Pollen and Geochronological Data from South Florida: Taylor Creek Site 2

by

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Abstract

Many recent changes in plant and animal communities of the Everglades have been attributed to human alteration of the environment, such as changes in the hydrologic regime and increased agricultural activity, but cause-and-effect relationships between environmental and biotic changes have not been documented scientifically. This report on pollen and geochronological evidence from cores collected along Taylor Creek is the first of a series documenting the biotic history of a series of sites in southern Florida.

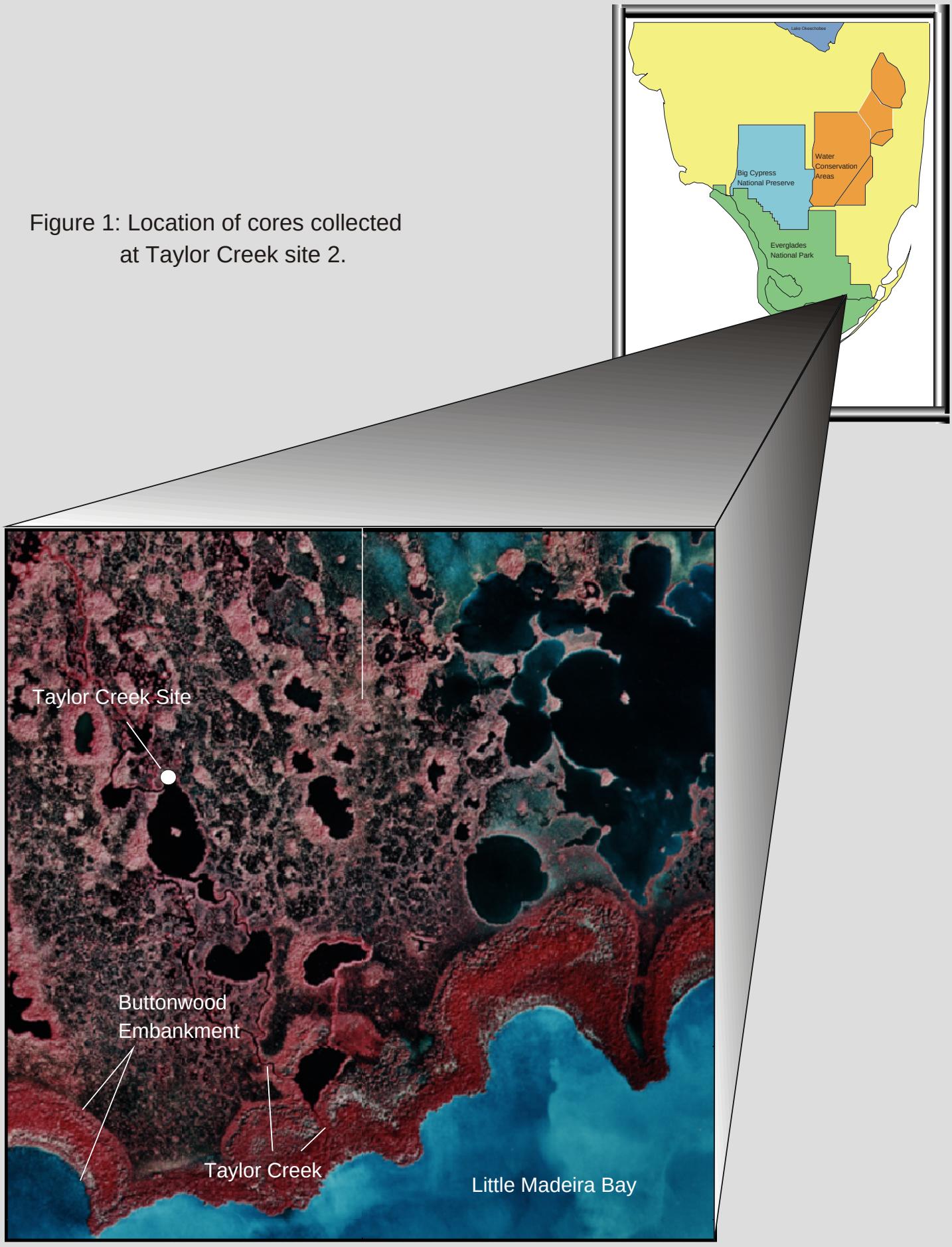
Pollen and geochronology were analyzed from two cores collected at site 2 along Taylor Creek, one short core (35 cm long) to provide high-resolution data and one long core (98 cm long) to provide a record of the last few millenia. Analysis of pollen assemblages from these cores indicate that marsh and slough vegetation, primarily sawgrass with some incursions by cattails, dominated the area for most of the last two millenia, until about 1950-1960. At that point, sawgrass pollen declined to lower abundances than recorded elsewhere in the core, and tree pollen became much more abundant in the cores. This change reflects the vegetational response to alterations in the hydrologic system throughout much of the last century.

Introduction

Changes in plant and animal communities of the historic Everglades have occurred over the last few decades, and many of these changes have been attributed to human activities in the region, such as construction and implementation of water control structures, agricultural activities, and development of urban areas. These changes have prompted actions to restore the Everglades and Florida Bay ecosystems to a "pristine" state, and management agencies are designing plans aimed at altering water-control and other land-use practices to achieve a sustainable, healthier ecosystem. Two critical questions in designing these plans are the natural range of variability of the ecosystem and the actual impact of human activities on the ecosystems. To address these questions, research sponsored by the South Florida Ecosystem Restoration Initiative at the USGS is focusing on analysis of a series of cores collected throughout the historic Everglades and Florida Bay and interpretation of floral and faunal changes over the last few thousand years, with particular emphasis on high-resolution studies of the last 150 years.

This report is the first in a series documenting pollen and geochronological evidence from cores collected in the historic Everglades. Taylor Creek Site 2 is located along the north side of a lake along Taylor Creek (25° 12.339'N, 80° 38.641'W) (Fig. 1). Taylor Creek extends from sawgrass marshes in its northern reaches through the Buttonwood Embankment and drains into Little Madeira Bay on the northern edge of Florida Bay. This core is one in a series of cores collected along Taylor Creek and in Taylor Slough. The site is a peat-accumulating environment dominated by dwarf *Rhizophora* (red mangrove) in the transition area between the Buttonwood Embankment to the south and the sawgrass marshes to the north.

Figure 1: Location of cores collected at Taylor Creek site 2.



Acknowledgements

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Methods of Investigation

Two cores were collected at Taylor Creek Site 2; the first (TC2-A) was collected in March, 1995 for pollen and Lead-210 analysis, consists entirely of peat and is 35 cm long. In May, 1995, a second core (TC2-B) from the same site was collected for geochemical analysis. This core was 98 cm long, with the upper 55 cm consisting of peat and the lower 43 cm consisting of marl. Core TC2-A was sampled at 1 cm intervals for the upper 25 cm and at 2 cm intervals below that. Core TC2-B was sampled for geochemical analyses at 2 cm intervals for the upper 20 cm, at 5 cm intervals from 20 to 40 cm, and at 10 cm intervals below that. Splits for pollen analysis were obtained from every sample below 30 cm and at several intervals above that to check for correlation with core TC2-A.

