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Post-glacial vegetational history of the Great Bog, Belgrade, Maine

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POST-GLACIAL VEGETATIONAL HISTORY OF THE GREAT BOG, BELGRADE, MAINE

by

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ABSTRACT

POST-GLACIAL VEGETATIONAL HISTORY OF THE GREAT BOG, BELGRADE, MAINE

By John P. Dawson

A 6-m vibracore taken from the Great Bog in Belgrade, Maine, was sampled for pollen analysis at 10-cm intervals. Samples were processed in the laboratory using standard techniques developed by Faegri and Iversen. The sediment in the sample was reduced to a residue of pollen which was mounted on microscope slides. A minimum of 300 pollen grains was identified and counted at each level using a compound microscope at 400x magnification. Five radiocarbon dates were taken from the core at stratigraphic boundaries. Lastly, pollen concentration and pollen accumulation rates were calculated.

The uppermost 3.8 m of the core is fine peat; this overlies 1.5 m of lacustrine clay below which are additional organic deposits. Approximately 1.5 m of silty clay was lost from the bottom of the core during coring. ^{14}C dates from above and below the clay are statistically equivalent, suggesting very rapid deposition; a basal date on the core is also statitically equivalent in age, but is probably contaminated. Rapid deposition of the clay could have been caused by mass wasting or upland denudation. Dramatic erosion of the uplands could be caused by clearing of vegetation by a forest fire, but this is not supported by any significant charcoal in the core. Additional work is

planned to delimit the areal extent of the clay unit and resolve the apparent dating anomalies in the lower core.

Although the post-glacial pollen record generated in this study at Great Bog is incomplete, it is highly detailed. The pollen record indicates that the Great Bog was an open embayment of Great Pond from 8,500 to 6,500 b.p. The change in the aquatic vegetation at the site from the open-water taxa *Nuphar, Nymphaea,* and *Brasenia* to *Eriocaulon* and abundant *Sphagnum* spores suggests that the water level at Great Bog may have dropped and subsequently allowed a *Sphagnum* mat to develop. It is possible that this occurred at the same time as a mid-Holocene drop in water level of lakes throughout Maine.

Pinus dominated the regional vegetation also until 6,500 b.p. when *Tsuga* and *Fagus* appeared in significant percentages. *Tsuga* had a temporary demise around 4,000 b.p. that is recorded regionally and was possibly caused by a pathogen. At 30-cm depth, there was an increase in *Ambrosia,* which reflects agricultural clearing at the start of European colonization of this region.

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Over the course of this past year, there have been many who have helped make this project possible. First, I must thank Associate Professor Robert Nelson, otherwise known as Dr. Bob, for being my mentor not only for this project, but also for all my years at Colby. All the advice that he has given will last for my entire lifetime.

I would like to thank Merck Research Laboratories for the Merck/Leighton Fellowship that made it possible to work on this project during the summer of 1994. I would also like to thank the Division of Natural Sciences at Colby College for two grants (to Assistant Professor Paul Doss and Associate Professor Robert Nelson) that paid for the five radiocarbon dates, and the Independent Studies Committee for allowing me to do this project under the Senior Scholars' Program.

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<u>*DEDICATION*</u>

This is dedicated to my mom. Without her strength and joy of life, none of this would have been possible.

INTRODUCTION

The post-glacial vegetational history of central Maine is only known from a few detailed pollen records (Figure 1 and Table 1). Pollen analyses performed in Maine during the 1940s and 1950s (Deevey, 1951; Potzger and Friesner, 1948; Graham, 1948) did not have radiocarbon dates to aid in reconstructions of the timing in the changes in the post-glacial vegetational history, nor were they as detailed as more recent research (Anderson *et al.*, 1992; Davis *et al.*, 1975).

Today, the vegetation at the Great Bog is highly variable from one area to another. Ferrini (1995) studied the pollen in 12 surface samples from Great Bog. She was able to show that the modern pollen rain at Great Bog is statistically the same at all sites, despite the variability in the vegetation throughout the bog. This implies that any changes in the pollen record of major taxa at Great Bog will represent changes in the regional vegetation and not small variations in the local vegetation. Although the pollen record reflects changes in the regional vegetation, elements that make up the local vegetation do appear as minor elements in the record. These plants (aquatics, heaths, etc.) produce very little pollen compared to upland plants, so their long-term presence or absence can be the only basis for interpretation. More to the point, any minor to moderate fluctuations in pollen percentages of open-water aquatics cannot be interpreted with any certainty.

The primary objective of this study was to obtain a well-dated and detailed post-glacial pollen record at Great Bog that could augment existing records in central Maine. Along with the changes in the regional vegetation, it is hoped that changes in the vegetation at Great Bog itself can be understood better. The final objective of this study was to understand better the stratigraphy of Great Bog.

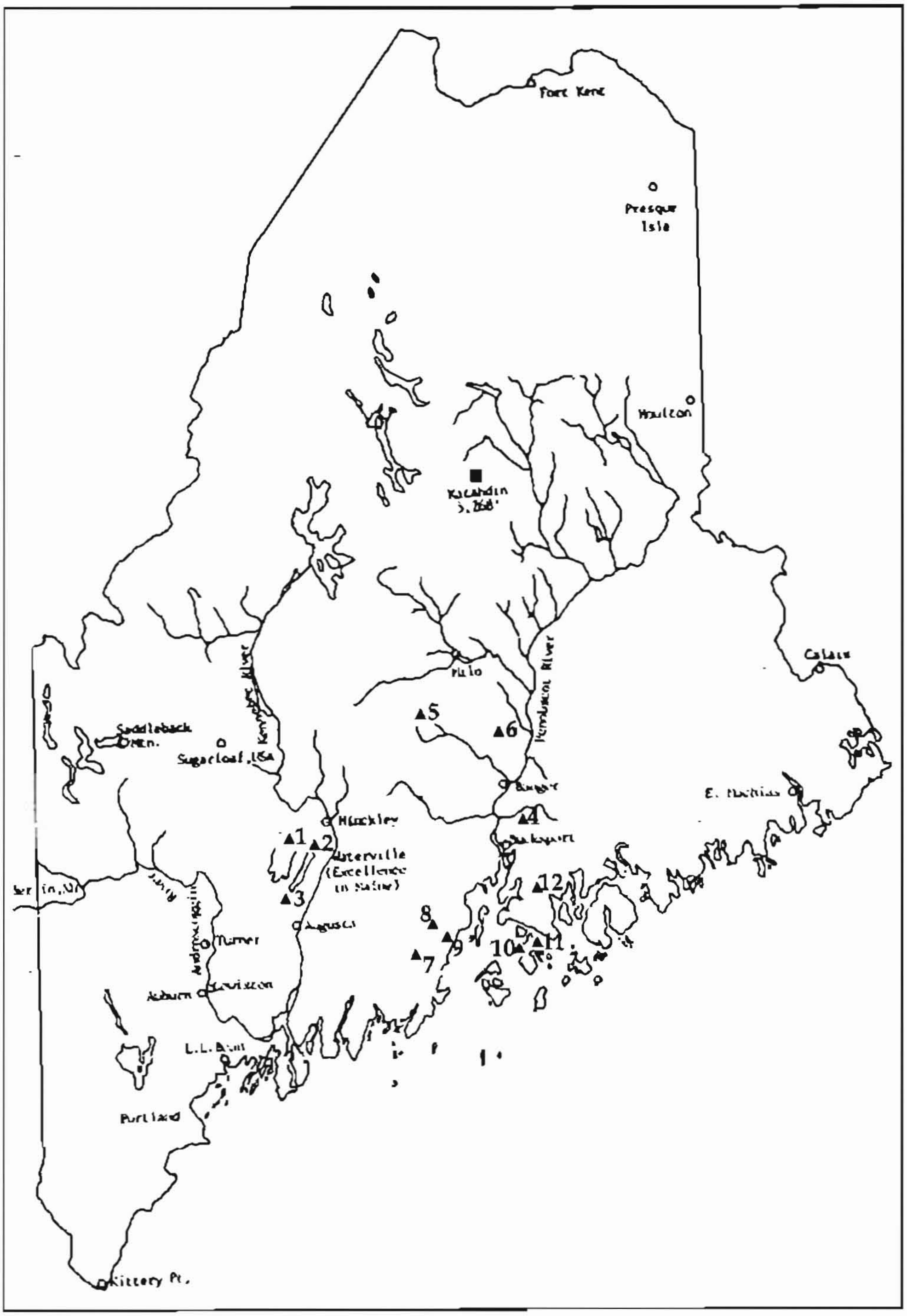

Figure 1: Map of Maine showing selected sites that are mentioned in this paper. Site 1 is the location of this study at Great Bog, Belgrade. See Table 1 for description of each site.

Table 1: List of sites in figure 1 with their locations and references.

SITE	LOCATION	REFERENCES
1	Great Bog, Belgrade	This Study
2	Muddy Pond, Oakland	Deevey, 1951
3	Gould Pond, Sidney	Deevey, 1951
4	Moulton Pond, near Bucksport	Davis *et al.*, 1975
5	Gould Pond, Dexter	Anderson *et al.*, 1992
6	Orono Bog, Orono	Graham, 1948
7	W. Rockport Bog ,W. Rockport	Potzger & Friesner, 1948
8	Mullins Pond, Camden	Potzger & Friesner, 1948
9	Mt. Megunticock Bog, Camden	Potzger & Friesner, 1948
10	Keith's Heath, MDI	Potzger & Friesner, 1948
11	Morrison's Heath, MDI	Potzger & Friesner, 1948
12	George's Heath, Franklin	Potzger & Friesner, 1948

LOCATION AND DESCRIPTION OF STUDY SITE

Great Bog is located in Belgrade, Maine, bordering Great Pond, and covers an area of 0.5 square miles. It is approximately 1.5 miles long (north to south) and 0.5 miles wide (east to west). It is bordered to the west by Horse Point, an esker segment, and to the east by Bickford Hill (Figure 2). Great Bog may have been created through a process called paludification, in which the boundaries of a lake are flooded due to climate or geologic change (BOFEA, 1991).

The vegetation in Great Bog today mainly consists of a *Sphagnum* mat

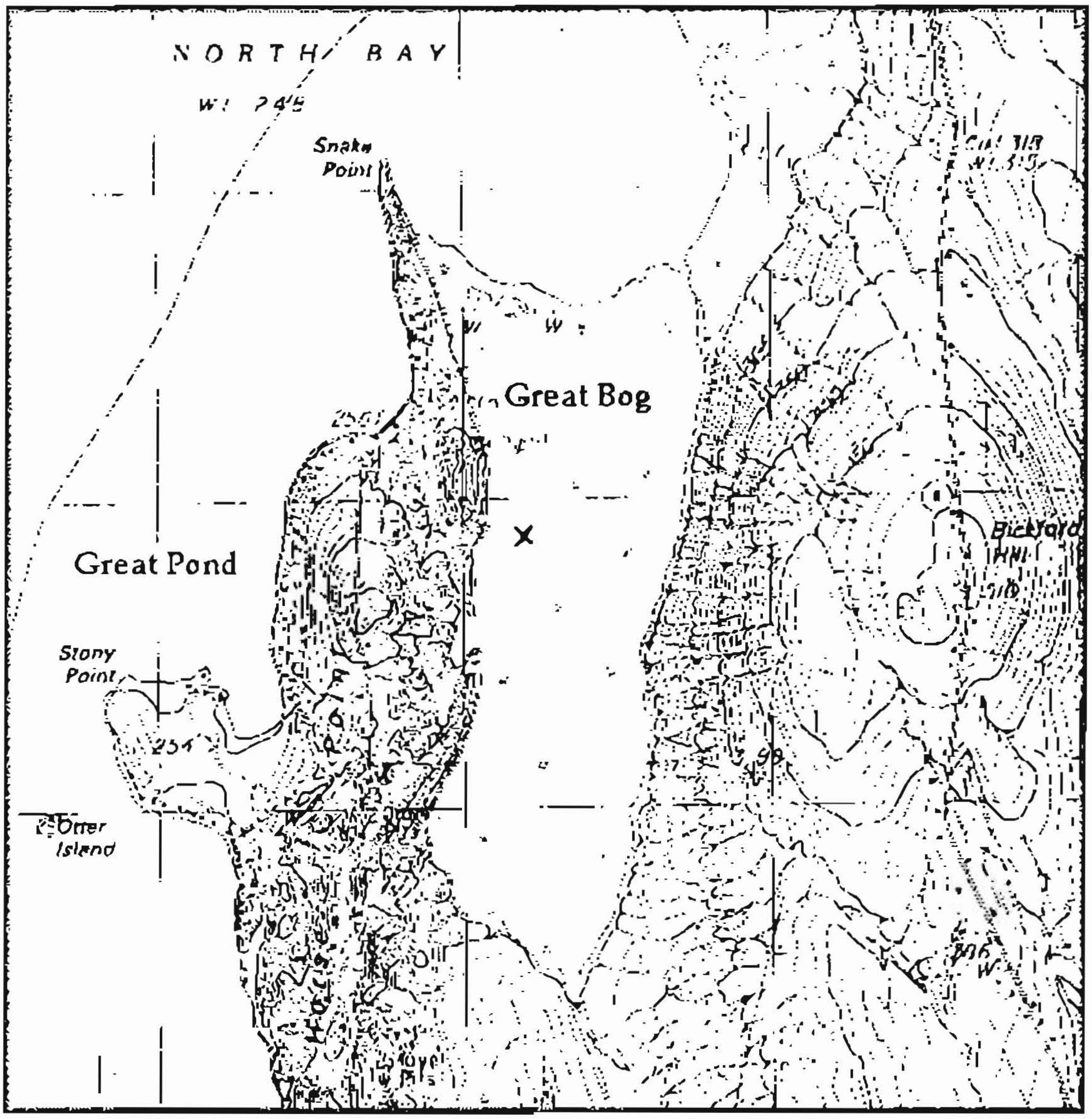

Figure 2: A map of Great Bog, which is adjacent to North Bay of Great Pond. The "X" marks the approximate location from which the core was taken. (Adapted from the USGS Rome, Maine 7.5-minute quadrangle with scale 1 : 24,0000.)

with *Osmunda cinnamomea* (cinnamon fern), *Picea mariana* (black spruce), *Nemopanthus mucronatus* (mountain holly), and *Chameadaphne calyculata* (leatherleaf). The uplands immediately around the bog are covered mostly by *Tsuga canadensis* (hemlock) and *Pinus strobus* (white pine) with

Lycopodium spp. (club mosses), *Betula spp.* (birch), *Corylus sp.* (filbert), *Osmunda cinnamomea*, and *Acer rubrum* (red maple). *Acer saccharum*, (sugar maple), *Quercus rubra* (red oak) and *Fagus grandifolia* (beech) are major hardwoods farther away from the bog margins.

METHODS

Field Methods

In the summer of 1993, Assistant Professor Paul Doss and students from the Colby College Department of Geology collected a 6-m core from Great Bog using vibracoring techniques (Thompson *et al.*, 1991). For vibracoring, a concrete vibrator is used to make an oscillation in a 30-ft section of 3-inch diameter aluminum irrigation pipe while it is held upright with the aid of a 14-ft tripod. The base of the pipe liquefies the sediment below it and sinks into the ground under its own weight. Afterwards, it was capped off at the top and removed from the ground. While in the field, the 6-m core was cut into smaller sections, sealed, and transported to the laboratory.

