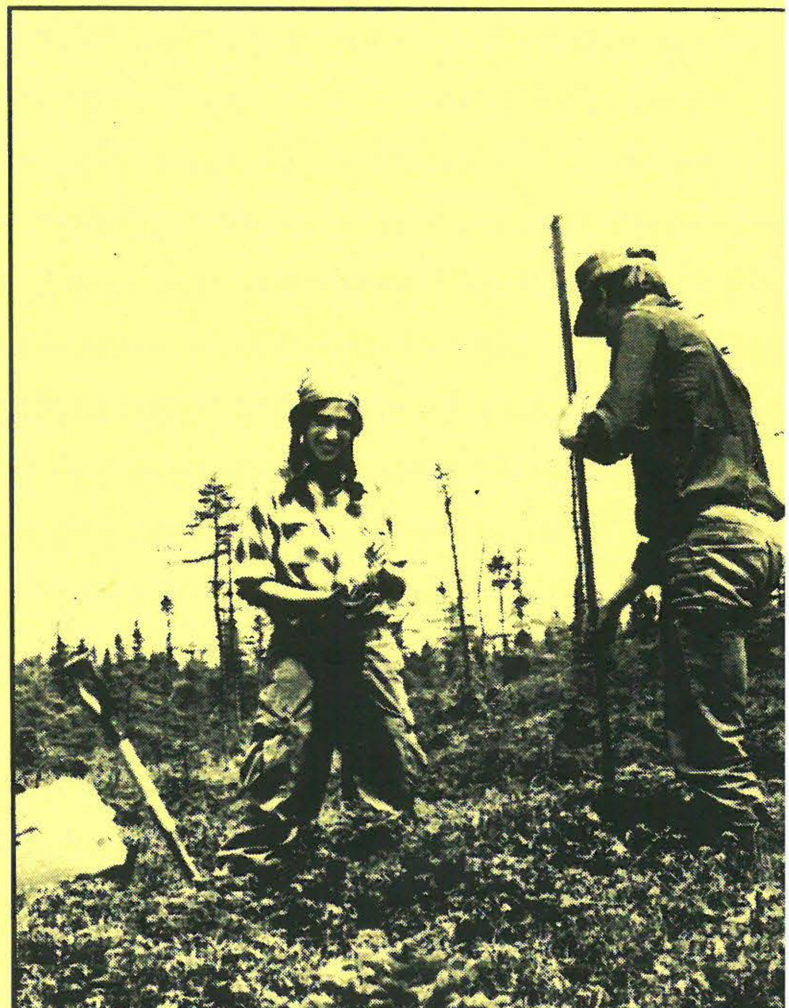
BULLETIN 33

PEAT ACCUMULATION RATES IN SELECTED MAINE PEAT DEPOSITS

By
Kimmo Tolonen
Ronald B. Davis
Lissa S. Widoff



Walter A. Anderson, State Geologist
Maine Geological Survey
DEPARTMENT OF CONSERVATION

BULLETIN 33

PEAT ACCUMULATION RATES IN SELECTED MAINE PEAT DEPOSITS

by

Kimmo Tolonen

Department of Botany
University of Helsinki
Helsinki, Finland

Ronald B. Davis

Lissa S. Widoff

Institute for Quaternary Studies
and
Department of Botany and Plant Pathology
University of Maine at Orono
Orono, Maine

Maine Geological Survey
DEPARTMENT OF CONSERVATION

Walter A. Anderson, State Geologist

1988

The laws and policies of Maine and the United States prohibit discrimination in Department of Conservation programs and/or employment because of race, religion, national origin, sex, age, or handicap. Any person who believes discrimination has occurred should contact the Commissioner, Maine Department of Conservation, Station #22, Augusta, Maine 04333; Telephone (207) 289-2211.

CONTENTS

ILLUSTRATIONS

TABLES

APPENDIXES

INTRODUCTION

Purpose of Study

The objective of this study was to determine the net rates of peat accumulation in selected peatlands in Maine. Accumulation rates were determined separately in long peat cores encompassing all or most of the Holocene, and in short peat cores encompassing the past few centuries. Dating of the peat was carried out by Carbon-14 analysis, pollen counts and correlations, and yearly moss increment counts. These results were supplemented by studies of moss height growth in 1981, and by studies of peat decomposition in 1980 and 1981.

Location of Study Sites

Cores and other observations came primarily from four unmined and one mined peatland: (1) Crystal Bog (CyB) and adjacent Crystal Fen (CyF) in Aroostook County; (2) Caribou Bog (Ca) in Penobscot County; (3) Great Heath (GH) in Washington County; (4) Big Heath (BH) in Hancock County; and (5) mined portions of Denbo Heath (D) in Washington and Hancock Counties. In addition, more limited information was obtained from some sites in the following peatlands: (6) Great Sidney Bog (SB) in Kennebec County; (7) Carrying Place Cove Bog (CP) in Washington County; (8) Keith Bog (K) in Washington County; and two mined peatlands at Jonesport in Washington County: (9) one formerly mined by New England Peat Industries (EP); and (10) Jonesport Heath (JP). The locations of these ten peatlands are shown in Figure 1, and the sampling sites on each peatland are shown in Figures 2 through 11. Photographs of some of the deposits are included in Appendix I.

Methodology

Peat Coring and Sectioning

At the Great Heath, the extensive results of Cameron (Davis and Anderson, 1980) were used for choosing representative coring locations. During the 1981 field season, numerous sites were cored along several transects in both the northern and southern parts of Caribou Bog, along three transects on Big Heath, and on Crystal Bog. For the cores at all the peatlands, including Denbo Heath, New England Peat Industries Heath, Jonesport Heath, Carrying Place Cove Bog, and Great Sidney Bog, the peat strata were carefully described. This information helped in selecting the core site from which the peat samples were to be analyzed, and strengthened general conclusions regarding peat types, degree of decomposition, frequency of peat fires, etc. At the other bogs and the fen, only three or four preliminary borings were carried out before selecting a representative sampling site.

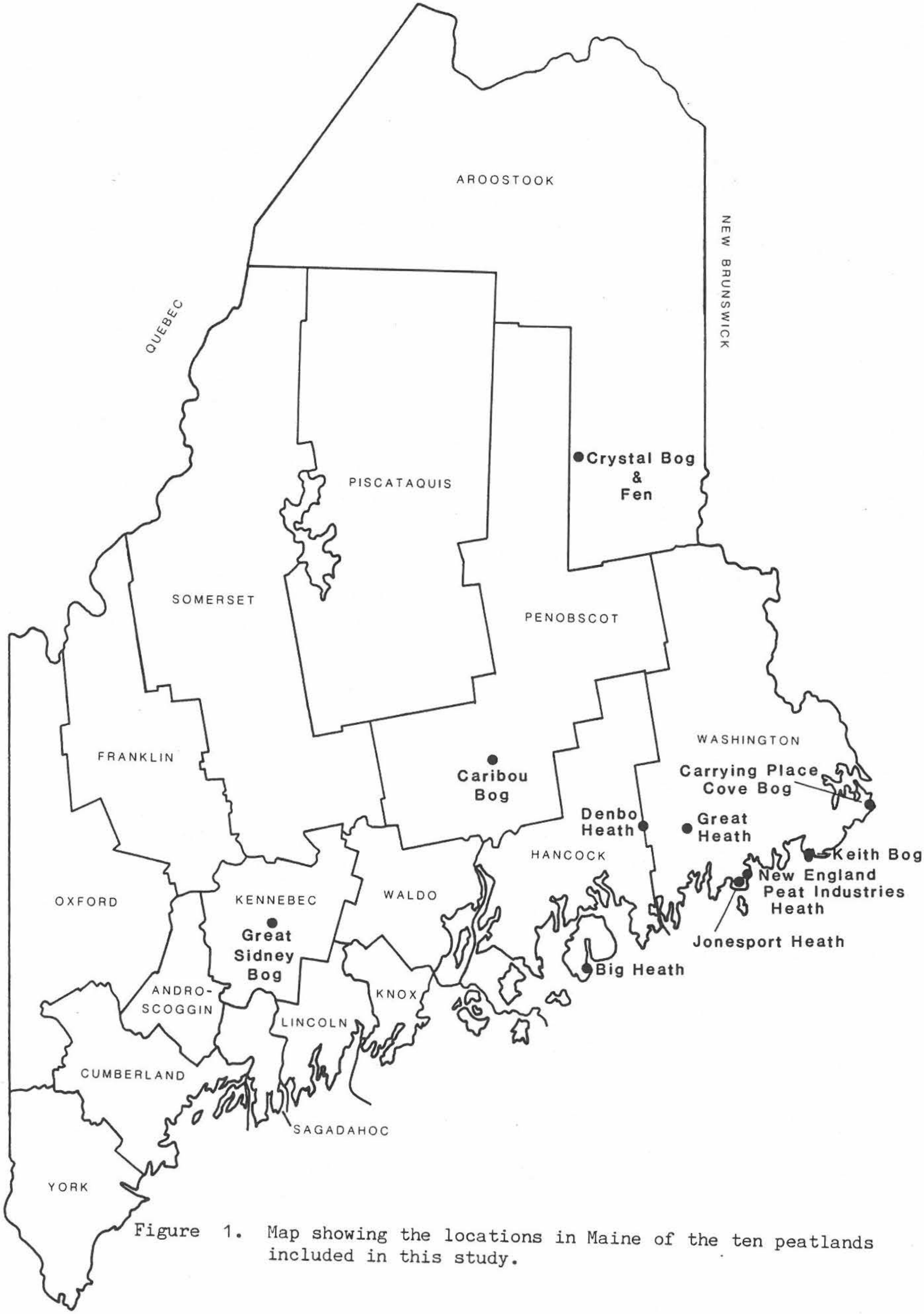
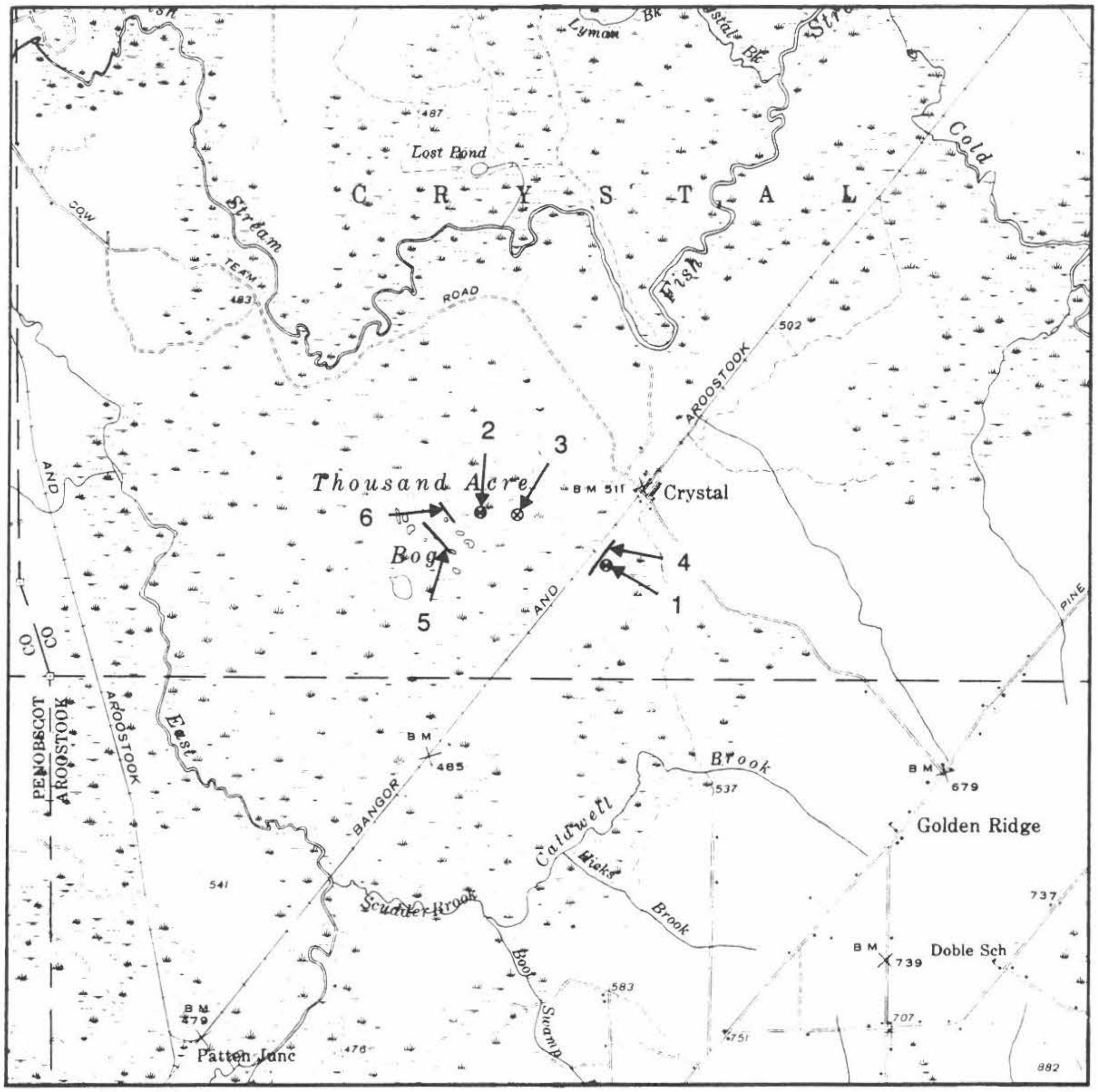
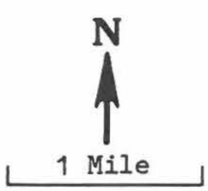


Figure 1. Map showing the locations in Maine of the ten peatlands included in this study.

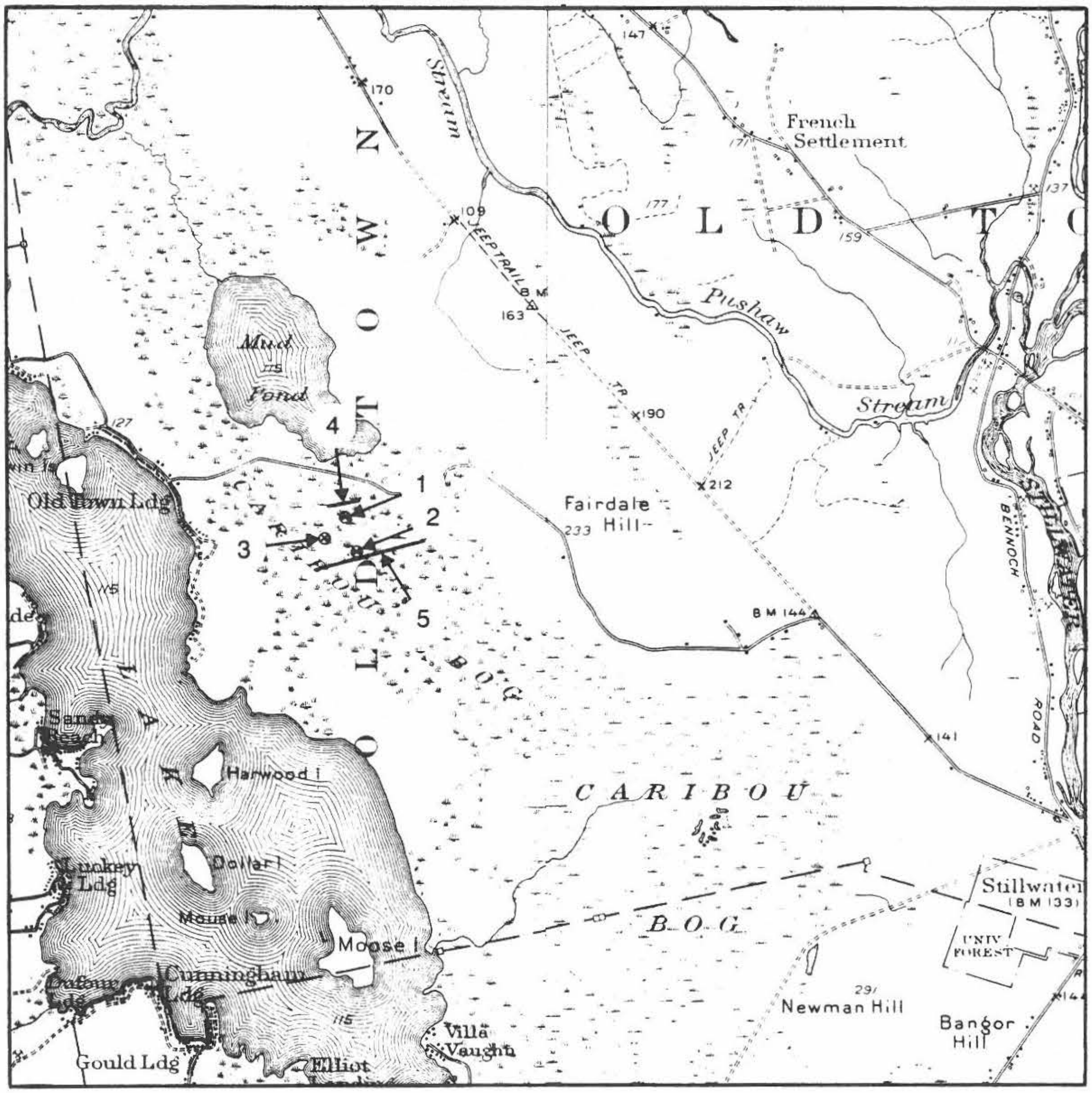


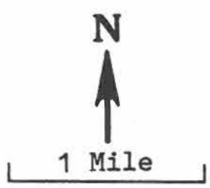


EXPLANATION

1 - Long Core CyF1
2 - Long Core CyB2
    Short Core Cy2B
    Short Core CyC
3 - Short Core CyHH R1, R2
    Short Core Cy2HO
    Decomposition Strips
    #25-28, 31, 32
4 - Decomposition Strips
    #24, 30, 33-40
5 - Decomposition Strips
    #1-15
6 - Decomposition Strips
    #16-24

Figure 2. Map showing sample sites at Crystal Bog and Fen, Sherman 15 minute quadrangle, Aroostook County.

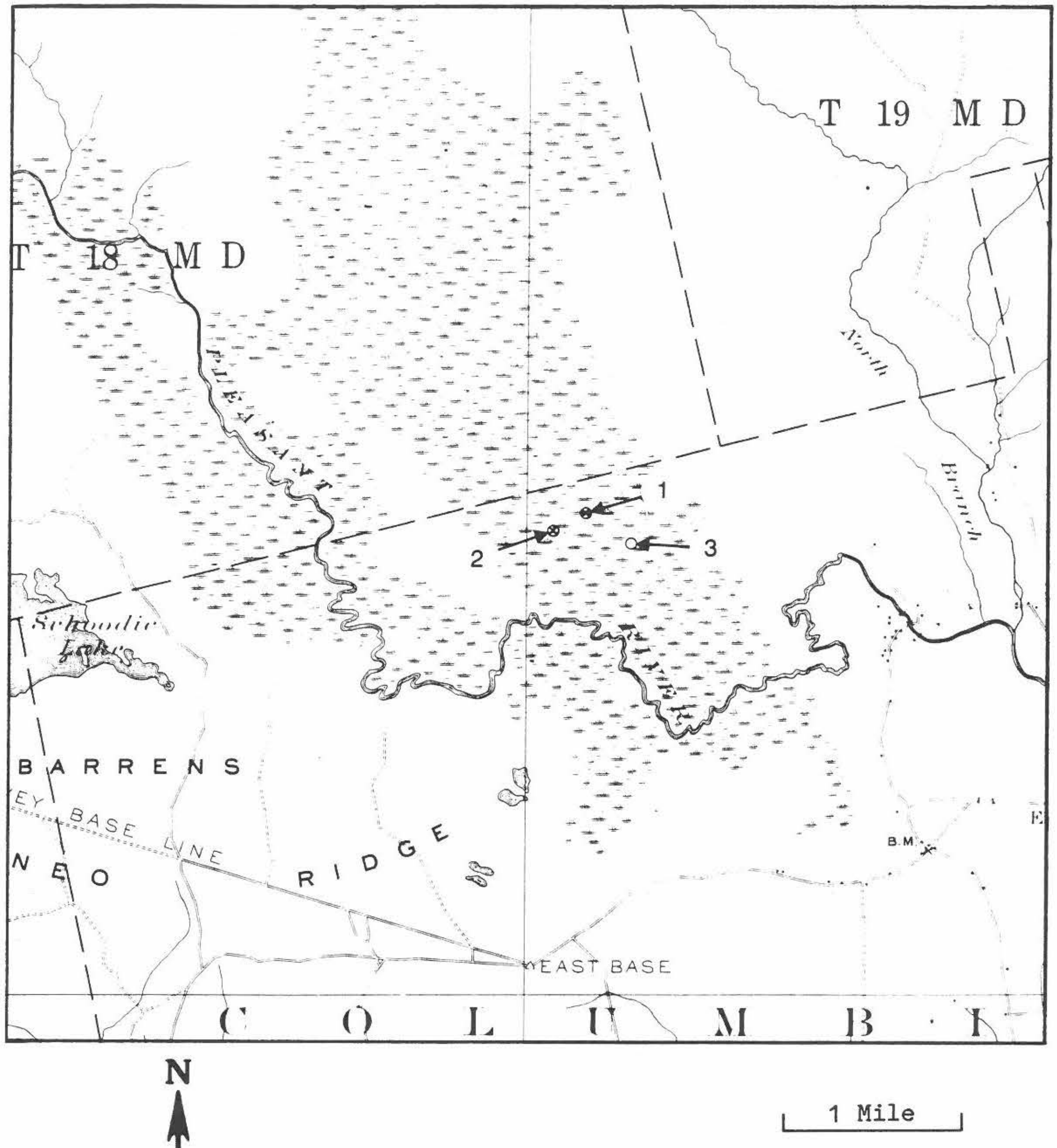




EXPLANATION

1 - Long Core Ca1
2 - Long Core Ca2
3 - Short Core Ca Oct. 17 A,B
Short Core CalA-D/R
Short Core CalB
Short Core CalR
Short Core Ca2(203)
Short Core Ca2A
Short Core Ca2R
4 - Growth Strips #21-36
5 - Decomposition Strips #72-107

Figure 3. Map showing sample sites at Caribou (Bangor-Orono) Bog, Bangor and Orono 15 minute quadrangles, Penobscot County.



EXPLANATION

1 - Site 10
- Long Core GH1
- Short Core GH1A
- Short Core GH1B
- Short Core GH1C 1R-5R
- Decomposition Strips #49-60
- Growth Strips #11-20

2 - Pond Site
- Short Core GHD
- Short Core GHD50
- Short Core GHE
- Short Core GHF
- Short Core GHT
- Short Core GH-prodn
- Decomposition Strips #43-48
- Growth Strips #1-10

3 - Decomposition Strips #61-70

Figure 4. Map showing sample sites at the Great Heath, Cherryfield 15 minute quadrangle, Washington County.

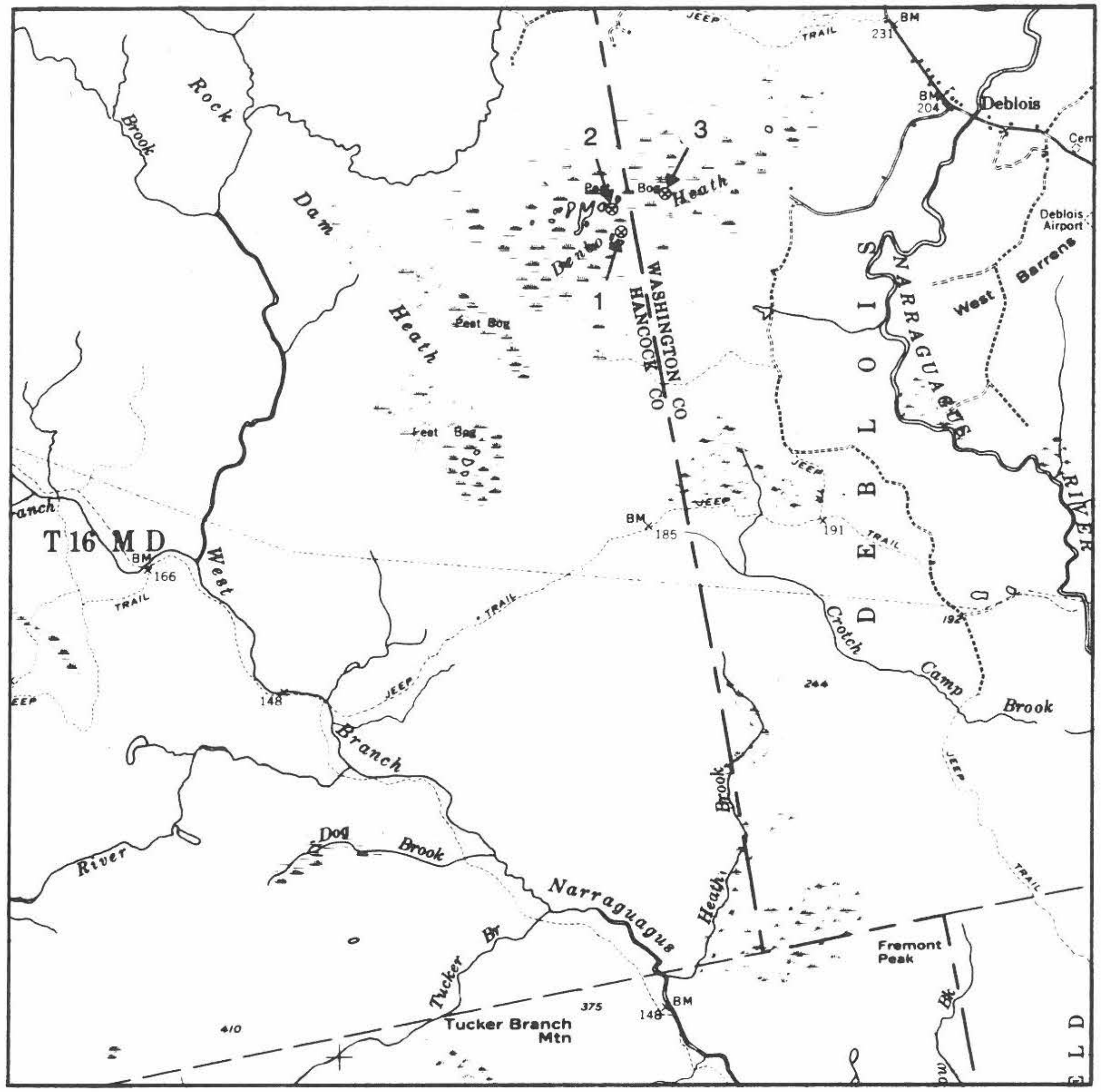
N

1 Mile

EXPLANATION

1 - Point 3
  Long Core BHP3
  Short Core BHP3D
2 - Short Core BHS1
  Short Core BHS2
  Short Core BHHP
3 - Decomposition Strip Transect #139-145
4 - Decomposition Strip Transect #108-138
5 - Growth Strip Transect #37-46

Figure 5. Map showing sample sites at Big Heath, Acadia National Park and Vicinity 15 x 22.5 minute quadrangle, Hancock County.



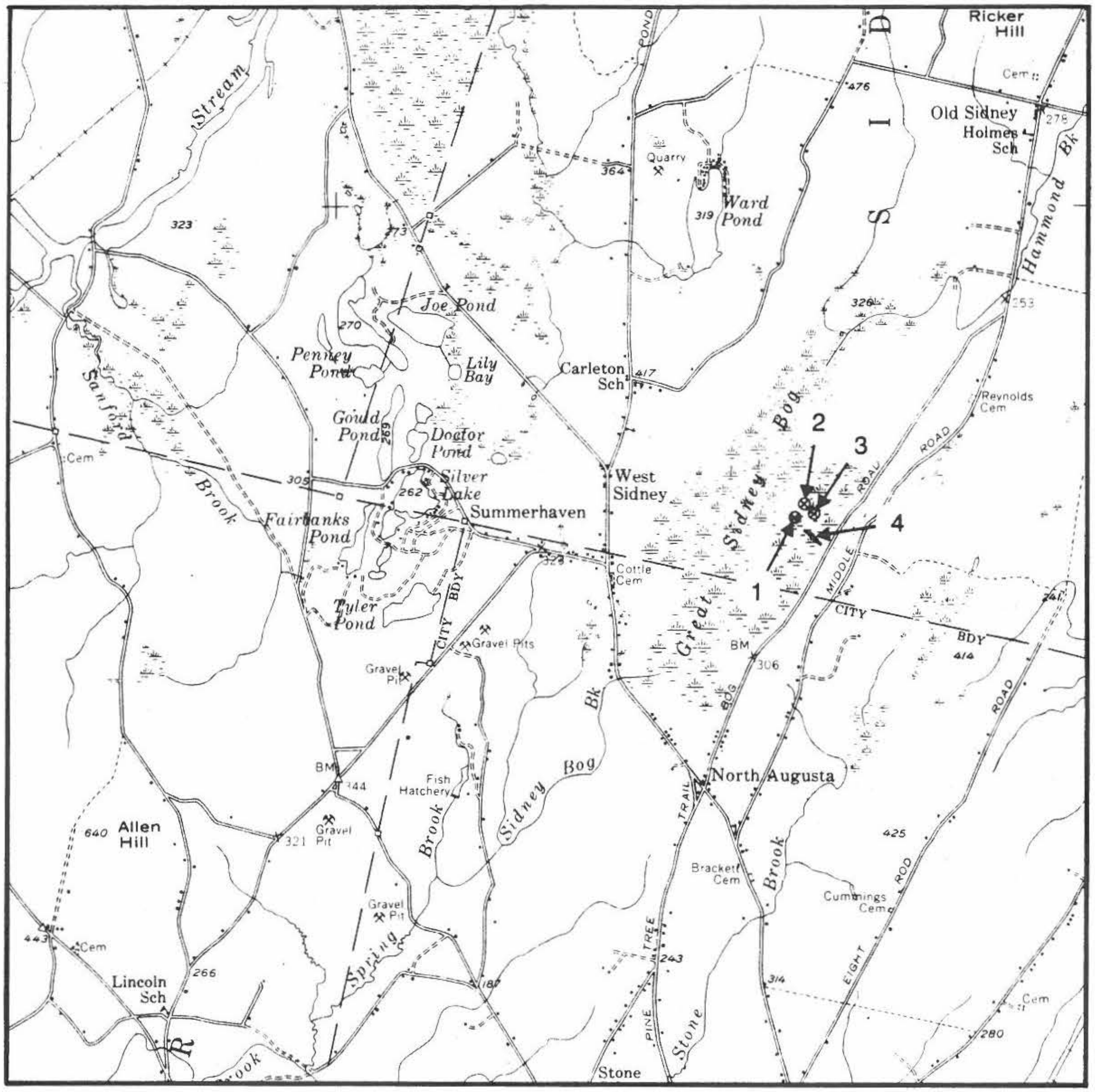
N

1 Mile

EXPLANATION

1 - Short Core DI
2 - Short Cores DII 1-5
3 - Short Cores DIII 1-18

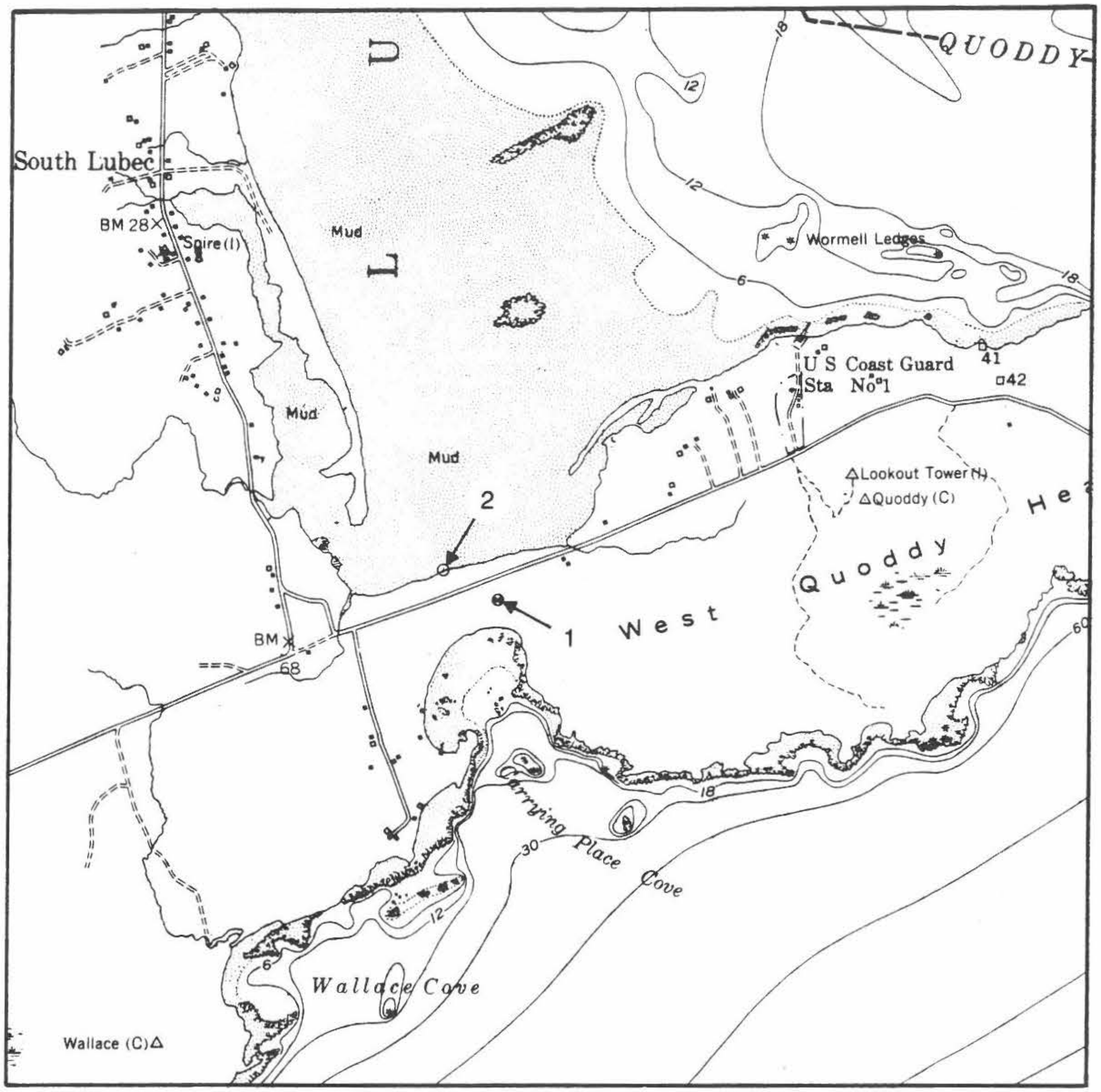
Figure 6. Map showing sample sites at Denbo Heath, Tunk Lake 15 minute quadrangle, Hancock and Washington Counties.



