Appendix C
Pollen Analysis of Selected Vibracores

POLLEN ANALYSIS OF CORE SEDIMENTS FROM THE KARNAK QUAD, TEXAS AND OLD SODA LAKE BED, LOUISIANA

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Introduction

For certain regions of Texas fossil pollen records of vegetational change are available for reconstructing the last 20,000 year period. In general, the fossil pollen records Texas as having cool-loving and mesic vegetational zones during the full glacial period (22,500-14,000 years B.P.) followed by a late glacial period (14,000-10,000 years B.P.) reflecting a climatic transition to vegetation more characteristic of drier and warmer climates (Bryant & Holloway, 1985).

The full glacial to late glacial vegetational transition in west Texas and regions of the Llano Estacado in northwest Texas, changed from low elevation stands-of conifers in protected habitats to a loss of most conifers and a gradual replacement by scrub and grasslands (Hafsten, 1961; Oldfield & Schoenwetter, 1975). In Southwest Texas full-glacial pinyon and ponderosa pine stands in canyons and south-facing slope regions were replaced by scrub grasslands and a mosaic of diminishing pinyon-juniper woodlands and parklands (Bryant,1969; Bryant & Holloway, 1985). In central Texas the open deciduous woodlands were gradually replaced by parklands of oaks and finally by grasslands and oak savannas during the mid-to-late Holocene (Bryant, 1977; Larson et al., 1972).

The vegetation and climatic changes during the late glacial period in east Texas (14,000-10,000 years B.P.) is not as well defined as it is for most other regions of the state. This lack of definition, primarily due to soil conditions that do not preserve pollen, has left many questions unanswered. As noted by Bryant and Holloway, over a twenty-year period, sediments recovered from both archaeological and environmental sites have failed to provide sufficient fossil pollen to conduct statistically valid analyses (Bryant & Holloway, 1985).

We believe that the absence of fossil pollen in the majority of east Texas soils results from any of a number of factors. First, the regional soils consist of oxisols and alfisols which are characterized by their high oxidation rates and low percentages of organic matter. Under such circumstances fossil pollen rarely preserve well (Bryant & Holloway, 1983). Second, the high amount of rainfall in most of east Texas contributes to a cyclic wetting and drying phenomenon which is known to be highly destructive to pollen grains. As Holloway (1981) has demonstrated, prolonged, cyclic wetting and drying of pollen grains structurally weakens the outer wall (exine) and contributes to mechanical degradation of the entire grain. Third, the high rates of microbial activity in the leaf litter layer of many temperate deciduous forests, such as those in east Texas and western Louisiana, selectively degrade some pollen taxa and completely destroy others (Goldstein, 1960).

A few samples of late glacial pollen have been recorded from sediments in the Tunica Hills region of western Louisiana. Analyses of those soils show they contain pollen taxa such as _Picea_ (spruce), Pinus (pine), _Quercus_ (oak), and Larix (larch); suggesting that western Louisiana, and perhaps neighboring regions of east Texas, was still covered by elements of a mixed conifer-deciduous woodlands during part of the late glacial period (Delcourt & Delcourt, 1977; Kolb & Fredlund, 1981).

Bryant and Holloway (1985) have used pollen evidence from nearby areas to reconstruct the vegetational changes they believe occurred in the deciduous woodlands in east Texas from the middle of the full-glacial through the end of the late-glacial period. First, they see a reduction or disappearance of some cool-loving plants such as Picea glauca, corvlus (hazelnut), and Alnus (alder); and lower proportions of Acer (maple), Betula (birch), Faaus (beech) and Carpinus (American hornbeam) in the changing forest of the late glacial period. Coupled with this is a suspected increase in the proportions of Quercus (oak), Liquidambar (sweet gum), and Pinus. However, Bryant and Holloway state that their reconstructions are based on guesses rather than confirmed evidence based on available pollen records from east Texas and western Louisiana sediments.

Materials and Method

As requested, we examined 14 sediment samples from five cores collected from the Karnack Quad in Texas and the Old Soda Lake Bed in Louisiana. The procedure we used to recover fossil pollen from these samples was based on techniques we have found to be successful on Quaternary-age sediments of this type.

