Palynological analysis of Five Samples from Big Spring Trench Three

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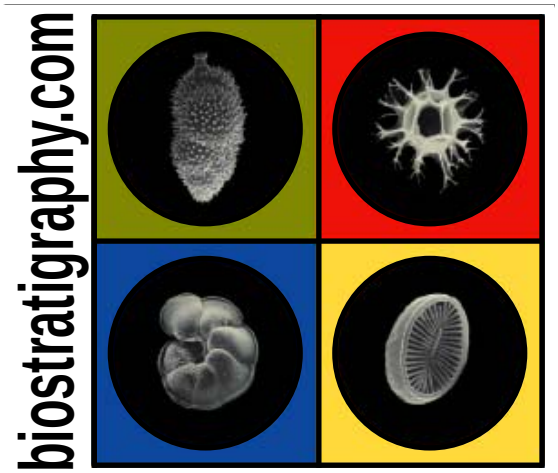

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January 18, 2005

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January 18, 2005

Executive summary

Palynological analysis of 5 samples from Big Spring Trench Three produced 3 stratigraphic units defined by palynological content. The pollen analyses suggest a sedimentary progression from a natural fluvial / marsh environment at the base of Big Spring Trench 3 to an in-filled Sphagnum swamp at the top.

Except for the reduction of *Carya* spp (Pecan) and the conifers, other pollen types that would have marked major settlement events were not observed. These marker pollen may be more likely recovered from more organic rich lacustrine sediments nearby.

The relative abundance (and apparent concentration) of microscopic charcoal particles increases upward. Although the analyses were semi-quantitative, the general trend of charcoal abundance seems to mirror the trend in magnetic susceptibility.

Introduction:

Five trench samples from Big Spring Trench 3 were provided by Robert Walter, Department of Geological Sciences, Case Western Reserve University for palynology processing and analysis. This work was undertaken for the purpose of interpreting changes in paleoenvironments in response to colonization and settlement.

Methods:

Samples were washed to remove oil / oil-based mud. Carbonate minerals were dissolved using HCl and silicate minerals removed using HF. The organic residue was washed with cold HNO_3 followed by a wash with ammonia or KOH. The residues were sieved through a 10 µm mesh screen to remove small particles that would be unidentifiable in transmitted light microscopy. Residues were mounted on a coverslip with polyvinyl alcohol and fixed to a microscope slide with elvacite. Samples were examined at a minimum of 500X.

The palynological sample processing was performed by PaleoLab (jointly operated by BaselineDGSI, Inc. and Biostratigraphy.com) in The Woodlands, TX. Slides and residues were shipped to Biostratigraphy.com in Garland, TX for sample analysis. Dr. Pierre A. Zippi performed all analyses and interpretations.

Results:

The five samples from Big Spring Trench 3 yielded 48 palynomorph taxa. Most samples produced abundant and well-preserved palynomorphs. The semi-quantitative palynomorph distribution is shown in Enclosure 1.

The results of the Big Spring Trench 3 pollen analyses are listed below.

Sample 30-35 cm

Very Abundant	Charcoal
Rare	Cuticle
Common	Tracheids
Present	Pinus spp
Present	Tsuga? (poor preservation, questionable identification)
Present	Botrychium virginianum
Present	Cheilanthes ?feei
Rare	Lycopodium clavatum
Rare	Sphagnum spp
Present	Monoporate ellipsoidal flat base fungal spore
Very Abundant	Monoporate ellipsoidal fungal spores

Common	Monoporate spheroidal fungal spores
Common	Monoporate triangular fungal spores
Present	Tricellate 1p fungal spore
Rare	Dictyosporites spp
Present	Arthrobotrys ring cells
Rare	Fungal fragments
Abundant	Mycorrhizal fungal spores w/stalks

Sample 70-75 cm

Very Abundant	Charcoal
Rare	Resin spheres
Abundant	Tracheids
Common	Ipomoea spp (Morning glory)
Present	Liliaceae
Abundant	Botrychium virginianum
Present	Dennstaedtia (small triangular trilete bordered laesurae)
Common	Lycopodium spp (clavate)
Very Abundant	Sphagnum spp
Present	Arthrinium spp
Common	Monoporate ellipsoidal fungal spores
Abundant	Monoporate spheroidal fungal spores
Common	Monoporate triangular fungal spores
Present	Dicellate ascospore
Common	Fungal fragments
Common	Mycorrhizal fungal spores w/stalks

