varves, except for the top 6 cm (22 years; see below) where the cores were disturbed by the coring process. Lead-210 was used to date that section.

Figure 3.2: Marker beds in all three cores, core 1 (top), core 2 (middle), core 3 (bottom). The bottom of the core is to the right, and the pins denote 10-year sections of the core, photo no. DSC09945.

After the cores were cross-dated, the distance in millimetres between each pin was measured on each frozen core (Figure 3.3) using a Leica Wild M3C stereo microscope with a Mini-scale and System Encoder connected to an Acurite III digital counter with a precision of 0.001 mm. The software J2X was used to transfer data to a spreadsheet for analysis.

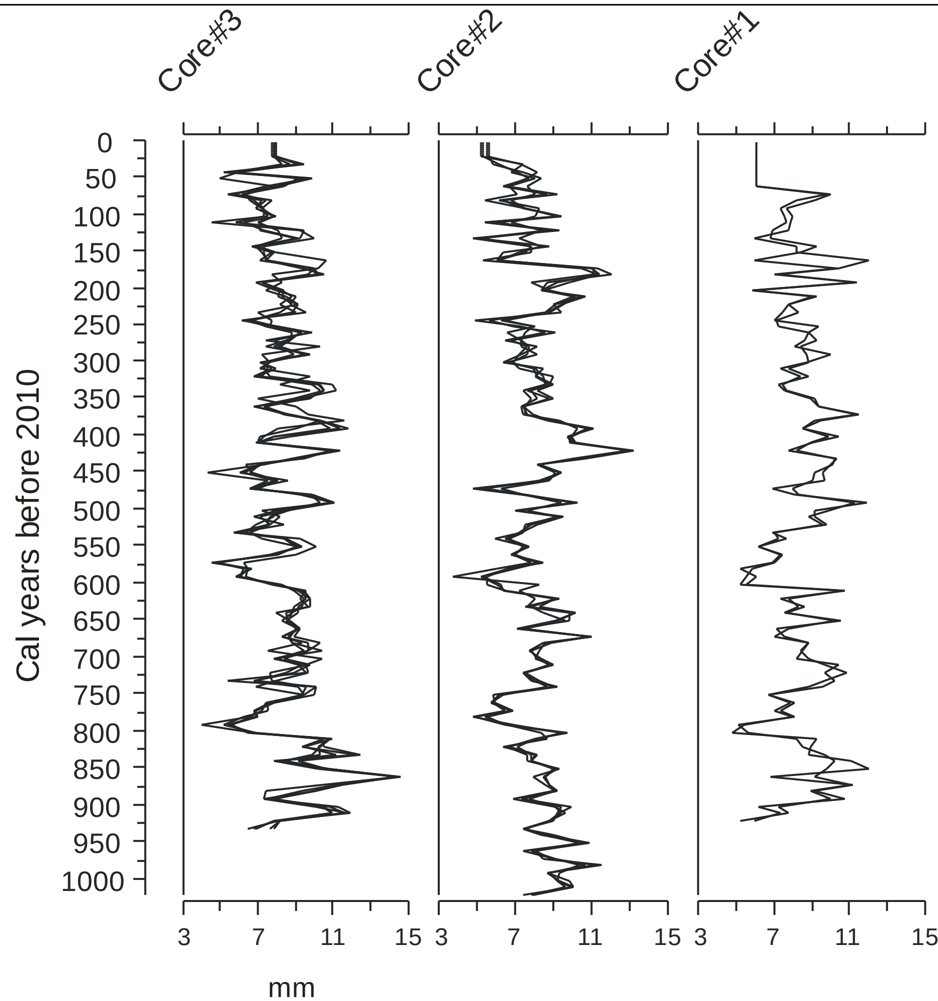

Figure 3.3: Depth measurements for cores 1-3 from Lac Noir. Core 3 contains 5 measurements, core 2 has 4 meaurements and core 1 has 2 measurements. Note core #1 had a longer estimate at the top than core #2 and 3 because the varves were disturbed further down the core than the other two.

The distance between pins was measured 2-5 times on each core and averaged (Figure 3.4). Comparison of the times series of the average depth replicate measurements showed that the cross-dating is mostly consistent between cores and that each core had similar patterns of layers (Figure 3.4).

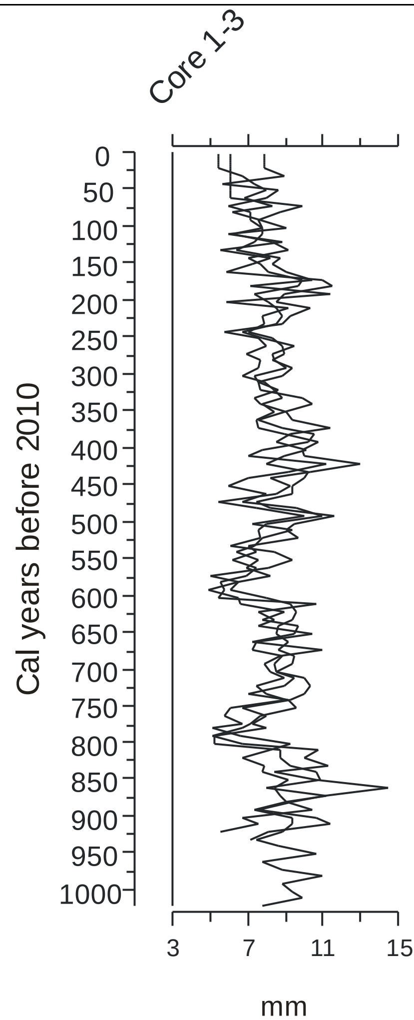

Figure 3.4: Plot of average depth measurements of each core against age, determined by the cross-dated varve series.

3.3 Chronology

Two sediment samples were picked for organic matter and sent to Beta Analytic for accelerator-mass spectrometry (AMS) ^{14}C dating. The radiocarbon ages were calibrated using the program CALIB V6.0.0 and calibration dataset INTCAL 09.14c (Stuiver & Reimer, 1993; Reimer *et al*., 2009).

Sediments from the top 20 cm, as well as at 23-24 cm, 27-28 cm, 32-33 cm and 36-37 cm depth from the Livingstone core were sent to Flett Research Ltd for ^{210}Pb dating. The ^{210}Pb chronology was estimated based on a linear regression model applied to the dates.

The first 6.5 cm of sediment at the top of the 3 cores were disturbed; therefore a single depth measurement (from the sediment water interface to the first pin) was taken. The sediment was divided into 10 equal amounts (0.65 cm) for pollen analysis; this was based on the lengths of the older sections. To assign ages to the uppermost 6.5 cm the ^{210}Pb ages were used. The ^{210}Pb results indicate an age of 16 years at 4.5 cm and 27 years at 7.5 cm, suggesting that the disturbed portion represents 22 years (Appendix C).

To develop the chronology, we therefore had available two radiocarbon dates, the ^{210}Pb series and the cross-dated varve sequence. In addition, the *Ambrosia* rise, discussed below, indicating the presence of European agriculture was a distinct marker on the pollen diagram and could be used to verify the chronology (although not used to develop the chronology). The different methods provided some support for each other, but also indicated differences. The chronology will be discussed in Chapter 4.

3.4 Pollen and charcoal analysis

Core #2 was chosen for pollen analysis because it is the longest core and had the clearest laminations. The core was sub-sampled at 10 year intervals and placed in vials to be used for pollen processing.

One cc of sediment was removed from the vials using a calibrated brass sampler and deposited into plastic centrifuge tubes. Two *Lycopodium* spore tablets were added to each sample to calculate pollen concentrations (Bennett & Willis, 2001; Stockmarr, 1971; Faegri &Iversen, 1989). The sediment was processed using standard methods (Faegri *et al*., 1989), including HCl, KOH, acetolysis, and HF treatments and storage in Silicone oil. The exotic markers were counted with the native pollen of that sample using a Nikon 90i microscope at 400x magnification, with identifications performed at 100x magnification with oil emersion. The various depths were counted in random order to ensure no temporal bias in the resulting pollen diagram (Appendix D). Photographs of the pollen were taken with a camera attached to the microscope and output into the imaging software *NIS*-Elements version 3.0 (Figure 3.5). An average of 510 grains was counted for each subsample. Pollen keys (O'Kapps, 2000; Faegri *et al*. 1989; McAndrews *et al*. 1973; Richard, 1970) and books (Moore *et al*. 1999; Traverse, 2007; Lewis *et al*. 1983) as well as reference slides from the Paleoclimatology and Climatology Laboratory collection were used as references for pollen identification.

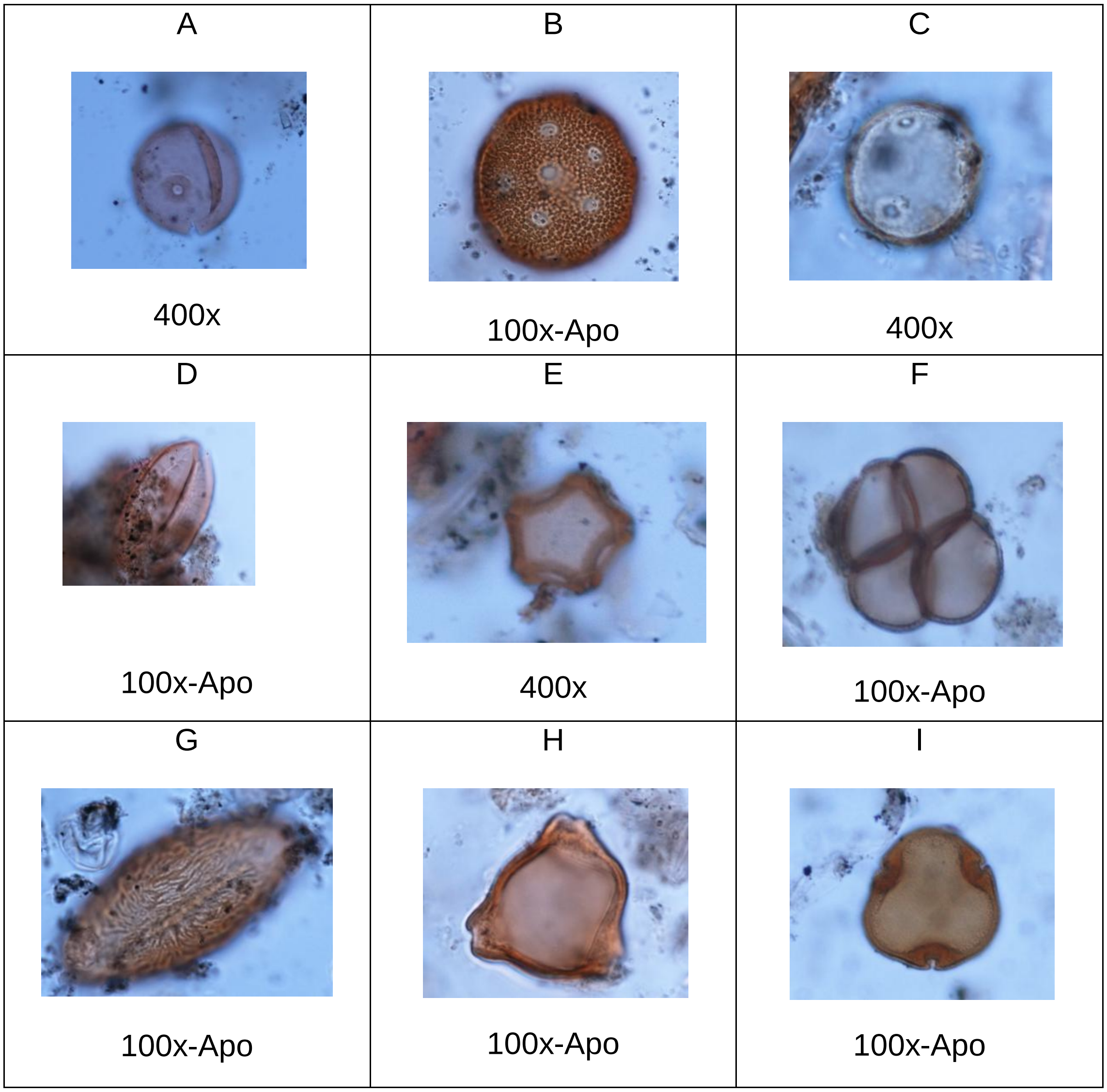

Figure 3.5: Examples of pollen found in Lac Noir sediments. A) Poaceae (monoporate), B) Caryophyllaceae (periporate), C) *Plantago* (periporate), D) *Ephedra nevadensis* (polyplicate), E) *Alnus rugosa* (stephanoporate), F) *Typha latifolia* (tetrad), G) *Acer rubrum* (tricolpate), H) *Myrica gale* (triporate), I) *Tilia americana* (triporate).

Micro-charcoal was counted and measured on the pollen slides (Whitlock & Larsen, 2002). Particles were classified into 4 size classes (1: 218.75≤ x< 437.5 μm^2, 2: 437.5≤ x< 875 μm^2, 3: 875≤ x< 1750 μm^2 and 4: ≥1750) (Appendix E) and total area summed (Whitlock & Larsen, 2002). A grid in the imaging software *NIS*-Elements version 3.0 was created and used to classify the particles (See Appendix F for example). The samples were counted randomly and recorded in their respective count sheets.

3.5 Paleoclimate reconstructions

Warm season (JJA) temperatures and (JJA) precipitation were reconstructed using the Modern Analogue Technique (MAT) (Sawada, 2006) and version 1.8 of the North American Modern Pollen Database (Whitmore *et al*., 2005). Modern pollen data spanning the entire eastern deciduous forest between 50°-100°W longitude and 20°-50°N latitude were extracted as potential candidates for the modern analogue. The average of the first three analogues (Williams and Shuman, 2008) was used to compute the reconstructed summer climate variables (JJA temperature and JJA precipitation). A pollen sum of 24 arboreal pollen (AP) taxa was used for the analogue computations. Experiments with an expanded sum, and with non-arboreal pollen (NAP) taxa included found only small differences.

Chapter 4

Results

Climatic change causes abrupt shifts in forests, inferred from a high-resolution lacustrine record, Southwestern Québec, Canada.

Key words: Varves, Québec, Holocene, Pollen, Forest Dynamics, Paleoclimate Reconstruction, Charcoal, Eastern Deciduous Forest, Lake Sediments

4.1 Introduction

Ecological studies are documenting impacts of global warming on ecosystems around the world, such as range extensions of species into new areas. In the deciduous forest of eastern North America, as well as elsewhere in the world, discerning present-day climate impacts on the vegetation is complicated by the changes in the forest over the past centuries caused by human activities, such as succession after farm abandonment. Many studies have shown the impact of European (e.g. Whitney, 1994) or Native American (e.g. McAndrews & Boyko-Diakonow, 1989; Bunting *et al*., 1998; Munoz & Gajewski, 2010) activities on the forest composition over the past millennium. In addition, climate variability of the past few millennia has impacted the forests, although details about vegetation - climate interactions at decadal to century scales are not well understood. For example, Gajewski (1987) and Finkelstein *et al*., (2005) showed that recent changes in the composition of the conifer-hardwood forests of eastern North America, previously attributed to land-use changes associated with agriculture or pollution, were actually initiated centuries before the European settlement of the area, and could be associated with climate variability such as the Little Ice Age

(LIA; ~AD 1450-1850) and Medieval Warm Period (MWP; ~AD 800-1200). However, only few studies have had the necessary temporal resolution to provide insight into decadal to century-scale climate variability and its impact on the forests of eastern North America (e.g. Swain 1973, 1978, Gajewski *et al*., 1985, 1987; McAndrews & Boyko-Diakonow, 1989; Fuller, 1997; Booth *et al*. 2012). Studies of the past 1000 years can provide context for understanding the current response of vegetation to global warming (Gajewski, 1987, 1993). At much longer timescales, the postglacial environmental history of North America has been extensively studied, documenting the migration of the major tree taxa following deglaciation and their response to long-term climate changes over the Holocene (Bryant & Holloway, 1985; Wright *et al*., 1993; Williams *et al*., 2004).

The purpose of this study is to investigate the history of climate, vegetation changes and fire occurrence during the last 1000 years using annually-laminated sediments from a small lake in the Gatineau Hills of southwestern Quebec. The presence of varved sediments (annual laminations) provide an opportunity to examine changes in vegetation and fire occurrence at continuous intervals, thereby providing multi-decadal to centennial-scale information about the timing of fluctuations in the pollen and charcoal record. The presence of varves also permits the more accurate estimation of pollen accumulation rates (PAR), as individual pollen samples are accurately and independently dated. The relationship between climate, vegetation and fire is investigated, and climate is reconstructed at multi-decadal scales. This project can answer several questions: 1) To what extent have climate variations of the past millennium affected the vegetation in southwestern Quebec? 2) Can we see the impact of the Medieval Warm Period (MWP) and the Little Ice Age (LIA) on the terrestrial ecosystems of this region? 3) If so, how have these climate changes affected the forest composition and primary production, as well as fire occurrence? 4) How has human settlement impacted vegetation communities and fire occurrence in the last 200 years? 5) Can these data provide new insight into climate variability of this the past 1000 years?

Lac Noir (45°46'31.91"N, 75° 8'6.23"W, 176 m a.s.l.) is located 60 km north-east of Ottawa (Figure 4.1). It is a small lake of about 10 ha (Ministère du Québec, 1991), with a maximum depth of 16.2 m. The lake is at the bottom of a valley with a steep hillside (400 m a.s.l) to the west and some agricultural land within a kilometer to the east. There are two summer cabins on the lake but otherwise there is no other land use presently on the shore.

The study area is located on the boundary between the St-Lawrence Lowlands and the Laurentian Highlands of the Precambrian shield (Braun, 1950; Mott & Camfield, 1969). The Laurentian Highlands are characterized by rolling hills 100 m or more above uneven valleys (Mott & Farley-Gill, 1981). The mixed forest in south-western Quebec is the transition zone between the boreal forest to the north and the deciduous forest to the south (Braun, 1950; Ritchie, 1987; Burns, 1990; Richard, 1993). Many tree species of the eastern Deciduous Forest have their northern range in the study area (Ritchie, 1987) which may make the pollen record of this site sensitive to climate variability.

4.2 Methods

Three cores were collected from the deepest part of Lac Noir using a freezer corer (Shapiro, 1958). The cores were clearly laminated along the entire length, with distinct “marker” layers observed in each of the cores that were used for cross-dating (Fritts, 1976). A pin was inserted in the sediments at every 10 couplets (10 years) independently in each of the three cores and the sequences then cross-dated. The distance between pins was measured on each core using a Mini-scale and System Encoder connected to an Acurite III digital counter with a precision of 0.001 mm.

Conductivity, temperature and pH were measured on June 27th, 2012 using a multi-meter YSI™ SCT model, and dissolved oxygen was measured using a multi-meter YSI™ 51B model. Percent dissolved oxygen (DO) was calculated based on the YSI meter saturation values (DO (mg/L)/ Saturation DO*100).

One-cc of sediment from each10 year increment was processed using standard methods (Faegri *et al*., 1989), including HCl, KOH, acetolysis, and HF treatments and storage in Silicone oil. Two *Lycopodium* spore tablets were added to each sample to calculate pollen concentrations and the varve width measurements were used to compute pollen accumulation rates (PAR) (Stockmarr, 1971; Faegri *et al*., 1989). An average of 510 grains was counted for each subsample.

Micro-charcoal was counted and measured on the pollen slides (Whitlock & Larsen, 2002). Particles were classified into 4 size classes (1: 218.75≤ x< 437.5 μm^2, 2: 437.5≤ x< 875 μm^2, 3: 875≤ x< 1750 μm^2 and 4: ≥1750) and total area summed (Whitlock & Larsen, 2002). A grid in the imaging software *NIS*-Elements version 3.0 was used to classify the particles. Loss-on-ignition (LOI) was conducted on each 10-year sample (Heiri *et al*., 2001).

Two sediment samples were picked for organic matter and sent to Beta Analytic for accelerator-mass spectrometry (AMS) ^{14}C dating. The radiocarbon ages were calibrated using the program CALIB V6.0.0 and calibration dataset INTCAL 09.14c (Stuiver & Reimer, 1993; Reimer *et al*., 2009).

Another sediment core (94 cm) was retrieved, using a 5-cm diameter clear plastic tube fitted with a piston and lowered to the sediment using drive rods (Wright, 1967). The first 30 cm were sub-sampled at 0.5 cm intervals into plastic bags and the remainder horizontally extruded. Sediment from the top 20 cm, as well as at 23-24 cm, 27-28 cm, 32-33 cm and 36-37 cm depth from the Livingstone core were sent to Flett Research Ltd for ^{210}Pb dating. Whole core magnetic susceptibility of this core was measured at 1-cm intervals using a Bartington™ MS2C meter and Loop Sensor.

Warm season (JJA) temperatures and (JJA) precipitation were reconstructed using the Modern Analogue Technique (MAT) (Sawada, 2006) and version 1.8 of the North American Modern Pollen Database (Whitmore *et al*., 2005). Modern pollen data spanning the entire eastern deciduous forest between 50°-100°W longitude and 20°-50°N latitude were extracted as potential candidates for modern analogue. The average of the first three analogues was used to compute the reconstructed climate variables (JJA temperature and precipitation). A pollen sum of 24 arboreal pollen (AP) taxa was used for the analogue computations, including the most abundant tree pollen taxa in the region. Experiments with an expanded sum, and with non-arboreal pollen (NAP) taxa included found only small differences.

4.3 Results

4.3.1. Water chemistry profile

On the day of sampling in June 2012, the top of the water column contained 96% dissolved oxygen (Table 1), an indication that mixing is occurring between the atmosphere and the surface of the water. Dissolved oxygen decreased slowly for the first 4 meters, then decreased rapidly between 4 and 10 meters and stabilized between 10 and 16 meters (Figure 4.2). The bottom of the lake at that location was anoxic with only 3% oxygen. Since the measurements were taken in summer, this lake could be holomictic (one overturn per year), or it could be meromictic where the water layers never intermix during spring or fall overturn. Both types of lakes are ideal for varve formation. Since Lac Noir is deep and beside a rocky cliff, mixing of the water column may be suppressed, and if mixing occurs, it isn't reaching the bottom (hence the presence of varves). There was thermal stratification in Lac Noir during the month of June at least, with the metalimnion (depth zone of maximum decrease in temperature) (Reeves, 1968) between 4 and 6 meters. On the day of sampling, the temperature was 21°C at the water surface and decreased to 4°C at the bottom indicating the presence of a hypolimnion (Figure 4.2). Conductivity was 72 µS (Table 1, Figure 4.2) at the surface and rapidly decreased to 60 µS between 4 and 6 meters and decreased again to 58 µS between 6 and 10 meters, indicating a low number of dissolved ions in the water column. pH was 8.2 at the surface and 6.9 at the bottom.

4.3.2. Chronology

The sediments of Lac Noir were clearly laminated throughout, with couplets consisting of greyish and dark brown layers. Nine marker beds were observed between 11 and 75 cm in each core and were used to cross-date the sequences. When cross-dating the laminations between the marker beds, there was a maximum readjustment of 10 years in each section needed to reconcile the three cores section.

The age-depth curve (Figure 4.3) was determined by the cross-dated varve counts of the three cores. Comparison of the times series of the average depth replicate measurements showed that the cross-dating is mostly consistent between cores and that each core had similar patterns of layers (Figure 3.4). Since there were slight differences among series, the series were divided into four sections (the top 72 years and bottom 100 years were not included) and further correlation was attempted in each section by matching the curves. This required an adjustment of a maximum 20 years in each section (Figure 3.4). The cross-dating procedure indicates an overall error of a maximum 2.3% in 850 years (of the total 1022 year record).

Three independent dating methods were used in this study to verify the accuracy of the varve chronology; two radiocarbon age determinations (Table 2), a series of ^{210}Pb dates (Table 3) and the *Ambrosia* rise (discussed below). The uppermost sediments were slightly disturbed, and varves, although identifiable, were more difficult to measure. The uppermost 6.5 cm were therefore simply divided into 10 equal intervals for pollen analysis, and the ages of these uppermost 10 samples were assigned based on the results of the ^{210}Pb dates. When this was done, the Cesium-137 peak, which occurs at 11.5 cm, is within 5 years of the estimated date of 47 years (Figure 4.3). In addition, one of the ^{14}C dates intersects the varve-based chronology (Figure 4.3) however the other is over a hundred years older. If the varve-based chronology is accepted, the *Ambrosia* rise, located at 18 cm in the sediment core (below), which in this region dates the European colonization and agriculture, is reasonably dated at 180 years ago by the varve chronology.

Note that, with the exception of the ^{210}Pb ages on the uppermost 6.5 cm, the remainder of the ^{210}Pb ages were not used in developing the chronology, nor was the uppermost ^{14}C determination used (Figure 4.3). If we were to accept the entire ^{210}Pb chronology, the *Ambrosia* rise would be dated to 60-70 years ago, which is too young. The Ottawa-Gatineau region was settled by Europeans beginning in the early 1800s and the St Lawrence lowlands experienced deforestation by European settlement starting between 250 and 200 cal BP and culminating 150 years ago (Muller & Richard, 2001) so a date for the *Ambrosia* rise of the mid 1800s is more reasonable. Further, if all of the radiometric dates were to be accepted, it would imply large changes in sedimentation rate which are not seen in the laminations. Therefore, the varve chronology was used for this study, except for the uppermost 6.5 cm.

4.3.3. Pollen record

The pollen assemblages during the past 1000 years were dominated by arboreal taxa, primarily *Pinus*, *Tsuga*, *Betula* and *Fagus*. The pollen percentage diagram was divided into three zones based on the results of a principal components analysis of the pollen percentages (below).

Between 450-1020 years ago (Zone 1; 40-90 cm; AD 990-1560) *Tsuga* and *Fagus* pollen maintained high percentages, while *Pinus haploxylon*, *Picea* and *Abies* had relatively lower values (Figure 4.4). *Betula* pollen showed little long-term trend over the past 1000 years at this site. *Acer* pollen generally had higher percentages between 450-1020 years ago than in the subsequent 450 years. *Alnus* pollen percentages were relatively low in Zone 1, reaching values of 0.6 % between 500 and 700 years ago.

Between 200-450 years ago (Zone 2; 20-40 cm; AD 1560-1810) *Pinus haploxylon* pollen twice reached high values (29% 430 years ago and 41% 240 years ago), with slightly lower percentages between these two times. *Pinus diploxylon* pollen percentages, although variable, increased during this time. There was an abrupt decrease in the percentages of many arboreal species 450 years ago that marked the beginning of this zone. *Betula* pollen percentages abruptly decreased 430 years ago, when *Pinus* pollen percentages increased, and again 240 years ago. *Tsuga* and *Fagus* pollen percentages both decreased rapidly around 430 years ago as well and maintained lower percentages until increasing slightly between 250-270 years ago. *Picea* and *Abies* pollen percentages increased in Zone 2, with *Picea* reaching 6.8% around 420 years ago. *Salix* pollen percentages increased to 3% around 400 years ago and *Alnus* increased 450 years.

Between 0-180 years ago (Zone 3; 0-20 cm; present- AD 1810), the pollen composition was dominated by high percentages of *Ambrosia,* Poaceae and other non-arboreal pollen (NAP) such as Asteraceae, Plantaginaceae and *Rumex*-type. *Ambrosia* pollen increased 180 years ago, reached maximum values of 11% 80 years ago, and subsequently decreased to 2.7%. *Pinus haploxylon* pollen percentages began decreasing around 220 years ago, reaching minimum values of 4.9 % approximately 150 years ago. Low values were maintained before increasing again around 80 years ago. *Alnus* pollen increased beginning around 180 years ago before decreasing again around 70 years ago.

Total pollen accumulation rates (PAR; Figure 4.5) were higher between 450-1022 years ago, and abruptly decreased 450 years ago. PAR increased slightly between 400 to 250 years ago and decreased between 0-200 years ago. Total PAR was high in the uppermost samples, but this may be a consequence of the way sedimentation rate was estimated in these levels.

Between 450-1020 years ago (zone 1), pollen accumulation rates were relatively high for hardwoods such as *Betula*, *Fagus, Acer* and other AP, and relatively low for *Pinus, Picea* and *Abies*. At 450 years ago, the PAR of the hardwood taxa and *Tsuga* abruptly decreased, remaining low for 50 years (Other AP, *Betula*), or for the remainder of Zone 2 (*Tsuga*, *Fagus* and *Acer*). The “Other AP” category includes *Larix*, *Carpinus/Ostrya*, *Carya*, *Fraxinus*, *Juglans*, *Tilia* and *Ulmus* and PAR of these individual taxa decreased at this time (not shown). While PAR of the hardwoods and *Tsuga* were low, those of *Abies*, *Picea, Pinus* and *Alnus* increased. At 400 years ago, *Salix* pollen rapidly increased for a brief period, followed by a decrease to low levels. *Pinus haploxylon* PAR increased again 300 years ago, and reached its maximum 270 years ago, before decreasing again around 190 years ago. Between 0-200 years ago (zone 1), PARs were higher for non-arboreal pollen such as *Ambrosia*, Poaceae, Plantaginaceae, *Rumex*-type.

A principal components analysis was used to summarize changes in the pollen percentages (Table 4, Figure 4.6, Appendices G & H). The first component explains 34.3 % of the variance and the second 13.3% of the variance. The first component is negatively correlated with *Tsuga, Acer,* and *Fagus*, positively correlated with *Pinus, Picea, Abies*, and NAP percentages. The second component is negatively correlated with *Tsuga, Acer* and *Fagus* and positively correlated with *Pinus haploxylon, Picea* and *Abies*. The third component, which explains 8.7% of the variance, is positively correlated with *Pinus,* and shrubs, and negatively correlated with most NAP.

Scores of the first component are negative in Zone 1, become positive abruptly at the transition from Zone 1 to Zone 2, and become larger in Zone 3 (Figure 4.6). Scores of the second component are negative until 620 years ago, when scores oscillate minimally about zero at the upper part of Zone 1. They abruptly become positive at the transition from Zone 1 to Zone 2 and are negative in Zone 3. Scores of the third component show high frequency oscillations around zero, with values typically negative in Zone 3.

4.3.4. Micro-Charcoal

Charcoal PAR was quite low, with few peaks during the past 1000 years (Figure 4.7). In Zone 1, total charcoal influx was relatively low, with one large peak 890 years ago. In Zone 1, there was an increase in charcoal influx between 180-50 years ago as well as in the past 20 years.

4.3.5. Sediment Analysis

Magnetic susceptibility (Figure 4.8) varies only slightly prior to 530 years ago and begins to decrease to low values by 400 years ago. Loss-on-ignition at 550^{o}C (LOI 550), which indicates organic matter (Figure 4.8) increased starting ~400 years ago to reach a high of 38% 390 years ago, maintaining higher percentages before gradually decreasing between 0-240 years ago. LOI 950, which indicates carbonate content (Figure 4.8) increased ~930-990 years ago, remained steadily decreasing between 440-890 years ago and increased again between 180-330 years ago but reaching levels of 7%. Carbonate material has been decreasing since 180 years ago.

4.3.6. Climate reconstruction

Paleoclimate reconstructions based on the pollen percentages show an abrupt change at the beginning of Zone 2. From 880-1022 years ago, summer temperatures ranged between 17.8-18.5°C (Figure 4.8) and between 450-880 years ago, temperatures oscillated around the mean. Between 200-450 years ago, temperatures ranged between 16.9-17.9°C. In the last 200 years, temperature increased to 18°C 100 years ago, before decreasing briefly and again increasing in the last 20 years.

Summer (JJA) precipitation reconstructions showed relatively moist conditions in Zone 1 and overall drier conditions in Zones 2 and 3 (Figure 4.8). Precipitation reached values of up to 104 mm in Zone 1, values being especially high between 460-700 years ago and 790-890 years ago. Precipitation decreased in Zone 2, reaching lows of 80 mm, with dry periods 410-440 years ago, and 230-310 years ago. In Zone 3, precipitation remained relatively low.

Mapping the location of the sites chosen as best analogue shows differences between the zones that lead to the climates being reconstructed (Figure 4.9). In Zone 1, most analogues are found in southern Quebec and northern New York State. In Zone 2, reconstructed as relatively cold and dry, samples are selected across a wide area of the conifer hardwood forests of eastern North America. In Zone 3, where relatively warm and moist conditions are reconstructed, many samples find analogues from the state of Maine as well. The temperatures at the sites chosen as first (best) analogue for each zone (Figure 4.10) indicates that in Zone 1, many of the sites have warmer temperatures than in zone 2 and 3, and they are closer to the Atlantic Ocean. In zone 2, most sites chosen as analogues today have lower temperatures than those chosen in zone 1 and 3, and in zone 3, the best analogues are still generally cold, with sites having warmer temperatures than those chosen as analogues for samples from zone 2. Generally, the results of this climate reconstruction show that temperatures decreased during the Little Ice Age, and today are still lower than during the Medieval Warm Period.