Sampling

In order to obtain representative samples of the various environments in south Florida, 23 cores were taken throughout the region. The sites were co-located with other studies so that the results could be correlated to changes in chemistry and ecology. All cores, including those in this study, were taken with a modified piston core 10.16 cm (4 inches) in diameter which was capable of taking a 1 meter core. At Taylor Creek Site 2, only the "peat" was sampled by physically moving the surface vegetation aside and beginning the coring at the "soil level." Extreme care was taken not to pull the surface vegetation leaving the peat undisturbed. However, in some localities in southern Florida, the water depth and the thickness of the vegetation severely hindered this method. At these sites, some surface vegetation was sampled.

Upon completion of coring, each core was capped and transported to the laboratory. In the laboratory, cores were extruded at 1 or 2 centimeter increments, weighed and sacked. Because of the extremely permeable nature of the material, wet bulk density could not be accurately measured, and only dry bulk density was determined. In sampling for radiometeric analyses, roots were removed physically prior to chemical dissolution.

Pollen

Peat samples weighing approximately 0.5 g were used for pollen preparation; for marl samples, weights ranged from 20-40 g. Samples were dried and weighed before being spiked with *Lycopodium* marker tablets for calculation of absolute pollen concentrations (Stockmarr, 1971). Samples were treated with HCl to dissolve the marker tablet, neutralized with deionized water, and rinsed twice with glacial acetic acid to dry the

material for acetolysis. Samples were acetolyzed in a hot water bath for 10 minutes, neutralized, and treated with 10% KOH in a hot water bath for 15 minutes. After neutralization, the samples were sieved with 200 µm and 10 µm nylon mesh to remove extraneous plant material and clay-sized particles. Some samples were run through a heavy-liquid separation with $ZnCl_2$ (S.G. = 2.1) to further clean samples. The pollen residue was mixed with warm glycerine jelly and mounted on microscope slides for examination.

Absolute pollen concentrations were calculated using the marker-grain method described by Benninghoff (1962). Marker tablets of *Lycopodium* spores were the source of the exotic grains, and the quantity of *Lycopodium* spores in the marker tablets was determined by the manufacturer with a Coulter Counter following the procedures of Stockmarr (1973). The concentration of spores in these tablets is 12,542 +/- 416. Absolute pollen concentration was calculated using the formula (Maher, 1981):

pollen per gram dry sediment =

((pollen grains counted/marker grains counted) x 12,542)/weight of sediment.

To calculate percent abundance, at least 100 grains were counted per sample. Ideally, 300 grains were counted, but in some samples sparse pollen in the preparations made acceptance of lower numbers necessary. Pollen assemblages were quantified from 28 samples in core TC2-A and 12 samples in core TC2-B. Results of the counts are presented in Tables 1 and 2.

Geochronological Analyses

Data Analysis

Lead-210 (^{210}Pb), with a half-life of 22.8 years, is ideal for south Florida ecosystem studies. A member of the ^{238}U series, the disequilibrium between ^{210}Pb and its ancestor is caused by the physio-chemical activity of the intermediate gaseous progenitor, Radon-222. ^{222}Rn is formed by the decay of radium isotopes, either by recoil on the ejection of the alpha particle or by diffusion into the atmosphere at a rate of about 42 atoms per minute per square centimeter of the Earth's surface. This isotope, in turn, rapidly decays to form ^{210}Pb. This newly formed lead isotope, removed by rain or snow, has a residence time in the atmosphere of »10 days. The highly reactive lead is rapidly adsorbed to or incorporated in the depositing sediment. This flux produces a concentration of "unsupported" ^{210}Pb, (lead whose activity is greater than that of its radium grandparent, ^{226}Ra). Ages of the sediment are calculated by determining the decrease in ^{210}Pb activity at each level which is a function of time. If the initial concentration is known, or is estimated using ^{7}Be data, then the "age" of a horizon is calculated by the following:

$$T_{age} = \ln(A_{^{210}Pb_0} / A_{^{210}Pb_h}) \times 1/\lambda$$

substituting the constants,

$$T_{age} = \ln(A_{^{210}Pb_0} / A_{^{210}Pb_h}) \times 1/0.03114;$$

where A_{210Pb_0} is the unsupported ^{210}Pb activity in disintegrations per minute at time zero (the present) and A_{210Pb_h} is the activity in disintegrations per minute at depth h, is the decay constant for ^{210}Pb. Ideally, a plot of ^{210}Pb activity with a log scale (X-axis) versus depth (Y-axis) will be a straight line. The slope of the line indicates the relative sedimentation rate. A steep slope represents a site of slow accumulation.

All measurements of continuous variables are made with uncertainty (error), that include a combination of random errors, systematic errors, or simple misjudgements in observation, which all combine to introduce a degree of uncertainty. Random errors arise from radioactive decay processes, or the measurements of supporting information. Systematic errors occur if there is a miscalibration of the instrumentation. Misjudgments arise from unrecognized "contamination" of the sample. In isotopic dating of sediment, it is assumed that the "law of superposition" is applicable. If sedimentary mixing, either natural or anthropogenic, is unrecognized, the results will be faulty.

Carbon-14 (^{14}C) also is produced in the Earth's atmosphere by the interaction of cosmic ray particles with nitrogen (N), oxygen (O), and carbon (C). Of these, nitrogen (N) is the most important in terms of the amount of ^{14}C produced. All ^{14}C produced is rapidly oxidized to CO_2 and is assimilated into the carbon cycle. As CO_2 containing the ^{14}C becomes incorporated in all carbon-based materials, a balance is established between intake, respiration, and decay. ^{14}C has a half-life of 5,730 years producing an effective range of applicability of 100 to 70,000 years. This upper limit is useful in studies of the south Florida ecosystem to calibrate other methods.

Radioelement measurements

Along with measurement of ^{210}Pb activity of each sample, the distribution of Cesium-137 (^{137}Cs), Beryllium-7 (^{7}Be), and Radium-226 (^{226}Ra) was also determined on selected cores. ^{137}Cs was measured by γ - spectroscopy, measuring the activity of the 0.662 Mev energy which is unique to this isotope. ^{7}Be is determined by measuring the activity of the 0.578Mev energy. ^{226}Ra is determined by the measuring of the activity of its great-great-great granddaughter, Bismuth-214 (^{214}Bi). This assumes that the radium is in equilibrium with its immediate daughter, Radon-222 (^{222}Rn), and this isotope is in radioactive equilibrium with ^{214}Bi. Because of the short half-life of the intermediate daughters and ^{214}Bi, this is a very safe assumption, but the mobility of radon requires the sealing of this sample and waiting two weeks until radon and radium achieve equilibrium. These analyses were made with a GeLi detector coupled to a multichannel analyzer.