EXPLANATION

1 - Long Core SB1L
2 - Short Core SB1S
Short Core SB1R
3 - Short Core SB2
4 - Decomposition Strips #150-155 (not retrieved)

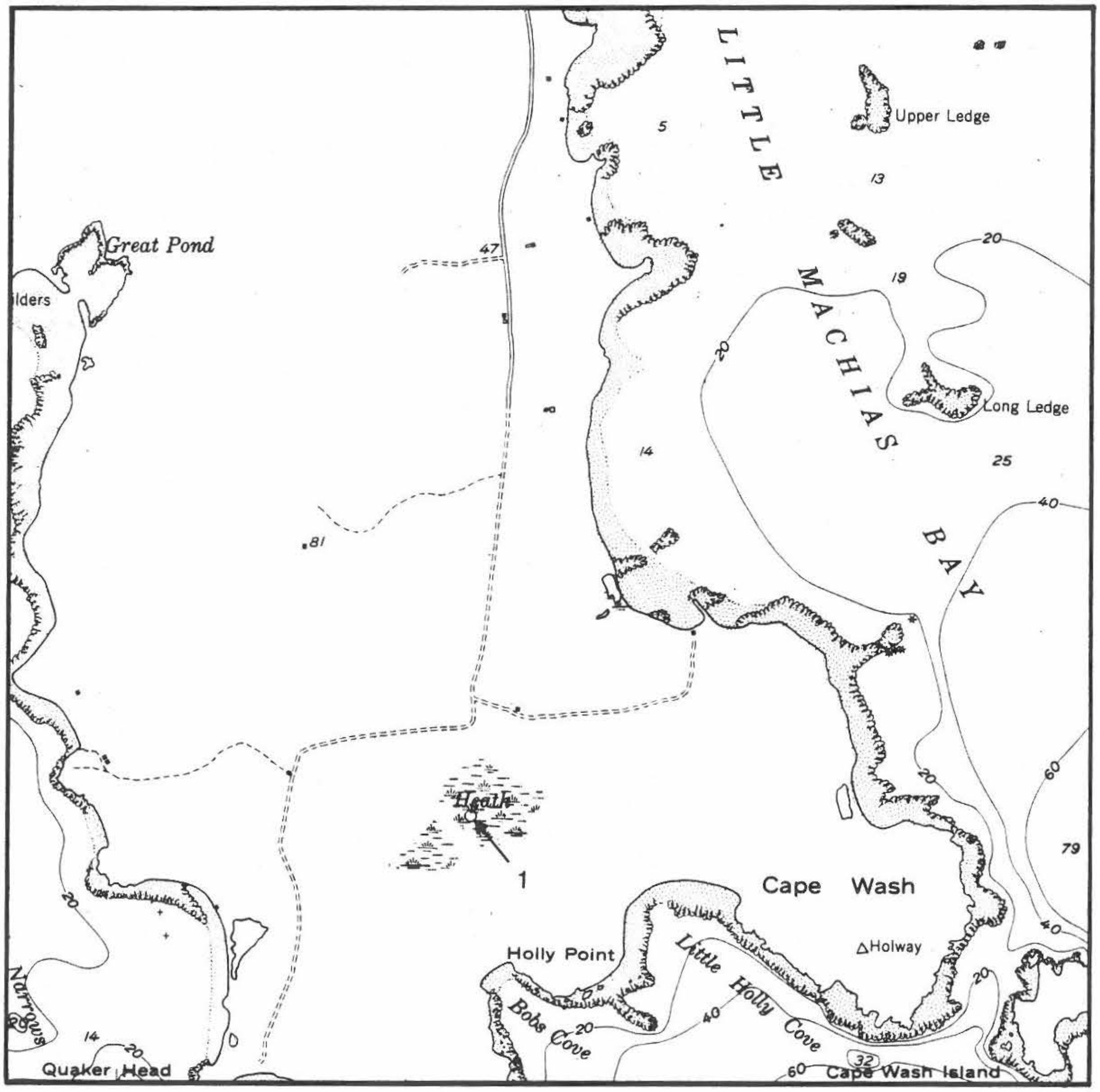
Figure 7. Map showing sample sites at Great Sidney Bog, Augusta 15 minute quadrangle, Kennebec County.



EXPLANATION

1 - Long Core Cove 1
Short Core Cove 2
2 - Peat Cliffs

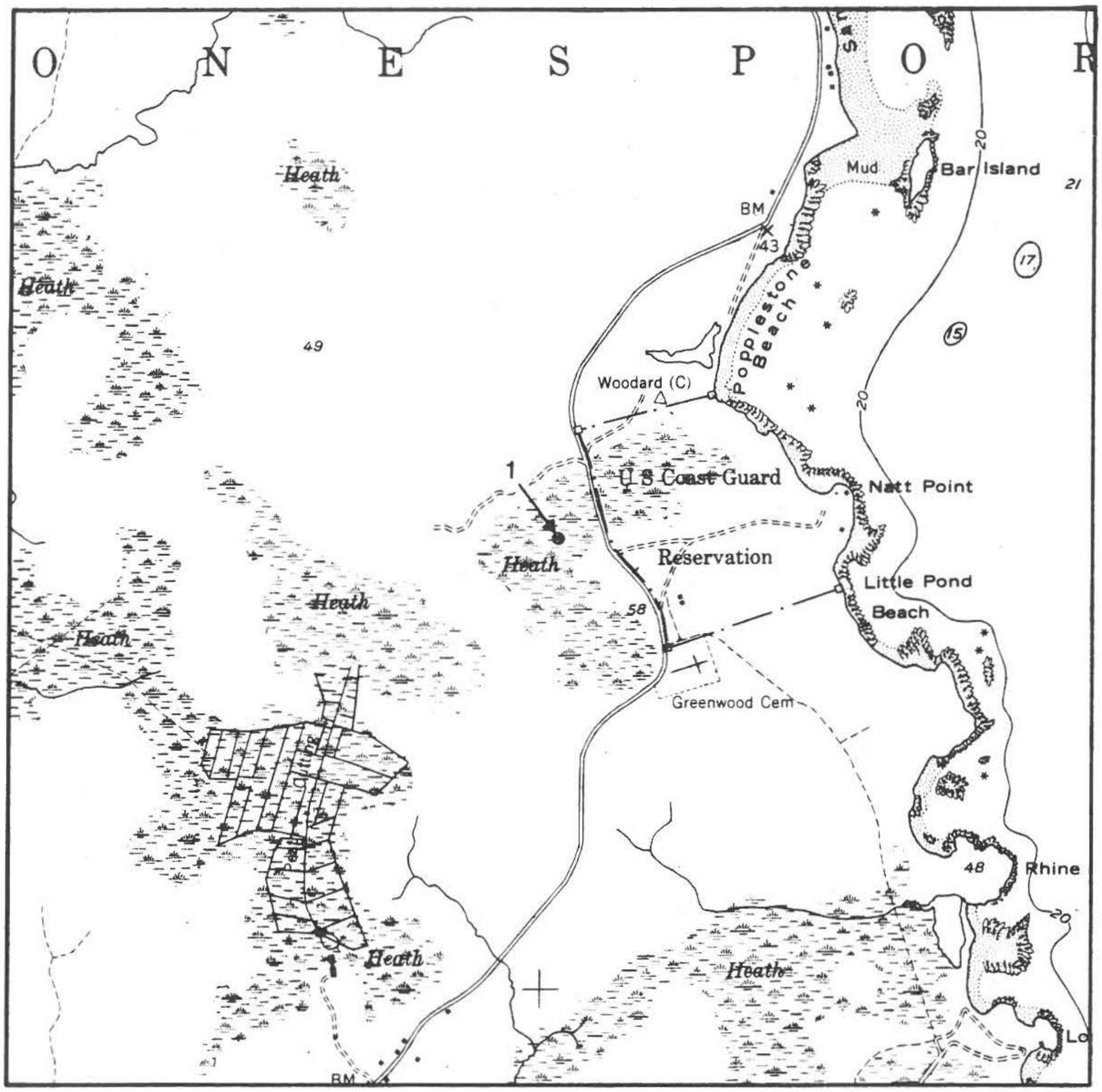
Figure 8. Map showing sample sites at Carrying Place Cove Bog, Lubec 7.5 minute quadrangle, Washington County.

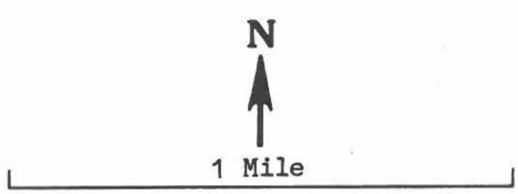


EXPLANATION

1 - Short Core Keith ID

Figure 9. Map showing sample site at Keith Bog, Machias Bay 7.5 minute quadrangle, Washington County.

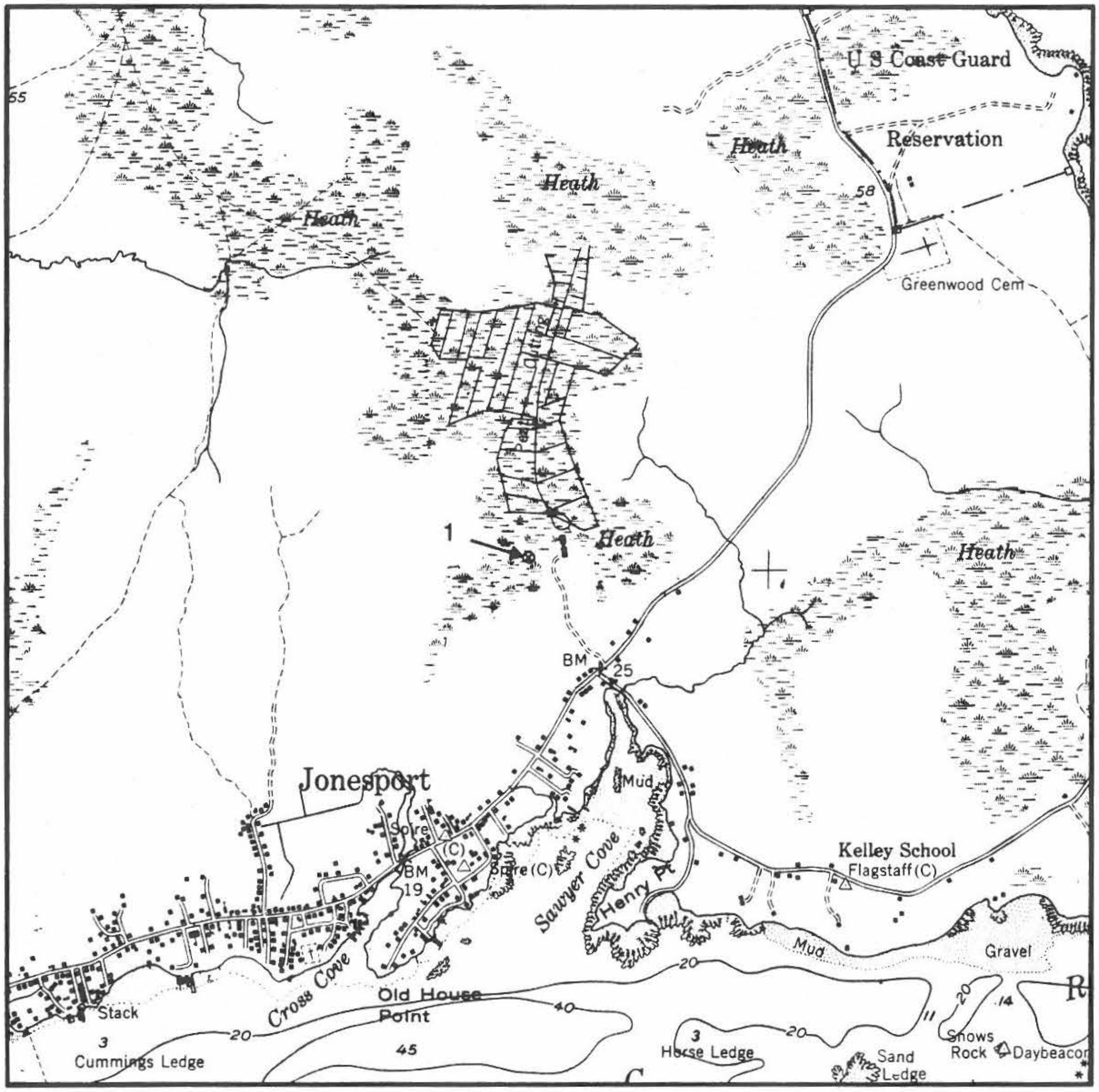




EXPLANATION

1 - Short Core EP1
Short Core EP2A,B

Figure 10. Map showing sample site at New England Peat Industries peatland, Jonesport 7.5 minute quadrangle, Washington County.



EXPLANATION

1 - Short Core JP1

Figure 11. Map showing sample site at Jonesport Heath, Jonesport 7.5 minute quadrangle, Washington County.

Both long and short cores were taken to obtain samples and determine peat stratigraphy. Samples were obtained from seven long cores, ranging from 408 to 780 cm in length, from the following localities: Crystal Bog (CyB2); Crystal Fen (CyF1); Caribou Bog (Ca1 and Ca2); Great Heath (GH1); Big Heath (BHP3); and Great Sidney Bog (SB1). The long cores, excluding the top 0.3 to 1.1 m, were taken with a Russian peat sampler with a diameter of 10 cm and a length of 50 cm (Tolonen and Ijas, 1982). These cores extended down to the interface between peat and predominantly mineral (lacustrine) sediments or soil. For the weakly decomposed peat at the top, the well-sharpened tube samplers described below were used. A total of 476 peat samples of known volume, mostly in 10 cm increments, was analyzed from the long cores.

From the 10 peatlands studied, 56 short cores were obtained with pistonless tube samplers (including one designed by A. Damman of the University of Connecticut) with stainless steel walls 1 mm thick measuring 12 or 20.3 cm in diameter. The short cores ranged from 26 to 150 cm in length, averaging about 60 cm, and were cut in 2.5 or 5 cm increments. A total of 655 samples was analyzed from these cores.

Peat stratigraphy was determined in the field by examining numerous cores extending down to the peat-mineral sediment interface. These cores were obtained with a Russian peat sampler with a diameter of 5 cm and a length of 50 cm (Jowsey, 1966; Tolonen, 1968; Day et al., 1979). From the cores, which were discarded in the field, peat type, degree of humification (as an indication of decomposition) on the von Post scale, relative moisture content, cotton grass fiber content, root content and composition, wood content, and additional constituents such as seeds and fruits were described. Special attention was given to recording the occurrence of charcoal and ashed peat. In describing the layers, the peat index system of von Post (1924) was applied (Day et al., 1979, p. 184-185; Lappalainen, 1980). The degree of decomposition (humification) is expressed on a scale of 1 to 10 (H_{1-10}), where peat graded H_1 contains plant matter which has undergone little or no visible degradation and grade H_{10} refers to amorphous peat humus with few or no identifiable plant remains. A rough comparison of von Post's method with the fiber method commonly used in the United States (e.g. Sneddon et al., 1971) is given in Tolonen, 1982.

Drying of Samples

The peat samples were dried to constant weight at 68°C. For comparison, 43 samples from different depths were dried further at 105°C for several days. On the average, the results showed a water content 0.1% greater and a bulk density (see below) about 0.001 $g \cdot cm^{-3}$ lower than those obtained at 68°C. The differences were not considered significant enough to correct.

Peat Dating Methods

The rates of vertical accumulation of peat were determined in the long cores by Carbon-14 dating. Nine dates were obtained for core CyF1, eight for CyB2, one for Ca2, two for GH1, and eight for BHP3. Supplementary dates for peat and underlying sediments were obtained based on the correlation of pollen zones and boundaries with Carbon-14 dated pollen diagrams from other studies in Maine (e.g., Davis et al., 1975). Pollen diagrams were constructed for three of the long cores (Ca2, BHP3, GH1) and are shown in Appendix II. Pollen preparations were made using KOH, acetolysis, and safranin stain, and the residue was mounted in glycerine. For each level, 100 to 200 arboreal pollen grains were counted along with any additional non-arboreal grains and spores. All the radiocarbon ages were converted to calendar years using the values given by Damon et al. (1972) extrapolated to 1980.

The moss increment dating method originally published by Pakarinen and Tolonen (1977) was applied in 27 short cores. Nine of these cores came from formerly mined sites. This dating method was refined by Tolonen during the winter of 1980, so that it is now possible to give an objective measure of the accuracy of the dating of each individual sample. The moss increment dating method can be briefly described as follows. A vertical core sample including living surface vegetation is cut with scissors into horizontal slices. The thickness of these slices can vary from 10 to 100 (or even more) mm, depending on the density of peat and other factors, but must always be thick enough that the stems of mosses go through both the top and bottom of the slice. Theoretically, the dating method can be applied from the surface down to lower levels in a core until the stems are lying horizontally.

About 30 moss stems which extend from top to bottom of each slice are measured for length when straightened. The mean and standard deviation are calculated. Accurately distinguishable annual increments are subsequently measured for length from these and other stems from the same slice. The innate markers on *Sphagnum* mentioned by Clymo (1970) are used. The mean and standard deviation of the annual increments are then calculated. The accumulation time for each slice is the mean stem length divided by the mean increment length, and the standard deviation is the combined standard deviations of these two measurements (stems + increments). All the standard deviations in the appendixes are obtained this way.

Moss increment dating is not possible in hollows or lichenous depressions. In these areas, the peat was dated using stratigraphic changes in pollen types associated with forest clearance (land settlement), agricultural activity, and other datable events during the past approximately 300 years. The increase and decrease of *Ambrosia* (ragweed) pollen was found to be useful in this respect. Pollen diagrams prepared for 11 short cores are shown in Appendix IV.

Calculation of Net Accumulation Rates of Peat

To calculate net accumulation rates of peat, the following equations were applied:

(1) $A = 1000 \cdot \underline{a} \cdot D_b$ where

A = net accumulation rate of dry peat in $g \cdot m^{-2} \cdot yr^{-1}$

$\underline{a}$ = rate of vertical accumulation of the deposit in $mm \cdot yr^{-1}$ (obtained with different dating methods described in text)

D_b = bulk density of peat in $g \cdot cm^{-3}$

Bulk density was determined by the equation:

(2) $$D_b = \frac{\text{weight of the sample in g after drying at } 68^{\circ}C}{\text{volume of sample before drying in } cm^3}$$

Decomposition Studies

Decomposition tests using standard cellulose pulp strips (Lähde, 1969) were carried out at four peatlands. Cellulose has been used as a standard material in soil microbiology for several reasons; its advantages and disadvantages are discussed, for instance, by Rosswall (1974). The basic assumption is that the weight loss of pulp strips placed in peat layers for a given time (in this case, one year) is a relative measure of the microbial breakdown of organic (plant) debris in the same layers. Partial support for this hypothesis has been found by means of gas-exchange analyses (Lähde, 1969; Jones and Gore, 1978; Silvola and Hanski, 1979).

Each strip placed in the peat was 50 or 75 cm long, consisting of 10 or 15 5-cm pieces in a 75 x 5 cm nylon mesh envelope. Before assembling a strip, the pieces were dried and weighed. The strips were emplaced vertically with the uppermost edge at the surface. The longer strips were placed in hummocks and the shorter strips in hollows in late October or early November 1980, and were retrieved one year later. The strips were disassembled into their 5 cm pieces, gently rinsed to remove adherent plant material and peat, dried, and weighed. The number of strips retrieved from each peatland was: Crystal Bog, 10; Crystal Fen, 6; Caribou Bog, 17; Great Heath, 10: and Big Heath, 15.

Growth and Yield Studies

To measure vertical growth, strips of inelastic nylon mesh were anchored in three of the peatlands in November and December of 1980. Each had a stitched line near the top which served as a reference level against which the growth of *Sphagnum* species could be measured (see Lindholm, 1979). These stabilized during the winter and early spring. In April, 1981, three to five moss plants adjacent to each strip were selected and their capitula marked for later identification. The positions of the growing tips were noted on the mesh. In mid November to December the positions were observed again, and the difference was considered to be a measure of vertical growth in 1981. All strips were placed in either low or high hummocks or on *Sphagnum* lawns. The number of sites (strips) from which data were obtained at each peatland are as follows: Caribou Bog, 13; Great Heath, 14; and Big Heath, 10.

The moss yield, which was assumed to be equal to the annual dry matter production minus any decomposition by consumption by heterotrophs, was also determined. The final moss increment, starting at the end-of-1979 capitulum, was harvested, dried, and weighed in November, 1980 or in the spring of 1981 before new growth started. This increment contained the 1980 yield. A "capitulum correction" (Clymo, 1970) was made on the production data.

Previous Work

Earlier studies about the dry matter accumulation in the peatlands of Maine are nonexistent (cf. Worley, 1981). Radiocarbon dates from peatlands in different parts of Maine (Kennedy, 1963; Gajewski, 1979), as well as pollen diagrams by Osvald (1970), allow calculation of rough estimates for the mean vertical height growth of peat during the millenia since the deglaciation. These figures, however, have little value for several reasons, the most important ones being:

1. The true peat accumulation (in terms of given mass per area) remains unknown because of the absence of bulk density data.

2. There is little relevant information about the vegetational or peat type of the appropriate sites.

Very few data from North America can be applied in estimating the peat growth during the past few centuries in great detail (Hemond, 1980). The question about the net accumulation rate and the renewability of peat has not been studied much in Europe as well (see Tolonen, 1979).

Acknowledgments

Funding for this project was provided by the Maine Geological Survey; we are also grateful for the Survey's logistical support. We appreciate the assistance of several University of Maine students and scientists who helped in the field and in the compiling and computing of results. The staff of the Maine and U.S. Geological Surveys, particularly Andrews Tolman and William Nichols, was most helpful in the field at the Great Heath. Dr. Robert Stuckenrath, Jr. of the Smithsonian Institution and the University of Maine Institute for Quaternary Studies provided the numerous indispensible radiocarbon dates. Sally Rooney's assistance in the field is gratefully acknowledged. Furthermore, we wish to thank Professors Thomas C. Hess and Steven A. Norton for their discussions and assistance. We also thank Stephen Norton for the travel funds he provided for the completion of field work in the summer of 1981. Additional funds and assistance for the completion of this project were provided from Dr. Davis' Hatch Project budget and staff. For this support, we thank the Maine Agricultural Experiment Station. Finally, we appreciate Ben Wilson's expert drafting of the final illustrations.

RESULTS AND DISCUSSION

Chronology

Radiocarbon dates from the long cores are given in Table 1. Three pollen diagrams with associated dates derived by pollen correlation in long cores are given in Appendix II. Eleven pollen diagrams from short cores are given in Appendix IV.

Age/depth curves based on Carbon-14 dates only (CyF1 and CyB2) and on a combination of radiocarbon dates and pollen correlations (Ca2, GH1, and BHP3) are given in Appendix III.

Dates based on the moss increment method are given on some of the pollen diagrams in Appendix IV. Complete results for 27 cores in 10 peatlands are shown in Appendix V. The standard deviation of these dates is commonly not less than 3%, often 5 to 10%, and sometimes as great as 30% at the top of the core. This deviation originates both from the great variation in the lengths of the annual increments and from the total lengths of the individual stems through the core section being studied. The inaccuracy involved in the determination of the annual increments and the measurement of the lengths cannot be totally eliminated or distinguished from the other possible sources of variation.

On a previously mined site at Denbo Heath, historical data provided a reliable method for dating the easily recognizable depth of initiation of new growth. This also provided a rigorous test of moss increment dating from the same sites. Another site that provided historical control was Carrying Place Cove Bog (see p. 33).

Accumulation Rates

The net accumulation rate (A) of peat for any depth is a product of the vertical accumulation rate (a) of the peat deposit and the bulk density (D_b) of the peat. Both are closely correlated with the degree of decomposition (humification) as shown by various authors (e.g. Boelter, 1969; Paivanen, 1969; Zurek, 1976; Tolonen, 1979). Fires also affect peat accumulation (e.g., Auer, 1928; Osvald, 1970; Pakarinen, 1974; Tolonen, 1982). Charred horizons were found in all the long cores and several of the short cores.

The following summary views the data set as a whole as if the four major unmined peatlands were representative of peatlands in Maine. According to Table 2, the standard deviation (S.D.) for the averages of a for the five long cores dated was about 57%, while the corresponding S.D. for the averages of D_b was about 20%. The mean and S.D. of D_b were calculated for all the individual long core samples ($n = 476$) and the following was obtained: $D_b = 0.0713 \pm 0.0167\ g \cdot cm^{-3}$; S.D. = 23.4%. Bulk density profiles for six of the cores are given in Appendix VI.

Table 1. Radiocarbon dates from selected peatlands in Maine. The fourth column gives the uncorrected ages in ^{14}C years before present (= A.D. 1950, $T_{\frac{1}{2}}$ for ^{14}C = 5568 years). In the last column, the ^{14}C ages were converted to "real years" using the figures in Damon et al. (1972) and extended to A.D. 1980.

Laboratory number	Depth (cm)	Uncorrected ^{14}C age (yrs±S.D. B.P.)	Calendar years (before A.D. 1980)
1. Crystal Fen (CyF1)			
SI-4796	45-50	200±60	280
SI-4797	120-125	3105±75	3231
SI-4798	195-200	4980±85	5781
SI-4934	230-235	5585±55	6386
SI-4935	270-275	6140±60	6967
SI-4799	295-300	5215±70	6044*
SI-4800	320-325	7650±70	7680
SI-4936	395-400	8175±75	8205
SI-4801	405-406	8290±90	8320
2. Crystal Bog (CyB2)			
SI-4925	97-100	920±75	931
SI-4926	146-150	2145±75	2203*
SI-4927	186-190	2210±70	2311
SI-4928	277-280	2730±70	2956
SI-4929	325-330	3780±55	4299
SI-4930	426-430	6480±85	6329
SI-4931	487-490	5480±70	7326
SI-4932	595-600	8425±135	8455
3. Caribou Bog (Ca2)			
SI-4933	865-870	9425±100	9455
4.Great Heath (GH1)			
SI-4937	140-145	1525±70	1536
SI-4938	235-240	3795±80	4320
5. Big Heath (BHP3)			
SI-4802	65-70	70±50	175
SI-4803	125-130	220±60	309
SI-4804	155-160	875±60	888
SI-4805	250-255	1265±55	1261
SI-4806	295-300	2025±65	2094
SI-4807	320-325	2580±50	2766
SI-4808	440-445	5810±70	6670
SI-4809	487-488.5	6565±90	7404

* = omitted in the age/depth regression

Table 2. Long term net accumulation rate (dry g · m^{-2} · yr^{-1}) in four peatlands (five cores) in Maine on the basis of averages of bulk density of peat and the mean vertical accumulation rate for each particular section. For CyF1, CyB2, and BHP3, the vertical accumulation rates are derived from accumulation rate graphs obtained from age/depth curves based on best-fit polynomial regressions. The deepest section at each site directly overlays lacustrine or predominantly mineral sediments.

CyF = Crystal Fen (eight ^{14}C dates)
CyB = Crystal Fen (seven ^{14}C dates)
Ca2 = Caribou Bog Core 2 (pollen correlations, one ^{14}C date)
GH1 = Great Heath Point 10 (pollen correlations, and two ^{14}C dates)
BHP3 = Big Heath Core 3 (eight ^{14}C dates)
z = Peat-gyttja junction at 580 cm; bulk density for peat only; accumulation rate based on date in gyttja.
xx = Averages of section averages, excluding top section.
xxx = Averages of core section averages, excluding top sections (n=22)

Site	Depth (cm)	Time period (calendar years before A.D. 1980)	Vertical accumulation rate (mm.yr^{-1})	Bulk density ($g.cm^{-3}\pm S.D.$)	%S.D.	Net peat accumulation rate ($g.m^{-2}.yr^{-1}\pm S.D.$)	%S.D.
CyF1	0-50	0-400	1.50	0.074±.010	13.5	119.7±33.5	28.0
	50-200	400-5760	0.15	0.109±.018	16.5	15.9±2.7	17.0
	200-310	5760-7480	0.35	0.092±.010	10.6	31.5±4.5	14.2
	310-400	7480-8270	0.55	0.106±.014	13.2	57.6±7.8	13.5
	$\bar{x}\pm$ S.D.		0.35±0.20^{xx}	0.1000±.0182	18.2	35.0±21.1^{xx}	60.2
CyB2	30-60	330-610	1.70	0.060±.018	30.0	115.8±8.0	6.9
	60-160	610-1830	0.60	0.061±.006	9.8	37.2±5.1	13.6
	160-270	1830-3490	1.39	0.063±.008	12.7	81.3±21.6	26.5
	270-380	3490-5300	0.44	0.069±.009	12.3	29.9±7.1	23.7
	380-540	5300-7850	0.75	0.081±.007	8.4	52.8±7.4	14.0
	540-597	7850-8450	0.92	0.081±.011	11.5	74.2±11.6	15.7
	$\bar{x}\pm$ S.D.		0.82±0.36^{xx}	0.071±.010	13.5	55.1±22.4^{xx}	40.6
Ca2	0-100	0-200	5.00	0.0372±.0214	57.5	186.1±107.0	57.5
	100-150	200-1000	0.63	0.0662±.0068	10.3	41.7±4.3	10.3
	150-295	1000-3650	0.55	0.0692±.0102	14.7	38.1±5.6	14.7
	295-385	3650-6530	0.31	0.0808±.0062	7.7	25.0±1.9	7.6
	385-460	6530-7600	0.70	0.0710±.0086	12.1	49.7±6.0	12.1
	460-640 (580)^{z}	7600-?9000	1.29	0.0741±.0089	12.0	95.6±11.5	12.0
	$\bar{x}\pm$ S.D.		0.70±0.36^{xx}	0.0723±.0050	6.9	50.0±27.0^{xx}	54.0
GH1	0-20	0-200	1.00	0.0622±.0039	6.3	62.2±3.9	6.3
	20-140	200-1480	0.94	0.0708±.0055	7.8	66.5±5.2	7.6
	140-240	1480-3910	0.41	0.0671±.0101	15.1	27.5±4.1	14.9
	240-385	3910-5540	0.89	0.0532±.0073	13.7	47.3±6.5	13.7
	385-480	5540-6830	0.74	0.0658±.0135	20.5	48.7±10.0	20.5
	480-710	6830-9500	0.86	0.0691±.0104	15.1	59.4±8.9	15.0
	710-780	9500-10500	0.70	0.0802±.0073	9.1	56.1±5.1	9.1
	$\bar{x}\pm$ S.D.		0.76±0.19^{xx}	0.0679±.0167	24.6	47.2±14.0^{xx}	29.6
BHP3	0-50	0-127	3.93	0.035±.068	19.8	138.6±51.9	37.5
	50-200	127-892	1.75	0.0408±.0129	31.6	70.5±32.5	46.2
	200-270	892-1600	0.50	0.0515±.0035	6.7	29.1±14.0	48.2
	270-460	1600-7111	0.10	0.0842±.0232	27.6	7.7±2.2	28.3
	$\bar{x}\pm$ S.D.		0.78±0.86^{xx}	0.0722±.0283	39.2	35.7±31.8^{xx}	89.1
^{xxx}All but the top sections sections (n = 22) ± S.D.:			0.70±0.40	0.0730±0.015		45.72±21.76	
Relative S.D. (%) of the above:			57.14		20.54		47.60
Median of the above, excluding top sections:			0.67	0.0691		39.90	

The variation in D_b obviously is much smaller (often greater than 20% and less than 40% within individual profiles) than that of a, and therefore a accounts for most of the variation in A. The median for a in the data, excluding top sections, was 0.67 mm · yr^{-1}. According to the calculations made for New Brunswick peatlands dated by the Carbon-14 method (Keys, 1981), a values for subsurface peat range from 0.5 to 1.7 mm · yr^{-1}, which is almost the same range reported for raised bogs in Europe (Zurek, 1976; Tolonen, 1973, 1979). A mean bulk density of 0.0573 ± 0.0252 g · cm^{-3} (n = 135) was calculated from the data given by Korpijaakko (1975) for raised bogs in New Brunswick. His samples were obtained with a specially designed volumetric peat sampler which minimized water loss (Korpijaakko, 1981).

In the five dated long cores, the long-term net accumulation rate (A) of subsurface peat varies between 7.7 ± 2.2 and 95.6 ± 11.5 g · m^{-2} yr^{-1} (Table 2) due mainly to the great differences obtained for the vertical accumulation rate (a). Generally, the upper 50 cm of the cores are excluded from the calculation of these rates because they are in part above the water table and the anaerobic limit, and therefore are still exposed to strong decay processes. The mean value for A is 45.7 ± 21.8 g · m^{-2} yr^{-1}, but the median value of 39.9 g · m^{-2} yr^{-1} shows that the distribution is skewed.

If the average net accumulation rates of peat in each core are considered, no clear geographic regularity is evident. The peatlands are more or less unique. In four of the five cores, high net peat accumulation rates occurred during the oldest (first) millennium of peat accumulation (Table 2).

More reliable averages can be calculated (Table 3) using the peat accumulation values for each 10 cm layer, including top sections, in the four best dated cores (Appendix III). These figures are similar to those based on section means (Table 2). The medians, which are lower than the means, again indicate that the distribution is skewed (overestimated).

The average net accumulation rates (A) given above represent the very long time span from the present to about 7,000 to 10,500 years B.P. But in every core, there is great variation in A on a shorter time scale. Because this variation is mainly due to the vertical accumulation rate (a), it is interesting to compare the cores to see if changes in a and A can be correlated. One common feature is that during 8,000 to 7,000 years B.P., the vertical accumulation rate (and also A) was relatively rapid in the four peatlands where layers from this time were recorded (Table 2; Appendix III). This peat is weakly to moderately decomposed and was formed in fairly moist conditions. It is typically composed of the remains of Bryales (= Hypnum), especially *Drepanocladus* and *Scorpidium spp.* This correlates with the end of the "pine-birch-oak period" and the expansion and increase in abundance of *Tsuga* (hemlock) in Maine (Davis et al., 1975). It also correlates with an increase in *Betula lutea* (yellow birch) and a decrease in forest fire frequency as indicated by decreased amounts of charcoal in a lake sediment core from the region of Crystal Bog (Anderson, 1979). These factors all suggest a moistening of the climate.

Table 3. Range, means (±S.D.), medians, and 95% confidence limits for net peat accumulation rates ($g \cdot m^{-2} \cdot yr^{-1}$) in the four best-dated peat cores and average for all raised bogs studied.

Bog	Range	Mean±S.D.	Median	(±95% confidence)	Number of samples (n)
GH	21-75	50.24±13.58	53.0	44.5-57.0	75
CyB	20-127	56.70±25.81	47.8	43.8-62.0	57
CyF	11-153	34.98±29.32	31.2	18.6-43.9	39
BH	4-205	42.91±44.72	27.5	10.0-59.0	47
Average for all the raised bogs studied (GH, CyB, BH, Ca)		50.36±28.90			184

From about 7,000 to 3,000 years B.P., or perhaps from 7,000 to 1,500 years B.P. in Big Heath and Great Heath, both the net and vertical accumulation rates were commonly much less than prior to 7,000 years B.P. The species composition varies greatly from core to core, but peat containing the remains of wood and cotton grass is abundant. There is a high degree of decomposition in all the peat from this period. Several charcoal layers have been encountered in some of the peatlands. This is the period of maximum development of hardwood forests in Maine, and it may have generally been the warmest part of the Holocene (Davis et al., 1975; Anderson, 1979).

Net accumulation rates increase in the uppermost portions in all the raised bogs examined, starting about 1500 years B.P. at Great Heath and Big Heath (the rate (A) at Great Heath was low only from 1480 to 3910 years B.P.). These peat layers contain an increased number of *Sphagnum spp.* remains and display a decreasing degree of humification which suggests widespread moister (and cooler?) conditions. These changes can be interpreted as a response of peat-forming processes to the accelerated deterioration of climate in recent millennia in northern New England as reflected in the history of forest vegetation (Bradstreet and Davis, 1975) and oxygen isotope records (Stuiver, 1970).

Samples were dated by the moss increment method for 19 cores from unmined sites in eight peatlands (Appendix V). In most cases, the estimation of peat accumulation by this method was possible only above the water table and in hummocks. Dating was performed for certain hollows and depressions by means of pollen analysis (Appendix IV).

Wide variations in net peat accumulation rates have been observed from site to site and from level to level within the cores (Appendix V). These different rates result from the great variation in both the bulk density and the rate of vertical accumulation (a). The highly variable proportion of dwarf shrubs and other woody remains in the samples is probably largely responsible for this variation. Replicate samples from one hummock at Caribou Bog, site Ca2A, do not deviate very much from each other (Figure 12).

