HINKSON SITE PALYNOLOGY

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March 1990

INTRODUCTION

Use of sediment samples collected from the Hinkson Site for a classroom research project late in 1989 provided opportunity to extract and examine the pollen they contained. Since the effort was undertaken by students with no prior experience of pollen study, the raw data is to some degree suspect. However, the student work was supervised by experienced personnel, and students were encouraged to rely on supervisory help whenever a problematic issue arose. The samples should be re-observed before any additional data is recovered or further analysis proceeds, but that would be more a means of insuring comparability and consistancy of data sets than a required quality control. The available data seems wholly adequate to the kinds of interpretations developed in this report.

POLLEN EXTRACTION

There are a number of different pollen extraction techniques which have proven effective for archaeological site-context deposits of the Colorado Plateau, and no two researchers commonly employ exactly the same ones. The technique used here (Schoenwetter 1979) is standard for this laboratory, though in this case a "spike" of exotic <u>Lycopodium</u> spores was added to allow absolute pollen frequency calculations using the formula of Pearsall (1989:282).

The technique was successful in producing pollen in analyzable quantities from 15 of the 22 samples. Three of the depauperate samples were collected from culturally sterile deposits pre-dating construction of Hinkson 17. The other four were collected from profile 18 at LZ401. Pollen concentration calculations document that the depauperate samples contain fewer than 800 pollen grains/cc original sample, while the others contain more than 1400 grains/cc and normally contain more than 2500 grains/cc. The distinction is probably a function of the amount of pollen trapped in the samples originally, rather than a function of pollen preservation or the extraction technique employed.

OBJECTIVES

Problem-orientation is a requirement of palynological study which conditions most field and laboratory attributes of research designs. As pollen analysis may provide a variety of forms of information useful to archaeological research, a number of different ultimate objectives can be identified which would be aided by recovery of pollen records from these samples. Prior to delineating ultimate objectives and designing large-scale research programs to persue them, however, it is normally appropriate to identify modest goals and to implement a phased research design that proceeds in a highly controlled fashion.

Most questions of archaeological significance are necessarily grounded on issues demanding relatively secure knowledge of relative and/or chronometric antiquity. That is, to have a basis for understanding whether one body of archaeological record represents a point in time prior to, subsequent to or contemporaneous with another body of record, and how much older or younger it is. In Southwestern studies of the second millenium AD, such control is normally provided by intimate or direct association of archaeological records with tree-ring samples, archeomagnetic samples or by ceramic assembleges which can be cross-dated by direct association with such information. Samples of sediments associated with such records, and the pollen they contain, can be similarly cross-dated in absence of indications that site formation processes have caused pollen of earlier or subsequent periods to become incorporated in the sample.

However, many archaeological contexts which occur in Colorado Plateau sites yield information which is only indirectly associated with tree-rings, archaeomagnetic dates or dendrologically cross-dated ceramic styles. Determining the antiquity of such archaeological records is less secure unless another dating technique is available. Fortunately, they may be directly associated with palynological information that can identify the date the pollen and sediment in which it has been trapped was deposited through application of the Colorado Plateau Pollen Chronology (CPPC). The objective of this pollen study was to determine if application of the Colorado Plateau Pollen Chronology would support:

(1) the inference that separate aliquots of the same pollen sample yield the same CPPC date:

(2) the inference that pollen samples of ostensibly equivalent antiquity but dissimilar cultural function in the same room yield the same CPPC date;

(3) the inference that pollen samples of ostensibly equivalent antiquity deposited at different rooms in the site would yield the same CPPC date; and

(4) the inference that pollen samples of ostensibly distinctive antiquity deposited in the same room yield distinctive CPPC dates.

As a secondary interest, the general palynological character of some stratified sample sequences from terraces at LZ401 was also explored.