Laboratory Methods

In the laboratory, the irrigation pipe was cut lengthwise using a circular saw. The core was sampled at 10-cm intervals and two to three cubic centimeters of sediment removed at each level using a paring knife. To avoid contamination by airborn particles in the laboratory the surface layer at each level was scraped off before extracting the sample. In addition to this, five samples for radiocarbon dating were taken at the major stratigraphic boundaries: at the bottom of the core, at the bottom of the clay unit, at the top of the clay unit, at the 1.93-m depth, and at the 0.42-m depth, where there was a slight change in the coloration of the peat unit. All samples were placed in sterile plastic bags, sealed, and stored in a refrigerator until final processing.

The sediment samples were processed in the laboratory using techniques developed by Faegri and Iversen (1989) which reduce the volume of the sediment down to a pollen-rich residue. The basic steps are:

1) dissolve the amorphous organic decomposition products with 5% potassium hydroxide in a boiling water bath for 10 minutes,
2) remove particles larger than pollen grains by coarse sieving with a 250μm mesh,
3) dissolve any carbonates with 10% hydrochloric acid in a boiling water bath for 10 minutes,
4) dissolve silicates with 48% hydrofluoric acid in a boiling water bath for 30 minutes, and
5) dissolve some of the cellulose through acetylation, a process that uses a mixture of one part sulfuric acid and nine parts acetic anhydride, in a boiling water bath for five minutes.

Samples that were composed mostly of clay were sieved using a 10μm mesh (Cwynar *et al.*, 1979), and were treated by hydrofluoric acid in a boiling water bath for one to two hours. The remaining residue of mostly pollen was mounted on microscope slides. Due to expected low pollen abundance's in the clay unit, samples were processed only at the top, bottom, and approximate middle of this unit.

In order to compute pollen accumulation rates, the initial volume of the sample, the final volume of the sample, and the amount of sediment placed on each slide were recorded. Final residues were kept in a tert-butyl alcohol (TBA) at a ratio of one part sample to three parts TBA (1:1 for the levels 1-50 cm). There were approximately 4.17 µl (7.14 µl for samples 1-50 cm) of sediment in each drop placed on the study slides, based on measurements made in the laboratory that counted the number of drops of residue there are in a milliliter.

Pollen grains in each sample were identified and counted using a binocular compound microscope at 400X magnification. A modern reference collection and various guides and keys were used to help in the identification of pollen grains (Kapp, 1969; Moriya,1976; McAndrews *et al.*, 1973). Samples were examined until a minimum of 300 pollen grains were identified and counted. The number of identified non-aquatic pollen grains was used as the basic pollen sum, from which were to calculated the percentages of different pollen and spore types in each sample. At first, all of the pollen grains on the microscope slide were identified and counted, because pollen accumulation rates were being computed . This proved to be very time consuming since some slides had 1,000 to 2,000 pollen grains on them. To avoid having to count 1,000 to 2,000 pollen grains, only one-half or one-quarter of a slide was examined. In addition to identifying and counting the pollen in the samples, charcoal was examined for any qualitative changes throughout the core.

The computer program TILIA was used to create a pollen diagram, to calculate the pollen accumulation rate, and to perform a cluster analysis on the data. Microsoft Excel was used to record the raw pollen counts and to calculate pollen concentrations in the samples (see Appendices). To calculate the pollen concentration the following formula was used:

$$P_c = \Sigma\, P / (\, n_s \times n_d \times sed \,) \times V_f \,/\, V_i$$

Where P_c is the pollen concentration (number of pollen grains per cubic centimeter of sediment), ΣP is the basic pollen sum, n_s represents the percentage of the microscope slide counted, n_d is the number of drops on the slide, sed is the number of cubic centimeters of sediment in each drop, and V_f and V_i represent the final and initial volumes of the sample in cubic centimeters respectively. Finally, average sedimentation rates were calculated based on sediment thickness between the radiocarbon dates.

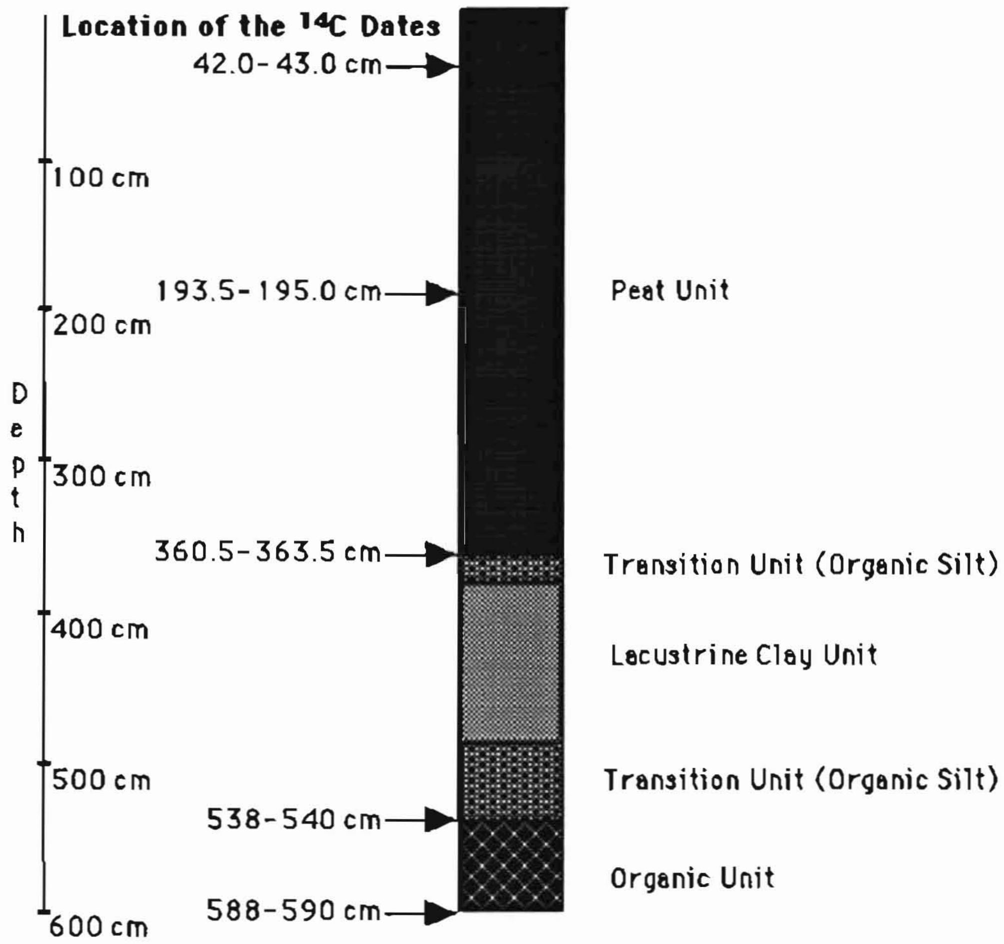

Figure 3: The basic stratigraphy of the core showing location of the radiocarbon dates.

Results

Stratigraphy of the Core and Radiocarbon Dates

At the bottom of the core there is approximately 60 cm of clayey organic sediments (Figure 3). Around 5.4 m a transition from the clayey organic sediment to a lacustrine clay begins and ends around 4.9 m where the organic component of the sediment declines. Overlying the clay is another transition layer from 3.8 m to 3.6 m into a peat unit at the top of the core.

While extracting the core from the bog, it was estimated in the field that approximately 1.5 m of silty clay was lost from the end of the core. This probably broke off at a stratigraphic boundary. Another core taken from Great Bog at a location that was closer to the margin than the core used in this study has a thicker unit of clay in it (Doss, personal communication).

Due to rapid drying in the laboratory, the core contracted about 10 cm before sampling was completed; therefore the sample marked 590 cm probably represents 600 cm.

Table 2: Table of radiocarbon dates for Great Bog core. Dates are based on the Libby half-life of 5568 years; ages are ± 1 σ.

TELEDYNE Sample number	Sample Depth (cm)	$-\delta^{14}C$	Age in Years B.P.
I - 17,827	42.0 - 43.0	146 ± 8	1270 ± 80
I - 17,828	193.5 - 195.0	513 ± 7	5780 ± 120
I - 17,829	360.5 - 363.5	657 ± 8	8590 ± 200
I - 17,830	538.0 - 540.0	658 ± 9	8620 ± 240
I - 17,831	588.0 - 590.0	645 ± 9	8320 ± 240

An average sedimentation rate of 0.331 mm/yr. was calculated between the top of the core and the radiocarbon date at 0.42-m depth, an average sedimentation rate of 0.335 mm/yr. was calculated between the radiocarbon date at 0.42-m depth and the radiocarbon date at 1.93-m depth, and an average sedimentation rate of 0.594 mm/yr. was calculated using the radiocarbon date at 1.93-m depth and the radiocarbon date above the clay unit at 5.38-m depth. All ages for the major changes in the pollen record were estimated using these average sedimentation rates. With the standard errors included the bottom three radiocarbon dates (I-17,829 to I-17,831) are statistically the same.

The Pollen Record

In the pollen record at the bottom of the core, *Nuphar* (pond lily), *Nymphaea* (water lily), *Potamogeton* (pondweed), *Brasenia* (watershield), and Cyperaceae (sedges) are present (Figure 4). The total for these aquatics at the bottom of the core is between 2.5% and 8% of the basic pollen sum up until the 5.4-m depth, at the beginning of the transition from the organic unit to the clay unit, where the percentage drops. Above the clay unit the aquatics increase again.

At the 2.3-m depth *Sphagnum* appears in the record. There is an overlap between the open-water aquatics and the *Sphagnum* until the 2.0-m depth where the total percent of the aquatics declines to less than 2%. This overlap is mainly due to the presence of *Eriocaulon* (pipewort), and this is the only time this pollen taxon is present in the record. *Sphagnum* is present in varying percentages throughout the rest of the pollen record. In addition to *Sphagnum*, *Myrica* (sweet gale) and Ericales (e.g. bog laurel and Labrador tea)

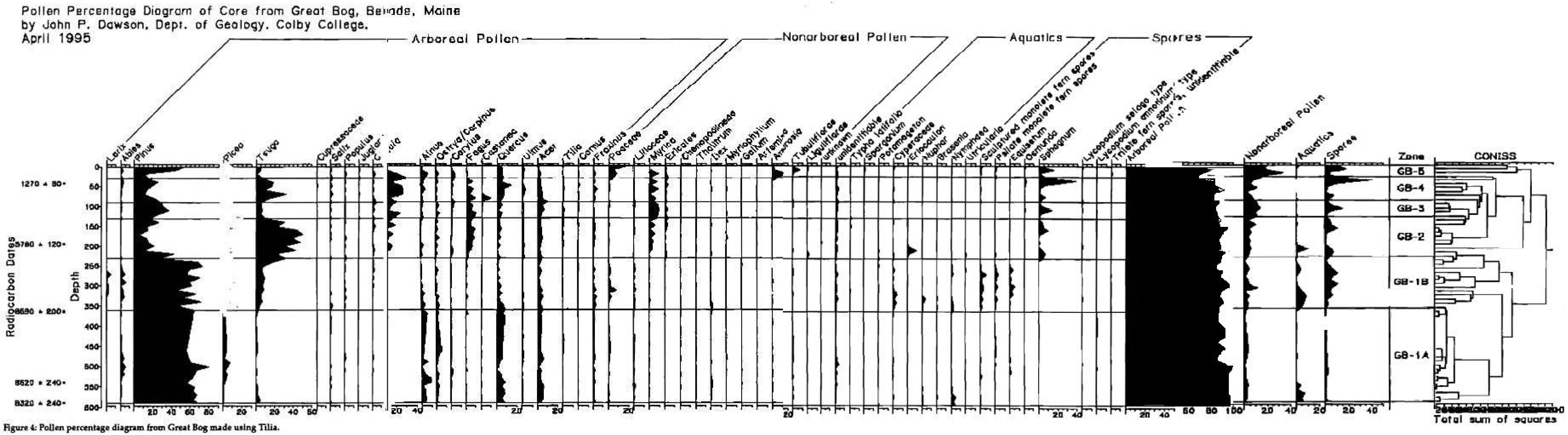

Figure 4: Pollen percentage diagram from Great Bog made using Tilia.

are present in the record from the 2.3-m depth to the top of the core. Finally, *Osmunda* is sporadically present in the record in low abundance.

Early in the pollen record *Pinus* is present in percentages ranging from 45% to 80%. *Quercus* (oak) is also found in the record early on, but in percentages ranging from 4% to 10%. At the 3.6-m depth, *Betula* declines from greater than 10% to less than 5%. *Picea* is also present early in the pollen record, but without any dramatic changes. Hardwood taxa such as *Acer, Ulmus* (elm), *Corylus* and *Fraxinus* (ash) are also present throughout the pollen record. *Populus* (poplar) is also present throughout the core, but in values less than 2.5%.

At the 2.3-m depth *Pinus* and *Quercus* decline and there is a dramatic increase in *Tsuga* percentages. Along with the increase in *Tsuga, Betula* increases and *Fagus* (beech) appears for the first time in the record in significant abundance. *Tsuga* has a peak at the 2.1-m depth with subsequent decline from 1.3 to 0.9 m. There are increases in *Pinus* and the total nonarboreal pollen during the *Tsuga* decline. With very low percentages, *Carya* (hickory) and *Tilia* (linden) are present in the upper part of the record.

At the 30-cm depth, there is a spike in *Ambrosia*, Poaceae (grasses), Tubuliflorae (e.g. *Aster* or goldenrod), and Liguliflorae (e.g. dandelion) with declines in *Pinus* , *Picea, Tsuga, Fagus,* and *Fraxinus*. Poaceae has a secondary spike at the top of the core along with a small increase in percent for *Pinus, Picea*, and *Tsuga* and decline in *Ambrosia*. *Fagus* and *Fraxinus* do not have any subsequent increases.