The activity of ^{210}Pb was determined by measuring its grand daughter, Polonium-210 (^{210}Po). ^{210}Po, decays solely by α -radiation and is extremely easy to measure with surface barrier detectors. The ^{210}Po is isolated from the samples by dissolving the material and plating the isotopes on a silver planchet (Flynn, 1968). During the dissolution of the sample, a known amount of the trace isotopes ^{209}Po is added. By comparison of the activity of the tracer to that of the unknown, the amount of ^{210}Pb can be determined.

Results

Pollen

Core TC2-A

Three distinct pollen zones are identifiable based on percentage data from this core. The lowermost zone (35-24 cm) is dominated by *Pinus* (pine) pollen (33- 67%), with *Myrica* (wax myrtle) pollen abundant (13-23%) (Fig. 2). *Cladium* (sawgrass) pollen is common (6-10%) throughout this interval, and other taxa present in low (<5%) percentages include *Rhizophora* (red mangrove), *Conocarpus* (buttonwood), *Quercus* (oak), and members of the Asteraceae (aster) and Chenopodiaceae/Amaranthaceae (pigweed/amaranth) families.

The middle zone (24-13 cm) is dominated by *Cladium* and Asteraceae pollen (ranging from 11-30% and 5-26%, respectively). *Rhizophora* pollen is slightly more abundant in this interval but still comprises <5% of the assemblages, and *Avicennia* (black mangrove) pollen makes its first appearance in this interval.

The upper zone (13-0 cm) has higher percentages of *Rhizophora* (3-15%), *Quercus* (4-12%), and Chenopodiaceae/Amaranthaceae pollen (3-8%). *Cladium* pollen drops to lower percentages (0.6-4%) than any other intervals in the core. The abundance of Asteraceae pollen also declines but remains at higher abundances (5.5-11%) than in the lower part of the core.

The absolute pollen concentration shows a peak in the middle zone of the core (Fig. 3),where concentrations typically are twice as high as in the upper and lower portions of the core. Three taxa, *Cladium*, *Myrica*, and Asteraceae, are particularly

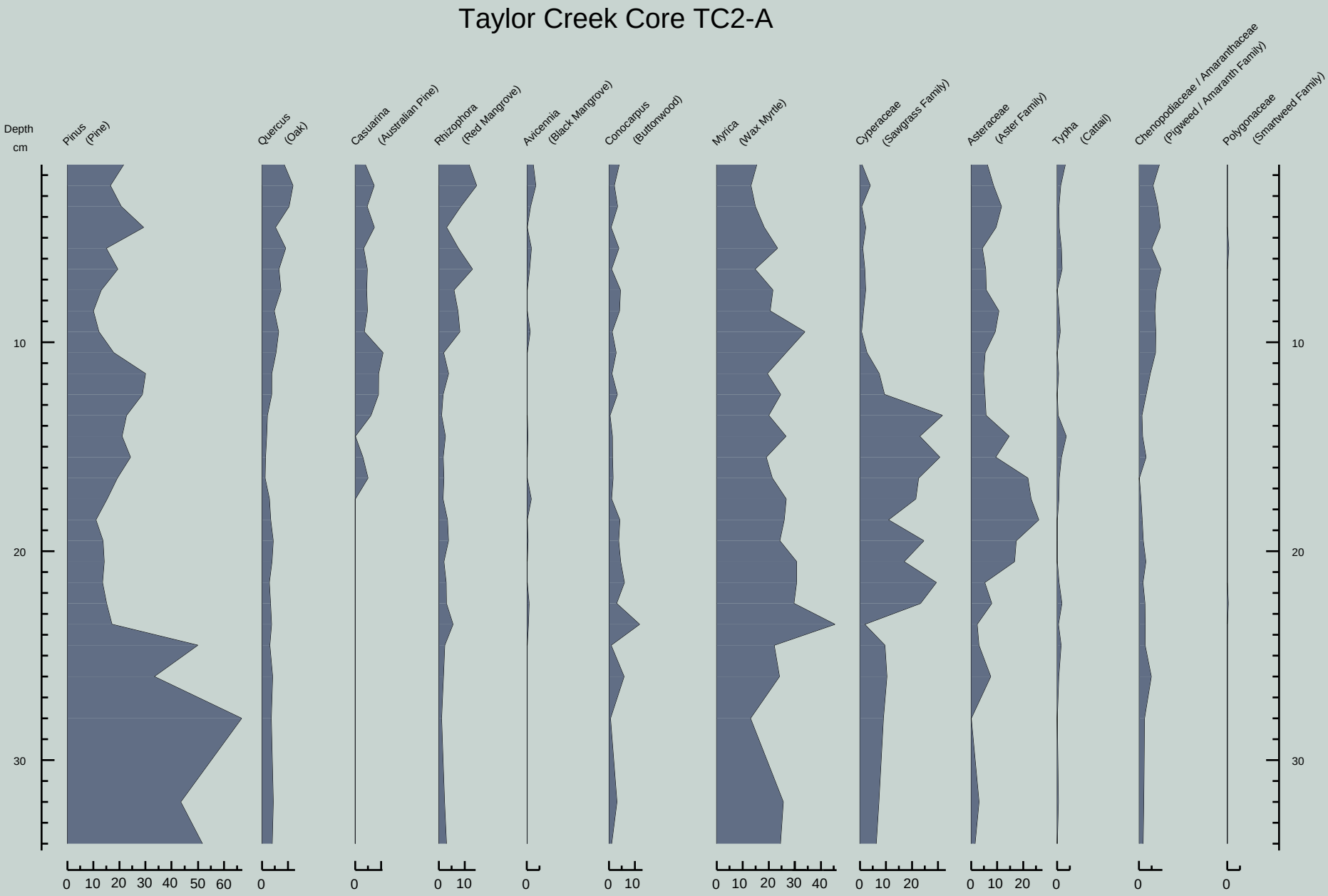


Figure 2: Percent abundance of pollen of major plant taxa in Taylor Creek Core TC2-A.