The summer precipitation reconstruction is based on the same analogues as for temperature. Sites chosen as best analogue for samples from zone 1 have higher precipitation than those chosen from zone 2 and 3 (Figure 4.11). The Medieval Warm Period (zone 1) was warmer and wetter, while the Little Ice Age (zone 2) was cold and drier. During the European settlement to present time, the climate has been cold and dry until the last 20 years or so when it has been warmer than the MWP.

One other continuously-sampled and varve-dated pollen diagram is available from southern Ontario (Crawford Lake; McAndrews & Boyko-Diakonov, 1989; www.ncdc.noaa.gov/paleo). A principal components analysis was performed on the Crawford Lake diagram and the scores from the pollen diagram of Lac Noir were plotted alongside those of Crawford Lake (Table 5, Figure 4.12) to compare community-level changes (cf Gajewski, 1987) in the two areas. At both sites, a major transition in pollen assemblages occurred between AD 1500 and AD 1550, and another associated with European agriculture (Figure 4.12).

The paleoclimate reconstructions from Lac Noir were compared to other high resolution pollen-based paleoclimate reconstructions from the conifer-hardwood forest region (Gajewski, 1988) as well as long tree-ring series (Guyette & Cole, 1999; Guyette & Cole n.d; Guyette, n.d.; Cook, 1982a,b) and a tree-ring based Palmer Drought Severity Index for grid point 260 (Cook & Krusic, 2004; Cook *et al*., 2004) (Figure 4.13). Lac Noir, Basin Pond and Lake of the Clouds show higher temperatures during the MWP (Zone 1), and all the lakes show a decrease in temperature during the LIA (Zone 2). Lac Noir and Basin Pond show similar trends in precipitation, such as drier conditions during the LIA, while this isn't as evident for Clear Pond and Lake of the Clouds. The tree-ring series show high frequency variability, but do not show the lower-frequency changes identified in the pollen record.

4.4 Discussion

The pollen diagram was divided into three periods based on changes in the pollen assemblages and these correspond broadly to well-known climate intervals of the past 1000 years (Cook *et al*., 2004; Moberg *et al*., 2005; D'Arrigo *et al*., 2006; Mann *et al*., 2008;): Zone 1 (>450 years ago, <AD 1560) corresponds to the latter part of Medieval Warm Period (MWP) and transition into the subsequent Little Ice Age (LIA, Zone 2; 200-450 years ago; AD 1560-1810), and Zone 3 (0-200 years ago; AD 1810-present) is the European settlement of the region. The climate variability during this time period affected the relative abundance of the taxa in the forests and the pollen production of the species.

Throughout the past 1000 years, *Pinus*, *Tsuga*, *Betula*, *Fagus* and other arboreal taxa were dominant in the pollen record, indicating a mixed conifer-hardwood forest (Burns & Honkala, 1990), a conclusion supported by mapping the location of the modern analogues of the fossil assemblages (Figure 4.9). Between 450-1020 years ago (AD 990-1560), *Tsuga*, *Fagus* and *Acer* pollen percentages were relatively high, which can be qualitatively interpreted as being due to relatively warm and moist conditions, and the climate reconstruction based on the Lac Noir pollen also reconstructed warm conditions. A relatively warm climate has been documented during this time in many regions of the northern hemisphere (Ljungqvist *et al*., 2012; Moberg *et al*., 2005; Cook *et al*., 2004), as well as in eastern North America (Gajewski, 1988; Viau *et al*., 2006, 2012; Viau & Gajewski, 2009). The slightly higher pollen production shown from the pollen accumulation rates (PAR) from the sediments of Lac Noir suggests a relatively productive forest during the Medieval Warm Period (800-1200 AD).

Although charcoal area accumulation rates show a peak between 870-890 years ago (Figure 4.7), pollen percentages and PAR do not reveal any significant changes in forest composition and production at this time. This may be that the fire was small and local and the pollen from elsewhere in the surrounding region continued to accumulate in the Lac Noir sediments, or the fire was elsewhere in the region, and similarly, pollen continued to accumulate from the immediate slopes surrounding the lake. Overall, fire was not an important influence on the forests over the past millennium. Long *et al*. (2011), Carcaillet & Richard (2000), Fuller (1997), Clark *et al*. (1996) and Clark & Royall (1996) have also shown that fire occurrence is not a dominant factor affecting forest dynamics in the conifer-hardwood forest of south-eastern Canada and north-eastern US because of the presence of tree species with low flammability (Burns & Honkala, 1990; Hély *et al*., 2000) and a moist climate, leading to less accumulation of fuel due to high decomposition at the forest floor (Moore *et al*. 1999).

At 450 years ago (1550 AD), there was an abrupt decrease in pollen accumulation rates of *Tsuga, Fagus, Acer, Betula* and other trees, while boreal taxa and several shrubs increased slightly (*Alnus, Salix*). This corresponds to the onset of the Little Ice Age (Gajewski, 1987; Campbell & McAndrews, 1991), which at this site occurred abruptly and with a significant impact on the vegetation. Although pollen percentages and PARs of southern tree taxa and birch returned to relatively high levels within 50 years, taxa characteristic of the conifer-hardwood forest (*Betula, Fagus* and *Tsuga*) remained low until the present day. Although some tree-ring series from the region show a decrease in growth at this time, others do not (Figure 4.13). Gajewski *et al*. (1987) and Gajewski (1987) demonstrated that *Tsuga* and *Fagus* decreased, while softwoods increased at roughly the same time at sites spanning the conifer-hardwood forest from Maine to Minnesota. More detailed comparison to these other sites is not possible due to the relatively low resolution of the previous study (typically every 40 years). This abrupt change in pollen production, coinciding with the onset of the Little Ice Age, suggests a significant and abrupt climate oscillation lasting several decades, with an impact on the vegetation.

Pollen production, and by inference forest production (Hicks, 1999), decreased during the LIA, presumably because of the impact of the climate deterioration during this time. PAR of boreal taxa increased as more pollen was transported to the site from the increased northerly wind flow associated with cooling (Gajewski, 1998). Although most tree taxa showed an abrupt decrease in PAR between 450 and 400 years ago, the subsequent response differs among taxa, with some remaining at low levels through Zone 2 (e.g. *Tsuga*, *Fagus*, *Acer*) and others subsequently increasing between ~260-400 years ago, followed by a subsequent decrease between ~205-260 years ago. A slight increase in *Salix* pollen and charcoal accumulation rates during the first interval is further evidence of a more severe climate impact on the vegetation during the first cooling.

Pollen percentages also demonstrate that forest composition changed during the LIA. For example, during the first cold interval of the Little Ice Age (~400-450 years ago), *Betula* decreased and *Pinus haploxylon* increased, while between ~275-400 years ago, *Pinus haploxylon* decreased and *Betula* increased; finally in the third interval ~200-275 years ago, *Pinus* increased and *Betula* again decreased. Lower resolution records

(Anderson, 1985) do not show the same trends in vegetation composition during the LIA; very-high resolution records with continuous sampling such as presented in this study are necessary to illustrate vegetation response to decadal climate oscillations (Fig. 4.4).

The overall similarity and interpretation of the principal score series of Crawford Lake and Lac Noir, if the impact of Native agriculture is accounted for (McAndrews & Boyko-Diakonow, 1989; Clark & Royall, 1996; Munoz & Gajewski, 2010), is striking. Principal component scores for Lac Noir and Crawford Lake indicate changes at similar times in the vegetation, with the exception of the period in which Iroquoians inhabited the forest around Crawford Lake (Appendices G & H). There is no evidence of native impacts on the forest in the Gatineau region (Munoz & Gajewski, 2010). Iroquoians impacted the Crawford Lake area, starting 1360 AD, thereby masking some impacts of climate variability at this site. The overall similarly of the climate reconstructions from the several high-resolution pollen sequences (Figure 4.13) further indicates that multi-decadal climate changes can significantly influence forest production and composition. The present study indicates that the transition to the LIA occurred rapidly (*ca.* AD 1560), in the course of a couple of decades; this is not inconsistent with the record of Basin Pond, Clear Pond, etc, as they were sampled at lower resolution.

A prominent increase in herbaceous taxa, including *Ambrosia*, Poaceae, Plantaginaceae and *Rumex* occurred 180-200 years ago, and corresponds with the European settlement of the region (Muller & Richard, 2001). *Pinus haploxylon* percentages started to decrease before the arrival of the Europeans, but once they arrived, *Pinus* continued to decrease, suggesting a climate shift from colder LIA temperatures to warmer temperatures starting 220 years ago (AD 1790) followed by land clearing from the Europeans, and this is supported by the temperature reconstruction of Lac Noir. Since AD 1810, many AP taxa (*Pinus*, *Tsuga*, *Fagus*, other AP) show a gradual decrease in both pollen percentages and accumulation rates, but this is a continuation of a trend begun during the LIA (Gajewski, 1987). Fire occurrence also increased during the past 200 years, associated with burning of fields in preparation for agriculture (Muller *et al*., 2008); other lakes in north-eastern North America recorded an increase in charcoal influx during this time (Clarke & Royall, 1996). Overall pollen accumulation in the lake sediments continued to decrease after the European settlement as a consequence of logging and burning associated with the clearing of the fields and the resultant lower density of trees on the landscape. The greatest impact during settlement was on *Pinus* whereas climate changes during the LIA had the biggest impact on hardwoods.

There are several conclusions from this study of relevance to understanding future climate change impacts on the forests of the eastern North America, and elsewhere. Climate changes in past (MWP, LIA) greatly affected the forests of the conifer-hardwood forests of eastern North America, as global warming is doing now, and the study of these can provide insight into potential future impacts.

The transition to the Little Ice Age caused an abrupt change in the forests of the Gatineau Hills. This is shown by the percentage, total concentration and PAR diagrams, which indicate lowered biological production for 50 years, during a period of cold and dry conditions. Some taxa rebounded (e.g., *Betula*, although we don't know which species, and there may have been a species replacement), but *Tsuga*, *Acer* and *Fagus,* never returned to the levels they had before the LIA. Thus, some of the changes observed in the forests today are simply a return to conditions present during the Medieval Warm Period, and this period could be studied as a partial analogue of the future forest. The rapidity of the change between the Medieval Warm Period and the Little Ice Age is comparable to that being observed today and therefore a more detailed analysis of this transition would provide insight into rapid climate changes and how they impact forest ecosystems.

Finally, a comparison of the climate reconstructions based on pollen assemblages and those from tree-rings in the same area show that paleoclimate reconstructions based primarily on tree-rings (e.g. Mann *et al*., 2008) are underestimating past climate variability, as they don't show the MWP and LIA as clearly as does the pollen. All of the high-resolution pollen-based paleoclimate reconstructions show a similar century-scale variability that is not seen in tree-ring records. This may be the result of the methodology of developing tree-ring chronologies, but this observation needs to be incorporated into future large-scale climate estimates. Combining tree-rings and lake sediments may be better to reconstruct climate and explain changes in vegetation communities is therefore essential in paleoclimate and paleoecological studies.

4.5 Acknowledgements

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Table 1

Temperature, pH, conductivity and dissolved oxygen profiles of Lac Noir, sampled on June 27th, 2012.

Depth (m)	temp (°C)	Conductivity (µmHOS)	pH	DO (mg/L)	Saturation level(DO)	% DO
0	21.0	72	8.2	8.6	8.90	96.63
2	17.0	72	-	8.3	9.65	86.01
4	12.0	60	-	8.2	10.76	76.21
6	7.0	60	-	5.8	12.12	47.85
8	6.0	58	-	3.5	12.43	28.16
10	5.4	58	-	1.2	12.60	9.52
12	4.0	-	-	0.7	13.09	5.35
14	3.9	-	-	0.4	13.09	3.06
16	4.1	-	6.9	0.5	13.09	3.82

Table 2

Radiocarbon age determinations and calibrated ages (using CALIB 6.0; Stuiver and Reimer, 1993; Reimer *et al*. 2009) for Lac Noir, southwestern Quebec. Both samples are based on plant material picked from the sediment.

Laboratory No.	Depth (cm)	$^{13}C/^{12}C$ ratio	Conventional Radiocarbon Age	Calibrated ^{14}C Age ranges (probability distribution)	Sigma
BETA-276987	41-42	-27.2 o/oo	580 ± 40 BP	540-562 (0.33) 593-637 (0.67)	1 σ
				528-573 (0.34) 577-653 (0.65)	2 σ
BETA-276988	77-78	-26.5 o/oo	980 ± 40 BP	799-813 (0.13) 826-866 (0.43) 901-924 (0.43)	1 σ
				794-958 (1.00)	2 σ

Table 3

Pb-210 Activity and estimated age of sediments for Lac Noir, Quebec. Age was estimated with a linear regression model. The Cs-137 peak occurs at 11.5 cm; corresponding to maximum Cs-137 production which occurred in AD1963, 46 years ago.

Depth (cm)	Total Pb-210 Activity (DPM/g)	Age (yr)	Total Cs-137 Activity (DPM/g dry wt)
0.5	45.9	1.8	-
2.5	36.3	8.8	-
4.5	29.3	15.9	-
7.5	22.4	26.5	-
8.5	-	-	6.32
9.5	-	-	8.62
10.5	25.5	41.7	20.87
11.5	-	46	24.58
12.5	-	-	8.38
13.5	-	-	2.89
14.5	16.8	58.9	-0.23
16.5	-	-	3.13
19.5	8.0	80.5	-
23.5	6.6	97.7	-
27.5	2.6	-	-
32.5	1.5	-	-
36.5	1.5	-	-

Table 4

Principal component loadings and eigenvalues for Lac Noir.

Taxon	Comp 1	Comp 2	Comp 3
Pinus diploxylon	0.99	-0.23	2.08
Pinus haploxylon	0.49	1.98	0.26
Picea	0.78	1.32	0.80
Abies balsamea	0.37	1.50	-0.10
Tsuga canadensis	-1.44	-0.76	0.52
Acer	-1.00	-1.27	0.10
Betula	-0.45	0.23	-1.76
Fagus	-1.39	-1.02	0.11
Other AP	0.16	0.54	-0.09
Alnus type	1.45	0.16	-0.47
Salix	0.87	0.48	-0.04
Other shrubs	0.67	-0.81	2.06
Asteraceae	0.99	-0.42	-0.56
Ambrosia	1.30	-1.06	-1.28
Poaceae	1.35	-1.09	-1.07
Plantaginaceae	0.89	-1.07	-0.37
Rumex type	1.09	-0.68	-0.47
Other NAP	1.00	-1.22	1.28
Eigenvalues	**0.34**	**0.13**	**0.09**

Table 5

Principal component loadings and eigenvalues for Crawford Lake.

Taxon	**Comp 1**	**Comp 2**	**Comp 3**
Pinus	1.00	1.37	-0.77
Cupressaceae	0.28	-0.28	1.80
Tsuga	0.01	1.82	-0.63
Acer	-1.57	-0.52	-0.25
Betula	0.31	-0.12	-1.33
Fagus	-1.59	-0.55	-0.46
Carya	-1.02	0.13	0.80
Fraxinus	-1.25	-0.25	0.34
Juglans	-0.77	-0.87	0.90
Ostrya type	-0.60	1.20	1.24
Quercus	0.10	1.85	0.85
Tilia	-0.99	-0.16	-1.09
Ulmus	-1.06	-1.11	-0.30
Other trees & shrubs	0.54	-0.48	2.35
Ambrosia	1.22	-1.33	-0.26
Poaceae	1.32	-1.10	0.04
Other herbs	1.29	-0.99	-0.20
Eigenvalues	**0.32**	**0.21**	**0.09**

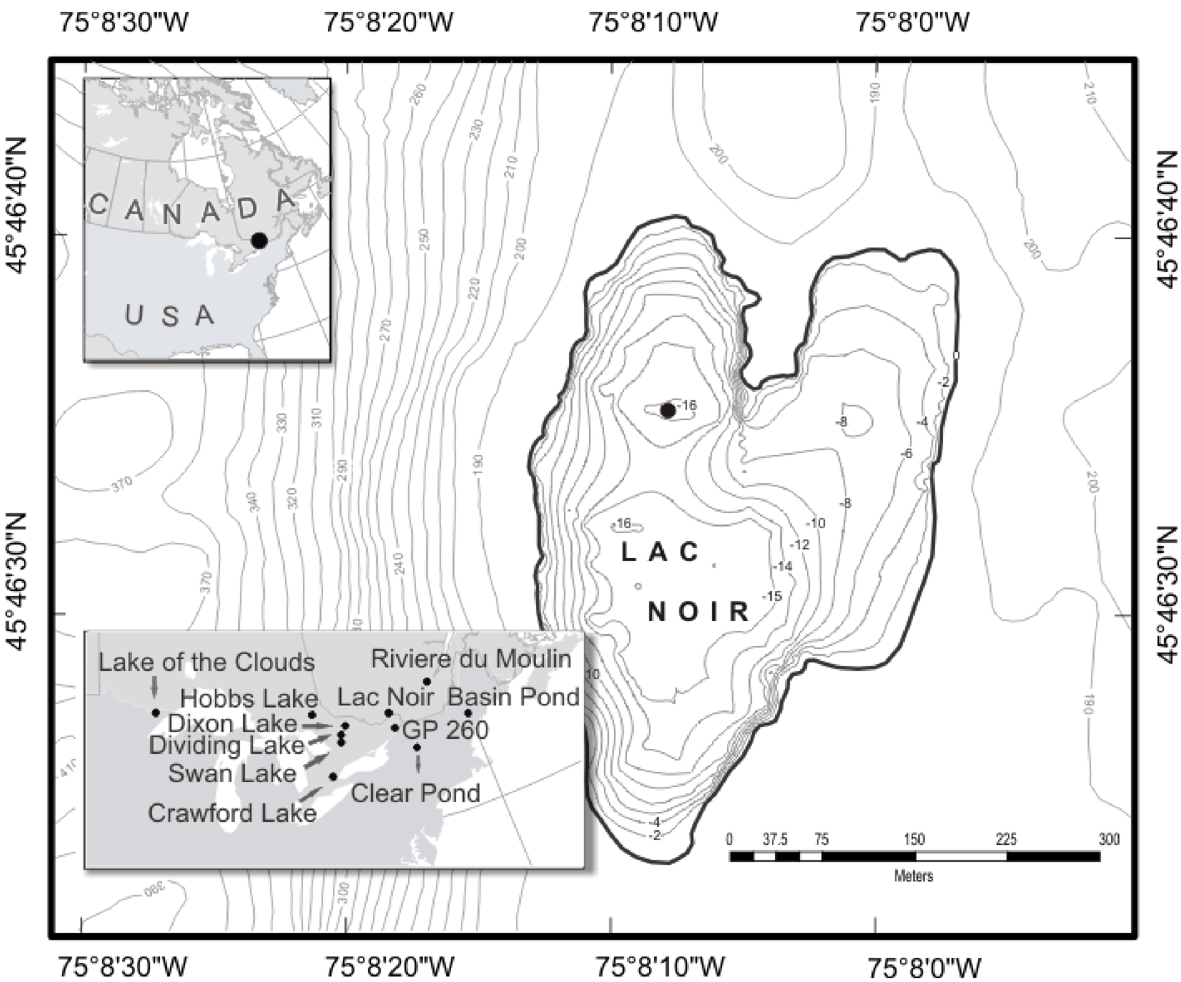

Fig. 4.1: Location of Lac Noir in southern Quebec with contour intervals. The dot represents the coring location. Inset map at top left showing location of study area. Inset map at bottom left showing lakes and tree-ring data locations relating to figure 4.13.

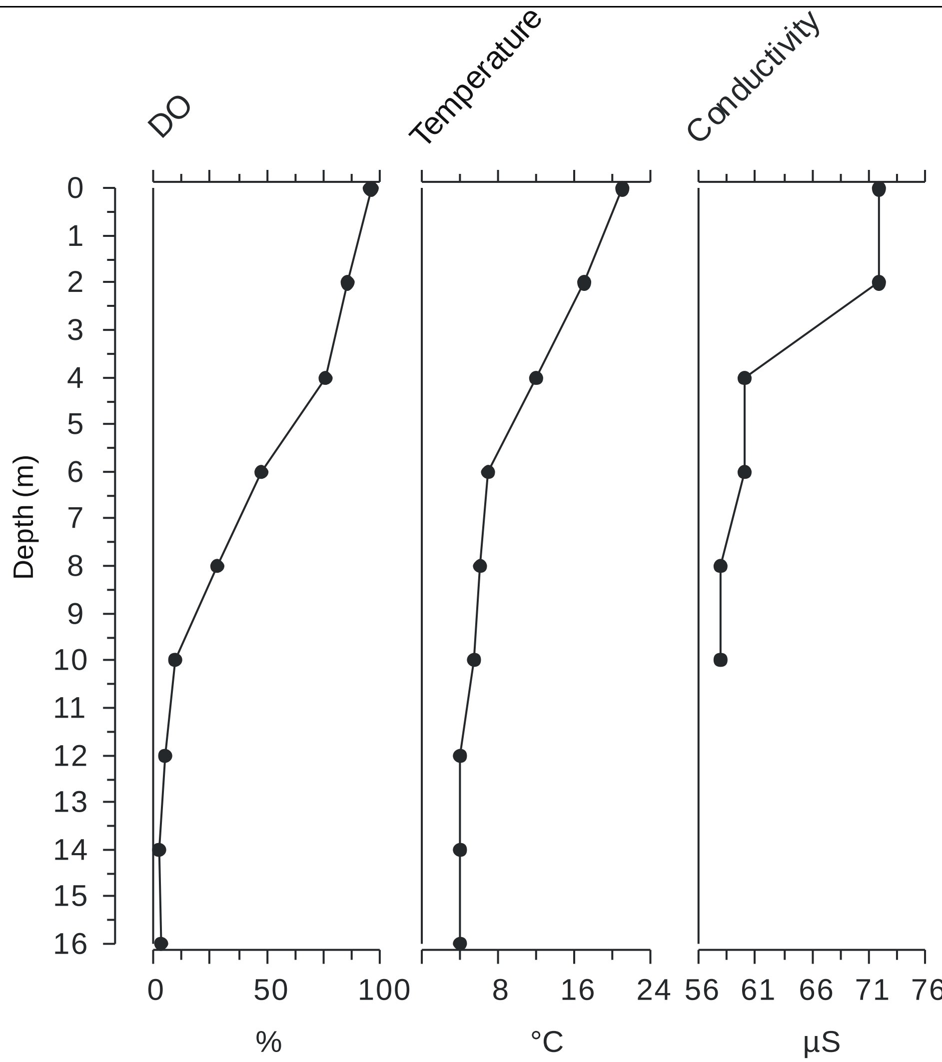

Figure 4.2: Water chemistry profile**:** Percent dissolved oxygen, temperature and conductance as a function of lake depth of Lac Noir. pH values are 8.2 at 0 m and 6.9 at 16 m. Data collected June 27th, 2012.

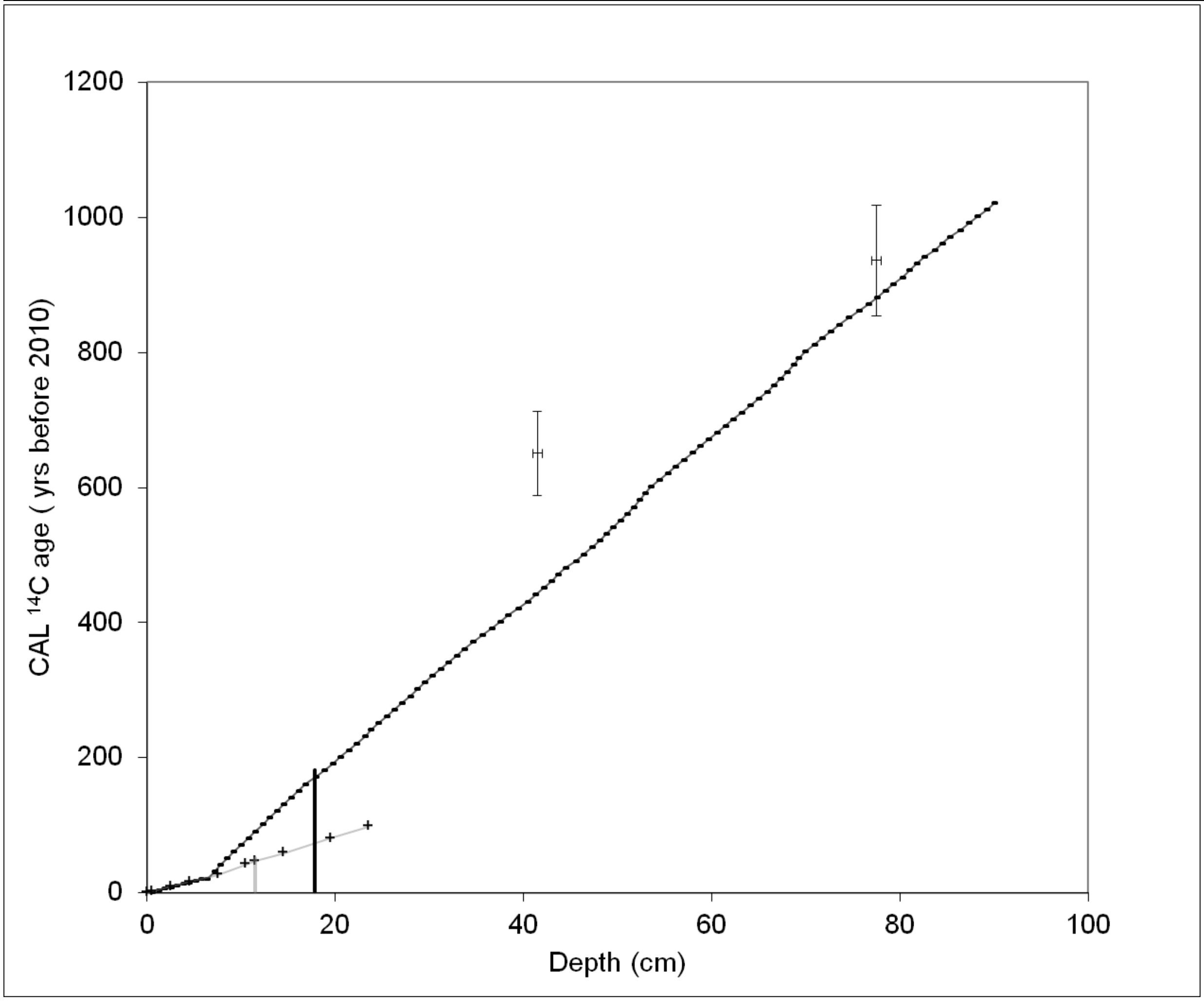

Fig. 4.3: Chronology for Lac Noir sediment core. Series of connected black horizontal lines indicate the varve-based chronology. Calibrated radiocarbon ages are illustrating the total 2 sigma range. The ^{210}Pb age determinations, along with a linear regression age-depth model are illustrated by the connected plus symbols. The vertical light-grey line shows the depth of Cs-137. The dark-grey vertical line shows the depth of the beginning of the *Ambrosia* rise. See text for details.

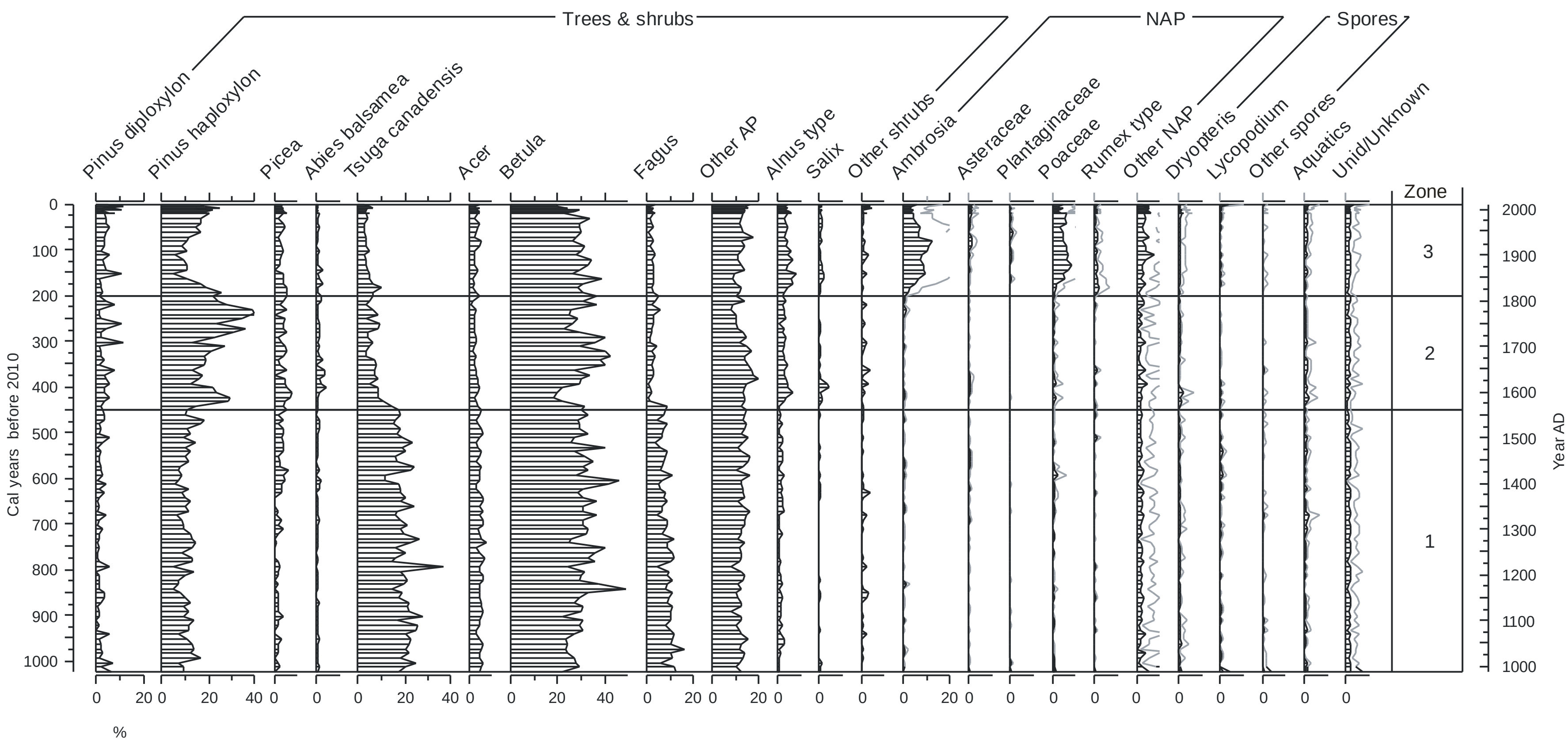

Fig. 4.4: Pollen percentage diagram for Lac Noir, Quebec. Only major taxa are shown. NAP shown with 5x exaggeration.

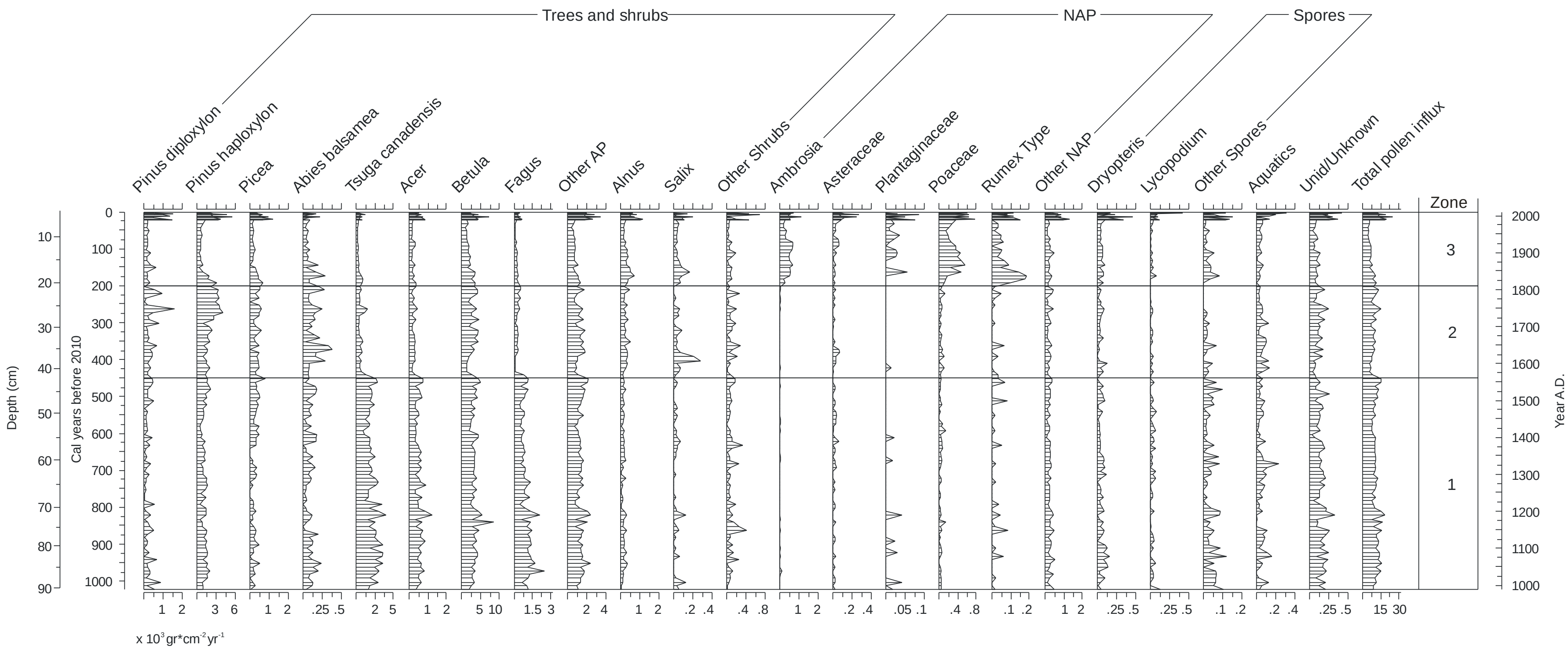

Fig. 4.5: Pollen accumulation rates (PAR) from Lac Noir, Quebec. Note changes in scale. Total pollen influx based on AP+NAP, including spores, but excluding aquatics.