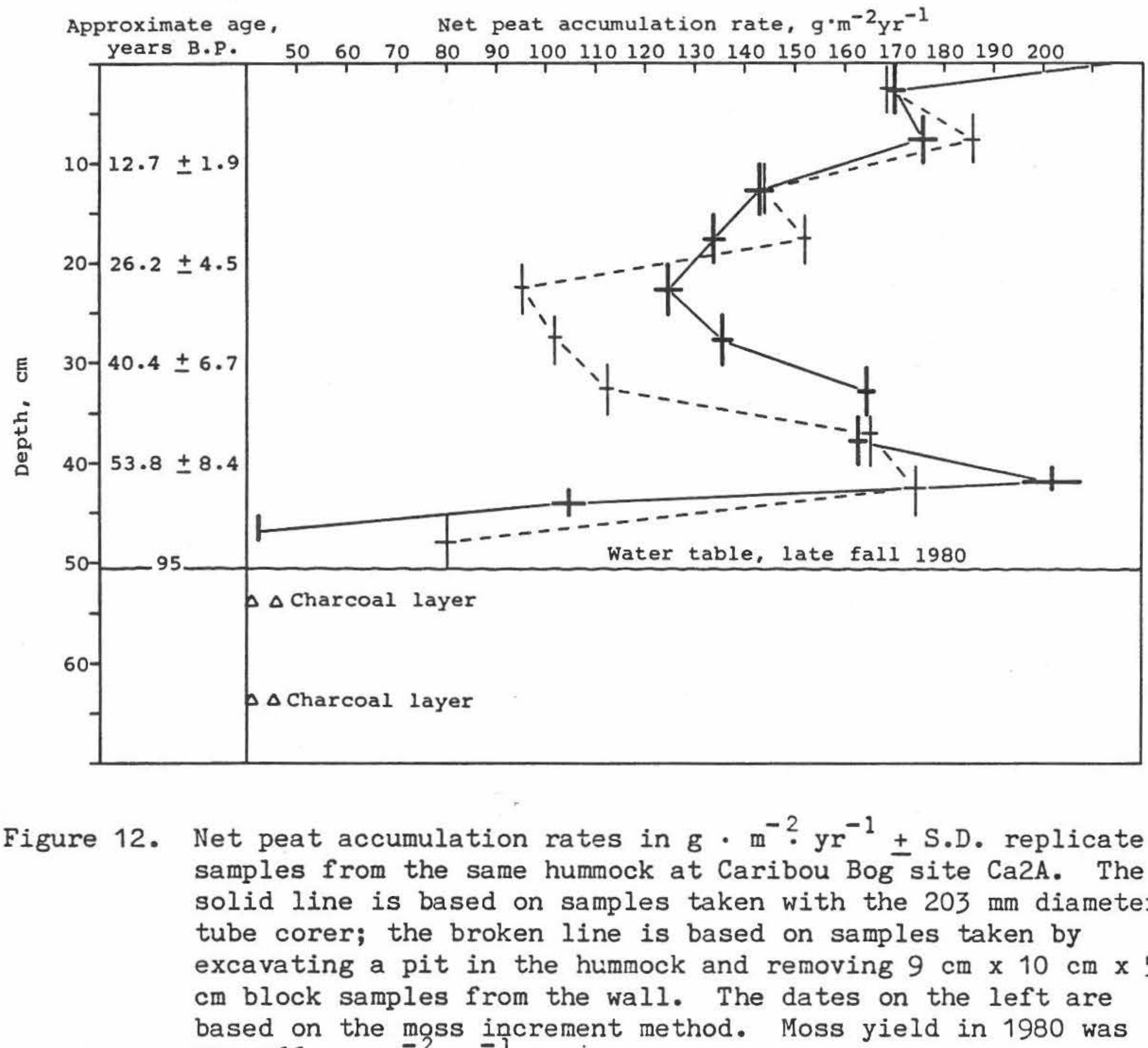


Figure 12. Net peat accumulation rates in $g \cdot m^{-2} \cdot yr^{-1} \pm$ S.D. replicate samples from the same hummock at Caribou Bog site Ca2A. The solid line is based on samples taken with the 203 mm diameter tube corer; the broken line is based on samples taken by excavating a pit in the hummock and removing 9 cm x 10 cm x 5 cm block samples from the wall. The dates on the left are based on the moss increment method. Moss yield in 1980 was 200-266 $g \cdot m^{-2} \cdot yr^{-1}$.

Cores from hummocks (Appendix V) yielded net peat accumulation rates (A) of 42 to 768 $g \cdot m^{-2} \cdot yr^{-1}$ without any clear geographical regularity. In some cores, similar rates of peat accumulation were obtained for levels dated about 60 years ago and for the present living surface. That is the case for the layers above the average water table where both compression and decomposition of peat are known to be incomplete (e.g., Pakarinen and Tolonen, 1977), and considerable amounts of "living" roots and dwarf shrub stems are still present. This occurrence of younger, mostly living material in the near-surface peat (dated as much as 130 years B.P.) explains the seemingly great discrepancy between the short term averages in Figure 13 and 14 and the long term averages in Tables 2 and 3. For peat both slightly above the water table and below it in the anaerobic zone (where reached by the short cores), accumulation rates come close to the long-term averages based on the long cores, viz.: in Crystal Bog core CyHH, A was about 60 $g \cdot m^{-2} \cdot yr^{-1}$, in Caribou Bog cores Ca1A-D and Ca2A around 41 $g \cdot m^{-2} \cdot yr^{-1}$, in Big Heath core BHP3 about 60 $g \cdot m^{-2} \cdot yr^{-1}$, in Great Heath core GHD around 50-60 $g \cdot m^{-2} \cdot yr^{-1}$, and in Denbo Heath core DI6 around 75 $g \cdot m^{-2} \cdot yr^{-1}$ (moss) (Appendix V).

In cores from a hollow (Figure 15) and a lichen-covered depression (Figure 16), net peat accumulations in the top layers (55-96 $g \cdot m^{-2} \cdot yr^{-1}$ and about 43 $g \cdot m^{-2} \cdot yr^{-1}$, respectively) resemble the long-term averages (Tables 2 and 3). When some of the hummock cores were "cleaned" of what appeared to be living plant stems and roots, the results for A came closer to the long-term averages.

The regrowth of a *Sphagnum* bog was observed on three mined peatlands in eastern Maine by means of core studies. On Denbo Heath, New England Peat Industries peatland, and Jonesport Heath (cf. Trefethen and Bradford, 1944; Damman, 1977), sites were selected where moss peat mining was stopped several decades ago. On Denbo Heath, Elton Nason of the Down East Peat Company directed us to an area where peat mining last took place in 1952 (see Figures 1-3 in Appendix I; cores DIII 1-18). On other cut-away sites nearby, the last mining occurred a few years before 1952 (Figure 4 in Appendix I; cores DII 1-4).

In cores taken from the area mined in 1952, the 1952 level was clearly identifiable (Appendix I) as an abrupt change in the character of the peat starting at a sandy layer (possibly windblown from a nearby road). Moss increment dating carried out on one of the 18 short cores from this area agreed well (31.9 $\pm$ 6.2 yrs before 1981) with the known date of mining. A random sampling (the 18 cores) made along a 10 m transect in this area revealed a post-mining net accumulation rate of 123 to 375 $g \cdot m^{-2} \cdot yr^{-1}$ (= 1.23 to 3.75 x 10^3 $kg \cdot ha^{-1} \cdot yr^{-1}$) (Figure 17). As seen in Figure 17, there is no correlation between these figures for the net accumulation rate and the 1980 yield ($g \cdot m^{-2}$) which roughly corresponds to the production of vegetation at the top of each core. The key factor in peat accumulation is decay, not production. In long term growth measurements in some bogs in coastal Maine, Damman (pers. comm., 1985) has observed that periods of stagnation within a hummock are followed by rapid growth and vice versa.

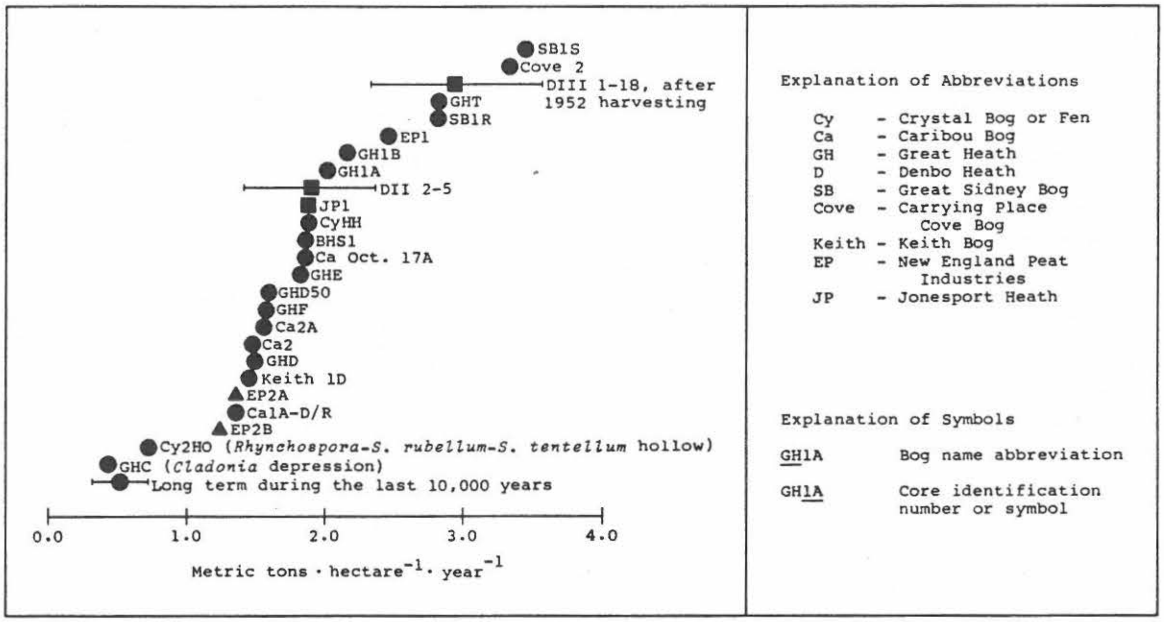


Figure 13. Average net peat accumulation rates in metric tons per hectare per year without ash correction, during all or part of the last 30 years in some raised bogs in Maine. Squares indicate 30 year average rates for mined sites where mining stopped over 30 years ago, and triangles indicate less than 30 year average rates for mined sites where mining stopped less than 30 years ago. Unmined sites are denoted by circles. Three of the values are bracketed by their standard errors. For comparison, the long term rate for the Holocene is given as the bottom entry.

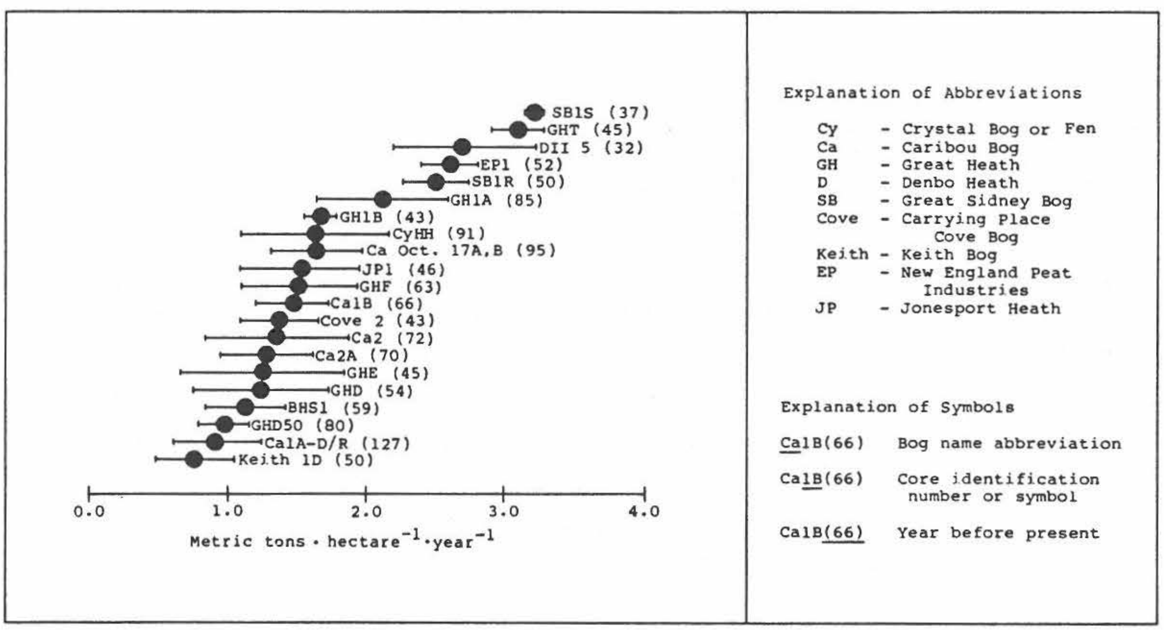


Figure 14. Average net peat accumulation rates in metric tons per hectare per year without ash correction for the period from 30 years B.P. to the given year B.P. indicated in parentheses. Dates were determined by the moss increment method.

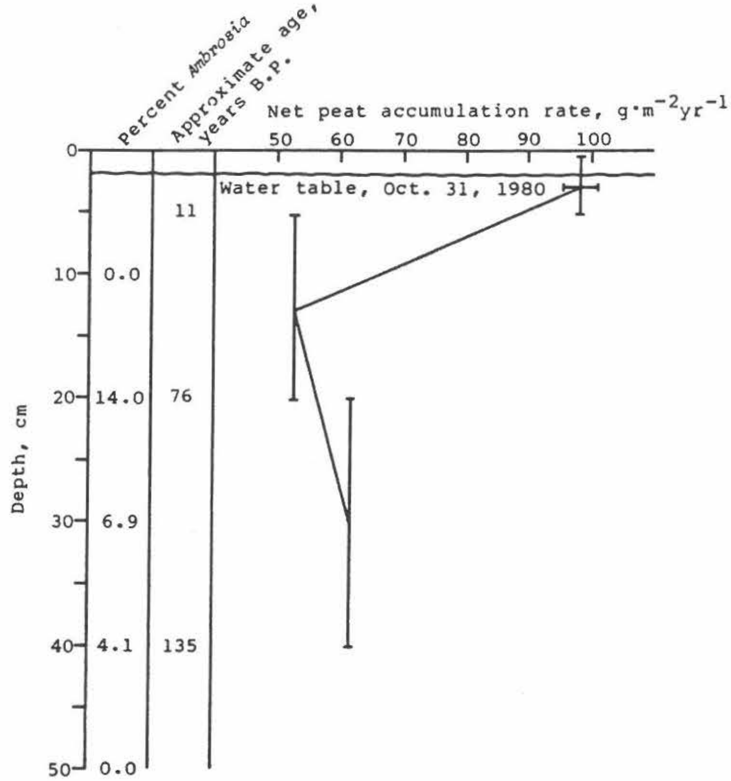


Figure 15. Net peat accumulation rates in g · m^{-2} · yr^{-1} in core Cy2HO from a hollow (*Rhynchospora - Sphagnum rubellum - S. tenellum*) at Crystal Bog. The bottom two approximate ages are based on pollen analysis (e.g. *Ambrosia* percent) and the known age of settlement and maximum agriculture in the townships near the bog. The top age is based on the moss increment method.

The primary results (Appendix V) and the summary (Figure 13 and 14) indicate that the post-mining peat accumulation rate at Denbo Heath is very close to the highest rates from unmined sites for both the last 30 years and the period before that. The accumulation rate at only two or three unmined core sites exceeded that of Denbo III. These unmined sites, like the Denbo III site, are very shrubby, apparently due to peatland fires in recent decades. Our preliminary interpretation, therefore, is that the disturbance of surface vegetation and near-surface peat, in these cases either by peat mining or burning, resulted in favorable circumstances for the growth of plants whose remains are resistant to decomposition. Alternatively, or in addition, such disturbances may temporarily remobilize plant nutrients, which prior to the disturbance were stored in unavailable forms, leading to a spurt in plant growth.

A precondition for such rapid regrowth of open peat fields or cut-away areas following mining is a fairly level surface. Based on observations of the New England Peat Industries sites, erosion by running water on a sloping surface effectively prevents all moss growth and also the growth of almost all the other mire plants except cotton grass (see Figures 6-9 in

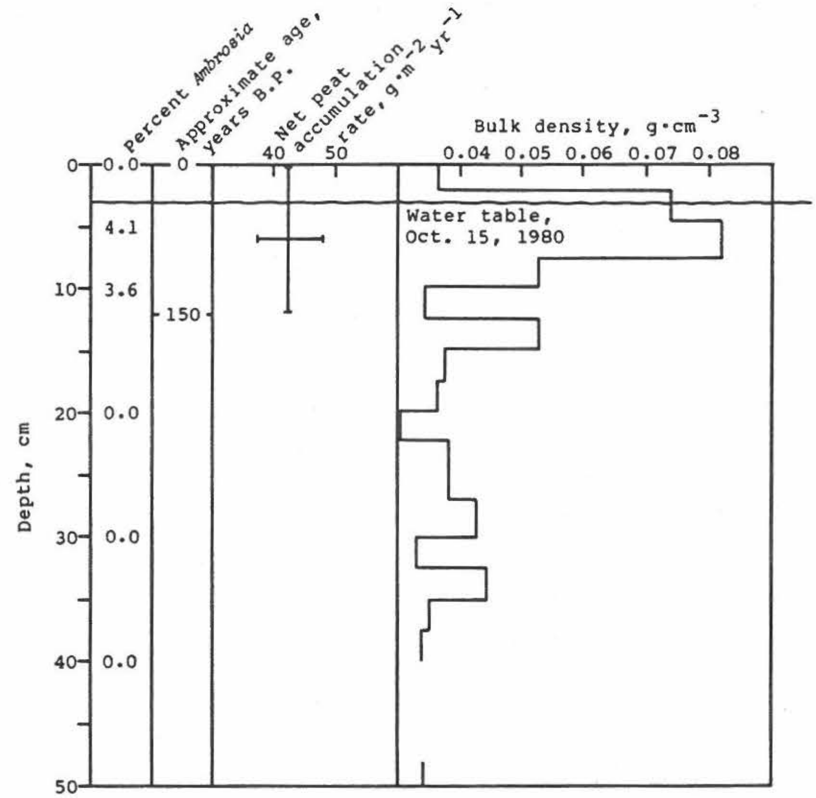


Figure 16. Net peat accumulation rates in g · m^{-2} · yr^{-1} in a core from a lichen-covered (*Cladonia*) depression at Great Heath site GH1C. Bulk densities (D_b) in g · cm^{-3} are shown by the broken line histogram. The approximate age of the 12.5 cm level is based on pollen analysis (e.g. *Ambrosia* percent) and the known age (~1830) of settlement of the townships near the bog.

Appendix I). Our data are insufficient, however, to specify the conditions under which good peat rejuvenation will take place after mining. We can only say that the regrowth can, under some conditions, produce considerable amounts of slightly decomposed new peat starting 2-5 years after manual or machine mining operations cease.

Reliability and Representativeness of the Foregoing Results

According to Davis and Anderson (1980), the ash content of peat from raised bogs in Maine generally is very low, usually 0.5-3.0%. Hence, ignoring the ash correction for equation (1) is of little consequence. The net accumulation rate (A) is almost entirely due to in situ biological processes and fire, as opposed to inorganic sedimentation.

The reliability of the bulk density values for samples below the water table can be checked in part by comparing them to the water content (as percent of wet weight) of the same samples. The check is based on the fact that the amount of water in saturated peat is dependent on the pore volume which, in turn, inversely depends on the degree of decomposition. In fact,

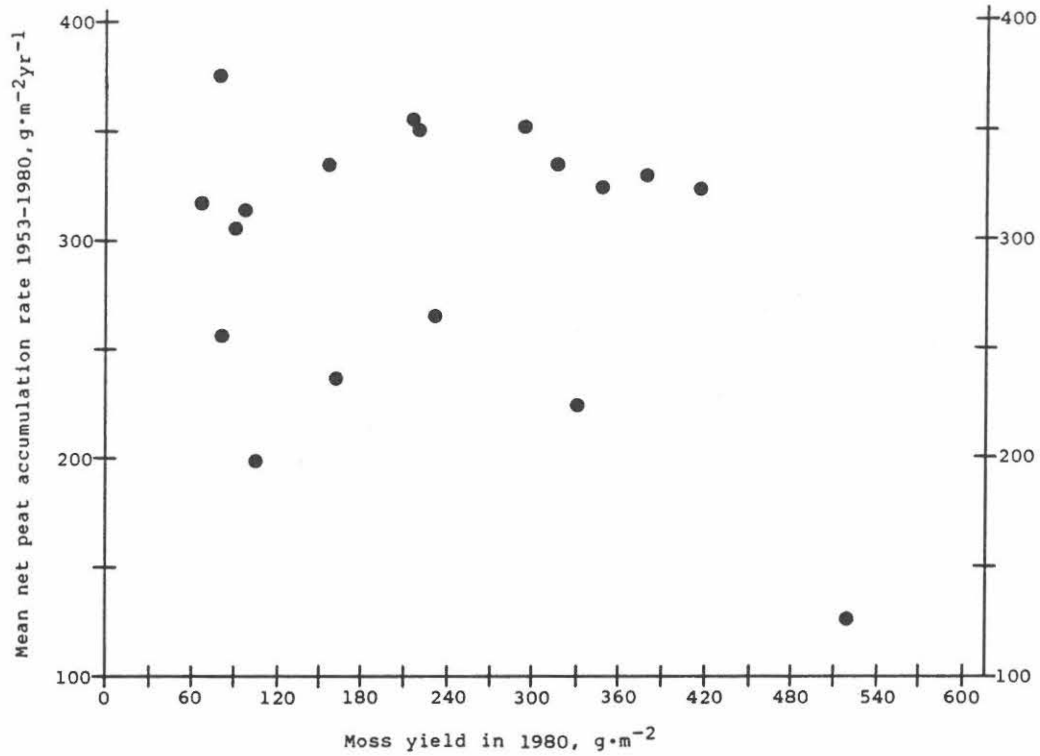


Figure 17. The relationship between net peat accumulation rate since 1952 and moss yield in 1980 at 18 sites along a 10 m transect in an area of Denbo Heath where peat mining ceased in 1952. A = 292.9 ± 64.9 g · m^{-2} · yr^{-1} (n = 18).

it has been demonstrated (Boelter, 1969; Paivanen, 1969) that bulk density can be used as a measure of decomposition; this relationship will be discussed below. In obtaining the long cores, particular attention was paid to retaining all the water contained in the peat. The relationships between bulk density and water content are expressed in the following equations: BHP3 (3); CyB2 (4); CyF1 (5); Ca1 (6); Ca2 (7); GH1 (8); and SB1L (9):

(3)	$y = -0.011100x + 1.0962$	$r = -0.975$	$n = 54$
(4)	$y = -0.010182x + 1.0143$	$r = -0.985$	$n = 65$
(5)	$y = -0.010640x + 1.0547$	$r = -0.913$	$n = 58$
(6)	$y = -0.010160x + 1.0129$	$r = -0.961$	$n = 64$
(7)	$y = -0.011000x + 1.0883$	$r = -0.938$	$n = 62$
(8)	$y = -0.009130x + 0.9189$	$r = -0.906$	$n = 75$
(9)	$y = -0.009308x + 0.9329$	$r = -0.937$	$n = 72$

where: y = bulk density in g · m^{-3}
x = water content of freshly collected peat as % wet weight
r = correlation coefficient
n = number of samples

The plots for these relationships are given in Appendix VII.

For comparison, the following equation was derived from the data in Korpijaakko (1975) from two raised bogs in New Brunswick where he used an excellent volumetric sampler (Korpijaakko, 1981). This equation is almost the same as for Great Heath.

(10) $y = -0.009538x + 0.9521 \quad r = 0.993 \quad n = 135$

These high correlation coefficients and the great efficiency of our peat sampler when compared with two other samplers (Tolonen and Ijas, 1982)[1] support our contention that sampling of peat below the water table was truly volumetric. Similar results were obtained by Tolonen (unpublished data) for Kaurastensuo Bog, a raised bog in southern Finland, viz.:

(11) $y = -0.010696x + 1.0604 \quad r = -0.9804 \quad n = 59$

The theoretical calculations for the same relationship by Scott et al. (1980) resulted in two equations, fairly close to ours, viz.:

(12) $y = -0.010617x + 1.0590 \quad r = -1.000$

for peats saturated with water (= minimum gas content), and

(13) $y = -0.0999x + 0.9994 \quad r = -1.000$

for peat with "maximum gas content."

The water percentages of 85 to 90 given by Bastin and Davis (1909) which have so far been used in the Maine Peat Resource Evaluation Program (Davis and Anderson, 1980) in the equation converting fresh peat volumes to tonnages may be invalid for the majority of undisturbed peat deposits in Maine. Our studies suggest that in most raised bog peat strata in Maine the mean water content is about 92-94%. The primary, original data of Davis and Anderson (1980, Tables 2-5) are somewhat lower than this. If our figures are right, the commonly used values from Bastin and Davis (1909) give an overestimation of the dry peat yield for Maine peatlands by a factor of about 1.6-2.0.

The energy content of peat on a dry weight basis increases as peat is humified, and the caloric value can be much higher than that of the original peat-forming plant species. Therefore, as peat accumulation rates (A) change through a peat core, energy accumulation rates do not change by the same proportion if the degree of humification is changing. The results for such relationships from different geographic regions and by different authors vary greatly, but as a rough average, a completely humified peat (H_{10} in the von Post scale) would have an energy content on a dry weight basis about 20-25% higher than the same peat species in a wholly unhumified condition (H_1) e.g., Salmi, 1954; Makila, 1980).

---

[1]The same instrument used by Tolonen and Ijas (1982), i.e. their "large Russian peat sampler" (100 x 500 mm), was used in the work reported here.

Most of the peat in the long cores is moderately decomposed, and probably has an energy content which is not more than 10% greater than the slightly decomposed peat in many of the short cores from hummocks. An attempt was made to directly determine the energy content of peat of differing degrees of humification from our cores by sending them to a laboratory for BTU analysis. The results, however, proved to be unreliable. In the absence of BTU data, it is possible to estimate energy accumulation rates in a peatland by using the close relationship between energy content and in situ water content. The following calculations demonstrate this method for peat from the Great Heath.

For the Great Heath, Davis and Anderson (1980, Table 5) supply data for BTU/lb dry peat and water percent for 70 peat samples. Excluding the three greatly deviating data pairs (DOE Nos. K97639, 97668, 97701) we derived equations for the relationship between ash-corrected[2] heating value (y1 in BTU/lb dry peat) and water content, viz.:

(14) $\ln y1 = 10.591 - 0.20121 \ln X$, $r = -0.821$, $p < 0.001$, $n = 87$

and between non-ash-corrected heating value (y2) and moisture content, viz.:

(15) $\ln y2 = 10.287 - 0.16131 \ln X$, $r = 0.824$, $p < 0.001$, $n = 67$

where X = percent water content per unit dry weight of peat, i.e. % water of fresh sample/100 - % water of fresh sample. For reed-sedge peats (y3) Davis and Anderson, 1980), the corresponding equation is:

(16) $\ln y3 - 10.800 - 0.22783 \ln X$, $r = 0.890$, $p < 0.001$, $n = 17$

These relationships are plotted in Figure 18.

Equation 15 was used for converting the net accumulation rates of dry peat for the Great Heath to energy accumulation rates (Figure 19). Energy accumulation rates varied between 105 $kcal/m^{-2}/yr^{-1}$ and 370 $kcal/m^{-2}/yr^{-1}$, closely following the trend for net accumulation rates. A good estimate for current primary production on ombrotrophic shrubby half-open peatlands is about 500 $g \cdot m^{-2} \cdot yr^{-1}$ (Clymo, 1970; Reinikainen, 1976, 1981; Damman, pers. com. 1981) containing some 4200-5000 kcal/kg. Assuming the applicability of this figure, the net energy accumulation rate in the Great Heath is only about 5 to 16 percent of the energy produced at the peat surface.

Utilizing 150 successive C-14 dates from an open peat face in Denmark (see Tolonen, 1979), Aaby and Tauber (1975) have shown that it is very difficult, if not impossible, to indisputably determine the rate of vertical accumulation (a) for any raised bog deposit. Therefore, our long-term averages based on Carbon-14 dating can be considered to be gross working approximations only. Given this situation, even approximate ages derived by pollen correlation can be used (Appendixes II and III). All the long-term peat accumulation figures should be considered as more or less uncertain estimates due to the vagueness in dating.

---

[2]Ash-corrected BTU/lb = $\frac{100 \cdot \text{noncorrected BTU/lb}}{100 - \text{ash } \%}$

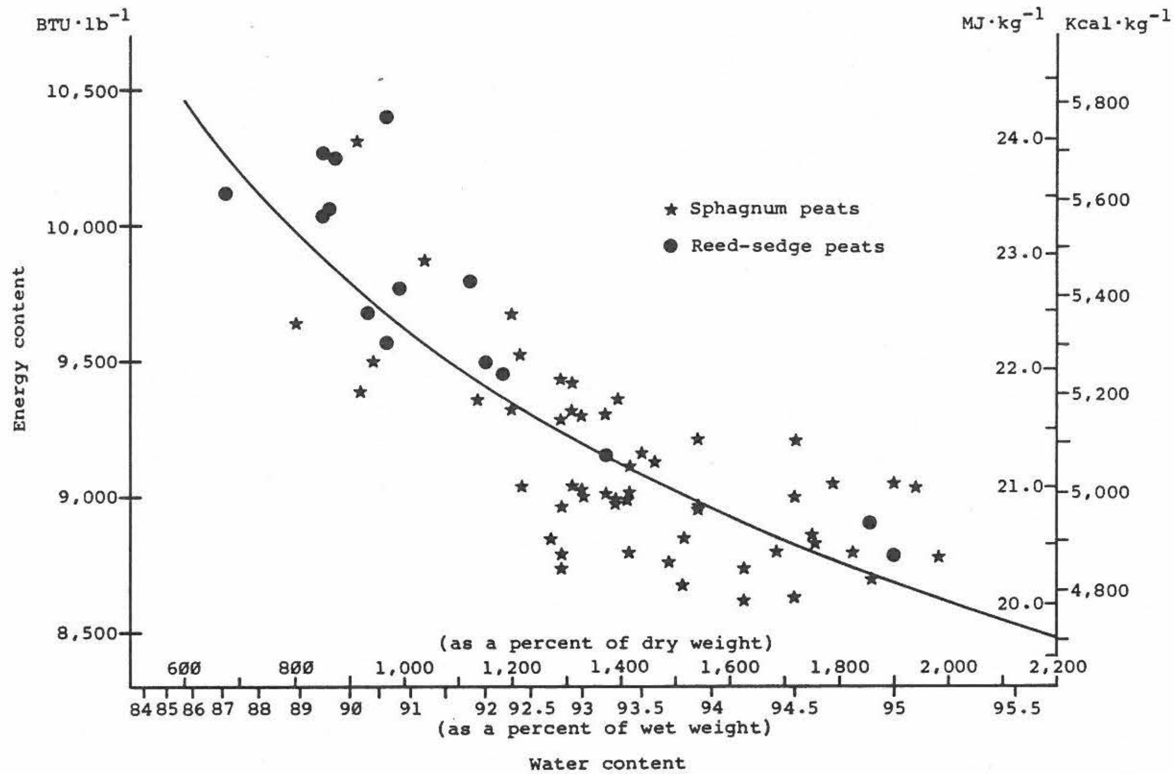


Figure 18. The relationship between energy content and percent water in long core 1 at Great Heath (Cameron & USGS site 10), without ash correction for both peat types. lny = 0.161311nx + 10.2872, r = -0.824, n = 67. Original data from Davis and Anderson (1980, Table 5).

Nevertheless, the age/depth curves for CyB2, CyF1, and core BHP3 resulted in vertical accumulation rates which, when plotted against the values for degree of decomposition (von Post) for corresponding peat sections, show a highly significant (P<0.001) negative correlation in linear regression equations (Table 4). The explanation for the weak correlation in Great Heath and the lack of correlation in Caribou Bog is that too few levels were dated for an adequate description of the complicated variation of the vertical accumulation rate along the core. This variation, due to fire or other factors is obscured by the long-term averages (cf. Tolonen, 1979, p. 283-286).

The slopes (m) of equations for the relationship between the vertical accumulation rate and the degree of decomposition for two Maine raised bogs (Crystal Bog and Big Heath) are generally steeper than those for European bogs (Table 4). The very steep slope in the equation for Big Heath seems to be due to the favorable climatic conditions for *Sphagnum* growth in the foggy coastal zone during the last millennium. This interpretation agrees with observations made in maritime New Brunswick (Korpijaakko, 1975; Damman, 1977, 1979; Jones and Gore, 1975). However, the slope in the Big

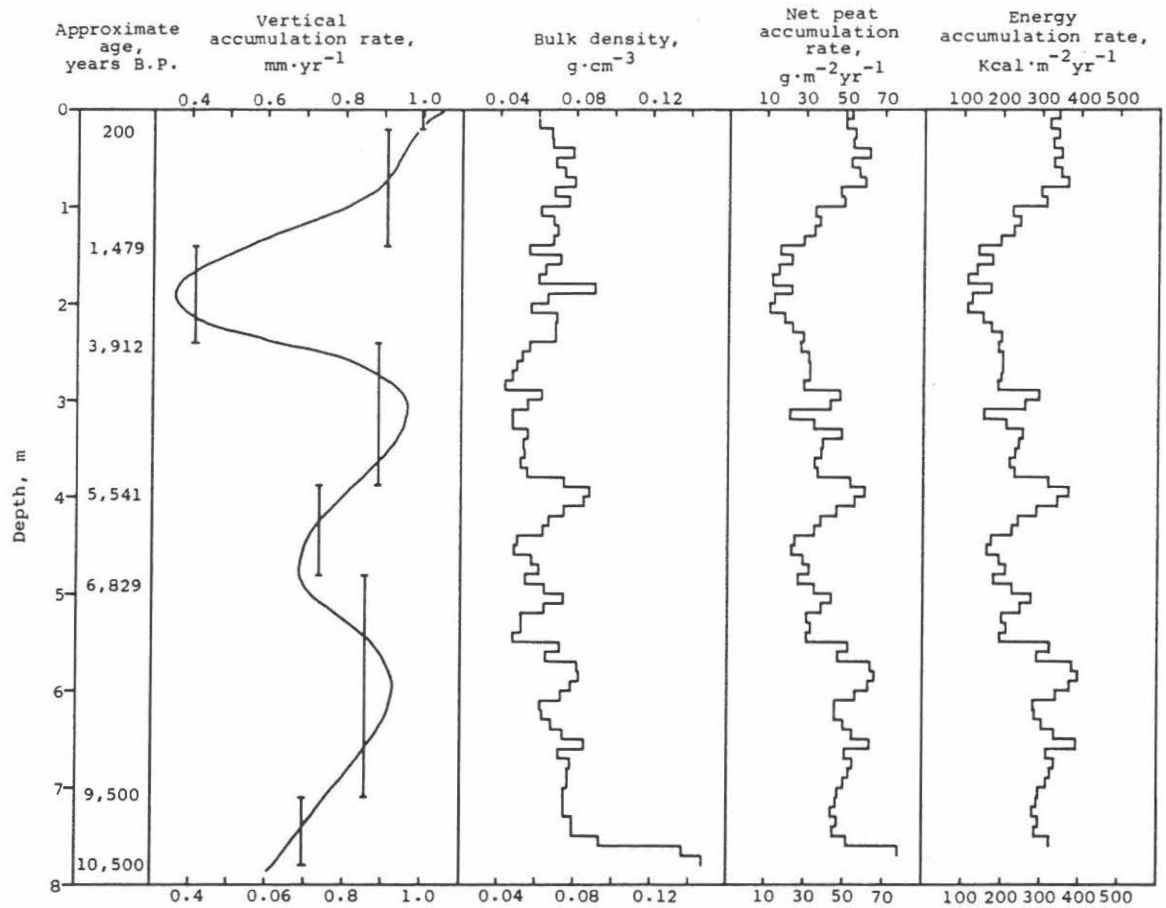


Figure 19. For core GH1 (Nichols et al., 1984, piezometer cluster site 10 on Figure 2) from Great Heath: profiles of vertical accumulation rate (a), bulk density (D_b), net peat accumulation rate (A), and energy accumulation rate.