Pollen Concentration and Pollen Accumulation Rates

The pollen concentration (Figure 5) throughout the core is highly

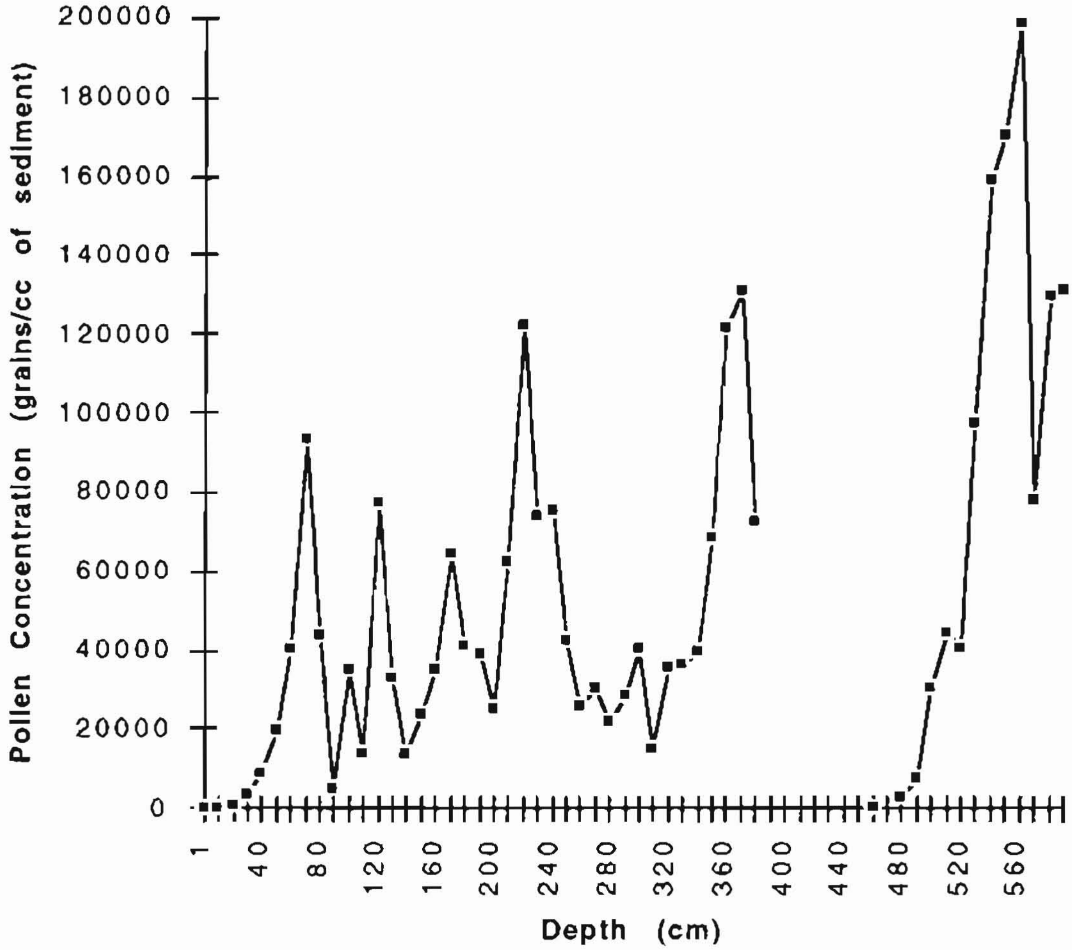

Figure 5: The change in the pollen concentration (# pollen grains/cm^3 of sediment) in the record.

variable. There is a dramatic decline in pollen concentration in the clay unit starting at the 5.2-m depth. Following this decline, there is a rapid increase in the pollen concentration at 3.6 m which is followed by a decline. There are also peaks in the concentration at 2.3 m, 1.7 m, 1.2 m, and 0.7 m. After the final peak at 0.7 m, the pollen concentration continually decreases to the top of the core. Overall, the pollen concentration seems to increase with depth in

Pollen Accumulation Rates for Core from Great Bog, Belgrade, Maine
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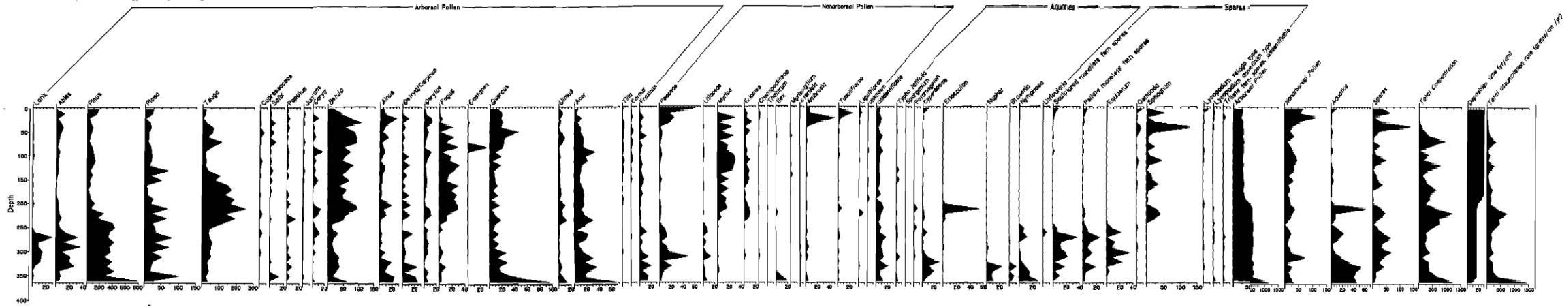

Figure 6: Pollen accumulation rates (# grains/cm2 of sediment/yr) for a core from Great Bog.
Note that the horizontal scales are not the same for each pollen taxon.

the core, except in the clay unit where concentrations were orders of magnitude lower than in the organic sediments.

Because the bottom three radiocarbon dates are statistically the same, pollen accumulation rates were only calculated above 3.6 m (Figure 6). For the overall accumulation rate, there are peaks at 2.3 m, 1.2 m, and 0.7 m with the rest of the graph being relatively unchanging. For the last 0.5 m the pollen accumulation rate has very low values.

The pollen accumulation rates follow the same general trends as the pollen percentages for the major taxa in the record. *Pinus* has a high accumulation rate until 2.3 m where it starts to decline. *Betula* has a low accumulation rate until the 2.3-m depth where it increases along with an increase in the accumulation rate for Poaceae. The *Tsuga* accumulation rate starts to increase at the 2.5-m depth and peaks around the 2.3-m depth with a subsequent decline from 1.5 to 0.9 m. During the *Tsuga* decline, there are increases in *Pinus* and the total nonarboreal pollen accumulation rates. At the 0.3-m depth, there is an increase in the *Ambrosia* accumulation rate with drops in rates for *Pinus, Tsuga, Betula,* and *Fagus*. Finally, at the very top of the core rates for *Pinus, Tsuga,* and Poaceae increase, and *Ambrosia* decreases.

DISCUSSION

The Clay Unit

The post-glacial sedimentation record at Great Bog is unusual for Maine. It has an organic unit that was deposited around 8,500 years ago, based on the radiocarbon dates. On top of this organic unit there is a lacustrine clay unit, which in turn is overlain by a peat unit.

The bottom three radiocarbon dates are statistically the same (Table 2). The date above the clay unit and the date below the clay unit are believable, because it is conceivable that an inorganic unit could be deposited very rapidly. Very low pollen concentration (Figure 5) throughout the clay unit supports this interpretation. The basal radiocarbon date is highly suspect, because the radiocarbon dates suggests rapid deposition of the 0.6-m organic unit at the bottom of the core, yet sediments such as this are usually deposited over a longer period of time. The sample submitted for analysis was most likely contaminated by younger organics from the higher in the core during coring operations in the field.

The rapid deposition of the clay unit could have been the result of a slumping of the uplands. Another core taken closer to the margin of the bog than the core in this study had a thicker unit of clay and supports this hypothesis (Doss, personal communication). It is interesting to note that Horse Point, an esker segment, does not have any the marine Presumpscot clays on it (Mostoller, 1994), which are typically found in the stratigraphic record throughout lowland coastal Maine (Bloom, 1963; Stuiver and Borns, 1975). Therefore, the clay unit found in the stratigraphy of Great Bog could have originated from Horse Point to the west of the bog. Also, rapid erosion of the uplands around the bog can be the result of a forest fire that may have destroyed the vegetation. This is, however, not supported by the sparse charcoal evidence in the core. Overall, it is difficult to interpret charcoal data from any core, since presence of charcoal could represent local or regional forest fires, but a high abundance of charcoal would likely represent a major fire in the region. In the record at Great Bog, there does not appear to be a peak in charcoal abundance at the same time as the start of deposition of the clay unit.

Development of Great Bog

Great Bog has had an exciting history over the past 8,500 years. Early in the pollen record *Nuphar*, *Nymphaea*, *Potamogeton*, and *Brasenia* were present, which indicates that Great Bog had open water and was relatively shallow. In fact, Great Bog was an open embayment of Great Pond.

Around 6,500 b.p. *Eriocaulon* appears in the record with the first appearance of *Sphagnum*. At the same time, *Nuphar*, *Nymphaea*, and *Brasenia* disappear from the record. *Eriocaulon*, since it is a submergent aquatic, exists in very shallow water depths or very clear bodies of water, while *Nymphaea*, *Nuphar*, and *Brasenia*, which are emergent aquatics, can exist in slightly deeper waters. *Eriocaulon* is found in Great Pond today in water depths up to 2 m. The presence of *Eriocaulon* indicates that it is possible that the depth of the water in Great Bog had decreased. This could be caused by the natural process of sediment filling in the lake or by a mid-Holocene lake level drop recorded in some lakes of Maine between 6,700 and 8,800 b.p. (Northrop, 1995). The latter possibility is consistent with late-glacial arid conditions seen in eastern North America prior to 6,000 b.p. (Harrison, 1989). Whatever the case may be, a decrease in water depth in the basin undoubtedly helped facilitate the development of the *Sphagnum* mat.

Eriocaulon, along with other aquatics at the site, disappeared around 6,000 b.p., which indicates that the *Sphagnum* mat of the bog had completely closed in. The small tree and shrub zone at Great Bog, which is typically found at the margin of most bogs today, started to develop with the appearance of *Myrica* and Ericales.

Regional Vegetation

By visually inspecting the diagram (Figure 4), zonation of the major trends in the vegetation was made. The period where *Pinus* has high percentages, from the bottom of the core to the 2.3 m depth, was named Zone GB-1. A subzone of this, GB-2A, marks the brief decline in *Betula*. Zone GB-2 is marked by maximum values for *Tsuga*, and Zone GB-3 starts at the decline of *Tsuga* and ends with the start of Zone GB-4, where the abundance of *Tsuga* increases again. The final zone, GB-5, is from the 0.3-m depth to the top of the core, where *Ambrosia* dramatically increased. The cluster analysis that was performed using TILIA supports this zonation.

The pollen record at Great Bog starts with Zone GB-1 which represents a conifer-hardwood forest with high amounts of *Pinus* and *Quercus*. Also, *Picea had relatively low percentage of abundance during this period.* This zone can be correlated to Zone IIA at Moulton Pond (Davis *et al.*, 1975), to the White Pine and Hardwoods Zone at Gould Pond (Anderson *et al.*, 1992), and to the "pine period" zones of early researchers (Deevey, 1951; Graham, 1948; Potzger and Friesner, 1948). During this period the climate in the region could have been warm and dry. Davis *et al.* (1975) also suggested that *Pinus* could also be found at locations where the soil is poor, since it is a pioneer. At Moulton Pond the "pine period" lasted from 9,700 to 7,100 b.p., whereas at Gould Pond it lasted from 10,550 to 7,300 b.p. Around 8,600 b.p., at the beginning of Subzone GB-1B, *Betula* declines in abundance in the region. This decline in *Betula* is seen in all locations in Maine (Anderson *et al.*, 1992; Davis and Jacobson, 1985; Davis *et al.*, 1975; Deevey, 1951; Graham, 1948; Potzger and Friesner, 1948). At Great Bog, the end of this period came at ca. 6,500 b.p.

At the start of Zone GB-2, about 6,500 b.p., *Tsuga* and *Betula* increased in abundance as *Pinus* declined. Also, *Fagus* appears in the record for the first time in significant amounts. This period could represent a time when the climate in the region was cooler and more moist than earlier. This zone correlates well with Zone II (7,100 - 4,700 b.p.) at Moulton Pond and the early part of the hemlock and hardwood zone (7,300 - 200 b.p.) at Gould Pond.

In Zone GB-3, *Tsuga* experienced a dramatic drop in abundance between 4,000 and 2,700 b.p. At the same time *Pinus*, Poaceae, and other taxa show slight increases, which were probably due to space being opened up in the forest for them to grow during the *Tsuga* demise. Some researches attribute this demise of *Tsuga* to a pathogen that is similar to the chestnut blight and Dutch elm disease of modern times (Allison *et al.*, 1986), but almost none of the studies in Maine mention this as a cause. In fact, many believe that this was just a change to warmer and drier climates (Deevey, 1951; Graham, 1948) while others neither attributed much importance to it (Davis *et al.*, 1975) or did not know what to make of it (Potzger and Friesner, 1948).

This decline in *Tsuga* at Great Bog apparently occurred more recently than at other sites in Maine, where it was recorded from 5,500 to 4,300 b.p. (Anderson *et al.*, 1992; Davis *et al.*, 1975). However, this discrepancy could merely be a reflection of errors in estimated timing based on the calculated average sedimentation rates. In general, deposition and compaction of sediments are non-linear processes and discrepancies in the estimated dates can be attributed to this. With additional radiocarbon dates, it would be easier to estimate sedimentation rates and hence the time when the changes occurred, or to date the critical horizon directly.

As for correlation of Zone GB-3 to other pollen records, neither Davis *et al.* (1975) nor Anderson *et al.* (1992) make a zonation that includes the decline in *Tsuga*. Davis *et al.* (1975) do have Zone III that lasted from 4,700 to 200 b.p., which extends from approximately the middle of the *Tsuga* demise to the beginning of the European period.

In the Great Bog record, when *Tsuga* increases in abundance again and *Pinus* and Poaceae decrease, Zone GB-4 begins. This period lasted from 2,700 to 200 b.p. and is marked by the forest returning to the composition it had before the *Tsuga* demise. At the end of this time period there is a peak in *Ambrosia* and a smaller peak in Poaceae. Concurrently, most of the arboreal taxa experience decreases in abundance. This is typically interpreted as the beginning of European colonization of this region around 200 b.p., when the forests were cleared for agriculture. Sedimentation rates yielded a date of around 900 b.p. for the peak in *Ambrosia*, but this inconsistency in the date is likely due to differential compaction of the sediments.

Lastly, at the top of the core, there were slight increases in *Pinus* and *Tsuga*, which indicates that the forests started to return their condition during pre-European times as agriculture declined in the latter half of the twentieth century. In addition to this, *Ambrosia* drops and Poaceae has a large peak in percentage, which could reflect the growing dominance of dairy pasture and hayfields as agricultural practices shifted in the past half-century to dominance by dairying. *Ambrosia* does not flourish in such relatively stable herbaceous environments, but Poaceae, Tubuliflorae, and Liguliflorae do.

The pollen record at Great Bog does not represent all of post-glacial time even for this local area. Radiocarbon dates on wood fragments taken from kettles near Horse Point suggest that this area was ice-free as early as 12,000 b.p. (Stuiver and Borns, 1975). The basal radiocarbon date on the Great

Bog core is about 8,300 b.p., but correlation of the pollen record at Great Bog to other sites in Maine (Anderson *et al.*, 1992; Davis *et al.*, 1975) suggest that the basal sediments in the core could be as old as 10,500 b.p. or as young as 9,000 b.p.

Transitions of the Forests

Generally, pollen accumulation rates can let a researcher know when the forest have started to change while the pollen percentages only reflect what the relative composition of the forest at a giving time (Faegri and Iversen, 1989). At Great Bog, the pollen accumulation rates basically follow the same major trends as the pollen percentages. Therefore, the forests in Maine do not experience rapid changes and in fact, they slowly change from one type to another.

An instance when the forests appear to change rapidly is at the beginning of Zone GB-2 around 6,500 b.p., when *Tsuga* increased. Here the pollen accumulation rate of *Tsuga* started to increase and actually peaked earlier than in the pollen percentages. Also, during the *Tsuga* demise and subsequent revival, most of the major elements in the forests, including *Pinus* and *Betula*, had accumulation rates that rapidly increased. Pollen accumulation rates peak for *Ambrosia* and Poaceae during European colonization of this region, while accumulation rates for *Tsuga*, *Pinus*, *Betula*, and hardwood taxa have decreased.

CONCLUSIONS

The stratigraphy of Great Bog is unusual for post-glacial sediments in Maine in that there are organic-rich sediments beneath a thick lacustrine clay.

Radiocarbon dates and low pollen abundance suggest that this clay unit was very rapidly deposited. This local anomaly could have been due to mass wasting or upland denudation. Forest fires, that would result in clearing of the vegetation in the uplands around Great Bog, making the sediments more susceptible to erosion, but are not supported by definitive charcoal evidence in the record.

