Tracking the fire history and succession of the Bloomingdale bog

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Abstract

This study examined core samples from the Bloomingdale bog. This bog was chosen for its great span over the landscape. The study was conducted in order to locate and identify changes that may have been induced by variation in local water tables from such things as climate change, change in ecosystem dynamics, and from degradation. Also, to establish the foundation information for future studies to expand on. This study included two transects across the bog. Each transect had seven points where samples where extracted. These points were selected randomly along each transect, as to avoid some bias in the study. We quantified the organic matter, the major transition layers, and four carbon dates. This data was used to determine the major transitions in organic material in the bog, when the bog experienced these changes, and a fire history pattern of the bog. In addition, the data showed where and when a possible significant drought had occurred in the bog. This study is the backbone for future studies perhaps on such subjects as climate change, watersheds effects on local wetland ecosystems, and a possible fire history for this area.

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Introduction

The Bloomingdale bog is located in Bloomingdale New York. It was chosen for this study for its massive span over the landscape. This bog has the overall appearance of being well developed, which would suggest it is thousands of years old. Bogs have the tendency to be very long lasting, and are known for their great ability to preserve subjects of organic matter for an extraordinarily long time (Britannica, 2012).

This would suggest that a bog is a wonderful location for studies that examine water table change over time, climate change impact on local ecosystems, and agricultural impacts on wet landscapes. These studies have been and will be a large challenge for scientist "Anticipation how ecosystem structure and function will respond to future and ongoing environmental change is a critical challenge for ecologists" (Talbot, Richard, Roulet, and Booth, pg.1, 2009).

There are very few studies in bogs that gather the basic information that will be needed to further our understanding of the past, current, and future climatic changes. The study that was conducted on this bog will provided the important information that future studies could use as a base of information to build of from.

Our study examined patterns in material, major succession transitions, and other possible identifiable information that such a bog can offer to better the understanding of the past climatic effects of such landscapes.

Every area or section of land across the world has a possibility for some sort of fire history. In the location of this bog, no one has really ever tracked and identified the history of occurrence of fires. This study was able to identify the fire history for the area near the bog, with the use of core samples that showed the charcoal layers. The use of extracting intact core samples will allow us to see the banding pattern of charcoal layers and with the comparison of the carbon dates, a possible time line for the fire history will be developed. The major questions of this study are, is there succession transitions that indicate past climate changes in the Bloomingdale bog, and what is the fire history of this bog?

Literature Review

The Holocene epoch is what the time period form the last ice age period to now in the northern New York area (Brown, Seppa, Shoups, Fausto, Rasmussen & Birks, 2011). This starts at about 12000 years before present (B.P.) through to today. There are three sections of time commonly referred to in the Holocene epoch the early, middle, and late. The early period of the Holocene being from about 12000 yr B.P. through until about 800 yr B.P.. The middle is about 800 yr B.P. up to about 500 yr. B.P.. The late then is from 500 yr B.P. up to today (Brown, et al., 2011). The early period is thought to have been warmer then now, particularly the summer, which is thought to be drier. The middle was a bit less warm then before and in-between wet and dry. Now it is commonly thought that there was a medieval warm period, saying it was warmer about 1100-700 years B.P.. More recent a little ice age occurred, suggesting it was colder at about 700-200 years ago. In addition, it is getting wetter still (Brown, et al., 2011). This is the basic history of what is known about the Holocene epoch for the Adirondacks, North American, and Europe area.

Some studies look at history signs of climatic effects on different ecosystem elements such as water levels in lakes, land cover types, and drought episodes. One such study was conducted to identify the developmental history of the Adirondacks, using the New York lakes around the high peaks area. The Holocene vegetation changes are pretty well understood. “There have been major regional and local changes in vegetation, in some cases involving shifts from conifer domination to hardwoods and back to conifers ounce again. Some of these changes were driven by climate, some by different migration rates” (Whitehead, Charles, Jackson, Sol & Engstrom, pg. 186., 1989). This change in vegetation types were driven by many factors but one important one could be the difference in climate factors. The early Holocene was warmer and dryer creating conditions that would allow for a more rapid rate of weathering to soils. This will in turn create a more acidic environment one that was more favorable to the spruce mixed forest (Whitehead, et al., 1989).

A study that examined pollen and used there results to reconstruct changes in the regional moisture balance of the Northeast that occurred during the last 12000 years B.P. The study's result shows that a major shift in the moister conditions between 9000 and 6000 years B.P. Estimates of annual precipitation continued to rise at most of the study sites between 6000 and 3000 years B.P. This led to conclude through their data that an increase in moisture supply continued into the late Holocene (Webb, Anderson & Webb III, 1993).

A related study conducted in the McFail's cave, New York found similar results about the Holocene period (Van Beynen, Schwarcz & Ford, 2004). The study from the cave found that a warmer and more wet period then present during 7000 and 7600 years. In addition, the study showed that from 7000 to 3000 years B.P. was steadily progressing more towards the present more cooler and wetter period. Similar to most studies looking at historical temperatures this study also found that a warm period happened around 2500 years B.P. (Van, et al., 2004).

An important part of the Holocene period is the amount of precipitation. Knowing what the storm patterns were for this time could represent important climatic changes that have happened. A study conducted in northeastern United States used lake sediments to determine what the storminess of this period was (Noren, Blerman, Steig, Lini &

Southon, 2002). The studies results follow a typical trend for the Holocene period. Starting with the results from approximately 12000 years B.P. one can see that this area had a far amount of storms, as you move from 12000 to approximately 7000 or 8000 years B.P., the storminess seemed to drop off into a drought. This drought did not lift until approximately the transition area from middle Holocene to late. The late end of their data shows that the storminess is on the rise again and in even higher amounts then the early Holocene period (Noren, et al., 2002).