Sample 80-85 cm

Abundant	Charcoal
Present	Resin spheres
Present	Cuticle
Common	Tracheids
Present	Carya spp
Present	Carex? spp
Present	Tricolpate small deformed
Rare	Botrychium virginianum
Rare	Cheilanthes ?feei
Present	Osmundaceae
Common	Polypodiaceae spp (smooth monolete)
Rare	Dennstaedtia (small triangular trilete bordered laesurae)
Present	Equisetum? spp
Present	Lycopodium spp (clavate)
Present	Sphagnum spp
Present	Arthrinium spp
Abundant	Monoporate spheroidal fungal spores
Abundant	Monoporate triangular fungal spores
Common	Fungal fragments

Rare	Fungal hyphae
Rare	Mycorrhizal fungal spores w/stalks

Sample 110-115 cm

Common	Charcoal
Very Abundant	Resin spheres
Abundant	Cuticle
Abundant	Tracheids
Abundant	Populus? (degraded, questionable identification)
Present	Quercus
Abundant	Polypodiaceae spp (smooth monolete)
Common	Dennstaedtia (small triangular trilete bordered laesurae)
Present	Lycopodium spp (clavate)
Rare	Fungal fragments

Sample 120-125 cm

Present	Charcoal
Very Abundant	Resin spheres
Very Abundant	Cuticle
Very Abundant	Tracheids
Present	Acer
Abundant	Carya spp
Present	Juglans? (poor pres)
Present	Ostrya virginiana
Present	Populus?
Present	Quercus
Present	Abies
Present	Picea
Common	Pinus spp
Present	Tsuga?
Present	Croton sp
Present	Echinate (Asteraceae) 25 µm
Present	Cirsium ?horridulum
Present	Liliaceae
Present	Saggitaria lancifolia (Alismataceae)
Present	Utricularia foliosa
Present	Botrychium virginianum
Present	Osmundaceae
Very Abundant	Polypodiaceae spp (smooth monolete)
Present	Polypodium (verrucate monolete)
Present	Pteris spp (smooth trilete)
Abundant	Dennstaedtia (small triangular trilete bordered laesurae)
Present	Lycopodium lucidulum
Present	Fungal fragments
Very Abundant	Mycorrhizal fungal spores w/stalks
Present	Zygnemataceae

Discussion:

The pollen content along with the taxonomic and environmental groupings (Figures 1 and 2) can be used to divide the Big Spring Trench 3 into 3 units.

The first unit consists of the lowest 2 samples. These samples are characterized by common forest and floodplain tree pollen and pteridophyte spores, rare fungi, common aquatic (marsh) angiosperms and a lack of swamp bryophytes (Sphagnum). The lowest sample at 120-125 cm contains the highest diversity of pollen and spores and may represent the pre-disturbance low gradient fluvial to slough-like marsh environments. This interpretation s supported by the relatively high numbers of floodplain/fluvial and shallow water aquatic pollen. The content of the sample at 110-115 is transitional between 120-125 cm and 80-85 cm.

The second unit consists of two samples, 80-85 cm and 70-75 cm. These samples are characterized by a near absence of forest tree pollen, a reduction in floodplain/fluvial pollen and spores and a dramatic increase in fungal spores. The marsh/swamp component differs between sample 80-85 cm and 70-75 cm. The lower sample contains a few questionable occurrence of aquatic/marsh pollen, while the upper sample contains abundant Sphagnum spp. spores. This suggests the development of Sphagnum swamps nearby this site.

Although the uppermost sample, at 30-35 cm, is more similar to the second unit than the to the first, it can be separated from unit 2 based on a drop in the abundance of spores and pollen of all types and a marked abundance of monoporate fungal spores and mycorrhizal fungi. This change in pollen content may be due the harsh preservational properties of shallow soil horizons. Fungi or soil swelling animals may have consumed the non-fungal palynomorphs.

The relative abundance (and apparent concentration) of microscopic charcoal particles increases upward though the samples. Although the analyses were semi-quantitative, the general trend of charcoal abundance seems to mirror the trend in magnetic susceptibility (R. Walters, pers. comm., 2004).

Mycorrhizal fungi (root fungi) is present throughout the section. These occurrences may be due to modern day root penetration of the sediment layers, or they may represent root penetration synchronous with sedimentation.