THE COLORADO PLATEAU POLLEN CHRONOLOGY

When a sufficient number of cross-dated pollen records for different periods of time become available for a region, district or site, they may be arrayed in the chronological order suggested by the cross-dates and their relative stratigraphic positions. If patterns of palynological data occur change with the passage of time, one may accept the operating assumption that an ecosystem condition or variable (e.g. vegetational response to changes in climatic or weather conditions) has varied over time at the geographic scale relevant to the data base. If controlled tests of the assumption continue to support it, the assumption provides basis for the inference that the data patterns and changes involved are sources of information which may be used to identify the antiquity of any new pollen records from the geographic area that derive from the same sorts of deposits as the original samples.

A pollen chronology of this sort was developed for Colorado Plateau archaeological site-context deposits two decades ago (Schoenwetter 1970), and has been tested and applied since then at a number of archaeological sites (Euge' and Schoenwetter 1977; Petersen 1983; Rosenberg 1977; Schoenwetter 1976, 1987; Scott 1977, 1978). The Colorado Plateau Pollen Chronology (CPPC) provides estimates of the antiquity of site-context pollen records within temporal intervals -- e.g. AD 1075 - 1125, 1125 - 1215, 1215 - 1240, 1240 -

1275. The intervals are not equivalent in length, and the true antiquity of the sample may fall anywhere within the interval. Unlike radiocarbon or archaeomagnetic dates, the boundaries of the temporal intervals were established by cross-dating to averages of tree-ring records. Thus the interval covers a specific number of calendar years rather than the number of years representing the standard error or standard deviation from a central point estimate of antiquity. However, different episodes of the CFPC are palynologically recognized by identical characteristics. For example, pollen records cross-dated to AD 1240 - 1275 are indistinguishable from those cross-dated to AD 1315 - 1335 in respect to the attributes that allow dating. So "pollen dates" provided through application of the CFPC are expressed as alternative possibilities (e.g. AD 1240 - 1275 or 1315 - 1335). Discrimination among the alternative possibilities is normally independently evidenced by associated archaeological record and/or the stratigraphic positions of samples.

RESULTS AND DISCUSSION: GENERAL

The pollen observations recorded for each sample by each student are tabulated in Appendix I. Since raw pollen data is rarely interpretable, the appendix is primarily presented as a convenience to future pollen analyses. In any case, these data are difficult to evaluate because student inexperience may have introduced biases. One may note, for example, that student MW consistantly observed more *Quercus*, more *Fraxinus* and more Indeterminants pollen than other students. Though this might be a feature of the pollen spectra of

SITE #	1496	1118	1000A	1080B	1073	1483	1483	1157		LZ401	LZ401	LZ401	LZ401	LZ401	LZ401	LZ401
CONTEXT	PITFILL	HEARTHFILL	PITFILL	PITFILL	POSTHOLE FILL	INNER HATCHCOVER	UNDER SIDESTONE	MIDDEN		1A	1A	1A	2	2	2	2
										0 - 5	5 - 10	10 - 15	0 - 5	5 - 10	10 - 15	16 - 20
									POLLEN FREQUENCIES							
PICEA										+						
PINUS	0.3	7.0	+	0.7	1.0	7.3	0.2			11.6	+	1.9	0.9	0.6	1.4	2.6
JUNIPERUS	0.1	3.3	2.7	1.4	1.4	2.4	1.7	2.9		38.4	16.2	10.0	2.3	6.1		4.9
QUERCUS	0.1	1.2	16.8	12.0		3.9	2.0	2.4		3.1	1.2	4.0	23.0	10.0	0.9	1.6
ACACIA			2.7	2.4				18.6					1.8	1.7		
ULMUS	+															
RIPARIAN TREES		0.8	3.2			2.7	1.7			1.9	1.2	0.8		2.2	1.8	2.5
CHENO-AM	33.0	40.0	54.5	50.5	25.6	23.9	11.7	65.9		22.3	38.5	40.5	28.1	57.6	27.1	23.5
ALL COMPOSITAE	24.5	29.0	13.6	19.4	57.0	15.0	23.9	9.1		19.1	20.3	20.9	14.7	33.1	13.6	4.0
GRAMINEAE			1.8	2.4		28.5	18.9			0.9	10.9	1.0	18.8		41.8	58.3
LEGUMINOSAE-TYPE	12.1	9.4			4.3	4.4	+			2.7	7.3	8.5			3.2	
SPHAERALCEA	13.6	2.4			1.9	1.6	3.2				+					0.5
ZEA					+	2.1	11.3								0.9	2.0
OTHER ETHNOBOTANICS	+	+				2.5	1.3								0.5	
									POLLEN STATISTICS							
TOTAL POLLEN SUM	470	245	220	208	211	710	1282	208		224	247	482	217	228	231	204
ADJ. POLLEN SUM	273	160	181	154	186	543	913	150		134	172	366	180	181	193	194
ADJ. AP%	17.2	17.8	22.0	26.0	5.9	17.9	16.2	7.3		61.9	25.6	22.7	34.4	47.0	2.0	3.3