When the Holocene started to leave its early period and shift into the middle period other ecosystem effects started to emerge. The records of studies show that land cover types changed, water levels in the great lakes fluctuated, and forest would start to merge into the prairie grass in some areas and the prairie grass would merge into the forest in other areas (Booth, Notaro, jackson & Kutzbach, 2006). Some of this may have been from a widespread of drought episodes in the western great lakes region during the past 2000 years. A study conducted in this area using peat lands sediments as records of hydroclimate variability (Booth, et al., 2006). The studies results suggest a time after 600 B.P. to have had a frequency of fire, and little peat accumulation. This is consistent with the plant types found with the drier time period (Booth, et al., 2006). The droughts between 1000 and 700 B.P. showed to extend across most of the western United States, when compared with tree ring analysis across multi-decades of drought events. The extent of eastern coverage of such droughts is hard to determine for there is little records or data collected that core multi-decades (Booth, et al., 2006).

During the mid-Holocene, the climate differed from present day climate. This time the northeastern United States was drier then present day records. The amount of land moisture, temperature, and ocean circulation indicate that the northeastern parts of the United States was much drier then today (Diffebaugh, Ashfaq, Shuman, Williams & Bartlein, 2006).

During the Holocene, the great lakes water levels had a high amount of fluctuation, as well as the land cover types. The northwestern great lakes region was particularly dry during the 8800 B.P. and 5700 B.P. calendar years (Booth, Jackson & Thompson, 2002). Mid-Holocene climatic shifts are related to atmospheric circulation in the great lakes region. In the great lakes region a dying off of some aquatic submerged species (Booth, et al., 2002) indicates a drying trend approximately 8800 calendar years B.P. Also in the results of a study in the great lakes region one can see the concentration of pine evident at around 7000 calendar years B.P., supporting the often trend of this being a more dry period allowing for a dominance of pine (Booth, et al., 2002).

The Bloomingdale bog is the product of a long process of natural dynamics that create a unique type of landscape. A peat bog is often a mass of peat and other associated vegetation floating on water. Not all bogs are floating on water, the bog in our study is a peat moss bog that is simply resting on thousands of years of organic matter build up underneath. The most common process for bog development in areas that experienced glaciation is, the glacier during retreat scored or gouged depressions in the underlying rock. As the glacier melted it deposited water into the depression, or water found its way there from the surrounding watershed. This water would then if the chemical and mineral balance was correct support peat moss to grow along the edges. The peat moss would eventually grow from the edges towards the center creating the landscape that is known as a bog (Encyclopedia Britannica, 2012).“Peat lands are wetlands that accumulate partly decomposed plant residues that become the substrate on which vegetation grows" (Talbot, Richard, Roulet & Booth, pg.2, 2009). In most cases this peat mass will slowly cover the entire water body from the edges towards the center. Bogs tend to show a state of rapid decomposition in the early development from litter. "In the first few years, litter will experience very rapid initial decomposition caused by processes such as leaching of soluble organic materials" (Yu, Turetsky, Campbell & Vitt, pg.162, 2001). The slow and long lasting traits of bogs make them a great study site when one is examining events or the build up of organic matter over large time periods. A bog tends to be very acidic in nature making it a perfect substrate for preserving most organic materials (Encyclopedia Britannica, 2012).

In order to obtain data from the bog one could simple collect surface samples but this would not tell one very much about what lies beneath. Deep under the surface of a bog is where the story really begins, at the deepest level one can find the parent material, which in the northeastern United States this will usually be some form of sand. There is a good basic way to gather this information, using a corer sampler device. The use of such corer devices is essential to maintain the vertical structure of the area sampled (Parada, 2008).

Some new types of coring tools have been developed for different types of sediment studies, and one new one is the pedal corer. The pedal corer is a lightweight simple device that does not disturb the sediment structure and provides easy access to the sample contained inside the core (Parada, 2008).

A more technical type is the motorized corer, this was designed as an improvement from the hand style corer used in ice coring. This device is best descried as a cylindrical tube with cutting knifes on the inside, which drill down into the sediment at desired locations. The large improvement on the design was changing the material the cutting knifes are constructed from (Nornberg, Goodsite & Shotyk, 2004). In addition, this style corer allows for a continuous record of peat accumulation, this feature is essential in paleoenvironmental studies (Nornberg, et al., 2004). The corer device used in our study is much simpler design that is common in paleocology studies. The device used is able of collecting 50 cm core samples at a time, with large rod extensions that allow the user to reach their desired depth for collection. Core samples form peat bogs can allow for the collection of data that will aid in answering questions about climate changes in history, fire history of an area, ecosystem changes, forest types and how they have changed in history, and even human effects on the wetlands.

One study that was conducted looking at pollen surface fossils was able to track a climate history for the northeastern United States. This study focused on looking at the changes in mean annual precipitation, effective soil moisture index (Webb, et al., 1993). This study is similar to what one could look at using bog core samples. They found that from about 12000 years B.P. through today there has been significant changes in precipitation, effective soil moisture index, as well as lake fluctuations, and determined how all these elements effect the composition of pollen (Web, et al., 1993). The pollen of an area can provide information about plant composition at different time periods. For example, some trees enjoy a more arid environment, while other trees will enjoy a much more moist environment. Both these different tree types will leave behind a pollen bank that later one could retrieve with such things as core samples. Some of these tree species could then be used as an indicator for determining weather the land was wet or dry. One study found that the low estimates for annual precipitation at 12000 and 9000 yr B.P. reflect the dominate influence of being a high conifer mainly spruce, and northern pines (Webb, et al., 1993). The study also found that the low annual precipitation but high soil moisture at 12000 yr B.P., suggests a dominate role of cold temperatures to explain the regionally high water levels (Webb, et al., 1993).