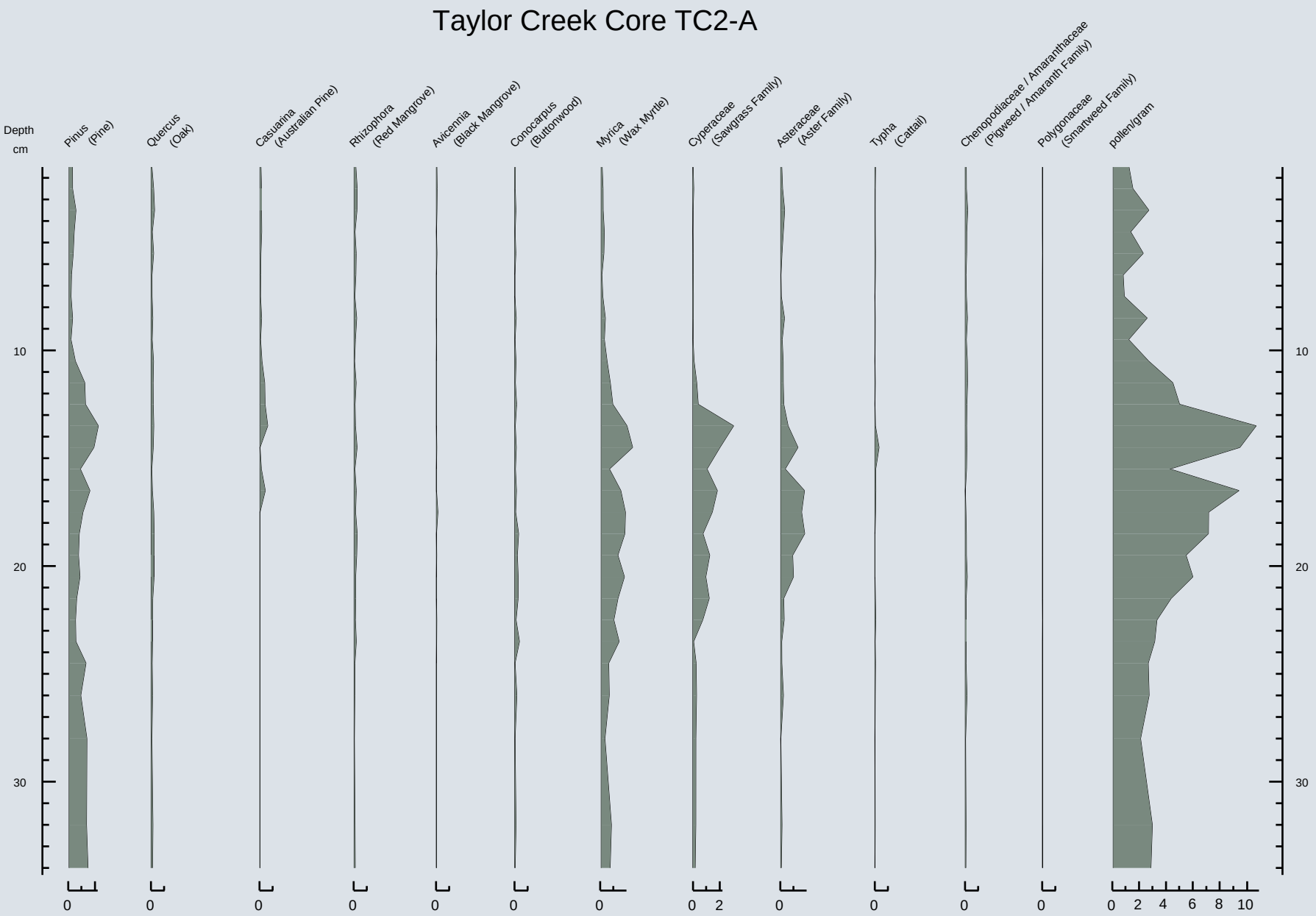


Figure 3: Absolute pollen concentration (x 10^4 grains g^{-1}) of major plant taxa in Taylor Creek Core TC2-A.

abundant in this interval, accounting for the higher total pollen concentration. *Pinus* pollen is present in relatively constant abundances in the lower 25 cm of the core, but its abundance decreases by half in the upper 10 cm. *Cladium*, *Myrica*, and Asteraceae pollen also decrease to very low values in the upper 10 cm of the core.

Core TC2-B

Samples were taken from this core to provide a pollen record of the lower 63 cm of the core, which were not obtained in the first coring attempt. Several intervals in the upper 35 cm also were examined for pollen to correlate these results with those of Core TC2-A. Three pollen zones can be identified in this core (Fig. 4). The lowest zone (98-70 cm) is dominated by *Pinus* pollen (57-95%). *Cladium* and *Myrica* pollen also are common, comprising up to 14% and 19% of the assemblage, respectively. The middle zone (70-30 cm) has higher percentages of *Cladium* (17-46%), *Myrica* (12-38%), *Typha* (cattail) (1-10%) and Asteraceae (1-14%) pollen. The upper zone (30-0 cm) has the highest percentages of *Myrica* (31-58%), and pollen of the Asteraceae is common (3-22%). *Cladium* pollen generally is less abundant than in the other zones, ranging from 0.6% to 5.5% of the assemblage.

The absolute pollen concentrations show two peak abundances, one at 60-40 cm depth, and another between 30 cm and 15 cm (Fig. 5). The lower peak reflects higher concentrations of *Cladium*, *Typha*, and Asteraceae pollen, and the upper peak reflects increased abundances of *Myrica*, *Pinus*, and Asteraceae pollen. *Pinus* pollen is present in fairly consistent amounts in the lower 80 cm but decreases by half in the upper 15 cm.