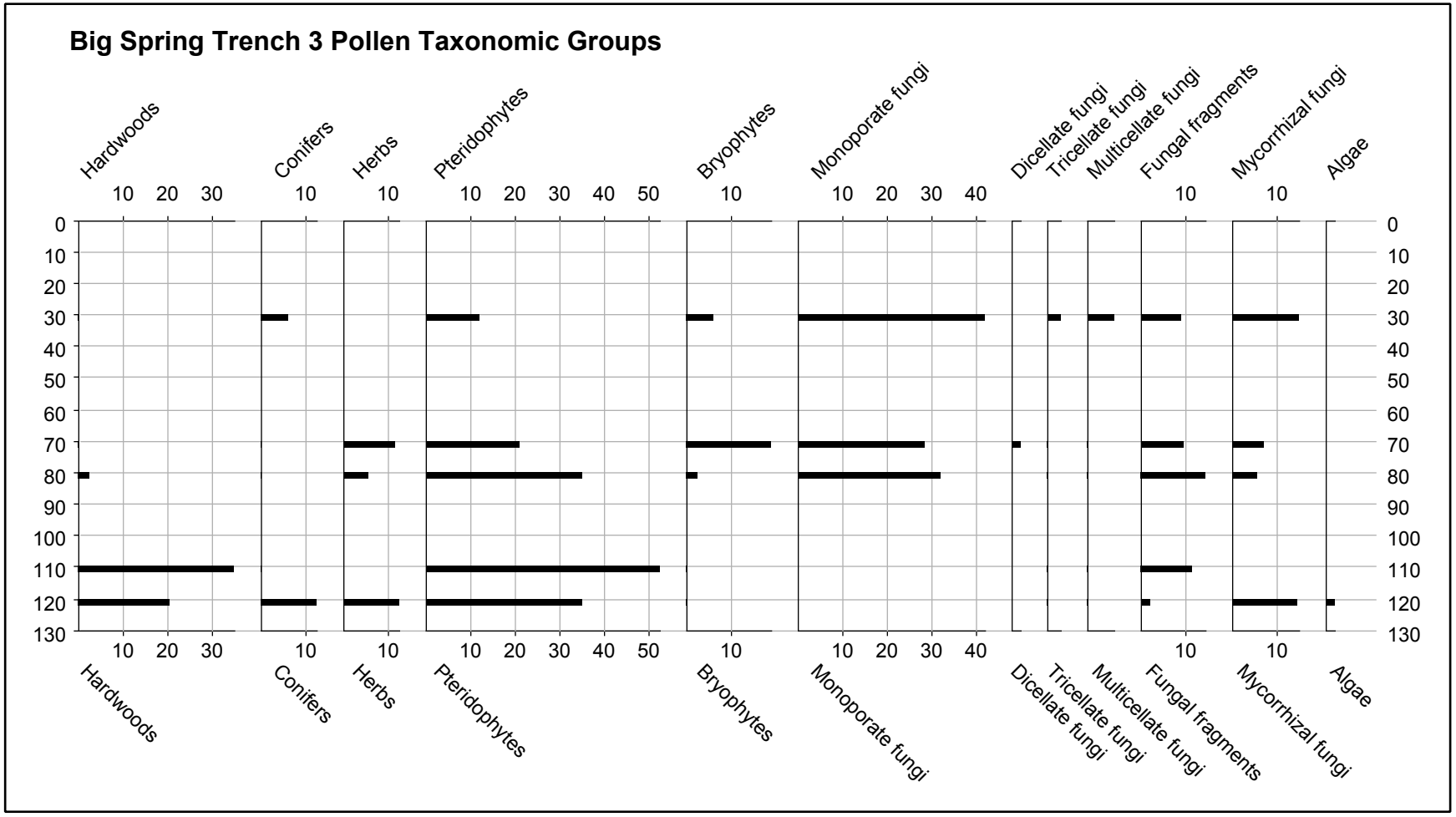

Figure 1: Abundance of pollen and spores grouped by taxonomic similarity

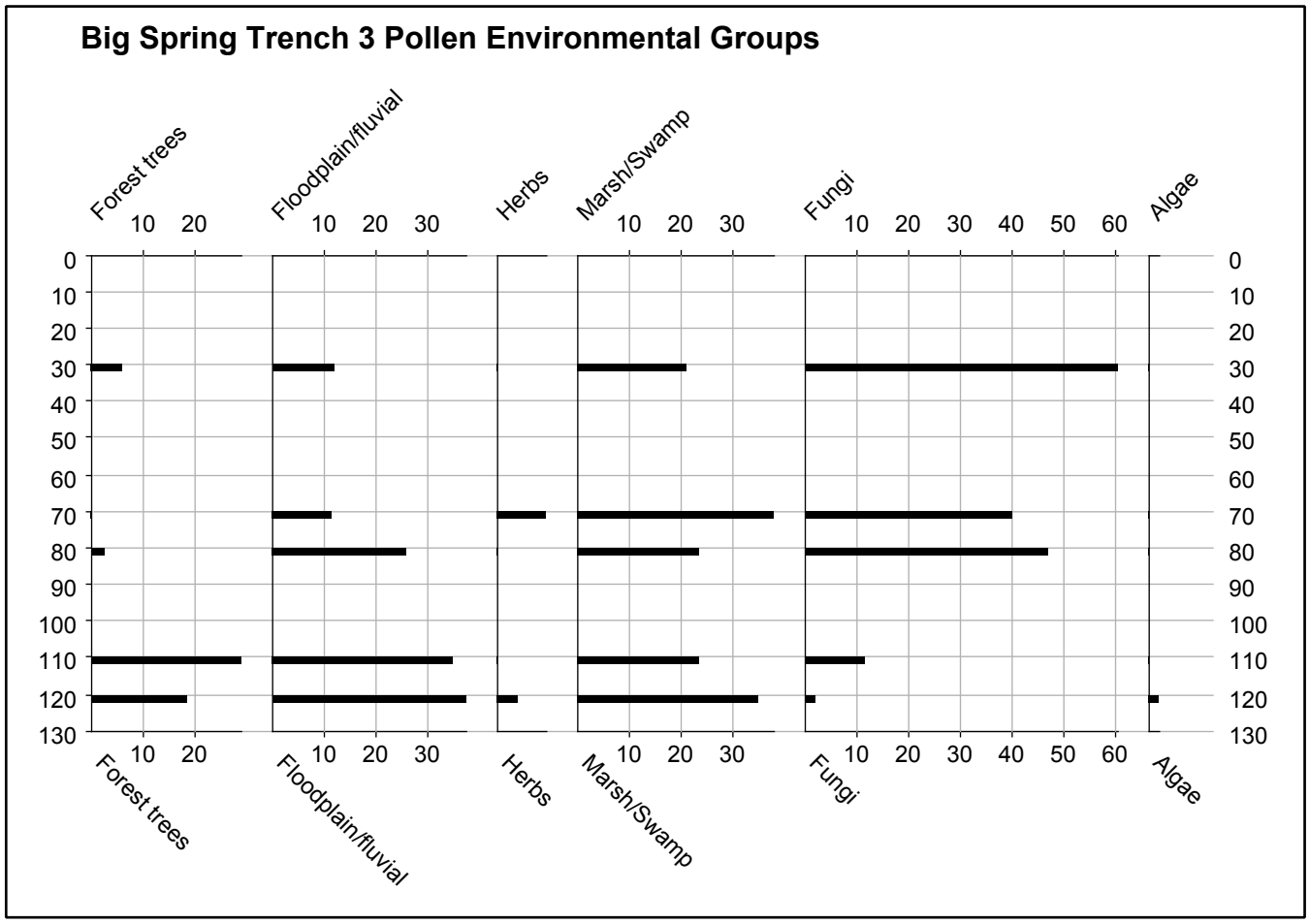

Figure 2: Abundance of pollen and spores grouped by environmental preference

Summary:

The pollen analyses suggest a sedimentary progression from a natural fluvial / marsh environment at the base of Big Spring Trench 3 to an in-filled Sphagnum swamp at the top.

Except for the reduction of *Carya* spp (Pecan) and the conifers, other pollen types that would have marked major settlement events were not observed. These marker pollen may be more likely recovered from more organic rich lacustrine sediments nearby.