TABLE 1: POLLEN FREQUENCIES AND POLLEN STATISTICS

the samples she observed. it might also be true that MW was inclined to recognize badly damaged palynomorphs as pollen requiring some sort of taxonomic label. Similarly, student CS consistantly observed more Gramineae and *Zea* pollen than other students. It may have occurred in the samples, but it also [illegible] identify palynomorphs as Gramineae and *Zea* pollen that other students recognized as spores. It will also be noted that in four cases multiple pollen counts have been generated for individual samples. Two observers are involved in one instance, three in the second instance, and one in the other two cases. The effect is to produce a larger body of observations for these samples which may be "collapsed" into a single pollen record. I have used collapsed pollen records in construction of Table 1.

Table 1 presents the principle pollen frequency values for the project samples. Though arguments can be presented to identify likely errors in this data base, I have taken the observations at face value and calculated pollen frequencies for Table 1 on the basis of all observed pollen (Total Pollen Sum). Table 1 also provides the size of the Adjusted Pollen Sum (see Schoenwetter and Eddy 1964:71 for the taxa involved) and the Adjusted Arboral Pollen Frequency (Adj. AP%) for the sample. It is this pollen statistic which identifies the CPPC position for site-context pollen records.

RESULTS AND DISCUSSION: HINKSON SITE

Two pollen extractions were performed on separate aliquots of sample #1080, collected as pitfill at Locus 1, Room 1 at Hinkson 13. The Adj. AP% value for one is 22.6 and for the other is 25.0. They are statistical equivalents, and both lie within the range of values that date 1240 - 1275 or 1315 - 1335 in the CFPC.

Two samples were recovered from different cultural/depositional contexts in Room 1 at Hinkson 15. Separate aliquots of sample #1496, of pitfill, were examined by separate students -- one of whom also observed the pollen of sample #1118, which had been deposited in a hearth. Both samples were ostensibly deposited about the date of room abandonment. The Adj. AP% values are 19.0, 15.5 and 17.8. They are statistical equivalents and all lie within the range that dates AD 1075 - 1125 or 1275 - 1315 in the CFPC.

The four samples collected from Room 1 at Hinkson 17 were ostensibly deposited at different times. The two collected from below grinding stone supports (#1461 and #1462) are from deposits that predate room construction. Neither yielded sufficient pollen for analysis. The sample collected from hearthfill (#1414) was ostensibly deposited at the end of room occupation, but it too was unanalyzable. Pollen in the midden sample (#1157) is associated with pottery suggesting deposition occurred early in the occupation of Ojo Bonito. It's Adj. AP% value is 7.3, which lies within the range that dates AD 1075 - 1125 or 1275 - 1315 in the CFPC.