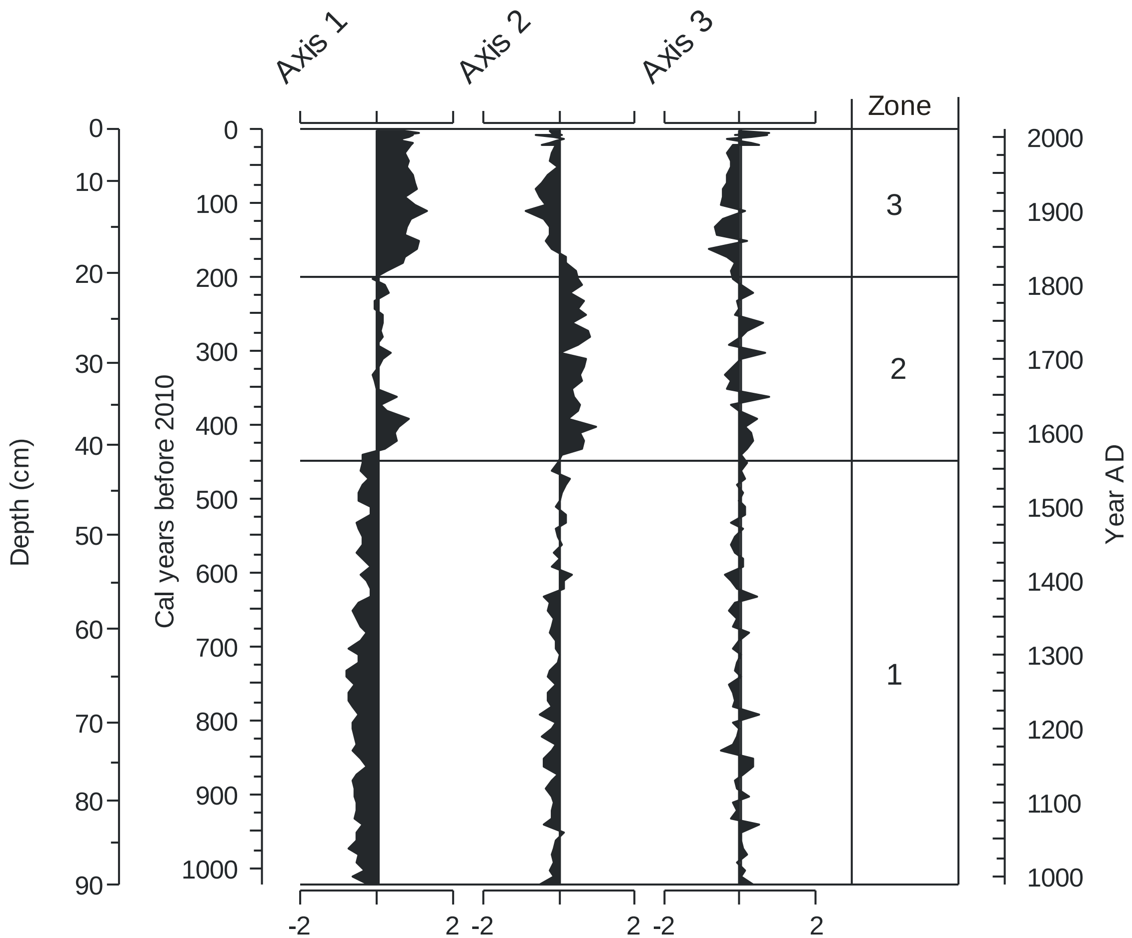

Fig. 4.6: Time series of Principal Component scores of pollen percentages from Lac Noir, Quebec.

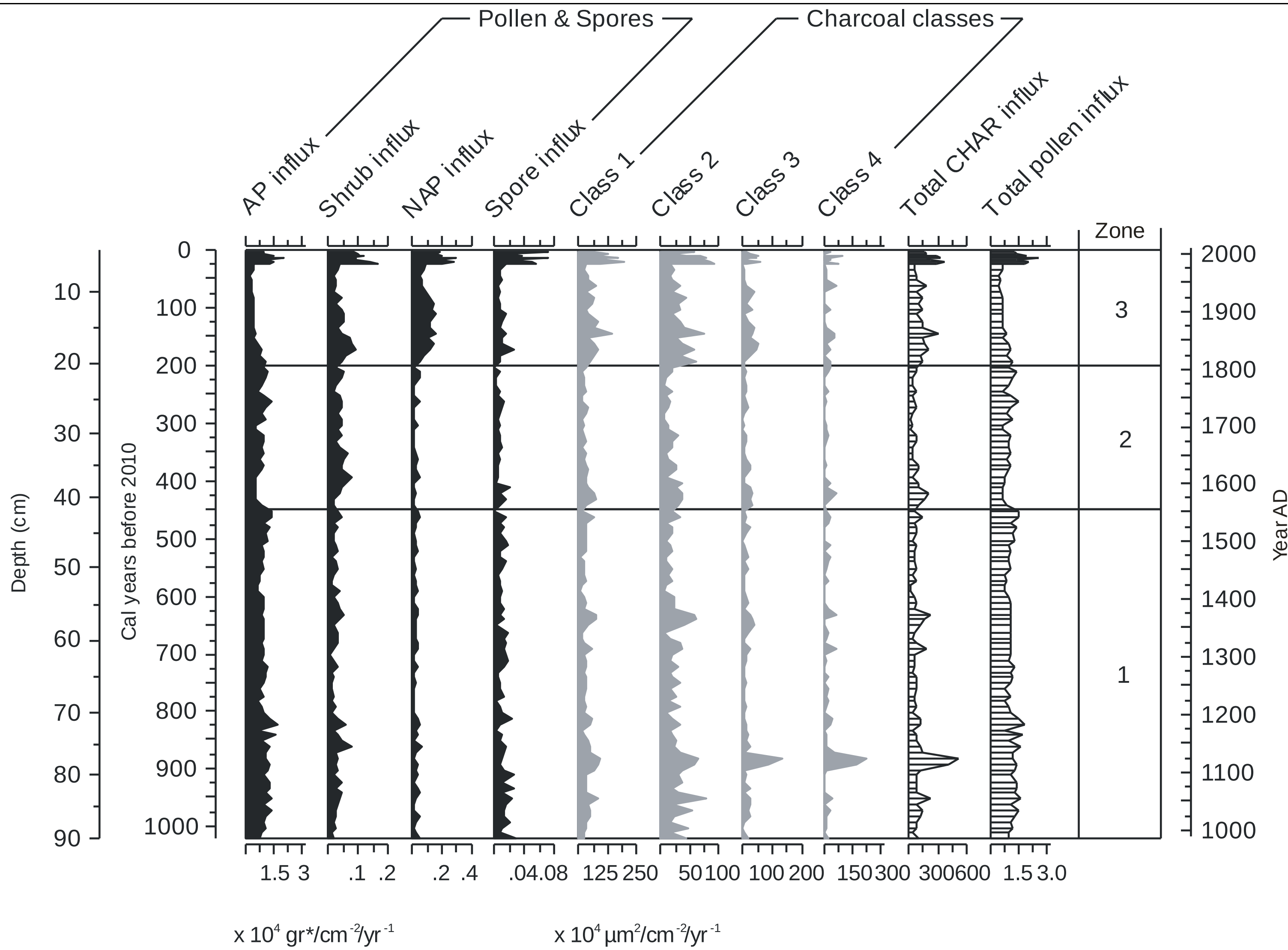

Fig. 4.7: Micro-charcoal influx into sediments from Lac Noir, Quebec. Size classes are (1) 219 ≤ x < 438 µm^2, (2) 438 ≤ x < 875 µm^2, (3) 875 ≤ x < 1750 µm^2, (4) 1750>x µm^2.

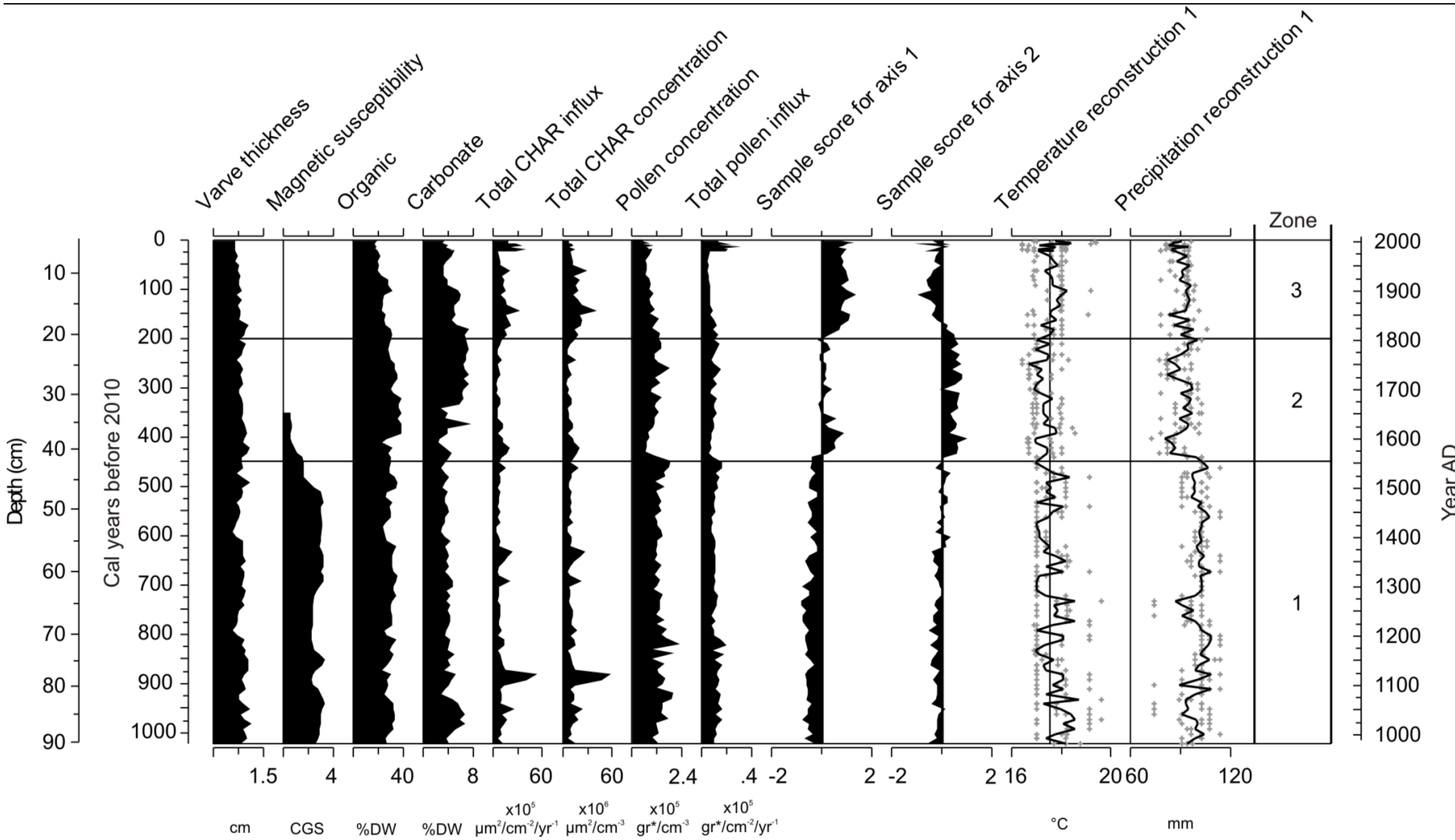

Fig. 4.8: Summary diagram from Lac Noir, Quebec, including sediment characteristics, charcoal and pollen influx, principal component scores and paleoclimate reconstructions. The temperature and precipitation reconstruction is the average based on the top three analogues; actual values of the first three analogues are plotted using grey plus signs. The vertical axis for temperature is plotted at 17.5 °C, representing the overall average of the record.

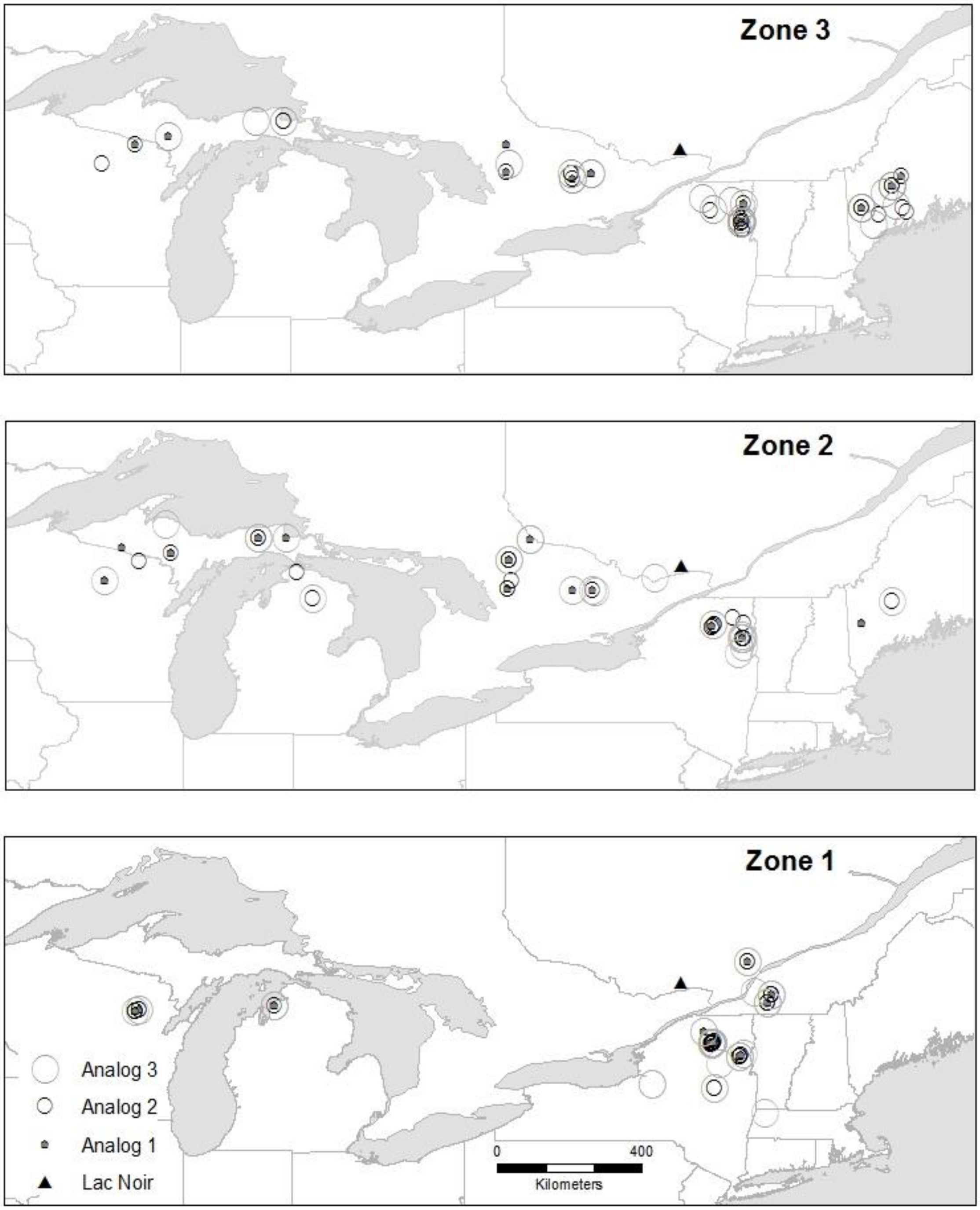

Fig. 4.9: Location of the first three analogues from the climate reconstruction for each zone.

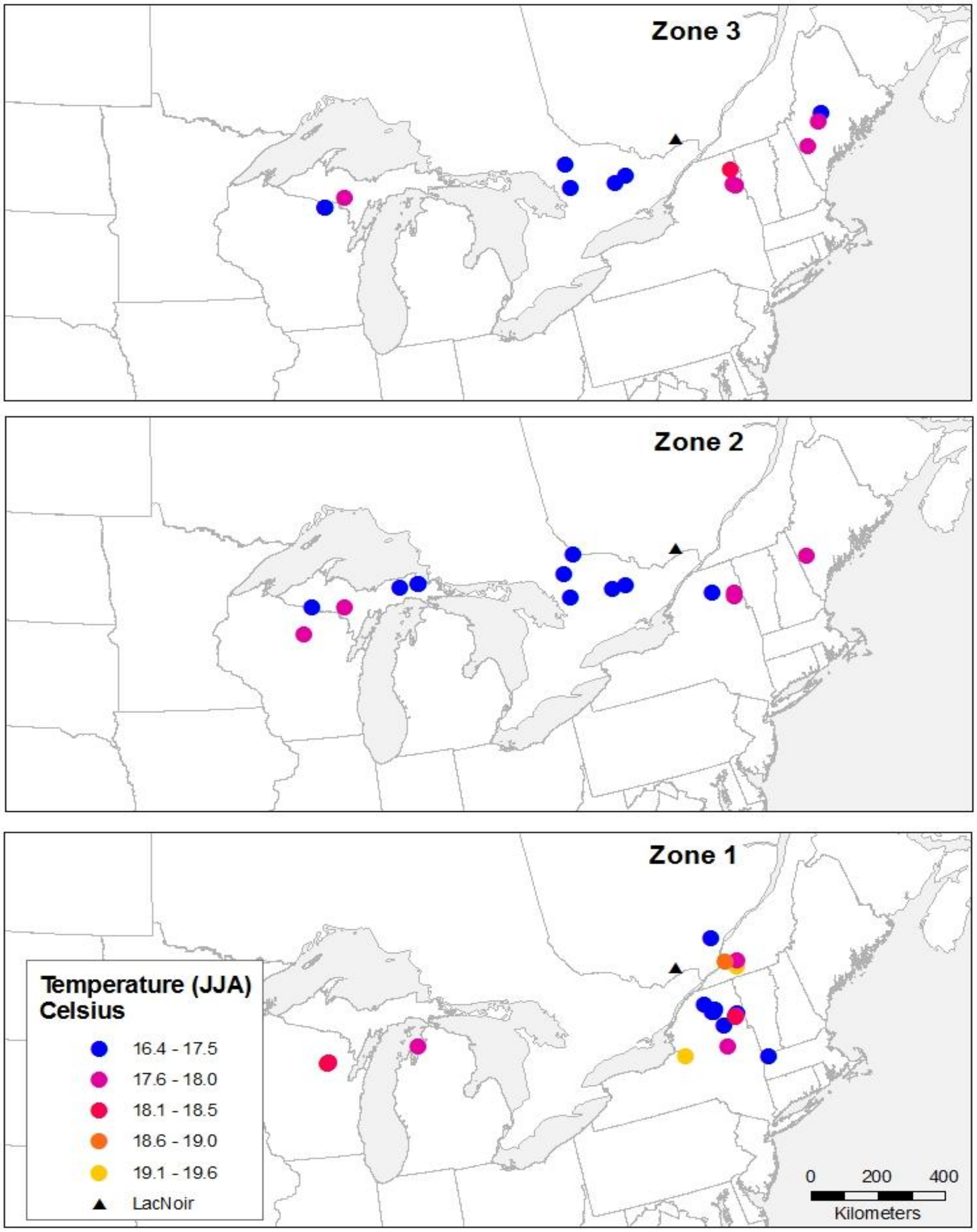

Figure 4.10: Summer temperatures at the sites chosen as the best (1st) analogue for each zone. Note: some sites are repeated; hence the reduced amount of sites seen on the map.

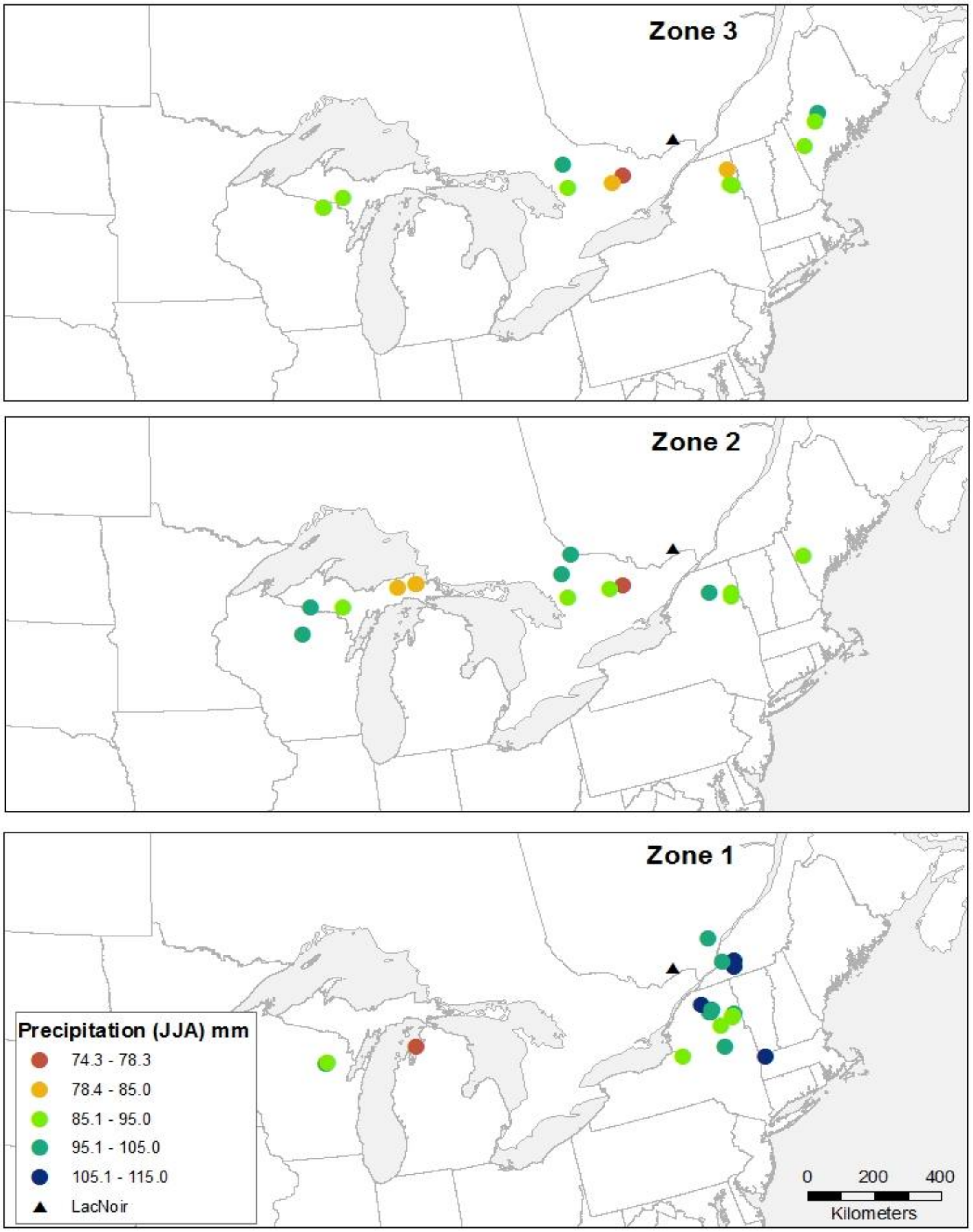

Figure 4.11: Summer precipitation at the sites chosen as best (1st) analogue for each zone.

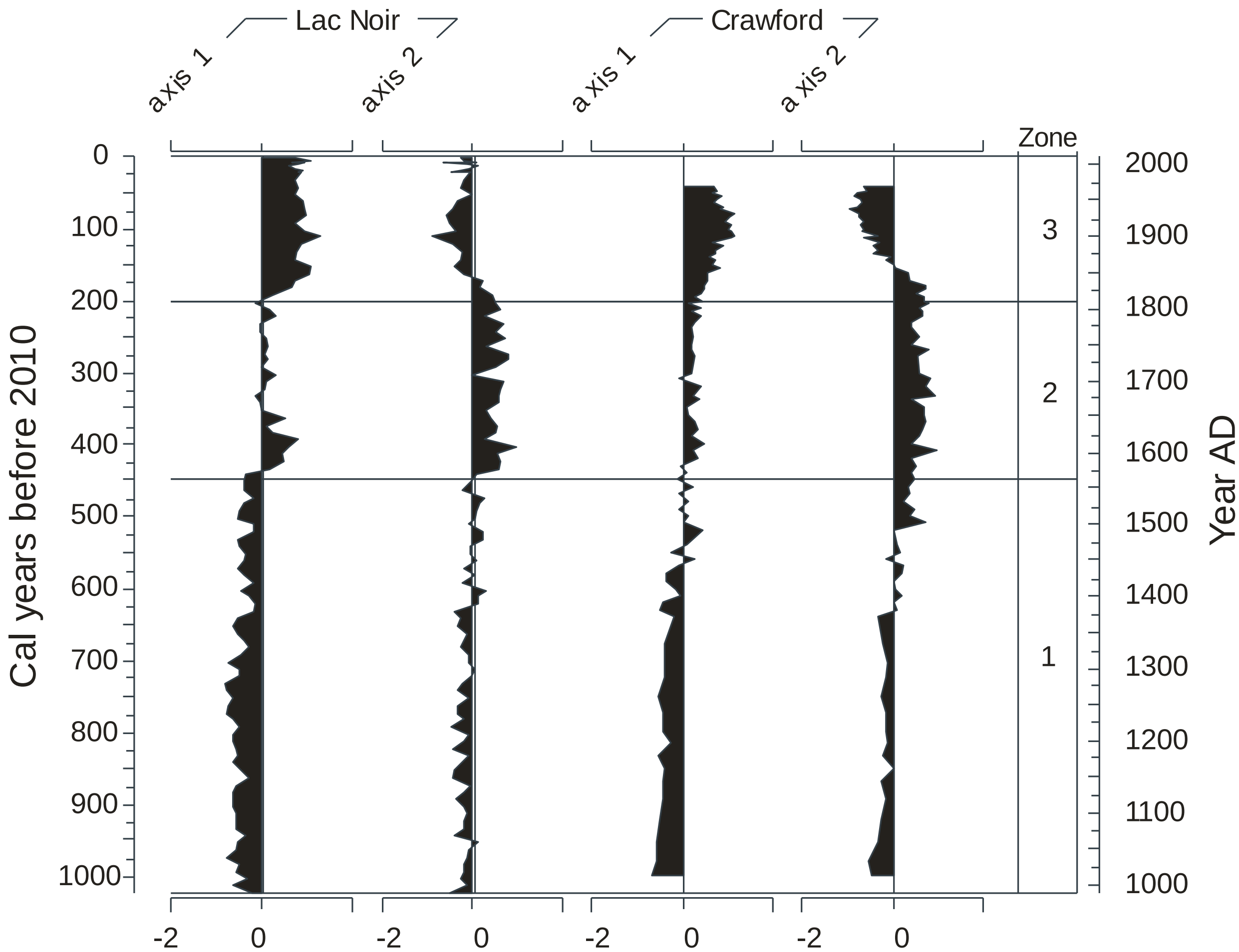

Figure 4.12: Principal Component scores of pollen percentages from Lac Noir and Crawford Lake.

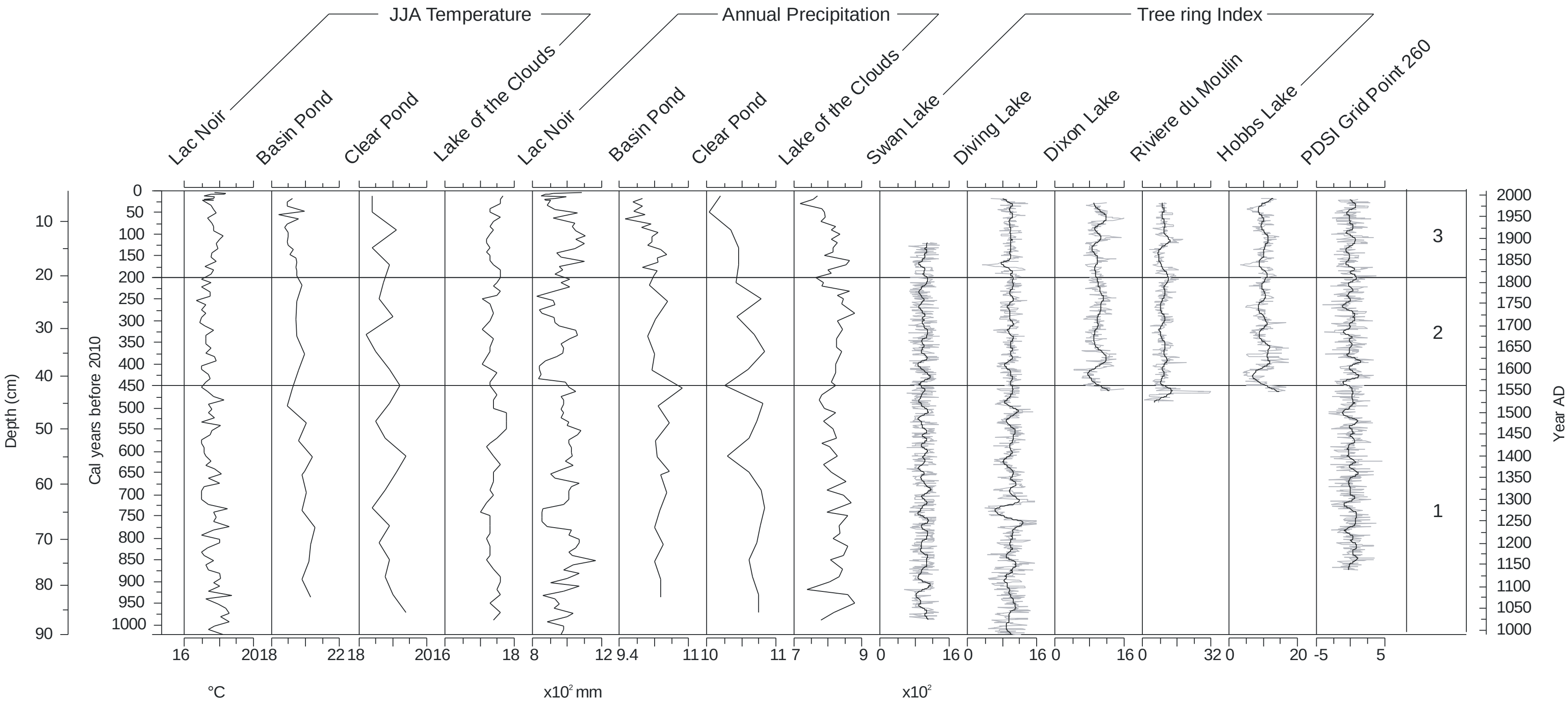

Figure 4.13: Climate reconstruction from high resolution pollen diagrams from lakes in north eastern North America, tree-ring records from the study area, and the Palmer Drought Severity Index of grid point 260, (the closest to Lac Noir). Tree-ring indices and PDSI estimates have a loess smoothing of 0.05.

Chapter 5

Summary

Sediments were collected from Lac Noir, in southwestern Quebec in order to study environmental change of the past millennium. Each individual pollen spectrum spanned 10 years of accumulation and the core was analysed at continuous intervals. The result was therefore a high temporal-resolution record of vegetation and climate for the region. The focus was on the past 1000 years because this time span contains the Medieval Warm Period, Little Ice Age, the European settlement of Quebec and Ontario and contemporary climate warming.

Sediments contained fine laminations which were cross-dated to develop the chronology of the record. Lead-210 and radiocarbon dates were used to verify the annual nature of the varves, although the results were not definitive. The *Ambrosia* rise, located at 18 cm in the sediment core, which in this region dates the European colonization and agriculture, was reasonably dated at 180 years ago if the varve chronology is accepted and when using the ^{210}Pb ages to date the uppermost several cm of the core, which were disturbed.