All fossil pollen soil samples were processed in the same manner so that their data would be comparable. From each sample we removed 20 ml of soil. To this we added a "spike" of 11,300 ± 400 spores of the cryptogram Lycopodium to each sample. These spores are what palynologists refer to as "exoctics" and were added to enable us to calculate the pollen concentration values of each fossil sample.

The soil samples were processed for pollen, using several steps. Carbonates were removed, using concentrated hydrochloric acid. Small rocks and coarse-grained silicates were removed by swirling and decanting. This process was repeated several times for each sample before the remaining rocks and large-grained silicates were checked and discarded. Fine-grained silicates, not removed by decanting, were dissolved in a solution of 70% hydrofluoric acid.

After removal of the carbonates and silicates, each sample was sonicated for five minutes in a Delta D-5 sonicator to disaggregate pollen from the remaining matrix. This was followed by a zinc bromide heavy density separation used to isolate the remaining inorganic detritus from the pollen. Finally, a short, weak bleach treatment was used to oxidize the remaining non-pollen organic materials.

All samples were stained with saffranin-0 and mounted in glycerin for examination. Identification and counting were performed using a Nikon binocular microscope. Identifications of pollen and spore types in each sample were checked against modern and fossil reference materials on file in the Texas A&M Palynology Laboratory. These include the Texas A&M Modern Pollen Reference Collection and the Mobil Oil Pollen Reference Collection. The pollen counts from each sample are listed in Tables l-14.

A statistically-valid quantitative pollen count was attempted for each sample, as recommended by Barkley (1934) and Martin (1963). Their studies showed that the data reliability per sample was over 90% when 200 pollen grains were counted, but that the 90 percentile increased only slightly after counting an additional 1,800 pollen grains. Based on these findings, we attempted to count 200-300 individual pollen grains per sample (excluding fungal spores and exotic Lycopodium spores). As noted in the tables, we were to reach suitable pollen counts in all but three samples (V4 P-l, V4 P-3, ST10 P-2). The three samples contained so few preserved fossil grains that we were unable to make reliable counts even after viewing several slides of each sample.

Each fossil pollen grain was identified to the genus level whenever possible. If the grain could not be differentiated from similar genera based on morphology, it was identified to the family level. For one taxon (Vitis) we listed the pollen type as "cf" meaning that it compares favorably with (but may not necessarily be) the type we have named. For your use, we have also included a sheet of photographs showing some of the representative taxa.

while examining the fossil pollen in these samples, we found a high incidence of Tertiary pollen grains. They were present in many of the samples but exceptionally common in samples from the V3, V4 and ST12 cores. The appearance of these grains in sediments of late Pleistocene and Holocene strata strongly supports our belief that the sediments we examined are mixed with, or contaminated by, Tertiary-aged pollen from nearby sources. Because the region of east Texas and western Louisiana is known to have outcrops of lignites, we presume the pollen grains we found are from weathered lignitic materials of nearby Tertiary outcrops.

Results

The relative pollen counts of each sample is presented in Tables 1-14. As mentioned earlier, also provided are black and white contact sheets of the diagnostic pollen types recovered from these samples. Only 11 of 14 samples contained sufficient fossil pollen to conduct statistically valid counts in excess of 200 grains.

The most common pollen taxa recovered in these samples are: Pinus (pine), Cheno-Am (a combined term used for pollen taxa in the Chenopodiaceae family and the genus Amaranthus), genera of the

Asteraceae (composite) family, Quercus (oak), genera of the Poaceae (grass) family, Carya (pecan and hickory), and Liquidambar (Sweet gum). These pollen taxa represent plants common to the indigenous floral communities of east Texas and west Louisiana, and are Still common in that region. Many of these pollen taxa are among the types that would be the most likely to remain preserved, due to their chemical and morphological structure, and are among the types of fossil pollen that are likely to be recognizable even after they have undergone severe degradation. Other taxa, such as Betula (birch), corvlus (hazelnut), Myrica (bayberry), and Carpinus (American hornbean) are types that would be less likely to remain preserved, yet are present in small amounts in some samples, especially the sediments of the V4 core.

Other pollen types found in these samples include Juglans (walnut), Nyssa (black. gum), Populus (poplar), Fraxinus(ash), salix (willow), and Myriophyllum (water milfoil). One type, Typha Liquidambar (cat-tail) and/or Sparganium (bur-reed) are so similar morphologically that we combine these into a single category.