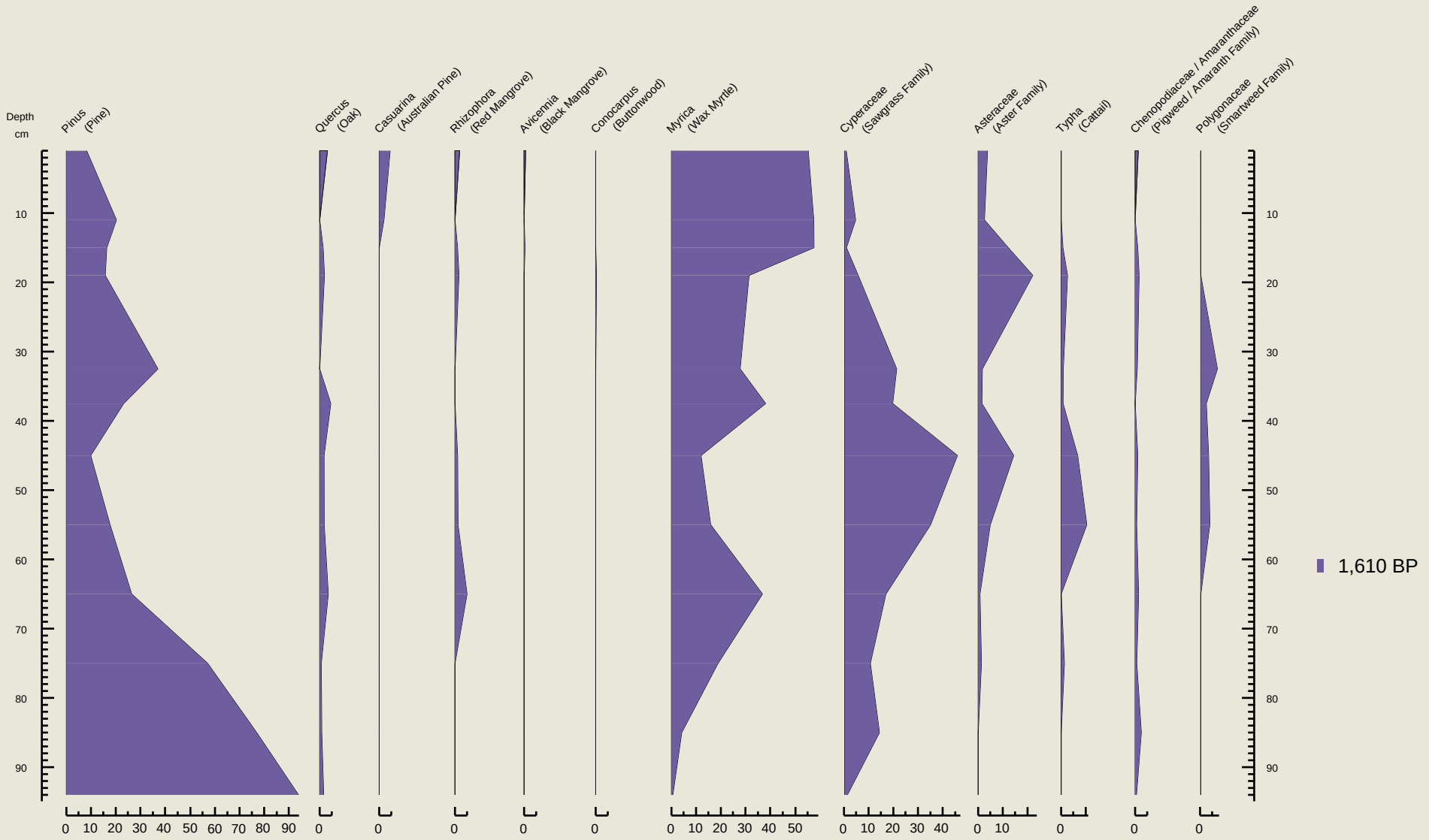


Figure 4: Percent abundance of pollen of major plant taxa in Taylor Creek Core TC2-B.

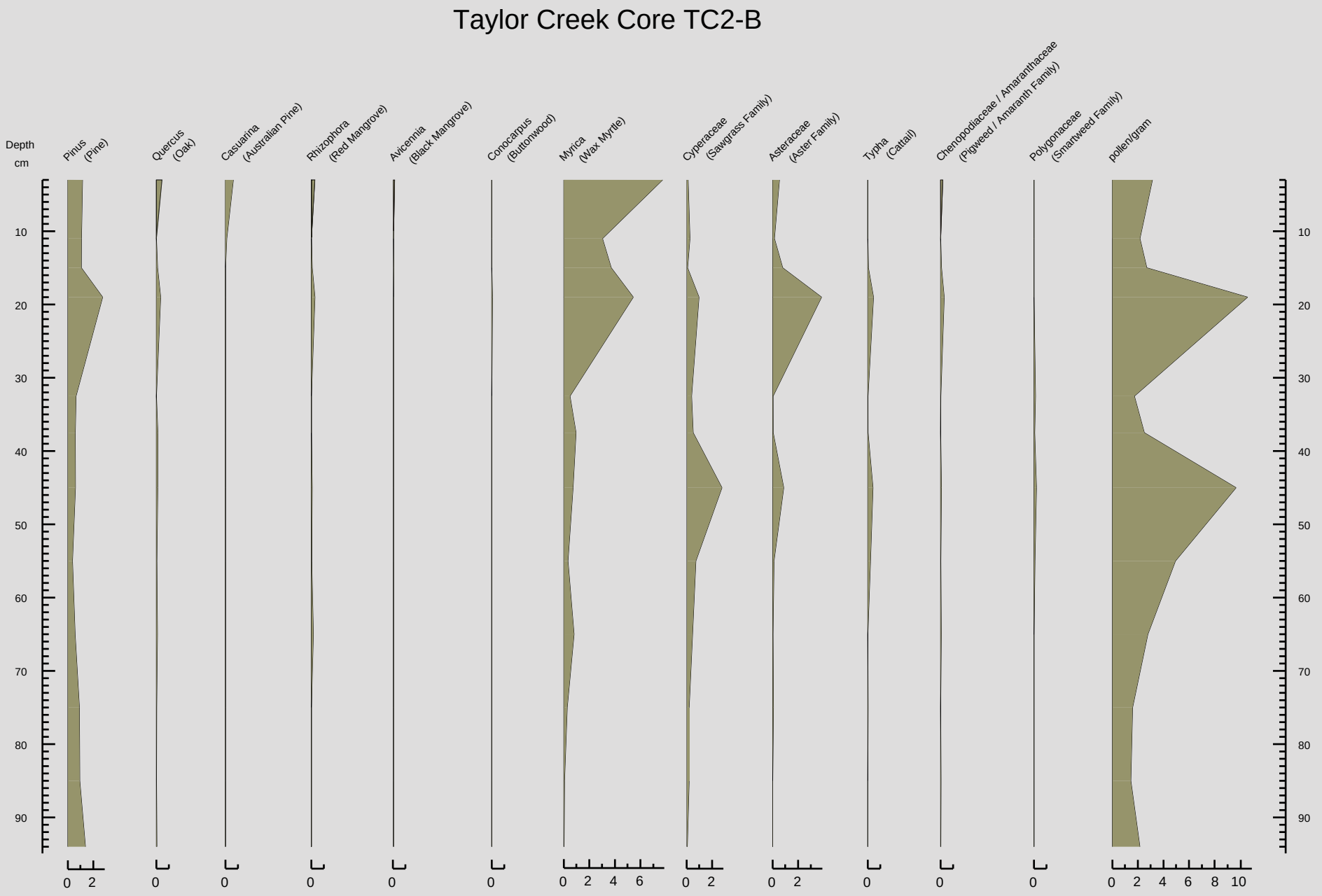


Figure 5: Absolute pollen concentration (x 10^{4}grains g^{-1}) of major plant taxa in Taylor Creek Core TC2-B.

Myrica pollen is present in low concentrations in the lower two zones, but increases to higher concentrations in the upper 30 cm of the core.

Geochronology

A radiocarbon date of 1,610 BP was obtained from the marl layer at 60 cm depth. For ^{210}Pb analyses, the calculation of "dates" is dependent on the model that best describes the geochemistry of ^{210}Pb. There are two "end member" models which have been widely applied to the "dating" of sedimentary deposits: the Constant Initial Concentration or CIC model and the Constant Rate of Supply or the CRS model. The CIC model assumes that the ^{210}Pb activity in the depositional system has been constant through time. This assumption requires that the total ^{210}Pb concentration is equal to or supersedes the capacity of the "attaching" medium to sequester it. Given this assumption, it does not matter how the rate of supply of sediment varies, the initial concentration is always constant. The CRS model assumes that the flux of ^{210}Pb to the sediment has been constant and if the rate of sediment accumulation changes, the concentrations of ^{210}Pb will become either diluted or concentrated. The use of either of these models requires that ^{210}Pb does not migrate after deposition and that the regional flux is constant. Delphino and others (1993) presented data which suggests that the flux in south Florida has been constant for the last 150 years. Studies examining factors that may cause lead mobility indicate that migration can occur only in extremely acidic environments (Binford, 1990). The sediments in the Everglades are neutral to slightly acidic (William Orem, 1995, personal communication), and there is no evidence to suggest post-depositional movement.