Throughout the past 1000 years, *Pinus*, *Tsuga*, *Betula*, *Fagus* and other arboreal taxa were dominant in the pollen record, indicating a mixed conifer-hardwood forest in the region during the past millennium. There were, however marked changes in the relative and absolute abundance of the various taxa, indicating small changes in the composition of the forest and/or changes in pollen transport to the site due to changes in air mass movements. Principal Components Analysis was used to divide the record into three distinct zones: The first corresponded in time to the Medieval Warm Period, when deciduous species (*Fagus, Acer, Tsuga*) dominated the forest composition during a relatively warm and moist climate. The second period corresponds to the Little Ice Age, when pollen of coniferous species (*Pinus, Picea*) became more abundant in a colder and dry climate. The third zone corresponds to the European settlement of the region when non-arboreal taxa (*Ambrosia, Rumex*, Asteraceae) dominated because of land clearance and logging.

Charcoal influx varied little in the past 1000 years, with only one distinct peak 890 years ago, however neither the pollen percentages nor the pollen accumulation rates (PAR) reveal any significant changes in forest composition or production at that time. Fire was therefore not a major factor causing changes in the forest composition during the past millennium

The pollen percentage and PAR diagrams show an abrupt change at the beginning of the Little Ice Age in Lac Noir sediments, characterized by a rapid decrease in deciduous tree taxa 450 years ago, with an increase in the pollen of coniferous species. This rapid shift in pollen input to the lake is indicative of an abrupt change in climate, similarly found in other regions of northeastern North America. However, previous work has not had the temporal resolution to indicate the abruptness of this change. A quantitative paleoclimate reconstruction based on the pollen data showed relatively moist summer conditions in Zone 1 and overall drier conditions in Zones 2 and 3. This rapid response in vegetation seen in the pollen diagrams has not been previously identified in lower-resolution records from southern Quebec and Eastern Ontario. Continuous high-resolution records can show more detail in the timing of the response of vegetation to climate change, and provide evidence that vegetation can respond to climate change at decadal scales rather than centennial to millennial scales.

The varves in the first 6 cm of these frozen cores were disturbed, and this increased the uncertainty in the absolute timing of changes in the record. It would be necessary to collect other cores from this lake (perhaps in the other deep basin), but also find other lakes with varved sediments in order to obtain a better understanding of the timing of vegetation changes and climate events in southwestern Quebec and Eastern Ontario. Similarly, although it is assumed in this study that the abrupt change 450 years ago is the local vegetation response to the onset of the Little Ice Age, it would be important to replicate these results from other sites in the region. If this conclusion is verified this could provide important information about the sensitivity of the mixed conifer-hardwood forest to climate change.

This research was performed at a decadal resolution, however, the remarkable results suggest it would be profitable to attempt further studies at sub-decadal resolution (2-5 years). The fact that most studies from this region were done at a lower temporal resolution (40 years and greater), made it difficult to compare between records; there is potential to better resolve paleoclimate variability in this region using lake-sediment studies.

The paleoclimate reconstructions from Lac Noir were compared to other high resolution pollen reconstructions from the conifer-hardwood forest region (Gajewski, 1988) as well as long tree-ring series (Guyette & Cole, 1999; Guyette, n.d.; Cook, 1982a,b) and a tree-ring based Palmer Drought Severity Index for this location (Cook & Krusic, 2004; Cook *et al*., 2004). Lac Noir, Basin Pond and Lake of the Clouds show higher temperatures during the MWP (Zone 1), and all the lakes show a decrease in temperature during the LIA (Zone 2). Lac Noir and Basin Pond show similar trends in precipitation, such as drier conditions during the LIA. Tree-ring series show high frequency variability, but do not show the lower-frequency changes identified in the pollen record. Combining tree-rings and lake sediments as methods to reconstruct climate and explain changes in vegetation communities is therefore essential in paleoclimate and paleoecological studies.

Suggestions for future work are:

1: Collect a longer record from Lac Noir to analyze the Holocene vegetation sequence at a high resolution. Results of this study have shown that the site has the potential to record small climate variations that occur over several decades, and a Holocene-scale study will put the past 2000 years in context.;

2: Analyze the pollen sequences from other lakes in the Outaouais region that contain varves and compare chronologies and vegetation profiles among them. This will confirm the results presented in this study, and also enable a more detailed analysis of the timing of the various changes through replication.;

3: Study the process of varve formation in these lakes and analyze the varve characteristics and thickness as an alternative paleoclimate index.

This study has shown that the forests of the Ottawa region have responded rapidly to small climate variations in the past. Pollen analysis from lakes with varved sediments has the potential to provide high-resolution paleoclimate records of the Holocene, and faithfully reconstruct the scale and magnitude of Holocene climate variability.

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Appendix A

Magnetic Susceptibility data

	Series 1			Series 2			Series 3		
Age before 2010	SAMPLE interval (cm)	METER reading	SUSC	SAMPLE interval (cm)	METER reading	SUSC	SAMPLE interval (cm)	METER reading	SUSC
352	33	0.5	0.59	33	0.1	0.33	33	0.6	0.61
362	34	0.5	0.59	34	0.1	0.34	34	0.6	0.59
372	35	0.5	0.59	35	0.2	0.45	35	0.8	0.77
382	36	0.5	0.59	36	0.1	0.35	36	0.9	0.84
392	37	0.5	0.59	37	0	0.26	37	0.8	0.72
402	38	0.4	0.49	38	0	0.27	38	0.9	0.8
412	39	0.5	0.58	39	0.1	0.38	39	1	0.88
422	40	0.7	0.78	40	0.3	0.58	40	1.2	1.05
432	41	1	1.08	41	0.5	0.79	41	1.5	1.33
442	42	1.3	1.38	42	1	1.3	42	1.9	1.71
452	43	1.5	1.58	43	1.1	1.41	43	2.1	1.89
472	44	1.4	1.48	44	1.1	1.41	44	2.1	1.86
482	45	1.5	1.58	45	1.1	1.42	45	2.1	1.84
492	46	1.8	1.87	46	1.5	1.83	46	2.5	2.22
502	47	2.2	2.27	47	1.9	2.24	47	3	2.7
512	48	2.8	2.87	48	2.4	2.74	48	3.6	3.27
532	49	3	3.07	49	2.6	2.95	49	3.7	3.35
542	50	2.9	2.97	50	2.4	2.76	50	3.6	3.23
552	51	2.8	2.87	51	2.4	2.77	51	3.6	3.21
572	52	2.9	2.97	52	2.4	2.77	52	3.7	3.29
582	53	2.9	2.96	53	2.5	2.88	53	3.7	3.26
602	54	2.8	2.86	54	2.5	2.89	54	3.6	3.14
612	55	2.8	2.86	55	2.4	2.8	55	3.6	3.12
622	56	2.8	2.86	56	2.3	2.7	56	3.6	3.1
632	57	3	3.06	57	2.5	2.91	57	3.7	3.17
642	58	3.1	3.16	58	2.6	3.02	58	3.9	3.35
662	59	3	3.05	59	2.6	3.03	59	3.9	3.33
672	60	2.9	2.95	60	2.4	2.83	60	3.8	3.21
682	61	3	3.05	61	2.6	3.04	61	3.9	3.28
692	62	3.1	3.15	62	2.6	3.05	62	3.9	3.26
702	63	2.8	2.85	63	2.3	2.76	63	3.7	3.04
712	64	2.5	2.55	64	2	2.47	64	3.4	2.72
722	65	2.3	2.35	65	1.9	2.37	65	3.3	2.59
742	66	2.3	2.34	66	1.7	2.18	66	3.2	2.47
752	67	2.3	2.34	67	1.7	2.19	67	3.2	2.45
762	68	2.3	2.34	68	1.7	2.2	68	3.2	2.43
782	69	2.3	2.34	69	1.7	2.2	69	3.2	2.4
792	70	2.3	2.34	70	1.6	2.11	70	3.1	2.28
812	71	2.1	2.14	71	1.6	2.12	71	3.1	2.26
822	72	2.2	2.23	72	1.7	2.23	72	3.2	2.34
832	73	2.4	2.43	73	1.9	2.43	73	3.4	2.51
842	74	2.9	2.93	74	2.3	2.84	74	3.8	2.89
852	75	3.3	3.33	75	2.6	3.15	75	4.1	3.17
862	76	3	3.03	76	2.4	2.96	76	4.1	3.15
872	77	2.5	2.53	77	1.9	2.46	77	3.6	2.63
882	78	2.2	2.23	78	1.7	2.27	78	3.3	2.3

Age before 2010	Series 1 SAMPLE interval (cm)	METER reading	SUSC	Series 2 SAMPLE interval (cm)	METER reading	SUSC	Series 3 SAMPLE interval (cm)	METER reading	SUSC
892	79	2.1	2.12	79	1.6	2.18	79	3.2	2.18
902	80	2.3	2.32	80	1.7	2.29	80	3.3	2.26
912	81	2.8	2.82	81	2.1	2.69	81	3.7	2.64
932	82	3.3	3.32	82	2.5	3.1	82	4.2	3.11
942	83	3.3	3.32	83	2.7	3.31	83	4.4	3.29
952	84	3.1	3.12	84	2.5	3.12	84	4.1	2.97
962	85	3	3.02	85	2.3	2.92	85	4	2.85
972	86	3	3.01	86	2.4	3.03	86	4.1	2.92
982	87	3	3.01	87	2.4	3.04	87	4.1	2.9
992	88	2.9	2.91	88	2.3	2.95	88	4	2.78
1002	89	2.9	2.91	89	2.3	2.95	89	3.9	2.66
1012	90	2.7	2.71	90	2.1	2.76	90	3.9	2.63
1022	91	2.5	2.51	91	1.9	2.57	91	3.7	2.41

Appendix B

Loss-on-Ignition data

Year before 2010	Crucible weight (g)	Dry weight + cruc	weight 550 + cruc	weight 950 + cruc	DW105	DW 550-cruc	DW 950-cruc	DW 550 %	DW 950 %
2.3	9.2836	9.3272	9.3192	9.3182	0.0436	0.0356	0.0346	18.3486	3.1193
4.6	9.8955	9.9543	9.9444	9.9431	0.0588	0.0489	0.0476	16.8367	3.0068
6.9	9.6085	9.6525	9.6452	9.6442	0.0440	0.0367	0.0357	16.5909	3.0909
9.2	9.9117	9.9547	9.9476	9.9466	0.0430	0.0359	0.0349	16.5116	3.1628
11.5	9.5584	9.6089	9.6003	9.5989	0.0505	0.0419	0.0405	17.0297	3.7703
13.8	9.5576	9.6119	9.6021	9.6007	0.0543	0.0445	0.0431	18.0479	3.5064
16.1	10.3014	10.3441	10.3370	10.3359	0.0427	0.0356	0.0345	16.6276	3.5035
18.4	9.0799	9.1423	9.1314	9.1295	0.0624	0.0515	0.0496	17.4679	4.1410
20.7	9.7685	9.8215	9.8120	9.8106	0.0530	0.0435	0.0421	17.9245	3.5925
22	8.9271	8.9772	8.9676	8.9658	0.0501	0.0405	0.0387	19.1617	4.8862
32	10.3121	10.3632	10.3524	10.3507	0.0511	0.0403	0.0386	21.1350	4.5245
42	9.6935	9.7273	9.7209	9.7200	0.0338	0.0274	0.0265	18.9349	3.6213
52	9.5258	9.5776	9.5673	9.5661	0.0518	0.0415	0.0403	19.8842	3.1506
62	8.3884	8.4398	8.4301	8.4289	0.0514	0.0417	0.0405	18.8716	3.1751
72	9.4224	9.4602	9.4518	9.4509	0.0378	0.0294	0.0285	22.2222	3.2381
82	9.2278	9.2570	9.2490	9.2482	0.0292	0.0212	0.0204	27.3973	3.7260
92	8.5728	8.6151	8.6035	8.6023	0.0423	0.0307	0.0295	27.4232	3.8582
102	9.8215	9.8637	9.8506	9.8489	0.0422	0.0291	0.0274	31.0427	5.4787
112	9.4712	9.5189	9.5074	9.5053	0.0477	0.0362	0.0341	24.1090	5.9874
122	9.3807	9.4332	9.4208	9.4186	0.0525	0.0401	0.0379	23.6190	5.6990
132	9.5648	9.6299	9.6151	9.6128	0.0651	0.0503	0.0480	22.7343	4.8049
142	9.5577	9.6166	9.6034	9.6013	0.0589	0.0457	0.0436	22.4109	4.8489
152	9.6012	9.6559	9.6422	9.6402	0.0547	0.0410	0.0390	25.0457	4.9726
162	9.6768	9.7487	9.7314	9.7291	0.0719	0.0546	0.0523	24.0612	4.3505
172	9.9607	10.0099	9.9973	9.9954	0.0492	0.0366	0.0347	25.6098	5.2520
182	8.8239	8.8506	8.8428	8.8414	0.0267	0.0189	0.0175	29.2135	7.1311
192	9.6297	9.6669	9.6555	9.6537	0.0372	0.0258	0.0240	30.6452	6.5806
202	9.1275	9.1581	9.1492	9.1474	0.0306	0.0217	0.0199	29.0850	8.0000
212	9.1632	9.2027	9.1915	9.1896	0.0395	0.0283	0.0264	28.3544	6.5418
222	8.9779	9.0084	8.9999	8.9983	0.0305	0.0220	0.0204	27.8689	7.1344
232	9.7612	9.7954	9.7855	9.7838	0.0342	0.0243	0.0226	28.9474	6.7602
242	9.6226	9.6466	9.6396	9.6384	0.0240	0.0170	0.0158	29.1667	6.8000
252	9.6779	9.7162	9.7039	9.7021	0.0383	0.0260	0.0242	32.1149	6.3916
262	9.3595	9.3946	9.3833	9.3816	0.0351	0.0238	0.0221	32.1937	6.5869
272	8.7573	8.7855	8.7756	8.7741	0.0282	0.0183	0.0168	35.1064	7.2340
282	9.2595	9.2894	9.2789	9.2775	0.0299	0.0194	0.0180	35.1171	6.3679
292	9.4242	9.4511	9.4426	9.4412	0.0269	0.0184	0.0170	31.5985	7.0781
302	8.8456	8.8738	8.8655	8.8642	0.0282	0.0199	0.0186	29.4326	6.2695
312	8.5210	8.5548	8.5442	8.5427	0.0338	0.0232	0.0217	31.3609	6.0355
322	9.1933	9.2173	9.2081	9.2070	0.0240	0.0148	0.0137	38.3333	6.2333
332	9.9277	9.9611	9.9491	9.9477	0.0334	0.0214	0.0200	35.9281	5.7006
342	9.3314	9.3691	9.3557	9.3550	0.0377	0.0243	0.0236	35.5438	2.5252
352	9.1143	9.1463	9.1341	9.1332	0.0320	0.0198	0.0189	38.1250	3.8250
362	9.3579	9.3995	9.3849	9.3839	0.0416	0.0270	0.0260	35.0962	3.2692
372	10.3913	10.4086	10.4020	10.4011	0.0173	0.0107	0.0098	38.1503	7.0751
382	10.2260	10.2580	10.2459	10.2450	0.0320	0.0199	0.0190	37.8125	3.8250
392	9.0126	9.0452	9.0327	9.0318	0.0326	0.0201	0.0192	38.3436	3.7546
402	9.0836	9.1215	9.1116	9.1109	0.0379	0.0280	0.0273	26.1214	2.5119
412	10.0205	10.0635	10.0540	10.0533	0.0430	0.0335	0.0328	22.0930	2.2140

Year before 2010	Crucible weight (g)	Dry weight + cruc	weight 550 + cruc	weight 950 + cruc	DW105	DW 550-cruc	DW 950-cruc	DW 550 %	DW 950 %
422	9.6530	9.6852	9.6755	9.6747	0.0322	0.0225	0.0217	30.1242	3.3789
442	8.6240	8.6612	8.6504	8.6493	0.0372	0.0264	0.0253	29.0323	4.0215
452	9.6012	9.6420	9.6300	9.6290	0.0408	0.0288	0.0278	29.4118	3.3333
462	9.1245	9.1725	9.1588	9.1578	0.0480	0.0343	0.0333	28.5417	2.8333
472	9.3976	9.4505	9.4354	9.4341	0.0529	0.0378	0.0365	28.5444	3.3422
482	10.4305	10.4719	10.4584	10.4572	0.0414	0.0279	0.0267	32.6087	3.9420
492	9.7459	9.7873	9.7730	9.7720	0.0414	0.0271	0.0261	34.5411	3.2850
502	9.9068	9.9523	9.9370	9.9360	0.0455	0.0302	0.0292	33.6264	2.9890
512	9.0052	9.0525	9.0400	9.0387	0.0473	0.0348	0.0335	26.4271	3.7378
522	9.7417	9.7928	9.7801	9.7788	0.0511	0.0384	0.0371	24.8532	3.4599
532	10.0295	10.0740	10.0606	10.0595	0.0445	0.0311	0.0300	30.1124	3.3618
542	9.1042	9.1474	9.1350	9.1338	0.0432	0.0308	0.0296	28.7037	3.7778
552	9.3068	9.3445	9.3334	9.3323	0.0377	0.0266	0.0255	29.4430	3.9682
562	9.6358	9.6766	9.6644	9.6634	0.0408	0.0286	0.0276	29.9020	3.3333
572	9.3203	9.3687	9.3566	9.3554	0.0484	0.0363	0.0351	25.0000	3.3719
582	9.2542	9.2945	9.2850	9.2841	0.0403	0.0308	0.0299	23.5732	3.0372
592	9.4054	9.4496	9.4388	9.4379	0.0442	0.0334	0.0325	24.4344	2.7692
602	9.2338	9.2870	9.2733	9.2720	0.0532	0.0395	0.0382	25.7519	3.3233
612	9.3117	9.3629	9.3492	9.3476	0.0512	0.0375	0.0359	26.7578	4.2500
622	9.4237	9.4561	9.4452	9.4444	0.0324	0.0215	0.0207	33.6420	3.3580
632	9.2713	9.3191	9.3041	9.3028	0.0478	0.0328	0.0315	31.3808	3.6987
642	9.2704	9.3140	9.3009	9.2996	0.0436	0.0305	0.0292	30.0459	4.0550
652	8.8261	8.8561	8.8471	8.8463	0.0300	0.0210	0.0202	30.0000	3.6267
662	9.3772	9.4156	9.4038	9.4027	0.0384	0.0266	0.0255	30.7292	3.8958
672	11.0113	11.0598	11.0443	11.0431	0.0485	0.0330	0.0318	31.9588	3.3649
682	9.6738	9.7080	9.6961	9.6951	0.0342	0.0223	0.0213	34.7953	3.9766
692	9.0565	9.0919	9.0798	9.0786	0.0354	0.0233	0.0221	34.1808	4.6102
702	10.2110	10.2490	10.2369	10.2356	0.0380	0.0259	0.0246	31.8421	4.6526
712	9.4703	9.5078	9.4960	9.4950	0.0375	0.0257	0.0247	31.4667	3.6267
722	9.8646	9.9035	9.8906	9.8894	0.0389	0.0260	0.0248	33.1620	4.1954
732	9.2409	9.2818	9.2694	9.2683	0.0409	0.0285	0.0274	30.3178	3.6577
742	9.3373	9.3787	9.3665	9.3652	0.0414	0.0292	0.0279	29.4686	4.2705
752	8.6484	8.6834	8.6732	8.6722	0.0350	0.0248	0.0238	29.1429	3.8857
762	10.2671	10.3064	10.2943	10.2931	0.0393	0.0272	0.0260	30.7888	4.1527
772	9.6160	9.6575	9.6448	9.6435	0.0415	0.0288	0.0275	30.6024	4.2602
782	9.3705	9.4113	9.3990	9.3978	0.0408	0.0285	0.0273	30.1471	4.0000
792	9.8039	9.8566	9.8441	9.8427	0.0527	0.0402	0.0388	23.7192	3.6129
802	9.3851	9.4284	9.4168	9.4157	0.0433	0.0317	0.0306	26.7898	3.4550
812	9.9630	10.0041	9.9903	9.9890	0.0411	0.0273	0.0260	33.5766	4.3017
822	9.1335	9.1738	9.1616	9.1604	0.0403	0.0281	0.0269	30.2730	4.0496
832	8.5777	8.6208	8.6085	8.6073	0.0431	0.0308	0.0296	28.5383	3.7865
842	8.4351	8.4846	8.4690	8.4672	0.0495	0.0339	0.0321	31.5152	4.9455
852	7.9082	7.9648	7.9479	7.9463	0.0566	0.0397	0.0381	29.8587	3.8445
862	8.4205	8.4634	8.4519	8.4506	0.0429	0.0314	0.0301	26.8065	4.1212
872	7.7652	7.8433	7.8263	7.8245	0.0781	0.0611	0.0593	21.7670	3.1344
882	8.1870	8.2357	8.2212	8.2194	0.0487	0.0342	0.0324	29.7741	5.0267
892	8.1115	8.1636	8.1497	8.1480	0.0521	0.0382	0.0365	26.6795	4.4376
902	10.4381	10.4929	10.4778	10.4762	0.0548	0.0397	0.0381	27.5547	3.9708
912	9.2916	9.3511	9.3355	9.3340	0.0595	0.0439	0.0424	26.2185	3.4286
922	10.0915	10.1465	10.1332	10.1321	0.0550	0.0417	0.0406	24.1818	2.7200
932	7.7531	7.8147	7.7973	7.7952	0.0616	0.0442	0.0421	28.2468	4.6364
942	7.8556	7.8996	7.8859	7.8841	0.0440	0.0303	0.0285	31.1364	5.5636
952	8.6189	8.6599	8.6468	8.6450	0.0410	0.0279	0.0261	31.9512	5.9707
962	8.2464	8.2864	8.2734	8.2715	0.0400	0.0270	0.0251	32.5000	6.4600

972	8.0449	8.0855	8.0721	8.0704	0.0406	0.0272	0.0255	33.0049	5.6946
982	7.8505	7.8878	7.8765	7.8747	0.0373	0.0260	0.0242	30.2949	6.5630
Year before 2010	Crucible weight (g)	Dry weight + cruc	weight 550 + cruc	weight 950 + cruc	DW105	DW 550-cruc	DW 950-cruc	DW 550 %	DW 950 %
992	8.2699	8.3028	8.2923	8.2911	0.0329	0.0224	0.0212	31.9149	4.9605
1002	7.8502	7.8991	7.8856	7.8841	0.0489	0.0354	0.0339	27.6074	4.1718
1012	8.2584	8.3155	8.3011	8.2996	0.0571	0.0427	0.0412	25.2189	3.5727
1022	8.5344	8.5710	8.5615	8.5604	0.0366	0.0271	0.0260	25.9563	4.0874

Appendix C

Chronology data

AD corrected by Lead-210	Cal year before 2010	Average of the 3 average columns (cm)	Cum Average of the 3 cumulative average columns (cm)
2008	2.3	0.65	0.65
2005	4.6	0.65	1.29
2003	6.9	0.65	1.94
2001	9.2	0.65	2.59
1999	11.5	0.65	3.24
1996	13.8	0.65	3.88
1994	16.1	0.65	4.53
1992	18.4	0.65	5.18
1989	20.7	0.65	5.83
1988	22	0.65	6.47
1978	32	0.72	7.20
1968	42	0.64	7.83
1958	52	0.76	8.59
1948	62	0.69	9.28
1938	72	0.81	10.09
1928	82	0.74	10.83
1918	92	0.74	11.57
1908	102	0.82	12.39
1898	112	0.66	13.05
1888	122	0.82	13.87
1878	132	0.70	14.57
1868	142	0.80	15.37
1858	152	0.77	16.14
1848	162	0.76	16.91
1838	172	1.04	17.95
1828	182	0.94	18.89
1818	192	0.92	19.81
1808	202	0.75	20.56
1798	212	0.94	21.50
1788	222	0.86	22.36
1778	232	0.84	23.20
1768	242	0.65	23.86
1758	252	0.79	24.65
1748	262	0.87	25.52
1738	272	0.81	26.33
1728	282	0.81	27.14
1718	292	0.87	28.01
1708	302	0.76	28.77
1698	312	0.77	29.54
1688	322	0.82	30.36
1678	332	0.87	31.23
1668	342	0.86	32.09
1658	352	0.88	32.97
1648	362	0.81	33.78
1638	372	0.93	34.71
1628	382	0.96	35.67
1618	392	0.99	36.66
1608	402	0.93	37.58
1598	412	0.87	38.45
1588	422	1.07	39.52
1578	432	0.99	40.51
1568	442	0.85	41.36
1558	452	0.82	42.18
1548	462	0.86	43.04
1538	472	0.65	43.70
1528	482	0.84	44.54
1518	492	1.08	45.62
1508	502	0.82	46.45
1498	512	0.86	47.31
1488	522	0.84	48.15

1478	532	0.68	48.83
AD corrected by Lead-210	Cal year before 2010	Average of the 3 average columns (cm)	Cum Average of the 3 cumulative average columns (cm)
1468	542	0.74	49.57
1458	552	0.77	50.35
1448	562	0.75	51.10
1438	572	0.67	51.77
1428	582	0.62	52.39
1418	592	0.56	52.95
1408	602	0.66	53.61
1398	612	0.89	54.50
1388	622	0.87	55.37
1378	632	0.86	56.23
1368	642	0.87	57.09
1358	652	0.95	58.04
1348	662	0.80	58.83
1338	672	0.89	59.73
1328	682	0.90	60.63
1318	692	0.86	61.49
1308	702	0.84	62.33
1298	712	0.95	63.28
1288	722	0.89	64.17
1278	732	0.83	65.00
1268	742	0.91	65.92
1258	752	0.75	66.66
1248	762	0.72	67.38
1238	772	0.70	68.08
1228	782	0.66	68.74
1218	792	0.57	69.31
1208	802	0.71	70.01
1198	812	0.92	70.94
1188	822	0.85	71.79
1178	832	0.95	72.73
1168	842	0.90	73.63
1158	852	1.02	74.65
1148	862	1.03	75.68
1138	872	1.03	76.71
1128	882	0.92	77.63
1118	892	0.85	78.48
1108	902	0.89	79.37
1098	912	0.95	80.31
1088	922	0.75	81.06
1078	932	0.75	81.81
1068	942	0.86	82.67
1058	952	1.07	83.74
1048	962	0.78	84.52
1038	972	0.89	85.41
1028	982	1.09	86.50
1018	992	0.89	87.39
1008	1002	0.94	88.33
998	1012	0.99	89.32
988	1022	0.78	90.10

Appendix D

Pollen data

depth cm	A.D corrected by Lead210	Cal years before 2010	SUM DIP	SUM Hap	SUM UNDIFF	1/2 Pinus/2	Picea glauca	Picea mariana	Picea	1/2 Picea/2	1/2 Abies/2	Abies b.	Tsuga cana	Larix
0.65	2007.7	2.3	11.0	42.0	22.0	24.0	7.0	0.0	1.0	5.5	0.5	1.0	12.0	7.0
1.29	2005.4	5	25.0	41.0	36.0	36.5	3.0	4.0	4.0	3.0	0.0	6.0	22.0	2.0
1.94	2003.1	7	7.0	64.0	24.0	38.0	3.0	4.0	7.0	1.5	0.0	3.0	30.0	0.0
2.59	2000.8	9	14.0	32.0	31.0	31.0	8.0	8.0	4.0	2.0	0.0	3.0	21.0	1.0
3.24	1998.5	12	29.0	53.0	24.0	29.5	7.0	2.0	3.0	2.5	0.0	0.0	15.0	3.0
3.88	1996.2	14	5.0	50.0	30.0	34.0	2.0	5.0	7.0	5.0	1.5	3.0	16.0	0.0
4.53	1993.9	16	8.0	44.0	20.0	41.0	1.0	5.0	10.0	4.0	0.0	3.0	18.0	0.0
5.18	1991.6	18	11.0	35.0	25.0	34.5	6.0	9.0	7.0	4.5	0.0	0.0	10.0	0.0
5.83	1989.3	21	16.0	36.0	25.0	46.5	3.0	5.0	6.0	3.5	0.0	1.0	22.0	4.0
6.47	1988	22	11.0	57.0	17.0	33.0	2.0	6.0	5.0	5.5	3.5	4.0	17.0	1.0
7.2	1978	32	10.0	39.0	38.0	28.5	1.0	0.0	9.0	2.0	1.0	4.0	24.0	0.0
7.83	1968	42	11.0	44.0	23.0	28.5	3.0	6.0	5.0	5.0	1.5	2.0	14.0	0.0
8.59	1958	52	11.0	30.0	21.0	30.0	1.0	1.0	13.0	6.0	1.5	5.0	12.0	0.0
9.28	1948	62	7.0	30.0	28.0	36.0	1.0	3.0	9.0	3.0	2.0	4.0	13.0	0.0
10.09	1938	72	9.0	28.0	14.0	24.0	1.0	0.0	4.0	4.5	2.0	2.0	19.0	0.0
10.83	1928	82	11.0	35.0	9.0	14.0	3.0	3.0	6.0	2.0	1.0	5.0	16.0	1.0
11.57	1918	92	8.0	20.0	19.0	13.0	5.0	2.0	8.0	1.5	0.0	1.0	19.0	0.0
12.39	1908	102	4.0	23.0	20.0	13.5	4.0	2.0	11.0	2.0	2.5	4.0	22.0	2.0
13.05	1898	112	10.0	10.0	16.0	18.5	7.0	2.0	5.0	0.5	0.0	3.0	12.0	0.0
13.87	1888	122	6.0	20.0	12.0	20.0	3.0	1.0	3.0	6.0	2.0	3.0	17.0	0.0
14.57	1878	132	6.0	23.0	16.0	23.0	0.0	2.0	3.0	6.5	2.0	2.0	19.0	0.0
15.37	1868	142	9.0	23.0	14.0	23.0	0.0	0.0	9.0	4.5	2.0	9.0	20.0	0.0
16.14	1858	152	20.0	9.0	24.0	14.5	9.0	4.0	3.0	1.5	1.0	2.0	23.0	0.0
16.91	1848	162	3.0	22.0	14.0	23.0	2.0	1.0	9.0	6.5	3.0	6.0	25.0	0.0
17.95	1838	172	4.0	35.0	14.0	48.0	1.0	2.0	12.0	5.5	6.0	8.0	35.0	1.0
18.89	1828	182	5.0	52.0	18.0	29.0	2.0	3.0	14.0	5.5	0.5	4.0	49.0	2.0
19.81	1818	192	8.0	86.0	10.0	33.0	3.0	4.0	10.0	11.5	1.0	2.0	32.0	0.0
20.56	1808	202	2.0	56.0	29.0	31.5	3.0	2.0	17.0	6.0	1.0	10.0	32.0	3.0
21.5	1798	212	11.0	64.0	17.0	43.0	0.0	1.0	11.0	6.0	3.0	7.0	25.0	1.0
22.36	1788	222	20.0	69.0	40.0	43.0	3.0	3.0	3.0	2.5	0.0	3.0	17.0	4.0
23.2	1778	232	2.0	89.0	24.0	85.0	2.0	0.0	7.0	16.5	2.0	2.0	33.0	1.0

depth cm	A.D corrected by Lead210	Cal years before 2010	SUM DIP	SUM Hap	SUM UNDIFF	1/2 Pinus/2	Picea glauca	Picea mariana	Picea	1/2 Picea/2	1/2 Abies/2	Abies b.	Tsuga cana	Larix
23.86	1768	242	3.0	114.0	40.0	65.5	0.0	0.0	15.0	11.0	1.5	5.0	46.0	2.0
24.65	1758	252	7.0	104.0	31.0	65.0	4.0	5.0	10.0	8.5	4.5	2.0	20.0	1.0
25.52	1748	262	29.0	64.0	34.0	39.0	6.0	7.0	3.0	3.0	0.0	8.0	48.0	5.0
26.33	1738	272	12.0	103.0	34.0	65.5	2.0	3.0	10.0	7.0	2.5	5.0	49.0	3.0
27.14	1728	282	7.0	97.0	28.0	41.0	4.0	4.0	14.0	6.0	2.0	6.0	22.0	2.0
28.01	1718	292	7.0	72.0	16.0	36.5	1.0	3.0	3.0	3.0	3.0	4.0	21.0	1.0
28.77	1708	302	19.0	22.0	31.0	38.0	4.0	1.0	5.0	4.5	0.0	5.0	28.0	2.0
29.54	1698	312	3.0	65.0	41.0	41.0	2.0	0.0	16.0	8.0	2.5	7.0	24.0	2.0
30.36	1688	322	5.0	54.0	24.0	36.0	4.0	1.0	18.0	3.0	0.5	1.0	19.0	3.0
31.23	1678	332	4.0	33.0	24.0	36.5	4.0	1.0	5.0	6.5	3.0	4.0	17.0	4.0
32.09	1668	342	8.0	52.0	21.0	30.0	0.0	1.0	2.0	8.5	4.5	8.0	34.0	2.0
32.97	1658	352	3.0	43.0	21.0	33.5	2.0	0.0	6.0	4.5	0.0	1.0	41.0	2.0
33.78	1648	362	16.0	26.0	26.0	35.0	11.0	7.0	4.0	6.0	2.5	17.0	36.0	1.0
34.71	1638	372	7.0	38.0	12.0	44.0	0.0	0.0	6.0	8.0	6.0	12.0	35.0	2.0
35.67	1628	382	12.0	46.0	19.0	35.0	3.0	3.0	15.0	6.0	6.0	4.0	47.0	2.0
36.66	1618	392	13.0	28.0	19.0	28.5	4.0	6.0	4.0	10.0	0.0	10.0	22.0	1.0
37.58	1608	402	12.0	74.0	22.0	27.5	4.0	4.0	13.0	9.5	6.0	15.0	47.0	1.0
38.45	1598	412	9.0	54.0	38.0	44.5	7.0	4.0	17.0	10.0	1.5	6.0	46.0	1.0
39.52	1588	422	14.0	72.0	32.0	55.5	8.0	0.0	17.0	8.5	3.0	2.5	43.0	0.0
40.51	1578	432	5.0	37.0	43.0	61.5	7.0	0.0	11.0	4.5	1.0	4.0	49.0	1.0
41.36	1568	442	6.0	40.0	15.0	25.5	4.0	2.0	10.0	3.5	1.0	3.0	77.0	6.0
42.18	1558	452	7.0	31.0	6.0	22.0	3.0	1.0	13.0	7.0	1.5	1.0	84.0	3.0
43.04	1548	462	11.0	37.0	12.0	29.0	3.0	3.0	2.0	3.0	0.0	1.0	123.0	1.0
43.7	1538	472	10.0	48.0	22.0	28.0	2.0	3.0	10.0	2.0	2.5	5.0	78.0	2.0
44.54	1528	482	4.0	47.0	17.0	27.5	4.0	2.0	5.0	1.5	3.5	4.0	83.0	1.0
45.62	1518	492	4.0	24.0	18.0	24.5	1.0	2.0	11.0	7.0	3.5	4.0	100.0	2.0
46.45	1508	502	4.0	29.0	14.0	22.0	1.0	3.0	13.0	3.5	1.5	2.0	83.0	0.0
47.31	1498	512	8.0	15.0	25.0	23.0	2.0	1.0	8.0	4.0	0.0	2.0	91.0	3.0
48.15	1488	522	9.0	56.0	6.0	23.0	0.0	3.0	14.0	4.5	2.5	4.0	126.0	2.0
48.83	1478	532	2.0	28.0	7.0	17.0	2.0	2.0	10.0	6.5	2.5	2.0	96.0	2.0
49.57	1468	542	7.0	38.0	13.0	27.0	1.0	2.0	9.0	8.5	4.0	1.0	120.0	2.0
50.35	1458	552	2.0	25.0	14.0	21.5	0.0	2.0	7.0	4.0	0.5	5.0	91.0	4.0
51.1	1448	562	3.0	27.0	17.0	16.5	1.0	1.0	7.0	3.0	0.5	0.0	80.0	1.0
51.77	1438	572	7.0	25.0	9.0	10.5	2.0	4.0	5.0	3.5	2.0	1.0	124.0	3.0