The samples recovered from Hinkson 15 fall into two groups. One contains two samples recovered from pitfill inside what appears to have been a structure located in a plaza (#1080A and #1080B), and a sample (#1079) collected from fill of a postmould of that structure. Sample #1079 is ostensibly older than #1080A and B. Sample #1079 yields an Adj. AP% value of 5.9 while the collapsed Adj. AP% value for Sample #1080 is 23.8. They are not statistical equivalents, and the ostensibly older sample dates AD 1075 - 1125 or 1275 - 1315 in the CPPC while the ostensibly younger one dates AD 1240 - 1275 or 1315 - 1335.

The second group contains two samples that were probably sealed beneath stone slabs at different times. The ostensibly younger sample (#1483) was probably sealed beneath a hatchcover late in the occupation of the kiva. It yielded a collapsed Adj. AP% value of 17.9, which would date AD 1075 - 1125 or 1275 - 1315 in the CPPC. The ostensibly older sample (#1484) was probably sealed beneath a shelfstone at the time the kiva was [illegible]. It yielded a collapsed Adj. AP% value of 16.2, which would date it to the same CPPC range as the ostensibly younger sample. However, aliquots of this sample were independently analyzed by three different students, CS, SM and TP. The collapsed Adj. AP% value obtained by CS is 9.3, while those obtained by SM and TP are 24.6 and 29.9, respectively. The disparity between CS's observations and the others is a statistically significant function of CS's larger value for Gramineae pollen. If CS's observations are excluded, the collapsed Adj. AP% value obtained by the other students suggests the older sample dates in the range of AD 1240 - 1275 or 1315 - 1335 in the CPPC. I am inclined to favor this alternative.

The congruence in CPPC dates for the aliquots of sample #1080 suggests the pollen record of a given sample is likely repeatedly to yield the same CPPC date. Similarly, the congruence in CPPC dates for the samples from Hinkson 13 suggests that pollen records of a particular antiquity are likely to yield the same CPPC date even if they are collected from locations of dissimilar cultural function.

In the Hinkson 13 case this could be because the loci were abandoned before deposition of the pollen records. But that would not explain why samples from Hinkson 13 date to the same CPPC intervals as samples from dissimilar cultural contexts elsewhere at Hinkson (Samples #1080, #1414, #1079 and #1484) and other sites on the Colorado Plateau.

Finally, the information from Hinkson 13 identifies a lack of congruence in CPPC dates for samples which are likely to be of distinct absolute antiquity, though they were recovered from the same archaeological features. Overall, then, application of the CPPC to identify the probable antiquity of particular samples -- and their associated archaeological records -- seems reliable.

Accepting the archaeological evidence that the pollen record of sample #1157 was deposited early in the occupation of Ojo Bonito (which is estimated to have been occupied about AD 1300), CPPC dating of Hinkson pollen records suggests most of the sampled deposits were laid down between AD 1275 and 1315. Given the likelihood that the kiva at Hinkson 13 was constructed before the sediment of sample #1483 was sealed beneath the hatchcover, and the likelihood that sample #1484 dates to the construction episode, the kiva seems to have been constructed in the AD 1240 - 1275 interval. The pitfill date for the structure in the plaza, however, is AD 1315 - 1335.

RESULTS AND DISCUSSION: THE TERRACE SEQUENCES

Pollen sample sequences were collected at 3 locations from the artificial terrace features at LZ 401 at 5 cm intervals. Collections were made in hopes that analysis would allow identification of the horizon of terrace construction and/or determination of the cultural