We were able to identify many of the Tertiary-age pollen grains found in these samples by comparing them with reference material and published photographs of Tertiary pollen from reports conducted on sediments from other locales in the southern United States. Unfortunately, some of the Tertiary pollen is so similar morphologically to taxa of Quaternary-age types that separating the pollen into their respective time periods is nearly impossible. Some of the Tertiary pollen found in these samples were of types that are distinctively different from Quaternary pollen, and these could be determined as being Tertiary-age contaminants. Some of these distinctive Tertiary pollen types include: Choanopollenites *Momipites Deltoidospora, Caryapollenites, Polyatriopollenites, Ilexpollenites, Nyssapollenites, Tiliapollenites, Alnus triana, Nudopollis,* and *Symplocus.*

During pollen counts we assign pollen grains that are broken, corroded, or degraded beyond recognition to a category called indeterminates. This means that we believe that even with the best set of comparative pollen types one could find, the accurate identification of these grains would not be possible. As noted in the counts, the percentage frequency of indeterminate pollen ranged from a low of 4.5% to 17.9%. Pollen listed as unknown means that the grain was well preserved, but we lacked sufficient types in our comparative collection to make a positive identification.

The pollen concentration for each sample is a reflection of how much pollen remained preserved in each ml of sediment. Concentration values are useful because they can indicate differences in sedimentation rates, preservation rates, and differences in initial forest pollen dispersion and production rates. The concentration values for these samples ranged from 3,135 to 60,876 grains/ml of sediment.

Discussion

Many factors could have contributed pollen to the original composition of the core samples we examined. These factors include: the type of pollination mechanism used by the plants in the nearby forest, the volume of pollen produced by each of the different plant taxa, differences in the pollen dispersion patterns of nearby plants, and the physical characteristics (i.e., the size, weight, and aerodynamics of the pollen) of the various pollen types that were produced and dispersed.

Once deposited, some or all of the fresh pollen could have been lost due to degradation either before or after it became fossilized. Studies have shown that each pollen type reacts differently to various agents of degradation. How rapid or slow the degradation process will be for each pollen type will depend on factors such as: pollen recycling, the chemical composition of pollen wall, surface ornamentation and morphology patterns, and the pollen grain's susceptibility to degradation by mechanical, chemical, or biological agents (Bryant 1978, 1988; Bryant and Holloway 1983: Holloway 1989; O'Rourke 1990).

Pollen concentration values are used during pollen analyses to determine the density of fossil grains in a sample. This aspect is generally defined as the number of pollen grains recovered per unit volume, or weight, of sediment. The reason that fossil pollen concentration values are reconstructed for sediments is indicated by the types of data this technique can provide. For example, pollen concentration values are useful indications of sedimentation rate and can reveal the degree to which a depositional environment may have been disturbed and/or mixed. Concentration values can also suggest the quality of pollen grain preservation and can indicate when the fossil pollen in a deposit may not be an accurate representation of the original environmental conditions.

Hall (1981) was one of the first to suggest that sediment samples yielding fewer than 1000 fossil pollen grains per gram of soil were probably indicative of highly degraded conditions and that the remaining pollen was usually so modified that it was no longer useful for interpretive purposes. An example of this is seen in the three samples we examined which did not contain a minimum of 1OOO+ pollen grains per gram of sediment.

Pollen concentration values commonly found in the soils of deciduous forests, like those of east Texas and western Louisiana, can be as low as 20,000 or reach levels of nearly one million pollen grains per gram of deposit. Thus, many of the samples from your cores were within the expected pollen concentration values for the area where they were collected. Almost half (6) of the samples had pollen concentration values between 0-10,000 grains/ml, which is considered low for deciduous forests. However, the low recovery rate could reflect significant destruction of the pollen after it was deposited. The remainder of the samples (8) had concentration values that ranged between 20,900-60,876 grains/ml, amounts more commonly found in the soils of deciduous forests. Although only one sample fell below the 1000 grain limit mentioned by Hall (1981), the pollen concentration values of another five samples were not significantly high enough to consider as valid indicators of the actual pollen record for the region. In the context of this study, it appears that the samples with the lowest concentration values are indicative of both a modified depositional environment and the presence of pollen in an active state of decay. This assessment is supported by the high levels of indeterminate pollen grains caused by severe degradation.