Binford (1990) used the CRS model in calculation of rates of sedimentation in lakes in Florida. Delphino and others (1993) applied the model to peats in the Water Conservation Areas. Application of the CRS model, however, does not account for mixing or post depositional disturbances, and failure to do so could produce invalid and/or misleading conclusions. In an attempt to circumvent this problem, a variation of this model was used for this report. This method calculates the best-fit of the natural log of the ^{210}Pb distribution. Each core was examined prior to calculations, and, if there is suggestion of mixing, data from those sections are excluded. The ^{210}Pb natural log values from the unmixed portion of the core are plotted and a best-fit calculated. If the best-fit has a correlation coefficient (r^2) of greater than 0.9 it is considered a good fit. The apparent ^{210}Pb age for each level is calculated using the formula for the best-fit line. In cases where there was disruption of the sedimentary record, it is impossible to calculate an age. The rate of accumulation for that part of the core in which there is no disruption of the sedimentary record, however, is valid within the error of determination. The best fit model used in this report gives a date of 1877 for the 12-13 cm interval.

The degree of uncertainty inherent in these analyses was addressed in a manner similar to Binford (1990), Robbins (1996), and Delphino and others (1993); a combination of First-Order Analysis and Monte Carlo Simulation. Binford (1990) concluded that there was a generally good agreement between these two procedures.

One problem inherent in ^{210}Pb dating is what Binford (1990) termed "old date error." This is a product of the procedure by which "equilibrium" is defined. In cores where there is ^{226}Ra data, "equilibrium" is assumed to be the activity at which the activity of ^{210}Pb and ^{226}Ra are equal. In cores with no ^{226}Ra data, a procedure similar to that of

Binford and others (1990) was employed. This method examines the ^{210}Pb distribution and where the data approach the asymptote, the mean and the standard deviation of ^{210}Pb concentrations are calculated below this level. The number of data points included depends on visual inspection of the curve. These parameters are used in a t-test to compare the ^{210}Pb values at subsequently higher sections. When the level is reached that is significantly different (95% level of confidence), that point is considered to be the limit of unsupported^{210}Pb. Although, theoretically, the unsupported ^{210}Pb never reaches equilibrium, this procedure artificially reduces the "unsupported activity" to zero, and those "dates" calculated near this "lower limit of detection" are artificially "old". The lead-210 activity from core TC2-A is shown in Figure 6.

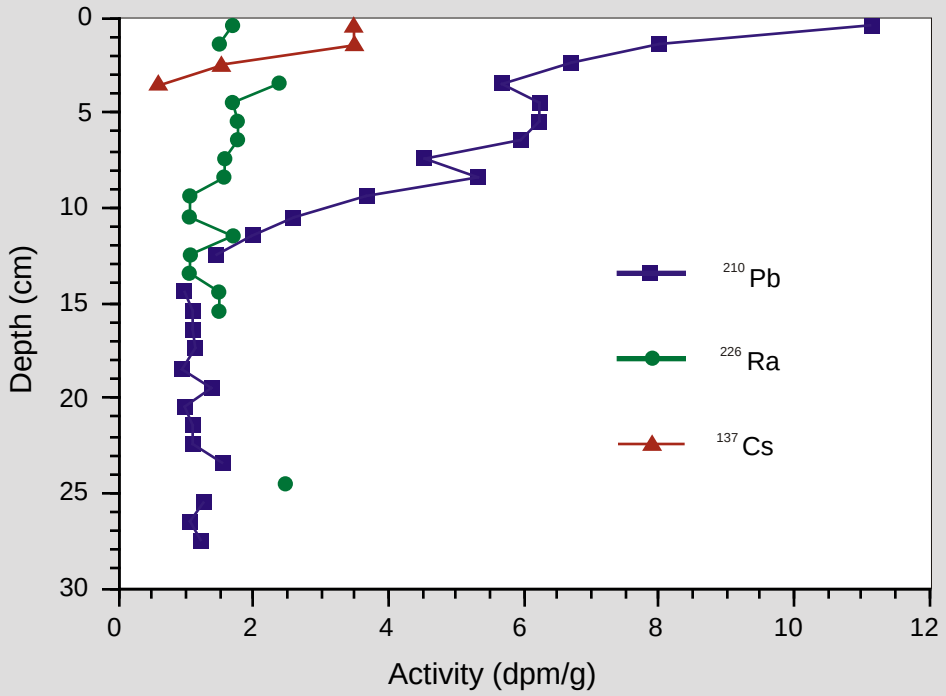
Discussion

Correlation of TC2-A and TC2-B

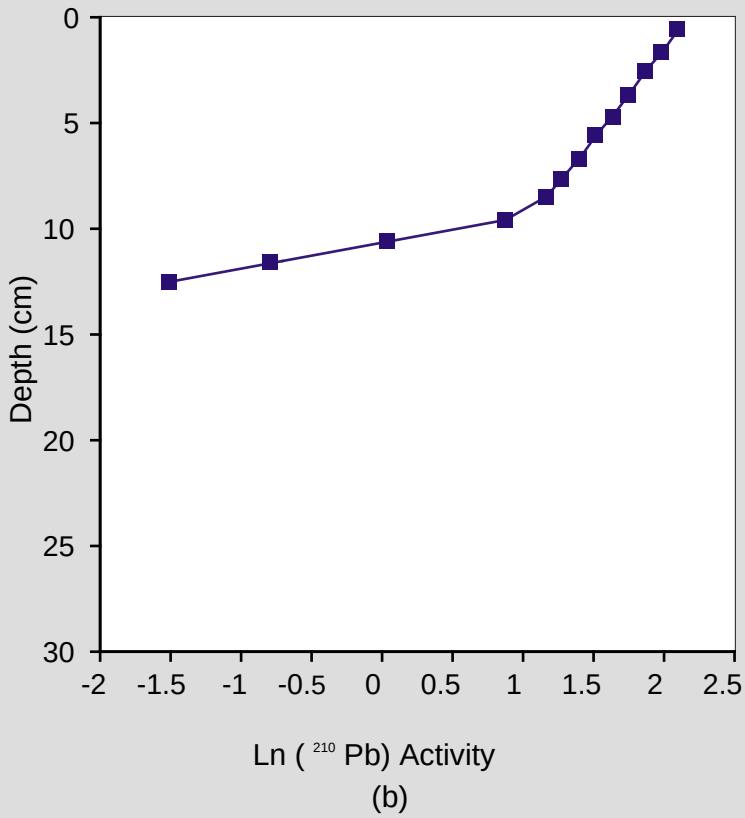
Several samples were taken from the upper 30 cm of the long core (TC2-B) to correlate it with core TC2-A. Although wax myrtle pollen is much more abundant in TC2-B, the peaks in aster abundance (both percentage and absolute concentration) occur at the same interval in each core (18-20 cm). The increased abundances of oak and red mangrove occur in the upper 15 cm of both cores.