Heath equation is probably due in part to frequent fires which resulted in a considerable retardation in the vertical accumulation rate and a loss of organic matter from the bottom 2 m of peat. In one core, 38 charcoal layers were recorded, most in the bottom 2 m. In fact, the linear solutions in the above mentioned relationship were not the best ones for the peatlands in Maine. The data fit curvilinear models more closely (Table 5). In Big Heath the degree of decomposition alone explained 89.6% of the variation in the vertical accumulation rate (see Figure 20) when the second degree polynomial was used.

Table 4. Linear regression equations ($y = mx + b$) for the relationship of vertical accumulation rate ($mm\ yr^{-1} = y$) vs. degree of decomposition by von Post's method (H_{1-10}) in some European peatlands (Tolonen, 1979) and in four Maine peatlands.

Location	m	b	Correlation coefficient (r)	significance	Number of samples (n)
Germany-S. Sweden	-0.154	1.713	-0.717	$p < 0.001$	21
South Finland	-0.224	1.935	-0.817	$p < 0.001$	40
Crystal Fen	-0.197	1.700	-0.589	$p < 0.001$	40
Crystal Bog	-0.298	2.457	-0.632	$p < 0.001$	60
Big Heath	-0.466	3.880	-0.897	$p < 0.001$	48
Great Heath	-0.004	0.802	-0.031	not significant	76
Caribou Bog	Impossible to treat due to the numerous burned layers.				

Table 5. Curvilinear equations for the relationships in Table 4. Varrassuo data from Tolonen (1979).
y = vertical accumulation rate in $mm \cdot yr^{-1}$
x = degree of decomposition (von Post)

Location	Equation	Correlation Coefficient (r)	Number of sections (n)
Varrassuo, Finland	$\ln y = 2.401 - 0.76x$	-0.804	14
Big Heath	$y = 5.73 - 1.298 + 0.0713x^2$	-0.947	50
Crystal Bog	$\ln y = 1.629 - 1.187 \ln x$	-0.725	60
Crystal Fen	$y = 2.889 - 1.340 \ln x$	-0.690	40

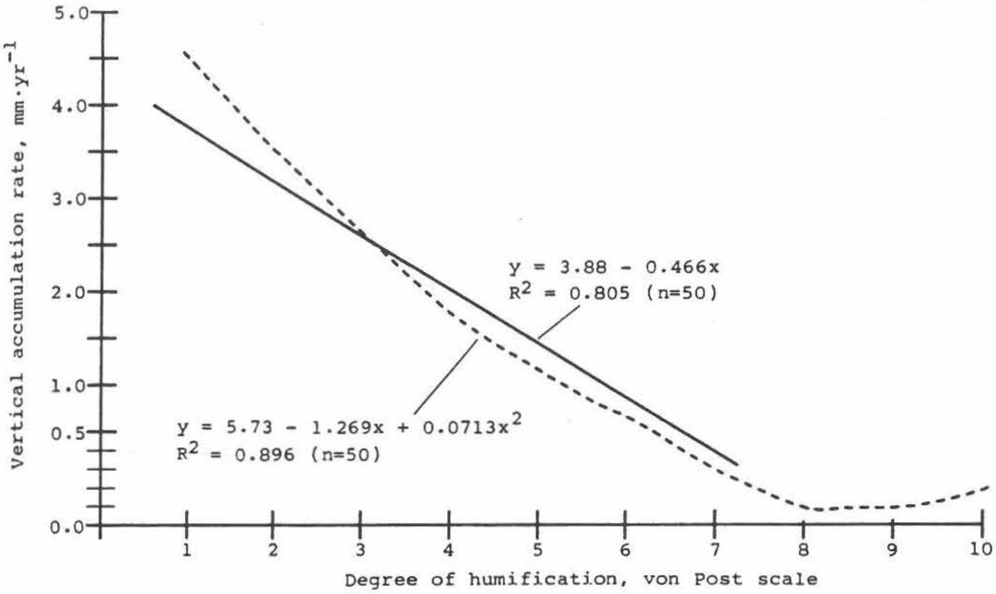


Figure 20. The relationship between the vertical accumulation rate (a) and the von Post degree of humification (H) for long core p3 from Big Heath.

By adding depth to the vertical accumulation rate model for Big Heath, an even "better" equation was found:

$$(17)\quad y_2 = 5.680 - 1.162X_1 + 0.0767X_1{}^2 - 0.3359X_2.$$
$$R^2 = 0.9318$$

where

y = vertical growth mm yr^{-1}
X_1 = degree of decomposition (H_{1-10})
X_2 = depth below surface in meters

This suggests that the autocompaction of peat plays a role in the final vertical accumulation rate. However, due to the high correlation between degree of decomposition and depth, it is difficult to judge how great the effect of compaction alone is. For instance, the correlation (r) between a and depth is -0.7 at Big Heath. Nevertheless, the confirmation of a close relationship of a with degree of decomposition gives support to the validity of our dating of the long cores.

The reliability of dating of the short cores was discussed above; it is ±30% in the worst cases or youngest samples and much less in the older strata. Historical control in Denbo Heath as described above revealed an age of 29 years which agrees very well with the moss increment dating 31.9 ± 6.2 years. Another opportunity for testing the reliability of moss increment dating was found in the literature on Carrying Place Cove Bog

(Osvald, 1955). The basal part of one short core there was dated by moss increments to be 43.3 ± 8.2 years old. Immediately below the dated level there was a distinct layer of burned dwarf shrubs. Osvald (1955) witnessed the effects of a peatland fire on the same small bog in late September 1927: "fires had ravaged parts of the bog, and on the dry parts there was but little natural vegetation left." Historical control thus gives 54 years between that fire and our coring in 1981. *Polytrichum strictum* predominates the very basal part of our short core. It seems likely that it took a few years after the severe fire before the plant cover rejuvenated at the site.

In a recent paper, Hemond (1980) used lead-210 dating for a short peat core from a floating-mat *Sphagnum* bog in Massachusetts and found that the net peat accumulation rate during the past 150 years was about 180 g · m^{-2} · yr^{-1}. That figure agrees well with the average from the short cores and with the values from Big Heath for the past 2000 years.

Samples were analyzed from long core Ca2 from Caribou Bog. This core was located about 75 m from Ca1. Differences in bulk densities between the two cores were statistically insignificant ($p<0.001$).

Dependence of Bulk Density on the Degree of Decomposition

The results of other researchers indicate that the dry bulk density of peat has a high positive correlation with the degree of decomposition as expressed by the von Post scale (e.g. Paivanen, 1969; Silc and Stanek, 1977; Scott et al., 1980). Lower correlations for *Sphagnum* peat ($r = 0.75$) were found by Tolonen and Saarenmaa (1979), Makila (1980), and Korpijaakko et al. (1981), and for *Carex* peats, the correlations were even lower and sometimes insignificant. In a relatively large data set from 135 New Brunswick peatlands (Korpijaakko, 1975), the corresponding correlation for *Sphagnum* peats was $r = 0.709$. The coefficients for similar linear regression equations are given in Table 6 for Caribou Bog, Crystal Fen, Great Heath, Crystal Bog, and Big Heath. In all but one case (Caribou Bog), the correlation coefficients are statistically highly significant ($p<0.001$). They are so low, however, that it is not advisable to use the equations for practical purposes (cf. Tolonen and Saarenmaa, 1979; Tolonen and Ijas, 1982). Their scientific value is discussed below.

Height Growth in 1981

The average growth in 1981 for each *Sphagnum* species at each bog is given in Table 7. In most cases the individual plants showed significant height growth. However, there were instances where there was no visible growth. There are several factors which may have caused a lack of true or perceptible growth in some *Sphagnum* individuals. In some instances the nylon mesh strip fell on top of the plant being studied. This may have reduced growth due to shading or mechanical damage. Final measurements sometimes resulted in what appeared to be negative growth. This could be due to frost action or other instability of the growth strips.

The number of strips (Table 7) and individual plants finally measured were much lower than the number of strips initially emplaced or the number of plants marked. This was due to the "loss" of all or some of the plants

Table 6. Regression equations ($y = mx + b$) for the relationship of bulk density ($kg \cdot m^{-3} = y$) vs. degree of decomposition (von Post scale $= x$) in five Maine peat deposits.

Deposit	m	b	Correlation coefficient (r)	Significance
Caribou Bog	2.560	+57.49	0.255	$p = 0.01$
Crystal Fen	7.255	+57.10	0.356	$p = 0.01$
Great Heath	7.034	+29.32	0.731	$p < 0.001$
Crystal Bog	3.532	+51.680	0.431	$p < 0.001$
Big Heath	5.606	+41.310	0.608	$p < 0.001$

Table 7. Average (with standard deviation) *Sphagnum* moss height growth rates in mm during 1981 on some Maine peatlands by direct measurements (nylon mesh strips).

n = Number of strips where individuals of the taxon were measured

Location	*S. fuscum*	*S. magellanicum*	*S. rubellum*	*S. flavicomans*
Big Heath	3.17±1.26 n=2	-	4.13±3.57 n=4	3.81±2.43 n=10
Great Heath	10.34±4.48 n=12	14.25±13.17 n=3	-	-
Caribou Bog	14.71±8.37 n=9	2.5±.71 n=1	14.50±384 n=2	-

at a strip. Oftentimes the *Sphagnum* died of unknown, ostensibly natural causes. Liverworts, especially *Mylia anomala* sometimes formed dense networks among *Sphagnum* mats resulting in dead or severely stressed *Sphagnum* plants.

The average figures in Table 7 are in good agreement with those obtained by increment counting the last year's growth in similar microhabitats at the same peatlands described above. A very slow growth is noticeable for Big Heath mosses. That agrees with the results of Pakarinen and Tolonen (1977, Figure 2) and Pakarinen (1978, Figure 2) who found much shorter annual increments in *Sphagnum* individuals on hummocks along the coast of Finland compared to inland. Hummocks in the coastal zone are very tight and firm, possibly due to climatic factors. The growth figures from the two inland sites in Maine are comparable with those reported from inland sites in southern Finland (Lindholm, 1979, 1981).

Moss Yield in 1980

Moss yield measured in 30 samples (Table 8) taken from hummocks on six peatlands averaged 257 $\pm$ 64 g dry wt $\cdot$ $m^{-2} \cdot yr^{-1}$ (range 142-414 g). The two greatest values measured (355 g, 414 g) are from Denbo Heath DII4 and DII5 where clearly distinguishable dust from peat mining is involved. The second highest figures (334 g, 324 g) are from a formerly mined site of New England Peat Co. (Jonesport; EP1) and from a pristine site at Caribou Bog (Ca Oct. 17). For a hollow in Crystal Bog, a value of 208.5 g $\cdot$ $m^{-2} \cdot yr^{-1}$ was obtained. The results agree with those of Osheyack (1981, p. 30) for a shrubby ombrotrophic *Sphagnum* bog in Vermont, viz. 144-300 g $\cdot$ $m^{-2} \cdot yr^{-1}$, and with those in corresponding vegetation in Finland, viz. 70-300 g $\cdot$ $m^{-2} \cdot yr^{-1}$ (Pakarinen, 1978, p. 19).

In our material the production of *Sphagnum* has a negative correlation with the distance of the water table from the peat surface ($r = -0.409$, $p < 0.05$ $n = 30$). This is in accord with the old concept of peat scientists that the growth of *Sphagnum* slows down with increasing height of the hummock because the capillary rise of water in peat has a certain limit in every climatic area. The greater the above ground biomass of vascular plants (mainly dwarf shrubs), the lower was the production of *Sphagnum* ($r = -430$, $p < 0.05$, $n = 22$). This is natural because the growth of hummock *Sphagnum* is retarded by increased shade.

No clear geographical differences can be seen in these moss production values. Nevertheless, the two pristine coastal peatland sites, Cove and EP1, both possessed very high figures (over 300 g $\cdot$ $m^{-2} \cdot yr^{-1}$) whereas all the Great Heath sites had values around 200-250 g $\cdot$ $m^{-2} \cdot yr^{-1}$.

Decomposition in 1980-1981

Table 9 gives the results of decomposition measurements as an average percent loss in dry weight per microsite type in each peatland. Graphs of the more complete data appear in Appendix VIII. Decomposition generally decreases from south (Big Heath) to north (Crystal Bog and Fen). This appears to be the case of the average of all the sites from given peatlands and for the corresponding microsites between peatlands. The decrease in decomposition may be due to the longer season of frozen substrate and frost going northward away from the coast. This would reduce the period of decomposition.

The vertical gradient in decomposition is steepest where the water table lies close to the ground surface, indicating that decomposition is most rapid in the aerobic layer (cf. Lähde, 1969, p. 18). A second peak in decomposition is particularly noticeable in the profiles from Great Heath (Table 9, Appendix VIII). This occurs less consistently at the other peatlands. This phenomenon is unexplained at this time.

Table 8. Dry weight production of *Sphagnum* (moss yield, 1980) for thirty hummock microsites at six Maine peatlands.

CORE	MOSS YIELD 1980 ($g \cdot m^{-2} \cdot yr^{-1}$)	VASCULAR PLANT GROUND BIOMASS	WATER TABLE DEPTH	*Sphagnum* SPECIES (% COVER)
Ca2 (203mm)	266	315	50	fusc.(85), nem.(5)
Ca Oct 17A	324	253	60	fusc.(84), rub.(15)
Ca1A-D/R	221	166	58	fusc.(95), rub.(1)
Ca1B	142	120	60	fusc.(99), rub.(1)
Ca2A	200	211	51	fusc.(75), rub.(25)
Ca2R	308	200	48	fusc.
CyHH	228	164	53	fusc., nem.
CyHHR2	168	124	53	fusc.
GH1A	196	272	62	fusc., flav., imbr.
GH1B	251	109	60	flav.
GHD50	208	213	57	fusc., flav.
GHT35	207	164	57	fusc., imbr.
GHD	240	55	53	flav.
GHE	240	219	32	fusc.(80), rub.(15)
GHF	240	220	36	rub.(60), fusc.(15), imbr.(10)
GH10 1R	247	219	45	acut.
GH10 2R	197	110	45	acut.
GH10 3R	235	154	45	acut.
GH10 4R	241	186	45	fusc.(90), rub.(2)
GH10 5R	218	230	45	fusc.(65), flav.(35), rub.(5)
EP1	334	33	40	fusc.
EP2B	188	96	25	fusc.
Cove 2	321	168	15	imbr., flav.
D II 1	252	1002	28	magell.
D5	281	102	43	rub., fusc.
D6	284	46	33	rub., fusc.
DII 4	355	80	40	fusc., rub.
DII 5	414	90	35	fusc., rub.
DII 2	315	86	43	fusc., rub.
DII 3	328	170	34	fusc., rub.

KEY

fusc. - *fuscum*
nem. - *nemoreum*
rub. - *rubellum*
flav. - *flavicomans*
imbr. - *imbricatum*
acut. - *acutifolia*
magell.- *magellanicum*

Table 9. Average decomposition values (percent loss in dry weight) from different depths at various microsites at five Maine peatlands, November 1980 to November 1981.

	High Hummock	Low Hummock	Lawn	Moss Hollow	Wet Site	*Cladonia* Depression
Great Heath						
0- 5 cm	42±22					19±15
5-10	14± 7					32±16
10-15	10±11					19± 8
15-20	4± 3					5± 6
20-30	6± 8					3± 3
30-40	14± 9					3± 5
40-50	22±15					2± 2
50-60	4± 5					2± 1
60-70	3± 4					2± 2
70-75	6± 6					1± 2
Caribou Bog						
0- 5 cm	20±13	15±15		21±22		
5-10	22±10	13±17		10±11		
10-15	2± 2	4± 5		6± 6		
15-20	0± 1	3± 4		5± 5		
20-30	2± 2	6± 7		3± 3		
30-40	7± 7	5± 4		5± 2		
40-50	1± 1	5± 3		5± 2		
50-60	3± 1	6± 2				
60-70	8± 2	6± 5				
70-75	9± 5	7± 3				
Big Heath						
0- 5	54±22	24±19	44±29		75±23	
5-10	31±25	9±11	24±18		36± 6	
10-15	24±20	16±23	4± 3		5±12	
15-20	12±16	5± 4	2± 1		2± 5	
20-30	17±21	6± 4	2± 0		2± 6	
30-40	13±14	2± 2	3± 1		3± 9	
40-50	5± 6	2± 1	4± 3		7± 2	
50-60	8± 5	1				
60-70	8± 6	0				
70-75	10± 2	2				
Crystal Bog						
0- 5	39±25	14± 7		9		7± 8
5-10	20±17	8± 7		28		18±23
10-15	22±19	3± 1		10		6± 3
15-20	13± 8	3± 3		4		6± 7
20-30	11± 5	10± 8		2		5± 1
30-40	7± 1	7± 5		4		5± 1
40-50	3± 1	3± 0		10		5± 1
50-60	2± 2	6± 3		11		3
60-70	1± 1	8± 2		11		3
70-75	3± 2	8± 2		10		2
Crystal Fen						
0- 5	25±14					
5-10	22±14					
10-15	10± 5					
15-20	7± 4					
20-30	6± 1					
30-40	5± 1					
40-50	6± 1					
50-60	4					
60-70	5					
70-75	4					

The small amount of decomposition at Crystal Fen (Table 9) is surprising given the presence of moderately to highly humified surface peat there. Perhaps the composition of the pulp strips differed markedly from the herb and graminoid vegetation of the fen. At the bog sites, there was better agreement between the decomposition results and the surface peat quality.

SUMMARY AND CONCLUSIONS

Ten peatlands were studied to determine net rates of peat accumulation (A). Three of these contain areas that are presently being mined or have been mined. Rates (A) were determined on three time scales: (1) all or most of the Holocene; (2) the most recent few decades to as much as two or three centuries; and (3) the most recent year or two.

On the first time scale, mean rates for five "long cores" from four raised bogs and a fen range from 35.0 to 55.1 $g_2 \cdot m^{-2} \cdot yr^{-1}$ (means 45.7 $\pm$ 21.8; median 39.9) (1 $g \cdot m^{-2}$ equivalent to 10^{-2} metric tons per hectare), with standard deviations of 30 to 89 percent. Most of the variance is due to the within-core variation in the vertical accumulation rates (a). Some of the short-term variation in a is due to peatland fires. Charred horizons are common. Longer-term variation may be caused by climatic change. There is some common behavior of a among all the cores, e.g., vertical accumulation slowed about 7,000 years ago. The means for a in each core range from 0.35 to 0.82 $mm \cdot y^{-1}$ (median 0.67).

Results for A come very close to the mean value of 0.45 $tons \cdot ha^{-1} \cdot yr^{-1}$ given by Mattson and Koutler-Andersson (1954) for southern Swedish raised bogs. In a relatively comprehensive study by Tolonen (1977 and 1979) the ranges were 0.25-0.48 and 0.19-0.68, respectively, while Jones and Gore (1978) gave higher values of 0.46-0.70 and 1.29-2.04 for two blanket bogs in central and northern England.

On the second time scale, there are large differences in A among short core sites at the same peatland and at different peatlands. Also, within individual cores there was great variation with depth. One of the important causes of this variation is the highly variable proportion of woody remains, living woody stems and roots, and associated variable degrees of decomposition. In hummocks, values for A ranged from 42 to 768 $g \cdot m^{-2} \cdot yr^{-1}$. Most of these values exceed those for the first time scale because of the presence of living and barely-decomposed dead plants in the upper peat. Below the water table and in hollows the rates are similar for the first and second time scales.

Studies of moss height growth in 1981 and moss yield in 1980 gave results for the third time scale. Rates are comparable to those from peat above the water table on the second time scale.

Some of the highest rates of recent peat accumulation occur at a site at Denbo Heath where the top layers of peat were mined three decades ago. In contrast, at certain mined sites in peatlands at Jonesport, regeneration is slow or non-existent. The factors accounting for these differences could not be formally investigated, but slope and erosion by running water may be important in inhibiting regeneration.

Energy accumulation rates at the Great Heath in the past 10,000 years are estimated to vary between 105 and 370 kcal $\cdot$ m^{-2} $\cdot$ yr^{-1}. These rates are only about 5 to 16 percent of the probable past net primary production rates, illustrating the great importance of decomposition in peat forming processes. For Big Heath, where vertical accumulation rates (*a*) and degrees of humification (H) were satisfactorily determined, models for peat accumulation were developed that show that the variation of H accounts for about 90 percent of the variance in *a*. The results of studies of the decomposition of pulp strips inserted into the peatlands for one year agree with observations and interpretations of the relationships between H, *a*, and A in the short cores.

The description of net accumulation rates of peat is difficult because of the great variation in the rates over time, even at a single site in a single peatland. Local factors such as slope, microtopography, and fire are important causes of variation. The task is especially difficult where one must sample and date highly humified peat strata that are often quite thin.

As a by-product of this project, numerous values for dry bulk density per unit wet volume have been accumulated from Maine peatlands. It is strongly recommended that these data be taken into account, because they provide a firm basis for predicting dry peat (both moss peat and fuel peat) yield in these peat deposits. They are preferable to the hypothetical conversion factors from Bastin and Davis (1909) which are still in use. From field moisture content (% water) of peat samples obtained with any equipment which retains the in situ water, one can reliably calculate the yield of peat.

Regarding the question of the renewability of Maine's peat resource, under some circumstances the regeneration of peat following cessation of mining can be comparable to the highest rates of recent peat accumulation on unmined surfaces. But in both situations, the dry matter accumulation rate decreased steeply over time as decomposition increased, resulting in very slow net accumulation rates (A). A high rate for A for a few decades following mining does not justify the unqualified designation of peatlands as "renewable resources" on other than a geological time scale. The natural transformation of peat recently formed at the surface into peat which is conventionally considered to be of high quality for fuel purposes is largely a result of the processes of decomposition and compaction. Net vertical accumulation rates for such peats are very slow; 10-40 cm per millennium are common, and in extreme cases, rates are even slower.

REFERENCES

Aaby, G., and Tauber, H., 1975, Rates of peat formation in relation to degree of humification and local environment, as shown by studies of a raised bog in Denmark: Boreas, v. 4, p. 1-17.

Anderson, R. S., 1979, A holocene record of vegetation and fire at Upper South Branch Pond in Northern Maine: Unpublished M.S. thesis, University of Maine at Orono, 62 p.

Auer, U., 1928, Present peat bogs in southeastern Canada: Comm. Inst. Forest. Finl., v. 13, p. 1-55.

Bastin, E. S., and Davis, C. A., 1909, Peat deposits of Maine: U.S. Geol. Surv. Bull. 376, 125 p.

Boelter, D. H., 1969, Physical properties of peats as related to degree of decompositon: Soil Science Soc. Amer. Proc., v. 33, p. 606-609.

Bradstreet, T. E., and Davis, R. B., 1975, Mid-postglacial environments in New England with emphasis on Maine: Arctic Anthropology, v. 12. p. 7-22.

Cameron, C., and Anderson, W., 1980, Peat Resources of the Great Heath, Washington County, Maine: U.S. Geol. Surv. Open-File Rpt. 80-379, 31 p.

Clymo, R. S., 1970, The growth of *Sphagnum*: methods of measurement: J. Ecol., v. 58, p. 13-49.

Damman, A. W. H., 1977, Geographical changes in the vegetation pattern of raised bogs in the Bay of Fundy region of Maine and New Brunswick: Vegetatio B5, p. 137-151.

Damman, A. W. H., 1979, Georgraphic patterns in peatland development in eastern North America: Proc. Int. Symp. on Classification of Peat and Peatlands, Int. Peat. Soc. Helsinki, p. 42-57.

Damon, P. I., Long, A., and Wallick, E. I., 1972, Dendrochronologic calibration of the carbon-14 timescale: Proc. of the Eighth Int. Radiocarbon Dating Conf., Wellington, New Zealand, p. 44-59.

Davis, J., and Anderson, W., 1980, Maine Peat Resource Evaluation Program: 1979 Field Season: Maine Geol. Surv. Open-File No. 80-5, 94 p.

Davis, R. B., Bradstreet, T. E., Stuckenrath, R., Jr., and Borns, H. W., Jr., 1975, Vegetation and associated environments during the past 14,000 years near Moulton Pond, Maine: Quaternary Research, v. 5, p. 435-465.

Day, J. H., Rennie, P. J., Stanek, W., and Raymond, G. P., eds., 1979, Peat testing manual: National Res. Counc. Canada, Assoc. Comm. on Geotechn. Res., Techn., Mem. 125, p. 1-193.

Gajewski, K. J., 1979, Environmental history of Caribou Bog, Penobscot County, Maine: M.S. thesis, University of Maine at Orono, 22 p.

Hemond, H., 1980, Biogeochemistry of Thoreau's Bog, Concord, Massachusetts: Ecol. Monogr., v. 50, p. 507-526.

Jones, H. E., and Gore, A. J. P., 1978, A simulation of production and decay in a blanket bog: in O. W. Heal and D. F. Perkins, eds., Ecological Studies, v. 27, Springerverlag, Berlin, p. 160-186.

Jowsey, P. C., 1966, An improved peat sampler: New Phytol, v. 65, p. 245-248.

Kennedy, R. A., 1963, The relationships of maximum peat depth to some environmental factors in bogs and swamps in Maine: Maine Agricultural Experiment Station Bull. No. 620, University of Maine, 57 p.

Keys, D., 1981, A regional description and preliminary zonation of the peatlands in New Brunswick: Unpublished draft, March 1981, 29 p., Dept. of Natural Resources, Fredericton, N.B.

Korpijaakko, M., 1975, Studies on the hydraulic conductivity of peat: Ph.D. thesis, University of New Brunswick, N.B., Canada, 121 p.

Korpijaakko, M., 1981, A piston sampler for undisturbed peat samples: Suo, v. 32, p. 7-8.

Korpijaakko, M., Haikio, J., and Laino, J., 1981, Vasipitoisuudan ja maatuneisuuden vaikutus turpeen kuivatilavuuspainoon (Effect of water content and degree of humification on dry density of peat): Suo, v. 32, p. 39-43.

Lähde, E., 1969, Biological activity in some natural and drained peat soils with special reference to oxidation-reduction conditions: Acta Forestalia Fennica, v. 94, p. 1-69.

Lappalainen, E., 1980, Peat resource estimation; report on energy use of peat: United National conference on new and renewable sources of energy, 1981, Ministry of Trade and Industry of Finland, Helsinki, Annex 1, p. 14-23.

Lindholm, T., 1979, Annual height growth of some hummock mosses in southern Hame: Suo, v. 30, p. 13-16.

Lindholm, T., 1981, Growth rhythm of *Sphagnum fuscus* (Schimp.) Klinggr. in the Laaviosuo Bog, southern Finland: Suo, v. 32, p. 115-118.

Makila, M., 1980, Tutkimus Toholammin turvevarojan kayttokelpoisuudesta ja turpeen eri ominalsuuksien valisista riippuvuuksista (The peat resources of Toholampi municipality and their potential use both correlations between different peat factors): Geol. tutkimuslaitos, maaperaosasto, Raportti P 13.6/8015 p. 1-137, Espoo, Finland.

Mattson, S., and Koutler-Andersson, E., 1954, Geochemistry of a raised bog: Kungl. Lantbrukshogsk. Ann., v. 21, p. 321-366.

Nichols, W. J., Jr., Smath, J. A., and Adamik, J. T., 1984, Hydrologic data for the Great and Denbow Heaths in eastern Maine, October 1980 through September 1981: Maine Geol. Surv. Open-File No. 84-5, 43 p.

Osheyack, G., 1981, Net primary production and biomass of peatland vegetation in Shelburne, Vermont: M.S. thesis, University of Vermont, Burlington, 69 p.

Osvald, H., 1955, The vegetation of two raised bogs in northeastern Maine: Sv. Bot. Tidsskr., v. 49, p. 110-118.

Osvald, H., 1970, Vegetation and stratigraphy of peatlands in North America: Acta Univ. Upsaliensis Ser V:C, v. 1, p. 9-94.

Paivanen, J., 1969, The bulk density of peat and its determination: Silva Fennica, v. 3, p. 1-19.

Pakarinen, P., 1974, Development of vegetation after fire in continental raised bogs: Suo, v. 26, p. 1-4.

Pakarinen, P., 1978, Production and nutrient ecology of three *Sphagnum* species in southern Finnish raised bogs: Ann. Bot. Fennici, v. 15, p. 15-26.

Pakarinen, P., and Tolonen, K., 1977, On the growth-rate and dating of surface peat: Suo, v. 28, p. 19-24.

Reinikainen, A., 1976, How to study a mire ecosystem: Suo, v. 27, p. 9-18.

Reinikainen, A., 1981, Models as means in the investigation and use of mire-ecosystem: Suo, v. 32, p. 141-145.

Rosswall, T., 1974, Cellulose decomposition studies on the tundra: in A. J. Holding, O. W. Heal, S. F. Maclean, Jr., and P. Flanagan, eds., Soil Organisms and Decomposition in Tundra: Tundra Biome Steering Committee, Stockholm, p. 325-340.

Saimi, M., 1954, Investigation of the caloric values of peats in Finland: 1st International Peat Congress, Dublin, Ireland, Sectia B3, 9 p.

Scott, J. B., Korpijaakko, E. O., and Tibbetts, T. E. 1980, Development of conservation factors for expressing peat resource estimates: Symposium Papers, Peat as an Energy Alternative, Arlington, Virginia, Institute of Gas Technology, p. 37-49.

Silc, T., and Stanek, W., 1977, Bulk density estimation of several peats in northern Ontario using the von Post humification scale: Can. J. Soil Sci., v. 57, 75 p.

Silvola, J., and Hanski, I., 1979, Carbon accumulation in a raised bog: Oecologica (Berl.), v. 37, p. 285-295.

Sneddon, J. I., Farnstad, L., and Lackulich, L. M., 1971, Fiber content determination and the expression of results in organic soils: Can. J. Soil Sci., v. 51, p. 138-141.

Stuiver, M., 1970, Oxygen and carbon isotope ratios of fresh-water carbonates as climatic indicators: Jour, Geophys. Res., v. 75, p. 5247-5257.

Tolonen, K., 1968, Soiden kehityshistorian tutkimusmenetelmista. II. Turvekairoista (On methods used in studies of the peatland development. II. On the peat samplers): Suo, v. 18, p. 86-92.

Tolonen, K., 1973, On the rate and pattern of peat formation during the post-glacial time: Suo, v. 24, p. 83-88.

Tolonen, K., 1977, On dry matter accumulation and bulk density values in three South Finnish raised bogs: Suo, v. 28, p. 1-8.

Tolonen, K., 1979, Peat as a renewable resource: long-term accumulation rates in northeuropean mires: Proc. Intern. Symposium on Classification of Peat and Peatlands, International Peat Society, p. 282-296.

Tolonen, K., 1982, Usefulness of five common methods of determining the degree of decomposition in estimating the amount and energy content of fuel peat in Finland: Suo, v. 33, p. 133-142.

Tolonen, K., and Ijas, L., 1982, Comparison of two peat samplers used in estimating the dry peat yield in field inventories: Suo, v. 33, p. 33-42.

Tolonen, K., and Saarenmaa, L., 1979, The relationship of bulk density to three different measures of the degree of peat humification: Proc. Int. Symp. Classification of Peat and Peatlands, International Peat Society, p. 227-238.

Trefethen, J. M., and Bradford, R. B., 1944, Domestic fuel possibilities of Maine peat: Maine Geol. Surv. Bull. 1, 47 p.

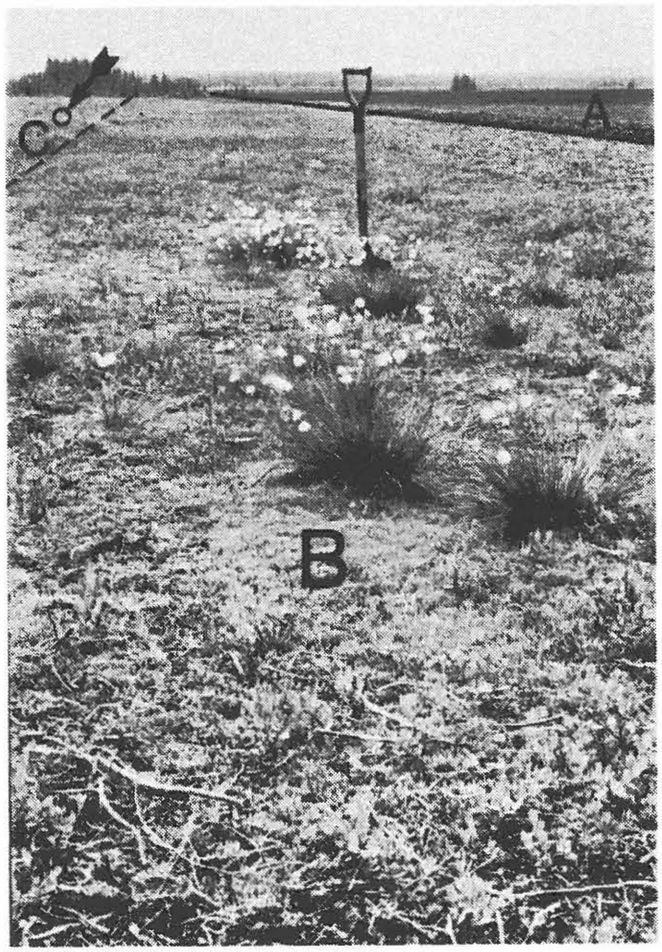
von Post, L., 1924, Das genetische System der organogenen Bildungen Schwedens: Comite Internat. d. Pedologie IV Comm. Nr. 22.

Worley, I., 1981, Maine Peatlands--Their Abundance, Ecology and Relevance to the Critical Areas Program: Maine State Planning Office, Planning Rpt. No. 76, 387 p.

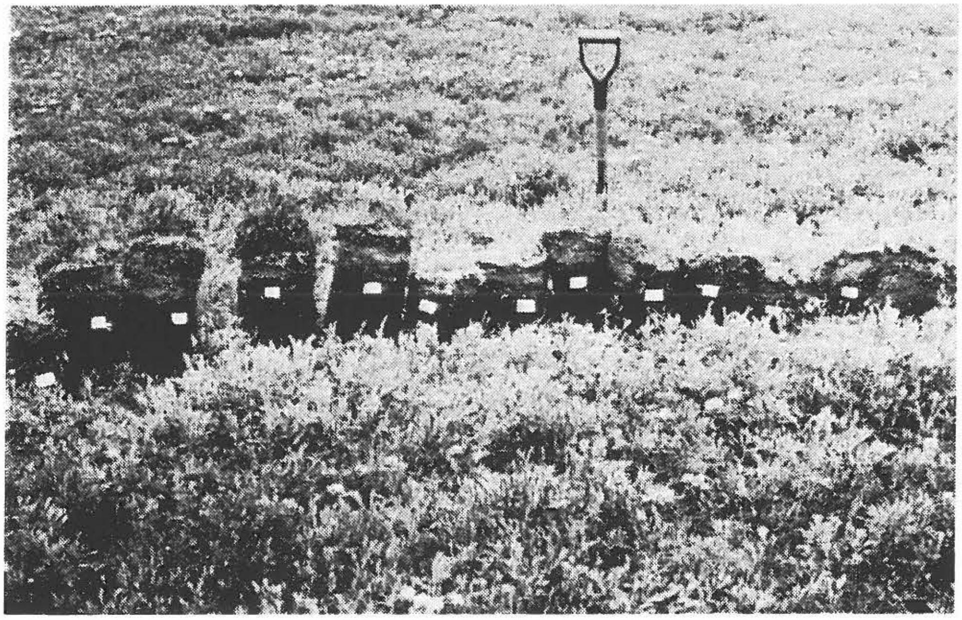
Zurek, S., 1976, The problem of growth of the Eurasian peatlands in the Holocene: Proc. 5th Int. Peat Congress, Poznan, Poland, v. 2, p. 99-122.