In a similar study conducted on peat lands examined the ecological responses to drainage in raised bogs, focused on the importance of answering the often-challenging questions for ecologist, how to anticipate how an ecosystem structure and function will respond to future and ongoing environmental changes (Talbot, Richard, Roulet & Booth, 2009). In this study, it mentions how although there is a change in the relative amounts of rain and snow, and increased evaportranspiraton rates, this may lead to increased summer droughts in many northeastern peat lands (Talbot, et al., 2009). These studies are most significant when a large enough amount of data is collected to support this type of extrapolation. “Our ability to forecast ecosystem responses to these changes is contingent on the availability of empirical data sets that are sufficient in temporal depth and resolution to capture a broad range of past climatic conditions and ecosystem responses”(Ireland & Booth, pg. 11, 2011).

A study done in the area near ours, in the Brandreth bog found that this bog was aged back to the last ice age. This bog also showed that during the early Holocene the area was dominated by pine trees, and did not turn into a peat moss bog until the late Holocene (Overpeck, 1985). In this study, the author concludes that the major vegetation types in this area have migrated from the south into the Adirondacks as a response from a climate change. Interestingly that the results showed that during the time of low moisture the pollen was dominated by pine species much like the studies discussed before (Overpeck, 1985).

In addition, other Paul Smith's College students have conducted studies using core samples on similar landscapes. Jason Fitzpatrick conducted core sample from lost pond in the high peaks area of the Adirondacks dated to be 13,000 calendar years B.P. This would suggest that the ice age ended in the high peaks area before the lower elevations. Therefore, the bogs in lower elevations must have formed at a later time because of this. Similar to this study is the one that was done near Jones pond. There are two bogs that were examined in this area by Paul Smith's College students, one near the pond that was dated as 8000 calendar years B.P., and had deeper deposits in this time frame then the Bloomingdale bog. The bigger bog in this area across the road from the previously mentioned bog dated to be younger at only 5500-6000 calendar years B.P., with the depth of cores being only 3 meters.

Bogs also can provide one with information on fire frequency assuming there has been fires in the area and that the fires deposited charcoal in the bog. Lots of different areas in the United States have had some sort of wild fire. The northeastern United States may not have had as many as other parts of the United States.

Soil charcoal found in sediments can provide information about an areas fire history. Soil charcoal can be used as indicator for past climatic events through the Holocene, and for prehistoric land use particularly agriculture practices (Titiz & Sanford Jr., 2007). "Climate change could be better understood by integrating data from fire disturbance and other paleoecological studies into larger scale models" (Titiz & Sanford Jr., pg.681, 2007).

The Holocene period may have had climatic effects that influenced the frequency of such fire events. A study conducted in the wet tropical forest of central Guyana showed that the frequency of charcoal sediments increased with depth in sediment (Hammond, Steege & Borg, 2007). This also would be saying that the older sections of sediment had more fires. The study found that a steady pattern was shown between 1800 and 900 calendar years B.P. (Hammond, et al., 2007). This is during the Holocene drier period connecting the results to the other previously mentioned studies. “Sample ages date across most of the main transitional climate phases currently believed to have affected regional precipitation through out the Holocene” (Hammond, et al., pg.155, 2007).

Most people know that one can learn a large amount about the future by looking back at the history. In addition, most people know that water has the potential to transport a large amount of material. Water through its normal movement may then have the possibility of gathering bits and pieces or evidence of what events where going on at any even moment around or near where the water takes its everyday course through out history. One then might say that water would often flow through some type of wetland such as a bog. When water slowly trickles through a bog, it deposits some of the evidence it has been carrying or in other words creates the sediment that which the bog vegetation will grow on. One could say this makes a bog similar to a library holding records of historical events.

Methods

The location of our study is the Bloomingdale bog, located in Bloomingdale, New York. This bog was selected for this study for its large area and relatively easy accessibility. The bog is located along a railroad bed, currently being used as a recreation dog-walking trail. This trail gave us a way to access the bog with very little restrictions.

Transect lines were established through the bog dividing it into three parts by randomly selecting where we thought the middle of the bog was and then again where the half way point between the middle and the far north edge is, these two selected lines we used as our transect lines. Along the transect lines, seven random sample points were established by us, and the location of these points were recorded using a Global Positioning System (GPS). Each point was randomly selected along the transect lines at different distances apart. We extracted full profile cores from two of these seven sample points.

At each selected sample point along the transect lines a coring tool was used. The core sampler used was of steel construction and able to take 50 cm intact core sample. This coring tool was used at each point to determine the depth of bog material. This was done by attaching the extension rods; pipes with threads on each end that when applied together construct a handle at any length as desired. After the rods were in place a handle attached to the end of the rods, this then was pushed vertically straight into the bog material until we could feel it encounter the parent material, sand, located at the bottom of the bog material. Then a piece of tape was placed on the handle of the core tool at the upper most surface of bog material. The tools handle was then rotated clock wise to allow the knife portion of the core sampler to extract the 50 cm core from the section of bog immediately above the sand. The tool is then pulled straight up out of the bog material and laid horizontally on the surface of the bog for examination. At this time, we collected the overall depth of bog material by measuring from the tape previously placed on the tool to the opposite end of the corer tool where the 50 cm core had encountered sand.

We used a meter stick and visual observation to determine the locations of suspected charcoal layers. A digital picture was also taken of the core samples at this time often with the use of a finger to highlight the charcoal bands. Visual observations of the types of materials contained in the core sample were made and noted in our field data journal. The core sample was then wrapped in aluminum foil for safe transportation and preservation.

The labeling we used to keep track of the samples location, day of collection, and sample point collected from is of an alphanumeric type. For example, the first day of fieldwork we labeled the first core as (core A1A). The first A indicating the first day, the number one (1) indication the first point along the transect, and the second (A) indicating that it is the first 50 cm of bog material working from the sand upwards to the surface of the peat moss. The second day of samples would be labeled (core B1A), and this same pattern was continued for every day of fieldwork.