Long-Term Trends

A record of pollen assemblages covering more than the last 1,600 years is provided by the long core. The bottom sample (90-98 cm) is unusual in the high percentage of pine pollen (95%) and scarcity of any other pollen types. However, pollen concentration data



(a)



(b)

Figure 6: a) Profile of ^{210}Pb, ^{226}Ra, and ^{137}Cs activity vs. depth in Taylor Creek Core TC2-A.

b) Natural log of ^{210}Pb activity vs. depth.

indicates that pine pollen is no more abundant in that sample than elsewhere in the core, whereas pollen of other taxa is virtually absent. Between 90 cm depth in the core TC2-B and 12 cm depth in core TC2-A, sawgrass pollen is a common to abundant component of the assemblages, and its concentration in the sediment indicates at least a doubling of abundance between 60 cm and 40 cm. Pollen of other marsh and slough vegetation also is more abundant between 60 cm and 30 cm, particularly that of cattail, smartweed (*Polygonum*), and aster. Although red mangrove pollen is present in the lower part of the core, it is a minor component of the assemblages. These data indicate that marsh and slough vegetation was the dominant element of plant communities in this region prior to about 1950. Fluctuations in the composition of this vegetation reflect natural changes in hydroperiod and nutrient availability.

Short-Term Trends

The last 150 years is represented by the upper 15-20 cm of core, and a major vegetational shift is indicated by the pollen assemblages at about 10 cm. Below that point, sawgrass and aster pollen are common to abundant components of the assemblage, but above that sawgrass pollen decreases to lower abundances than anywhere else in the core. Above that point, tree pollen increases in abundance, including red and black mangroves, oak, australian pine (which was introduced at around the turn of the century) and (based on TC2-B), wax myrtle. Using radiocarbon dates and the current age model for this core, the pollen record indicates that sawgrass pollen was a dominant element of assemblages for a few hundred years prior to 1880, dropping to abundances comparable to those at the bottom of the core in the early 1900s (Fig. 2). Analyses of floral and faunal remains from

core T24, collected at the mouth of Taylor Creek, also document vegetational changes and an increase in poly- and euhaline species at about the turn of the century (G. Lynn Brewster-Wingard, pers. comm.). Such correlations indicate that both vegetation and nearshore benthic assemblages in Little Madeira Bay were affected by some environmental disturbance at that time. By 1960, the abundance of sawgrass pollen had dropped to lower levels than anywhere else in the core. Several hydrologic changes have occurred since the turn of the century, altering the timing and amount of fresh-water flow to the area. Tamiami Trail construction was underway from 1915-1928, and, although culverts are in place to facilitate water movement, sheet flow has effectively been stopped by the presence of the highway. The levees and canals delimiting the Water Conservation Areas were built during the 1950s and early 1960s, and the C111 canal was built during the early 1960s; all of these structures have altered delivery of water to the Taylor Slough area (Light and Dineen, 1994; Lodge, 1994). Changes in the hydrologic regime are further documented by aerial photographs taken in the 1940s , which show that the southernmost lake along Taylor Creek has decreased in size by almost half (Charles W. Holmes, pers. comm.). Some or all of these changes probably acted as catalysts for the decreased representation of sawgrass in the pollen record and subsequent increase in abundance of pollen of tree and hammock vegetation.

Summary

Analysis of pollen assemblages from a core collected in Taylor Creek indicate that marsh and slough vegetation, primarily sawgrass with some incursions by cattails, dominated the area for most of the last two millenia, until about 1950-1960. At that point,

sawgrass pollen declined to lower abundances than recorded elsewhere in the core, and tree pollen became much more abundant in the cores. This change reflects the vegetational response to alterations in the hydrologic system throughout much of the last century.

References Cited

Benninghoff, W.S., 1962, Calculation of pollen and spore density in sediments by addition of exotic pollen in known quantities: Pollen et Spores, v. 4, p. 332-333.

Binford, M.W., 1990, Calculation and uncertainity analysis of ^{210}Pb dates for PIRLA project lake sediment cores: Journal of Paleolimnology, v.3, p. 253-267.

Delphino, J.J., Crisman,T.L., Gottgens, J.F., Rood, B.E., and Earle, C.D.A., 1993, Spatial and temporal distribution of mercury in Everglades and Okefenokee wetland sediments: Final Report, Department of Environmental Engineering Science, Univ. of Florida, Gainesville, FL, 140 p.

Flynn, W.W., 1968, The determination of low levels of polonium-210 in environmental materials: Analytica Chimica Acta, v 43, p. 221-227.

Light, S.S., and Dineen, J.W., 1994, Water Control in the Everglades: A historical Perspective. *in* Davis, S.M., and Ogden, J.C., editors, Everglades: The Ecosystem and Its Restoration: Delray Beach, Florida, St. Lucie Press, p. 47-84.

Lodge, T.E., 1994, The Everglades Handbook: Delray Beach, Florida, St. Lucie Press, 228 p.

Maher, L.J., Jr., 1981, Statistics for microfossil concentration measurements employing samples spiked with marker grains: Review of Palaeobotany and Palynology, v. 32, pp. 153-191.

Robbins, J.A., Wang, X., and Rood, R.W., 1996, Sediment coring dating: Semi-annual report to the South Florida Water Management District, unpublished manuscript, 100 p.

Stockmarr, J., 1971, Tablets with spores used in absolute pollen analysis: Pollen et Spores, v. 8, p. 615-621.

Stockmarr, J., 1973, Determination of spore concentration with an electronic particle counter: Danmarks Geologiske Undersøgelse, Ärbog 1972, p. 87-89.

Table 2. Percent abundance of pollen of plant taza found in Taylor Creek Long Core 2 (TC2-B)

Depth	TREE AND SHRUB TAXA	*Alnus* (Alder)	*Avicennia* (Black Mangrove)	*Betula* (Birch)	*Bumelia* (Bumelia)	*Bursera simbaruba* (Gumbo Limbo)	*Casuarina* (Australian Pine)	*Celtis* (Hackberry)	*Cephalanthus* (Buttonbush)	*Conocarpus* (Buttonwood)	*Cyrilla* (Cyrilla)	*Ilex* (Holly)	*Juglans* (Walnut)
0-2		1.90	0.63	0.63	0.63	1.90	4.43	1.90	0.00	0.00	0.00	0.00	0.00
10-12		0.00	0.00	0.00	0.00	0.00	1.91	0.00	0.00	0.00	0.00	0.00	0.00
14-16		0.70	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00
18-20		0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	1.29	0.00
30-35		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35-40		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.75
40-50		0.35	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50-60		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	4.29	0.00
60-70		0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70-80		0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.65	0.00	0.65	0.65	0.00
80-90		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90-98		0.00	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54

Table 2. Percent abundance of pollen of plant taza found in Taylor Creek Long Core 2 (TC2-B)