Appendix I.

Photographs of some of the peatlands studied and sites sampled.



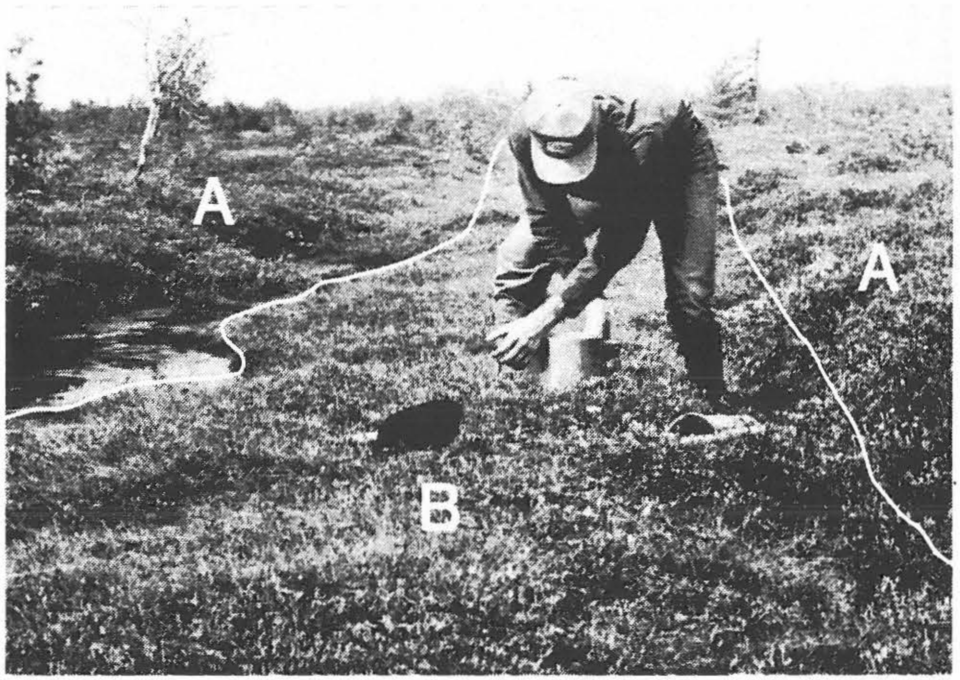
1 Dome at Denbo Heath, June 1981, showing recolonization by cottongrass, *Polystrichum strictum*, and dwarf shrubs two years after the mining of milled peat. Current mining (1981) is several meters to the right. Arrow and circle denote the sampling site shown in photos 2 and 3. A = mined in 1981; B = mined in 1978-79; C = last mined in 1952.



2

3

2 & 3 Dome area C at Denbo Heath (see photo 1), July 1981. Regrowth since last mining of peat in 1952 is shown in cores taken with an open steel cylinder (203 mm diam., photo 3). The 1952 junction is labelled with white pieces of paper in photo 2, and is clearly visible in photo 3.

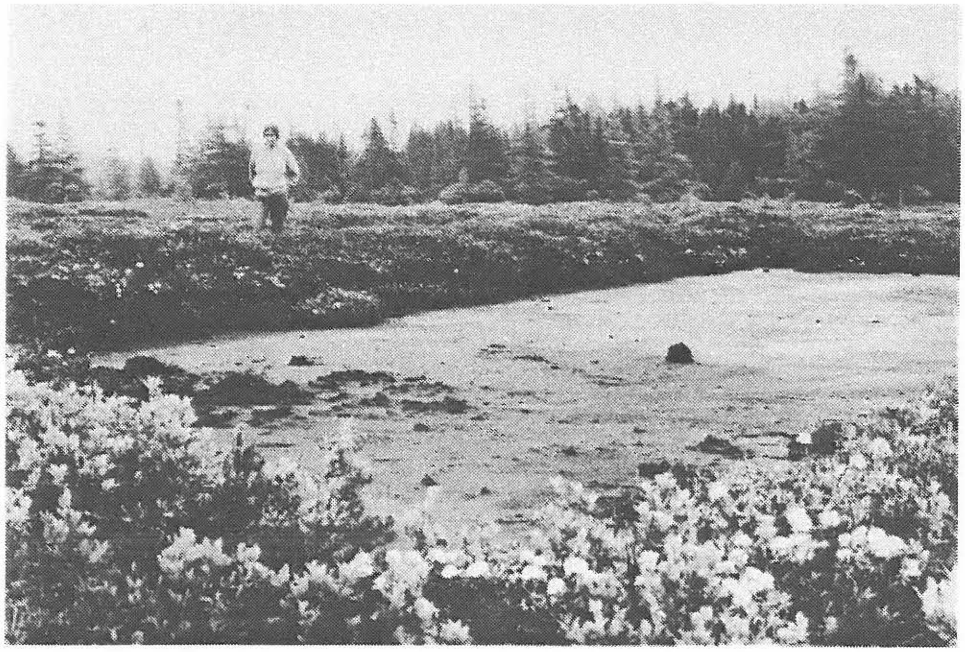


4 Denbo Heath coring site DII 1-5, June 1981. Areas A are unmined and now more or less undisturbed; area B was last mined around 1948-1950 and was cut down about a meter below the A surface. Field assistant Michael Routhier is shown taking a short core with the 203 mm diameter tube corer.

5 Project technician Lissa Widoff and field assistant Michael Routhier taking a long core from an unmined site at New England Peat Industries peatland site EP1, June 1981. A short core just taken can be seen on the left.

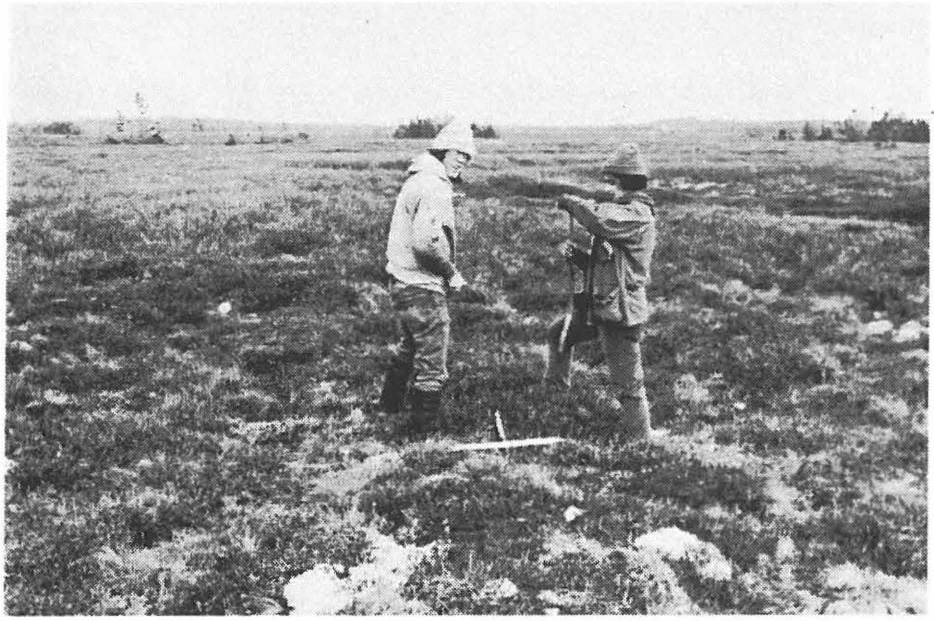
6 New England Peat Industries peatland, June 1981. A trench last mined about 10 years before shows regrowth in only very small areas. Conditions are unstable due to erosion by water and regelation.

7 New England Peat Industries peatland sites EP2A and EP2B, June 1981, at a wide trench last mined about 10 years ago. A short core is being taken by field assistant Michael Routhier and project technician Lissa Widoff to study regrowth since mining. Regrowth is restricted to the ends of the trench where erosion by running water has been weak. Area A is unmined; area B is the formerly mined trench, originally about a meter deep.

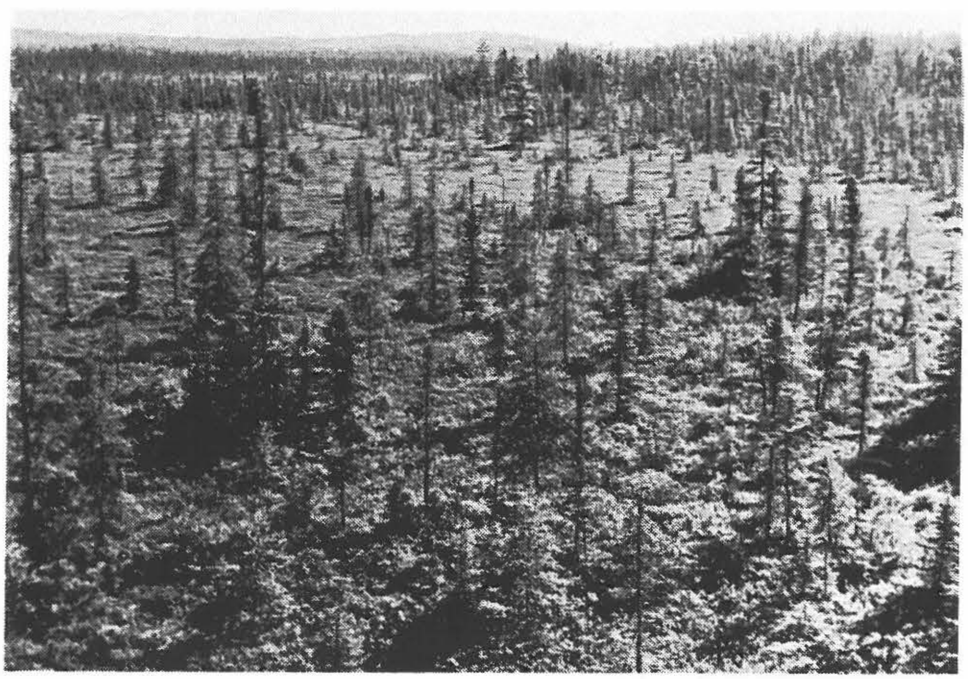


8 Jonesport Heath, July 1981. The conditions at this formerly mined site have been too unstable for the regrowth of peat-forming vegetation. At this site, rising methane bubbles may have contributed to the instability. Project technician Lissa Widoff stands beyond the old cutting.

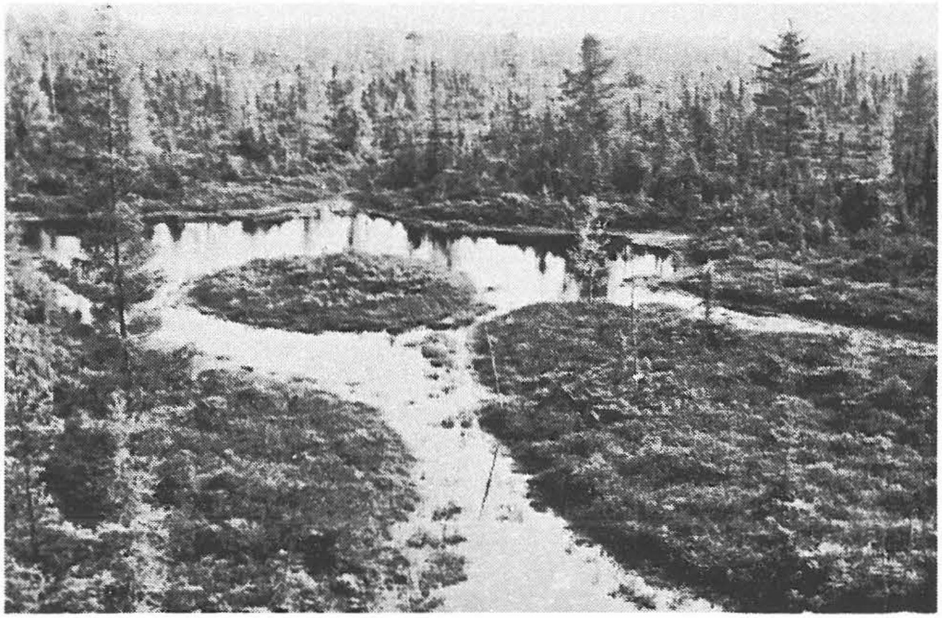
9 Jonesport Heath, June 1981. Regrowth of peat-forming plants is very weak or absent on almost all of the cut away depressions at this peatland, even on sites where mining ceased over 30 years before. The reasons for this lack of regrowth compared to the rapid regrowth at certain sites at Denbo Heath is unknown. Project technician Lissa Widoff stands to the right of the old cutting.



10 Project technician Lissa Widoff, assisted by Dennis Anderson, preparing a strip of pulp pieces for subsequent insertion into the Great Heath in November 1980 for study of decomposition. Cores GH1, GHD50, and GHT are from this site. White areas are *Cladonia* depressions, grey areas *Sphagnum fuscum* hummocks with some *S. flavicomans* and *S. imbricatum*.



11 Northern part of Caribou Bog, Fall 1979. Detailed studies come from several short and two long cores from surfaces like those in photo. The vegetation is very rich in vigorous dwarf shrubs apparently due to repeated bog fires during the last two centuries.



12 Caribou Bog, October 1980. Pools are rare at this bog and are concentrated in one area of the southern part. Most if not all of the pools are secondary in origin and are quite shallow in comparison with the total peat depth under them.

13 The location of long core CyB2 at Crystal Bog is marked in September 1980 by flagged rod in front and to the right of Sally Rooney. Two meters to the left and behind her is a *Sphagnum rubellum* - *S. tenellum* - *Rhychospora* hollow (site Cy2HO) where a core was taken. The peat below the small pond was cored in February, 1981. The pond was only 1 m deep and clearly secondary; hummock type peat was found some 1.5 m below the recent water surface.

Appendix II.

Pollen diagrams for three long cores. Percentages are based on the sum of all pollen. For Great Heath and Caribou Bog, the peat is described by standard symbols. ^{14}C dates with lab number and ^{14}C dates based on pollen zone correlations (see text) are given on the right. In parentheses with each ^{14}C date is the calendar year equivalent (Damon et al., 1972). For Caribou Bog, the top date (200 calendar years B.P.) is based on the known date of settlement and the beginning of forest clearance and agriculture in the region surrounding the bog; pollen of weeds begins just above this dated level.

COMMON ENGLISH NAMES FOR POLLEN TYPES LISTED IN THIS APPENDIX

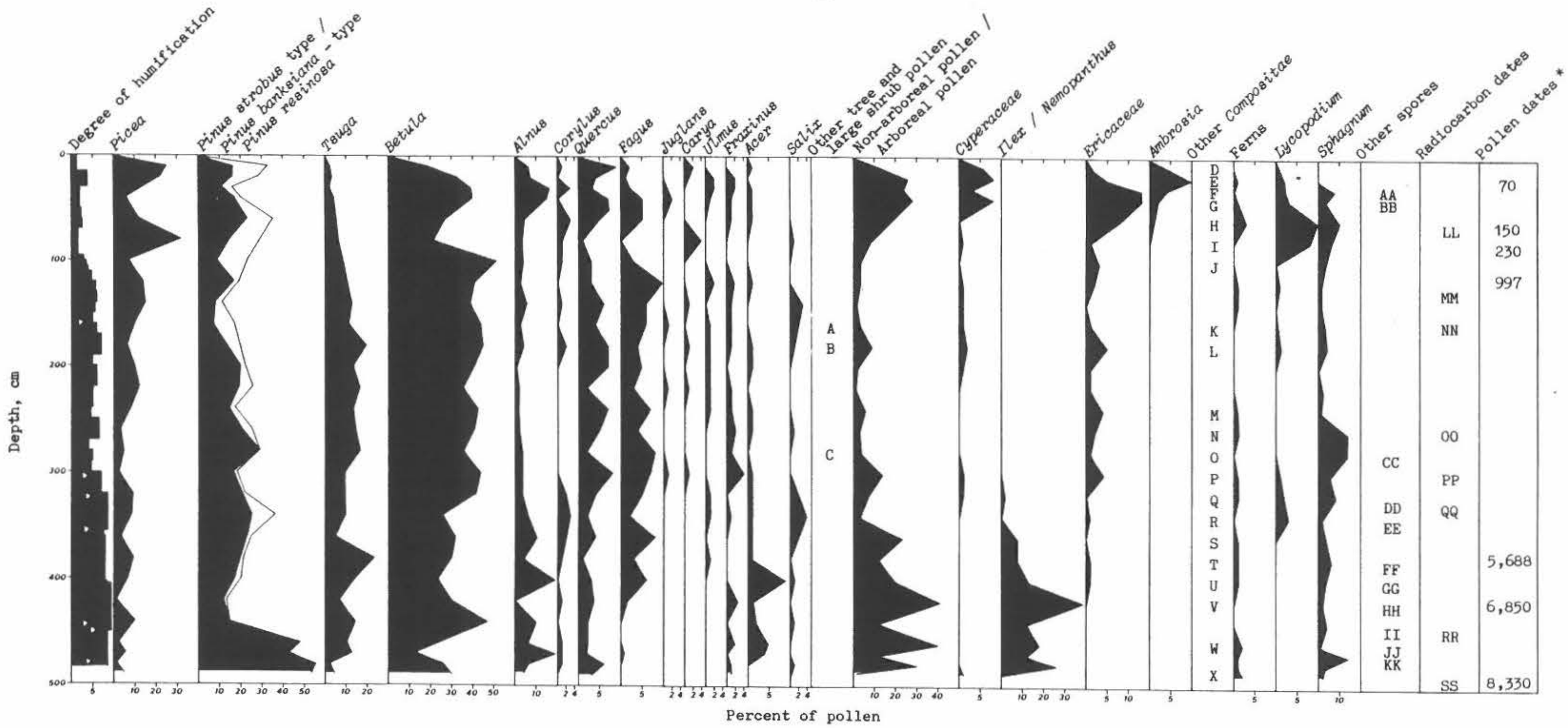
TREE AND LARGE SHRUB POLLEN

Latin Name	English Name
Picea	Spruce
Abies	Fir
Larix	Larch
Pinus strobus	White pine
Pinus banksiana	Jack pine
Pinus resinosa	Red pine
Tsuga	Hemlock
Juniperus	Juniper
Thuja	Cedar
Betula	Birch
Carpinus	Hornbeam
Ostrya	Hop-hornbeam
Alnus	Alder
Corylus	Hazel nut
Quercus	Oak
Fagus	Beech
Juglans	Walnut
Carya	Hickory
Ulmus	Elm
Fraxinus	Ash
Acer	Maple
Salix	Willow
Other Tree and Shrub Pollen	
Nyssa	Gum
Tilia	Basswood
Populus	Poplar
Cornus	Dogwood
Castanea	Chestnut

NON-ARBOREAL POLLEN AND SPORES

Latin Name	English Name
Gramineae	Grass family
Cerealea	Cereal group
Triticum	Wheat
Cyperaceae	Sedge family
Chenopodiaceae	Goosefoot family
Rumex	Dock, sorrel
Plantago	Plantain
Ilex	Holly
Nemopanthus	Mountain holly
Empetrum nigrum	Black crowberry
Ericaceae	Heath shrubs family
Ericales	Heath group
Ambrosia	Ragweed
Compositae	
Other Non-Arboreal Pollen	
Typha	Cattail
Umbelliferae	Parsley Family
Artemisia	Wormwood, sage (composite family)
Cruciferae	Mustard family
Menyanthes	Buckbean
Lemna	Duckweed
Myrica	Sweet gale
Iva	Marsh-elder
Myriophyllum	Water-milfoil
Polygonum	Smartweed family
Spores	
Pteridium	Bracken fern
Ferns	
Lycopodium	Clubmoss
Sphagnum	Sphagnum moss
Other Spores	
Osmunda	Fern
Bryales	Moss

Big Heath: Long Core BHP3



EXPLANATION

Other Tree and Large Shrub Pollen

A - *Nyssa* (1)
B - *Tilia* (1)
C - *Carpinus-Ostrya* (1)

Other Non-Arboreal Pollen

D - Other *Compositae* (1)
E - *Gramineae* (1)
Other *Compositae* (1)
Typha (1)
F - *Gramineae* (1)
Other *Compositae* (1)
Umbelliferae (1)
G - *Rumex* (1)
Gramineae (3)
Artimisia (1)
Umbelliferae (1)
H - *Gramineae* (2)
Rumex (1)
I - *Gramineae* (3)
Other *Compositae* (3)
J - *Chenopodiaceae* (1)
K - *Artemisia* (1)
Other *Compositae* (1)
L - *Gramineae* (1)
Other *Compositae* (1)
M - Other *Compositae* (2)
N - Other *Compositae* (2)
O - Other *Compositae* (3)
P - Other *Compositae* (9)
Q - Other *Compositae* (4)
R - Other *Compositae* (1)
S - Unknown (7)
Other *compositae* (7)
Cruciferae (4)
T - *Cruciferae* (4)
U - *Cruciferae* (5)
Other *Compositae* (2)
V - *Menyanthes* (1)
Crucifeae (1)
W - Other *Compositae* (1)
Menyanthes (1)
Cruciferae (1)
X - Other *Compositae* (1)

Other Spores

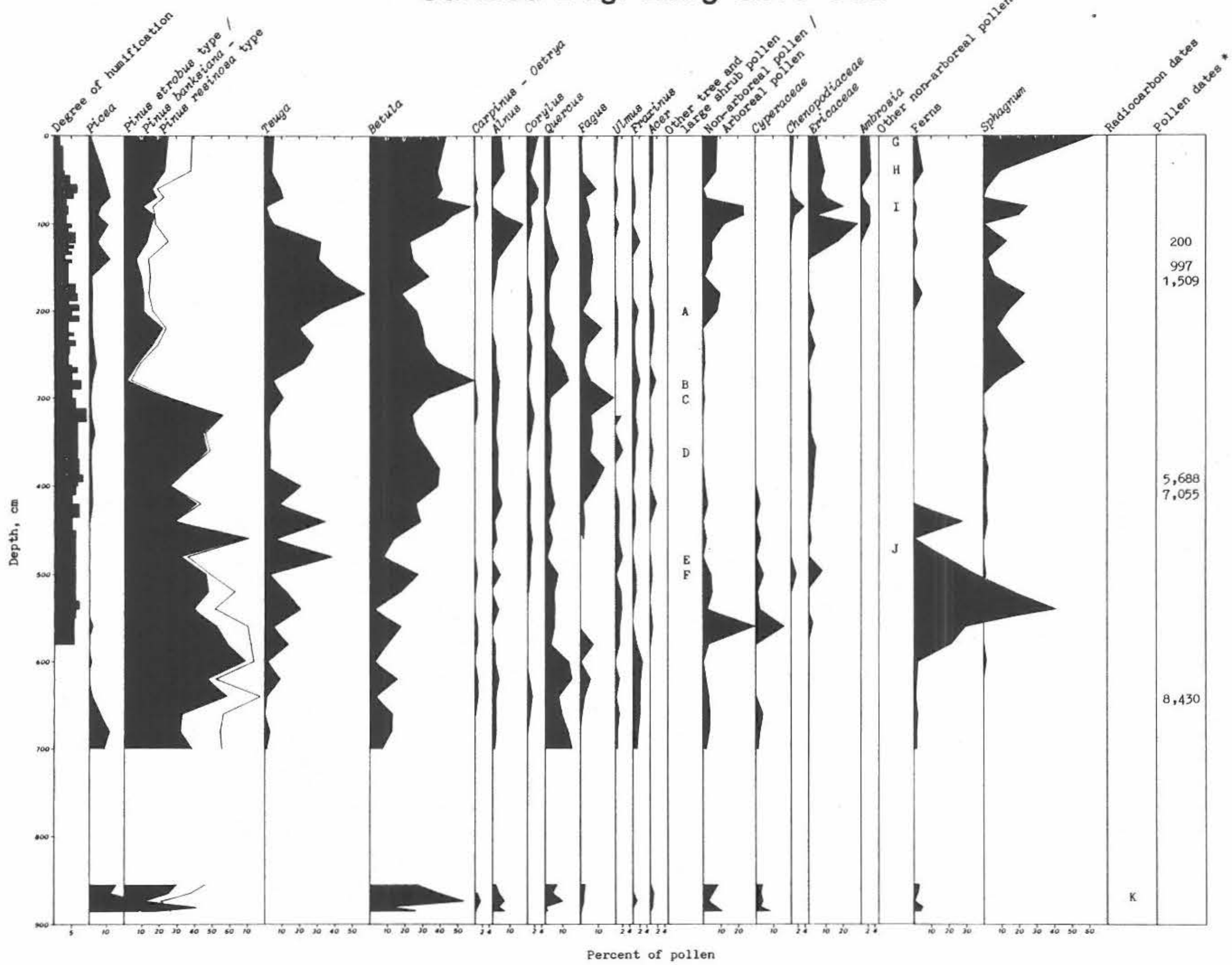
AA - *Pteridium* (1)
BB - *Pteridium* (1)
CC - *Pteridium* (1)
DD - *Pteridium* (1)
EE - *Osmunda* (1)
FF - *Osmunda* (4)
GG - *Pteridium* (1)
HH - *Osmunda* (4)
II - *Osmunda* (2)
JJ - *Osmunda* (3)
KK - *Osmunda* (3)

Radiocarbon Dates

LL - 70 ± 50 (175*)
SI-4802
MM - 220 ± 60 (309*)
SI-4803
NN - 875 ± 60 (888*)
SI-4804
OO - 1265 ± 55 (1261*)
SI-4805
PP - 2025 ± 65 (2094*)
SI-4806
QQ - 2580 ± 50 (2766*)
SI-4807
RR - 5810 ± 70 (6670*)
SI-4808
SS - 6565 ± 90 (7404*)
SI-4809

* Calendar years, before 1980

Caribou Bog: Long Core Ca2



EXPLANATION

Other Tree and Large Shrub Pollen

A - *Carya* (1)
B - *Juglans* (2)
Carya (1)
C - *Carya* (2)
D - *Populus* (1)
E - *Tilia* (1)
F - *Carya* (2)

Other Non-Arboreal Pollen

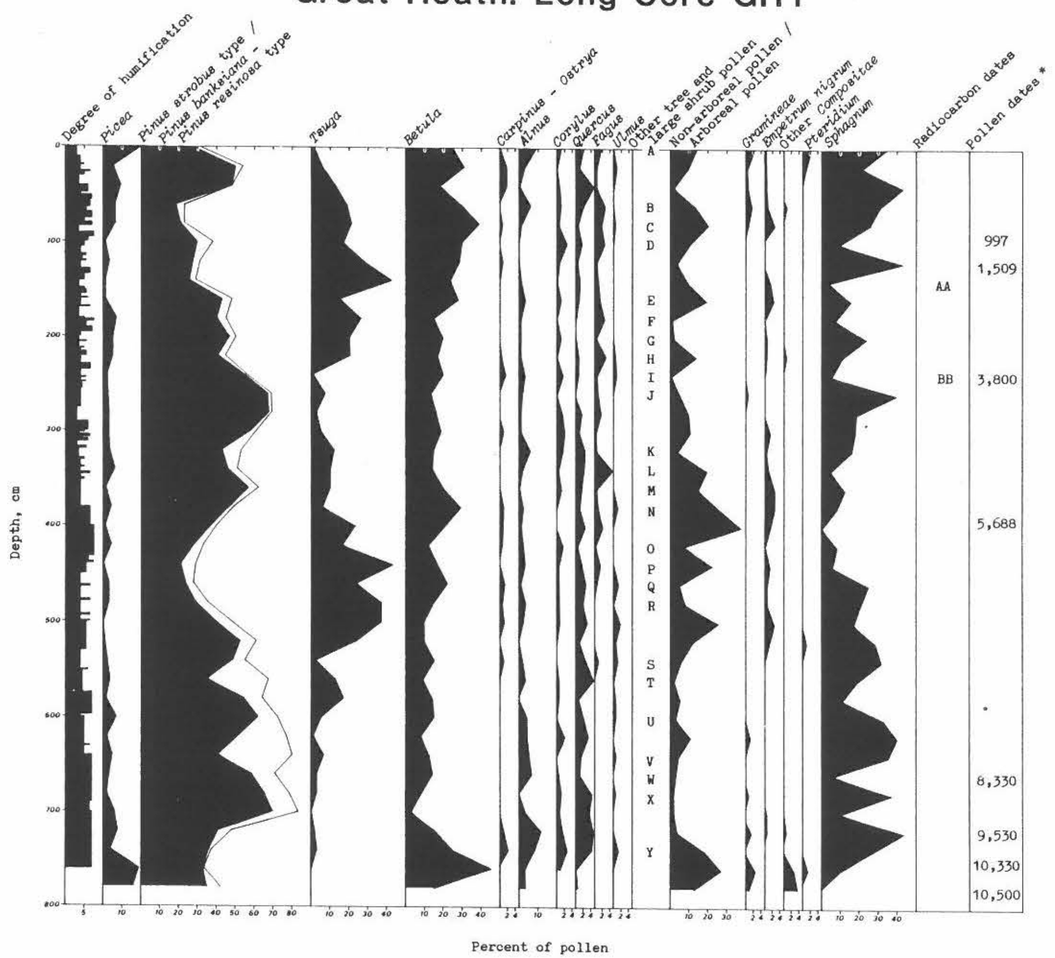
G - *Rumex* (1)
Chenopodiaceae (1)
Artemisia (1)
H - *Chenopod* (1)
I - *Rumex* (6.0)
Plantago (2)
Triticom
J - *Lemna* (29)

Radiocarbon Dates

K - 9425 ± 100 (9455*)
SI-4933

* Calendar years, before 1980

Great Heath: Long Core GH1



EXPLANATION

Other Tree and Large Shrub Pollen

A - *Carya* (1)
B - *Acer* (1)
C - *Acer* (1)
D - *Carya* (0.8)
E - *Acer* (1.7)
F - *Acer* (1.8)
G - *Fraxinus* (2)
H - *Acer* (2)
Carya (0.6)
I - *Carya* (4.5)
J - *Carya* (1)
K - *Acer* (1)
L - *Carya* (1)
M - *Tilia* (1)
N - *Acer* (1)
O - *Carya* (1)
Fraxinus (1)
P - *Fraxinus* (1)
Populus (1)
Q - *Acer* (1)
R - *Populus* (1)
S - *Carya* (1)
T - *Tilia* (1)
Acer (1)
U - *Carya* (1)
V - *Juglans* (1)
W - *Acer* (1)
X - *Carya* (1)
Y - *Carya* (2)

Radiocarbon Dates

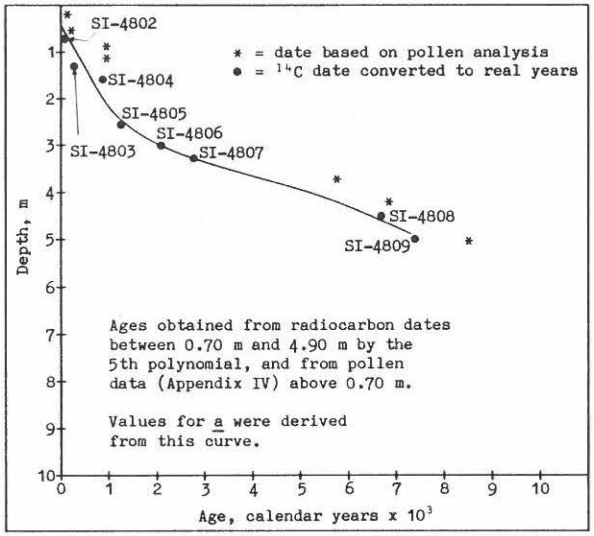
AA - 1525 ± 70 (1536*)
SI-4937
BB - 3795 ± 80 (4320*)
SI-4938

* Calendar years, before 1980

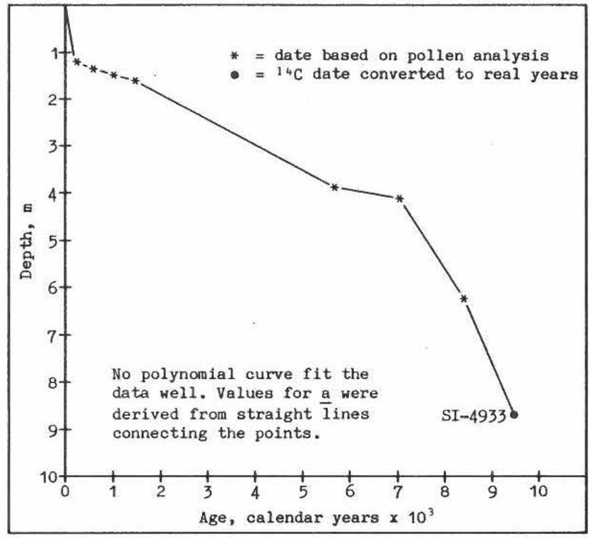
Appendix III.

Age-depth curves for Crystal Bog site CyB2, Crystal Fen site CyF1, Caribou Bog site Ca2, Great Heath site GH1, and Big Heath site BHP3. ^{14}C dates are indicated by laboratory number (see Table 1), dates based on pollen zone correlation by asterisks. All dates are converted to calendar years (see text).

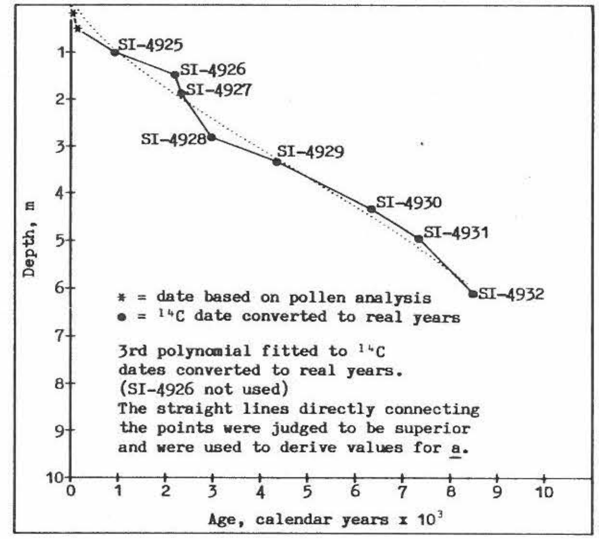
Big Heath: Long Core BHP3



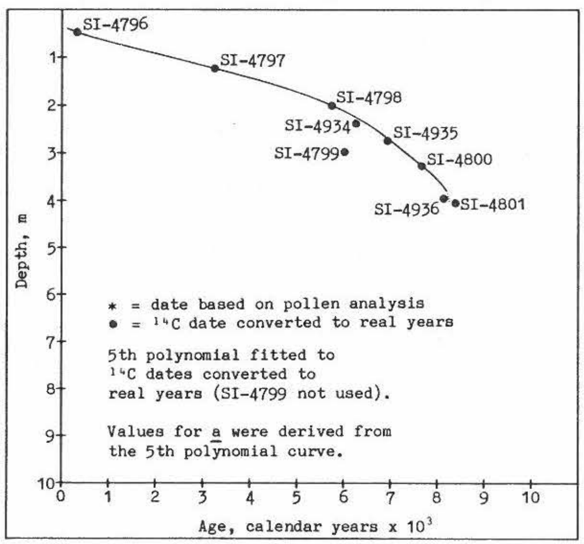
Caribou Bog: Long Core Ca2



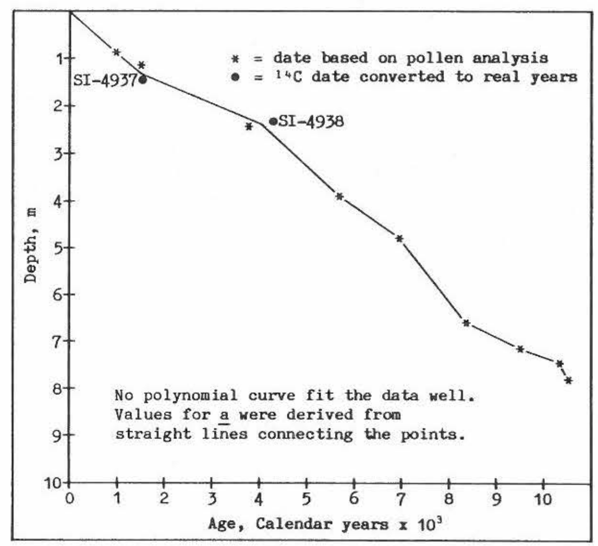
Crystal Bog: Long Core CyB2



Crystal Fen: Long Core CyF1



Great Heath: Long Core GH1



Appendix IV.