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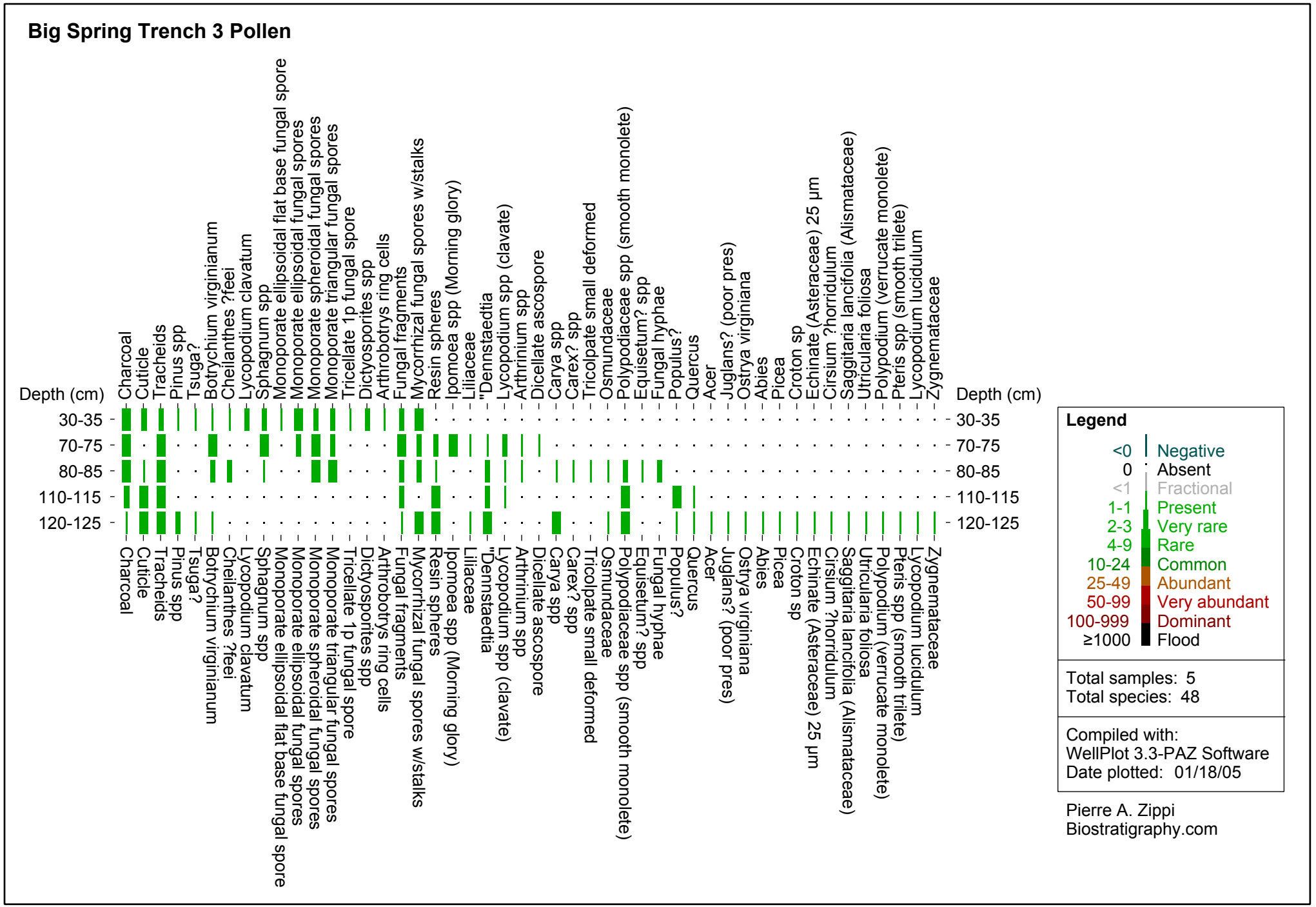
Enclosure 1


Big Spring Trench 3 Pollen
Depth (cm)
30-35
70-75
80-85
110-115
120-125
Charcoal
Cuticle
Tracheids
Pinus spp
Tsuga?
Botrychium virginianum
Cheilanthes ?feei
Lycopodium clavatum
Sphagnum spp
Monoporate ellipsoidal flat base fungal spore
Monoporate ellipsoidal fungal spores
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Monoporate triangular fungal spores
Tricellate 1p fungal spore
Dictyosporites spp
Arthrobotrys ring cells
Fungal fragments
Mycorrhizal fungal spores w/stalks
Resin spheres
Ipomoea spp (Morning glory)
Liliaceae
"Dennstaedtia
Lycopodium spp (clavate)
Arthrinium spp
Dicellate ascospore
Carya spp
Carex? spp
Tricolpate small deformed
Osmundaceae
Polypodiaceae spp (smooth monolete)
Equisetum? spp
Fungal hyphae
Populus?
Quercus
Acer
Juglans? (poor pres)
Ostrya virginiana
Abies
Picea
Croton sp
Echinate (Asteraceae) 25 µm
Cirsium ?horridulum
Saggitaria lancifolia (Alismataceae)
Utricularia foliosa
Polypodium (verrucate monolete)
Pteris spp (smooth trilete)
Lycopodium lucidulum
Zygnemataceae
Legend
<0 Negative
0 Absent
<1 Fractional
1-1 Present
2-3 Very rare
4-9 Rare
10-24 Common
25-49 Abundant
50-99 Very abundant
100-999 Dominant
≥1000 Flood
Total samples: 5
Total species: 48
Compiled with:
WellPlot 3.3-PAZ Software
Date plotted: 01/18/05
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Biostratigraphy.com