One type of pollen, Corylus (hazelnut), occurred in a number of the sediment samples, yet it comes from a plant that no longer grows in east Texas or western Louisiana. Available climatic and pollen data from other regions suggest this plant became extant in these regions by the end of the Pleistocene. Thus, the few grains of hazelnut we found in a number of the samples most probably came from grains that were recycled from earlier-aged Pleistocene sediments or from hazelnut pollen that may have been present in some of the nearby recycled Tertiary sediments.

Based on our pollen analysis of these samples, we do not believe that any type of reliable fossil pollen assemblage can be reconstructed and used for paleoenvironmental interpretation. When we compare the radiocarbon dates with the results of our pollen counts for various samples we note a number of inconsistencies. For example, what data we might expect to find in valid fossil pollen records from these various time periods does not compare with what we actually recovered. For example, samples that are dated as being Holocene, or even late glacial, in age contain pollen types that should not be present. In addition, these same deposits also contain pollen grains known to be Tertiary in age. Therefore, even in the 11 samples which yielded statistically valid fossil pollen counts, the information recovered is of minimal value. Second, as stated earlier, many of the Tertiary-age and Quaternary-age fossil pollen types (i.e. pine, oak, composite, chestnut, hazelnut, American hornbean, etc.) look nearly identical because these plants, and their ancestors, produced nearly identical pollen types.

Unfortunately, there is no currently known method to split the similar-looking fossil pollen types of Tertiary and Quaternary-age plants into separate categories with any degree of reliability. Third, although we cannot be certain, we suspect that most, if not all, of the Quaternary-aged pollen in some of these samples may have been destroyed and was replaced by already-fossilized fossil pollen that were recycled from Tertiary sources. We also suspect that the absence, or near total absence, of any fossil pollen in some of the samples may reflect severe weathering that destroyed not only the Quaternary-aged pollen, but also affected any recycled Tertiary pollen that may have been present.

The results of this pollen analysis are consistent with the results exhibited by samples we have examined in the past from other east Texas alluvial soils. Although we were unable to reconstruct the late Quaternary paleoenvironment, based on the pollen record, we believe that this analysis was useful. The study showed that the sediments in the area are characterized by a mixture of Tertiary and Quaternary materials. Consequently, unless future cores are recovered outside this mixed sediment zone, we suspect future pollen studies will be similar to those of the present study.

For your information, we have listed general information about some of the pollen types found in the samples:

1. Alnus (alder) Pinus (pine), Quercus (oak), Betula (birch) pollen are from plants that produce great quantities of pollen that are normally considered less likely to be decay-resistant. In addition, these taxa produce prolific amounts of pollen that are widely dispersed by atmospheric winds. As a result, pollen from these taxa are often over-represented in the fossil pollen record and traces can often appear in small percentages even hundreds of miles from their. point of dispersal.
2. The prevalence of Pinus, Quercus, carya (pecan or hickory), and Betula, accompanied by Juglans (walnut), Castanea (chestnut), and Fraxinus (ash), would normally be considered types commonly found in the soils of a mixed hardwood deciduous forest. As such, they are considered key indicators of this type of past vegetation.
3. The presence of Carpinus (American hornbean), Myrica (bayberry), Alnus, Acer (maple), Nyssa (black gum), Salix (willow), Liquidambar (sweet gum), Typha angustifolia (cat-tail), Sparganium (bur-reed), and Myriophyllum (water milfoil), are pollen types generally associated with wet to swampy-type environments.
4. POACEAE (grass) pollen is a windborne type that is often found in many different types of environments. Grasses do not produce as much pollen as some airborne pollinators, but they do produce large quantities. Unfortunately, the only grass pollen grain that we can identify with certainty is maize (Zea). We suspect that many of the grass grains found in these samples could have come from swamp-type grasses that may have been part of the local vegetation cover at the site.
5. The ASTERACEAE (composites) family is composed of many genera with similar morphological features. This makes it difficult to differentiate between individual taxa under the light microscope. Consequently, the pollen taxa in this family are often divided into three major groups based on three major morphological types. These include: the Ambrosia group, the Helianthus group, and the Chicorium group. In general, many genera in the Ambrosia group are types found in drier environments, while the taxa in the Helianthus group are more commonly found in more mesic environments. The Chichorium group is also most commonly found in mesic environments. The presence of small pollen percentages of these groups in these samples reflects the probable presence of these plant types in local vegetation.
6. Several types of dinoflaggelates were identified in the V4 core samples. This suggests the deposits were either formed

while the area was a swamp or it may mean that the dinoflaggelates could have been recycled into these deposits from nearby Tertiary deposits

7. The INDETERMINATE category is composed of pollen grains that are so badly degraded that we could not identify them on the basis of morphological characteristics. These grains are included in counts as a general guide to the quality of pollen preservation in a sample.
8. The UNKNOWN category consists of those few pollen grains that are well to fairly well preserved, but represent types we were not able to identify. We suspect that most of these may represent recycled Tertiary types we were not able to identify from our collections or from the published sources we used.