Pollen diagrams for eleven short cores. Percentages are based on the sum of all pollen. Dates based on known dates of settlement and beginnings of forest clearance and agriculture in the region surrounding the bog are given under "pollen dates". When dates are available (Appendix V), moss increment dates are also given.

COMMON ENGLISH NAMES FOR POLLEN TYPES LISTED IN THIS APPENDIX

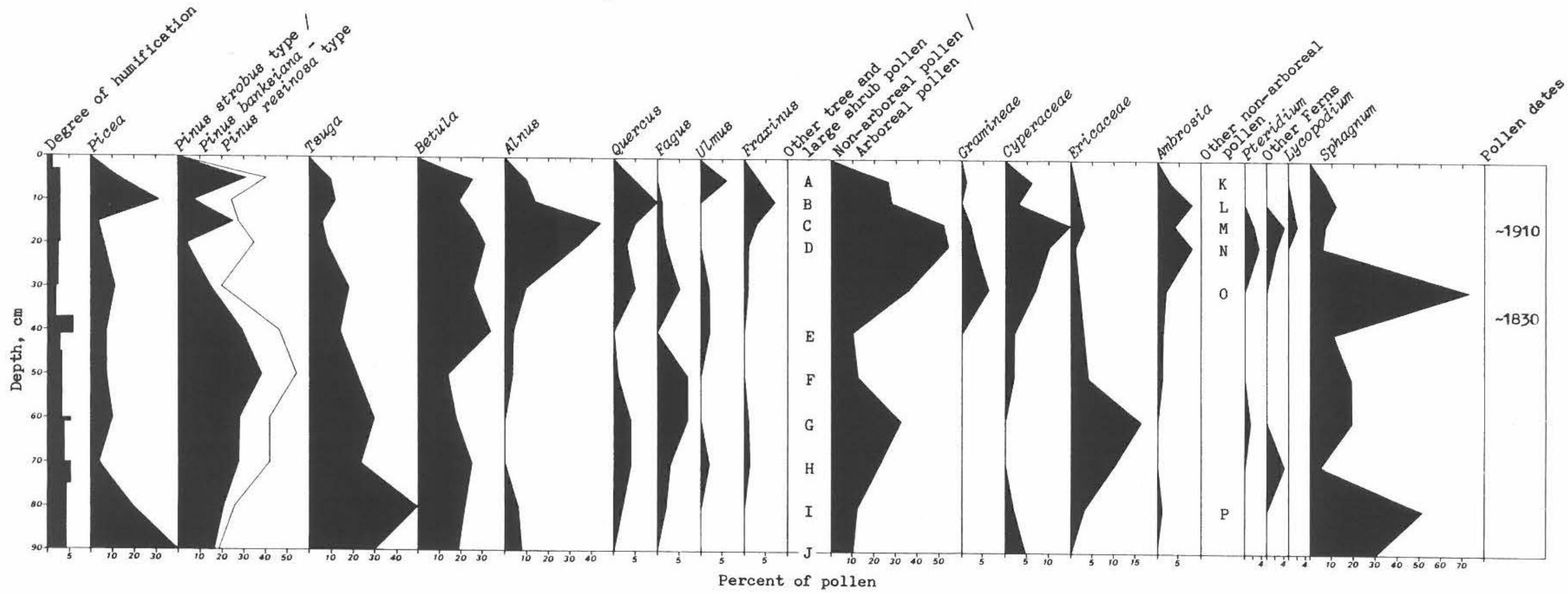
TREE AND LARGE SHRUB POLLEN

Latin Name	English Name
Picea	Spruce
Abies	Fir
Larix	Larch
Pinus strobus	White pine
Pinus banksiana	Jack pine
Pinus resinosa	Red pine
Tsuga	Hemlock
Juniperus	Juniper
Thuja	Cedar
Betula	Birch
Carpinus	Hornbeam
Ostrya	Hop-hornbeam
Alnus	Alder
Corylus	Hazel nut
Quercus	Oak
Fagus	Beech
Juglans	Walnut
Carya	Hickory
Ulmus	Elm
Fraxinus	Ash
Acer	Maple
Salix	Willow
Other Tree and Shrub Pollen	
Nyssa	Gum
Tilia	Basswood
Populus	Poplar
Cornus	Dogwood
Castanea	Chestnut

NON-ARBOREAL POLLEN AND SPORES

Latin Name	English Name
Gramineae	Grass family
Cerealea	Cereal group
Triticum	Wheat
Cyperaceae	Sedge family
Chenopodiaceae	Goosefoot family
Rumex	Dock, sorrel
Plantago	Plantain
Ilex	Holly
Nemopanthus	Mountain holly
Empetrum nigrum	Black crowberry
Ericaceae	Heath shrubs family
Ericales	Heath group
Ambrosia	Ragweed
Compositae	
Other Non-Arboreal Pollen	
Typha	Cattail
Umbelliferae	Parsley Family
Artemisia	Wormwood, sage (composite family)
Cruciferae	Mustard family
Menyanthes	Buckbean
Lemna	Duckweed
Myrica	Sweet gale
Iva	Marsh-elder
Myriophyllum	Water-milfoil
Polygonum	Smartweed family
Spores	
Pteridium	Bracken fern
Ferns	
Lycopodium	Clubmoss
Sphagnum	Sphagnum moss
Other Spores	
Osmunda	Fern
Bryales	Moss

Big Heath: Short Core BHHP



EXPLANATION

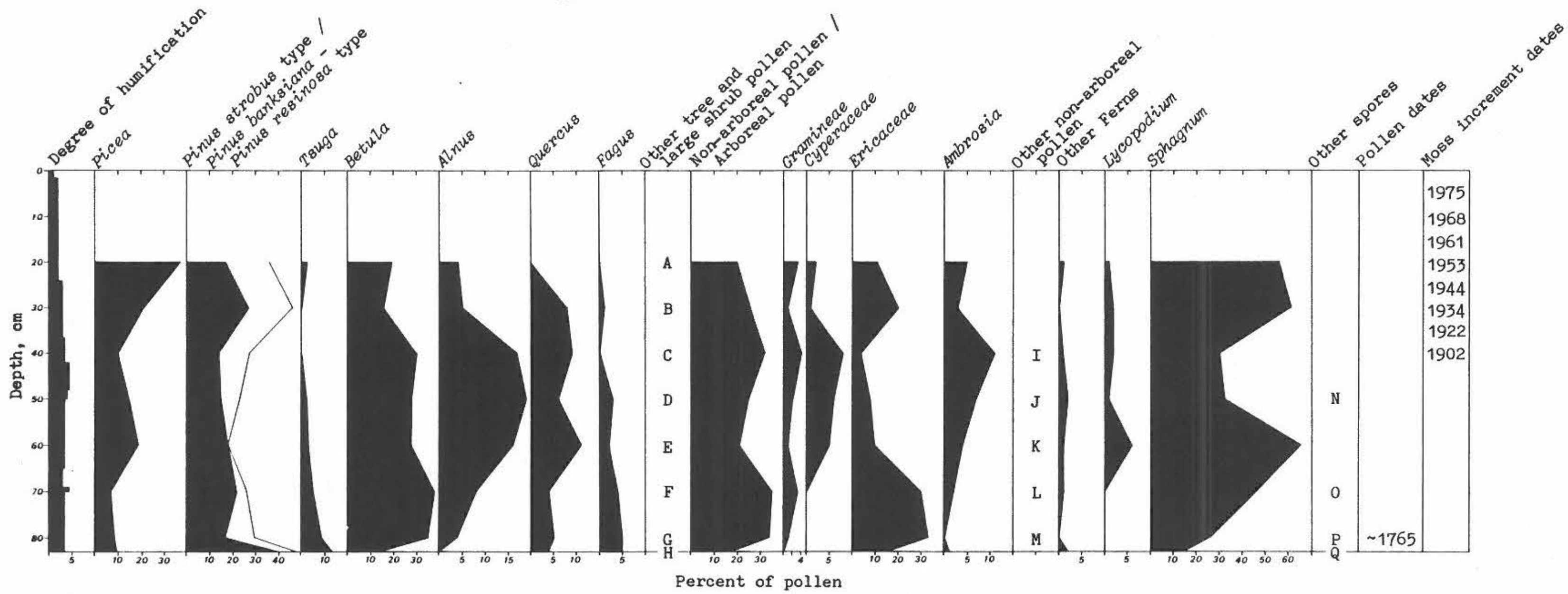
Other Tree and Large Shrub Pollen

A - *Thuja* (2)
B - *Salix* (1)
Abies (2)
C - *Corylus* (6)
D - *Populus* (1)
Corylus (1)
E - *Tilia* (1)
F - *Abies* (1)
Tilia (1)
Acer (1)
Carpinus-Ostrya (1)
G - *Corylus* (1)
Thuja (1)
H - *Carya* (2)
Acer (1)
Abies (1)
I - *Corylus* (1)
J - *Corylus* (2)

Other Non-Arboreal Pollen

K - Other *Compositae* (3)
L - Other *Compositae* (2)
M - *Cerealea* (2)
N - *Cerealea* (1)
Other *Compositae* (1)
Unknown (2)
O - Other *Compositae* (1)
P - *Umbelliferae* (1)

Big Heath: Short Core BHS1



EXPLANATION

Other Tree and Large Shrub Pollen

A - *Corylus* (2)
B - *Salix* (1)
C - *Ulmus* (1)
Salix (1)
Carya (3)
D - *Tilia* (1)
Corylus (2)
Carya (1)
E - *Juglans* (1)
Acer (2)
F - *Ulmus* (1)
Carpinus-Ostrya (2)
Fraxinus (1)
G - *Fraxinus* (1)
H - *Corylus* (1)
Fraxinus (1)
Ulmus (1)

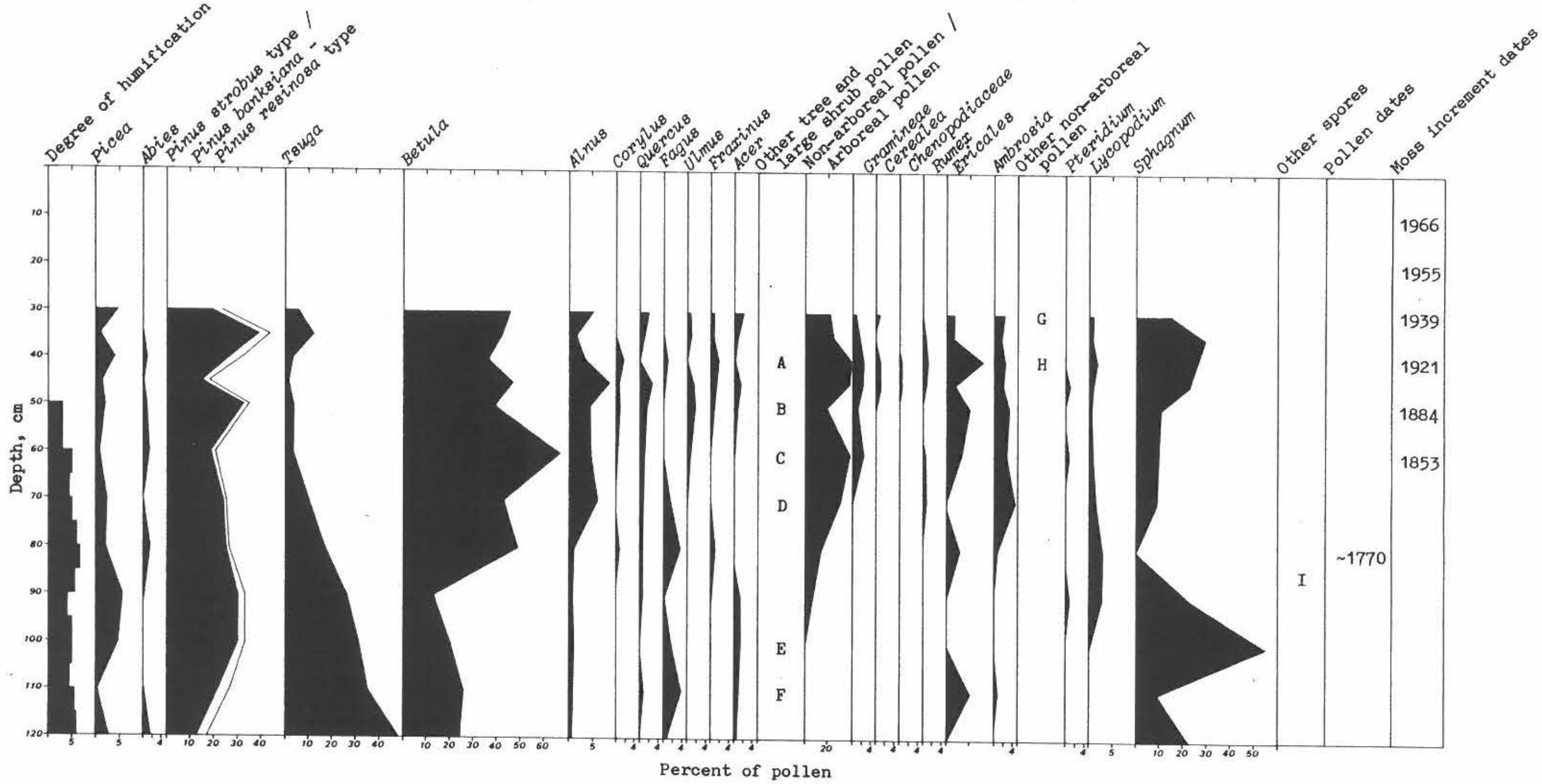
Other Non-Arboreal Pollen

I - Other *Compositae* (4)
Myrica (1)
J - Other *Compositae* (1)
Iva (1)
K - *Myrica* (1)
L - *Rumex* (1)
M - Other *Compositae* (1)

Other Spores

N - *Pteridium* (1)
O - *Pteridium* (1)
P - *Pteridium* (1)
Q - *Pteridium* (1)

Caribou Bog: Short Core Ca1 A-D/R



EXPLANATION

Other Tree and Large Shrub Pollen

A - *Thuja/Juniperus* (1)
Juglans (1)
Carya (1)
Populus (1)
Carya (2)
B - *Castanea* (1)
C - *Carya* (1)
D - *Carya* (1)
Juglans (1)
Tilia (1)
Carpinus-Ostrya (1)
E - *Juglans* (1)
F - *Carpinus-Ostrya* (1)

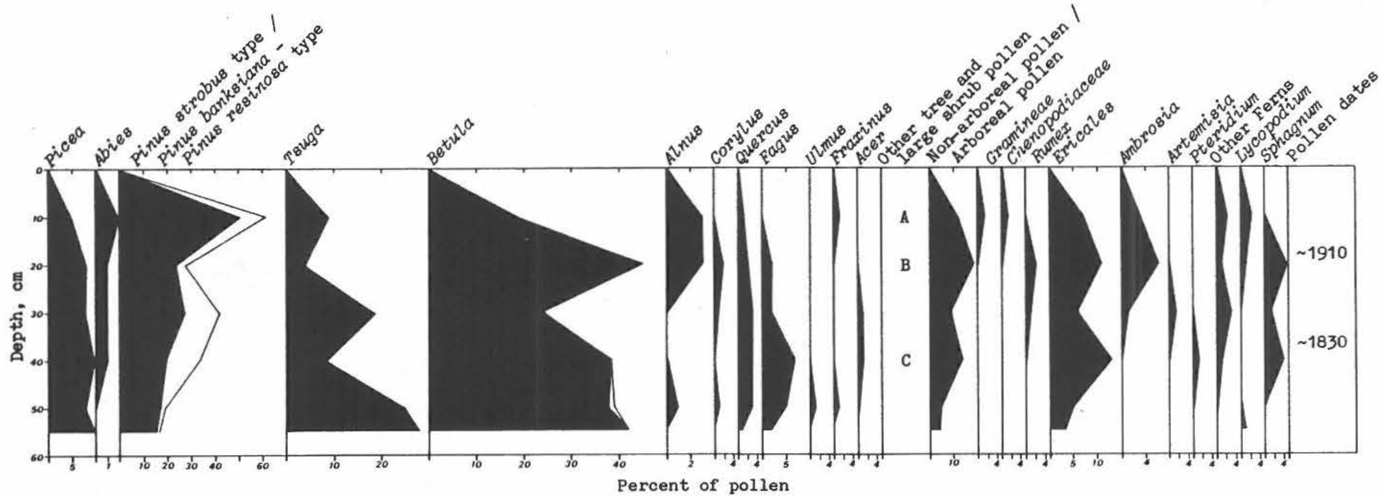
Other Non-Arboreal Pollen

G - *Polygonum* (.9)
H - *Polygonum* (.9)

Other Spores

I - *Bryales* (24.1)

Crystal Bog: Short Core CyC

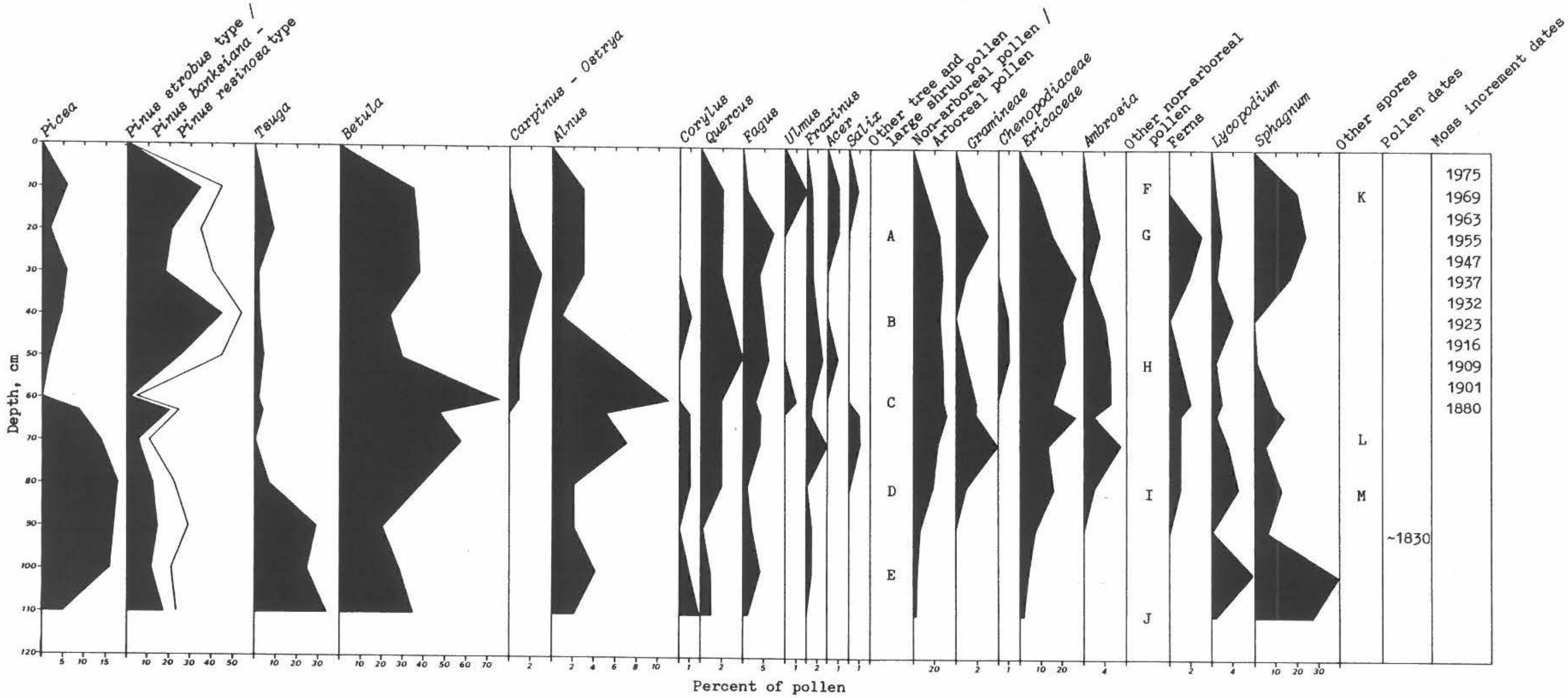


EXPLANATION

Other Tree and Large Shrub Pollen

A - *Carpinus-Ostrya* (1)
B - *Carpinus-Ostrya* (1)
Unknown (1)
Populus (2)
Carya (1)
C - *Populus* (1)
Unknown (1)

Crystal Bog: Short Core CyHH



EXPLANATION

Other Tree and Large Shrub Pollen

A - *Juglans* (1)
Tilia (1)
B - *Carya* (1)
Juglans (1)
C - *Populus* (4)
D - *Abies* (2)
E - *Abies* (1)

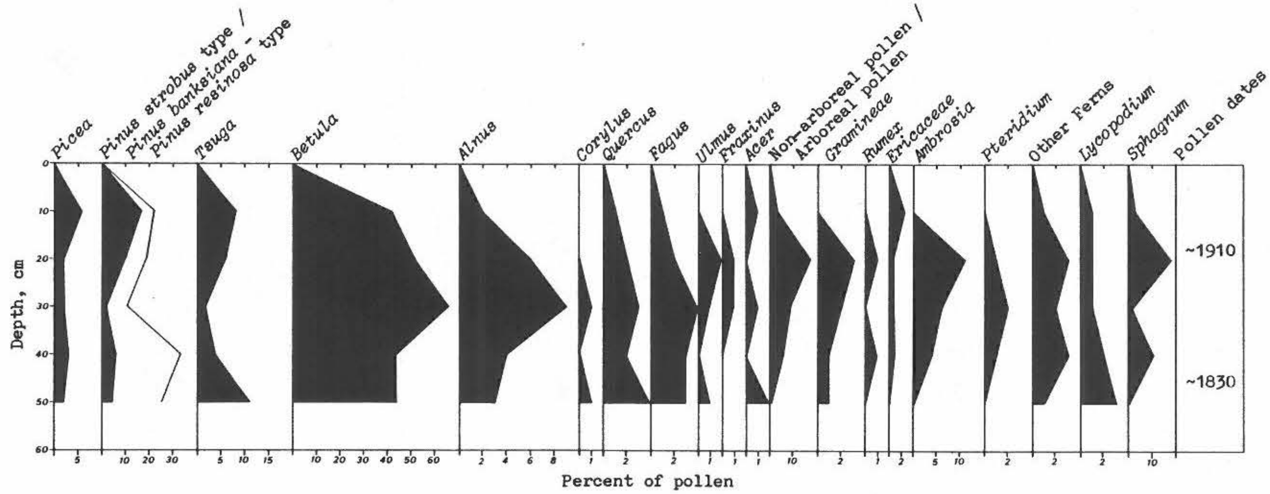
Other Non-Arboreal Pollen

F - *Cyperaceae* (1)
Rumex (1)
G - *Cyperaceae* (2)
H - Other *Compositae* (1)
I - Other *Compositae* (1)
J - Other *Compositae* (1)

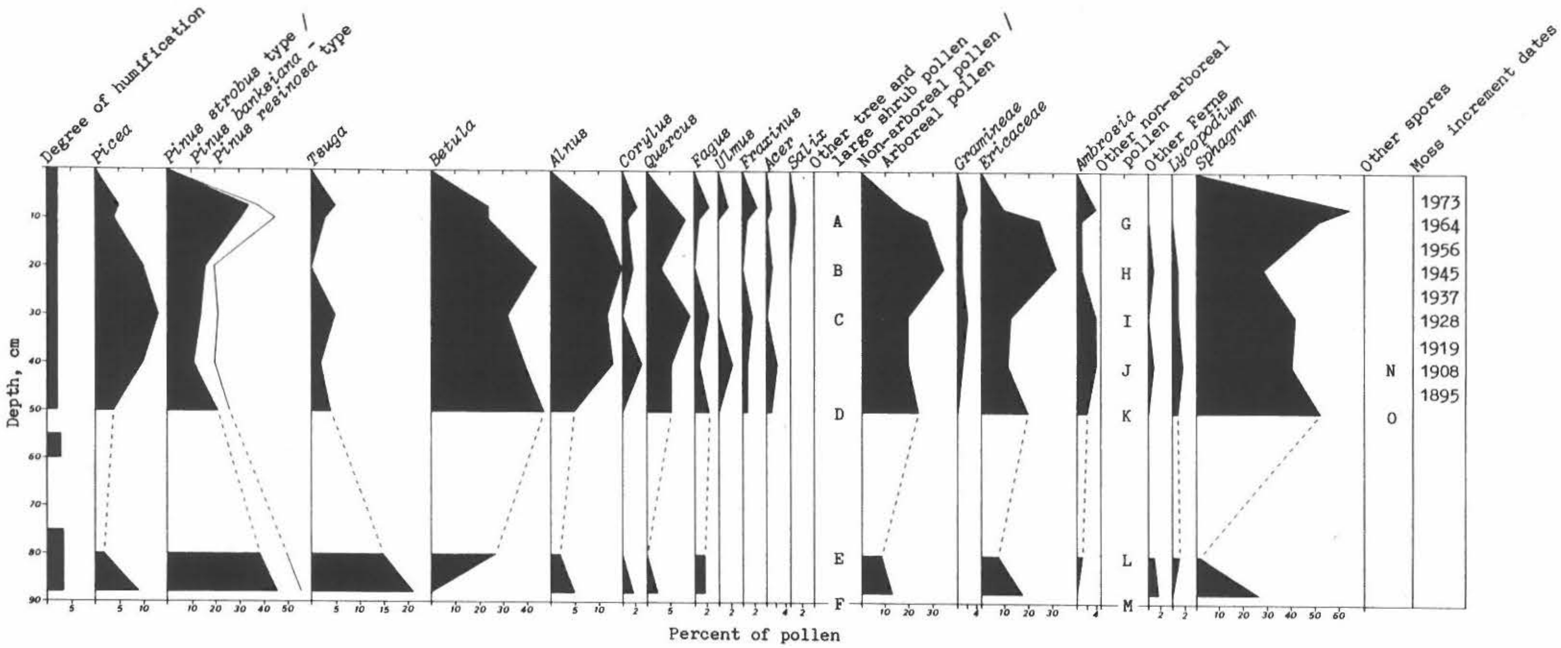
Other Spores

K - *Bryales* (1)
L - *Pteridium* (1)
M - *Pteridium* (1)

Crystal Bog: Short Core Cy2HO



Great Heath: Short Core GH1A



EXPLANATION

Other Tree and Large Shrub Pollen

A - *Carya* (1)
Juglans (1)
B - *Carya* (1)
Juglans (1)
Abies (1)
C - *Juglans* (2)
D - *Carpinus-Ostrya* (2)
E - *Carpinus-Ostrya* (1)
F - *Abies* (2)
Populus (1)

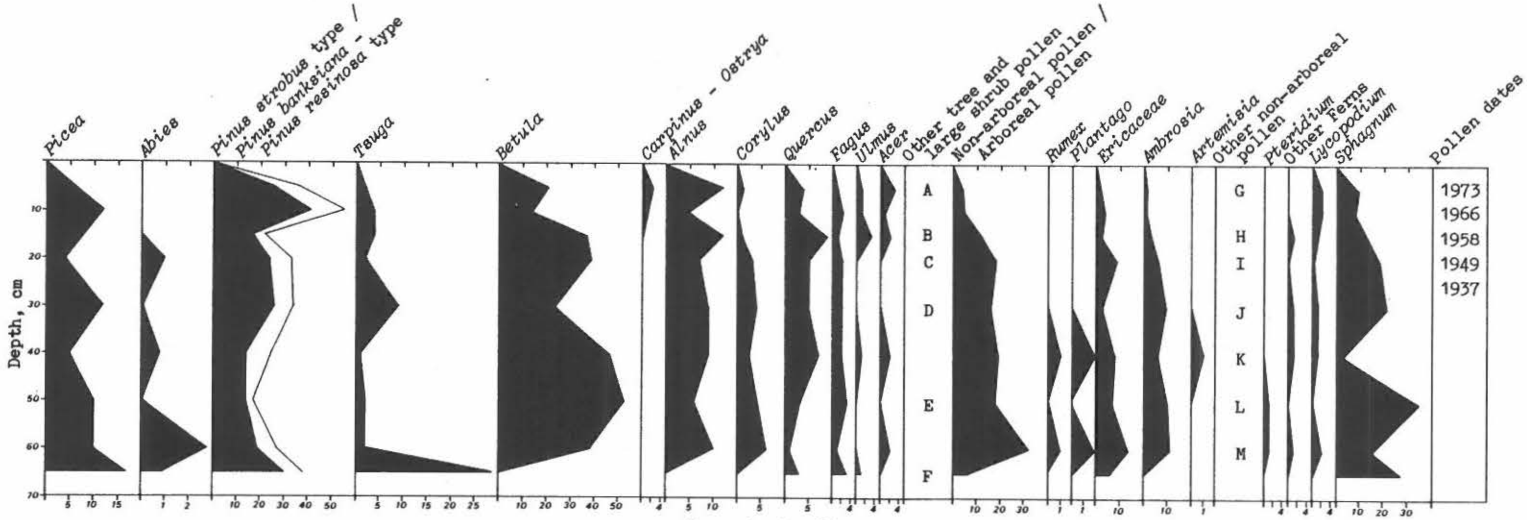
Other Non-Arboreal Pollen

G - *Cyperaceae* (2)
H - Other *Compositae* (1)
Chenopodiaceae (1)
I - *Artemisia* (1)
J - Other *Compositae* (1)
Cyperaceae (1)
Polygonum (2)
K - *Polygonum* (2)
L - Other *Compositae* (1)
M - *Empetrum nigrum* (2)

Other Spores

N - *Pteridium* (1)
O - *Pteridium* (1)

Great Heath: Short Core GH1B



EXPLANATION

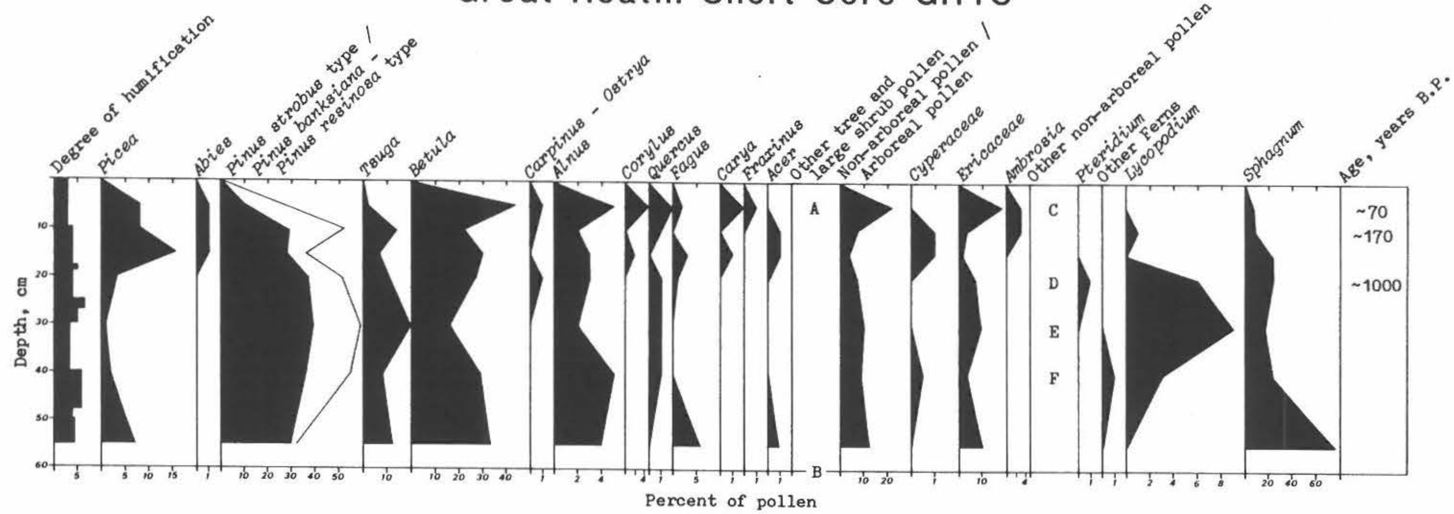
Other Tree and Large Shrub Pollen

A - *Fraxinus* (2)
B - *Fraxinus* (2)
C - *Fraxinus* (1)
Juglans (1)
Cornus (1)
D - *Juglans* (1)
E - *Carya* (1)
F - *Larix* (1)

Other Non-Arboreal Pollen

G - Other *Compositae* (1)
H - *Gramineae* (2)
Other *Compositae* (3)
Cyperaceae (2)
I - Other *Compositae* (3)
Gramineae (1)
J - *Gramineae* (1)
Other *Compositae* (3)
K - *Empetrum nigrum* (1)
Other *Compositae* (1)
L - *Gramineae* (1)
M - *Gramineae* (2)
Cerealea (2)
Unknown (2)
Other *Compositae* (1)

Great Heath: Short Core GH1C



EXPLANATION

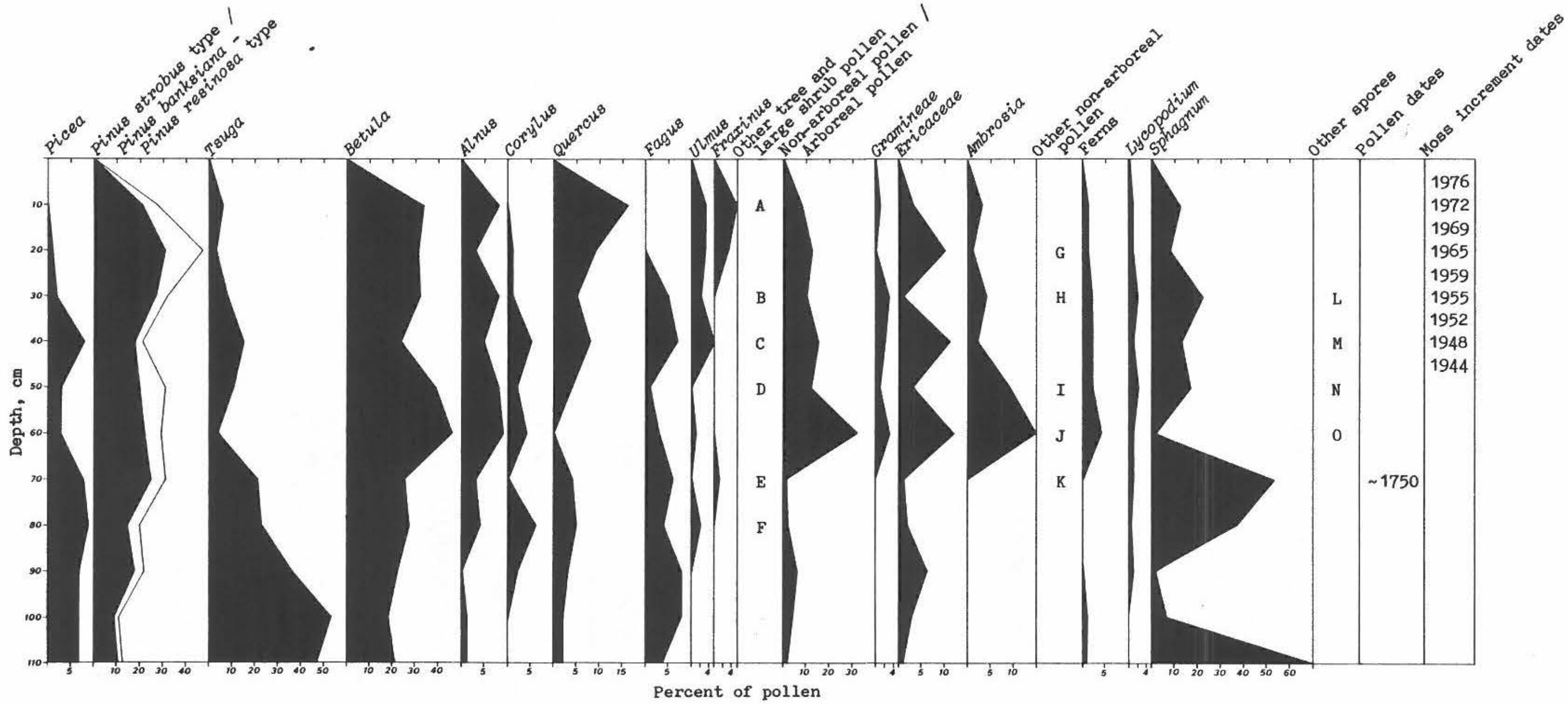
Other Tree and Large Shrub Pollen

A - *Larix* (1)
B - *Ulmus* (1)
Juglans (1)

Other Non-Arboreal Pollen

C - *Gramineae*
Empetrum (2)
D - Unknown (1)
E - Unknown (1)
Artemisia (1)
F - *Typha* (7)

Sidney Bog: Short Core SB1



EXPLANATION

Other Tree and Large Shrub Pollen

A - *Salix* (2)
B - *Salix* (1)
Acer (1)
Juglans (2)
Carya (1)
C - *Juglans* (2)
Salix (1)
D - *Tilia* (1)
E - *Carya* (1)
Salix (1)
F - *Salix* (1)

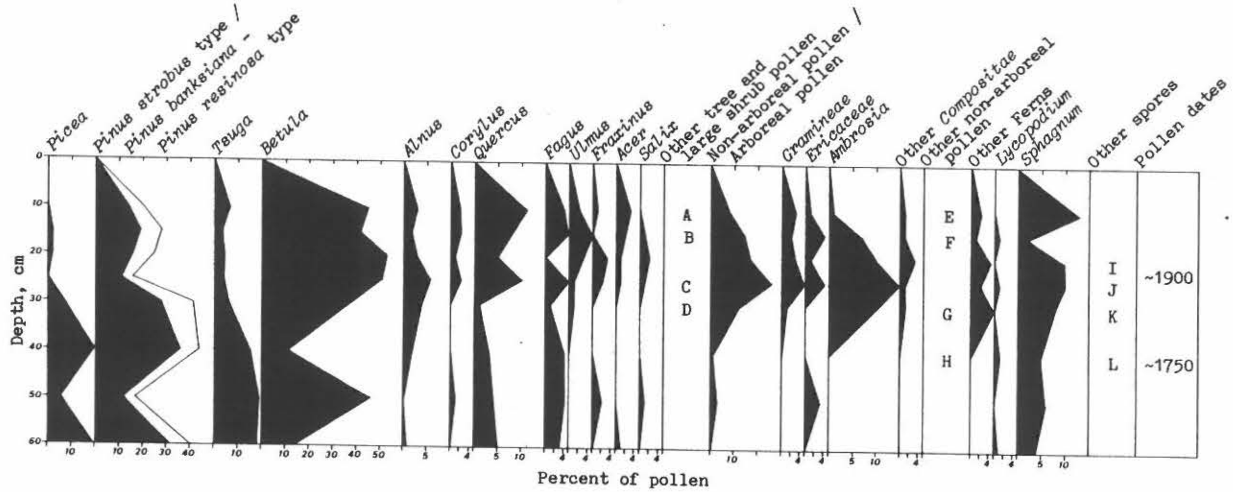
Other Non-Arboreal Pollen

G - Other *Compositae* (1)
H - Other *Compositae* (3)
I - *Cyperaceae* (1)
J - *Myriophyllum* (1)
Other *Compositae* (1)
Cyperaceae (1)
K - *Myriophyllum*

Other Spores

L - *Pteridium* (1)
M - *Pteridium* (1)
N - *Pteridium* (1)
O - *Pteridium* (1)

Sidney Bog: Short Core SB2



EXPLANATION

Other Tree and Large Shrub Pollen

A - *Juglans* (2)
B - *Juglans* (2)
C - *Carya* (1)
D - *Carya* (1)

Other Non-Arboreal Pollen

E - *Cyperaceae* (1)
F - Unknown (1)
G - *Artemisia* (1)
H - *Umbelliferae* (1)

Other Spores

I - *Pteridium* (1)
J - *Pteridium* (4)
K - *Pteridium* (2)
L - *Pteridium* (1)

Appendix V.