The basal radiocarbon date on the sediment and pollen records is about 8,300 b.p. Correlation to other pollen records in the region (Anderson et al., 1992; Davis et al., 1975) suggest that the true basal age is probably at least 9,000 b.p., but no older than 10,500 b.p.

Presence of open-water aquatics, such as *Nuphar, Nymphaea,* and *Brasenia,* indicates that Great Bog was an open embayment of Great Pond, up until 6,500 b.p. when a *Sphagnum* mat developed. A change from *Nuphar, Nymphaea,* and *Brasenia* to *Eriocaulon* could possibly be caused by a mid-Holocene lowering of lake levels throughout Maine (Northrop, 1995). It took about 500 years for the *Sphagnum* mat to become complete, as indicated by the disappearance of open-water aquatics.

The pollen record indicates that the region around Great Bog was dominated by *Pinus* and *Quercus* up until 6,500 b.p., when *Tsuga, Betula, Fagus* and other hardwoods increased in abundance and the *Sphagnum* mat developed. From 4,000 to 2,700 b.p. *Tsuga* experienced a demise in prevalence in the regional vegetation, while *Pinus* and Poaceae increased in abundance. This decline in *Tsuga* could be the result of a pathogen that attacked only this taxon in the forest (Allison *et al.*, 1986). This demise of *Tsuga* at Great Bog is later than at other sites in Maine (Anderson *et. al.*, 1992; Davis *et. al.*, 1975). *Tsuga* had a subsequent increase in abundance, while *Pinus* and Poaceae declined.

At 30 cm depth, *Ambrosia* peaked in abundance along with Poaceae. This represented the beginning of European colonization in the area. Average sedimentation rates suggest that this occurred 900 b.p., but the average sedimentation rates are undoubtedly in error over this brief section of the core due to differential compaction of the sediments in the record. Peaks in *Pinus*, *Tsuga*, and Poaceae and an *Ambrosia* decline within the last 50 years record the historical agricultural shift from row crops to production of hay and pasture, with reforestation of much previously farmed land.

Each of the zones at Great Bog, which represent major changes in the regional vegetation, correlate well with other pollen records in central and coastal Maine. The changes in the regional vegetation around Great Bog apparently occurred later than at other sites in Maine (Anderson *et al.*, 1992; Davis *et al.*, 1975).

Pollen accumulation rates in the record do not show many rapid transitions from one forest to another. During the changeover from a *Pinus*- and *Quercus*-dominated forest to a *Tsuga* and *Betula* forest, pollen accumulation rates are very high. Also, during European colonization, the accumulation rates are relatively high and indicate that the forests rapidly changed to adjust for deforestation.

Overall, the pollen record at Great Bog does not represent all of the post-glacial vegetational history, but the record obtained is highly detailed and reasonably well-dated. Future research needs to be done at Great Bog to delimit the areal extent of the clay unit in the stratigraphy, to resolve the question of the problematic basal radiocarbon date, and to obtain a complete post-glacial pollen record. In addition to this, more modern palynological studies need to be performed in Maine in order to understand better the dynamics of the post-glacial vegetational history in the region.

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APPENDIX A

RAW POLLEN DATA

1CM LEVEL BASIC POLLEN SUM =	344	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN		
Larix		0.0%
Abies	1	0.3%
Pinus	183	53.2%
Picea	25	7.3%
Tsuga	19	5.5%
Cupressaceae		0.0%
Salix		0.0%
Populus	2	0.6%
Juglans		0.0%
Carya		0.0%
Betula	17	4.9%
Alnus	6	1.7%
Ostrya/Carpinus		0.0%
Corylus	1	0.3%
Fagus		0.0%
Castanea		0.0%
Quercus	13	3.8%
Ulmus	1	0.3%
Acer	5	1.5%
Tilia	1	0.3%
Cornus		0.0%
Fraxinus		0.0%
TOTAL ARBOREAL POLLEN	274	79.7%
NONARBOREAL POLLEN		
Poaceae	63	18.3%
Liliaceae		0.0%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	5	1.5%
Tubuliflorae		0.0%
Liguliflorae	2	0.6%
unknown		0.0%
unidentifiable (not added into NAP)	7	2.0%
TOTAL NONARBOREAL POLLEN	70	20.3%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	9	2.6%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	9	2.6%
SPORES		
Sculptured monolete fern spores	7	2.0%
Psilate monlete fern spores	6	1.7%
Equisetum		0.0%
Sum of monolete fern spores	13	3.8%
Osmunda	8	2.3%
Sphagnum	8	2.3%
Lycopodium selago type	7	2.0%
Lycopodium annotinum type	1	0.3%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	37	10.8%

10 CM LEVEL BASIC POLLEN SUM =	607	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN		
Larix		0.0%
Abies	20	3.3%
Pinus	261	43.0%
Picea	41	6.8%
Tsuga	31	5.1%
Cupressaceae		0.0%
Salix	1	0.2%
Populus		0.0%
Juglans	4	0.7%
Carya		0.0%
Betula	70	11.5%
Alnus	12	2.0%
Ostrya/Carpinus		0.0%
Corylus	6	1.0%
Fagus		0.0%
Castanea		0.0%
Quercus	34	5.6%
Ulmus	11	1.8%
Acer	6	1.0%
Tilia	1	0.2%
Cornus	2	0.3%
Fraxinus	2	0.3%
TOTAL ARBOREAL POLLEN	502	82.7%
NONARBOREAL POLLEN		
Poaceae	30	4.9%
Liliaceae		0.0%
Myrica	2	0.3%
Ericales	9	1.5%
Chenopodiineae	3	0.5%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia	1	0.2%
Ambrosia	10	1.6%
Tubuliflorae	43	7.1%
Liguliflorae	7	1.2%
unknown		0.0%
unidentifiable (not added into NAP)	7	1.2%
TOTAL NONARBOREAL POLLEN	105	17.3%
AQUATICS		
Typha latifolia		0.0%
Sparganium	1	0.2%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	1	0.2%
SPORES		
Sculptured monolete fern spores	5	0.8%
Psilate monlete fern spores	7	1.2%
Equisetum		0.0%
Sum of monolete fern spores	12	2.0%
Osmunda		0.0%
Sphagnum	94	15.5%
Lycopodium selago type		0.0%
Lycopodium annotinum type	1	0.2%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	107	17.6%

20 CM LEVEL BASIC POLLEN SUM =	348	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN		
Larix		0.0%
Abies	2	0.6%
Pinus	39	11.2%
Picea	1	0.3%
Tsuga	4	1.1%
Cupressaceae		0.0%
Salix		0.0%
Populus	5	1.4%
Juglans		0.0%
Carya	9	2.6%
Betula	76	21.8%
Alnus	26	7.5%
Ostrya/Carpinus	11	3.2%
Corylus	12	3.4%
Fagus	4	1.1%
Castanea		0.0%
Quercus	18	5.2%
Ulmus	3	0.9%
Acer	12	3.4%
Tilia		0.0%
Cornus	2	0.6%
Fraxinus	7	2.0%
TOTAL ARBOREAL POLLEN	231	66.4%
NONARBOREAL POLLEN		
Poaceae	26	7.5%
Liliaceae		0.0%
Myrica	31	8.9%
Ericales	4	1.1%
Chenopodiineae	2	0.6%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	50	14.4%
Tubuliflorae	4	1.1%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	8	2.3%
TOTAL NONARBOREAL POLLEN	117	33.6%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	1	0.3%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	1	0.3%
SPORES		
Sculptured monolete fern spores	1	0.3%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	1	0.3%
Osmunda	1	0.3%
Sphagnum	33	9.5%
Lycopodium selago type		0.0%
Lycopodium annotinum type	1	0.3%
Trilete fern spores, unidentifiable	3	0.9%
SUM OF ALL SPORES	39	11.2%

30 CM LEVEL BASIC POLLEN SUM =	926	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	17	1.8%
Pinus	149	16.1%
Picea	46	5.0%
Tsuga	73	7.9%
Cupressaceae	3	0.3%
Salix	19	2.1%
Populus		0.0%
Juglans	4	0.4%
Carya		0.0%
Betula	296	32.0%
Alnus	42	4.5%
Ostrya/Carpinus		0.0%
Corylus	35	3.8%
Fagus	2	0.2%
Castanea	5	0.5%
Quercus	57	6.2%
Ulmus	9	1.0%
Acer	15	1.6%
Tilia	10	1.1%
Cornus		0.0%
Fraxinus	2	0.2%
TOTAL ARBOREAL POLLEN	784	84.7%
NONARBOREAL POLLEN (NAP)		
Poaceae	48	5.2%
Liliaceae	1	0.1%
Myrica	1	0.1%
Encales	36	3.9%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia	2	0.2%
Ambrosia	49	5.3%
Tubuliflorae	2	0.2%
Liguliflorae	3	0.3%
unknown		0.0%
unidentifiable (not added into NAP)	19	2.1%
TOTAL NONARBOREAL POLLEN	142	15.3%
AQUATICS		
Typha latifolia	2	0.2%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	2	0.2%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	5	0.5%
Equisetum	2	0.2%
Sum of monolete fern spores	7	0.8%
Osmunda		0.0%
Sphagnum	64	6.9%
Lycopodium selago type	2	0.2%
Lycopodium annotinum type	1	0.1%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	74	8.0%

40 CM LEVEL BASIC POLLEN SUM =	409	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	12	2.9%
Pinus	103	25.2%
Picea	22	5.4%
Tsuga	75	18.3%
Cupressaceae		0.0%
Salix		0.0%
Populus	5	1.2%
Juglans		0.0%
Carya	3	0.7%
Betula	67	16.4%
Alnus	9	2.2%
Ostrya/Carpinus	6	1.5%
Corylus	5	1.2%
Fagus	25	6.1%
Castanea		0.0%
Quercus	20	4.9%
Ulmus	1	0.2%
Acer	12	2.9%
Tilia	4	1.0%
Cornus	1	0.2%
Fraxinus	5	1.2%
TOTAL ARBOREAL POLLEN	375	91.7%
NONARBOREAL POLLEN (NAP)		
Poaceae	1	0.2%
Liliaceae	1	0.2%
Myrica	29	7.1%
Ericales	3	0.7%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	4	1.0%
TOTAL NONARBOREAL POLLEN	34	8.3%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	0	0.0%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda	8	2.0%
Sphagnum	156	38.1%
Lycopodium selago type		0.0%
Lycopodium annotinum type	1	0.2%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	165	40.3%

50 CM LEVEL BASIC POLLEN SUM =	1731	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	32	1.8%
Pinus	316	18.3%
Picea	66	3.8%
Tsuga	302	17.4%
Cupressaceae	29	1.7%
Salix	21	1.2%
Populus		0.0%
Juglans	1	0.1%
Carya	8	0.5%
Betula	447	25.8%
Alnus	23	1.3%
Ostrya/Carpinus		0.0%
Corylus	39	2.3%
Fagus		0.0%
Castanea		0.0%
Quercus	236	13.6%
Ulmus	22	1.3%
Acer	52	3.0%
Tilia	13	0.8%
Cornus	24	1.4%
Fraxinus	2	0.1%
TOTAL ARBOREAL POLLEN	1633	94.3%
NONARBOREAL POLLEN (NAP)		
Poaceae	19	1.1%
Liliaceae		0.0%
Myrica	27	1.6%
Ericales	51	2.9%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	1	0.1%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	25	1.4%
TOTAL NONARBOREAL POLLEN	98	5.7%
AQUATICS		
Typha latifolia	1	0.1%
Sparganium		0.0%
Potamogeton	2	0.1%
Cyperaceae	5	0.3%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	8	0.5%
SPORES		
Sculptured monolete fern spores	2	0.1%
Psilate monlete fern spores	2	0.1%
Equisetum		0.0%
Sum of monolete fern spores	4	0.2%
Osmunda	21	1.2%
Sphagnum	100	5.8%
Lycopodium selago type	1	0.1%
Lycopodium annotinum type	1	0.1%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	127	7.3%

60 CM LEVEL BASIC POLLEN SUM =	296	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	1	0.3%
Abies	4	1.4%
Pinus	40	13.5%
Picea	11	3.7%
Tsuga	28	9.5%
Cupressaceae	1	0.3%
Salix		0.0%
Populus	1	0.3%
Juglans		0.0%
Carya	4	1.4%
Betula	81	27.4%
Alnus	12	4.1%
Ostrya/Carpinus	3	1.0%
Corylus	3	1.0%
Fagus	19	6.4%
Castanea		0.0%
Quercus	21	7.1%
Ulmus	9	3.0%
Acer	13	4.4%
Tilia	2	0.7%
Cornus		0.0%
Fraxinus	11	3.7%
TOTAL ARBOREAL POLLEN	264	89.2%
NONARBOREAL POLLEN (NAP)		
Poaceae	3	1.0%
Liliaceae		0.0%
Myrica	24	8.1%
Ericales	3	1.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex	1	0.3%
Myriophyllum	1	0.3%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	9	3.0%
TOTAL NONARBOREAL POLLEN	32	10.8%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	1	0.3%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	1	0.3%
SPORES		
Sculptured monolete fern spores	1	0.3%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	1	0.3%
Osmunda		0.0%
Sphagnum	4	1.4%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	5	1.7%

70 CM LEVEL BASIC POLLEN SUM =	975	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	10	1.0%
Pinus	104	10.7%
Picea	28	2.9%
Tsuga	316	32.4%
Cupressaceae	2	0.2%
Salix	21	2.2%
Populus		0.0%
Juglans	6	0.6%
Carya		0.0%
Betula	272	27.9%
Alnus	8	0.8%
Ostrya/Carpinus		0.0%
Corylus	7	0.7%
Fagus	30	3.1%
Castanea		0.0%
Quercus	66	6.8%
Ulmus	18	1.8%
Acer	45	4.6%
Tilia	4	0.4%
Cornus	10	1.0%
Fraxinus		0.0%
TOTAL ARBOREAL POLLEN	947	97.1%
NONARBOREAL POLLEN (NAP)		
Poaceae	4	0.4%
Liliaceae		0.0%
Myrica	12	1.2%
Ericales	10	1.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	2	0.2%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	16	1.6%
TOTAL NONARBOREAL POLLEN	28	2.9%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	0	0.0%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	1	0.1%
Equisetum		0.0%
Sum of monolete fern spores	1	0.1%
Osmunda		0.0%
Sphagnum	8	0.8%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	9	0.9%

80 CM LEVEL BASIC POLLEN SUM =	299	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	1	0.3%
Abies	1	0.3%
Pinus	70	23.4%
Picea	17	5.7%
Tsuga	54	18.1%
Cupressaceae		0.0%
Salix		0.0%
Populus	1	0.3%
Juglans		0.0%
Carya	2	0.7%
Betula	51	17.1%
Alnus	5	1.7%
Ostrya/Carpinus	2	0.7%
Corylus	1	0.3%
Fagus	28	9.4%
Castanea		0.0%
Quercus	20	6.7%
Ulmus	1	0.3%
Acer	15	5.0%
Tilia	2	0.7%
Cornus	2	0.7%
Fraxinus	5	1.7%
TOTAL ARBOREAL POLLEN	278	93.0%
NONARBOREAL POLLEN (NAP)		
Poaceae		0.0%
Liliaceae	1	0.3%
Myrica	17	5.7%
Ericales	2	0.7%
Chenopodiineae	1	0.3%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	5	1.7%
TOTAL NONARBOREAL POLLEN	21	7.0%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	0	0.0%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda	1	0.3%
Sphagnum	23	7.7%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	24	8.0%