Summary

If further research is planned for this study area, we recommend that the core sampling sites should be located as far away as possible from known Tertiary outcrops. Care should also be taken to determine if the soils of the region contain mixing from Tertiary deposits.

The reconstruction of the paleoenvironmental conditions that existed in Texas during the late Quaternary is an important goal that should not be abandoned. The region has a key geographic location in North America because it is the crossroad between the mixed deciduous and conifer forests of the southeastern United States and the arid and semi-arid flora of the American Southwest, In addition, the region could have been influenced by elements moving up from the semi-tropical and tropical flora from Mexico and could also record any late Quaternary vegetational movement from the south central portion of North America into the deciduous woodlands.

To date, very few regions of western Louisiana and no areas of east Texas have provided well preserved pollen records dating from the late Quatemary period. We encourage your efforts to find suitable cores of sediments that might provide reliable data for this area. Hopefully, someday soon we will find suitable sediments that will answer many of our questions about late Quaternary vegetational changes in the region of east Texas and western Louisiana.

Table 1-144

Quantitative pollen counts of samples from the Karnak Quad., Texas and the Old Soda Lake Bed, Louisiana.

Table 1

QUANTITATIVE POLLEN COUNT

Sample: V3 P-l Date:

Pollen Analyst: Eri Weinstein and Vaughn M. Bryant, Jr.

Date: October 13, 1992

Total Pollen Counted: 222

Fossil Pollen Concentration per gram of sediment: 7,909

Pollen Type	Percentage
ASTERACEAE	
Ambrosia group	4.9
Helianthus group	1.2
Chichorium group	.0
Carya	0.8
Cornus	0.4
Corylus	0.4
CYPERACEAE	1.2
Juglans	0.8
Liquidambar	11.0
Myrica	0.4
Nyssa	3.3
Pinus	29.6
POACEAE (excl. Zea)	4.1
Polygonum	0.8
Populus	3.7
Quercus	32.5
Ulmus	0.4
INDETERMINATE	4.5
UNKNOWN	.0
Total	100.0%

Table 2

QUANTITATIVE POLLEN COUNT

Sample: V7 P-2 Date:

Pollen Analyst: Eri Weinstein and Vaughn M. Bryant, Jr.

Date: October 13, 1992

Total Pollen Counted: 222

Fossil Pollen Concentration per gram of sediment: 70,110

Pollen Type	Percentage
Artemisia	0.5
ASTERACEAE	
Ambrosia group	15.3
Helianthus group	0.9
Chichorium group	.0
Carya	1.4
Corylus	0.9
Fraxinus	0.5
Juglans	0.5
Liquidambar	0.9
Pinus	23.9
POACEAE (excl. Zea)	7.2
Quercus.	27.0
Ulmus	0.5
INDETERMINATE	19.6
UNKNOWN	0.9
Total	100.0%

Table 3

QUANTITATIVE POLLEN COUNT

sample: V3 P-2 Date: 105 BP

Pollen Analyst: Eri Weinstein and Vaughn M. Bryant, Jr.

Date: October 13, 1992

Total Pollen Counted: 228

Fossil Pollen Concentration per gram of sediment: 51,984

pollen Type	Percentage
ASTERACEAE	
Ambrosia group	3.1
Helianthus group	2.6
Chichorium group	7.0
Carya	0.9
Corylus	0.9
Fraxinus	0.9
Juglans	0.4
Myrica	0.4
Nyssa	1.8
Pinus	40.2
POACEAE (excl. Zea)	1.3
Polygonum	1.8
Populus	2.2
Quercus	30.0
INDETERMINATE	6.1
UNKNOWN	0.4
Total	100.0%