The labels and identification of the top and bottom of each sample was determined in the field at the time of extraction. The top was identified as the upper most part of the sample when it was pulled straight out of the extraction point. In addition, arrows indicating the top were drawn on the aluminum foil to insure we could determine the correct direction of the samples later. This labeling was done in this same manner both on the inside surface of the foil and the outside surface of the foil. The samples then were transported off the bog in a box and brought to Paul Smith's College, for storage in a refrigerator for later observations.

The points along the transect that showed to have the greatest depths and the most abundance of marsh material were selected as being the locations were full profiles were extracted. Full profiles meaning a continuoius sample from the sand material working upwards to the surface peat moss material. We used the coring tool to extract the full profiles from these points. We did this by first pushing the sampler in a vertically straight position downwards through the bog material until it reached the parent material, sand, then turning it clock wise to extract the 50 cm sample. Tape was then placed at the surface of the bog to be used as a reference point later. The sample was then pulled up and collected in the manner described before with aluminum foil. We then measured from the tape down 50 cm and placed a piece of tape at this location on the tool. This tape was then used as a reference point to know when to stop the downward pushing of the tool approximately right above the sample before. This process was continued until the sampler reached the surface of the bog. This process was used at both locations where full profiles were collected. These locations were also documented with the use of the GPS.

Sections of both full cores were selected to be carbon dated to identify the age and completeness of the bog material on a time scale. The locations were selected to allow the most information. The first location selected for dating was immediately after the sand on the first full core sample taken, this allowed us to gain the overall age of the bog at this location. The second date was taken at a point just above the last charcoal layer on this same core sample. The next two dates were taken on both sides of a major transition of material type found within the second full core sample taken.

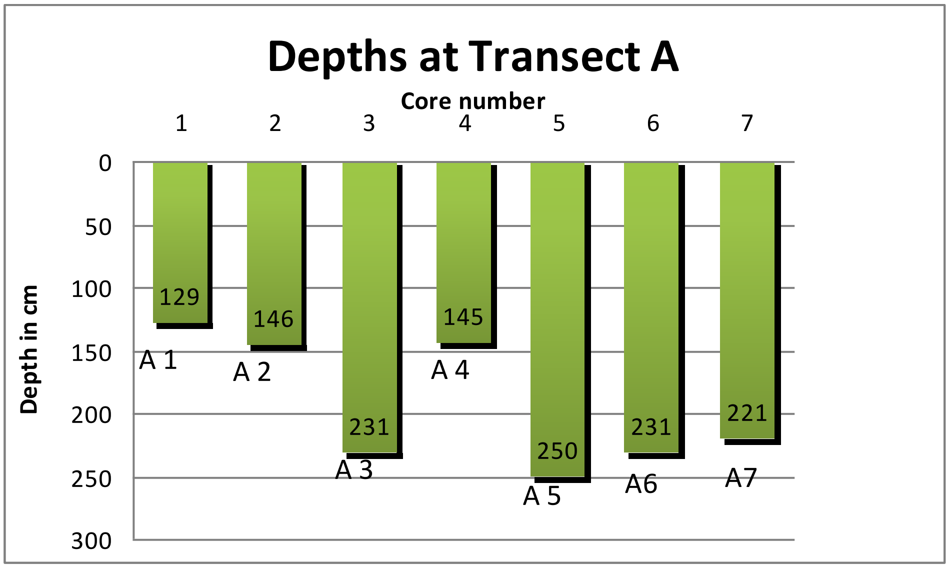
The samples for dating were collected for dating in a lab at Paul Smith's College. The samples were extracted using a small spatula shaped tool; the samples were about the size of a common garden pea. The samples were placed in sterile sample bags for shipping. The samples were then sent to a radiocarbon dating analyses company. The company we used was BETA ANALYTIC INC. located at 4985 s.w. 74 Court, Miami, Florida, USA, 33155. The company returned a report of radiocarbon dating analyses that provided the sample identification and the carbon date derived from the sample.

The same full cores were then used for the lab portion of our observations. We started by identifying which edge of the core we were going to extract sections from to observe under a microscope, leaving the opposite side untouched. We then placed a small amount of tap water into Petri dishes. Pea sized samples were taken out of the core sample at every 5 cm and placed in the water. We then observed the samples under a microscope. We examined the types of material that were present and categorized them with basic descriptions (woody debris, grassy, roots, other). These descriptions reflect what the materials most resembled when observed. We independently looked at the samples at every 5 cm under the microscope and corroborated percentages based on this observation and recorded the data in our notes.

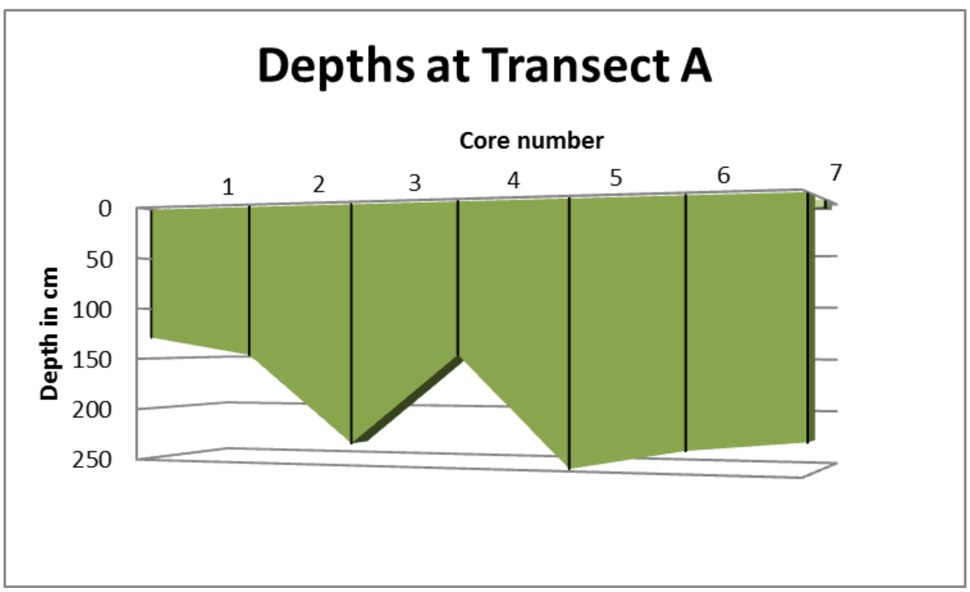
The percents of each type of material that we assigned to each 5 cm sample was then entered into Microsoft excel for the making of charts and graphs later used to analysis the results. The depths taken from the field portion of the study also were entered into this program for the construction of depth charts.