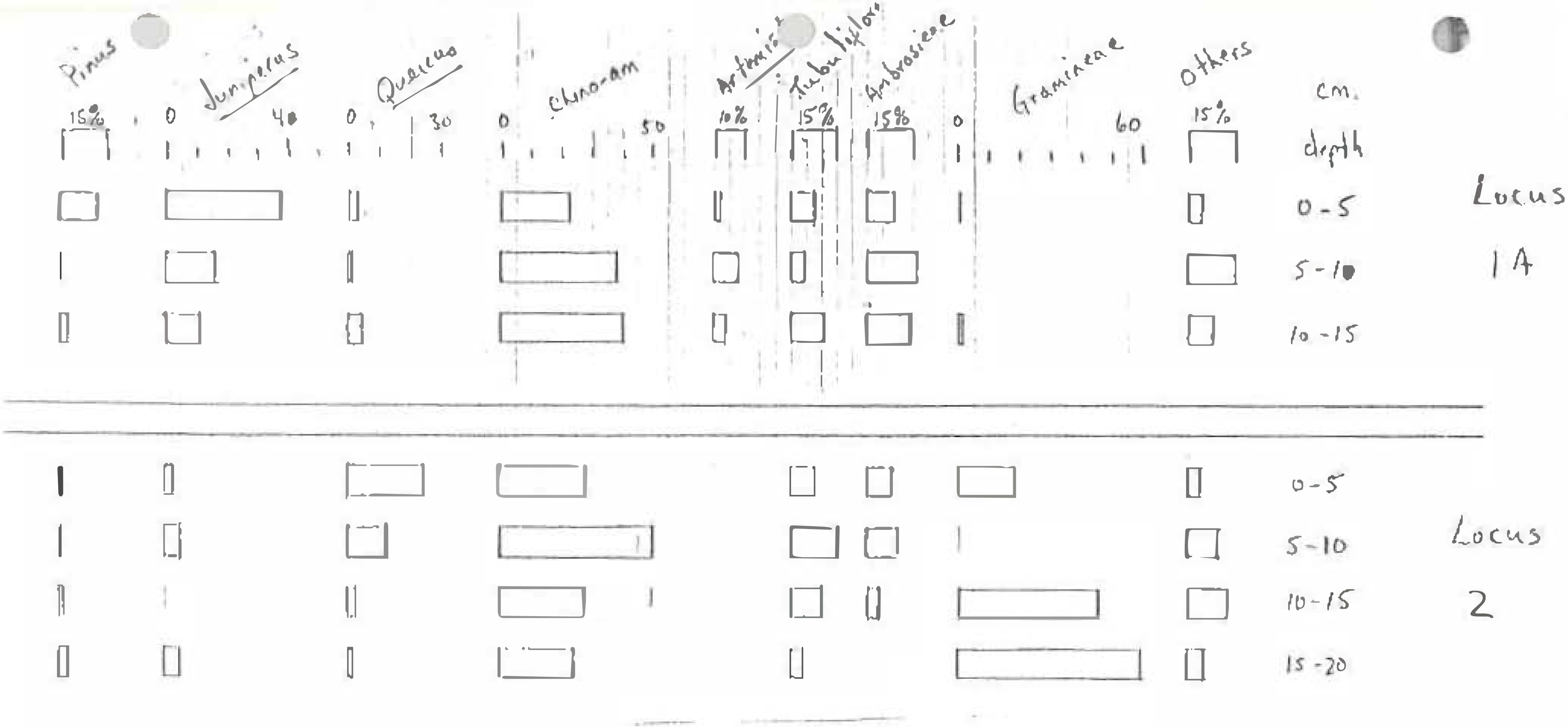

FIGURE 1: POLLEN SEQUENCES FROM THE LZ401 TERRACES

use or function of the terraces. Neither of these ambitions is well founded from the perspective of pollen study given the small numbers of terrace sequence samples that could be collected and analyzed. With small numbers of samples, stratigraphic horizons and prior events cannot be credibly identified by patterns of pollen assemblege changes over the course of time or by variaitions in pollen statistics. This leaves the analyst seeking to identify stratigraphic horizons and prior events on the basis of occurrence of index fossils (e.g. maize pollen as an index of a horizon of cultivation). Index fossils are rare in pollen sequences, unfortunately, and the absence of an index fossil is never an adequate basis for rejection of the hypothesis that the plant or plants involved did not occur in the local flora. Also, the presence of an index fossil is sometimes attributed to misidentification, contamination or record-keeping error (e.g. Berry 1985:290-92, 295-97).