90 CM LEVEL BASIC POLLEN SUM =	312	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix	1	0.3%
Abies	4	1.3%
Pinus	89	28.5%
Picea	19	6.1%
Tsuga	17	5.4%
Cupressaceae		0.0%
Salix	1	0.3%
Populus	3	1.0%
Juglans	1	0.3%
Carya	16	5.1%
Betula	68	21.8%
Alnus	7	2.2%
Ostrya/Carpinus		0.0%
Corylus	11	3.5%
Fagus	3	1.0%
Castanea		0.0%
Quercus	8	2.6%
Ulmus	1	0.3%
Acer	32	10.3%
Tilia	2	0.6%
Cornus		0.0%
Fraxinus	2	0.6%
TOTAL ARBOREAL POLLEN	285	91.3%
NONARBOREAL POLLEN (NAP)		
Poaceae	3	1.0%
Liliaceae	2	0.6%
Myrica	15	4.8%
Ericales	5	1.6%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	1	0.3%
Liguliflorae		0.0%
unknown	1	0.3%
unidentifiable (not added into NAP)	10	3.2%
TOTAL NONARBOREAL POLLEN	27	8.7%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	3	1.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	3	1.0%
SPORES		
Sculptured monolete fern spores	2	0.6%
Psilate monlete fern spores	1	0.3%
Equisetum		0.0%
Sum of monolete fern spores	3	1.0%
Osmunda		0.0%
Sphagnum	1	0.3%
Lycopodium selago type	2	0.6%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	6	1.9%

100 CM LEVEL BASIC POLLEN SUM =	297	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	2	0.7%
Abies	3	1.0%
Pinus	91	30.6%
Picea	19	6.4%
Tsuga	18	6.1%
Cupressaceae		0.0%
Salix		0.0%
Populus	2	0.7%
Juglans		0.0%
Carya	2	0.7%
Betula	51	17.2%
Alnus	4	1.3%
Ostrya/Carpinus	9	3.0%
Corylus	7	2.4%
Fagus	16	5.4%
Castanea		0.0%
Quercus	16	5.4%
Ulmus	3	1.0%
Acer	16	5.4%
Tilia		0.0%
Cornus	2	0.7%
Fraxinus	1	0.3%
TOTAL ARBOREAL POLLEN	262	88.2%
NONARBOREAL POLLEN (NAP)		
Poaceae	3	1.0%
Liliaceae	2	0.7%
Myrica	25	8.4%
Ericales	4	1.3%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	1	0.3%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	5	1.7%
TOTAL NONARBOREAL POLLEN	35	11.8%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	0	0.0%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda		0.0%
Sphagnum	10	3.4%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable	1	0.3%
SUM OF ALL SPORES	11	3.7%

110 CM LEVEL BASIC POLLEN SUM =	360	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	3	0.8%
Pinus	135	37.5%
Picea	22	6.1%
Tsuga	23	6.4%
Cupressaceae	3	0.8%
Salix	2	0.6%
Populus	2	0.6%
Juglans		0.0%
Carya	6	1.7%
Betula	49	13.6%
Alnus	1	0.3%
Ostrya/Carpinus	1	0.3%
Corylus	5	1.4%
Fagus	18	5.0%
Castanea		0.0%
Quercus	4	1.1%
Ulmus	3	0.8%
Acer	24	6.7%
Tilia	5	1.4%
Cornus	3	0.8%
Fraxinus	3	0.8%
TOTAL ARBOREAL POLLEN	312	86.7%
NONARBOREAL POLLEN (NAP)		
Poaceae	2	0.6%
Liliaceae	1	0.3%
Myrica	33	9.2%
Ericales	11	3.1%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae	1	0.3%
unknown		0.0%
unidentifiable (not added into NAP)	6	1.7%
TOTAL NONARBOREAL POLLEN	48	13.3%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	0	0.0%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda	4	1.1%
Sphagnum	49	13.6%
Lycopodium selago type	1	0.3%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	54	15.0%

120 CM LEVEL BASIC POLLEN SUM =	794	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	5	0.6%
Pinus	215	27.1%
Picea	27	3.4%
Tsuga	44	5.5%
Cupressaceae	1	0.1%
Salix		0.0%
Populus	7	0.9%
Juglans		0.0%
Carya	4	0.5%
Betula	196	24.7%
Alnus	15	1.9%
Ostrya/Carpinus	28	3.5%
Corylus	4	0.5%
Fagus	75	9.4%
Castanea		0.0%
Quercus	43	5.4%
Ulmus	6	0.8%
Acer	29	3.7%
Tilia	3	0.4%
Cornus	1	0.1%
Fraxinus	11	1.4%
TOTAL ARBOREAL POLLEN	714	89.9%
NONARBOREAL POLLEN (NAP)		
Poaceae		0.0%
Liliaceae	1	0.1%
Myrica	67	8.4%
Ericales	9	1.1%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum	2	0.3%
Galium		0.0%
Artemisia		0.0%
Ambrosia	1	0.1%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	12	1.5%
TOTAL NONARBOREAL POLLEN	80	10.1%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	1	0.1%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	1	0.1%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda	4	0.5%
Sphagnum	19	2.4%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable	1	0.1%
SUM OF ALL SPORES	24	3.0%

130 CM LEVEL BASIC POLLEN SUM =	524	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	5	1.0%
Pinus	86	16.4%
Picea	107	20.4%
Tsuga	55	10.5%
Cupressaceae		0.0%
Salix	5	1.0%
Populus		0.0%
Juglans	4	0.8%
Carya	8	1.5%
Betula	97	18.5%
Alnus	12	2.3%
Ostrya/Carpinus		0.0%
Corylus	5	1.0%
Fagus	36	6.9%
Castanea		0.0%
Quercus	10	1.9%
Ulmus	6	1.1%
Acer	18	3.4%
Tilia	6	1.1%
Cornus	2	0.4%
Fraxinus	5	1.0%
TOTAL ARBOREAL POLLEN	467	89.1%
NONARBOREAL POLLEN (NAP)		
Poaceae		0.0%
Liliaceae		0.0%
Myrica	41	7.8%
Ericales	15	2.9%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia	1	0.2%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	8	1.5%
TOTAL NONARBOREAL POLLEN	57	10.9%
AQUATICS		
Typha latifolia	6	1.1%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	1	0.2%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	7	1.3%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	1	0.2%
Equisetum		0.0%
Sum of monolete fern spores	1	0.2%
Osmunda		0.0%
Sphagnum	2	0.4%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	3	0.6%

140 CM LEVEL BASIC POLLEN SUM =	297	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	1	0.3%
Abies	1	0.3%
Pinus	78	26.3%
Picea	16	5.4%
Tsuga	91	30.6%
Cupressaceae	1	0.3%
Salix		0.0%
Populus	3	1.0%
Juglans		0.0%
Carya	3	1.0%
Betula	42	14.1%
Alnus	3	1.0%
Ostrya/Carpinus	6	2.0%
Corylus	3	1.0%
Fagus	13	4.4%
Castanea		0.0%
Quercus	7	2.4%
Ulmus	2	0.7%
Acer	8	2.7%
Tilia	1	0.3%
Cornus		0.0%
Fraxinus	4	1.3%
TOTAL ARBOREAL POLLEN	283	95.3%
NONARBOREAL POLLEN (NAP)		
Poaceae		0.0%
Liliaceae		0.0%
Myrica	4	1.3%
Ericales	7	2.4%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum	2	0.7%
Galium		0.0%
Artemisia		0.0%
Ambrosia	1	0.3%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	5	1.7%
TOTAL NONARBOREAL POLLEN	14	4.7%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	1	0.3%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	1	0.3%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda		0.0%
Sphagnum	13	4.4%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	13	4.4%

150 CM LEVEL BASIC POLLEN SUM =	302	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies		0.0%
Pinus	42	13.9%
Picea	45	14.9%
Tsuga	69	22.8%
Cupressaceae		0.0%
Salix	2	0.7%
Populus		0.0%
Juglans	1	0.3%
Carya	8	2.6%
Betula	60	19.9%
Alnus	3	1.0%
Ostrya/Carpinus		0.0%
Corylus	4	1.3%
Fagus	11	3.6%
Castanea		0.0%
Quercus	8	2.6%
Ulmus	2	0.7%
Acer	8	2.6%
Tilia	1	0.3%
Cornus	2	0.7%
Fraxinus	7	2.3%
TOTAL ARBOREAL POLLEN	273	90.4%
NONARBOREAL POLLEN (NAP)		
Poaceae	3	1.0%
Liliaceae		0.0%
Myrica	17	5.6%
Ericales	8	2.6%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown	1	0.3%
unidentifiable (not added into NAP)	5	1.7%
TOTAL NONARBOREAL POLLEN	29	9.6%
AQUATICS		
Typha latifolia	4	1.3%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	4	1.3%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda		0.0%
Sphagnum	15	5.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	15	5.0%

160 CM LEVEL BASIC POLLEN SUM =	478	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	1	0.2%
Abies	1	0.2%
Pinus	72	15.1%
Picea	8	1.7%
Tsuga	215	45.0%
Cupressaceae		0.0%
Salix		0.0%
Populus	1	0.2%
Juglans		0.0%
Carya	4	0.8%
Betula	49	10.3%
Alnus	3	0.6%
Ostrya/Carpinus	8	1.7%
Corylus	5	1.0%
Fagus	43	9.0%
Castanea		0.0%
Quercus	18	3.8%
Ulmus	5	1.0%
Acer	17	3.6%
Tilia	1	0.2%
Cornus		0.0%
Fraxinus	8	1.7%
TOTAL ARBOREAL POLLEN	459	96.0%
NONARBOREAL POLLEN (NAP)		
Poaceae	1	0.2%
Liliaceae	2	0.4%
Myrica	6	1.3%
Ericales	9	1.9%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown	1	0.2%
unidentifiable (not added into NAP)	9	1.9%
TOTAL NONARBOREAL POLLEN	19	4.0%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	1	0.2%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	1	0.2%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda	3	0.6%
Sphagnum	49	10.3%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	52	10.9%

170 CM LEVEL BASIC POLLEN SUM =	634	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies		0.0%
Pinus	38	6.0%
Picea	16	2.5%
Tsuga	320	50.5%
Cupressaceae		0.0%
Salix	3	0.5%
Populus		0.0%
Juglans	1	0.2%
Carya	2	0.3%
Betula	113	17.8%
Alnus	4	0.6%
Ostrya/Carpinus		0.0%
Corylus	6	0.9%
Fagus	37	5.8%
Castanea		0.0%
Quercus	10	1.6%
Ulmus	8	1.3%
Acer	28	4.4%
Tilia	2	0.3%
Cornus		0.0%
Fraxinus	4	0.6%
TOTAL ARBOREAL POLLEN	592	93.4%
NONARBOREAL POLLEN (NAP)		
Poaceae	1	0.2%
Liliaceae	2	0.3%
Myrica	36	5.7%
Ericales	1	0.2%
Chenopodiineae	1	0.2%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	1	0.2%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	6	0.9%
TOTAL NONARBOREAL POLLEN	42	6.6%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	1	0.2%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	1	0.2%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda		0.0%
Sphagnum	9	1.4%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	9	1.4%

180 CM LEVEL BASIC POLLEN SUM =	356	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	1	0.3%
Abies		0.0%
Pinus	48	13.5%
Picea	8	2.2%
Tsuga	142	39.9%
Cupressaceae	1	0.3%
Salix	1	0.3%
Populus	5	1.4%
Juglans	1	0.3%
Carya	1	0.3%
Betula	49	13.8%
Alnus	3	0.8%
Ostrya/Carpinus	12	3.4%
Corylus	2	0.6%
Fagus	29	8.1%
Castanea		0.0%
Quercus	13	3.7%
Ulmus	5	1.4%
Acer	17	4.8%
Tilia		0.0%
Cornus		0.0%
Fraxinus	6	1.7%
TOTAL ARBOREAL POLLEN	344	96.6%
NONARBOREAL POLLEN (NAP)		
Poaceae		0.0%
Liliaceae		0.0%
Myrica	6	1.7%
Ericales	4	1.1%
Chenopodiineae	1	0.3%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum	1	0.3%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	8	2.2%
TOTAL NONARBOREAL POLLEN	12	3.4%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	1	0.3%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	1	0.3%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda		0.0%
Sphagnum	1	0.3%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	1	0.3%

190 CM LEVEL BASIC POLLEN SUM =	1020	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	4	0.4%
Pinus	156	15.3%
Picea	69	6.8%
Tsuga	485	47.5%
Cupressaceae		0.0%
Salix		0.0%
Populus		0.0%
Juglans	1	0.1%
Carya	1	0.1%
Betula	130	12.7%
Alnus	4	0.4%
Ostrya/Carpinus		0.0%
Corylus	1	0.1%
Fagus	61	6.0%
Castanea		0.0%
Quercus	6	0.6%
Ulmus	7	0.7%
Acer	38	3.7%
Tilia	6	0.6%
Cornus		0.0%
Fraxinus	6	0.6%
TOTAL ARBOREAL POLLEN	975	95.6%
NONARBOREAL POLLEN (NAP)		0.0%
Poaceae		0.0%
Liliaceae		0.0%
Myrica	39	3.8%
Ericales	5	0.5%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	1	0.1%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	7	0.7%
TOTAL NONARBOREAL POLLEN	45	4.4%
AQUATICS		0.0%
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	0	0.0%
SPORES		0.0%
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda		0.0%
Sphagnum	9	0.9%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	9	0.9%

200 CM LEVEL BASIC POLLEN SUM =	332	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN		
Larix	1	0.3%
Abies	2	0.6%
Pinus	71	21.4%
Picea	11	3.3%
Tsuga	103	31.0%
Cupressaceae		0.0%
Salix		0.0%
Populus	4	1.2%
Juglans		0.0%
Carya	2	0.6%
Betula	56	16.9%
Alnus	12	3.6%
Ostrya/Carpinus	8	2.4%
Corylus	1	0.3%
Fagus	18	5.4%
Castanea		0.0%
Quercus	10	3.0%
Ulmus	7	2.1%
Acer	10	3.0%
Tilia	1	0.3%
Cornus		0.0%
Fraxinus	2	0.6%
TOTAL ARBOREAL POLLEN	319	96.1%
NONARBOREAL POLLEN		
Poaceae	1	0.3%
Liliaceae		0.0%
Myrica	8	2.4%
Ericales	3	0.9%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	1	0.3%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	6	1.8%
TOTAL NONARBOREAL POLLEN	13	3.9%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon	2	0.6%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	2	0.6%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda		0.0%
Sphagnum	1	0.3%
Lycopodium selago type	1	0.3%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	2	0.6%

210 CM LEVEL BASIC POLLEN SUM =	464	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN		
Larix		0.0%
Abies	3	0.6%
Pinus	46	9.9%
Picea	53	11.4%
Tsuga	198	42.7%
Cupressaceae		0.0%
Salix		0.0%
Populus		0.0%
Juglans		0.0%
Carya	11	2.4%
Betula	73	15.7%
Alnus	4	0.9%
Ostrya/Carpinus		0.0%
Corylus	8	1.7%
Fagus	23	5.0%
Castanea		0.0%
Quercus	2	0.4%
Ulmus	4	0.9%
Acer	9	1.9%
Tilia		0.0%
Cornus		0.0%
Fraxinus	1	0.2%
TOTAL ARBOREAL POLLEN	435	93.8%
NONARBOREAL POLLEN		
Poaceae	2	0.4%
Liliaceae		0.0%
Myrica	13	2.8%
Ericales	7	1.5%
Chenopodiineae	1	0.2%
Thalictrum	1	0.2%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	1	0.2%
Tubuliflorae	4	0.9%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	10	2.2%
TOTAL NONARBOREAL POLLEN	29	6.3%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton	5	1.1%
Cyperaceae	1	0.2%
Eriocaulon	42	9.1%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	48	10.3%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	1	0.2%
Equisetum		0.0%
Sum of monolete fern spores	1	0.2%
Osmunda		0.0%
Sphagnum	23	5.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type	1	0.2%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	25	5.4%