Results

Our findings show that the first transect sample points show a significant amount of change in overall depth. The shallowest point being 145 cm, and the deepest point being 257 cm. The bar charts that show a topographic representation of the bog are shown in Figure 1 and Figure 2

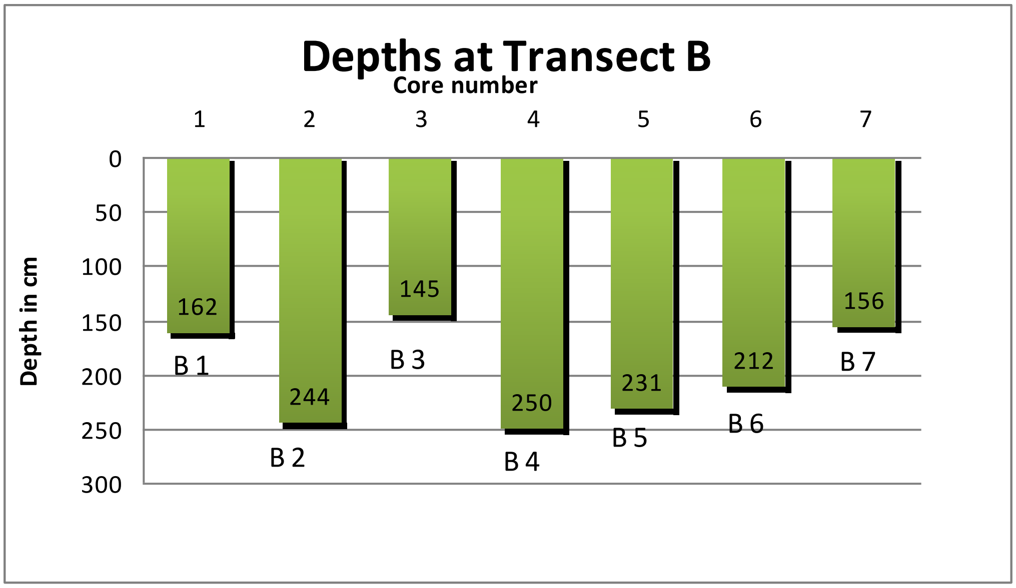


A representation of the different depths that were recorded on the transect.
Figure 1

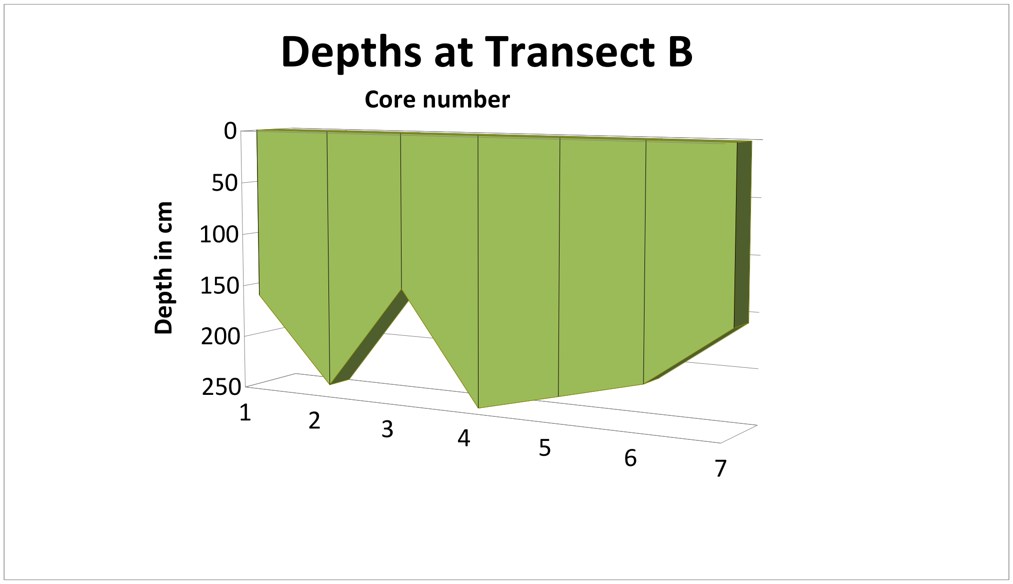


A representation of the different depths that were recorded on the transect.
Figure 2

The second transect provided similar results, again we found a fair amount of variability in the depths at each sample point. The second transect had the shallowest point being 156 cm, and the deepest being 215 cm. A bar chart that shows the topographical representation of this section of the bog is shown in figures 3 and 4.



A representation of the different depths that were recorded on the transect.
Figure 3



This graph is a representation of the different depths that were recorded on the transect.
Figure 4

The four carbon dates taken showed to be significant dates related to the transitions and charcoal band locations. The radiocarbon dates taken from the lowest part of core (A6A) at approximately 6 cm from the sand labeled as (BB-6) showed the bog material at this location to have a conventional radiocarbon age of 9640 +/- 40 years B.P.. On the same core sample, the carbon date location less then 1 cm above the last charcoal layer, 30 cm from the bottom labeled as (BB-6-30) showed to have a conventional radiocarbon age of 8550 +/- 40 years B.P.. The other two carbon dates where taken from the core labeled as (C1B). This is the middle section of the full core sample composed of three sections A, B, and C., it is part B of the A,B,C sections. The first carbon date from this sample labeled as(BB-C1B-21) from 21 cm from the bottom of the core sample showed to have a conventional radiocarbon age of 2200 +/- 30 years B.P.. The second sample from this same core was taken 25 cm from the bottom of the sample, labeled as (BB-C1B-25) which showed to have a conventional radiocarbon age of 730 +/- 30 years B.P.. These two samples were taken from both sides of a major transition in the bog material. Appendix C radiocarbon dating analysis report

Using the dates from above and below the charcoal layers within the sample we were able to develop a range of the frequency of historical fires in this area. The frequency range we found is that major fires happened every 206 - 239 years apart.