52.39	1428	582	6.0	19.0	8.0	19.5	7.0	3.0	15.0	13.0	4.0	4.0	134.0	1.0
52.95	1418	592	9.0	28.0	13.0	11.5	9.0	5.0	2.0	4.5	0.0	1.0	63.0	9.0

depth cm	A.D corrected by Lead210	Cal years before 2010	SUM DIP	SUM Hap	SUM UNDIFF	1/2 Pinus/2	Picea glauca	Picea mariana	Picea	1/2 Picea/2	1/2 Abies/2	Abies b.	Tsuga cana	Larix
53.61	1408	602	2.0	22.0	6.0	6.5	4.0	2.0	10.0	6.0	3.5	5.0	52.0	1.0
54.5	1398	612	8.0	11.0	12.0	22.0	2.0	0.0	11.0	3.0	2.5	6.0	96.0	0.0
55.37	1388	622	3.0	29.0	10.0	26.0	0.0	4.0	4.0	8.0	3.0	6.0	100.0	0.0
56.23	1378	632	7.0	19.0	14.0	20.5	8.0	4.0	4.0	1.5	0.0	0.0	96.0	4.0
57.09	1368	642	2.0	24.0	12.0	14.5	0.0	0.0	6.0	2.5	1.0	1.0	95.0	1.0
58.04	1358	652	1.0	25.0	12.0	21.5	0.0	0.0	5.0	1.5	0.0	2.0	85.0	0.0
58.83	1348	662	4.0	26.0	7.0	26.0	0.0	0.0	5.0	9.0	3.5	3.0	130.0	1.0
59.73	1338	672	2.0	32.0	11.0	23.0	1.0	1.0	5.0	2.0	2.5	0.0	90.0	3.0
60.63	1328	682	7.0	11.0	15.0	14.5	1.0	2.0	2.0	1.0	0.0	5.0	74.0	2.0
61.49	1318	692	4.0	27.0	5.0	13.5	2.0	3.0	8.0	3.5	1.0	6.0	90.0	1.0
62.33	1308	702	2.0	29.0	3.0	14.5	2.0	0.0	5.0	2.0	2.4	2.0	103.0	3.0
63.28	1298	712	6.0	23.0	11.0	16.5	0.0	4.0	9.0	4.0	1.5	2.0	88.0	1.0
64.17	1288	722	3.0	41.0	10.0	15.5	1.0	0.0	7.0	3.5	3.5	1.0	105.0	1.0
65	1278	732	2.0	32.0	16.0	22.0	0.0	0.0	2.0	2.5	1.0	3.0	137.0	4.0
65.92	1268	742	1.0	43.0	9.0	27.0	1.0	0.0	4.0	1.5	0.5	1.0	126.0	0.0
66.66	1258	752	2.0	31.0	17.0	19.0	0.0	0.0	3.0	0.5	0.0	2.0	81.0	0.0
67.38	1248	762	2.0	25.0	6.0	15.5	0.0	0.0	5.0	4.5	1.0	0.0	108.0	0.0
68.08	1238	772	2.0	38.0	6.0	24.0	0.0	0.0	4.0	1.5	1.0	1.0	79.0	0.0
68.74	1228	782	3.0	47.0	4.0	14.5	2.0	0.0	3.0	4.5	3.5	0.0	73.0	0.0
69.31	1218	792	13.0	11.0	20.0	12.0	6.0	3.0	2.0	1.5	0.0	0.0	191.0	1.0
70.01	1208	802	0.0	23.0	11.0	32.5	1.0	0.0	3.0	3.5	1.0	1.0	87.0	1.0
70.94	1198	812	2.0	24.0	11.0	18.0	4.0	0.0	5.0	2.5	1.0	1.0	101.0	2.0
71.79	1188	822	4.0	16.0	9.0	13.0	0.0	1.0	1.0	0.5	0.0	3.0	98.0	4.0
72.73	1178	832	3.0	20.0	8.0	8.5	1.0	2.0	6.0	1.5	3.0	3.0	97.0	0.0
73.63	1168	842	2.0	8.0	1.0	17.5	0.0	0.0	5.0	3.0	1.5	0.0	69.0	2.0
74.65	1158	852	9.0	19.0	17.0	16.0	3.0	2.0	3.0	3.0	0.0	0.0	100.0	0.0
75.68	1148	862	8.0	25.0	17.0	22.5	3.0	3.0	5.0	0.5	0.0	1.0	97.0	2.0
76.71	1138	872	8.0	50.0	5.0	14.5	0.0	2.0	6.0	4.5	3.0	6.0	121.0	3.0
77.63	1128	882	1.0	20.0	6.0	23.5	0.0	1.0	2.0	5.5	2.5	1.0	110.0	3.0
78.48	1118	892	4.0	29.0	16.0	21.0	3.0	1.0	5.0	2.5	1.5	4.0	120.0	0.0
79.37	1108	902	3.0	24.0	7.0	18.5	0.0	2.0	8.0	8.5	2.5	2.0	142.0	1.0
80.31	1098	912	0.0	24.0	21.0	22.5	0.0	1.0	5.0	0.5	0.5	2.0	84.0	2.0