220 CM LEVEL BASIC POLLEN SUM =	764	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	6	0.8%
Pinus	322	42.1%
Picea	29	3.8%
Tsuga	175	22.9%
Cupressaceae	5	0.7%
Salix		0.0%
Populus	1	0.1%
Juglans		0.0%
Carya	11	1.4%
Betula	74	9.7%
Alnus	14	1.8%
Ostrya/Carpinus	16	2.1%
Corylus	15	2.0%
Fagus	15	2.0%
Castanea		0.0%
Quercus	12	1.6%
Ulmus	8	1.0%
Acer	23	3.0%
Tilia		0.0%
Cornus		0.0%
Fraxinus	3	0.4%
TOTAL ARBOREAL POLLEN	729	95.4%
NONARBOREAL POLLEN (NAP)		
Poaceae	3	0.4%
Liliaceae	1	0.1%
Myrica	3	0.4%
Ericales	13	1.7%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex	4	0.5%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae	11	1.4%
unknown		0.0%
unidentifiable (not added into NAP)	11	1.4%
TOTAL NONARBOREAL POLLEN	35	4.6%
AQUATICS		
Typha latifolia	1	0.1%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	4	0.5%
Eriocaulon	4	0.5%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia	1	0.1%
TOTAL AQUATICS	10	1.3%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	5	0.7%
Equisetum		0.0%
Sum of monolete fern spores	5	0.7%
Osmunda		0.0%
Sphagnum	53	6.9%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	58	7.6%

230 CM LEVEL BASIC POLLEN SUM =	749	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	9	1.2%
Pinus	209	27.9%
Picea	79	10.5%
Tsuga	241	32.2%
Cupressaceae		0.0%
Salix	2	0.3%
Populus	18	2.4%
Juglans	1	0.1%
Carya		0.0%
Betula	64	8.5%
Alnus	2	0.3%
Ostrya/Carpinus		0.0%
Corylus	3	0.4%
Fagus	16	2.1%
Castanea		0.0%
Quercus	22	2.9%
Ulmus	17	2.3%
Acer	38	5.1%
Tilia		0.0%
Cornus		0.0%
Fraxinus	3	0.4%
TOTAL ARBOREAL POLLEN	724	96.7%
NONARBOREAL POLLEN (NAP)		
Poaceae	2	0.3%
Liliaceae		0.0%
Myrica	8	1.1%
Ericales	12	1.6%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia	1	0.1%
Ambrosia	2	0.3%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	9	1.2%
TOTAL NONARBOREAL POLLEN	25	3.3%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton	2	0.3%
Cyperaceae	5	0.7%
Eriocaulon	3	0.4%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	10	1.3%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	1	0.1%
Equisetum		0.0%
Sum of monolete fern spores	1	0.1%
Osmunda		0.0%
Sphagnum	32	4.3%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	33	4.4%

240 CM LEVEL BASIC POLLEN SUM =	630	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	4	0.6%
Pinus	431	68.4%
Picea	25	4.0%
Tsuga	122	19.4%
Cupressaceae		0.0%
Salix		0.0%
Populus		0.0%
Juglans		0.0%
Carya	4	0.6%
Betula	14	2.2%
Alnus	1	0.2%
Ostrya/Carpinus		0.0%
Corylus		0.0%
Fagus	1	0.2%
Castanea		0.0%
Quercus	8	1.3%
Ulmus	1	0.2%
Acer	17	2.7%
Tilia		0.0%
Cornus		0.0%
Fraxinus	1	0.2%
TOTAL ARBOREAL POLLEN	629	99.8%
NONARBOREAL POLLEN (NAP)		0.0%
Poaceae		0.0%
Liliaceae		0.0%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	1	0.2%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	4	0.6%
TOTAL NONARBOREAL POLLEN	1	0.2%
AQUATICS		0.0%
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	0	0.0%
SPORES		0.0%
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	2	0.3%
Equisetum	1	0.2%
Sum of monolete fern spores	3	0.5%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type	2	0.3%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	5	0.8%

250 CM LEVEL BASIC POLLEN SUM =	424	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	4	0.9%
Pinus	310	73.1%
Picea	22	5.2%
Tsuga	34	8.0%
Cupressaceae		0.0%
Salix		0.0%
Populus	3	0.7%
Juglans		0.0%
Carya	6	1.4%
Betula	13	3.1%
Alnus	1	0.2%
Ostrya/Carpinus		0.0%
Corylus	5	1.2%
Fagus	3	0.7%
Castanea		0.0%
Quercus	4	0.9%
Ulmus	2	0.5%
Acer	3	0.7%
Tilia		0.0%
Cornus		0.0%
Fraxinus	2	0.5%
TOTAL ARBOREAL POLLEN	412	97.2%
NONARBOREAL POLLEN (NAP)		
Poaceae	5	1.2%
Liliaceae	4	0.9%
Myrica	1	0.2%
Ericales	1	0.2%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	1	0.2%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	6	1.4%
TOTAL NONARBOREAL POLLEN	12	2.8%
AQUATICS		
Typha latifolia	1	0.2%
Sparganium		0.0%
Potamogeton	4	0.9%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea	5	1.2%
Utricularia		0.0%
TOTAL AQUATICS	10	2.4%
SPORES		
Sculptured monolete fern spores	4	0.9%
Psilate monlete fern spores	4	0.9%
Equisetum	6	1.4%
Sum of monolete fern spores	14	3.3%
Osmunda	1	0.2%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	15	3.5%

260 CM LEVEL BASIC POLLEN SUM =	300	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix	2	0.7%
Abies	7	2.3%
Pinus	178	59.3%
Picea	17	5.7%
Tsuga	20	6.7%
Cupressaceae	2	0.7%
Salix		0.0%
Populus	2	0.7%
Juglans		0.0%
Carya	6	2.0%
Betula	17	5.7%
Alnus	2	0.7%
Ostrya/Carpinus	8	2.7%
Corylus	2	0.7%
Fagus		0.0%
Castanea		0.0%
Quercus	7	2.3%
Ulmus	1	0.3%
Acer	11	3.7%
Tilia		0.0%
Cornus		0.0%
Fraxinus	6	2.0%
TOTAL ARBOREAL POLLEN	**288**	**96.0%**
NONARBOREAL POLLEN (NAP)		
Poaceae	6	2.0%
Liliaceae	4	1.3%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	1	0.3%
Tubuliflorae	1	0.3%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	3	1.0%
TOTAL NONARBOREAL POLLEN	**12**	**4.0%**
AQUATICS		
Typha latifolia	1	0.3%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	4	1.3%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea	3	1.0%
Utricularia	3	1.0%
TOTAL AQUATICS	**11**	**3.7%**
SPORES		
Sculptured monolete fern spores	3	1.0%
Psilate monlete fern spores	4	1.3%
Equisetum	11	3.7%
Sum of monolete fern spores	**18**	**6.0%**
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type	1	0.3%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	**19**	**6.3%**

270 CM LEVEL BASIC POLLEN SUM =	415	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	20	4.8%
Abies	22	5.3%
Pinus	235	56.6%
Picea	55	13.3%
Tsuga	33	8.0%
Cupressaceae		0.0%
Salix		0.0%
Populus		0.0%
Juglans		0.0%
Carya	2	0.5%
Betula	14	3.4%
Alnus	1	0.2%
Ostrya/Carpinus	2	0.5%
Corylus	3	0.7%
Fagus		0.0%
Castanea		0.0%
Quercus	3	0.7%
Ulmus		0.0%
Acer	13	3.1%
Tilia		0.0%
Cornus	1	0.2%
Fraxinus		0.0%
TOTAL ARBOREAL POLLEN	404	97.3%
NONARBOREAL POLLEN (NAP)		
Poaceae	9	2.2%
Liliaceae		0.0%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	2	0.5%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	12	2.9%
TOTAL NONARBOREAL POLLEN	11	2.7%
AQUATICS		
Typha latifolia	1	0.2%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar	1	0.2%
Brasenia		0.0%
Nymphaea	8	1.9%
Utricularia		0.0%
TOTAL AQUATICS	10	2.4%
SPORES		
Sculptured monolete fern spores	26	6.3%
Psilate monlete fern spores	17	4.1%
Equisetum		0.0%
Sum of monolete fern spores	43	10.4%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type	1	0.2%
Trilete fern spores, unidentifiable	2	0.5%
SUM OF ALL SPORES	46	11.1%

280 CM LEVEL BASIC POLLEN SUM =	624	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	9	1.4%
Abies	11	1.8%
Pinus	443	71.0%
Picea	31	5.0%
Tsuga	60	9.6%
Cupressaceae		0.0%
Salix		0.0%
Populus		0.0%
Juglans		0.0%
Carya	4	0.6%
Betula	15	2.4%
Alnus	4	0.6%
Ostrya/Carpinus	2	0.3%
Corylus	8	1.3%
Fagus		0.0%
Castanea		0.0%
Quercus	15	2.4%
Ulmus	1	0.2%
Acer	5	0.8%
Tilia		0.0%
Cornus		0.0%
Fraxinus	5	0.8%
TOTAL ARBOREAL POLLEN	613	98.2%
NONARBOREAL POLLEN (NAP)		
Poaceae	4	0.6%
Liliaceae	5	0.8%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	2	0.3%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	10	1.6%
TOTAL NONARBOREAL POLLEN	11	1.8%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	2	0.3%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia	1	0.2%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	3	0.5%
SPORES		
Sculptured monolete fern spores	13	2.1%
Psilate monlete fern spores	12	1.9%
Equisetum	14	2.2%
Sum of monolete fern spores	39	6.3%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type	1	0.2%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	40	6.4%

290 CM LEVEL BASIC POLLEN SUM =	635	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix	9	1.4%
Abies	38	6.0%
Pinus	377	59.4%
Picea	77	12.1%
Tsuga	55	8.7%
Cupressaceae		0.0%
Salix		0.0%
Populus	4	0.6%
Juglans		0.0%
Carya		0.0%
Betula	19	3.0%
Alnus		0.0%
Ostrya/Carpinus	5	0.8%
Corylus	5	0.8%
Fagus	3	0.5%
Castanea		0.0%
Quercus	7	1.1%
Ulmus	1	0.2%
Acer	12	1.9%
Tilia		0.0%
Cornus		0.0%
Fraxinus	1	0.2%
TOTAL ARBOREAL POLLEN	613	96.5%
NONARBOREAL POLLEN (NAP)		
Poaceae	14	2.2%
Liliaceae	1	0.2%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia	1	0.2%
Ambrosia	6	0.9%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	10	1.6%
TOTAL NONARBOREAL POLLEN	22	3.5%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon	1	0.2%
Nuphar	2	0.3%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	3	0.5%
SPORES		
Sculptured monolete fern spores	12	1.9%
Psilate monlete fern spores	7	1.1%
Equisetum	8	1.3%
Sum of monolete fern spores	27	4.3%
Osmunda	2	0.3%
Sphagnum		0.0%
Lycopodium selago type	1	0.2%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable	2	0.3%
SUM OF ALL SPORES	32	5.0%

300 CM LEVEL BASIC POLLEN SUM =	434	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix	11	2.5%
Abies	6	1.4%
Pinus	270	62.2%
Picea	16	3.7%
Tsuga	35	8.1%
Cupressaceae	1	0.2%
Salix		0.0%
Populus	1	0.2%
Juglans		0.0%
Carya	4	0.9%
Betula	17	3.9%
Alnus	6	1.4%
Ostrya/Carpinus	4	0.9%
Corylus	5	1.2%
Fagus	4	0.9%
Castanea		0.0%
Quercus	19	4.4%
Ulmus	2	0.5%
Acer	11	2.5%
Tilia	1	0.2%
Cornus		0.0%
Fraxinus	3	0.7%
TOTAL ARBOREAL POLLEN	416	95.9%
NONARBOREAL POLLEN (NAP)		
Poaceae	11	2.5%
Liliaceae	3	0.7%
Myrica		0.0%
Ericales	1	0.2%
Chenopodiineae	1	0.2%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	1	0.2%
Tubuliflorae	1	0.2%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	8	1.8%
TOTAL NONARBOREAL POLLEN	18	4.1%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton	1	0.2%
Cyperaceae	2	0.5%
Eriocaulon		0.0%
Nuphar	1	0.2%
Brasenia		0.0%
Nymphaea	1	0.2%
Utricularia		0.0%
TOTAL AQUATICS	5	1.2%
SPORES		
Sculptured monolete fern spores	14	3.2%
Psilate monlete fern spores	10	2.3%
Equisetum	25	5.8%
Sum of monolete fern spores	49	11.3%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	49	11.3%

310 CM LEVEL BASIC POLLEN SUM =	320	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix	7	2.2%
Abies	11	3.4%
Pinus	148	46.3%
Picea	28	8.8%
Tsuga	27	8.4%
Cupressaceae		0.0%
Salix		0.0%
Populus	4	1.3%
Juglans		0.0%
Carya		0.0%
Betula	20	6.3%
Alnus	1	0.3%
Ostrya/Carpinus	2	0.6%
Corylus	1	0.3%
Fagus	1	0.3%
Castanea		0.0%
Quercus	7	2.2%
Ulmus		0.0%
Acer	16	5.0%
Tilia		0.0%
Cornus		0.0%
Fraxinus	8	2.5%
TOTAL ARBOREAL POLLEN	281	87.8%
NONARBOREAL POLLEN (NAP)		
Poaceae	26	8.1%
Liliaceae	7	2.2%
Myrica	1	0.3%
Ericales	1	0.3%
Chenopodiineae	1	0.3%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia	1	0.3%
Ambrosia	2	0.6%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	7	2.2%
TOTAL NONARBOREAL POLLEN	39	12.2%
AQUATICS		
Typha latifolia	3	0.9%
Sparganium		0.0%
Potamogeton	1	0.3%
Cyperaceae	5	1.6%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea	1	0.3%
Utricularia		0.0%
TOTAL AQUATICS	10	3.1%
SPORES		
Sculptured monolete fern spores	12	3.8%
Psilate monlete fern spores	3	0.9%
Equisetum	5	1.6%
Sum of monolete fern spores	20	6.3%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	20	6.3%

320 CM LEVEL BASIC POLLEN SUM =	311	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	6	1.9%
Abies	10	3.2%
Pinus	205	65.9%
Picea	13	4.2%
Tsuga	17	5.5%
Cupressaceae		0.0%
Salix	1	0.3%
Populus		0.0%
Juglans		0.0%
Carya	1	0.3%
Betula	17	5.5%
Alnus	10	3.2%
Ostrya/Carpinus	1	0.3%
Corylus		0.0%
Fagus		0.0%
Castanea		0.0%
Quercus	15	4.8%
Ulmus	2	0.6%
Acer	9	2.9%
Tilia		0.0%
Cornus		0.0%
Fraxinus	1	0.3%
TOTAL ARBOREAL POLLEN	308	99.0%
NONARBOREAL POLLEN (NAP)		
Poaceae	2	0.6%
Liliaceae		0.0%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	1	0.3%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	3	1.0%
TOTAL NONARBOREAL POLLEN	3	1.0%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	15	4.8%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea	2	0.6%
Utricularia		0.0%
TOTAL AQUATICS	17	5.5%
SPORES		
Sculptured monolete fern spores	1	0.3%
Psilate monlete fern spores	1	0.3%
Equisetum	12	3.9%
Sum of monolete fern spores	14	4.5%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	14	4.5%