Samples collected from the 1B location yielded sufficiently fewer pollen grains that analysis was considered too time-consuming to be cost effective. Persistant study would have ultimately been rewarded with a statistically adequate number of pollen observations, but the contrast between these samples and others with respect to pollen concentration would have made comparison suspect because of their potential to have preserved pollen in a distinctive way.

The sample sequences collected at locus 1A and locus 2 are strikingly dissimilar as regards proportional representations of most taxa, though the taxa involved are the same (Figure 1). This suggests that the deposits trapped different pollen rains, thus were built up during different episodes of time. However, they are similar in that the pollen concentration values essentially double between the 5 - 10 cm and 10 - 15 cm depth level in both cases (Appendix 1). This index of improved conditions for pollen preservation occurs at the approximate level of the base of the rocks forming the terrace walls and may be related to terrace construction.

Two features of the terrace pollen sequences that deserve mention are the occurrence of Zea (maize) pollen in the lower levels of the locus 2 sequence, and the unusually large numbers of Leguminosae-type pollen grains observed below 5 cm depth in the locus 1A sequence. The Zea pollen record is interpretable as index fossil evidence of use of the terrace as a cornfield. It is curious, however, that the index would appear in the portion of the sequence in which pollen is more poorly preserved; and it is unfortunate that the observations were made by the student who's work may be least reliable in respect to identifications of maize and grass pollen.

Leguminosae-type pollen is morphologically quite variable, and the pollen taxon probably includes pollen of a number of genera within and outside this family of plants. However, the overwhelming majority of plants which produce pollen that would be identified as Leguminosae-type are insect-pollinated. Such plants produce and disperse relatively little pollen, and one expects pollen frequencies for this taxon to approximate those of such other insect-pollinated taxa as Onagraceae, Labitae, Solonaceae, Umbelliferae and Yucca. The pollen frequencies exhibited for Leguminosae-type pollen in the locus 1A samples (Figure 1) strongly suggest local overrepresentation, which is classically regarded as an index of highly localized floristic conditions, such as may be induced by human behavior. Interestingly, terrace locus 1A is not the only place where Leguminosae-type local overrepresentation occurs. The samples from Hinkson 15, and the younger sample from the kiva at Hinkson 13, also present this anomoly. It stretches credulity to consider the cases merely coincidental, but there isn't sufficient patterning in the information at hand to present a supportable explanation. A plausable hypothesis that accomodates both the pollen concentration and the local overrepresentation evidence is that subsequent to construction of the terrace walls, trash was added to the terrace surface and worked into the substrate as a fertilizing agent for crops to be grown on the terrace surface. Downwash (sensu Dimbleby 1985:2) has invested pollen of the trash/native A horizon mix stratum into the B horizon of the terrace soil profile since that event.

OTHER REMARKS

Even taking the prospects for pollen type misidentification by inexperienced observers into consideration, the taxonomic data provided by the Hickson samples presents some curious patterns. Given the ubiquity of *Zea* pollen in the occupation horizon pollen spectra of pueblos of the Colorado Plateau, it is surprising that maize pollen was observed in only three of the eight productive occupation samples from Hinkson, and two of those are of ceremonial room context. Other ethnobotainic pollen types (*Cleome*, *Cucurbita*, *Gossypium*, *Cylindropuntia*) occur with similar rarity, and their frequency is statistically greater than zero only in ceremonial room context. The occurrence of *Gossypium* (cotton) pollen is itself unusual for Anasazi sites, but is not suspect here because at least one of the observations was confirmed by an experienced palynologist.