depth cm	A.D corrected by Lead210	Cal years before 2010	SUM DIP	SUM Hap	SUM UNDIFF	1/2 Pinus/2	Picea glauca	Picea mariana	Picea	1/2 Picea/2	1/2 Abies/2	Abies b.	Tsuga cana	Larix
81.06	1088	922	5.0	34.0	12.0	18.0	0.0	1.0	3.0	3.0	1.5	3.0	132.0	1.0
81.81	1078	932	0.0	24.0	16.0	13.5	0.0	0.0	4.0	1.0	0.0	2.0	116.0	0.0
82.67	1068	942	12.0	17.0	11.0	22.5	0.0	1.0	0.0	2.5	0.5	4.0	98.0	1.0
83.74	1058	952	3.0	30.0	11.0	19.0	1.0	2.0	12.0	2.5	4.0	4.0	121.0	4.0
84.52	1048	962	6.0	38.0	12.0	22.0	0.0	1.0	6.0	1.0	1.5	5.0	116.0	1.0
85.41	1038	972	5.0	32.0	11.0	26.5	1.0	0.0	6.0	0.0	1.0	5.0	95.0	3.0
86.5	1028	982	7.0	32.0	8.0	34.5	2.0	1.0	5.0	3.0	2.0	2.0	119.0	0.0
87.39	1018	992	2.0	37.0	23.0	24.5	0.0	0.0	3.0	1.5	0.0	3.0	90.0	1.0
88.33	1008	1002	22.0	21.0	19.0	20.5	1.0	3.0	2.0	2.0	1.0	5.0	140.0	0.0
89.32	998	1012	5.0	25.0	8.0	22.5	3.0	1.0	9.0	2.0	2.0	5.0	108.0	0.0
90.1	988	1022	18.0	27.0	13.0	26.0	1.0	0.0	0.0	2.0	0.0	2.0	91.0	3.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Thuj/Jun	Acer rubrum	Acer saccharum	Acer Pensylvanicum	Acer saccharinum	Acer	Acer negundo	Betula	Cannabis	Carpinus/Ostrya	Carya	Castanea	Celtis
0.65	2007.7	2.3	25.0	10.0	8.0	0.0	0.0	2.0	0.0	88.0	0.0	7.0	0.0	0.0	
1.29	2005.4	5	5.0	4.0	3.0	0.0	0.0	2.0	0.0	93.0	0.0	9.0	0.0	0.0	2.0
1.94	2003.1	7	12.0	2.0	5.0	3.0	0.0	6.0	0.0	110.0	0.0	8.0	0.0	0.0	1.0
2.59	2000.8	9	0.0	4.0	11.0	0.0	0.0	5.0	0.0	120.0	0.0	10.0	2.0	0.0	0.0
3.24	1998.5	12	6.0	7.0	1.0	0.0	0.0	3.0	0.0	104.0	0.0	7.0	1.0	0.0	
3.88	1996.2	14	2.0	1.0	6.0	6.0	0.0	2.0	0.0	145.0	0.0	10.0	0.0	0.0	0.0
4.53	1993.9	16	2.0	2.0	5.0	5.0	0.0	11.0	0.0	135.0	0.0	11.0	1.0	0.0	0.0
5.18	1991.6	18	9.0	14.0	2.0	0.0	0.0	1.0	0.0	94.0	0.0	12.0	2.0	0.0	2.0
5.83	1989.3	21	2.0	8.0	7.0	0.0	0.0	7.0	0.0	110.0	0.0	10.0	1.0	0.0	0.0
6.47	1988	22	4.0	0.0	9.0	3.0	1.0	4.0	0.0	110.0	0.0	3.0	2.0	0.0	0.0
7.2	1978	32	0.0	1.0	1.0	3.0	0.0	9.0	0.0	188.0	0.0	6.0	0.0	1.0	0.0
7.83	1968	42	2.0	3.0	6.0	8.0	0.0	4.0	0.0	148.0	0.0	10.0	0.0	0.0	1.0
8.59	1958	52	5.0	2.0	6.0	6.0	0.0	3.0	0.0	132.0	0.0	11.0	0.0	0.0	1.0
9.28	1948	62	3.0	2.0	5.0	4.0	0.0	5.0	0.0	144.0	2.0	11.0	0.0	0.0	0.0
10.09	1938	72	8.0	0.0	6.0	3.0	1.0	3.0	0.0	132.0	0.0	12.0	2.0	0.0	1.0
10.83	1928	82	7.0	1.0	13.0	5.0	2.0	6.0	0.0	130.0	0.0	6.0	2.0	0.0	0.0
11.57	1918	92	7.0	1.0	6.0	7.0	0.0	9.0	0.0	157.0	0.0	9.0	2.0	0.0	0.0
12.39	1908	102	4.0	2.0	5.0	4.0	1.0	1.0	0.0	144.0	0.0	6.0	4.0	1.0	1.0
13.05	1898	112	4.0	4.0	3.0	0.0	0.0	4.0	0.0	128.0	0.0	8.0	0.0	0.0	0.0
13.87	1888	122	2.0	2.0	3.0	4.0	0.0	3.0	0.0	166.0	0.0	7.0	0.0	1.0	0.0
14.57	1878	132	3.0	1.0	2.0	2.0	0.0	4.0	0.0	160.0	2.0	11.0	0.0	0.0	0.0
15.37	1868	142	8.0	1.0	5.0	2.0	0.0	9.0	0.0	136.0	0.0	2.0	0.0	2.0	0.0
16.14	1858	152	4.0	2.0	10.0	0.0	0.0	2.0	0.0	111.0	0.0	10.0	0.0	0.0	0.0
16.91	1848	162	2.0	3.0	0.0	0.0	0.0	6.0	0.0	195.0	0.0	10.0	1.0	0.0	0.0
17.95	1838	172	3.0	3.0	3.0	3.0	0.0	4.0	0.0	166.0	0.0	5.0	0.0	0.0	0.0
18.89	1828	182	0.0	0.0	0.0	2.0	0.0	7.0	0.0	140.0	0.0	8.0	1.0	0.0	0.0
19.81	1818	192	0.0	0.0	10.0	2.0	0.0	3.0	0.0	152.0	0.0	6.0	1.0	0.0	0.0
20.56	1808	202	6.0	1.0	5.0	9.0	0.0	6.0	0.0	187.0	1.0	8.0	1.0	0.0	0.0
21.5	1798	212	5.0	1.0	1.0	1.0	0.0	4.0	0.0	146.0	0.0	8.0	1.0	0.0	1.0
22.36	1788	222	1.0	0.0	2.0	0.0	0.0	2.0	0.0	175.0	0.0	14.0	2.0	0.0	0.0
23.2	1778	232	1.0	0.0	3.0	4.0	3.0	6.0	0.0	126.0	0.0	5.0	1.0	1.0	0.0
23.86	1768	242	3.0	2.0	2.0	2.0	0.0	6.0	0.0	132.0	0.0	2.0	1.0	1.0	0.0
24.65	1758	252	2.0	1.0	4.0	5.0	0.0	5.0	0.0	159.0	0.0	8.0	3.0	0.0	0.0
25.52	1748	262	1.0	6.0	3.0	0.0	0.0	5.0	0.0	128.0	1.0	6.0	1.0	0.0	0.0
26.33	1738	272	2.0	0.0	3.0	3.0	0.0	5.0	0.0	121.0	0.0	8.0	0.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Thuj/Jun	Acer rubrum	Acer saccharum	Acer Pensylvanicum	Acer saccharinum	Acer	Acer negundo	Betula	Cannabis	Carpinus/Ostrya	Carya	Castanea	Celtis
27.14	1728	282	5.0	0.0	6.0	4.0	0.0	1.0	0.0	154.0	0.0	6.0	0.0	0.0	1.0
28.01	1718	292	2.0	0.0	7.0	1.0	2.0	6.0	0.0	208.0	0.0	11.0	1.0	0.0	0.0
28.77	1708	302	4.0	6.0	1.0	0.0	0.0	7.0	0.0	160.0	0.0	8.0	1.0	0.0	1.0
29.54	1698	312	5.0	0.0	3.0	4.0	0.0	6.0	0.0	154.0	0.0	9.0	0.0	0.0	0.0
30.36	1688	322	8.0	0.0	0.0	4.0	0.0	4.0	0.0	205.0	0.0	10.0	0.0	1.0	0.0
31.23	1678	332	3.0	1.0	2.0	6.0	0.0	5.0	0.0	197.0	0.0	11.0	0.0	0.0	0.0
32.09	1668	342	1.0	3.0	5.0	1.0	2.0	3.0	0.0	188.0	0.0	6.0	3.0	1.0	0.0
32.97	1658	352	6.0	0.0	4.0	8.0	0.0	2.0	0.0	207.0	0.0	6.0	2.0	0.0	0.0
33.78	1648	362	12.0	6.0	2.0	0.0	3.0	4.0	0.0	134.0	1.0	4.0	1.0	0.0	0.0
34.71	1638	372	12.0	3.0	4.0	3.0	1.0	3.0	0.0	162.0	0.0	9.0	2.0	0.0	0.0
35.67	1628	382	2.0	2.0	8.0	6.0	0.0	4.0	0.0	166.0	0.0	14.0	4.0	0.0	1.0
36.66	1618	392	1.0	5.0	7.0	0.0	0.0	6.0	0.0	143.0	0.0	13.0	2.0	0.0	0.0
37.58	1608	402	3.0	1.0	12.0	0.0	0.0	10.0	0.0	117.0	0.0	8.0	2.0	0.0	0.0
38.45	1598	412	5.0	2.0	7.0	9.0	0.0	2.0	0.0	107.0	0.0	5.0	1.0	1.0	0.0
39.52	1588	422	6.0	4.0	4.0	0.0	0.0	3.0	0.0	91.0	0.0	8.0	4.0	1.0	2.0
40.51	1578	432	2.0	2.0	1.0	3.0	0.0	8.0	0.0	99.0	0.0	5.0	3.0	0.0	1.0
41.36	1568	442	3.0	1.0	4.0	1.0	0.0	14.0	0.0	161.0	0.0	8.0	0.0	0.0	0.0
42.18	1558	452	2.0	3.0	15.0	4.0	0.0	2.0	0.0	141.0	0.0	8.0	3.0	1.0	0.0
43.04	1548	462	7.0	9.0	14.0	0.0	0.0	9.0	0.0	220.0	0.0	14.0	4.0	0.0	0.0
43.7	1538	472	2.0	1.0	5.0	7.0	0.0	3.0	0.0	138.0	0.0	7.0	0.0	0.0	0.0
44.54	1528	482	6.0	0.0	4.0	8.0	3.0	6.0	0.0	158.0	0.0	9.0	1.0	0.0	2.0
45.62	1518	492	3.0	3.0	9.0	5.0	2.0	9.0	0.0	159.0	0.0	9.0	3.0	0.0	2.0
46.45	1508	502	2.0	0.0	8.0	9.0	2.0	9.0	0.0	165.0	0.0	8.0	0.0	0.0	0.0
47.31	1498	512	3.0	1.0	8.0	0.0	0.0	11.0	0.0	130.0	0.0	9.0	1.0	0.0	0.0
48.15	1488	522	1.0	3.0	2.0	6.0	1.0	5.0	0.0	137.0	0.0	7.0	2.0	2.0	1.0
48.83	1478	532	3.0	2.0	4.0	4.0	0.0	8.0	0.0	203.0	0.0	3.0	1.0	3.0	2.0
49.57	1468	542	0.0	3.0	9.0	10.0	0.0	10.0	0.0	159.0	0.0	4.0	0.0	0.0	1.0
50.35	1458	552	2.0	0.0	7.0	9.0	0.0	12.0	0.0	180.0	0.0	9.0	1.0	1.0	0.0
51.1	1448	562	2.0	0.0	3.0	5.0	0.0	8.0	0.0	172.0	0.0	7.0	2.0	1.0	0.0
51.77	1438	572	2.0	3.0	7.0	10.0	3.0	5.0	0.0	157.0	0.0	10.0	2.0	0.0	0.0
52.39	1428	582	2.0	1.0	9.0	7.0	3.0	7.0	0.0	191.0	0.0	6.0	2.0	0.0	0.0
52.95	1418	592	15.0	7.0	8.0	0.0	0.0	10.0	0.0	148.0	0.0	9.0	1.0	0.0	0.0
53.61	1408	602	3.0	0.0	10.0	4.0	0.0	4.0	0.0	207.0	0.0	5.0	1.0	0.0	1.0
54.5	1398	612	2.0	0.0	4.0	7.0	0.0	5.0	1.0	224.0	0.0	11.0	0.0	2.0	1.0
55.37	1388	622	0.0	2.0	3.0	5.0	2.0	6.0	0.0	165.0	0.0	9.0	0.0	0.0	1.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Thuj/Jun	Acer rubrum	Acer saccharum	Acer Pensylvanicum	Acer saccharinum	Acer	Acer negundo	Betula	Cannabis	Carpinus/Ostrya	Carya	Castanea	Celtis
56.23	1378	632	1.0	12.0	5.0	0.0	0.0	8.0	0.0	149.0	1.0	9.0	1.0	0.0	0.0
57.09	1368	642	4.0	5.0	2.0	8.0	3.0	8.0	0.0	144.0	0.0	7.0	1.0	0.0	0.0
58.04	1358	652	1.0	0.0	4.0	10.0	0.0	17.0	0.0	172.0	0.0	7.0	1.0	1.0	0.0
58.83	1348	662	2.0	5.0	5.0	4.0	1.0	9.0	0.0	167.0	0.0	8.0	3.0	1.0	1.0
59.73	1338	672	2.0	1.0	8.0	10.0	5.0	9.0	0.0	172.0	1.0	9.0	0.0	0.0	0.0
60.63	1328	682	2.0	7.0	7.0	0.0	0.0	7.0	0.0	165.0	0.0	8.0	0.0	0.0	0.0
61.49	1318	692	3.0	3.0	13.0	4.0	0.0	9.0	0.0	154.0	0.0	7.0	2.0	0.0	0.0
62.33	1308	702	5.0	1.0	5.0	10.0	3.0	8.0	0.0	147.0	0.0	4.0	1.0	1.0	1.0
63.28	1298	712	1.0	1.0	6.0	5.0	0.0	5.0	0.0	153.0	0.0	4.0	0.0	1.0	0.0
64.17	1288	722	3.0	0.0	5.0	6.0	0.0	11.0	0.0	169.0	0.0	3.0	1.0	1.0	0.0
65	1278	732	4.0	4.0	5.0	4.0	0.0	13.0	0.0	132.0	0.0	6.0	0.0	0.0	0.0
65.92	1268	742	5.0	1.0	12.0	12.0	0.0	16.0	0.0	135.0	0.0	1.0	2.0	2.0	0.0
66.66	1258	752	2.0	2.0	5.0	5.0	0.0	5.0	0.0	202.0	1.0	5.0	0.0	0.0	1.0
67.38	1248	762	4.0	0.0	12.0	5.0	0.0	5.0	0.0	186.0	0.0	5.0	0.0	1.0	1.0
68.08	1238	772	1.0	3.0	10.0	9.0	0.0	12.0	0.0	162.0	0.0	7.0	1.0	0.0	1.0
68.74	1228	782	1.0	3.0	9.0	5.0	2.0	12.0	0.0	184.0	0.0	5.0	0.0	0.0	1.0
69.31	1218	792	1.0	14.0	5.0	0.0	0.0	6.0	0.0	124.0	0.0	16.0	0.0	0.0	0.0
70.01	1208	802	2.0	2.0	11.0	7.0	0.0	3.0	0.0	149.0	0.0	7.0	0.0	1.0	0.0
70.94	1198	812	2.0	1.0	7.0	5.0	0.0	17.0	0.0	152.0	0.0	4.0	0.0	0.0	2.0
71.79	1188	822	7.0	26.0	1.0	0.0	0.0	3.0	0.0	134.0	0.0	7.0	0.0	0.0	1.0
72.73	1178	832	0.0	4.0	8.0	5.0	0.0	5.0	0.0	182.0	0.0	7.0	0.0	0.0	0.0
73.63	1168	842	4.0	1.0	7.0	6.0	0.0	5.0	0.0	230.0	0.0	4.0	0.0	0.0	0.0
74.65	1158	852	1.0	10.0	3.0	0.0	0.0	9.0	0.0	168.0	1.0	6.0	0.0	0.0	0.0
75.68	1148	862	2.0	14.0	5.0	0.0	0.0	8.0	0.0	163.0	0.0	6.0	1.0	0.0	0.0
76.71	1138	872	3.0	1.0	10.0	6.0	3.0	8.0	0.0	150.0	0.0	5.0	1.0	1.0	0.0
77.63	1128	882	0.0	3.0	10.0	5.0	0.0	8.0	0.0	159.0	0.0	8.0	1.0	0.0	1.0
78.48	1118	892	1.0	1.0	9.0	7.0	0.0	18.0	0.0	161.0	0.0	7.0	0.0	0.0	0.0
79.37	1108	902	2.0	1.0	7.0	8.0	1.0	9.0	0.0	113.0	0.0	6.0	0.0	0.0	2.0
80.31	1098	912	3.0	2.0	4.0	11.0	0.0	6.0	0.0	152.0	0.0	5.0	0.0	0.0	0.0
81.06	1088	922	1.0	1.0	6.0	5.0	2.0	9.0	0.0	153.0	0.0	6.0	2.0	1.0	0.0
81.81	1078	932	1.0	1.0	5.0	6.0	1.0	2.0	0.0	141.0	0.0	4.0	1.0	0.0	0.0
82.67	1068	942	7.0	0.0	2.0	3.0	0.0	11.0	0.0	128.0	0.0	6.0	2.0	0.0	0.0
83.74	1058	952	2.0	4.0	4.0	3.0	0.0	11.0	0.0	124.0	0.0	5.0	1.0	0.0	0.0
84.52	1048	962	2.0	3.0	7.0	11.0	0.0	8.0	0.0	127.0	0.0	7.0	1.0	0.0	1.0
85.41	1038	972	0.0	4.0	9.0	0.0	0.0	11.0	0.0	110.0	0.0	7.0	3.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Thuj/Jun	Acer rubrum	Acer saccharum	Acer Pensylvanicum	Acer saccharinum	Acer	Acer negundo	Betula	Cannabis	Carpinus/Ostrya	Carya	Castanea	Celtis
86.5	1028	982	3.0	0.0	13.0	1.0	0.0	9.0	0.0	132.0	0.0	4.0	2.0	0.0	1.0
87.39	1018	992	1.0	1.0	4.0	8.0	0.0	10.0	0.0	137.0	0.0	11.0	2.0	0.0	0.0
88.33	1008	1002	1.0	7.0	14.0	0.0	0.0	10.0	0.0	155.0	0.0	14.0	1.0	0.0	0.0
89.32	998	1012	3.0	0.0	8.0	7.0	0.0	13.0	0.0	151.0	0.0	7.0	1.0	0.0	0.0
90.1	988	1022	7.0	6.0	11.0	0.0	0.0	5.0	0.0	115.0	0.0	13.0	0.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Fagus	Fraxinus 4c	Frax 3c	Juglans c	Juglans n	Nyssaceae	Populus	Quercus	Tilia	Ulmus	Urtica	Platanus	Alnus crispa
0.65	2007.7	2.3	16.0	4.0	4.0	2.0	0.0	0.0	8.0	9.0	0.0	5.0	0.0	0.0	0.0
1.29	2005.4	5	8.0	6.0	1.0	0.0	0.0	0.0	4.0	27.0	3.0	3.0	1.0	2.0	5.0
1.94	2003.1	7	6.0	5.0	2.0	1.0	0.0	0.0	5.0	28.0	1.0	3.0	0.0	5.0	3.0
2.59	2000.8	9	12.0	3.0	1.0	0.0	0.0	0.0	6.0	29.0	1.0	6.0	0.0	6.0	2.0
3.24	1998.5	12	10.0	4.0	3.0	2.0	0.0	0.0	7.0	24.0	0.0	5.0	0.0	0.0	1.0
3.88	1996.2	14	11.0	4.0	4.0	1.0	1.0	0.0	5.0	31.0	0.0	5.0	0.0	4.0	2.0
4.53	1993.9	16	10.0	1.0	3.0	0.0	0.0	0.0	2.0	39.0	1.0	6.0	0.0	2.0	2.0
5.18	1991.6	18	15.0	0.0	3.0	3.0	0.0	0.0	7.0	14.0	1.0	5.0	0.0	0.0	2.0
5.83	1989.3	21	15.0	2.0	4.0	0.0	0.0	0.0	1.0	23.0	0.0	3.0	0.0	0.0	1.0
6.47	1988	22	15.0	5.0	1.0	0.0	0.0	1.0	3.0	24.0	0.0	20.0	0.0	1.0	3.0
7.2	1978	32	9.0	9.0	2.0	1.0	0.0	5.0	2.0	27.0	1.0	12.0	0.0	1.0	0.0
7.83	1968	42	12.0	3.0	1.0	1.0	0.0	2.0	2.0	27.0	0.0	8.0	0.0	0.0	4.0
8.59	1958	52	12.0	1.0	4.0	2.0	0.0	0.0	3.0	23.0	1.0	6.0	1.0	0.0	3.0
9.28	1948	62	8.0	1.0	3.0	1.0	0.0	0.0	2.0	24.0	0.0	15.0	0.0	0.0	3.0
10.09	1938	72	11.0	6.0	2.0	1.0	0.0	2.0	1.0	29.0	1.0	19.0	0.0	2.0	0.0
10.83	1928	82	13.0	4.0	3.0	0.0	0.0	1.0	3.0	23.0	1.0	11.0	0.0	0.0	4.0
11.57	1918	92	8.0	2.0	2.0	1.0	0.0	0.0	4.0	29.0	0.0	7.0	1.0	4.0	3.0
12.39	1908	102	13.0	2.0	2.0	2.0	0.0	1.0	6.0	15.0	0.0	12.0	1.0	1.0	7.0
13.05	1898	112	16.0	2.0	2.0	7.0	0.0	0.0	9.0	11.0	0.0	6.0	1.0	0.0	3.0
13.87	1888	122	12.0	2.0	7.0	3.0	0.0	2.0	6.0	13.0	2.0	6.0	0.0	0.0	4.0
14.57	1878	132	15.0	3.0	1.0	3.0	0.0	0.0	7.0	15.0	1.0	12.0	1.0	1.0	4.0
15.37	1868	142	15.0	1.0	2.0	2.0	0.0	1.0	10.0	19.0	0.0	15.0	0.0	0.0	3.0
16.14	1858	152	10.0	3.0	2.0	2.0	0.0	0.0	3.0	7.0	0.0	7.0	1.0	1.0	1.0
16.91	1848	162	14.0	0.0	3.0	2.0	1.0	0.0	5.0	9.0	1.0	11.0	0.0	0.0	0.0
17.95	1838	172	18.0	2.0	6.0	3.0	0.0	0.0	3.0	18.0	6.0	9.0	0.0	0.0	9.0
18.89	1828	182	13.0	2.0	11.0	6.0	0.0	0.0	5.0	17.0	2.0	4.0	0.0	1.0	2.0
19.81	1818	192	13.0	5.0	5.0	3.0	0.0	3.0	0.0	20.0	4.0	8.0	1.0	0.0	1.0
20.56	1808	202	27.0	2.0	1.0	1.0	0.0	3.0	6.0	7.0	1.0	9.0	0.0	0.0	1.0
21.5	1798	212	17.0	2.0	7.0	2.0	0.0	3.0	7.0	15.0	2.0	8.0	1.0	2.0	0.0
22.36	1788	222	9.0	0.0	3.0	1.0	0.0	0.0	2.0	11.0	1.0	3.0	1.0	1.0	4.0
23.2	1778	232	28.0	3.0	5.0	3.0	0.0	0.0	2.0	12.0	0.0	5.0	0.0	0.0	3.0
23.86	1768	242	18.0	4.0	11.0	2.0	0.0	0.0	2.0	16.0	1.0	8.0	0.0	0.0	2.0
24.65	1758	252	21.0	3.0	6.0	2.0	0.0	2.0	2.0	11.0	2.0	12.0	0.0	3.0	2.0
25.52	1748	262	14.0	1.0	7.0	3.0	0.0	0.0	0.0	16.0	1.0	6.0	1.0	1.0	1.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Fagus	Fraxinus 4c	Frax 3c	Juglans c	Juglans n	Nyssaceae	Populus	Quercus	Tilia	Ulmus	Urtica	Platanus	Alnus crispa
26.33	1738	272	14.0	4.0	2.0	2.0	0.0	0.0	2.0	16.0	3.0	15.0	0.0	1.0	2.0
27.14	1728	282	11.0	1.0	5.0	4.0	0.0	0.0	5.0	28.0	0.0	9.0	0.0	3.0	1.0
28.01	1718	292	8.0	5.0	6.0	4.0	1.0	1.0	3.0	19.0	1.0	19.0	0.0	2.0	2.0
28.77	1708	302	6.0	1.0	2.0	1.0	0.0	0.0	4.0	16.0	2.0	7.0	1.0	2.0	4.0
29.54	1698	312	23.0	8.0	8.0	1.0	0.0	0.0	3.0	20.0	3.0	13.0	1.0	3.0	2.0
30.36	1688	322	11.0	5.0	4.0	5.0	0.0	0.0	5.0	22.0	3.0	17.0	0.0	4.0	3.0
31.23	1678	332	17.0	5.0	4.0	4.0	0.0	0.0	6.0	16.0	1.0	11.0	1.0	1.0	1.0
32.09	1668	342	14.0	5.0	9.0	4.0	0.0	0.0	7.0	16.0	1.0	14.0	0.0	0.0	1.0
32.97	1658	352	13.0	4.0	6.0	6.0	0.0	0.0	12.0	24.0	2.0	5.0	0.0	2.0	4.0
33.78	1648	362	12.0	3.0	10.0	2.0	0.0	0.0	6.0	20.0	0.0	16.0	5.0	1.0	1.0
34.71	1638	372	15.0	6.0	3.0	9.0	0.0	0.0	12.0	16.0	0.0	13.0	0.0	2.0	2.0
35.67	1628	382	14.0	6.0	12.0	6.0	0.0	4.0	5.0	36.0	0.0	15.0	0.0	0.0	3.0
36.66	1618	392	4.0	4.0	1.0	5.0	0.0	0.0	4.0	28.0	1.0	12.0	0.0	0.0	7.0
37.58	1608	402	9.0	1.0	8.0	5.0	0.0	0.0	7.0	21.0	1.0	16.0	0.0	2.0	3.0
38.45	1598	412	10.0	1.0	2.0	5.0	0.0	0.0	4.0	30.0	3.0	11.0	0.0	2.0	4.0
39.52	1588	422	7.0	1.0	4.0	1.0	0.0	0.0	9.0	20.0	1.0	10.0	0.0	2.0	3.0
40.51	1578	432	7.0	6.0	10.0	1.0	0.0	0.0	1.0	20.0	1.0	10.0	1.0	0.0	2.0
41.36	1568	442	46.0	2.0	11.0	1.0	1.0	0.0	5.0	19.0	1.0	7.0	0.0	2.0	1.0
42.18	1558	452	37.0	0.0	4.0	5.0	0.0	4.0	1.0	13.0	4.0	19.0	0.0	2.0	1.0
43.04	1548	462	49.0	4.0	15.0	1.0	0.0	0.0	4.0	18.0	7.0	15.0	0.0	2.0	0.0
43.7	1538	472	24.0	9.0	4.0	3.0	0.0	3.0	0.0	15.0	1.0	15.0	0.0	3.0	1.0
44.54	1528	482	49.0	1.0	4.0	3.0	0.0	6.0	3.0	23.0	2.0	18.0	0.0	0.0	3.0
45.62	1518	492	44.0	7.0	7.0	1.0	0.0	1.0	2.0	16.0	2.0	18.0	1.0	0.0	1.0
46.45	1508	502	33.0	2.0	6.0	1.0	0.0	4.0	2.0	27.0	1.0	9.0	0.0	1.0	1.0
47.31	1498	512	30.0	2.0	7.0	4.0	0.0	0.0	4.0	10.0	1.0	21.0	2.0	6.0	4.0
48.15	1488	522	22.0	1.0	12.0	3.0	0.0	0.0	4.0	13.0	3.0	17.0	0.0	2.0	1.0
48.83	1478	532	32.0	3.0	3.0	3.0	0.0	3.0	2.0	9.0	3.0	11.0	0.0	0.0	0.0
49.57	1468	542	54.0	4.0	6.0	4.0	0.0	0.0	3.0	28.0	3.0	16.0	0.0	0.0	0.0
50.35	1458	552	50.0	4.0	4.0	1.0	0.0	4.0	3.0	23.0	3.0	26.0	0.0	3.0	5.0
51.1	1448	562	36.0	4.0	7.0	3.0	0.0	7.0	1.0	19.0	2.0	17.0	0.0	1.0	1.0
51.77	1438	572	36.0	6.0	8.0	2.0	0.0	0.0	1.0	16.0	2.0	14.0	1.0	1.0	1.0
52.39	1428	582	35.0	1.0	11.0	2.0	0.0	5.0	1.0	9.0	4.0	13.0	1.0	0.0	0.0
52.95	1418	592	60.0	2.0	10.0	3.0	0.0	0.0	10.0	15.0	2.0	7.0	0.0	0.0	0.0
53.61	1408	602	32.0	1.0	6.0	4.0	0.0	2.0	2.0	13.0	1.0	12.0	0.0	2.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Fagus	Fraxinus 4c	Frax 3c	Juglans c	Juglans n	Nyssaceae	Populus	Quercus	Tilia	Ulmus	Urtica	Platanus	Alnus crispa
54.5	1398	612	29.0	1.0	11.0	6.0	0.0	0.0	2.0	15.0	0.0	13.0	0.0	1.0	1.0
55.37	1388	622	35.0	6.0	9.0	1.0	0.0	5.0	1.0	17.0	3.0	13.0	1.0	1.0	1.0
56.23	1378	632	41.0	2.0	5.0	2.0	0.0	0.0	5.0	18.0	3.0	13.0	2.0	4.0	1.0
57.09	1368	642	36.0	7.0	8.0	1.0	1.0	3.0	6.0	9.0	3.0	14.0	0.0	1.0	2.0
58.04	1358	652	42.0	3.0	8.0	1.0	0.0	1.0	1.0	13.0	8.0	4.0	0.0	3.0	1.0
58.83	1348	662	34.0	4.0	7.0	2.0	2.0	2.0	3.0	16.0	0.0	13.0	0.0	5.0	1.0
59.73	1338	672	42.0	3.0	11.0	0.0	1.0	0.0	5.0	18.0	5.0	24.0	0.0	2.0	1.0
60.63	1328	682	22.0	3.0	11.0	1.0	0.0	0.0	4.0	14.0	1.0	16.0	2.0	3.0	1.0
61.49	1318	692	42.0	4.0	7.0	1.0	0.0	3.0	5.0	7.0	2.0	21.0	1.0	3.0	2.0
62.33	1308	702	43.0	4.0	7.0	0.0	0.0	4.0	6.0	13.0	2.0	16.0	0.0	1.0	0.0
63.28	1298	712	40.0	0.0	7.0	0.0	0.0	6.0	6.0	10.0	3.0	14.0	0.0	3.0	1.0
64.17	1288	722	39.0	4.0	9.0	1.0	0.0	0.0	4.0	26.0	3.0	5.0	0.0	2.0	2.0
65	1278	732	62.0	3.0	7.0	2.0	0.0	0.0	2.0	9.0	2.0	14.0	0.0	2.0	2.0
65.92	1268	742	50.0	2.0	10.0	3.0	0.0	0.0	8.0	20.0	1.0	16.0	0.0	5.0	1.0
66.66	1258	752	43.0	1.0	6.0	3.0	0.0	0.0	2.0	18.0	2.0	11.0	0.0	5.0	0.0
67.38	1248	762	57.0	1.0	11.0	1.0	0.0	2.0	2.0	9.0	2.0	22.0	1.0	2.0	1.0
68.08	1238	772	62.0	0.0	2.0	1.0	0.0	1.0	0.0	23.0	3.0	17.0	0.0	1.0	0.0
68.74	1228	782	56.0	0.0	8.0	1.0	0.0	4.0	1.0	23.0	4.0	10.0	0.0	1.0	1.0
69.31	1218	792	23.0	2.0	0.0	0.0	0.0	0.0	2.0	8.0	0.0	10.0	2.0	1.0	0.0
70.01	1208	802	48.0	7.0	4.0	0.0	1.0	3.0	1.0	11.0	1.0	17.0	0.0	0.0	0.0
70.94	1198	812	46.0	6.0	6.0	5.0	0.0	1.0	4.0	21.0	2.0	13.0	0.0	3.0	2.0
71.79	1188	822	51.0	1.0	4.0	2.0	0.0	0.0	5.0	11.0	2.0	16.0	0.0	0.0	0.0
72.73	1178	832	44.0	3.0	4.0	0.0	0.0	5.0	2.0	8.0	3.0	17.0	1.0	0.0	3.0
73.63	1168	842	38.0	2.0	11.0	0.0	1.0	0.0	2.0	11.0	3.0	15.0	0.0	1.0	1.0
74.65	1158	852	57.0	3.0	6.0	1.0	0.0	0.0	2.0	13.0	4.0	9.0	1.0	4.0	1.0
75.68	1148	862	52.0	1.0	2.0	2.0	0.0	0.0	2.0	20.0	0.0	15.0	4.0	3.0	1.0
76.71	1138	872	52.0	3.0	13.0	0.0	0.0	2.0	2.0	17.0	0.0	12.0	0.0	2.0	0.0
77.63	1128	882	59.0	7.0	5.0	1.0	0.0	4.0	1.0	19.0	6.0	6.0	1.0	0.0	1.0
78.48	1118	892	57.0	0.0	4.0	2.0	0.0	1.0	1.0	13.0	2.0	9.0	1.0	0.0	0.0
79.37	1108	902	58.0	3.0	7.0	0.0	0.0	4.0	1.0	11.0	4.0	16.0	0.0	2.0	0.0
80.31	1098	912	53.0	2.0	5.0	0.0	0.0	0.0	2.0	14.0	5.0	18.0	0.0	2.0	0.0
81.06	1088	922	45.0	1.0	5.0	0.0	0.0	3.0	0.0	13.0	0.0	15.0	0.0	0.0	1.0
81.81	1078	932	45.0	2.0	4.0	1.0	0.0	0.0	2.0	15.0	1.0	17.0	0.0	4.0	1.0
82.67	1068	942	56.0	3.0	6.0	3.0	0.0	0.0	1.0	10.0	0.0	15.0	0.0	3.0	2.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Fagus	Fraxinus 4c	Frax 3c	Juglans c	Juglans n	Nyssaceae	Populus	Quercus	Tilia	Ulmus	Urtica	Platanus	Alnus crispa
83.74	1058	952	61.0	5.0	12.0	5.0	0.0	3.0	1.0	7.0	6.0	26.0	1.0	1.0	0.0
84.52	1048	962	52.0	1.0	9.0	0.0	0.0	3.0	0.0	23.0	1.0	12.0	0.0	2.0	2.0
85.41	1038	972	76.0	3.0	11.0	1.0	0.0	0.0	3.0	9.0	2.0	11.0	0.0	1.0	1.0
86.5	1028	982	58.0	2.0	13.0	2.0	0.0	5.0	4.0	19.0	0.0	17.0	1.0	0.0	0.0
87.39	1018	992	60.0	5.0	5.0	3.0	0.0	1.0	0.0	18.0	0.0	13.0	0.0	1.0	0.0
88.33	1008	1002	33.0	3.0	2.0	5.0	0.0	0.0	1.0	16.0	0.0	18.0	4.0	1.0	1.0
89.32	998	1012	65.0	1.0	4.0	2.0	0.0	0.0	4.0	11.0	1.0	16.0	0.0	1.0	1.0
90.1	988	1022	65.0	1.0	4.0	1.0	0.0	0.0	6.0	15.0	2.0	11.0	1.0	0.0	1.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Alnus rugosa	Corylus	Myrica	Comptonia	Salicaceae	Salix	Shepherdia c	Taxus canadensis	SUM Total	Aster-Tub	Aster-Ligul	Artemisia	Ambrosia	Cyperaceae	cf. Digitalis
0.65	2007.7	2.3	22.0	5.0	2.0	0.0	0.0	0.0	0.0	0.0	350.0	3.0	0.0	1.0	26.0	2.0	0.0
1.29	2005.4	5	9.0	12.0	4.0	0.0	0.0	5.0	0.0	0.0	390.5	4.0	0.0	0.0	17.0	1.0	0.0
1.94	2003.1	7	18.0	2.0	2.0	0.0	0.0	1.0	0.0	0.0	410.5	7.0	0.0	0.0	15.0	1.0	0.0
2.59	2000.8	9	16.0	19.0	5.0	0.0	0.0	0.0	0.0	0.0	413.0	2.0	0.0	0.0	14.0	0.0	0.0
3.24	1998.5	12	16.0	3.0	0.0	0.0	0.0	1.0	1.0	0.0	374.0	3.0	0.0	1.0	16.0	2.0	0.0
3.88	1996.2	14	13.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	415.5	5.0	0.0	0.0	22.0	2.0	0.0
4.53	1993.9	16	24.0	3.0	1.0	0.0	0.0	3.0	0.0	0.0	423.0	4.0	0.0	1.0	18.0	0.0	0.0
5.18	1991.6	18	23.0	1.0	3.0	0.0	0.0	2.0	0.0	0.0	357.0	2.0	0.0	0.0	11.0	2.0	0.0
5.83	1989.3	21	27.0	9.0	3.0	0.0	0.0	3.0	0.0	0.0	404.0	1.0	0.0	1.0	15.0	0.0	0.0
6.47	1988	22	20.0	4.0	1.0	0.0	0.0	2.0	0.0	0.0	398.0	7.0	0.0	2.0	21.0	4.0	0.0
7.2	1978	32	19.0	5.0	0.0	0.0	0.0	5.0	0.0	0.0	463.5	3.0	0.0	3.0	23.0	0.0	0.0
7.83	1968	42	14.0	4.0	1.0	1.0	0.0	5.0	0.0	0.0	410.0	2.0	1.0	1.0	29.0	0.0	0.0
8.59	1958	52	17.0	2.0	1.0	0.0	0.0	4.0	0.0	0.0	377.5	3.0	0.0	1.0	34.0	0.0	0.0
9.28	1948	62	14.0	3.0	2.0	0.0	0.0	3.0	0.0	0.0	391.0	0.0	0.0	0.0	29.0	0.0	0.0
10.09	1938	72	15.0	0.0	2.0	1.0	0.0	3.0	0.0	0.0	370.5	5.0	0.0	0.0	32.0	1.0	0.0
10.83	1928	82	19.0	4.0	5.0	0.0	0.0	4.0	0.0	0.0	373.0	3.0	3.0	0.0	59.0	0.0	0.0
11.57	1918	92	14.0	4.0	0.0	0.0	0.0	1.0	0.0	0.0	374.5	5.0	0.0	2.0	54.0	0.0	0.0
12.39	1908	102	20.0	3.0	1.0	1.0	0.0	2.0	0.0	0.0	372.0	1.0	0.0	2.0	47.0	1.0	0.0
13.05	1898	112	18.0	8.0	6.0	0.0	0.0	3.0	0.0	0.0	327.0	3.0	0.0	1.0	37.0	0.0	0.0
13.87	1888	122	25.0	4.0	3.0	0.0	0.0	2.0	0.0	0.0	372.0	1.0	0.0	1.0	36.0	2.0	0.0
14.57	1878	132	17.0	0.0	1.0	1.0	0.0	4.0	0.0	0.0	373.5	1.0	0.0	1.0	41.0	1.0	0.0
15.37	1868	142	15.0	1.0	1.0	0.0	0.0	4.0	0.0	0.0	367.5	2.0	0.0	3.0	39.0	0.0	0.0
16.14	1858	152	32.0	4.0	4.0	0.0	0.0	6.0	0.0	0.0	333.0	1.0	0.0	0.0	39.0	0.0	0.0
16.91	1848	162	29.0	2.0	0.0	2.0	0.0	9.0	0.0	0.0	419.5	1.0	0.0	2.0	32.0	1.0	0.0
17.95	1838	172	27.0	3.0	1.0	0.0	0.0	4.0	0.0	0.0	467.5	1.0	0.0	0.0	26.0	1.0	0.0
18.89	1828	182	22.0	5.0	1.0	0.0	0.0	3.0	0.0	0.0	436.0	0.0	0.0	3.0	13.0	0.0	0.0
19.81	1818	192	14.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	454.5	1.0	0.0	1.0	11.0	0.0	0.0
20.56	1808	202	11.0	2.0	1.0	0.0	0.0	0.0	0.0	0.0	488.5	0.0	0.0	0.0	2.0	0.0	0.0
21.5	1798	212	17.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	441.0	1.0	0.0	2.0	2.0	0.0	0.0
22.36	1788	222	5.0	5.0	6.0	0.0	0.0	0.0	0.0	0.0	455.5	0.0	0.0	0.0	1.0	0.0	0.0
23.2	1778	232	10.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	486.5	1.0	0.0	0.0	4.0	1.0	0.0
23.86	1768	242	12.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0	534.0	0.0	0.0	0.0	3.0	2.0	0.0
24.65	1758	252	19.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	535.0	1.0	0.0	1.0	1.0	1.0	0.0
25.52	1748	262	4.0	5.0	1.0	0.0	0.0	2.0	1.0	0.0	461.0	0.0	0.0	1.0	1.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Alnus rugosa	Corylus	Myrica	Comptonia	Salicaceae	Salix	Shepherdia c	Taxus canadensis	SUM Total	Aster-Tub	Aster-Ligul	Artemisia	Ambrosia	Cyperaceae	cf. Digitalis
26.33	1738	272	11.0	3.0	1.0	0.0	0.0	2.0	0.0	0.0	516.0	0.0	0.0	1.0	1.0	0.0	0.0
27.14	1728	282	11.0	2.0	2.0	0.0	0.0	3.0	0.0	0.0	495.0	0.0	0.0	1.0	0.0	0.0	0.0
28.01	1718	292	16.0	3.0	1.0	0.0	0.0	0.0	0.0	0.0	499.5	1.0	0.0	1.0	1.0	2.0	0.0
28.77	1708	302	9.0	9.0	2.0	0.0	0.0	0.0	1.0	0.0	414.5	0.0	0.0	0.0	0.0	0.0	0.0
29.54	1698	312	14.0	2.0	6.0	0.0	0.0	2.0	0.0	0.0	501.5	1.0	0.0	1.0	2.0	1.0	0.0
30.36	1688	322	9.0	1.0	4.0	0.0	0.0	4.0	0.0	0.0	497.5	0.0	0.0	2.0	1.0	0.0	0.0
31.23	1678	332	10.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	446.0	0.0	0.0	0.0	0.0	1.0	0.0
32.09	1668	342	14.0	1.0	2.0	0.0	0.0	1.0	0.0	0.0	473.0	0.0	0.0	1.0	1.0	1.0	0.0
32.97	1658	352	20.0	3.0	1.0	0.0	0.0	2.0	0.0	0.0	496.0	1.0	0.0	0.0	1.0	0.0	0.0
33.78	1648	362	11.0	10.0	6.0	0.0	0.0	1.0	1.0	0.0	459.5	0.0	0.0	0.0	0.0	1.0	0.0
34.71	1638	372	12.0	5.0	1.0	0.0	0.0	2.0	0.0	0.0	467.0	3.0	0.0	2.0	1.0	0.0	0.0
35.67	1628	382	18.0	2.0	0.0	0.0	0.0	4.0	0.0	0.0	530.0	4.0	0.0	2.0	0.0	1.0	0.0
36.66	1618	392	16.0	10.0	5.0	0.0	0.0	14.0	0.0	0.0	433.5	2.0	0.0	1.0	1.0	2.0	0.0
37.58	1608	402	18.0	0.0	1.0	0.0	0.0	21.0	0.0	0.0	501.0	2.0	0.0	3.0	0.0	4.0	0.0
38.45	1598	412	29.0	5.0	2.0	0.0	0.0	3.0	0.0	0.0	488.0	3.0	0.0	0.0	2.0	1.0	0.0
39.52	1588	422	16.0	1.0	0.0	0.0	0.0	5.0	0.0	0.0	458.5	0.0	0.0	1.0	2.0	0.0	0.0
40.51	1578	432	9.0	2.0	0.0	0.0	0.0	4.0	0.0	0.0	422.0	1.0	0.0	1.0	1.0	0.0	0.0
41.36	1568	442	4.0	3.0	2.0	0.0	0.0	1.0	0.0	0.0	491.0	0.0	0.0	0.0	1.0	0.0	0.0
42.18	1558	452	4.0	4.0	1.0	0.0	0.0	0.0	0.0	0.0	457.5	0.0	0.0	0.0	0.0	1.0	0.0
43.04	1548	462	9.0	4.0	3.0	0.0	0.0	2.0	0.0	0.0	635.0	0.0	0.0	1.0	1.0	0.0	0.0
43.7	1538	472	4.0	3.0	1.0	0.0	0.0	1.0	0.0	0.0	462.5	1.0	0.0	2.0	2.0	1.0	0.0
44.54	1528	482	8.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	518.5	1.0	0.0	1.0	0.0	0.0	0.0
45.62	1518	492	4.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0	513.0	0.0	0.0	1.0	0.0	1.0	0.0
46.45	1508	502	4.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	473.0	0.0	0.0	1.0	1.0	2.0	0.0
47.31	1498	512	5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	446.0	1.0	0.0	1.0	1.0	2.0	0.0
48.15	1488	522	10.0	2.0	1.0	0.0	0.0	1.0	0.0	0.0	509.0	1.0	0.0	2.0	1.0	0.0	0.0
48.83	1478	532	3.0	2.0	0.0	0.0	0.0	2.0	0.0	0.0	486.0	0.0	0.0	2.0	0.0	0.0	0.0
49.57	1468	542	11.0	3.0	1.0	1.0	0.0	0.0	0.0	0.0	562.5	2.0	0.0	3.0	0.0	1.0	0.0
50.35	1458	552	7.0	1.0	2.0	0.0	0.0	2.0	0.0	0.0	535.0	2.0	0.0	1.0	0.0	0.0	0.0
51.1	1448	562	8.0	2.0	1.0	0.0	0.0	1.0	0.0	0.0	467.0	2.0	0.0	1.0	2.0	0.0	0.0
51.77	1438	572	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	487.0	2.0	0.0	0.0	2.0	0.0	0.0
52.39	1428	582	5.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	550.5	1.0	0.0	0.0	1.0	1.0	0.0
52.95	1418	592	16.0	4.0	2.0	0.0	0.0	2.0	0.0	0.0	486.0	1.0	0.0	0.0	3.0	0.0	0.0
53.61	1408	602	6.0	2.0	0.0	1.0	0.0	1.0	0.0	0.0	440.0	0.0	0.0	0.0	1.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Alnus rugosa	Corylus	Myrica	Comptonia	Salicaceae	Salix	Shepherdia c	Taxus canadensis	SUM Total	Aster-Tub	Aster-Ligul	Artemisia	Ambrosia	Cyperaceae	cf. Digitalis
54.5	1398	612	8.0	2.0	0.0	3.0	0.0	2.0	0.0	0.0	524.5	1.0	0.0	0.0	1.0	0.0	0.0
55.37	1388	622	10.0	3.0	1.0	1.0	0.0	4.0	0.0	0.0	498.0	3.0	0.0	0.0	1.0	0.0	0.0
56.23	1378	632	8.0	15.0	3.0	0.0	0.0	2.0	0.0	0.0	488.0	0.0	0.0	1.0	0.0	0.0	0.0
57.09	1368	642	8.0	3.0	2.0	0.0	0.0	2.0	0.0	0.0	447.0	1.0	0.0	1.0	1.0	1.0	0.0
58.04	1358	652	8.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	461.0	1.0	0.0	0.0	0.0	0.0	0.0
58.83	1348	662	10.0	2.0	1.0	0.0	0.0	1.0	0.0	0.0	523.5	0.0	0.0	0.0	2.0	0.0	0.0
59.73	1338	672	13.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	517.5	1.0	0.0	1.0	2.0	0.0	0.0
60.63	1328	682	2.0	6.0	6.0	0.0	0.0	0.0	0.0	0.0	422.5	1.0	0.0	0.0	0.0	0.0	0.0
61.49	1318	692	4.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	465.0	2.0	0.0	0.0	0.0	1.0	0.0
62.33	1308	702	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	452.9	0.0	0.0	0.0	1.0	0.0	0.0
63.28	1298	712	2.0	1.0	2.0	0.0	0.0	1.0	0.0	1.0	438.0	0.0	0.0	0.0	1.0	2.0	0.0
64.17	1288	722	8.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	496.5	0.0	0.0	1.0	1.0	1.0	0.0
65	1278	732	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	496.5	1.0	0.0	1.0	1.0	0.0	0.0
65.92	1268	742	3.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	523.0	0.0	0.0	4.0	0.0	1.0	0.0
66.66	1258	752	4.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	480.5	1.0	0.0	1.0	1.0	1.0	0.0
67.38	1248	762	2.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0	502.0	0.0	0.0	0.0	0.0	2.0	0.0
68.08	1238	772	5.0	3.0	0.0	1.0	0.0	1.0	0.0	0.0	482.5	0.0	0.0	0.0	0.0	0.0	0.0
68.74	1228	782	6.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	492.5	0.0	0.0	2.0	0.0	1.0	0.0
69.31	1218	792	3.0	6.0	4.0	0.0	0.0	0.0	0.0	0.0	487.5	1.0	0.0	0.0	1.0	0.0	0.0
70.01	1208	802	3.0	1.0	0.0	1.0	0.0	1.0	0.0	0.0	445.0	1.0	0.0	0.0	0.0	2.0	0.0
70.94	1198	812	5.0	2.0	0.0	0.0	0.0	1.0	0.0	0.0	478.5	0.0	0.0	1.0	0.0	0.0	0.0
71.79	1188	822	8.0	2.0	1.0	0.0	0.0	3.0	0.0	0.0	434.5	0.0	0.0	0.0	0.0	1.0	0.0
72.73	1178	832	6.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	462.0	0.0	0.0	0.0	4.0	2.0	0.0
73.63	1168	842	3.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0	458.0	1.0	0.0	0.0	0.0	0.0	0.0
74.65	1158	852	6.0	9.0	6.0	0.0	0.0	2.0	0.0	0.0	494.0	0.0	0.0	0.0	0.0	0.0	0.0
75.68	1148	862	10.0	10.0	5.0	0.0	0.0	2.0	0.0	0.0	512.0	0.0	0.0	0.0	1.0	1.0	0.0
76.71	1138	872	8.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	525.0	0.0	0.0	2.0	1.0	0.0	0.0
77.63	1128	882	7.0	1.0	3.0	0.0	0.0	1.0	0.0	0.0	492.5	1.0	0.0	1.0	1.0	0.0	0.0
78.48	1118	892	9.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	511.0	1.0	0.0	1.0	0.0	0.0	0.0
79.37	1108	902	8.0	1.0	2.0	2.0	0.0	0.0	0.0	0.0	486.5	0.0	0.0	0.0	0.0	0.0	0.0
80.31	1098	912	6.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	454.5	0.0	0.0	1.0	3.0	0.0	0.0
81.06	1088	922	10.0	4.0	1.0	0.0	0.0	0.0	0.0	0.0	497.5	0.0	0.0	0.0	0.0	0.0	0.0
81.81	1078	932	5.0	1.0	0.0	0.0	0.0	2.0	0.0	0.0	438.5	1.0	0.0	1.0	1.0	0.0	0.0
82.67	1068	942	5.0	5.0	5.0	0.0	0.0	0.0	0.0	0.0	442.5	0.0	0.0	1.0	0.0	2.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Alnus rugosa	Corylus	Myrica	Comptonia	Salicaceae	Salix	Shepherdia c	Taxus canadensis	SUM Total	Aster-Tub	Aster-Ligul	Artemisia	Ambrosia	Cyperaceae	cf. Digitalis
83.74	1058	952	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	508.5	0.0	0.0	0.0	0.0	0.0	0.0
84.52	1048	962	11.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	494.5	1.0	0.0	1.0	0.0	0.0	0.0
85.41	1038	972	3.0	3.0	1.0	0.0	0.0	0.0	0.0	0.0	454.5	0.0	0.0	2.0	3.0	0.0	0.0
86.5	1028	982	8.0	1.0	0.0	1.0	0.0	0.0	0.0	1.0	511.5	0.0	0.0	0.0	2.0	2.0	0.0
87.39	1018	992	5.0	2.0	2.0	0.0	0.0	1.0	0.0	0.0	475.0	1.0	0.0	1.0	0.0	0.0	0.0
88.33	1008	1002	4.0	0.0	2.0	0.0	0.0	6.0	0.0	0.0	534.5	1.0	0.0	0.0	1.0	0.0	0.0
89.32	998	1012	1.0	1.0	0.0	0.0	0.0	2.0	0.0	0.0	490.5	0.0	0.0	1.0	1.0	3.0	0.0
90.1	988	1022	3.0	0.0	1.0	0.0	0.0	3.0	0.0	0.0	454.0	1.0	0.0	1.0	0.0	1.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Galium	Humulus	Poaceae	Zea mays	Anacardiaceae(Rhus)	Aquifoliaceae	Araceae	Balsaminaceae	cf.Campanulaceae	Caprifoliaceae	Caryophyllaceae	Chenopodiaceae	Cistaceae	Cornaceae	Cruciferae	Eleagnaceae	Ephedraceae	Eriocaulonaceae
0.65	2007.7	2.3	0.0	2.0	21.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.29	2005.4	5	0.0	3.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	4.0	0.0	0.0	0.0
1.94	2003.1	7	0.0	0.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	1.0	0.0	0.0	0.0
2.59	2000.8	9	0.0	1.0	22.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0
3.24	1998.5	12	0.0	7.0	13.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3.88	1996.2	14	0.0	0.0	13.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0	1.0	0.0	0.0	0.0
4.53	1993.9	16	0.0	0.0	11.0	1.0	0.0	1.0	0.0	0.0	0.0	1.0	1.0	2.0	0.0	3.0	0.0	0.0	0.0	0.0
5.18	1991.6	18	0.0	8.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0
5.83	1989.3	21	0.0	9.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.47	1988	22	0.0	2.0	29.0	1.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
7.2	1978	32	0.0	1.0	28.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.83	1968	42	0.0	3.0	30.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
8.59	1958	52	0.0	1.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
9.28	1948	62	0.0	1.0	20.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	1.0	0.0	0.0	0.0	0.0
10.09	1938	72	1.0	0.0	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
10.83	1928	82	0.0	1.0	23.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	0.0	0.0	2.0	0.0	0.0	0.0
11.57	1918	92	0.0	3.0	29.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	3.0	0.0	0.0	0.0	0.0
12.39	1908	102	0.0	1.0	27.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	1.0	0.0	0.0	1.0	0.0
13.05	1898	112	0.0	6.0	32.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0	0.0	3.0	0.0	0.0	0.0	0.0
13.87	1888	122	0.0	2.0	29.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	1.0	0.0	0.0	0.0	0.0
14.57	1878	132	0.0	2.0	37.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
15.37	1868	142	0.0	4.0	31.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
16.14	1858	152	0.0	1.0	17.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	1.0	2.0	0.0	0.0	0.0	0.0	1.0	0.0
16.91	1848	162	0.0	1.0	26.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
17.95	1838	172	0.0	4.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0	0.0
18.89	1828	182	0.0	2.0	9.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
19.81	1818	192	1.0	1.0	4.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
20.56	1808	202	0.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
21.5	1798	212	0.0	0.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0
22.36	1788	222	0.0	3.0	5.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0
23.2	1778	232	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23.86	1768	242	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0
24.65	1758	252	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
25.52	1748	262	0.0	3.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Galium	Humulus	Poaceae	Zea mays	Anacardiaceae(Rhus)	Aquifoliaceae	Araceae	Balsaminaceae	cf.Campanulaceae	Caprifoliaceae	Caryophyllaceae	Chenopodiaceae	Cistaceae	Cornaceae	Cruciferae	Eleagnaceae	Ephedraceae	Eriocaulonaceae
26.33	1738	272	0.0	2.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27.14	1728	282	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
28.01	1718	292	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28.77	1708	302	0.0	9.0	3.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29.54	1698	312	0.0	0.0	1.0	0.0	1.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
30.36	1688	322	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31.23	1678	332	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
32.09	1668	342	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
32.97	1658	352	0.0	3.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0
33.78	1648	362	0.0	8.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	0.0	0.0	0.0
34.71	1638	372	0.0	2.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35.67	1628	382	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	1.0	0.0	1.0	1.0	0.0	0.0	0.0
36.66	1618	392	0.0	8.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0
37.58	1608	402	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
38.45	1598	412	0.0	1.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39.52	1588	422	0.0	2.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40.51	1578	432	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0
41.36	1568	442	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	3.0	0.0	0.0	0.0	0.0
42.18	1558	452	0.0	2.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0
43.04	1548	462	0.0	4.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
43.7	1538	472	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
44.54	1528	482	0.0	3.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
45.62	1518	492	0.0	2.0	0.0	0.0	2.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46.45	1508	502	0.0	2.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
47.31	1498	512	0.0	3.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
48.15	1488	522	0.0	2.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	1.0	0.0	0.0	0.0
48.83	1478	532	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0
49.57	1468	542	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
50.35	1458	552	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0
51.1	1448	562	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0
51.77	1438	572	0.0	1.0	5.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52.39	1428	582	0.0	2.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.0	2.0	0.0	1.0	1.0
52.95	1418	592	0.0	6.0	10.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	1.0	0.0	0.0	0.0	0.0
53.61	1408	602	0.0	2.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Galium	Humulus	Poaceae	Zea mays	Anacardiaceae(Rhus)	Aquifoliaceae	Araceae	Balsaminaceae	cf.Campanulaceae	Caprifoliaceae	Caryophyllaceae	Chenopodiaceae	Cistaceae	Cornaceae	Cruciferae	Eleagnaceae	Ephedraceae	Eriocaulonaceae
54.5	1398	612	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
55.37	1388	622	0.0	1.0	3.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.0	1.0	0.0	0.0	0.0
56.23	1378	632	0.0	3.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0
57.09	1368	642	0.0	0.0	4.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
58.04	1358	652	0.0	2.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	4.0	0.0	0.0	0.0	0.0
58.83	1348	662	1.0	2.0	2.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	1.0	0.0
59.73	1338	672	0.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0	0.0
60.63	1328	682	0.0	4.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
61.49	1318	692	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
62.33	1308	702	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
63.28	1298	712	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
64.17	1288	722	0.0	2.0	2.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
65	1278	732	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
65.92	1268	742	0.0	2.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0
66.66	1258	752	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	2.0	1.0	0.0	0.0	0.0
67.38	1248	762	0.0	3.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0
68.08	1238	772	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0
68.74	1228	782	0.0	2.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0
69.31	1218	792	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0	0.0
70.01	1208	802	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0
70.94	1198	812	0.0	3.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0	0.0	0.0	1.0	0.0
71.79	1188	822	0.0	1.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0	0.0	0.0	1.0	0.0
72.73	1178	832	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	3.0	0.0	0.0	0.0	0.0
73.63	1168	842	0.0	1.0	4.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
74.65	1158	852	0.0	2.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75.68	1148	862	0.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
76.71	1138	872	0.0	4.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
77.63	1128	882	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
78.48	1118	892	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	3.0	0.0	0.0
79.37	1108	902	0.0	3.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
80.31	1098	912	0.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0
81.06	1088	922	0.0	0.0	2.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81.81	1078	932	0.0	3.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0
82.67	1068	942	0.0	7.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	2.0	0.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Galium	Humulus	Poaceae	Zea mays	Anacardiaceae(Rhus)	Aquifoliaceae	Araceae	Balsaminaceae	cf.Campanulaceae	Caprifoliaceae	Caryophyllaceae	Chenopodiaceae	Cistaceae	Cornaceae	Cruciferae	Eleagnaceae	Ephedraceae	Eriocaulonaceae
83.74	1058	952	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
84.52	1048	962	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0
85.41	1038	972	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
86.5	1028	982	0.0	1.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0
87.39	1018	992	0.0	0.0	2.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0
88.33	1008	1002	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
89.32	998	1012	0.0	0.0	2.0	0.0	2.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