The microscope observations that were conducted on the core sample labeled as (C1A) showed a fair amount of variation over the whole core sample. Starting at 10 cm being mostly dominated with woody debris at 50 %. Also 40% of the segment was made up of roots. Interestingly in the next 5 cm it turns into being mostly dominated by roots still making up 40% of that area, and grassy material makes up 30% of this segment. It shows this similar trend through out the remainder of this core sample with the percentages changing some but roots and grassy material are the dominate substances (Table 1).

Table 1 Percentages of microscope observation on material types for sample (C1A)

cm	grassy	roots	woody	charcoal	black spherical objects	other
50	0	0	0	0	0	0
45	30	20	10	0	0	45
40	45	25	15	0	0	10
35	45	20	5	0	0	30
30	30	25	10	0	0	35
25	40	30	15	0	0	15
20	30	40	20	5	5	4
15	30	40	20	0	0	10
10	10	40	50	0	0	0
5	0	0	0	0	0	0
0	0	0	0	0	0	0

From the microscope observations we are able to determine that starting with the lowest portion of the core labeled as (C1B) the segments observed at 5 cm showed to be mostly woody debris and grassy material. (Table 2). The segment observed at 10 cm and 15 cm showed very similar results of having mostly woody debris and grassy material. (Table 2). The segment observed at 20 cm would seem to be a possible beginning of a transition from the mainly woody debris and grassy material to a more roots dominated material. (Table 2). The segments from 25 cm through 35 cm show a similar abundance of a root dominated material with the roots making up 50-75% of the material. (Table 2). Another transition at 35 – 40 cm showed that this segment went from being dominated by grassy material to being dominated by sphagnum moss material. Segments at 40 and 45 cm showed to have 80-90% sphagnum moss dominated material. (Table 2).

Appendix A & B pie charts representing the percentages of materials observed at the transitions.

Table 2 Percentages of microscope observation on material types for sample (C1B)

cm	sphagnum	woody	grassy	roots	spore	white globular objects	other
50	0	0	0	0	0	0	0
45	90	0	5		0	0	5
40	80	5	0	5	0	0	10
35	0	5	5	75	0	0	5
30	0	5	5	75	0	0	5
25	0	30	10	50	0	0	10
23cm transition							
20	0	40	30	15	1	0	0
15	0	60	20	10	0	2	8
10	0	60	15	10	0	0	15
5	0	60	20	10	0	0	10
0	0	0	0	0	0	0	0

The microscope observations that were conducted on core sample labeled as (C1C) we found that overall this core sample was dominated by a grassy material. With only two locations being dominated by woody debris, this was between 0 and 5 cm and at 35cm. In addition, the location at 45 cm on this sample was the only location dominated by sphagnum moss. The segments observed at 5-30 cm showed to be dominated by the grassy material ranging from 20-40%. (Table 3). The observed segments at 35 cm expressed a woody debris dominated material. The observed section at 40 cm showed to be dominated by grassy material. The final segment observed on this core sample showed to be dominated by sphagnum moss. (Table 3).

Table 3 Percentages of microscope observation on material types for sample (C1C)

cm	grassy	roots	woody	moss	other
50	0	0	0	0	0
45	10	0	20	30	40
40	40	25	20	0	15
35	10	25	40	0	30
30	40	25	15	0	20
25	40	15	0	0	45
20	40	35	15	0	10
15	40	5	15	0	40
10	40	25	15	0	20
5	20	15	40	3	22
0	20	40	15	5	20

Discussion

Through our core sample data we were able to identify the changes in depth. The amount of change in depth was significant enough for us to approximately map the bottom of the bog. More specifically the humps and dips in the parent material, sand, found below the bog material. The topography under the bog is similar to that of any common land in the northeastern United States expressing high spots and low spots (see Figure 1).

Interestingly the Bloomingdale bogs depth of material is comparably thinner then other studies done in similar areas. Our average depth of the bog is two meters. The Brandreth bog from the high peaks area of the Adirondacks had core depths of ten meters, with a carbon date similar to that of the Bloomingdale bog of 12,000 calendar years B.P. but yet had significantly thicker bog material (Overpeck, 1985). In addition, other Paul Smith's College students found that the small bog near Jones pond is dated as being 8,000 calendar years B.P. and showed to have 7.3 meters of bog material. However the other Paul Smith's College students found that the bigger bog across the road at this same locations dated at being younger then the Bloomingdale bog at 5500-6000 calendar years B.P. but showed to have a more similar thickness to the Bloomingdale bog with a thickness of three meters.

The Bloomingdale bog is thinner then most bogs that developed in this area. The reason for this could be several things; the first logical reason may be that the bogs all started developing at different times because of local hydrology. Another explanation could be a drought may have caused for slower deposit in sediments or even caused some sediment to dry out and made transportable by wind. On the other hand, it could also be that a different process then most bogs created the Bloomingdale bog.

The four carbon dates that were conducted on our cores showed to have a significant amount of information. The first date taken on core (#6) about 6 cm above the sand layer dated the bogs age at this point as being 9640 +/- 40 years B.P. This suggests that the bog dates back as far as the last glacier retreat or about 12000 years ago. The second date of the core showed to be 8550 +/- 40 years B.P. Using the first date and the second date we were able to show that the fire history frequency range of every 206 – 239 years.