Moss increment dates, vertical accumulation rates ($\underline{a}$ = mm · yr^{-1}), bulk densities (D_b = mg · cm^{-3}), and net accumulation rates (A = g · m^{-2} · yr^{-1}) in short cores. Around 30 stems and increments were counted for each section (i.e., for each depth interval, for instance 5-15 cm).

Peatland & core number: BHS1 Core length: 50 cm Corer type: 203 mm Description: hummock Water Table 53cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cumulative yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	18.0		5.33 +,-1.20	5.3 +,-1.2	9.4 +,-2.1	219 +,-49		
5-10	23.9		6.84 +,-1.86	12 +,-2.2	7.3 +,-2.0	175 +,-47		
10-12.5	27.4		3.78 +,-0.88	16 +,-2.4	6.6 +,-1.5	181 +,-42		
12.5-15	26.8		3.13 +,-0.42	19 +,-2.4	8.0 +,-1.2	214 +,-32		
15-17.5	33.1		3.91 +,-0.53	23 +,-2.5	6.4 +,-1.0	211 +,-29		
17.5-20	24.3		4.09 +,-0.90	27 +,-2.6	6.1 +,-1.3	148 +,-33		
20-22.5	24.8		4.02 +,-0.88	31 +,-2.8	6.2 +,-1.4	154 +,-34		
22.5-25	24.0		4.93 +,-0.55	36 +,-2.8	5.1 +,-0.6	122 +,-14		
25-27.5	24.0		4.78 +,-0.53	41 +,-2.9	5.2 +,-0.6	125 +,-14		
27.5-30	21.1		5.10 +,-2.36	46 +,-3.7	4.9 +,-2.3	103 +,-48		
30-32.5	24.6		6.00 +,-1.31	52 +,-3.9	4.2 +,-0.9	103 +,-22		
32.5-35	27.7		6.50 +,-1.42	58 +,-4.2	3.8 +,-0.8	107 +,-22		
35-37.5	32.0			67		98		
37.5-40	27.6			78		63		
40-42.5	41.0					<82		
42.5-45	40.0					<80		
45-47.5	37.0					<74		
47.5-50	32.0					<64		

Peatland & core number: CalA-D/R Core length: 65 cm Corer type: Damman Description: hummock Water Table 58cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	19.7		6.55 +,-1.30	6.5 +,-1.3	7.6 +,-1.5	150 +,-30		
5-10	19.4		7.13 +,-1.18	14 +,-1.8	7.0 +,-1.2	136 +,-23		
10-12.5	18.9		4.00 +,-0.66	18 +,-1.9	6.3 +,-1.0	118 +,-20		
12.5-15	21.2		3.28 +,-0.53	21 +,-1.9	7.6 +,-1.2	162 +,-26		
15-17.5	19.3		4.32 +,-0.59	25 +,-2.0	5.8 +,-0.8	112 +,-15		
17.5-20	18.6		3.58 +,-0.68	29 +,-2.1	7.0 +,-1.3	130 +,-25		
20-22.5	20.2		4.70 +,-0.86	34 +,-2.3	5.3 +,-1.0	108 +,-20		
22.5-25	21.5		4.17 +,-0.56	38 +,-2.4	6.0 +,-0.8	129 +,-17		
25-27.5	17.7		3.53 +,-0.54	41 +,-2.4	7.1 +,-1.1	125 +,-20		
27.5-30	21.8		4.11 +,-0.83	45 +,-2.6	6.1 +,-1.2	133 +,-27		
30-32.5	18.3		4.89 +,-0.74	50 +,-2.7	5.1 +,-0.8	94 +,-14		
32.5-35	15.2		4.23 +,-0.72	56 +,-2.8	5.9 +,-1.0	90 +,-15		
35-37.5	13.3		4.23 +,-0.72	59 +,-2.9	5.9 +,-1.0	79 +,-13		
37.5-40	16.4		4.44 +,-0.75	63 +,-3.0	5.6 +,-1.0	92 +,-16		
40-42.5	20.8		4.46 +,-0.76	68 +,-3.1	5.6 +,-1.0	117 +,-20		
42.5-45	21.5		8.46 +,-1.33	76 +,-3.3	3.0 +,-0.4	63 +,-10		
45-47.5	15.8		9.50 +,-1.55	86 +,-3.7	2.6 +,-0.4	42 +,- 5		
47.5-50	21.5		10.0 +,-2.00	96 +,-4.2	2.5 +,-0.5	54 +,-11		
50-52.5	22.1		8.50 +,-1.70	104 +,-4.5	2.9 +,-0.6	65 +,-13		
52.5-55	22.1		7.00 +,-1.40	111 +,-4.7	3.6 +,-0.7	79 +,-36		
55-57.5	58.4		16.0 +,-3.20	127 +,-5.7	1.6 +,-0.3	91 +,-38		
57.5-60	48.4		*	150				
60-65	45.8		*	185 or more				

*Moss stems too horizontal for dating.

Peatland & core number: CalB   Core length: 50 cm   Corer type: T-corer   Description: hummock   Water Table 60cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	16.2		5.22 +,-0.86	5 +,-0.9	9.6 +.-1.6	155 +,-26		
5-10	19.4		6.50 +,-1.07	12 +,-1.4	7.7 +,-1.3	150 +,-25		
10-15	21.4		7.38 +,-1.20	20 +,-1.8	6.8 +,-1.1	145 +,-24		
15-20	25.1		6.70 +,-1.22	26 +,-1.8	7.5 +,-1.4	187 +.-34		
20-25	30.1		8.63 +,-1.57	34 +,-2.4	5.8 +.-1.1	174 +.-32		
25-30	28.2		9.96 +,-1.20	44 +,-2.7	5.0 +,-0.7	142 +,-19		
30-35	28.6		9.47 +,-1.33	54 +,-3.0	5.3 +.-0.8	151 +,-22		
35-40	28.2		11.89 +,-1.68	66 +,-3.4	4.2 +,-0.6	119 +.-17		
40-42.5	56.3		*SH 2.5-3,AC&Mag&DS	>75				
42.5-45	40.2		S AC H3	>95				
45-50	39.7							

*Moss stems too horizontal for dating.

Peatland & core number: Ca2   Core length: 95 cm   Corer type: 203 mm   Description: hummock   Water Table 48cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	23.1		6.91 +,-0.78	7 +,-0.8	7.2 +,-0.8	167 +,-21		
5-10	20.1		5.77 +,-1.08	13 +,-1.3	8.7 +,-1.6	174 +,-33		
10-15	17.7		6.21 +,-1.09	19 +,-1.7	8.0 +,-1.4	143 +,-25		
15-20	19.3		7.27 +,-1.50	26 +,-2.3	6.9 +,-1.2	133 +,-27		
20-25	17.6		7.09 +,-1.21	33 +,-2.6	7.0 +.-1.2	124 +,-30		
25-30	19.0		7.15 +,-1.01	40 +,-2.8	7.0 +,-1.0	133 +,-19		
30-35	21.0		6.43 +,-0.71	47 +,-2.9	7.8 +,-0.9	163 +,-18		
35-40	22.4		6.95 +,-1.00	54 +,-3.0	7.2 +,-1.0	161 +,-23		
40-42.5	29.2		7.28 +,-2.06	61 +,-3.7	6.9 +,-1.9	200 +,-57		
42.5-45	29.5		11.36 +,-3.21	72 +,-4.9	4.4 +,-1.2	130 +,-37		
45-47.5	29.3		*SH3	~85-90	1.4	42		
50-55			*ErS H4-5	>100				
55-60			*NS H6 Charc. @55					
60-65			*NErS H6 Charc. @65					

*Moss stems too horizontal for dating.

Peatland & core number: Ca2A   Core length: 50 cm   Corer type: hand cut   Description: hummock   Water Table 51cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	23.1		6.91 +,-0.78	7 +,-0.8	7.2 +,-0.8	167 +, -18.7		
5-10	21.8		5.90 +,-0.66	13 +,-1.0	8.5 +,-1.0	185 +, -20.7		
10-15	20.1		7.00 +,-0.79	20 +,-1.3	7.1 +,-0.8	144 +, -16.2		
15-20	17.0		5.63 +,-0.59	25 +,-1.4	8.9 +,-0.9	151 +, -15.0		
20-25	15.1		7.87 +,-1.31	33 +,-1.9	6.4 +,-1.1	96 +, -16.0		
25-30	18.3		9.05 +,-1.52	42 +,-2.5	5.5 +,-0.9	101 +, -17.0		
30-35	21.4		9.50 +,-1.45	52 +,-2.9	5.3 +,-0.8	113 +, -17.1		
35-40	25.8		7.93 +,-1.12	60 +,-3.1	6.3 +,-0.9	163 +, -23.0		
40-45	32.5		9.72 +,-1.37	70 +,-3.4	6.3 +,-0.9	167 +,-23.7		
45-50	43.2		*	>80	5.1 +,-0.7	~135		
					~3.1			

*Moss stems too horizontal for dating.

Peatland & core number: Ca Oct.17A   Core length: 50 cm   Corer type: 203 mm   Description: hummock   Water Table 60cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-2.5	27.0		3.72 +,-0.32	4 +,-0.3	7 +,-1	181 +,-16		
2.5-5	27.0		3.80 +,-0.67	8 +,-0.7	7 +,-1	178 +,-31		
5-7.5	33.1		4.24 +,-0.75	12 +,-1.1	6 +,-1	195 +,-34		
7.5-10	33.1		4.24 +,-0.75	16 +,-1.3	6 +,-1	195 +,-34		
10-12.5	41.5		4.42 +,-1.01	20 +,-1.7	6 +,-1	235 +,-54		
12.5-15	36.2		4.66 +,-0.91	25 +,-1.9	5 +,-1	194 +,-38		
15-17.5	24.4		5.56 +,-1.05	31 +,-2.2	5 +,-1	110 +,-21		
17.5-20	24.4		5.32 +,-0.79	36 +.-2.3	5 +,-1	115 +,-17		
20-22.5	46.7		5.95 +,-1.49	42 +,-2.8	4 +,-1	196 +,-49		
22.5-25	46.7		5.81 +,-1.55	48 +,-3.2	4 +,-1	201 +,-54		
25-27.5	39.7		5.69 +,-1.56	53 +,-3.5	4 +,-1	174 +,-48		
27.5-30	39.7		5.69 +,-1.56	59 +,-3.9	4 +,-1	174 +,-48		
30-32.5	34.5		5.13 +,-0.43	64 +,-3.9	5 +,-0	168 +,-14		
32.5-35	34.5		5.13 +,-0.43	69 +,-3.9	5 +,-0	168 +,-14		
35-37.5	32.7		5.25 +,-0.45	75 +,-3.9	5 +,-0	168 +,-14		
37.5-38	32.7		5.25 +,-0.45	~75	5 +,-0			
30-35	34.2		10.26 +,-0.86	69	5 +,-0	167 +,-14		
35-40	32.1		10.5 +,-0.91	80	5 +,-0	152 +,-13		
40-45	30.8		15.0 +,-1.50	95	3 +,-0	103 +,-10		
45-50	47.2			>100				

Peatland & core number: Cove 2   Core length: 32.5 cm   Corer type: 203 mm   Description: hummock   Water Table ~15cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	54.7		3.56 +,- 1.03	4 +,- 1.0	14 +,- 4	768 +,- 222		
5-10	42.1		3.73 +,- 1.01	7 +,- 1.4	13 +,- 4	564 +,- 153		
10-15	45.2		6.88 +,- 1.71	14 +,- 2.2	7 +,- 2	329 +,- 82		
15-17.5	20.1		4.20 +,- 0.45	18 +,- 2.3	6 +,- 1	120 +,- 13		
17.5-20	31.9		3.56 +,- 0.57	22 +,- 2.4	7 +,- 1	224 +,- 36		
20-22.5	28.9		4.60 +,- 0.63	26 +,- 2.4	5 +,- 1	157 +,- 22		
22.5-25	22.5		3.07 +,- 0.49	30 +,- 2.5	8 +,- 1	183 +,- 29		
25-27.5	17.8		4.06 +,- 0.72	34 +,- 2.6	6 +,- 1	110 +,- 19		
27.5-30	27.6		4.38 +,- 0.99	38 +,- 2.8	6 +,- 1	158 +,- 36		
30-32.5	31.1		5.23 +.- 0.6	43 +,- 2.8	5 +,- 1	149 +,- 17		

Peatland & core number: CyHH   Core length: 110 cm   Corer type: T-corer   Description: hummock

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	20.7		4.96 +,-1.15	5 +,- 1.2	10.0 +,-2.3	209 +,-48		
5-10	24.0		5.87 +,-1.00	11 +,- 1.5	8.5 +,-1.5	205 +,-35		
10-15	20.7		6.54 +,-1.12	17 +,- 1.9	7.7 +,-1.3	158 +,-27		
15-20	30.6		7.39 +,-1.26	25 +,- 2.3	6.8 +,-1.2	207 +,-36		
20-25	27.7		8.68 +,-1.24	33 +,- 2.6	5.8 +,-0.8	160 +,-23		
25-30	26.7		9.20 +,-1.31	43 +,- 2.9	5.4 +,-0.8	145 +,-21		
30-35	23.6		5.82 +,-1.22	48 +,- 3.1	8.6 +,-1.8	203 +,-43		
35-40	26.6		8.70 +,-1.82	57 +,- 3.6	5.8 +,-1.2	153 +,-32		
40-45	29.0		6.50 +,-1.36	64 +,- 3.9	7.7 +,-1.6	223 +,-47		
45-50	32.3		7.70 +,-1.61	71 +,- 4.2	6.5 +,-1.4	210 +,-44		
50-52.5	35.4		6.29 +,-1.32	78 +,- 4.4	4.0 +,-0.8	141 +,-29		
52.5-55	35.4		1.36 +,-2.85	91 +,- 5.2	1.8 +,-0.4	65 +,-14		
55-60	33.0		*	<100 +,- 25.0	<1.8	<59		
60-63	41.1		*	<150 +,- 25.0	<1.5	<60		
100-110			*	<300	<1.0			

*Moss stems too horizontal for dating.

Peatland & core number: DII 1* Core length: 53 cm Corer type: 203 mm Description: cut-away area Water Table 28cm

Depth (cm)	D_b^* total	D_b^* moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-10	20.7		7.59 +,- 1.01	8 +,- 1.0	13 +,- 2	273 +,- 36		
10-15	22.1		3.29 +,- .39	11 +,- 1.1	15 +,- 2	336 +,- 40		
15-20	19.5		3.46 +,- .42	14 +,- 1.2	14 +,- 2	282 +,- 34		
20-25	16.6		3.85 +,- .84	18 +,- 1.4	13 +,- 3	216 +,- 47		
25-30	17.2		3.24 +,- .48	21 +,- 1.5	15 +,- 2	265 +,- 39		
30-35	18.4		4.58 +,- .68	26 +,- 1.7	11 +,- 2	201 +,- 30		
35-40	19.3		4.48 +,- .54	30 +,- 1.7	11 +,- 1	215 +,- 26		

*Replicate for DI whose more correct D_b values are used here.

Peatland & core number: DII 3 Core length: 20 cm Corer type: 203 mm Description: cut-away area Water Table 34cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	23.3		4.40 +,- .48	4 +,- .05	11 +,- 1	265 +,- 30		
5-10	15.9		3.26 +,- 1.09	8 +,- 1.2	15 +,- 5	244 +,- 82		
10-15	18.0		3.91 +,- .56	12 +,- 1.3	13 +,- 2	230 +,- 33		
15-20			7.89 +,- .59	19 +,- 1.6	6 +,- 0			

Peatland & core number: DII 4 Core length: 40 cm Corer type: 203 mm Description: cut-away area Water Table 40cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	15.7		5.46 +,- 1.22	6 +,- 1.2	9 +,- 2	144 +,- 32		
5-10	11.3		3.87 +,- .99	9 +,- 1.6	13 +,- 3	147 +,- 37		
10-15	9.3		4.67 +,- .54	14 +,- 1.7	11 +,- 1	100 +,- 12		
15-20	13.7		4.74 +,- .68	19 +,- 1.8	11 +,- 2	145 +,- 21		
20-25	18.5		5.17 +,- 1.22	24 +,- 2.5	10 +,- 2	179 +,- 42		
25-30	14.2		4.10 +,- .59	28 +,- 2.6	12 +,- 2	173 +,- 25		
30-35	12.1		4.57 +,- .60	33 +,- 2.6	11 +,- 1	132 +,- 17		
35-37.5	16.8		2.40 +,- .32	35 +,- 2.6	21 +,- 3	350 +,- 47		

Peatland & core number: DII 5 Core length: 52 cm Corer type: 203 mm Description: cut-away area near U.S.G.S. well
Water Table 35cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	25.6		4.84 +,-0.95	5 +,-1.0	10 +,-2	264 +,-52		
5-10	16.6		5.11 +,-0.56	10 +,-1.1	10 +,-1	162 +,-18		
10-15	18.1		5.03 +,-1.24	15 +,-1.7	10 +,-2	180 +,-44		
15-20	21.4		5.57 +,-1.13	21 +,-2.0	9 +,-2	192 +.-41		
20-25	24.5		6.85 +,-0.78	27 +,-2.2	7 +,-1	179 +,-20		
25-30	35.3	26.3	7.23 +,-1.70	35 +,-2.7	7 +,-2	244 +.-57	182 +,-43	
30-35	27.1	14.6	9.69 +,-1.93	44 +,-3.4	5 +,-1	140 +,-28	75 +,-15	
35-40	37.0	26.1				before mining		
40-45	61.0					"		
45-50	37.8					"		

Peatland & core number: DIII 5 Core length: 27.5 cm Corer type: 203 mm Description: formerly harvested in 1952

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	21.0	19.5	3.93 +,- 1.10	4 +.- 1.1	13 +,- 4	267 +,- 30	248 +,- 26	7
5-10	24.0	22.3	3.37 +,- 0.90	7 +,- 1.4	15 +,- 4	356 +,- 95	331 +,- 88	7
10-15	25.7	23.1	4.45 +.- 0.73	12 +,- 1.6	11 +,- 2	289 +,- 47	260 +,- 43	10
15-17.5	23.2	21.8	2.35 +,- 0.44	14 +,- 1.7	11 +,- 2	247 +,- 46	232 +,- 43	6
17.5-20	27.3	22.5	2.21 +,- 0.34	16 +,- 1.7	11 +,- 2	309 +,- 47	255 +,- 39	18
20-22.5	35.0	31.9	3.97 +,- 1.13	20 +,- 2.0	6 +,- 2	221 +,- 63	201 +,- 57	9
22.5-25	38.3	35.0	4.85 +,- .62	25 +,- 2.1	5 +,- 1	197 +,- 25	180 +,- 23	7
25-27.5	73.0	71.9	6.73 +,- 1.23	32 +,- 2.5	4 +,- 1	271 +,- 50	267 +,- 49	2

Peatland & core number: EP1 **Core length:** 55 cm **Corer type:** 203 mm **Description:** unmined site Water Table 40cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-1.5	tot.prod.a.g.					476 +,- 1		
1.5-5	36.9		7.41 +,- 1.06	7 +,- 1.1	7 +,- 1	249 +,- 36		
5-10	21.4		4.53 +,- .93	12 +,- 1.4	11 +,- 2	236 +,- 49		
10-15	25.5		4.62 +,- 1.18	17 +,- 1.8	11 +,- 3	276 +,- 71		
15-20	24.9		4.21 +,- .85	21 +,- 2.0	12 +,- 2	224 +,- 45		
20-25	26.8		Sphag. 5.75 +,- .33 Polyt. 5.56 +,- 1.36	26 +,- 2.4	9 +,- 1	233 +,- 57		
25-30	26.0		4.73 +,- .49	31 +,- 2.5	11 +,- 1	275 +,- 28		
30-35	25.3		5.42 +,-1.67	36 +,- 3.0	9 +,- 3	234 +,- 72		
35-40	25.9		4.89 +,- .71	42 +,- 3.1	10 +,- 1	265 +,- 40		
40-45	26.9		4.85 +,- .55	46 +,- 3.1	10 +,- 1	277 +,- 32		
45-50	29.9		5.66 +,- .50	52 +,- 3.2	9 +,- 1	264 +,- 22		
50-55	38.2							

Peatland & core number: EP2A **Core length:** 25 cm **Corer type:** 203 mm **Description:** formerly harvested site

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	12.1		4.21 +,- 1.10	4 +,- 1.1	12 +,- 3	144 +,- 38		
5-10	7.2	6.5	3.56 +,- 0.54	8 +,- 1.2	14 +,- 2	101 +,- 15	91 +,- 14	12
10-15	10.8	9.3	3.26 +,- 0.61	11 +,- 1.4	15 +,- 3	166 +,- 31	143 +,- 27	13
15-20	14.8	12.4	5.58 +,- 1.66	17 +,- 2.2	9 +,- 3	133 +,- 39	111 +,- 33	16
20-25	32.7	27.9						15

Peatland & core number: EP2B   Core length: 25 cm   Corer type: 203 mm   Description: formerly harvested site

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	11.1	10.7	5.03 +,- 2.00	5 +,- 2	10 +,- 4	110 +,- 44	106 +,- 42	4
5-10	12.6	12.2	3.55 +,- 0.80	9 +,- 2.2	14 +,- 3	172 +,- 39	172 +,- 39	3
10-15	11.8	10.1						14
15-20	10.4	10.3	7.03 +,- 1.32		7 +,- 1	74 +,- 14	73 +,- 14	2
20-25	12.6							

Peatland & core number: GH1A   Core length: 88 cm   Corer type: T-corer   Description: hummock   Water Table 62cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	28.1		7.33 +,-0.24	7 +,-0.2	7 +,-0	191 +,-63		
5-10	28.4		8.38 +,-1.25	16 +,-1.3	6 +,-1	170 +,-25		
10-12.5	40.2		3.88 +,-0.57	20 +,-1.4	6 +,-1	202 +,-30		
12.5-15	31.4		4.77 +,-1.03	24 +,-1.7	5 +,-1	211 +,-45		
15-17.5	48.0		5.20 +,-1.12	30 +,-2.1	5 +,-1	231 +,-50		
17.5-20	42.4		5.51 +,-1.19	35 +,-2.4	5 +,-1	193 +,-42		
20-22.5	34.9		3.61 +,-0.78	39 +,-2.5	7 +,-2	242 +,-52		
22.5-25	43.7		4.12 +,-0.89	43 +,-2.7	6 +,-1	265 +,-57		
25-27.5	43.7		4.21 +,-0.72	47 +,-2.8	6 +,-1	260 +,-45		
27.5-30	52.4		4.53 +,-0.70	52 +,-2.8	6 +,-1	290 +,-45		
30-32.5	35.8		4.38 +,-0.68	56 +,-2.9	6 +,-1	204 +,-32		
32.5-35	37.1		4.94 +,-0.76	61 +,-3.0	5 +,-1	188 +,-29		
35-37.5	38.4			66 +,-3.1	5 +,-1	187 +,-29		
37.5-40	34.5		5.88 +,-1.31	72 +,-3.4	4 +,-1	147 +,-33		
40-42.5	42.8		6.25 +,-1.56	78 +,-3.7	4 +,-1	171 +,-43		
42.5-45	47.6		6.25 +,-1.56	84 +,-4.0	4 +,-1	190 +,-48		
45-47.5	36.7		*H 3	>95	<4	<148		
47.5-50	38.4		*H 3	>105	<4	<153		

*Moss stems too horizontal for dating.

Peatland & core number: GH1B   Core length: 67 cm   Corer type: Damman   Description: hummock   Water Table 60cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	30.1		6.68 +,-1.10	7 +,-1.1	7 +,-1	226 +,-37		
5-10	35.1		7.17 +,-1.16	14 +,-1.6	7 +,-1	245 +,-40		
10-15	37.8		8.25 +,-1.34	22 +,-2.1	6 +,-1	229 +,-37		
15-20	30.1		8.75 +,-1.42	31 +,-2.5	6 +,-1	172 +,-28		
20-25	41.0		12.0 +,-1.95	43 +,-3.2	4 +,-1	171 +,-28		
25-30	45.6		*H3-5			158		
30-35	53.7		*H4.5-5			157.9		
35-40			P					
40-45								
45-50			P					
50-52.5								
52.5-55								
55-60								
60-67.5			D					
60-65			P					

*Moss stems too horizontal for dating.

Peatland & core number: GHD   Core length: 95 cm   Corer type: Damman & T-corer   Description: hummock   Water Table 53cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	19.8		5.43 +,-0.71	5 +,-0.7	9 +,-1	182 +,-24		
5-10	23.7		6.76 +,-1.14	12 +,-1.3	7 +,-1	175 +,-29		
10-12.5	21.8		4.40 +,-0.63	17 +,-1.5	6 +,-1	124 +,-17		
12.5-15	17.5		3.26 +,-0.45	20 +,-1.6	8 +,-1	134 +,-19		
15-17.5	21.4		3.42 +,-0.48	23 +,-1.6	7 +,-1	156 +,-22		
17.5-20	19.6		3.68 +,-0.51	27 +,-1.7	7 +,-1	133 +,-19		
20-22.5	24.9		3.68 +,-0.51	31 +,-1.8	7 +,-1	169 +,-24		
22.5-25	26.6		4.67 +,-0.65	35 +,-1.9	5 +,-1	142 +,-20		
25-27.5	26.2		4.69 +,-0.71	40 +,-2.0	5 +,-1	140 +,-20		
27.5-30	35.8		5.09 +,-0.69	45 +,-2.1	5 +,-1	176 +,-24		
30-32,5	29.3		8.89 +,-1.21	54 +,-2.5	3 +,-0	82 +,-11		
32.5-35	26.2		minimum~10	>64	<3	~66		
35-37.5	26.2		minimum~10	>74	<3	<66		
37.5-40	32.7		minimum~10	>84	<3	<82		
40-42.5	31.9		minimum~ 7	>91	<4	<114		
42.5-45	27.1		minimum~11	>102	<2	<62		
45-47,5	26.6		*H3	>120		<60		
47.5-50	22.3		*H3 AC	>140		<51		
50-51	27.3		*H3 AC	>160		<62		
51-54	59.3		*H4.5-5 AC	>200				
54-60	50.9		*H4.5 AC					
60-65	80.8		*H4.5 AC					
65-67	67.1		*H4.5 AC					
80-85			*H5-3 AC					
90-95			*H6-3					

*Moss stems too horizontal for dating.

Peatland & core number: GHD50   Core length: 55 cm   Corer type: Damman   Description: hummock near pond   Water Table 57cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	20.5		5.50 +,-1.82	6 +,-1.8	9 +,-3	186 +,-62		
5-10	17.4		6.08 +,-0.81	11 +,-2.0	8 +,-1	143 +,-19		
10-125	18.6		2.61 +,-0.51	14 +,-2.1	10 +,-2	178 +,-35		
12.5-15	14.5		2.61 +,-0.51	17 +,-2.1	10 +,-2	139 +,-27		
15-17.5	19.3		2.77 +,-0.66	20 +,-2.2	9 +,-2	174 +,-42		
17.5-20	20.2		2.77 +,-0.66	22 +,-2.3	9 +,-2	182 +,-43		
20-22.5	18.6		3.19 +,-0.43	26 +,-2.4	8 +,-1	146 +,-20		
22.5-25	15.8		3.19 +,-0.43	29 +,-2.4	8 +,-1	124 +,-17		
25-27.5	18.0		3.58 +,-0.48	32 +,-2.4	9 +,-1	126 +,-17		
27.5-30	16.1		3.58 +,-0.48	36 +,-2.5	9 +,-1	112 +,-15		
30-32.5	18.9		4.53 +,-0.61	40 +,-2.6	6 +,-1	104 +,-14		
32.5-35	14.8		4.53 +,-0.61	45 +,-2.6	6 +,-1	82 +,-11		
35-37.5	15.8		5.00 +,-0.67	50 +,-2.7	5 +,-1	79 +,-11		
37.5-40	18.6		4.5 +,-0.6	54 +,-2.8	6 +,-1	103 +,-14		
40-42,5	21.2		5.0 +,-0.67	59 +,-2.8	5 +,-1	106 +,-14		
42.5-45	22.7		6.0 +,-0.80	65 +,-3.0	4 +,-1	95 +,-13		
45-47.5	26.8		7.0 +,-0.94	72 +,-3.1	4 +,-0	96 +,-13		
47.5-50	27.0		8.0 +,-1.07	80 +,-3.3	3 +,-0	85 +,-11		

Peatland & core number: GHE Core length: 26.5 cm Corer type: T-corer Description: pond area Water Table 32cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	26.7		7.12 +,-1.24	7 +,-1.2	7 +,-1	187 +,-33		
5-10	29.05		6.22 +,-0.00	13 +,-1.2	8 +,-1	234 +,-30		
10-12.5	34.1		4.25 +,-0.71	18 +,-1.4	6 +,-1	201 +,-33		
12.5-15	22.3		4.50 +,-0.93	22 +,-1.7	6 +,-1	124 +,-26		
15-17.5	27.9		4.50 +,-0.93	27 +,-1.9	6 +,-1	155 +,-32		
17.5-20	34.1		4.50 +,-0.93	31 +,-2.2	6 +,-1	190 +,-39		
20-23	21.8		7.00 +,-0.68	38 +,-2.3	4 +,-0	94 +,- 9		
23-26.5	21.8		8.33 +,-1.11	45 +,-2.5	4 +,-0	92 +,-12		

Peatland & core number: GHF Core length: 36 cm Corer type: T-corer Description: pond area Water Table 36cm

Depth (cm)	D total	D moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	27.6		7.57 +,-1.72	8 +,-1.7	7 +,-2	182 +,-41		
5-7.5	25.1		4.77 +,-0.80	12 +,-1.9	5 +,-1	132 +,-22		
7.5-10	25.1		4.77 +,-0.95	17 +,-2.1	5 +,-1	132 +,-26		
10-12.5	27.5		4.29 +,-0.86	21 +,-2.3	6 +,-1	160 +,-32		
12.5-15	30.6		4.43 +,-0.89	26 +,-2.5	6 +,-1	173 +,-35		
15-17.5	29.7		4.43 +,-0.95	30 +,-2.6	6 +,-1	168 +,-36		
17.5-20	21.8		4.43 +,-0.95	35 +,-2.8	6 +,-1	123 +,-26		
20-22.5	26.2		4.43 +,-1.50	39 +,-3.2	6 +,-2	148 +,-50		
22.5-25	22.7		4.43 +,-1.50	44 +,-3.5	6 +,-2	128 +,-43		
25-27.5	21.8		4.43 +,-1.50	48 +,-3.8	6 +,-2	123 +,-42		
27.5-30	22.1		4.43 +,-1.50	52 +,-4.1	6 +,-2	125 +,-42		
30-33	36.4		5.32 +,-1.60	58 +,-4.4	6 +,-2	226 +,-68		
33-35	29.5		5.32 +,-1.60	63 +,-4.7	6 +,-2	183 +,-55		

Peatland & core number: GHT Core length: 35 cm Corer type: T-corer Description: hummock Water Table 57cm

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5			5.50 +,-1.82	6 +,-1.8	9 +,-3	274		
5-10			6.08 +,-0.81	12 +,-2.0	8 +,-1	289		
10-15			5.92 +,-1.02	17 +,-2.2	10 +,-2	254		
15-20			5.53 +,-1.32	22 +,-2.6	9 +,-2	272		
20-25			6.38 +,-1.01	29 +,-2.8	8 +,-1	321		
25-30			7.15 +,-1.33	36 +,-3.1	7 +,-1	319		
30-35			9.06 +,-1.30	45 +,-3.4	6 +,-1	296		

Peatland & core number: JP1 Core length: 24.5 cm Corer type: 203 mm Description: formerly harvested site

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	26.8	22.5	7.0 +,- 1.47	7 +,- 1.5	7 +,- 2	191 +,- 40	161 +,- 34	
5-10	23.9	19.2	7.02 +,- 1.74	14 +,- 2.3	7 +,- 2	170 +,- 42	137 +,- 34	
10-15	32.3	27.4	8.00 +,- 1.86	22 +,- 2.9	6 +,- 1	202 +,- 47	171 +,- 40	
15-18.5	30.9	26.8	5.61 +,- 1.12	28 +,- 3.1	6 +,- 1	193 +,- 39	167 +,- 33	
18.5-21	46.5	36.7	10.84 +,- 2.08	38 +,- 3.8	2 +,- 0	107 +,- 21	85 +,- 16	
21-22*	114.0	99.8	7.46 +,- 2.13	46 +,- 4.3	1 +,- 0	153 +,- 44	134 +,- 38	
22-24.5*	53.5	44.0						

*Before regrowth.