Table 4

QUANTITATIVE POLLEN COUNT

Sample: V7 P-l Date: 840 BP
Pollen Analyst: Eri Weinstein and Vaughn M. Bryant, Jr.
Date: October 13, 1992
Total Pollen Counted: 217
Fossil Pollen Concentration per gram of sediment: 41,230

pollen Type	Percentage
Acer	0.5
Alnus	1.4
ASTERACEAE	
Ambrosia group	1.4
Helianthus group	0.5
Chichorium group	.0
Carya	1.8
Fraxinus	1.8
Liquidambar	1.8
Nyssa	0.5
Pinus	37.8
POACEAE (excl. Zea)	3.2
Quercus	22.1
Ulmus	0.9
INDETERMINATE	25.8
UNKNOWN	0.5
Total	100.0%

Table 11

QUANTITATIVE POLLEN COUNT

Sample: V4 P-3 Date:

Pollen Analyst: Eri Weinstein and Vaughn M. Bryant, Jr.

Date: October 14, 1992

Total Pollen Counted: 64

Fossil Pollen Concentration per gram of sediment: 24,320

Pollen Type	Number of Grains
ANACARDIACEAE	2
APIACEAE	8
ASTERACEAE	
Ambrosia group	1
Helianthus group	2
Chichorium group	0
Berchemia	1
Carpinus	6
Castanea	4
CYPERACEAE	1
Fagus	1
Myriophyllum	1
Nyssa	1
Pinus	2
POACEAE (excl. Zea)	6
Quercus	8
Rumex	1
Tillia	1
INDETERMINATE	16
UNKNOWN	17
Total	

Table 12

QUANTITATIVE POLLEN COUNT

Sample: V4 P-l Date:

Pollen Analyst: Eri Weinstein and Vaughn M. Bryant, Jr.

Date: October 14, 1992

Total Pollen Counted:

Fossil Pollen Concentration per gram of sediment: 3,135

Pollen Type	Number of pollen grains
ASTERACEAE	
Ambrosia group	1
Helianthus group	0
Chichorium group	0
CHENOPODIACEAE + *Amaranthus*	2
Liquidambar	1
POACEAE (excl. Zea)	1
Typha/Sparganium	2
INDETERMINATE	1
UNKNOWN	2
Total	

Table 13

QUANTITATIVE POLLEN COUNT

sample: V4 P6 Date:

Pollen Analyst: Eri Weinstein and Vaughn M. Bryant, Jr.

Date: October 14, 1992

Total Pollen Counted: 22b

Fossil Pollen Concentration per gram of sediment: 20,900

Pollen Type	Percentage
Alnus	1.8
ANACARDIACEAE	0.5
APIACEAE	0.5
ASTERACEAE	
Ambrosia group	0.9
Helianthus group	2.7
Chichorium group	.0
Betula	3.6
BRASSICACEAE	0.9
Carpinus	3.6
Carya	6.8
Castanea	19.0
CHENOPODIACEAE + *Amaranthus*	0.5
Corylus	1.8
CYPERACEAE	1.4
ERICACEAE	0.5
Fraxinus	1.4
LAMIACEAE	0.5
Myrica	1.4
Hyriophyllum	0.5
Picea	0.5
Pinus	3.6
POACEAE (excl. Zea)	8.1
Quercus	19.0
Rhus	1.8
Rumex	0.9
Salix	3.6
Typha/Sparganium	0.5
INDETERMINATE	11.4
UNKNOWN	2.3
Total	100.0%

Table 14

QUANTITATIVE POLLEN COUNT

Sample: ST12 P2 Date:

Pollen Analyst: Eri Weinstein and Vaughn M. Bryant, Jr.

Date: October 14, 1992

Total Pollen Counted: 228

Fossil Pollen Concentration per gram of sediment: 30,490

Pollen Type	Percentage
Acer	0.4
ASTERACEAE	
Ambrosia group	3.1
Belianthus group	1.8
Chichorium group	.0
Carpinus	0.9
Carya	4.4
Castanea	0.4
Juglans	0.4
Liquidambar	3.5
Myriophyllum	0.4
Nyssa	3.5
Pinus	18.5
POACBAB (excl. *Zea*)	17.1
Populus	3.5
Quercus	22.4
Salix	2.6
Typha/Sparganium	5.7
Ulmus	0.9
INDETERMINATE	8.3
UNKNOWN	2.2
Total	100.0%

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