Another anomoly is the identification of *Ulmus* (elm) pollen in the pitfill at Hinkson 17. Elm is widely cultivated in New Mexico today, but is not a native member of the flora. Since the identification was confirmed, and the pollen type is morphologically unique, the simplest explanation is that Sample #1496 was contaminated during the period of field collection by modern pollen rain. Unfortunately, the similarity of the pollen spectrum of this sample to those of all the other samples from the site calls for apt explanation if such contamination is assumed. The modern pollen rain expectably contains much more *Juniperus*, *Pinus* and Gramineae pollen than one observes in this pollen spectrum. The wide variety of arboreal taxa adapted to riparian habitats (*Betula*, *Alnus*, *Salix*, *Populus*, *Juglans*) is also noteworthy, considering the small size of the sample series and the fact that half the samples contain none of these pollen types.

Finally, there are curious patterns in the distribution of locally overrepresented insect pollinated pollen types. The situation for Leguminosae-type pollen has been discussed previously, but one may note that the distribution of *Sphaeralcea* (globe mallow) pollen exactly parallels that of Leguminosae-type (and strongly parallels that of ethnobotanic) pollen in the site-context deposits. It seems unlikely that these distributions are coincidental, though with such a small sample series the probability that they are effects of chance cannot be ruled out by statistical tests.

SUMMARY

The immediate objective of this pollen study was demonstration that pollen samples from the Hinkson Site could be independently dated by the CPFC conformably with antiquity estimates developed through analysis of ceramic assembleges. This was successfully accomplished. Given the probable interval of site occupation, the CPFC pollen dates range from AD 1240 - 1275 (construction date for the kiva at Hinkson 13) through AD 1275 - 1315 (construction date for the structure in the plaza at Hinkson 13, date for the sampled level in the midden at Hinkson 17, fill dates for the pits at Hinkson 15 and the k[illegible] 15) to AD 1315 - 1335 (fill date for the pit in the plaza structure at Hinkson 13).

A secondary objective was examination of the pollen records of sample sequences from the deposits of terrace features to identify evidence of terrace function(s) or dates of construction. The pollen spectra present no clear evidence of terrace antiquity, though the deposits of locus 1A seem likely to have been laid down at a time different from that of the deposits sampled at locus 2. Local overrepr[illegible] Leguminosae-type pollen at locus 1A and the occurrence of maize and ethnobotanic pollen in the lower samplee of locus 2 deposits suggests the terraces form an activity area which may have some relationship to activities undertaken in ceremonial rooms at Hinkson, but the data base available for study is far too small to examine the issue properly.

Pollen concentration values in the terrace samples rise sharply above the 5 - 10 cm depth, which is the level at which the base of

the terrace walls occur. This is consistant with a scenario in which the primary function of the terrace is retention of winter moisture to maximize growth conditions for maize germination during the Spring drought season. The terraces may have been located where they are because moisture seems to be retained in these colluvial deposits below 30 cm throughout the entire year. Construction of the terrace would store moisture in the level which would become warm enough soon enough to serve croplants (maize, for example, requires 55° F. for germination). Growth would allow their roots to reach the permanent moisture level soon before the end of the spring season, which would assure harvest well before early winter frosts.

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APPENDIX E: POLLEN OBSERVATIONS