The third and forth dates were taken before and after a major transition in the core labeled as (C1B) this core was the middle section of the full core profile extracted at this point along our second transect line. The date taken from 21 cm above the sand layer was 2200 +/- 30 years B.P. The date taken from 25 cm or just above the transition line was 730 +/- 30 years B.P. The material in the bog transitions from being dominated by woody debris and grassy materials to being dominated by roots, grassy, and moss material. This suggests that something happened that caused some of the bog matter to be missing. The most likely reason for this to happen in a bog would be a major drought where material was able to dry up and become dusty making it easy for the wind to relocate it elsewhere. These dates show, assuming core samples are complete and captured the whole story, that this bog has survived through the entire Holocene epoch.

When our data are compared to other data, they express the effects of a significant climate change. Data collected during a study looking at drought episodes in the great lakes area show that around the same dates as the possible drought in our bog the water table in the great lakes area was also significantly lower suggesting a drier time (Booth, Notaro, jackson & Kutzbach, 2006). The developmental history of the Adirondacks lakes also shows a significant amount of pine pollen approximately during the same dates, this would also suggest a drier climate during this time (Whitehead, Charles, Jackson, Smol & Engstrom, 1989). In addition a study that looked at storminess in the northeastern United States during the Holocene epoch found that this same time had low amount of storms indicating less precipitation during this time (Noren, Blerman, Steig, Lini & Southon, 2002).

The drought in the Bloomingdale bog at this date would suggest that when it gets warmer it also gets drier, and when it gets colder; it would then also get wetter. This does not match up with the most preferred climate models used today (Stager and Thill 2010). The most commonly supported climate models suggest that as it warms it tends to also get wetter. This is easy to comprehend when one thinks about the water cycle and how when it gets warmer more water evaporates from the surface of the earth and in return, more precipitation will follow. However, there are few scientist who believes that as it gets warmer it tends to also get drier, and that when it gets colder it will get wetter. The climate models are computer generated models that use a series of inputs are selected and from this, a projected outcome is developed. These models are often checked using data from past events to see if the predicted outcome is similar to what actually happened. In the Climate Change in the Champlain Basin report form the Nature Conservancy several computer models were used to predict average temperature change and precipitation change for this area. Out of the sixteen models the data was tested under they all agreed that the annual temperature would rise with current emissions. They however did not agree to how much the temperature would rise (Stager, Thill, 2010). More related to our study is what the models developed for precipitation. Under the moderate emissions scenario most models say little change or no significant change in the precipitation. However in the extreme emissions scenario eleven out of the sixteen models developed results that say precipitation will rise, all the models developed different amounts for how much it will rise. Four of the models predicted no real significant change. Interestingly though one model predicted that the perception would actually lower during this extreme emissions scenario (Stager, Thill, 2010). Our results and data from the bog suggest that one should consider the minority group in climate models. The data from the Bloomingdale bog supports the model in that when it gets warmer such as when emissions rise annual temperatures it would then also get drier. The history of this bog suggests that at the time it was warmer the bog was also drier. The major transition found showed a drought period during the warmer period.

Our study showed that there are major successional transitions in the Bloomingdale bog that were influenced by historical climate change. Future studies may be able to answer the questions of how these climate changes occurred when they did. The data from our study also suggest that the minority of climate models may have more significance then they are often allotted. Our data shows that some models that express less precipitation with warming should be considered and tested further. A future study one could conduct would be to examine the possible correlations between temperature and precipitation. This future study could have a focus on how it becomes drier when it becomes warmer and vise versa with cooling and getting wetter.

Our study was able to locate a fire history and frequency using the charcoal layers and carbon dates. The fire history range in frequency for the Bloomingdale bog is approximately a fire occurring every 206-236 years. Future studies may want to examine how this frequency has changed through time. A future study might look into what types of influences have occurred that would possible affect this frequency. Our study showed that significant information on local areas climate and fire history can be derived from bogs. Another type of study would be to examine the developmental stages of different types of bogs, including the effects of elevation on bog development.