Depth	*Liquidambar* (Sweet Gum)	*Myrica* (Wax Myrtle)	*Pinus* (Pine)	*Quercus* (Oak)	*Rhizophora* (Red Mangrove)	*Salix* (Willow)	*Ulmus* (Elm)	HERBACEOUS TAXA	Asteraceae (Aster Family)	Chenopodiaceae/Amaranthaceae (Pigweed/Amaranth Families)	Cyperaceae (Sawgrass Family	*Decodon* (Swamp Loosestrife)	Ericaceae (Heath Family)
0-2	0.00	55.70	8.23	3.16	1.90	0.00	0.00		3.80	1.27	0.63	0.00	1.27
10-12	0.64	57.96	20.38	0.00	0.00	0.00	0.00		2.55	0.00	4.46	0.00	0.00
14-16	0.00	58.04	16.43	1.40	1.05	0.00	0.00		12.24	1.05	0.70	0.00	0.00
18-20	0.00	31.61	15.81	1.94	1.61	0.00	0.00		22.26	1.61	5.48	0.97	0.00
30-35	0.85	27.97	37.29	0.00	0.00	0.00	0.00		1.69	0.85	21.19	0.00	0.00
35-40	0.00	38.35	23.31	4.51	0.00	0.00	0.00		1.50	0.00	19.55	0.00	0.00
40-50	0.71	12.01	9.89	1.77	1.06	0.00	0.00		14.49	1.06	45.94	0.00	0.00
50-60	0.00	15.95	17.79	1.84	1.23	0.00	0.00		4.91	0.61	34.97	0.00	0.00
60-70	0.00	37.06	26.57	3.50	4.90	0.70	0.70		0.70	1.40	16.78	0.00	0.00
70-80	0.00	18.95	57.52	0.65	0.00	0.00	0.00		1.31	0.65	10.46	0.00	0.00
80-90	0.00	4.17	77.50	0.83	0.00	0.00	0.00		0.00	2.50	14.17	0.00	0.00
90-98	0.00	0.54	94.57	1.63	0.00	0.00	0.54		0.00	0.54	1.09	0.00	0.00

Table 2. Percent abundance of pollen of plant taza found in Taylor Creek Long Core 2 (TC2-B)

Depth	Euphorbiaceae (Spurge Family)	Fabaceae (Bean/Legume Family)	*Hippocratea*	*Myriophyllum* (Milfoil)	Poaceae (Grass Family)	Polygonaceae (Smartweed Family)	*Sagittaria* (Arrowhead)	Solanaceae (Potato Family)	*Typha* (Cattail)	*Utricularia* (Bladderwort)	Tricolporate sp. A
0-2	0.00	6.33	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	1.27
10-12	0.64	3.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.91
14-16	0.35	1.05	0.00	0.00	0.00	0.00	0.35	2.80	0.70	0.35	0.00
18-20	0.32	2.26	0.32	0.32	0.00	0.00	0.00	7.42	2.58	0.00	0.32
30-35	0.00	1.69	0.00	0.00	0.00	6.78	0.00	0.00	0.85	0.00	0.00
35-40	1.50	2.26	0.00	0.00	0.75	2.26	2.26	0.00	0.75	0.00	0.75
40-50	0.35	1.06	0.00	0.00	0.00	3.18	0.00	0.71	6.71	0.00	0.00
50-60	1.84	1.23	0.00	0.00	0.00	3.68	0.00	0.00	10.43	0.61	0.00
60-70	0.70	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.40	1.40
70-80	0.00	3.27	0.00	0.00	1.31	0.00	0.00	0.00	1.31	0.65	0.65
80-90	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90-98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3. Data on activity of lead-210, cesium-137, and redium-226. (nc=not counted)

Interval Sampled (cm)	Depth for plot (cm)	^{210}Pb Activity	Excess 210 PB Activity	Error	Dry Bulk Density	Ln(^{210}Pb) Activity	^{226}Ra	^{137}Cs
0-1	0.5	11.165	9.445	0.034	0.100	2.122	1.720	3.500
1-2	1.5	8.032	6.532	0.021	0.129	2.005	1.500	3.500
2-3	2.5	6.734	6.734	0.012	0.108	1.887	NC	1.600
3-4	3.5	5.706	3.306	0.014	0.120	1.77	2.400	0.600
4-5	4.5	6.265	4.565	0.009	0.111	1.653	1.700	nc
5-6	5.5	6.246	4.446	0.010	0.108	1.535	1.800	nc
6-7	6.5	5.99	4.19	0.006	0.108	1.418	1.800	nc
7-8	7.5	4.559	2.959	0.006	0.110	1.3	1.600	nc
8-9	8.5	5.351	3.751	0.008	0.120	1.183	1.600	nc
9-10	9.5	3.668	2.568	0.008	0.127	0.879	1.100	nc
10-11	10.5	2.604	1.504	0.006	0.154	0.086	1.100	nc
11-12	11.5	1.972	0.272	0.006	0.127	-0.708	1.700	nc
12-13	12.5	1.488	0.388	0.006	0.095	-1.502	1.100	nc
13-14	13.5	nc	nc	nc	0.133	nc	1.100	nc
14-15	14.5	1.016	nc	nc	0.133	nc	1.500	nc
15-16	15.5	1.117	nc	nc	0.131	nc	1.500	nc
16-17	16.5	1.137	nc	nc	0.151	nc	nc	nc
17-18	17.5	1.16	nc	nc	0.173	nc	nc	nc
18-19	18.5	0.972	nc	nc	0.161	nc	nc	nc
19-20	19.5	1.408	nc	nc	0.181	nc	nc	nc
20-21	20.5	1.01	nc	nc	0.179	nc	nc	nc
21-22	21.5	1.139	nc	nc	0.184	nc	nc	nc
22-23	22.5	1.117	nc	nc	0.167	nc	nc	nc
23-24	23.5	1.564	nc	nc	0.177	nc	nc	nc
24-25	24.5	nc	nc	nc	0.174	nc	2.500	nc
25-27	25.5	1.276	nc	nc	0.322	nc	nc	nc
27-29	26.5	1.075	nc	nc	0.315	nc	nc	nc
29-31	27.5	1.229	nc	nc	0.293	nc	nc	nc
31-33	28.5	nc	nc	nc	0.293	nc	nc	nc
33-35	29.5	nc	nc	nc	0.299	nc	nc	nc
35-37	30.5	nc	nc	nc	0.272	nc	nc	nc
37-39	31.5	nc	nc	nc	0.330	nc	nc	nc
39-41	32.5	nc	nc	nc	0.287	nc	nc	nc
41-43	33.5	nc	nc	nc	0.265	nc	nc	nc
43-45	34.5	nc	nc	nc	0.284	nc	nc	nc
45-47	35.5	nc	nc	nc	0.273	nc	nc	nc
47-49	36.5	nc	nc	nc	0.287	nc	nc	nc
49-51	37.5	nc	nc	nc	0.262	nc	nc	nc
51-53	38.5	nc	nc	nc	0.273	nc	nc	nc
53-55	39.5	nc	nc	nc	0.292	nc	nc	nc
55-57	40.5	nc	nc	nc	0.323	nc	nc	nc
57-59	41.5	nc	nc	nc	0.445	nc	nc	nc
59-61	42.5	nc	nc	nc	0.723	nc	nc	nc
61-63	43.5	nc	nc	nc	0.866	nc	nc	nc
63-65	44.5	nc	nc	nc	0.899	nc	nc	nc
65-67	45.5	nc	nc	nc	0.850	nc	nc	nc
67-69	46.5	nc	nc	nc	0.942	nc	nc	nc
69-71	47.5	nc	nc	nc	1.032	nc	nc	nc