90.1	988	1022	0.0	14.0	3.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Ericaceae	Euphorbiaceae	Gentianaceae	Labiatae	Lamiaceae	Leguminosae	Marchantiaceae	Menyanthes trifoliata	cf.Montia fontana	Morus	Papaveraceae	Plantaginaceae	Polygonaceae	cf. Primulaceae	Pyrolaceae	Ranunculaceae	Rhamnaceae	Rubiaceae
0.65	2007.7	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	1.0	0.0	0.0
1.29	2005.4	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	0.0	0.0	6.0	0.0	0.0
1.94	2003.1	7	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
2.59	2000.8	9	0.0	0.0	0.0	2.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	3.0	4.0	0.0	0.0	11.0	0.0	1.0
3.24	1998.5	12	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	5.0	0.0	1.0
3.88	1996.2	14	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	2.0	1.0	0.0
4.53	1993.9	16	1.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.0	0.0
5.18	1991.6	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	12.0	0.0	2.0
5.83	1989.3	21	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	0.0	0.0	11.0	0.0	0.0
6.47	1988	22	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
7.2	1978	32	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0	0.0	0.0	0.0	2.0	2.0	0.0
7.83	1968	42	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	3.0	0.0	0.0
8.59	1958	52	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	1.0	0.0	0.0
9.28	1948	62	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	1.0	0.0	0.0	0.0
10.09	1938	72	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0	1.0	0.0	0.0	3.0	1.0	0.0
10.83	1928	82	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
11.57	1918	92	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0
12.39	1908	102	1.0	0.0	0.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0	0.0	0.0
13.05	1898	112	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	2.0	7.0	0.0	0.0	5.0	0.0	0.0
13.87	1888	122	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	2.0	1.0	0.0	0.0	3.0	0.0	0.0
14.57	1878	132	1.0	1.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.37	1868	142	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16.14	1858	152	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
16.91	1848	162	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0
17.95	1838	172	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.0	0.0
18.89	1828	182	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
19.81	1818	192	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20.56	1808	202	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0
21.5	1798	212	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0
22.36	1788	222	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	2.0	0.0	0.0
23.2	1778	232	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23.86	1768	242	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	0.0	1.0	1.0	0.0
24.65	1758	252	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.52	1748	262	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	3.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Ericaceae	Euphorbiaceae	Gentianaceae	Labiatae	Lamiaceae	Leguminosae	Marchantiaceae	Menyanthes trifoliata	cf.Montia fontana	Morus	Papaveraceae	Plantaginaceae	Polygonaceae	cf. Primulaceae	Pyrolaceae	Ranunculaceae	Rhamnaceae	Rubiaceae
26.33	1738	272	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27.14	1728	282	1.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	0.0
28.01	1718	292	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28.77	1708	302	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	4.0	0.0	0.0
29.54	1698	312	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30.36	1688	322	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0
31.23	1678	332	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
32.09	1668	342	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32.97	1658	352	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0
33.78	1648	362	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	1.0	0.0	0.0	5.0	0.0	0.0
34.71	1638	372	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
35.67	1628	382	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
36.66	1618	392	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0
37.58	1608	402	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	0.0
38.45	1598	412	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0
39.52	1588	422	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	1.0	0.0	0.0	0.0	2.0	0.0	0.0
40.51	1578	432	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0
41.36	1568	442	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
42.18	1558	452	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0
43.04	1548	462	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	3.0	0.0	0.0
43.7	1538	472	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
44.54	1528	482	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
45.62	1518	492	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46.45	1508	502	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0
47.31	1498	512	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
48.15	1488	522	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	2.0	0.0	0.0	1.0	0.0	0.0
48.83	1478	532	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49.57	1468	542	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
50.35	1458	552	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	3.0	0.0	0.0
51.1	1448	562	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51.77	1438	572	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	0.0
52.39	1428	582	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	3.0	0.0	0.0
52.95	1418	592	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	1.0	0.0	0.0
53.61	1408	602	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Ericaceae	Euphorbiaceae	Gentianaceae	Labiatae	Lamiaceae	Leguminosae	Marchantiaceae	Menyanthes trifoliata	cf.Montia fontana	Morus	Papaveraceae	Plantaginaceae	Polygonaceae	cf. Primulaceae	Pyrolaceae	Ranunculaceae	Rhamnaceae	Rubiaceae
54.5	1398	612	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0
55.37	1388	622	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
56.23	1378	632	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	1.0	0.0
57.09	1368	642	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
58.04	1358	652	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0
58.83	1348	662	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0
59.73	1338	672	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0
60.63	1328	682	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	3.0	0.0	0.0
61.49	1318	692	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
62.33	1308	702	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
63.28	1298	712	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
64.17	1288	722	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0
65	1278	732	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
65.92	1268	742	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
66.66	1258	752	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
67.38	1248	762	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
68.08	1238	772	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
68.74	1228	782	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0
69.31	1218	792	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	2.0	0.0	0.0
70.01	1208	802	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
70.94	1198	812	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0
71.79	1188	822	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0
72.73	1178	832	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0
73.63	1168	842	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
74.65	1158	852	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	3.0	0.0	0.0
75.68	1148	862	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	6.0	0.0	2.0
76.71	1138	872	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0
77.63	1128	882	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	1.0
78.48	1118	892	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	2.0	0.0
79.37	1108	902	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
80.31	1098	912	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81.06	1088	922	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0
81.81	1078	932	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0
82.67	1068	942	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Ericaceae	Euphorbiaceae	Gentianaceae	Labiatae	Lamiaceae	Leguminosae	Marchantiaceae	Menyanthes trifoliata	cf.Montia fontana	Morus	Papaveraceae	Plantaginaceae	Polygonaceae	cf. Primulaceae	Pyrolaceae	Ranunculaceae	Rhamnaceae	Rubiaceae
83.74	1058	952	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
84.52	1048	962	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
85.41	1038	972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
86.5	1028	982	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	2.0	1.0	0.0
87.39	1018	992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
88.33	1008	1002	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
89.32	998	1012	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
90.1	988	1022	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.0	0.0	0.0	1.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Rumex Type	Rosaceae	cf. Sambucus	cf. Scrofulariaceae	Solanaceae	Thalictrum	Trifolium	Umbelliferae	Violaceae	Vitaceae	Zosteraceae	SUM Total NAP	Cabombaceae	Haloragaceae	Hydrocharitaceae	Isoetes
0.65	2007.7	2.3	4.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.0	0.0	0.0	0.0	0.0
1.29	2005.4	5	2.0	4.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	0.0	0.0	0.0	4.0
1.94	2003.1	7	2.0	4.0	0.0	0.0	3.0	0.0	0.0	1.0	0.0	0.0	0.0	54.0	0.0	0.0	0.0	2.0
2.59	2000.8	9	1.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	72.0	0.0	0.0	0.0	3.0
3.24	1998.5	12	4.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	56.0	0.0	0.0	0.0	0.0
3.88	1996.2	14	1.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	57.0	0.0	0.0	0.0	0.0
4.53	1993.9	16	4.0	1.0	0.0	0.0	3.0	0.0	2.0	0.0	0.0	0.0	0.0	61.0	0.0	0.0	0.0	1.0
5.18	1991.6	18	3.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.0	0.0	0.0	0.0	0.0
5.83	1989.3	21	4.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	56.0	0.0	0.0	0.0	0.0
6.47	1988	22	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.0	0.0	0.0	0.0	1.0
7.2	1978	32	3.0	5.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	78.0	0.0	0.0	0.0	2.0
7.83	1968	42	4.0	4.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	84.0	0.0	0.0	0.0	1.0
8.59	1958	52	1.0	3.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	2.0	65.0	0.0	0.0	0.0	0.0
9.28	1948	62	5.0	2.0	0.0	0.0	3.0	0.0	1.0	0.0	0.0	0.0	0.0	72.0	0.0	0.0	0.0	0.0
10.09	1938	72	4.0	3.0	0.0	3.0	5.0	0.0	1.0	0.0	0.0	0.0	0.0	90.0	0.0	0.0	0.0	1.0
10.83	1928	82	5.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	107.0	0.0	0.0	0.0	2.0
11.57	1918	92	0.0	1.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	109.0	0.0	0.0	0.0	1.0
12.39	1908	102	4.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	98.0	0.0	0.0	0.0	0.0
13.05	1898	112	3.0	4.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	111.0	0.0	0.0	0.0	1.0
13.87	1888	122	2.0	2.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	89.0	0.0	0.0	0.0	0.0
14.57	1878	132	5.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	96.0	0.0	0.0	0.0	0.0
15.37	1868	142	5.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.0	0.0	0.0	0.0	0.0
16.14	1858	152	3.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	1.0
16.91	1848	162	8.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	79.0	0.0	0.0	0.0	0.0
17.95	1838	172	9.0	2.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	64.0	0.0	0.0	0.0	0.0
18.89	1828	182	10.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.0	0.0	0.0	0.0	1.0
19.81	1818	192	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.0	0.0	0.0	0.0	0.0
20.56	1808	202	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0
21.5	1798	212	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0	0.0	0.0	0.0	0.0
22.36	1788	222	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.0	0.0	0.0	0.0	0.0
23.2	1778	232	1.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0		0.0	0.0
23.86	1768	242	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	0.0	0.0	0.0	0.0
24.65	1758	252	1.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0	0.0
25.52	1748	262	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0	0.0	0.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Rumex Type	Rosaceae	cf. Sambucus	cf. Scrofulariaceae	Solanaceae	Thalictrum	Trifolium	Umbelliferae	Violaceae	Vitaceae	Zosteraceae	SUM Total NAP	Cabombaceae	Haloragaceae	Hydrocharitaceae	Isoetes
26.33	1738	272	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0
27.14	1728	282	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	1.0	0.0	0.0	0.0
28.01	1718	292	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	0.0
28.77	1708	302	1.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	0.0	0.0	0.0	2.0
29.54	1698	312	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	0.0	0.0	0.0	0.0
30.36	1688	322	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0
31.23	1678	332	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0
32.09	1668	342	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0
32.97	1658	352	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0	3.0
33.78	1648	362	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.0	0.0	0.0	0.0	2.0
34.71	1638	372	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0
35.67	1628	382	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0	0.0	0.0	0.0	1.0
36.66	1618	392	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.0	0.0	1.0	0.0	0.0
37.58	1608	402	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0	0.0	0.0	0.0	1.0
38.45	1598	412	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	16.0	0.0	0.0	0.0	0.0
39.52	1588	422	0.0	0.0	0.0	0.0	2.0	0.0	1.0	0.0	0.0	0.0	0.0	24.0	0.0	0.0	1.0	0.0
40.51	1578	432	1.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0
41.36	1568	442	2.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0
42.18	1558	452	1.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0	0.0
43.04	1548	462	3.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0	0.0	0.0	0.0	0.0
43.7	1538	472	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0	0.0
44.54	1528	482	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0
45.62	1518	492	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	0.0	0.0	0.0	0.0
46.45	1508	502	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	0.0	0.0	0.0	0.0
47.31	1498	512	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0
48.15	1488	522	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0
48.83	1478	532	0.0	2.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0
49.57	1468	542	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0	0.0
50.35	1458	552	1.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	0.0	0.0	0.0	1.0
51.1	1448	562	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	1.0
51.77	1438	572	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	0.0	0.0	0.0	1.0
52.39	1428	582	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.0	0.0	0.0	0.0	0.0
52.95	1418	592	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.0	0.0	0.0	0.0	0.0
53.61	1408	602	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	1.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Rumex Type	Rosaceae	cf. Sambucus	cf. Scrofulariaceae	Solanaceae	Thalictrum	Trifolium	Umbelliferae	Violaceae	Vitaceae	Zosteraceae	SUM Total NAP	Cabombaceae	Haloragaceae	Hydrocharitaceae	Isoetes
54.5	1398	612	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	1.0
55.37	1388	622	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0	0.0	0.0	0.0	1.0
56.23	1378	632	3.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.0	0.0	0.0	0.0	0.0
57.09	1368	642	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0
58.04	1358	652	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0	0.0
58.83	1348	662	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0	0.0	0.0	0.0	0.0
59.73	1338	672	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	0.0	0.0	0.0	0.0
60.63	1328	682	1.0	3.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0	0.0	0.0	0.0	4.0
61.49	1318	692	0.0	4.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0	0.0	0.0	0.0	1.0
62.33	1308	702	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0
63.28	1298	712	0.0	2.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0
64.17	1288	722	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	0.0	0.0	0.0	1.0
65	1278	732	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0
65.92	1268	742	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	0.0
66.66	1258	752	0.0	2.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0
67.38	1248	762	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0
68.08	1238	772	0.0	2.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	1.0
68.74	1228	782	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0
69.31	1218	792	2.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	1.0
70.01	1208	802	0.0	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	0.0	0.0	0.0	0.0
70.94	1198	812	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0
71.79	1188	822	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0	0.0
72.73	1178	832	0.0	1.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	0.0	0.0	0.0	0.0
73.63	1168	842	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	0.0	0.0	0.0	0.0
74.65	1158	852	1.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0
75.68	1148	862	3.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	0.0	0.0	0.0	0.0
76.71	1138	872	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0
77.63	1128	882	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	1.0
78.48	1118	892	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	0.0	0.0	0.0	0.0
79.37	1108	902	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0	0.0
80.31	1098	912	1.0	3.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	19.0	0.0	0.0	0.0	0.0
81.06	1088	922	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0
81.81	1078	932	2.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	2.0
82.67	1068	942	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0	0.0	0.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Rumex Type	Rosaceae	cf. Sambucus	cf. Scrofulariaceae	Solanaceae	Thalictrum	Trifolium	Umbelliferae	Violaceae	Vitaceae	Zosteraceae	SUM Total NAP	Cabombaceae	Haloragaceae	Hydrocharitaceae	Isoetes
83.74	1058	952	0.0	2.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	1.0
84.52	1048	962	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	0.0
85.41	1038	972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0
86.5	1028	982	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.0	0.0	0.0	0.0	0.0
87.39	1018	992	1.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	0.0	0.0
88.33	1008	1002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	4.0
89.32	998	1012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	0.0	0.0	0.0	0.0
90.1	988	1022	1.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.0	0.0	0.0	0.0	1.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Myriophyllum	Nymphaeaceae	Potamogeton	Saggitaria	Sparganium	Typhaceae	SUM Total Aquatics	Adiantum	Athyrium	Botrichium	Cysopteris	Dennstaedtia	Dryopteris	Equisetum	Lycopodium
0.65	2007.7	2.3	1.0	0.0	4.0	0.0	2.0	2.0	9.0	0.0	0.0	0.0	0.0	0.0	6.0	1.0	15.0
1.29	2005.4	5	0.0	1.0	1.0	0.0	0.0	1.0	7.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	2.0
1.94	2003.1	7	0.0	0.0	0.0	0.0	1.0	0.0	3.0	0.0	1.0	0.0	0.0	0.0	6.0	0.0	2.0
2.59	2000.8	9	0.0	0.0	0.0	0.0	0.0	1.0	4.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	3.0
3.24	1998.5	12	0.0	1.0	2.0	1.0	0.0	0.0	4.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	2.0
3.88	1996.2	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	9.0	0.0	2.0
4.53	1993.9	16	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	1.0
5.18	1991.6	18	0.0	0.0	2.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	2.0
5.83	1989.3	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	9.0	0.0	3.0
6.47	1988	22	0.0	0.0	0.0	0.0	2.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	8.0	1.0	3.0
7.2	1978	32	0.0	0.0	1.0	0.0	2.0	0.0	5.0	0.0	1.0	0.0	0.0	0.0	5.0	0.0	2.0
7.83	1968	42	0.0	0.0	1.0	1.0	0.0	2.0	5.0	0.0	0.0	1.0	0.0	0.0	6.0	0.0	0.0
8.59	1958	52	0.0	0.0	1.0	1.0	0.0	1.0	3.0	0.0	2.0	0.0	0.0	0.0	5.0	0.0	2.0
9.28	1948	62	0.0	0.0	2.0	0.0	3.0	1.0	6.0	0.0	0.0	0.0	0.0	0.0	4.0	1.0	0.0
10.09	1938	72	1.0	0.0	0.0	0.0	1.0	0.0	3.0	0.0	1.0	0.0	0.0	0.0	5.0	0.0	1.0
10.83	1928	82	1.0	0.0	0.0	0.0	1.0	0.0	4.0	0.0	1.0	0.0	0.0	0.0	2.0	1.0	0.0
11.57	1918	92	0.0	1.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	1.0
12.39	1908	102	2.0	0.0	0.0	0.0	0.0	1.0	3.0	0.0	1.0	0.0	0.0	0.0	5.0	0.0	0.0
13.05	1898	112	2.0	0.0	0.0	1.0	0.0	0.0	4.0	0.0	1.0	1.0	0.0	0.0	5.0	1.0	2.0
13.87	1888	122	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	5.0	0.0	0.0
14.57	1878	132	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	2.0
15.37	1868	142	0.0	0.0	2.0	1.0	1.0	0.0	4.0	0.0	1.0	0.0	0.0	0.0	6.0	0.0	1.0
16.14	1858	152	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	3.0	0.0	0.0	0.0	2.0	0.0	3.0
16.91	1848	162	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	4.0	0.0	0.0
17.95	1838	172	1.0	1.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	2.0	4.0	2.0	4.0
18.89	1828	182	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0
19.81	1818	192	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0
20.56	1808	202	0.0	0.0	1.0	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21.5	1798	212	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
22.36	1788	222	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
23.2	1778	232	1.0	0.0	1.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
23.86	1768	242	0.0	0.0	1.0	0.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	1.0
24.65	1758	252	0.0	0.0	0.0	0.0	0.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
25.52	1748	262	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	1.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Myriophyllum	Nymphaeaceae	Potamogeton	Saggitaria	Sparganium	Typhaceae	SUM Total Aquatics	Adiantum	Athyrium	Botrichium	Cysopteris	Dennstaedtia	Dryopteris	Equisetum	Lycopodium
26.33	1738	272	2.0	0.0	1.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	1.0
27.14	1728	282	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	3.0	0.0	1.0
28.01	1718	292	2.0	0.0	0.0	0.0	0.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
28.77	1708	302	4.0	0.0	1.0	0.0	1.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
29.54	1698	312	0.0	1.0	0.0	0.0	1.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
30.36	1688	322	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	1.0
31.23	1678	332	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
32.09	1668	342	0.0	0.0	2.0	1.0	1.0	1.0	5.0	0.0	0.0	0.0	1.0	0.0	4.0	0.0	1.0
32.97	1658	352	1.0	1.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
33.78	1648	362	1.0	1.0	0.0	0.0	0.0	1.0	5.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	0.0
34.71	1638	372	0.0	0.0	0.0	0.0	0.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
35.67	1628	382	0.0	0.0	0.0	0.0	0.0	2.0	3.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
36.66	1618	392	0.0	0.0	0.0	0.0	0.0	2.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
37.58	1608	402	1.0	0.0	1.0	0.0	3.0	2.0	8.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
38.45	1598	412	0.0	0.0	1.0	1.0	0.0	2.0	4.0	0.0	1.0	0.0	0.0	0.0	12.0	2.0	2.0
39.52	1588	422	0.0	1.0	3.0	0.0	0.0	3.0	8.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0
40.51	1578	432	0.0	0.0	0.0	0.0	1.0	4.0	5.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	3.0
41.36	1568	442	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	1.0
42.18	1558	452	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43.04	1548	462	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	2.0
43.7	1538	472	0.0	0.0	0.0	1.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0
44.54	1528	482	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	1.0	2.0	0.0
45.62	1518	492	0.0	1.0	0.0	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0
46.45	1508	502	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	3.0	1.0	1.0
47.31	1498	512	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	1.0	0.0	0.0	0.0	5.0	0.0	2.0
48.15	1488	522	0.0	0.0	1.0	0.0	1.0	0.0	2.0	1.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0
48.83	1478	532	0.0	0.0	1.0	0.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0
49.57	1468	542	4.0	0.0	1.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	4.0	1.0	5.0
50.35	1458	552	3.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	2.0
51.1	1448	562	0.0	0.0	1.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
51.77	1438	572	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	2.0
52.39	1428	582	0.0	0.0	1.0	1.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	3.0
52.95	1418	592	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	5.0
53.61	1408	602	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Myriophyllum	Nymphaeaceae	Potamogeton	Saggitaria	Sparganium	Typhaceae	SUM Total Aquatics	Adiantum	Athyrium	Botrichium	Cysopteris	Dennstaedtia	Dryopteris	Equisetum	Lycopodium
54.5	1398	612	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.0
55.37	1388	622	1.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	3.0
56.23	1378	632	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	2.0	0.0	0.0
57.09	1368	642	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	3.0
58.04	1358	652	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
58.83	1348	662	0.0	1.0	0.0	0.0	1.0	1.0	3.0	0.0	1.0	0.0	0.0	0.0	4.0	0.0	1.0
59.73	1338	672	0.0	0.0	3.0	1.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	1.0
60.63	1328	682	5.0	1.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	2.0	0.0	0.0	3.0	2.0	1.0
61.49	1318	692	0.0	0.0	2.0	0.0	1.0	1.0	5.0	0.0	0.0	0.0	0.0	0.0	5.0	1.0	0.0
62.33	1308	702	0.0	0.0	1.0	1.0	0.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	3.0
63.28	1298	712	0.0	1.0	2.0	0.0	0.0	1.0	4.0	0.0	0.0	0.0	0.0	0.0	6.0	1.0	1.0
64.17	1288	722	1.0	0.0	0.0	0.0	0.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	3.0
65	1278	732	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
65.92	1268	742	0.0	0.0	0.0	2.0	1.0	0.0	3.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0
66.66	1258	752	1.0	0.0	1.0	0.0	0.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	1.0
67.38	1248	762	0.0	0.0	1.0	0.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	2.0
68.08	1238	772	0.0	1.0	0.0	1.0	0.0	0.0	3.0	0.0	1.0	0.0	0.0	0.0	4.0	0.0	1.0
68.74	1228	782	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
69.31	1218	792	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
70.01	1208	802	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	3.0	0.0	0.0
70.94	1198	812	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	3.0	0.0	2.0
71.79	1188	822	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0
72.73	1178	832	1.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
73.63	1168	842	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
74.65	1158	852	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	1.0
75.68	1148	862	2.0	1.0	0.0	1.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0
76.71	1138	872	0.0	0.0	2.0	0.0	1.0	0.0	3.0	0.0	0.0	0.0	1.0	0.0	3.0	0.0	1.0
77.63	1128	882	0.0	0.0	1.0	0.0	2.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	2.0
78.48	1118	892	0.0	1.0	0.0	0.0	1.0	1.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
79.37	1108	902	0.0	2.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	4.0	1.0	0.0
80.31	1098	912	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	2.0
81.06	1088	922	0.0	1.0	1.0	0.0	1.0	1.0	4.0	0.0	1.0	0.0	0.0	0.0	3.0	0.0	0.0
81.81	1078	932	0.0	0.0	1.0	0.0	2.0	0.0	5.0	0.0	2.0	0.0	0.0	0.0	5.0	0.0	0.0
82.67	1068	942	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	1.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Myriophyllum	Nymphaeaceae	Potamogeton	Saggitaria	Sparganium	Typhaceae	SUM Total Aquatics	Adiantum	Athyrium	Botrichium	Cysopteris	Dennstaedtia	Dryopteris	Equisetum	Lycopodium
83.74	1058	952	0.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	4.0	1.0	2.0
84.52	1048	962	0.0	0.0	1.0	0.0	0.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0
85.41	1038	972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0
86.5	1028	982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	2.0
87.39	1018	992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	5.0	1.0	2.0
88.33	1008	1002	0.0	1.0	0.0	0.0	1.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	0.0
89.32	998	1012	2.0	0.0	1.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
90.1	988	1022	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	3.0	3.0	7.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Osmundaceae	Phegopteris	Polypodiaceae	Pteridium	Pediastrum	Thelypteris	Sphagnum	SUM Total spores	Unidentifiable	Unknown	Total	Lycop spike
0.65	2007.7	2.3	0.0	0.0	3.0	0.0	0.0	0.0	2.0	27.0	12.0	3.0	468.0	212.0
1.29	2005.4	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	6.0	1.0	469.5	209.0
1.94	2003.1	7	0.0	0.0	0.0	1.0	0.0	0.0	1.0	11.0	6.0	0.0	484.5	152.0
2.59	2000.8	9	0.0	0.0	2.0	2.0	0.0	0.0	3.0	15.0	6.0	0.0	510.0	206.0
3.24	1998.5	12	0.0	0.0	2.0	0.0	0.0	0.0	1.0	7.0	8.0	1.0	450.0	213.0
3.88	1996.2	14	0.0	0.0	0.0	1.0	0.0	0.0	0.0	15.0	4.0	2.0	493.5	119.0
4.53	1993.9	16	0.0	0.0	1.0	0.0	0.0	0.0	1.0	8.0	7.0	1.0	501.0	213.0
5.18	1991.6	18	0.0	0.0	3.0	0.0	0.0	0.0	1.0	12.0	7.0	1.0	441.0	130.0
5.83	1989.3	21	1.0	0.0	1.0	0.0	0.0	0.0	2.0	17.0	6.0	1.0	484.0	157.0
6.47	1988	22	0.0	0.0	0.0	2.0	0.0	0.0	2.0	16.0	7.0	0.0	497.0	112.0
7.2	1978	32	0.0	0.0	0.0	1.0	0.0	0.0	1.0	10.0	8.0	0.0	564.5	154.0
7.83	1968	42	0.0	0.0	0.0	0.0	0.0	0.0	1.0	8.0	8.0	1.0	516.0	180.0
8.59	1958	52	0.0	0.0	1.0	1.0	0.0	0.0	0.0	11.0	4.0	0.0	460.5	156.0
9.28	1948	62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	8.0	1.0	483.0	156.0
10.09	1938	72	0.0	0.0	0.0	0.0	0.0	0.0	2.0	9.0	9.0	1.0	482.5	169.0
10.83	1928	82	0.0	0.0	0.0	2.0	0.0	0.0	0.0	6.0	4.0	1.0	495.0	138.0
11.57	1918	92	0.0	0.0	0.0	2.0	0.0	0.0	0.0	8.0	3.0	2.0	498.5	122.0
12.39	1908	102	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	4.0	0.0	483.0	129.0
13.05	1898	112	0.0	0.0	0.0	5.0	1.0	0.0	0.0	16.0	8.0	2.0	468.0	102.0
13.87	1888	122	0.0	0.0	0.0	5.0	0.0	1.0	0.0	12.0	7.0	1.0	482.0	127.0
14.57	1878	132	0.0	0.0	1.0	10.0	0.0	0.0	1.0	18.0	7.0	0.0	494.5	119.0
15.37	1868	142	0.0	0.0	1.0	10.0	0.0	0.0	0.0	19.0	7.0	1.0	487.5	95.0
16.14	1858	152	0.0	0.0	0.0	4.0	0.0	0.0	3.0	15.0	6.0	0.0	429.0	117.0
16.91	1848	162	0.0	0.0	1.0	2.0	0.0	0.0	0.0	8.0	5.0	0.0	512.5	88.0
17.95	1838	172	0.0	0.0	0.0	14.0	0.0	0.0	0.0	26.0	5.0	0.0	564.5	109.0
18.89	1828	182	0.0	0.0	1.0	7.0	0.0	0.0	1.0	11.0	4.0	0.0	498.0	112.0
19.81	1818	192	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0	0.0	486.5	79.0
20.56	1808	202	0.0	0.0	0.0	2.0	0.0	0.0	0.0	2.0	6.0	1.0	513.5	85.0
21.5	1798	212	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	7.0	0.0	470.0	71.0
22.36	1788	222	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.0	0.0	484.5	76.0
23.2	1778	232	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.0	1.0	504.5	100.0
23.86	1768	242	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	3.0	1.0	563.0	107.0
24.65	1758	252	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	8.0	1.0	562.0	95.0
25.52	1748	262	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.0	6.0	2.0	492.0	60.0
26.33	1738	272	0.0	0.0	1.0	1.0	0.0	0.0	0.0	6.0	5.0	1.0	537.0	81.0
27.14	1728	282	0.0	0.0	0.0	2.0	0.0	0.0	1.0	8.0	6.0	0.0	521.0	102.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Osmundaceae	Phegopteris	Polypodiaceae	Pteridium	Pediastrum	Thelypteris	Sphagnum	SUM Total spores	Unidentifiable	Unknown	Total	Lycop spike
28.01	1718	292	0.0	0.0	0.0	1.0	0.0	0.0	0.0	3.0	8.0	1.0	525.5	83.0
28.77	1708	302	0.0	0.0	2.0	0.0	0.0	0.0	0.0	4.0	6.0	1.0	457.5	103.0
29.54	1698	312	1.0	0.0	0.0	1.0	0.0	0.0	0.0	4.0	10.0	1.0	531.5	128.0
30.36	1688	322	0.0	0.0	1.0	1.0	0.0	0.0	0.0	5.0	4.0	1.0	517.5	80.0
31.23	1678	332	0.0	0.0	1.0	0.0	0.0	0.0	0.0	3.0	5.0	0.0	464.0	89.0
32.09	1668	342	0.0	0.0	0.0	1.0	0.0	0.0	0.0	7.0	8.0	1.0	503.0	100.0
32.97	1658	352	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.0	2.0	521.0	86.0
33.78	1648	362	1.0	0.0	1.0	0.0	0.0	0.0	0.0	5.0	3.0	1.0	499.5	103.0
34.71	1638	372	0.0	0.0	1.0	0.0	0.0	0.0	0.0	2.0	9.0	0.0	495.0	95.0
35.67	1628	382	0.0	0.0	1.0	2.0	0.0	0.0	0.0	4.0	3.0	0.0	559.0	118.0
36.66	1618	392	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	9.0	2.0	485.5	139.0
37.58	1608	402	0.0	0.0	0.0	7.0	0.0	0.0	1.0	10.0	4.0	0.0	540.0	144.0
38.45	1598	412	1.0	0.0	0.0	6.0	0.0	0.0	0.0	24.0	7.0	0.0	539.0	164.0
39.52	1588	422	1.0	0.0	0.0	4.0	0.0	0.0	2.0	10.0	5.0	0.0	505.5	164.0
40.51	1578	432	0.0	0.0	2.0	3.0	0.0	0.0	0.0	14.0	3.0	0.0	459.0	167.0
41.36	1568	442	0.0	0.0	0.0	1.0	0.0	0.0	0.0	5.0	3.0	1.0	514.0	105.0
42.18	1558	452	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	3.0	0.0	475.5	54.0
43.04	1548	462	0.0	0.0	1.0	0.0	0.0	0.0	1.0	7.0	5.0	1.0	669.0	80.0
43.7	1538	472	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.0	3.0	1.0	486.5	67.0
44.54	1528	482	0.0	1.0	0.0	1.0	0.0	0.0	0.0	6.0	1.0	2.0	542.5	73.0
45.62	1518	492	1.0	0.0	0.0	1.0	0.0	0.0	0.0	5.0	10.0	2.0	544.0	107.0
46.45	1508	502	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	4.0	0.0	496.0	70.0
47.31	1498	512	0.0	0.0	1.0	1.0	0.0	0.0	3.0	13.0	1.0	2.0	478.0	91.0
48.15	1488	522	0.0	0.0	1.0	3.0	0.0	0.0	1.0	8.0	8.0	0.0	547.0	91.0
48.83	1478	532	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	9.0	1.0	508.0	79.0
49.57	1468	542	0.0	0.0	0.0	1.0	0.0	0.0	0.0	11.0	8.0	0.0	599.5	102.0
50.35	1458	552	0.0	0.0	1.0	1.0	0.0	0.0	0.0	7.0	6.0	2.0	572.0	88.0
51.1	1448	562	0.0	0.0	1.0	1.0	0.0	0.0	0.0	3.0	8.0	0.0	489.0	100.0
51.77	1438	572	0.0	0.0	1.0	0.0	0.0	0.0	0.0	5.0	7.0	0.0	518.0	91.0
52.39	1428	582	0.0	0.0	1.0	1.0	0.0	0.0	0.0	7.0	7.0	0.0	589.5	103.0
52.95	1418	592	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	6.0	4.0	534.0	83.0
53.61	1408	602	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.0	1.0	0.0	452.0	66.0
54.5	1398	612	0.0	0.0	0.0	2.0	0.0	0.0	0.0	5.0	3.0	0.0	541.5	96.0
55.37	1388	622	1.0	0.0	0.0	1.0	0.0	0.0	3.0	10.0	7.0	1.0	539.0	96.0
56.23	1378	632	1.0	0.0	1.0	1.0	0.0	0.0	1.0	7.0	8.0	2.0	528.0	99.0
57.09	1368	642	1.0	0.0	0.0	1.0	0.0	0.0	0.0	7.0	8.0	1.0	478.0	85.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Osmundaceae	Phegopteris	Polypodiaceae	Pteridium	Pediastrum	Thelypteris	Sphagnum	SUM Total spores	Unidentifiable	Unknown	Total	Lycop spike
58.04	1358	652	0.0	0.0	0.0	1.0	0.0	0.0	1.0	3.0	5.0	1.0	484.0	94.0
58.83	1348	662	1.0	0.0	2.0	3.0	0.0	0.0	0.0	12.0	5.0	1.0	561.5	85.0
59.73	1338	672	0.0	0.0	0.0	1.0	0.0	0.0	0.0	7.0	8.0	0.0	554.5	98.0
60.63	1328	682	0.0	0.0	0.0	0.0	0.0	0.0	1.0	9.0	5.0	2.0	467.5	90.0
61.49	1318	692	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	5.0	1.0	499.0	82.0
62.33	1308	702	1.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	8.0	1.0	480.9	86.0
63.28	1298	712	0.0	0.0	1.0	2.0	0.0	0.0	1.0	12.0	8.0	1.0	473.0	100.0
64.17	1288	722	0.0	0.0	0.0	1.0	0.0	0.0	0.0	6.0	9.0	0.0	530.5	79.0
65	1278	732	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	4.0	2.0	514.5	81.0
65.92	1268	742	0.0	0.0	0.0	2.0	0.0	0.0	1.0	5.0	6.0	3.0	551.0	89.0
66.66	1258	752	0.0	0.0	0.0	1.0	0.0	0.0	0.0	5.0	6.0	1.0	509.5	81.0
67.38	1248	762	0.0	0.0	0.0	1.0	0.0	0.0	0.0	6.0	7.0	2.0	534.0	101.0
68.08	1238	772	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	6.0	0.0	508.5	71.0
68.74	1228	782	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.0	1.0	513.5	100.0
69.31	1218	792	0.0	0.0	1.0	0.0	0.0	0.0	1.0	4.0	7.0	1.0	514.5	66.0
70.01	1208	802	0.0	0.0	1.0	0.0	0.0	0.0	0.0	5.0	10.0	1.0	474.0	73.0
70.94	1198	812	1.0	0.0	1.0	0.0	0.0	0.0	2.0	10.0	7.0	0.0	509.5	67.0
71.79	1188	822	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	7.0	1.0	457.5	44.0
72.73	1178	832	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	6.0	0.0	489.0	132.0
73.63	1168	842	1.0	0.0	0.0	1.0	0.0	0.0	0.0	4.0	3.0	0.0	477.0	52.0
74.65	1158	852	0.0	0.0	1.0	0.0	0.0	0.0	0.0	4.0	4.0	1.0	517.0	126.0
75.68	1148	862	0.0	0.0	2.0	1.0	0.0	0.0	0.0	6.0	9.0	0.0	555.0	77.0
76.71	1138	872	0.0	0.0	1.0	0.0	0.0	0.0	0.0	6.0	8.0	2.0	559.0	101.0
77.63	1128	882	1.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	7.0	1.0	520.5	88.0
78.48	1118	892	1.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	6.0	0.0	539.0	73.0
79.37	1108	902	0.0	0.0	0.0	3.0	0.0	0.0	0.0	8.0	7.0	1.0	517.5	75.0
80.31	1098	912	1.0	0.0	3.0	3.0	0.0	0.0	1.0	16.0	5.0	1.0	495.5	92.0
81.06	1088	922	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.0	1.0	522.5	57.0
81.81	1078	932	0.0	0.0	2.0	0.0	0.0	0.0	0.0	9.0	2.0	1.0	469.5	52.0
82.67	1068	942	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.0	1.0	476.5	71.0
83.74	1058	952	0.0	0.0	1.0	0.0	0.0	0.0	0.0	8.0	6.0	0.0	534.5	77.0
84.52	1048	962	0.0	0.0	0.0	1.0	0.0	0.0	0.0	8.0	8.0	0.0	523.5	79.0
85.41	1038	972	0.0	0.0	2.0	0.0	0.0	0.0	0.0	4.0	4.0	3.0	472.5	58.0
86.5	1028	982	1.0	0.0	1.0	0.0	0.0	0.0	0.0	6.0	6.0	2.0	547.5	104.0
87.39	1018	992	0.0	0.0	1.0	1.0	0.0	0.0	1.0	12.0	3.0	1.0	504.0	91.0
88.33	1008	1002	0.0	0.0	1.0	0.0	0.0	0.0	0.0	5.0	9.0	1.0	566.5	94.0