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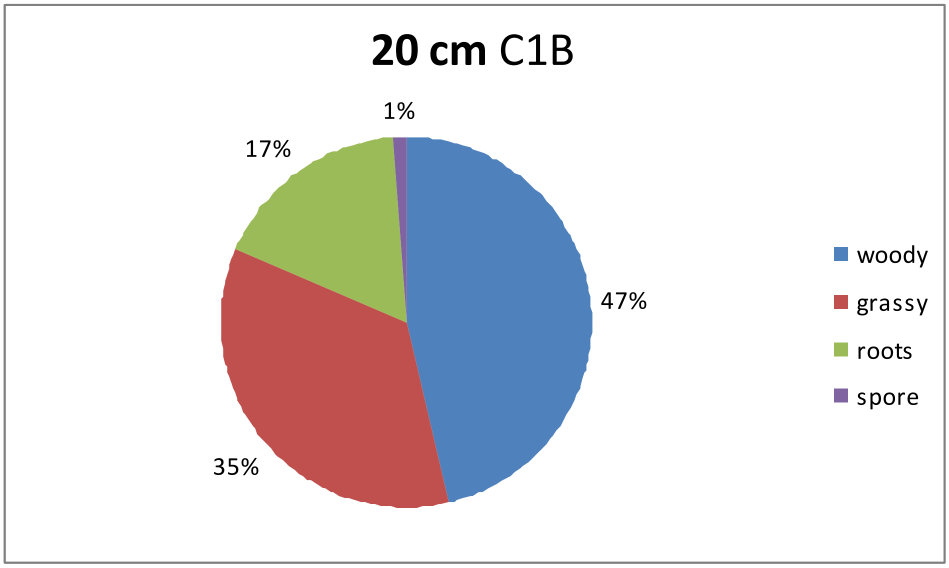
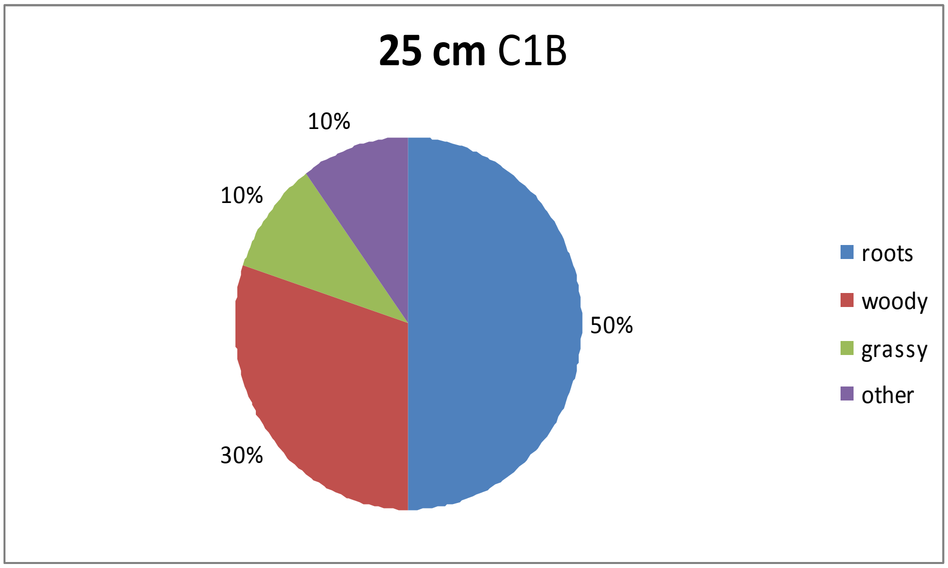
Appendix A

Pie charts representing percentages of material taken on both sides of major transition in core C1B (20cm, 25cm)



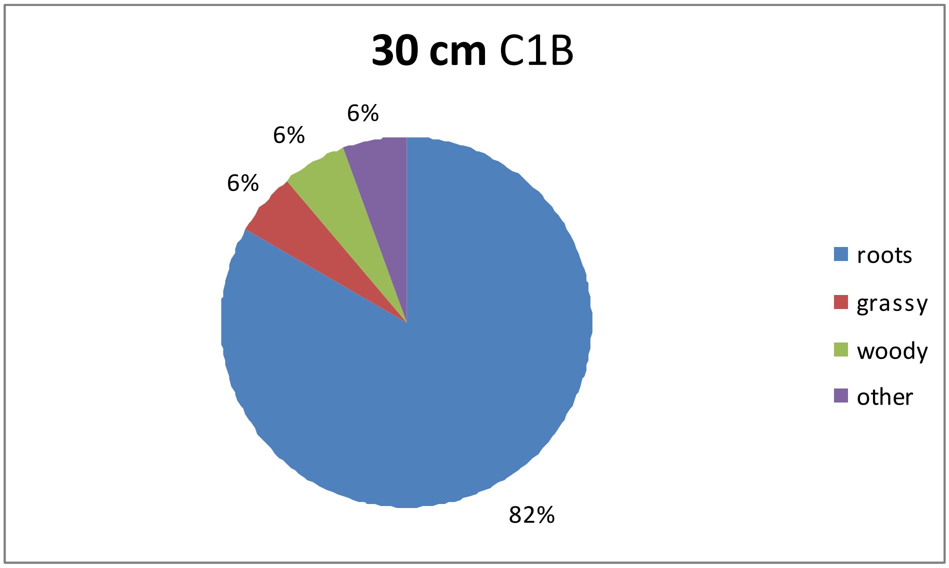
Percentages of materials observed with microscope at 20cm (just below major transition), Location of carbon date.



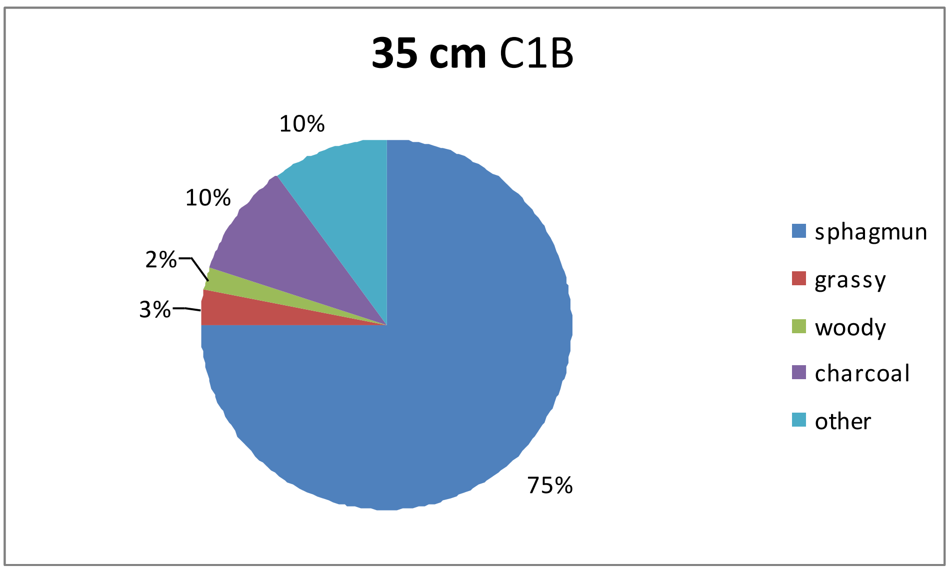
Percentages of materials observed with microscope at 25cm (just below major transition), Location of carbon date.

Appendix B

Pie charts representing percentages of material taken on both sides of major transition in core C1B (30cm, 35cm)



Percentages for a major transition observed from microscope observation at 30cm



Percentages for a major transition observed from microscope observation at 35cm