Peatland & core number: Keith 1 Core length: 35 cm Corer type: Damman Description: hummock

Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	15.4		4.94	5 +,- 0	9 +,- 0	140 +,- 0		
5-10	15.5		5.00	10 +,- 0	10 +,- 0	155 +,- 0		
10-15	19.3		6.07	16 +,- 0	8 +,- 0	159 +,- 0		
15-20	22.6		7.46 +,- 3.66	24 +,- 3.7	7 +,- 3	151 +,- 74		
20-25	17.7		7.71	31 +,- 3.7	6 +,- 0	115 +,- 0		
25-30	15.8		8.46 +,- 1.18	40 +,- 3.9	6 +,- 1	93 +,- 13		
30-35	12.0		10.21	50 +,- 3.9	5 +,- 0	59 +,- 1		

Peatland & core number: SB1R Core length: 50 cm Corer type: 203 mm Description: hummock Water Table 35cm

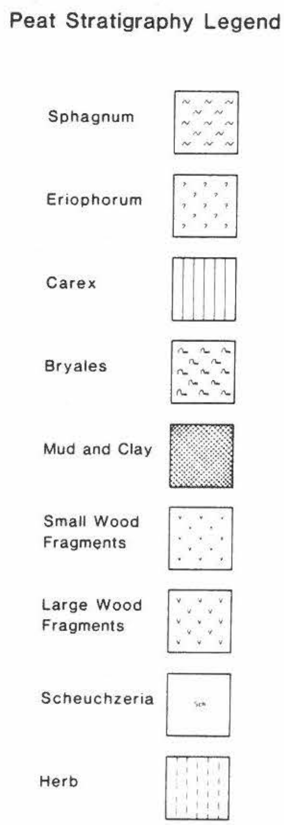
Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	30.4		5.97 +,- 3.84	6 +,- 3.8	8 +,- 5	255 +,- 164		
5-10	25.7		4.08 +,- 1.69	10 +,- 4.2	12 +,- 5	315 +,- 130		
10-15	21.3		3.71 +,- 1.70	14 +,- 4.5	13 +,- 6	287 +,- 132		
15-20	27.7		4.04 +,- 1.19	19 +,- 4.7	10 +,- 3	286 +,- 70		
20-25	29.5		5.07 +,- 1.85	24 +,- 5.0	10 +,- 4	291 +,- 106		
25-30	23.0		4.31 +,- 1.45	28 +,- 5.2	12 +,- 4	267 +,- 90		
30-35	26.3		5.52 +,- 2.50	34 +,- 5.8	9 +,- 4	238 +,- 108		
35-40	28.5		5.09 +,- 2.17	39 +,- 6.2	10 +,- 4	280 +,- 119		
40-45	26.2		5.65 +,- 1.96	44 +,- 6.5	9 +,- 3	232 +,- 81		
45-50	27.5		5.71 +,- 2.94	50 +,- 7.1	9 +,- 5	241 +,- 124		

Peatland & core number: SB1S Core length: 50 cm Corer type: 203 mm Description: hummock Water Table 35cm

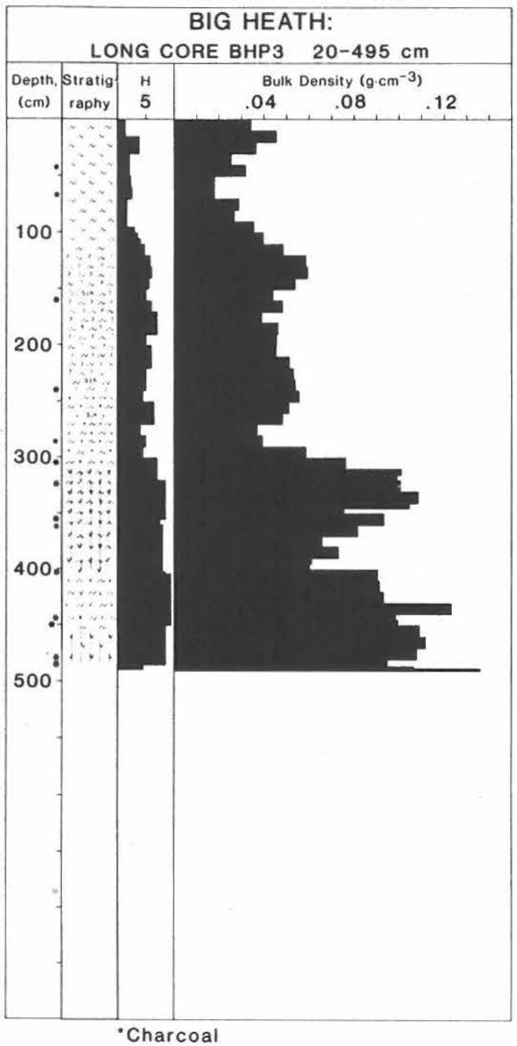
Depth (cm)	D_b total	D_b moss	Years +,- S.D.	Cum. yrs. +,- S.D.	a +,- S.D.	A +,- S.D. total	A +,- S.D. moss	Vasc. %
0-5	30.6		4.66 +,- 2.75	5 +,- 2.8	11 +,- 6	328 +,- 194		
5-10	25.7		4.31 +,- 1.75	9 +,- 3.3	12 +,- 5	298 +,- 121		
10-15	25.6		3.50 +,- 1.22	12 +,- 3.5	14 +,- 5	366 +,- 128		
15-20	24.9		3.39 +,- 1.04	16 +,- 3.6	15 +,- 5	367 +,- 113		
20-25	32.0		5.89 +,- 2.07	22 +,- 4.2	8 +,- 3	272 +,- 95		
25-30	27.4		3.81 +,- 1.36	26 +,- 4.4	3 +,- 5	360 +,- 128		
30-35	28.6		3.16 +,- 1.38	29 +,- 4.6	16 +,- 7	453 +,- 197		
35-40	27.1		4.22 +,- 1.46	33 +,- 4.8	12 +,- 4	321 +,- 111		
40-45	29.2		4.47 +,- 1.67	37 +,- 5.1	11 +,- 4	326 +,- 122		
45-50	37.1							

Appendix VI.

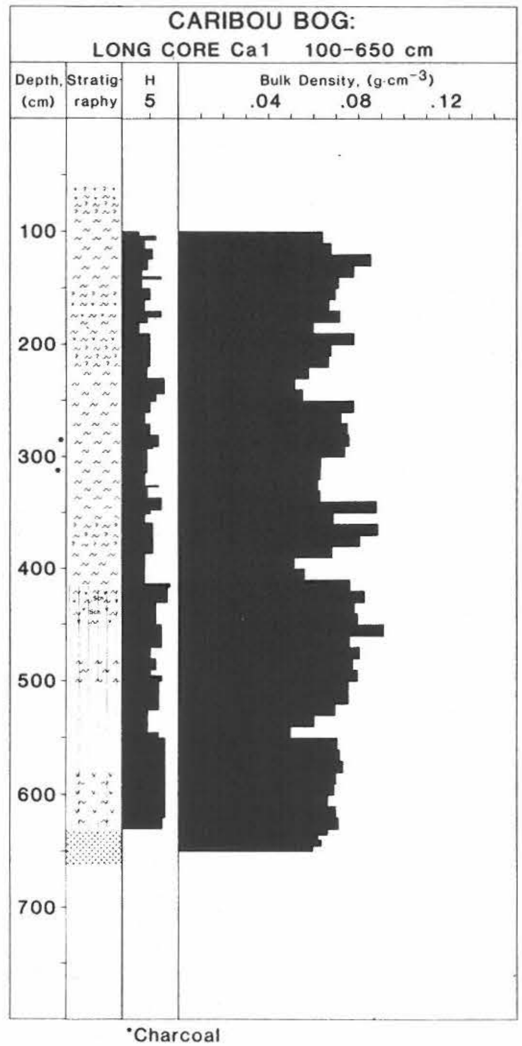
Bulk density ($D_b = g \cdot cm^{-3}$), stratigraphy, and von Post degree of humification ($H = 1\text{-}10$) for six long cores.



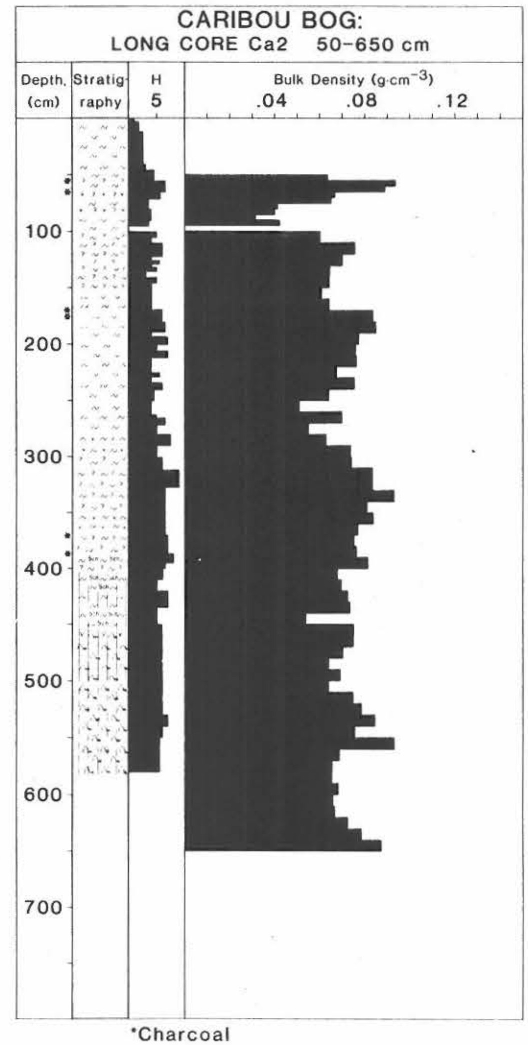
A coastal raised bog with black spruce-dwarf shrub hummocks and extensive *Scirpus cespitosus*, *Sphagnum*, and lichen lawns. A *Scirpus cespitosus*, *Sphagnum rubellum* lawn with lichens.



Sphagnum bog with black spruce, rich in tall dwarf shrubs and high hummocks. A high *Sphagnum fuscum* hummock.

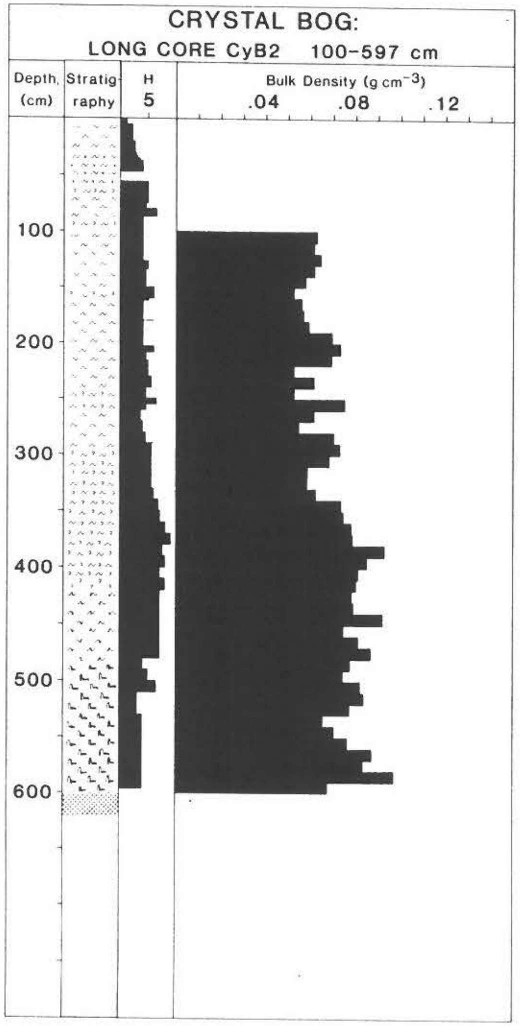


A high *Sphagnum fuscum* hummock.

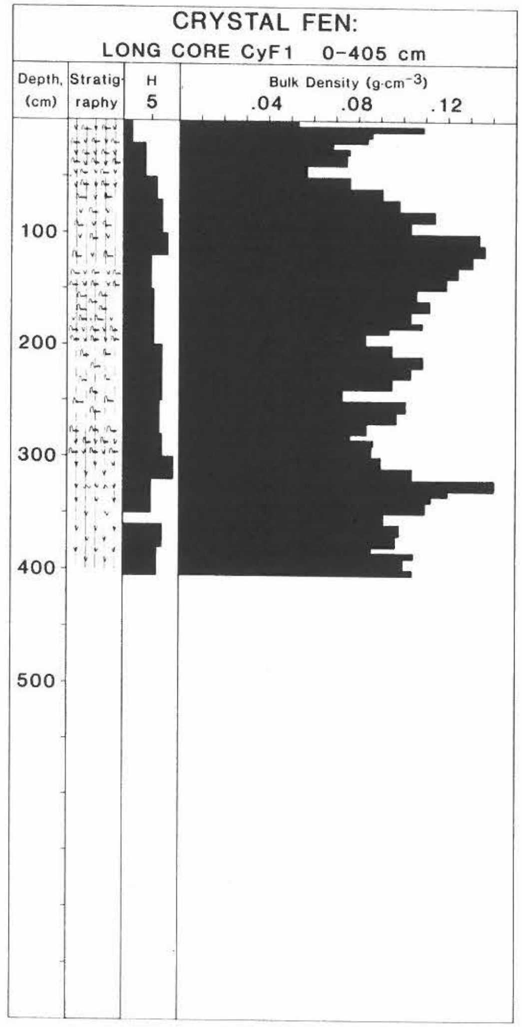


H = degree of humification

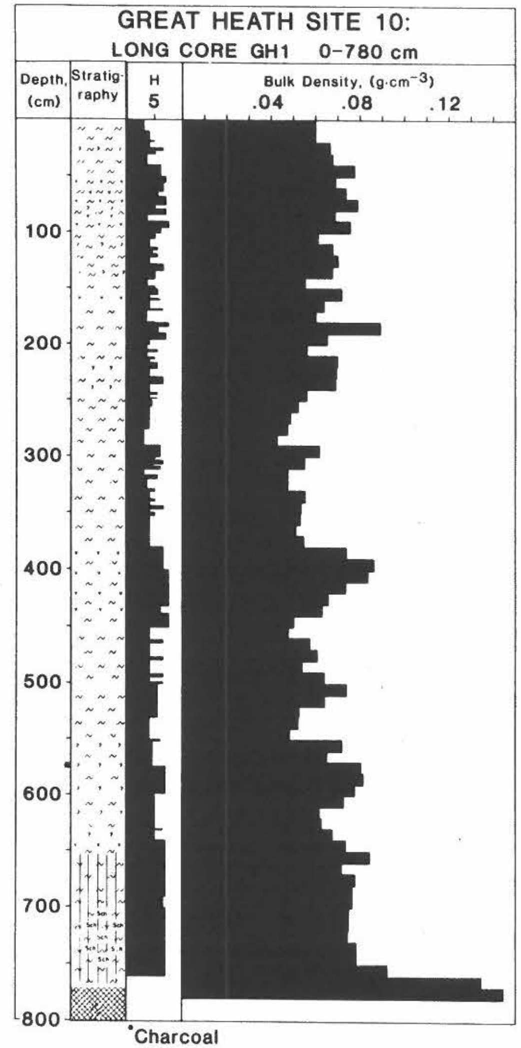
A concentric domed bog with plenty of pools and "ponds." The core was obtained from a low *Sphagnum rubellum* hummock close to a pool.



A rich sedge fen with plenty of herbs and mosses. Cover vegetation: *Campylium stellatum Scorpidium scorpioides*, *Drepanocladus revolvens*, etc.



An open domed bog. A lichen-covered small depression surrounded by very high *Sphagnum flavicomans* hummocks.

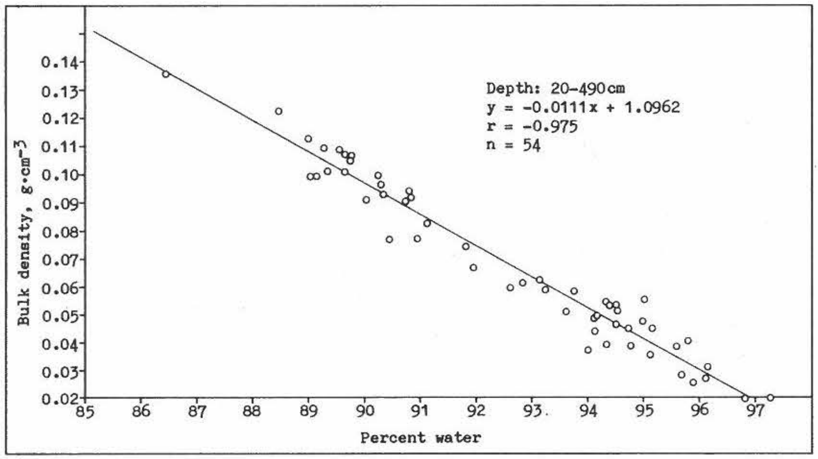


H = degree of humification

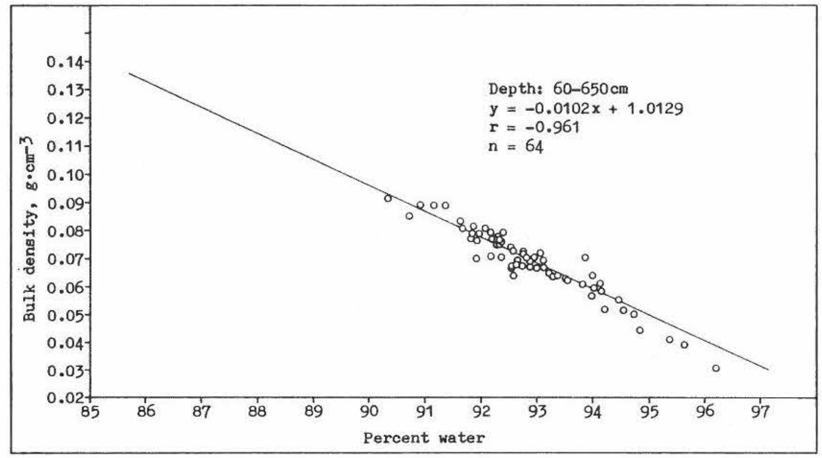
Appendix VII.

The relationship between bulk density ($D_b = g \cdot cm^{-3}$) and percent water for seven long cores from five peatlands.

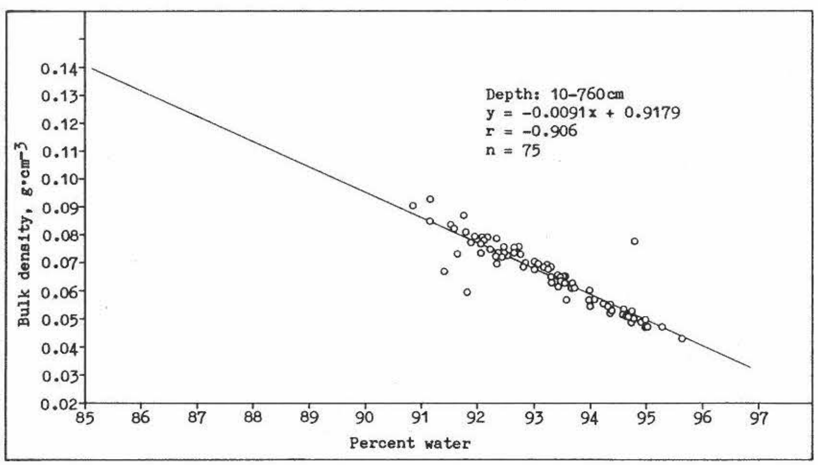
Big Heath: Long Core BHP3



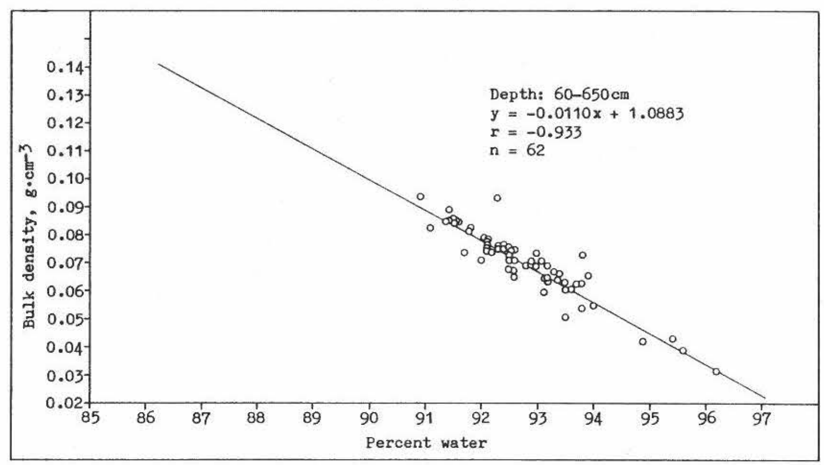
Caribou Bog: Long Core Ca1



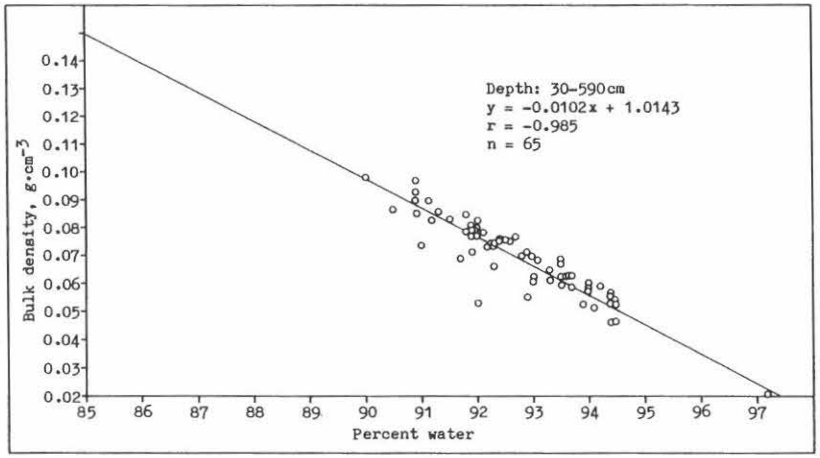
Great Heath Site 10: Long Core GH1



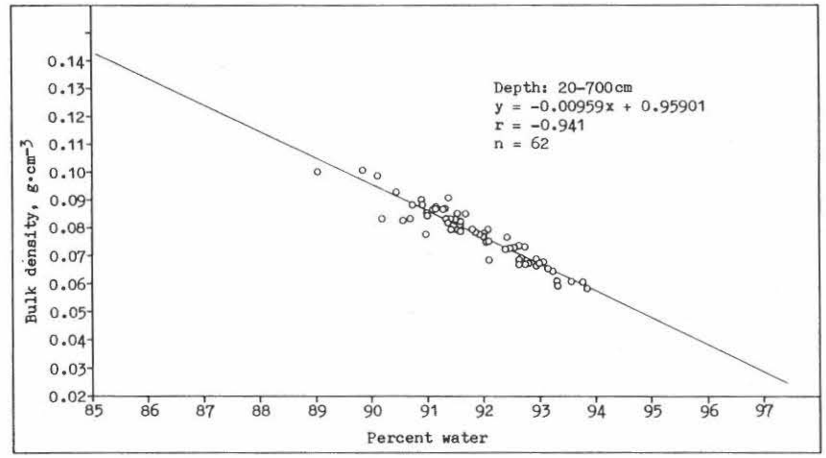
Caribou Bog: Long Core Ca2



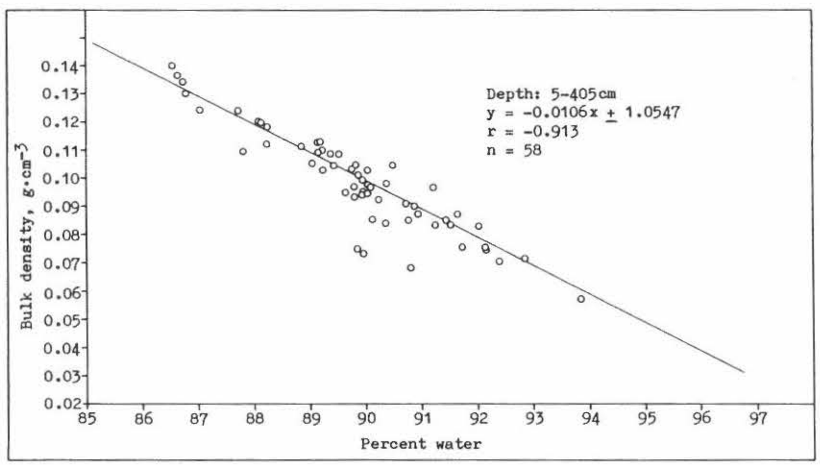
Crystal Bog: Long Core CyB2



Sidney Bog: Long Core SB1L



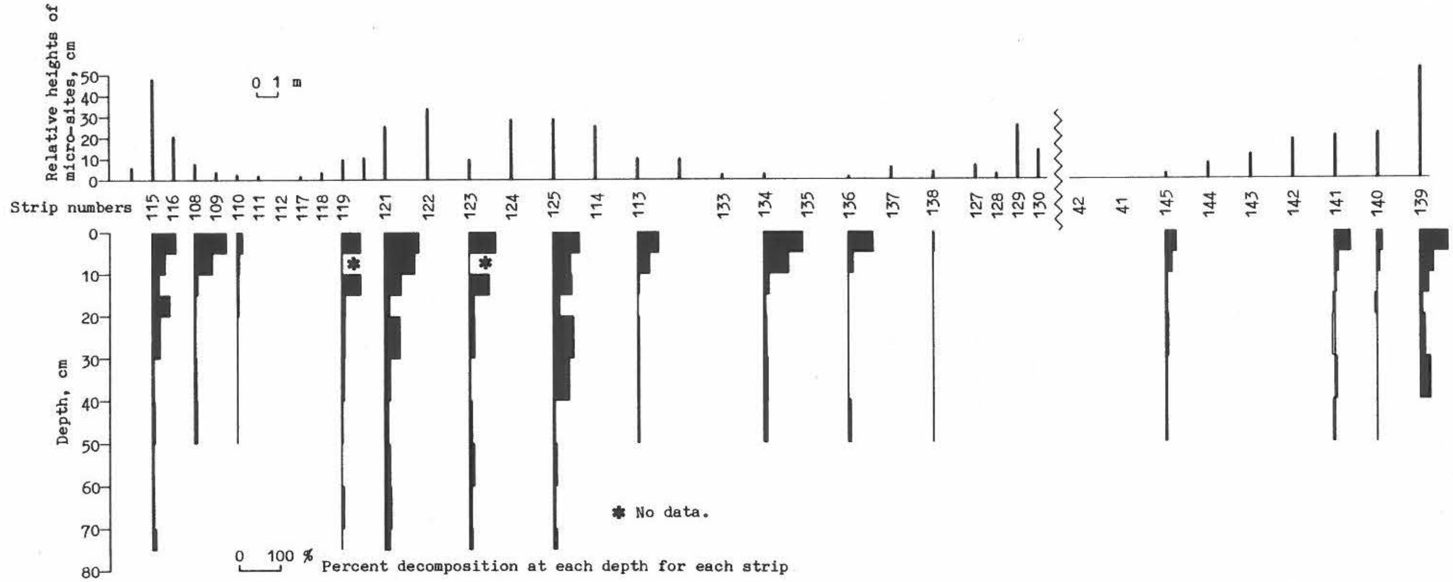
Crystal Fen: Long Core CyF1



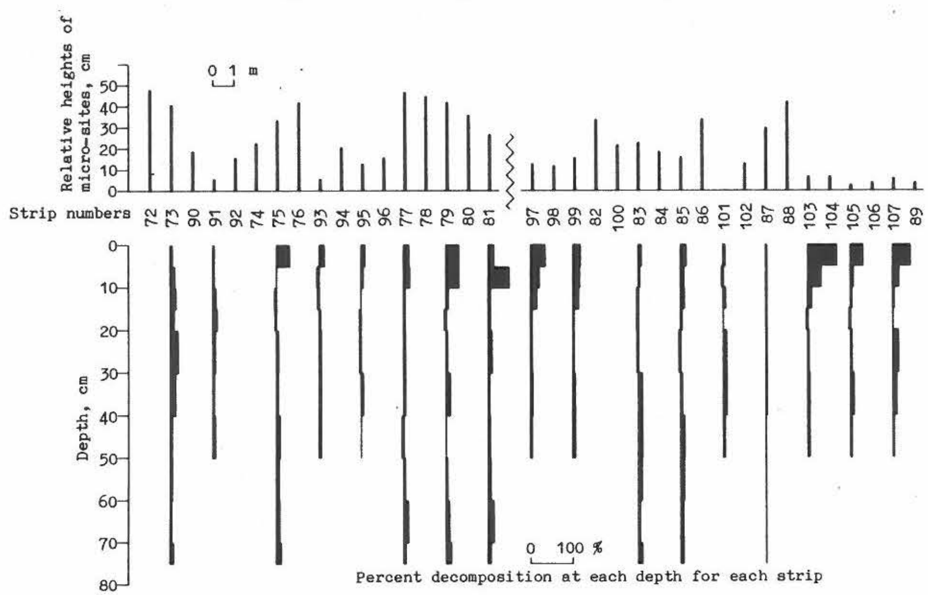
Appendix VIII.

Results of decomposition strip studies along five transects in four peatlands. The upper panel describes the sites along the transect; the lower panel gives the results in percent weight loss vs. depth for those strips finally retrieved and weighed.

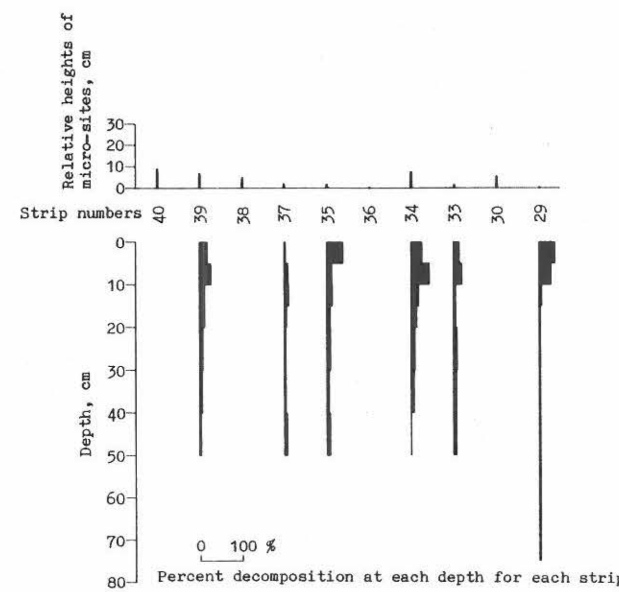
Big Heath - Decomposition strip transect

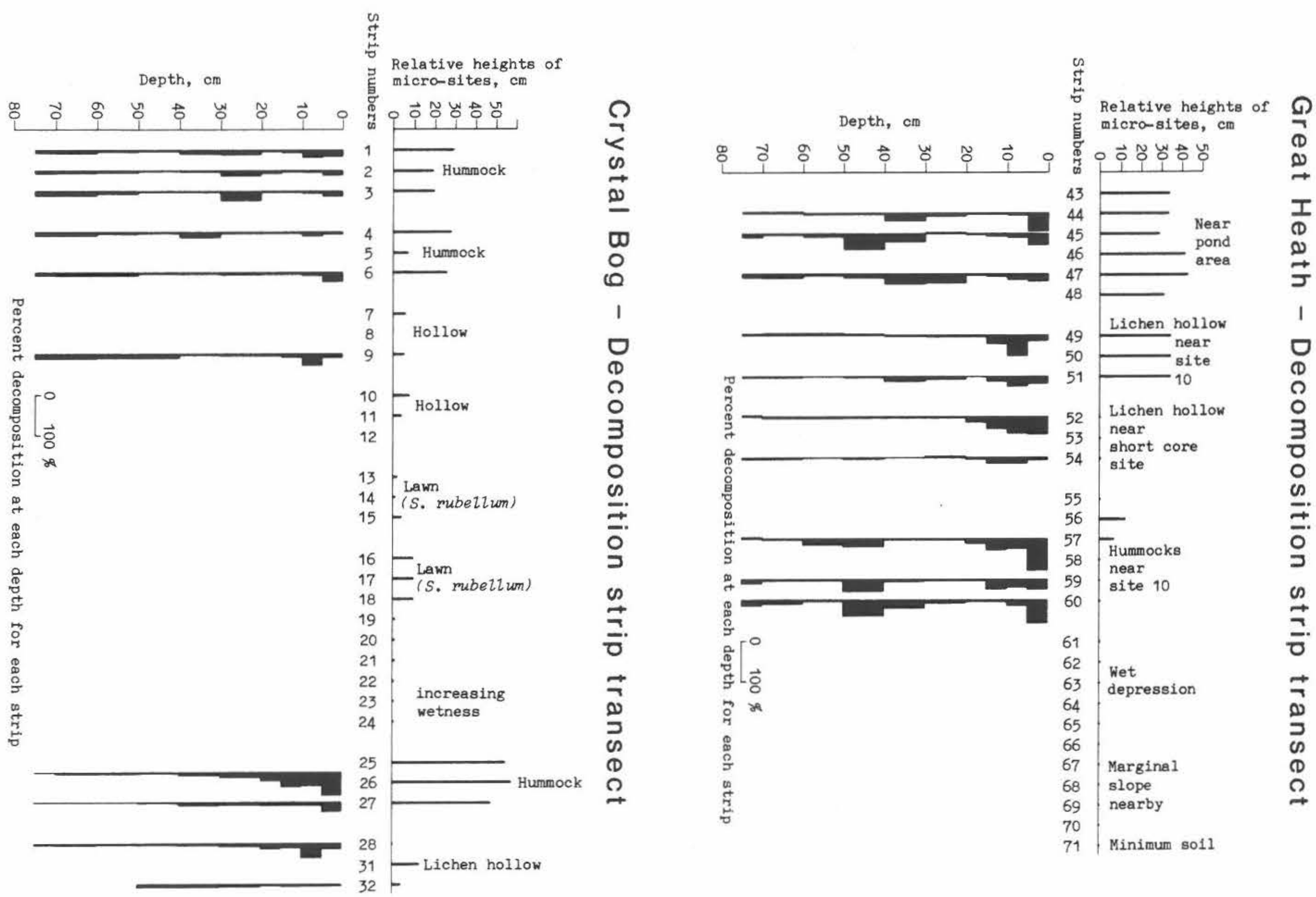


Caribou Bog - Decomposition strip transect



Crystal Fen - Decomposition strip transect




Crystal Bog - Decomposition strip transect
Great Heath - Decomposition strip transect
Depth, cm
Strip numbers
Relative heights of micro-sites, cm
Percent decomposition at each depth for each strip
0 100 %
Hummock
Hummock
Hollow
Hollow
Lawn (S. rubellum)
Lawn (S. rubellum)
increasing wetness
Hummock
Lichen hollow
Near pond area
Lichen hollow near site 10
Lichen hollow near short core site
Hummocks near site 10
Wet depression
Marginal slope nearby
Minimum soil