330 CM LEVEL BASIC POLLEN SUM =	314	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	2	0.6%
Abies	14	4.5%
Pinus	167	53.2%
Picea	10	3.2%
Tsuga	18	5.7%
Cupressaceae		0.0%
Salix		0.0%
Populus	5	1.6%
Juglans		0.0%
Carya		0.0%
Betula	20	6.4%
Alnus	6	1.9%
Ostrya/Carpinus	12	3.8%
Corylus		0.0%
Fagus	5	1.6%
Castanea		0.0%
Quercus	8	2.5%
Ulmus	3	1.0%
Acer	19	6.1%
Tilia		0.0%
Cornus		0.0%
Fraxinus	11	3.5%
TOTAL ARBOREAL POLLEN	300	95.5%
NONARBOREAL POLLEN (NAP)		
Poaceae	11	3.5%
Liliaceae	1	0.3%
Myrica	1	0.3%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae	1	0.3%
unknown		0.0%
unidentifiable (not added into NAP)	11	3.5%
TOTAL NONARBOREAL POLLEN	14	4.5%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	6	1.9%
Eriocaulon		0.0%
Nuphar	12	3.8%
Brasenia	5	1.6%
Nymphaea	5	1.6%
Utricularia		0.0%
TOTAL AQUATICS	28	8.9%
SPORES		
Sculptured monolete fern spores	9	2.9%
Psilate monlete fern spores	10	3.2%
Equisetum		0.0%
Sum of monolete fern spores	19	6.1%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type	1	0.3%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable	1	0.3%
SUM OF ALL SPORES	21	6.7%

340 CM LEVEL BASIC POLLEN SUM =	411	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	3	0.7%
Pinus	293	71.3%
Picea	11	2.7%
Tsuga	27	6.6%
Cupressaceae		0.0%
Salix		0.0%
Populus		0.0%
Juglans		0.0%
Carya	1	0.2%
Betula	19	4.6%
Alnus	6	1.5%
Ostrya/Carpinus	2	0.5%
Corylus	5	1.2%
Fagus	2	0.5%
Castanea		0.0%
Quercus	13	3.2%
Ulmus	2	0.5%
Acer	14	3.4%
Tilia		0.0%
Cornus		0.0%
Fraxinus	3	0.7%
TOTAL ARBOREAL POLLEN	401	97.6%
NONARBOREAL POLLEN (NAP)		
Poaceae	5	1.2%
Liliaceae	2	0.5%
Myrica	2	0.5%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	1	0.2%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	4	1.0%
TOTAL NONARBOREAL POLLEN	10	2.4%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	14	3.4%
Eriocaulon		0.0%
Nuphar	6	1.5%
Brasenia		0.0%
Nymphaea	11	2.7%
Utricularia		0.0%
TOTAL AQUATICS	31	7.5%
SPORES		
Sculptured monolete fern spores	2	0.5%
Psilate monlete fern spores	3	0.7%
Equisetum	3	0.7%
Sum of monolete fern spores	8	1.9%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	8	1.9%

350 CM LEVEL BASIC POLLEN SUM =	929	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix	3	0.3%
Abies	10	1.1%
Pinus	433	46.6%
Picea	159	17.1%
Tsuga	39	4.2%
Cupressaceae		0.0%
Salix	20	2.2%
Populus	8	0.9%
Juglans	2	0.2%
Carya		0.0%
Betula	24	2.6%
Alnus	37	4.0%
Ostrya/Carpinus	33	3.6%
Corylus	4	0.4%
Fagus	4	0.4%
Castanea		0.0%
Quercus	62	6.7%
Ulmus	11	1.2%
Acer	26	2.8%
Tilia		0.0%
Cornus	1	0.1%
Fraxinus	23	2.5%
TOTAL ARBOREAL POLLEN	899	96.8%
NONARBOREAL POLLEN (NAP)		
Poaceae	6	0.6%
Liliaceae	5	0.5%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex	14	1.5%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	3	0.3%
Tubuliflorae	1	0.1%
Liguliflorae	1	0.1%
unknown		0.0%
unidentifiable (not added into NAP)	13	1.4%
TOTAL NONARBOREAL POLLEN	30	3.2%
AQUATICS		
Typha latifolia	1	0.1%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	16	1.7%
Eriocaulon		0.0%
Nuphar	13	1.4%
Brasenia	11	1.2%
Nymphaea	23	2.5%
Utricularia		0.0%
TOTAL AQUATICS	64	6.9%
SPORES		
Sculptured monolete fern spores	15	1.6%
Psilate monlete fern spores	4	0.4%
Equisetum		0.0%
Sum of monolete fern spores	19	2.0%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable	1	0.1%
SUM OF ALL SPORES	20	2.2%

360 CM LEVEL BASIC POLLEN SUM =	822	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	3	0.4%
Pinus	544	66.2%
Picea	16	1.9%
Tsuga	22	2.7%
Cupressaceae		0.0%
Salix		0.0%
Populus		0.0%
Juglans		0.0%
Carya	3	0.4%
Betula	42	5.1%
Alnus	15	1.8%
Ostrya/Carpinus	17	2.1%
Corylus	4	0.5%
Fagus	2	0.2%
Castanea		0.0%
Quercus	66	8.0%
Ulmus	10	1.2%
Acer	47	5.7%
Tilia		0.0%
Cornus		0.0%
Fraxinus	9	1.1%
TOTAL ARBOREAL POLLEN	800	97.3%
NONARBOREAL POLLEN (NAP)		
Poaceae	2	0.2%
Liliaceae	4	0.5%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex	12	1.5%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	3	0.4%
Tubuliflorae	1	0.1%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	8	1.0%
TOTAL NONARBOREAL POLLEN	22	2.7%
AQUATICS		
Typha latifolia	2	0.2%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	2	0.2%
Eriocaulon		0.0%
Nuphar	7	0.9%
Brasenia	2	0.2%
Nymphaea	19	2.3%
Utricularia		0.0%
TOTAL AQUATICS	32	3.9%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	1	0.1%
Equisetum		0.0%
Sum of monolete fern spores	1	0.1%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type	2	0.2%
Trilete fern spores, unidentifiable	1	0.1%
SUM OF ALL SPORES	4	0.5%

370 CM LEVEL BASIC POLLEN SUM =	886	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix	3	0.3%
Abies	9	1.0%
Pinus	554	62.5%
Picea	12	1.4%
Tsuga	9	1.0%
Cupressaceae		0.0%
Salix	1	0.1%
Populus		0.0%
Juglans	1	0.1%
Carya		0.0%
Betula	75	8.5%
Alnus	54	6.1%
Ostrya/Carpinus	23	2.6%
Corylus	6	0.7%
Fagus	18	2.0%
Castanea		0.0%
Quercus	65	7.3%
Ulmus	4	0.5%
Acer	24	2.7%
Tilia		0.0%
Cornus	2	0.2%
Fraxinus	13	1.5%
TOTAL ARBOREAL POLLEN	873	98.5%
NONARBOREAL POLLEN (NAP)		
Poaceae	6	0.7%
Liliaceae	2	0.2%
Myrica	2	0.2%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex	1	0.1%
Myriophyllum		0.0%
Galium		0.0%
Artemisia	1	0.1%
Ambrosia	1	0.1%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	14	1.6%
TOTAL NONARBOREAL POLLEN	13	1.5%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	3	0.3%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea	1	0.1%
Utricularia		0.0%
TOTAL AQUATICS	4	0.5%
SPORES		
Sculptured monolete fern spores	1	0.1%
Psilate monlete fern spores	3	0.3%
Equisetum		0.0%
Sum of monolete fern spores	4	0.5%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type	1	0.1%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	5	0.6%

380 CM LEVEL BASIC POLLEN SUM =	626	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	4	0.6%
Pinus	392	62.6%
Picea	19	3.0%
Tsuga	2	0.3%
Cupressaceae		0.0%
Salix	3	0.5%
Populus		0.0%
Juglans		0.0%
Carya	2	0.3%
Betula	74	11.8%
Alnus	33	5.3%
Ostrya/Carpinus	9	1.4%
Corylus	5	0.8%
Fagus	2	0.3%
Castanea		0.0%
Quercus	48	7.7%
Ulmus	2	0.3%
Acer	23	3.7%
Tilia		0.0%
Cornus		0.0%
Fraxinus	5	0.8%
TOTAL ARBOREAL POLLEN	623	99.5%
NONARBOREAL POLLEN (NAP)		
Poaceae	1	0.2%
Liliaceae		0.0%
Myrica	1	0.2%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia	1	0.2%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	8	1.3%
TOTAL NONARBOREAL POLLEN	3	0.5%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	1	0.2%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	1	0.2%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	0	0.0%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type	5	0.8%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	5	0.8%

460 CM LEVEL BASIC POLLEN SUM =	319	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	2	0.6%
Abies	5	1.6%
Pinus	180	56.4%
Picea	13	4.1%
Tsuga	8	2.5%
Cupressaceae		0.0%
Salix		0.0%
Populus		0.0%
Juglans		0.0%
Carya	1	0.3%
Betula	32	10.0%
Alnus	7	2.2%
Ostrya/Carpinus	17	5.3%
Corylus	4	1.3%
Fagus		0.0%
Castanea		0.0%
Quercus	20	6.3%
Ulmus	3	0.9%
Acer	11	3.4%
Tilia	1	0.3%
Cornus		0.0%
Fraxinus	4	1.3%
TOTAL ARBOREAL POLLEN	308	96.6%
NONARBOREAL POLLEN (NAP)		
Poaceae	6	1.9%
Liliaceae	2	0.6%
Myrica		0.0%
Ericales	1	0.3%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	2	0.6%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	5	1.6%
TOTAL NONARBOREAL POLLEN	11	3.4%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar	1	0.3%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	1	0.3%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	2	0.6%
Equisetum		0.0%
Sum of monolete fern spores	2	0.6%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable	1	0.3%
SUM OF ALL SPORES	3	0.9%

480 CM LEVEL BASIC POLLEN SUM =	323	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	14	4.3%
Pinus	191	59.1%
Picea	6	1.9%
Tsuga	2	0.6%
Cupressaceae		0.0%
Salix		0.0%
Populus	5	1.5%
Juglans		0.0%
Carya	3	0.9%
Betula	34	10.5%
Alnus	4	1.2%
Ostrya/Carpinus	6	1.9%
Corylus	2	0.6%
Fagus		0.0%
Castanea		0.0%
Quercus	20	6.2%
Ulmus	2	0.6%
Acer	19	5.9%
Tilia		0.0%
Cornus		0.0%
Fraxinus	7	2.2%
TOTAL ARBOREAL POLLEN	315	97.5%
NONARBOREAL POLLEN (NAP)		
Poaceae	4	1.2%
Liliaceae		0.0%
Myrica	1	0.3%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum	1	0.3%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	2	0.6%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	6	1.9%
TOTAL NONARBOREAL POLLEN	8	2.5%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	2	0.6%
Eriocaulon		0.0%
Nuphar	1	0.3%
Brasenia	1	0.3%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	4	1.2%
SPORES		
Sculptured monolete fern spores	1	0.3%
Psilate monlete fern spores		0.0%
Equisetum	4	1.2%
Sum of monolete fern spores	5	1.5%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	5	1.5%

490 CM LEVEL BASIC POLLEN SUM =	338	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	1	0.3%
Abies	8	2.4%
Pinus	207	61.2%
Picea	27	8.0%
Tsuga	1	0.3%
Cupressaceae		0.0%
Salix		0.0%
Populus		0.0%
Juglans		0.0%
Carya	1	0.3%
Betula	21	6.2%
Alnus	22	6.5%
Ostrya/Carpinus	5	1.5%
Corylus	3	0.9%
Fagus	2	0.6%
Castanea		0.0%
Quercus	11	3.3%
Ulmus	3	0.9%
Acer	16	4.7%
Tilia		0.0%
Cornus		0.0%
Fraxinus	4	1.2%
TOTAL ARBOREAL POLLEN	332	98.2%
NONARBOREAL POLLEN (NAP)		
Poaceae	5	1.5%
Liliaceae		0.0%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex	1	0.3%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	13	3.8%
TOTAL NONARBOREAL POLLEN	6	1.8%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea	1	0.3%
Utricularia		0.0%
TOTAL AQUATICS	1	0.3%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	4	1.2%
Equisetum		0.0%
Sum of monolete fern spores	4	1.2%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type	1	0.3%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	5	1.5%

500 CM LEVEL BASIC POLLEN SUM =	666	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	41	6.2%
Pinus	534	80.2%
Picea	39	5.9%
Tsuga	4	0.6%
Cupressaceae		0.0%
Salix	1	0.2%
Populus	1	0.2%
Juglans		0.0%
Carya		0.0%
Betula	22	3.3%
Alnus	1	0.2%
Ostrya/Carpinus		0.0%
Corylus	1	0.2%
Fagus		0.0%
Castanea		0.0%
Quercus	13	2.0%
Ulmus		0.0%
Acer	5	0.8%
Tilia		0.0%
Cornus		0.0%
Fraxinus	2	0.3%
TOTAL ARBOREAL POLLEN	664	99.7%
NONARBOREAL POLLEN (NAP)		
Poaceae		0.0%
Liliaceae		0.0%
Myrica	1	0.2%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	1	0.2%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)		0.0%
TOTAL NONARBOREAL POLLEN	2	0.3%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	0	0.0%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	2	0.3%
Equisetum	6	0.9%
Sum of monolete fern spores	8	1.2%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type	3	0.5%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	11	1.7%

510 CM LEVEL BASIC POLLEN SUM =	553	
Taxon (Basic pollen sum = AP + NAP)	#	
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	17	3.1%
Pinus	373	67.5%
Picea	19	3.4%
Tsuga	5	0.9%
Cupressaceae		0.0%
Salix		0.0%
Populus	2	0.4%
Juglans		0.0%
Carya	4	0.7%
Betula	54	9.8%
Alnus	7	1.3%
Ostrya/Carpinus	6	1.1%
Corylus	8	1.4%
Fagus	4	0.7%
Castanea		0.0%
Quercus	9	1.6%
Ulmus	2	0.4%
Acer	23	4.2%
Tilia		0.0%
Cornus		0.0%
Fraxinus	13	2.4%
TOTAL ARBOREAL POLLEN	546	98.7%
NONARBOREAL POLLEN (NAP)		
Poaceae	3	0.5%
Liliaceae	2	0.4%
Myrica	1	0.2%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	1	0.2%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	11	2.0%
TOTAL NONARBOREAL POLLEN	7	1.3%
AQUATICS		
Typha latifolia	1	0.2%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	1	0.2%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores		0.0%
Equisetum	10	1.8%
Sum of monolete fern spores	10	1.8%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type	1	0.2%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	11	2.0%