depth cm	A.D corrected by Lead210	Cal years before 2010	Osmundaceae	Phegopteris	Polypodiaceae	Pteridium	Pediastrum	Thelypteris	Sphagnum	SUM Total spores	Unidentifiable	Unknown	Total	Lycop spike
89.32	998	1012	2.0	0.0	1.0	1.0	0.0	0.0	0.0	5.0	6.0	1.0	523.5	123.0
90.1	988	1022	1.0	0.0	1.0	0.0	0.0	0.0	1.0	17.0	10.0	2.0	518.0	93.0

Appendix E

Charcoal data

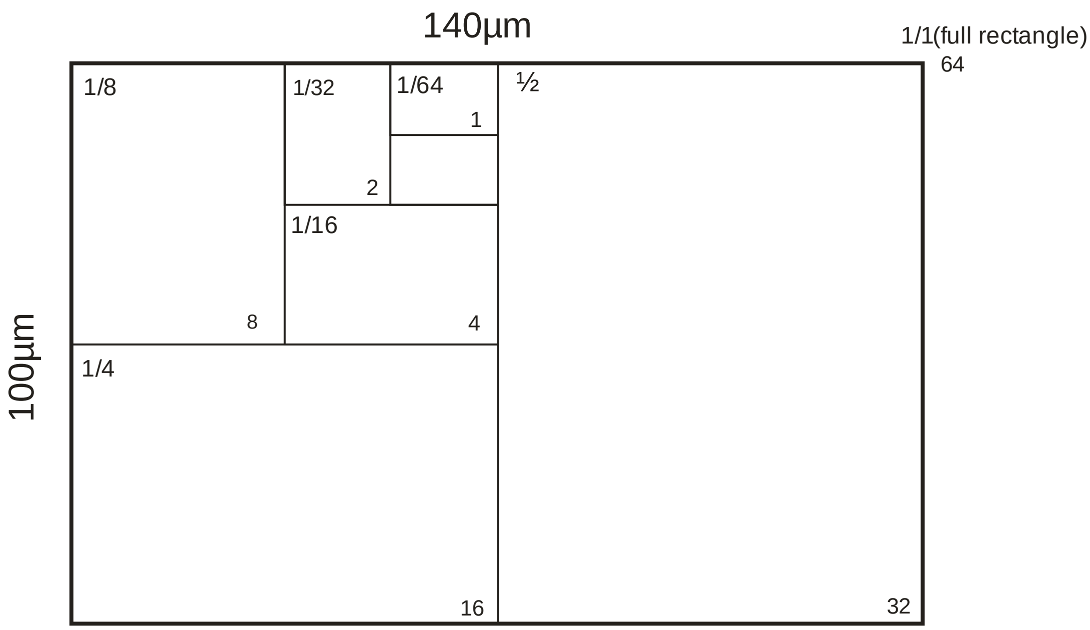
depth cm	AD	Before 2010	Class1 1/64≤x<1/32	Class 2 1/32≤x<1/16	Class 3 1/16≤x<1/8	Class 4 1/8≥	Lycop spikes	TOTAL counts
0.65	2007.7	2.3	19	8	1	1	49	29
1.29	2005.4	5	35	2	2	0	47	39
1.94	2003.1	7	20	6	4	0	51	30
2.59	2000.8	9	20	9	2	1	47	32
3.24	1998.5	12	45	10	3	1	48	59
3.88	1996.2	14	29	3	2	1	48	35
4.53	1993.9	16	32	10	0	1	49	43
5.18	1991.6	18	52	11	4	0	47	67
5.83	1989.3	21	25	12	1	2	48	40
6.47	1988	22	45	10	0	0	49	55
7.2	1978	32	26	13	1	2	50	42
7.83	1968	42	53	9	2	1	48	65
8.59	1958	52	48	9	3	1	48	61
9.28	1948	62	84	17	4	4	47	109
10.09	1938	72	33	9	9	0	48	51
10.83	1928	82	67	21	6	0	47	94
11.57	1918	92	61	15	4	0	48	80
12.39	1908	102	35	14	8	2	45	59
13.05	1898	112	57	11	2	0	50	70
13.87	1888	122	77	15	5	0	49	97
14.57	1878	132	66	20	10	1	47	97
15.37	1868	142	134	34	8	5	48	181
16.14	1858	152	45	13	6	2	48	66
16.91	1848	162	66	17	13	1	47	97
17.95	1838	172	59	21	8	2	48	90
18.89	1828	182	53	13	5	0	48	71
19.81	1818	192	45	25	2	4	50	76
20.56	1808	202	38	9	2	2	48	51
21.5	1798	212	17	8	3	2	48	30
22.36	1788	222	24	5	1	0	47	30
23.2	1778	232	23	2	3	0	47	28
23.86	1768	242	40	11	5	2	47	58
24.65	1758	252	20	5	2	0	47	27
25.52	1748	262	14	7	3	1	47	25
26.33	1738	272	42	6	5	0	48	53

27.14	1728	282	28	3	1	0	48	32
			Class1	**Class 2**	**Class 3**	**Class 4**		
depth cm	**AD**	**Before 2010**	**1/64≤x<1/32**	**1/32≤x<1/16**	**1/16≤x<1/8**	**1/8≥**	**Lycop spikes**	**TOTAL counts**
28.01	1718	292	18	3	0	0	47	21
28.77	1708	302	23	6	2	1	47	32
29.54	1698	312	19	7	0	1	50	27
30.36	1688	322	21	13	3	1	46	38
31.23	1678	332	32	8	3	1	48	44
32.09	1668	342	17	9	1	0	47	27
32.97	1658	352	27	5	2	0	48	34
33.78	1648	362	24	6	3	0	48	33
34.71	1638	372	32	10	5	1	46	48
35.67	1628	382	37	10	6	0	47	53
36.66	1618	392	24	4	1	0	48	29
37.58	1608	402	33	15	2	2	49	52
38.45	1598	412	37	11	5	1	47	54
39.52	1588	422	45	13	6	3	48	67
40.51	1578	432	59	14	5	1	48	79
41.36	1568	442	31	13	8	0	48	52
42.18	1558	452	20	9	2	1	48	32
43.04	1548	462	61	14	3	3	47	81
43.7	1538	472	39	6	1	2	48	48
44.54	1528	482	33	9	6	0	48	48
45.62	1518	492	26	7	3	0	48	36
46.45	1508	502	42	6	0	0	55	48
47.31	1498	512	28	7	1	3	47	39
48.15	1488	522	31	8	3	0	47	42
48.83	1478	532	11	5	5	2	47	23
49.57	1468	542	27	5	1	1	49	34
50.35	1458	552	24	9	5	1	47	39
51.1	1448	562	25	6	1	0	46	32
51.77	1438	572	37	11	3	1	48	52
52.39	1428	582	25	6	1	0	48	32
52.95	1418	592	20	6	2	0	49	28
53.61	1408	602	31	13	4	0	48	48
54.5	1398	612	34	11	5	0	53	50
55.37	1388	622	22	10	1	1	48	34
56.23	1378	632	68	24	6	3	48	101
57.09	1368	642	67	25	8	0	47	100
58.04	1358	652	35	15	8	0	47	58
58.83	1348	662	23	4	5	1	53	33

depth cm	AD	Before 2010	Class1 1/64≤x<1/32	Class 2 1/32≤x<1/16	Class 3 1/16≤x<1/8	Class 4 1/8≥	Lycop spikes	TOTAL counts
59.73	1338	672	17	7	1	1	48	26
60.63	1328	682	21	14	2	0	47	37
61.49	1318	692	52	15	6	2	46	75
62.33	1308	702	23	8	3	0	48	34
63.28	1298	712	24	6	3	1	49	34
64.17	1288	722	26	12	1	0	48	39
65	1278	732	23	7	2	0	48	32
65.92	1268	742	30	9	1	1	48	41
66.66	1258	752	35	16	4	0	46	55
67.38	1248	762	37	8	3	1	48	49
68.08	1238	772	27	14	2	0	48	43
68.74	1228	782	27	7	2	1	47	37
69.31	1218	792	42	24	6	1	50	73
70.01	1208	802	31	6	3	0	48	40
70.94	1198	812	49	8	2	2	50	61
71.79	1188	822	48	14	3	1	48	66
72.73	1178	832	16	6	3	0	48	25
73.63	1168	842	21	9	4	1	47	35
74.65	1158	852	33	9	3	1	47	46
75.68	1148	862	40	9	5	1	48	55
76.71	1138	872	36	12	2	4	46	54
77.63	1128	882	74	26	27	12	48	139
78.48	1118	892	75	24	19	8	47	126
79.37	1108	902	53	15	2	1	46	71
80.31	1098	912	26	11	3	0	47	40
81.06	1088	922	40	19	3	0	48	62
81.81	1078	932	39	11	8	0	48	58
82.67	1068	942	31	12	2	0	48	45
83.74	1058	952	62	27	5	3	48	97
84.52	1048	962	45	9	6	0	47	60
85.41	1038	972	46	22	4	3	48	75
86.5	1028	982	36	8	5	1	47	50
87.39	1018	992	37	7	1	1	50	46
88.33	1008	1002	29	18	0	1	47	48
89.32	998	1012	19	6	1	0	47	26
90.1	988	1022	28	20	5	2	48	55

Appendix F

Charcoal Grid



Measuring Area	**Counts**
1/1 Full rectangle = 100 * 140 µm = 14000 μm^2	1 Full rectangle = 64 squares
½ of rectangle = 100 * 70 µm = 7000 μm^2	½th rectangle = 32 squares
¼ of rectangle = 70 * 50 µm = 3500 μm^2	1/4th rectangle = 16 squares
1/8 of rectangle = 50 * 35 µm = 1750 μm^2	1/8th rectangle = 8 squares
1/16 of rectangle = 35 * 25 µm = 875 μm^2	1/16th rectangle = 4 squares
1/32 of rectangle = 25 * 17.5 µm = 437.5 μm^2	1/32 rectangle = 2 squares
1/64 of rectangle = 12.5 * 17.5 µm = 218.5 μm^2	1/64th rectangle = 1 square

Geometric mean

1/64th = SQRT ((219)*(438)) = 309.4 μm^2 (instead of 218.5 μm^2)

1/32 = SQRT ((438)*(875) = 618.7 μm^2 (instead of 437.5 μm^2)

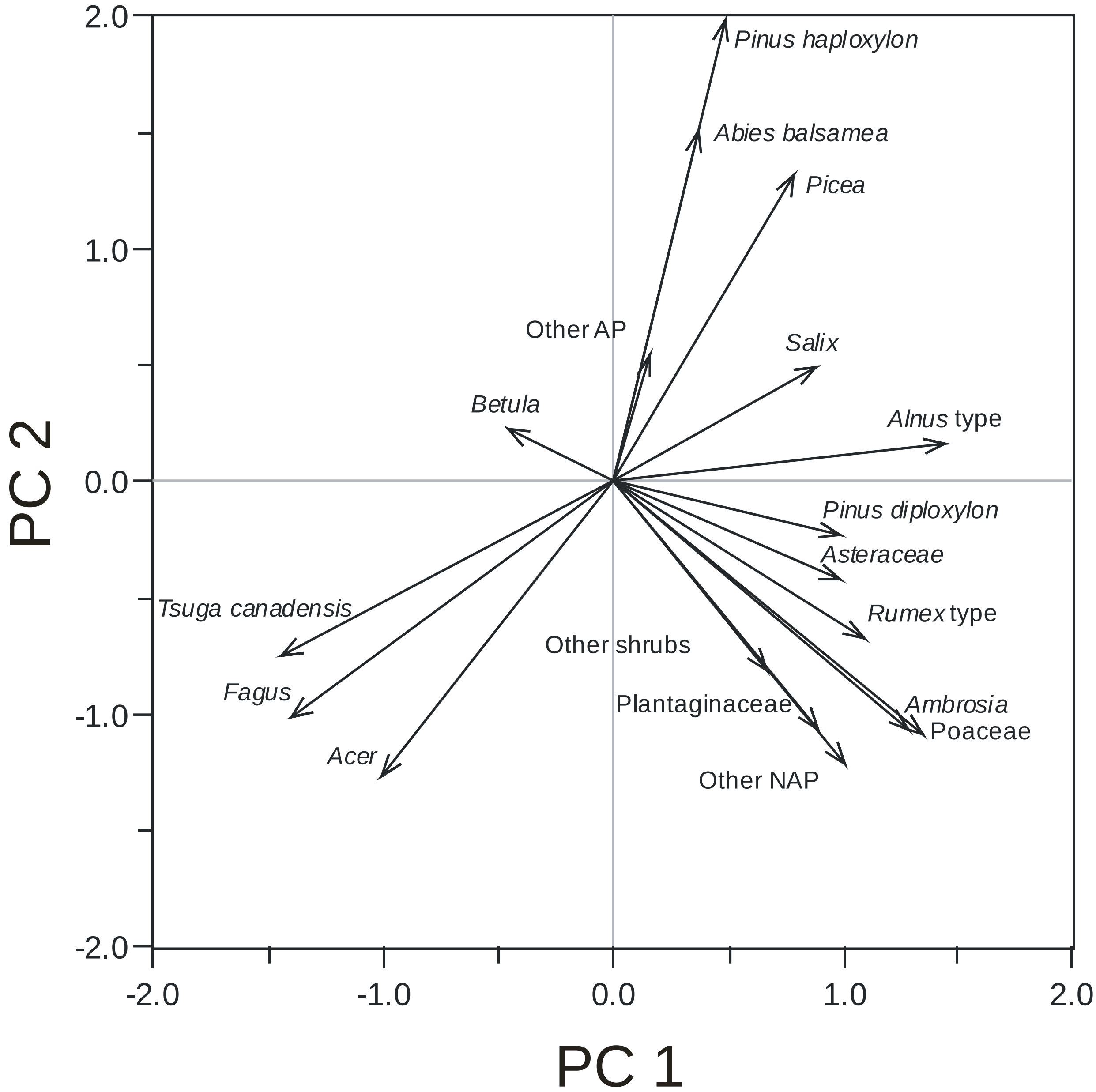
1/16 = SQRT ((875)*(1750)) = 1237.4 μm^2 (instead of 875 μm^2)

1/8 = 1750 μm^2 (particles counted individually)

The counts were multiplied by the geometric mean to get the total area per class.

Appendix G

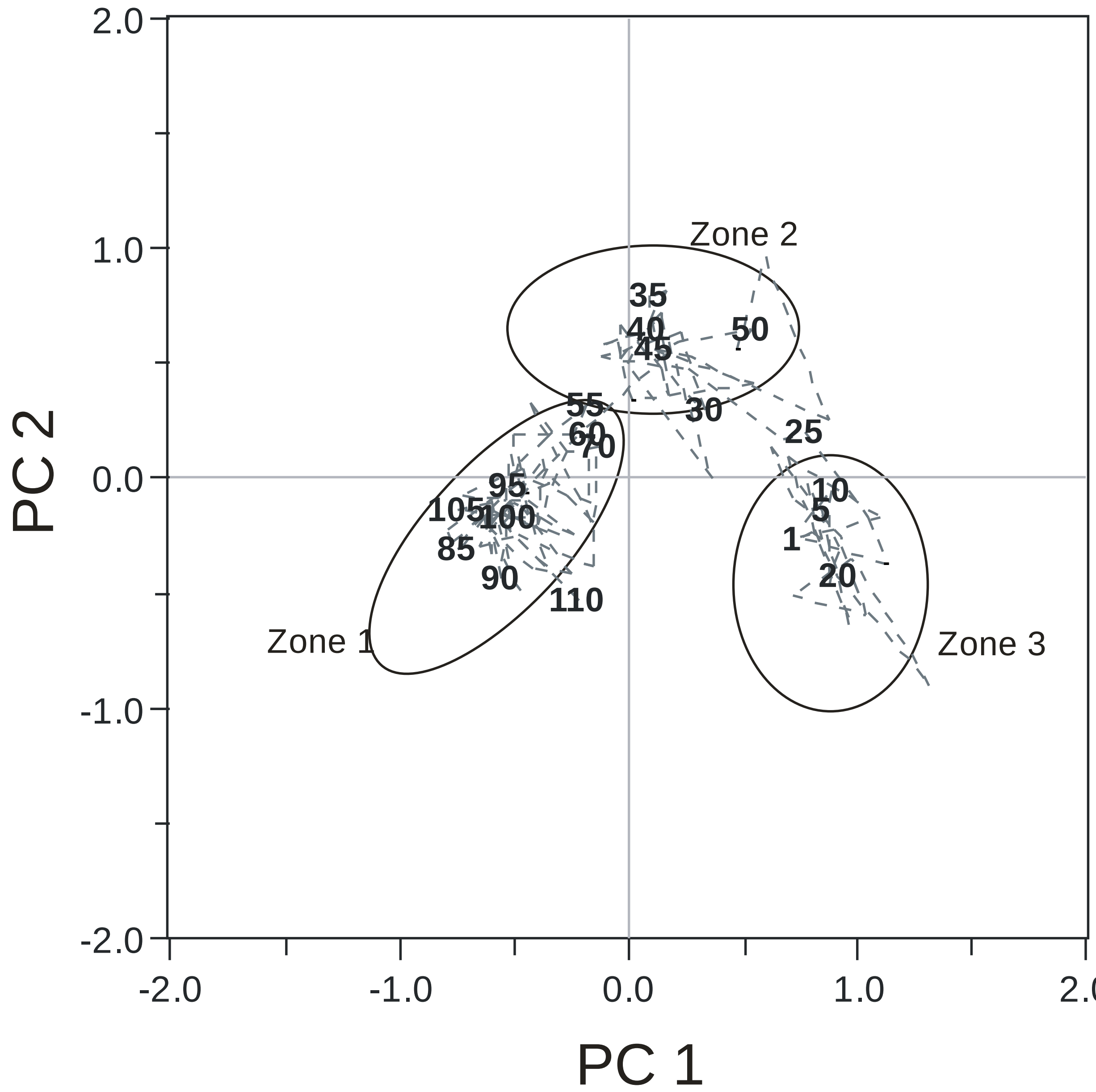
PCA Plots for Lac Noir



Sample species

Appendix G continued…

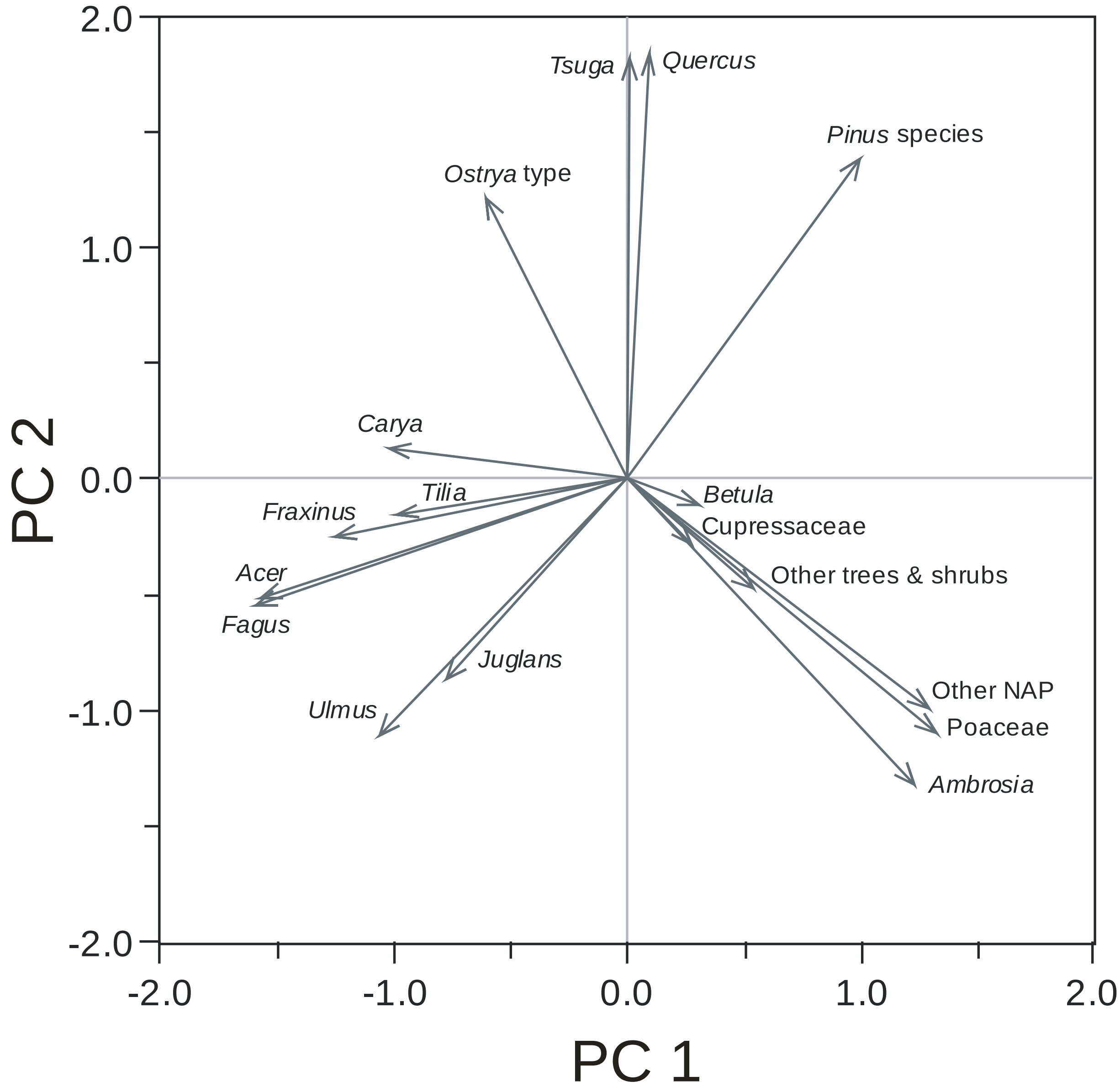
PCA Plots for Lac Noir



Sample scores

Appendix H

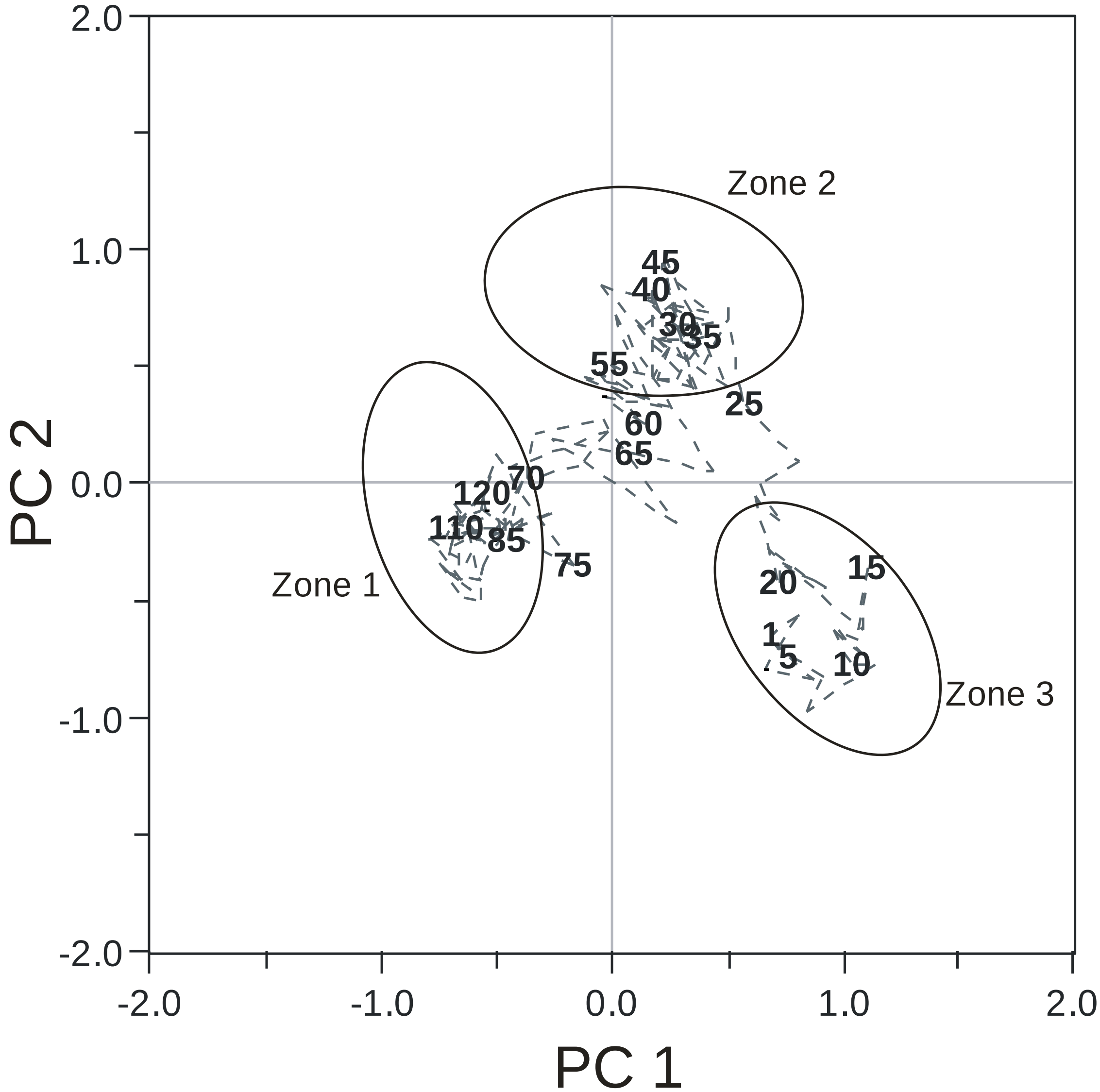
PCA Plots for Crawford Lake



Sample species

Appendix H continued…

PCA Plots for Crawford Lake



Sample scores