520 CM LEVEL BASIC POLLEN SUM =	463	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	1	0.2%
Abies	17	3.7%
Pinus	301	65.0%
Picea	21	4.5%
Tsuga	3	0.6%
Cupressaceae		0.0%
Salix		0.0%
Populus		0.0%
Juglans		0.0%
Carya		0.0%
Betula	35	7.6%
Alnus	17	3.7%
Ostrya/Carpinus	11	2.4%
Corylus	9	1.9%
Fagus		0.0%
Castanea		0.0%
Quercus	22	4.8%
Ulmus	3	0.6%
Acer	12	2.6%
Tilia		0.0%
Cornus		0.0%
Fraxinus	3	0.6%
TOTAL ARBOREAL POLLEN	455	98.3%
NONARBOREAL POLLEN (NAP)		
Poaceae	5	1.1%
Liliaceae		0.0%
Myrica	1	0.2%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	2	0.4%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	7	1.5%
TOTAL NONARBOREAL POLLEN	8	1.7%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	0	0.0%
SPORES		
Sculptured monolete fern spores	8	1.7%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	8	1.7%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type .		0.0%
Lycopodium annotinum type	2	0.4%
Trilete fern spores, unidentifiable	1	0.2%
SUM OF ALL SPORES	11	2.4%

530 CM LEVEL BASIC POLLEN SUM =	1945	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix	3	0.2%
Abies	29	1.5%
Pinus	1222	62.8%
Picea	76	3.9%
Tsuga	5	0.3%
Cupressaceae	1	0.1%
Salix	4	0.2%
Populus	5	0.3%
Juglans	2	0.1%
Carya	1	0.1%
Betula	137	7.0%
Alnus	188	9.7%
Ostrya/Carpinus	28	1.4%
Corylus	7	0.4%
Fagus	4	0.2%
Castanea		0.0%
Quercus	110	5.7%
Ulmus	10	0.5%
Acer	55	2.8%
Tilia		0.0%
Cornus	4	0.2%
Fraxinus	28	1.4%
TOTAL ARBOREAL POLLEN	1919	98.7%
NONARBOREAL POLLEN (NAP)		
Poaceae	7	0.4%
Liliaceae		0.0%
Myrica	3	0.2%
Ericales		0.0%
Chenopodiineae	1	0.1%
Thalictrum		0.0%
Ilex	10	0.5%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	4	0.2%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown	1	0.1%
unidentifiable (not added into NAP)	15	0.8%
TOTAL NONARBOREAL POLLEN	26	1.3%
AQUATICS		
Typha latifolia	2	0.1%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	5	0.3%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	7	0.4%
SPORES		
Sculptured monolete fern spores	1	0.1%
Psilate monlete fern spores	3	0.2%
Equisetum	2	0.1%
Sum of monolete fern spores	6	0.3%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type	1	0.1%
Lycopodium annotinum type	4	0.2%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	11	0.6%

540 CM LEVEL BASIC POLLEN SUM =	1036	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix	3	0.3%
Abies	6	0.6%
Pinus	582	56.2%
Picea	24	2.3%
Tsuga	4	0.4%
Cupressaceae	1	0.1%
Salix	1	0.1%
Populus		0.0%
Juglans	1	0.1%
Carya		0.0%
Betula	104	10.0%
Alnus	97	9.4%
Ostrya/Carpinus	5	0.5%
Corylus	10	1.0%
Fagus	2	0.2%
Castanea		0.0%
Quercus	97	9.4%
Ulmus	10	1.0%
Acer	42	4.1%
Tilia		0.0%
Cornus	1	0.1%
Fraxinus	21	2.0%
TOTAL ARBOREAL POLLEN	1011	97.6%
NONARBOREAL POLLEN (NAP)		
Poaceae	4	0.4%
Liliaceae		0.0%
Myrica	1	0.1%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex	19	1.8%
Myriophyllum		0.0%
Galium		0.0%
Artemisia	1	0.1%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	17	1.6%
TOTAL NONARBOREAL POLLEN	25	2.4%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar		0.0%
Brasenia		0.0%
Nymphaea		0.0%
Utricularia		0.0%
TOTAL AQUATICS	0	0.0%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	1	0.1%
Equisetum	2	0.2%
Sum of monolete fern spores	3	0.3%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type	1	0.1%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	4	0.4%

550 CM LEVEL BASIC POLLEN SUM =	1245	
Taxon **(Basic pollen sum = AP + NAP)**	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix	1	0.1%
Abies	14	1.1%
Pinus	811	65.1%
Picea	11	0.9%
Tsuga	30	2.4%
Cupressaceae	2	0.2%
Salix	3	0.2%
Populus	3	0.2%
Juglans		0.0%
Carya	3	0.2%
Betula	86	6.9%
Alnus	26	2.1%
Ostrya/Carpinus	30	2.4%
Corylus	8	0.6%
Fagus		0.0%
Castanea		0.0%
Quercus	77	6.2%
Ulmus	8	0.6%
Acer	76	6.1%
Tilia		0.0%
Cornus		0.0%
Fraxinus	13	1.0%
TOTAL ARBOREAL POLLEN	1202	96.5%
NONARBOREAL POLLEN (NAP)		
Poaceae	6	0.5%
Liliaceae	17	1.4%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae	2	0.2%
Thalictrum		0.0%
Ilex	13	1.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	1	0.1%
Tubuliflorae	4	0.3%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	12	1.0%
TOTAL NONARBOREAL POLLEN	43	3.5%
AQUATICS		
Typha latifolia	4	0.3%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae		0.0%
Eriocaulon	1	0.1%
Nuphar	15	1.2%
Brasenia	5	0.4%
Nymphaea	20	1.6%
Utricularia		0.0%
TOTAL AQUATICS	45	3.6%
SPORES		
Sculptured monolete fern spores	2	0.2%
Psilate monlete fern spores		0.0%
Equisetum	1	0.1%
Sum of monolete fern spores	3	0.2%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type	1	0.1%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable	1	0.1%
SUM OF ALL SPORES	5	0.4%

560 CM LEVEL BASIC POLLEN SUM =	1360	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	12	0.9%
Pinus	869	63.9%
Picea	20	1.5%
Tsuga	29	2.1%
Cupressaceae		0.0%
Salix	1	0.1%
Populus		0.0%
Juglans		0.0%
Carya	1	0.1%
Betula	103	7.6%
Alnus	51	3.8%
Ostrya/Carpinus	30	2.2%
Corylus	6	0.4%
Fagus	1	0.1%
Castanea		0.0%
Quercus	104	7.6%
Ulmus	9	0.7%
Acer	74	5.4%
Tilia		0.0%
Cornus		0.0%
Fraxinus	16	1.2%
TOTAL ARBOREAL POLLEN	1326	97.5%
NONARBOREAL POLLEN (NAP)		
Poaceae	7	0.5%
Liliaceae	16	1.2%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae	1	0.1%
Thalictrum		0.0%
Ilex	9	0.7%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia		0.0%
Tubuliflorae	1	0.1%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	14	1.0%
TOTAL NONARBOREAL POLLEN	34	2.5%
AQUATICS		
Typha latifolia	5	0.4%
Sparganium		0.0%
Potamogeton	2	0.1%
Cyperaceae	2	0.1%
Eriocaulon		0.0%
Nuphar	4	0.3%
Brasenia	4	0.3%
Nymphaea	15	1.1%
Utricularia		0.0%
TOTAL AQUATICS	32	2.4%
SPORES		
Sculptured monolete fern spores		0.0%
Psilate monlete fern spores	2	0.1%
Equisetum		0.0%
Sum of monolete fern spores	2	0.1%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type	1	0.1%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	3	0.2%

570 CM LEVEL BASIC POLLEN SUM =	459	
Taxon (Basic pollen sum = AP + NAP)	#	%
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	5	1.1%
Pinus	309	67.3%
Picea	7	1.5%
Tsuga	11	2.4%
Cupressaceae		0.0%
Salix		0.0%
Populus		0.0%
Juglans	1	0.2%
Carya	1	0.2%
Betula	24	5.2%
Alnus	14	3.1%
Ostrya/Carpinus	6	1.3%
Corylus	2	0.4%
Fagus		0.0%
Castanea		0.0%
Quercus	35	7.6%
Ulmus	4	0.9%
Acer	26	5.7%
Tilia		0.0%
Cornus	1	0.2%
Fraxinus	3	0.7%
TOTAL ARBOREAL POLLEN	449	97.8%
NONARBOREAL POLLEN (NAP)		
Poaceae	4	0.9%
Liliaceae		0.0%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex	2	0.4%
Myriophyllum		0.0%
Galium	1	0.2%
Artemisia	1	0.2%
Ambrosia		0.0%
Tubuliflorae	2	0.4%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	6	1.3%
TOTAL NONARBOREAL POLLEN	10	2.2%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	2	0.4%
Eriocaulon		0.0%
Nuphar	5	1.1%
Brasenia	4	0.9%
Nymphaea	24	5.2%
Utricularia		0.0%
TOTAL AQUATICS	35	7.6%
SPORES		
Sculptured monolete fern spores	4	0.9%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	4	0.9%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	4	0.9%

580 CM LEVEL BASIC POLLEN SUM =	744	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix	1	0.1%
Abies	6	0.8%
Pinus	476	64.0%
Picea	8	1.1%
Tsuga	38	5.1%
Cupressaceae	1	0.1%
Salix		0.0%
Populus		0.0%
Juglans		0.0%
Carya	2	0.3%
Betula	52	7.0%
Alnus	30	4.0%
Ostrya/Carpinus	4	0.5%
Corylus	3	0.4%
Fagus		0.0%
Castanea		0.0%
Quercus	44	5.9%
Ulmus	5	0.7%
Acer	45	6.0%
Tilia		0.0%
Cornus		0.0%
Fraxinus	10	1.3%
TOTAL ARBOREAL POLLEN	725	97.4%
NONARBOREAL POLLEN (NAP)		
Poaceae	2	0.3%
Liliaceae	8	1.1%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex	4	0.5%
Myriophyllum		0.0%
Galium		0.0%
Artemisia		0.0%
Ambrosia	3	0.4%
Tubuliflorae		0.0%
Liguliflorae	2	0.3%
unknown		0.0%
unidentifiable (not added into NAP)	10	1.3%
TOTAL NONARBOREAL POLLEN	19	2.6%
AQUATICS		
Typha latifolia	1	0.1%
Sparganium		0.0%
Potamogeton		0.0%
Cyperaceae	1	0.1%
Eriocaulon		0.0%
Nuphar	6	0.8%
Brasenia	4	0.5%
Nymphaea	21	2.8%
Utricularia		0.0%
TOTAL AQUATICS	33	4.4%
SPORES		
Sculptured monolete fern spores	4	0.5%
Psilate monlete fern spores	1	0.1%
Equisetum		0.0%
Sum of monolete fern spores	5	0.7%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	5	0.7%

590 CM LEVEL BASIC POLLEN SUM =	454	
Taxon (Basic pollen sum = AP + NAP)	**#**	**%**
ARBOREAL POLLEN (AP)		
Larix		0.0%
Abies	1	0.2%
Pinus	312	68.7%
Picea		0.0%
Tsuga	19	4.2%
Cupressaceae		0.0%
Salix	1	0.2%
Populus		0.0%
Juglans		0.0%
Carya		0.0%
Betula	29	6.4%
Alnus	15	3.3%
Ostrya/Carpinus	3	0.7%
Corylus	2	0.4%
Fagus		0.0%
Castanea		0.0%
Quercus	35	7.7%
Ulmus	6	1.3%
Acer	15	3.3%
Tilia	1	0.2%
Cornus		0.0%
Fraxinus	7	1.5%
TOTAL ARBOREAL POLLEN	446	98.2%
NONARBOREAL POLLEN (NAP)		
Poaceae	7	1.5%
Liliaceae		0.0%
Myrica		0.0%
Ericales		0.0%
Chenopodiineae		0.0%
Thalictrum		0.0%
Ilex		0.0%
Myriophyllum		0.0%
Galium		0.0%
Artemisia	1	0.2%
Ambrosia		0.0%
Tubuliflorae		0.0%
Liguliflorae		0.0%
unknown		0.0%
unidentifiable (not added into NAP)	5	1.1%
TOTAL NONARBOREAL POLLEN	8	1.8%
AQUATICS		
Typha latifolia		0.0%
Sparganium		0.0%
Potamogeton	2	0.4%
Cyperaceae		0.0%
Eriocaulon		0.0%
Nuphar	3	0.7%
Brasenia	3	0.7%
Nymphaea	19	4.2%
Utricularia		0.0%
TOTAL AQUATICS	27	5.9%
SPORES		
Sculptured monolete fern spores	5	1.1%
Psilate monlete fern spores		0.0%
Equisetum		0.0%
Sum of monolete fern spores	5	1.1%
Osmunda		0.0%
Sphagnum		0.0%
Lycopodium selago type		0.0%
Lycopodium annotinum type		0.0%
Trilete fern spores, unidentifiable		0.0%
SUM OF ALL SPORES	5	1.1%

APPENDIX B

POLLEN CONCENTARTION DATA

Level (cm)	#Pollen	# slides	# drops/slide	final vol.	initial vol.	#grains/cc-sed.
1	344	2	4	0.03	2.5	72
10	607	1	4	0.05	3.7	287
20	348	1	2	0.2	6	812
30	926	2	2	0.4	4	3242
40	409	0.25	1	0.2	5	9165
50	1731	1	2	0.6	3.7	19657
60	296	0.25	1	0.5	3.5	40562
70	975	0.5	1	0.5	2.5	93525
80	299	0.25	1	0.5	3.3	43456
90	312	1	5	0.8	2.5	4788
100	297	0.5	1	1	4.1	34743
110	360	1.5	1	0.7	2.9	13892
120	794	0.5	1	0.85	4.2	77070
130	524	0.5	1	0.45	3.4	33263
140	297	1	1	0.5	2.6	13697
150	302	0.5	1	0.6	3.7	23488
160	478	0.5	1	0.55	3.6	35025
170	634	0.5	1	0.7	3.3	64501
180	356	0.25	1	0.4	3.3	41392
190	1020	0.5	1	0.2	2.5	39137
200	332	0.5	1	0.3	1.9	25142
210	464	0.5	1	0.7	2.5	62312
220	764	0.5	1	0.8	2.4	122142
230	749	0.5	1	0.7	3.4	73960
240	630	0.5	1	0.6	2.4	75540
250	424	0.5	1	0.5	2.4	42366
260	300	1	1	1	2.8	25694
270	415	1	1	0.7	2.3	30289
280	624	1	1	0.35	2.4	21823
290	635	1	1	0.35	1.9	28051
300	434	0.5	1	0.35	1.8	40474
310	320	1	1	0.4	2.1	14617
320	311	0.5	1	0.7	2.9	36004
330	314	0.5	1	0.8	3.3	36509
340	411	0.5	1	0.5	2.5	39424
350	929	0.5	1	0.4	2.6	68548
360	822	0.25	1	0.4	2.6	121306
370	886	0.25	1	0.4	2.6	130751
380	626	0.25	1	0.35	2.9	72472
460	319	1	1	1	2.9	110
480	323	1	2	0.2	2.5	3098
490	338	1	2	0.4	2.2	7369
500	666	1	2	1.3	3.4	30533
510	553	0.25	3	0.9	3.6	44205
520	463	0.5	1	0.6	3.3	40375
530	1945	0.5	1	0.25	2.4	97172
540	1036	0.25	1	0.4	2.5	159002
550	1245	0.25	1	0.3	2.1	170606
560	1360	0.25	1	0.35	2.3	198519
570	459	0.25	1	0.55	3.1	78116
580	744	0.25	1	0.4	2.2	129758
590	454	0.25	1	0.9	3	130647
					sed. vol.	/drop (cc)
Total	grains =	31266		Samples	1-50cm	7.14E-03
				Other	samples	4.17E-03