SITE	15	15	15	13	13	13	13	13	13	13
FEAT #	1436	1436	11189	10009	10009	1879	1403	1403	1403	1401
ROOM	6	6	5	6	6	4	3	3	3	2
LEVEL	1	1	1	3	3	3	9	9	9	
CONTEXT	PITFILL	PITFILL	HEARTH	PITFILL	PITFILL	POSTHOLE FILL	UNDER HATCHCOVER	UNDER HATCHCOVER	UNDER HATCHCOVER	UNDER SHELLSTONE
PICEA										
PINUS	23	26	19	1	14	4	12	17	16	10
JUNIPERUS		3	8	6	7	3	6	5	7	3
QUERCUS	2	3	3	37	25	4	11	14	3	7
FRAXINUS				2					4	3
ULMUS	1									
ACACIA				6	6					
cf. MIMOSA										1
BETULA			1							
ALNUS						1				
SALIX				5	2	2	2	3	8	7
POPULUS			1				1	2		2
JUGLANS							1	1		1
CHENO AM	70	79	100	130	105	54	55	41	61	46
ARTEMISIA	2	12	3			53				
HI SPINE	28	21	31	23	25	19	35	31	70	21
LO SPINE	15	31	39	6	7	10	4	6	19	0
LIGULIFLORAE				1						
GRAMINEAE				4	5		50	79	71	73
LEGUMINOSAE TYPE	25	31	23			8	17	8	6	1
TRIBULUS			1							
cf. TIDESTROMIA				3						
ONAGRACEAE		1	2			4	1	1		1
SPHAERALCEA	30	26	0						6	8
LABIATAE										
UMBELLIFERAE									3	
SOLANACEAE		1					1	1		
POLYGONACEAE										2
TYPHA (latifolia)						2	1	2	3	
CYPERACEAE										
EPHEDRA N			3			8				
EPHEDRA T				1				2	3	
SARCOBATUS				3	1					
YUCCA										
AGAVE										
PLATYOPUNTIA	4	4	1						1	1
CYLINDROPUNTIA							7	1	2	10
CLEOME		1					1			
CUCURBITA								2	2	2
GOSSYPIUM							3		1	5
ZEA						1	7	3	5	18
UNKNOWN	6	3	4							
INDETERMINATE	5			6	11		2	3	1	3
TOTAL POLLEN GRS.	221	211	215	220	200	251	227	218	238	254
POLLEN/cc SAMPLE	7900	10000	4600	7100	6300	3100	2300	5900	2700	1800
OBSERVER	SH	BK	BK	RM	RM	BK	CS	CS	CS	CS

SITE	13	13	13	13	17	17	17	17	12401	12401
FEAT #	1401	1401	1401	1401	1161	1162	1111	1157		
ROOM	2	2	2	2	8	D	8		1A	1A
LEVEL					5	6	5	3		
CONTEXT	UNDER SHELLSTONE	UNDER SHELLSTONE	UNDER SHELLSTONE	UNDER SHELLSTONE	UNDER GRINDSTONE	UNDER GRINDSTONE	HEARTH	BURNED	0 - 5	5 - 10
PICEA									1	
PINUS	6	14	30	29				8	26	1
JUNIPERUS		1	1	17		3		6	7	3
QUERCUS	2	3	8	8						
FRAXINUS										
ULMUS										
ACACIA								98		
cf. MIMOSA										
BETULA				1						
ALNUS										
SALIX		6	1						1	3
POPULUS		1							3	
JUGLANS		2								
CHENO AM	48	67	63	69		27		137	50	35
ARTEMISIA									6	20
HI SPINE	8	68	67	31		6		2	16	11
LO SPINE	7	12	10	1				17	21	39
LIGULIFLORAE										
GRAMINEAE	61	46	21	29					2	
LEGUMINOSAE TYPE			2						6	27
TRIBULUS										
cf. TIDESTROMIA										
ONAGRACEAE										
SPHAERALCEA			8	25						1
LABIATAE				3						
UMBELLIFERAE										
SOLANACEAE										
POLYGONACEAE										
TYPHA (latifolia)										
CYPERACEAE	1									
EPHEDRA N										2
EPHEDRA T										
SARCOBATUS										
YUCCA										
AGAVE										
PLATYOPUNTIA										
CYLINDROPUNTIA		3								
CLEOME	1	1								
CUCURBITA	6	5								
GOSSYPIUM		2								
ZEA	33	21	30	35				3		5
UNKNOWN	6	6	4	7						
INDETERMINATE	3									
TOTAL POLLEN GRS.	215	258	265	264		11		208	224	217
POLLEN/cc SAMPLE	1000	1600	1400	1400		800		800	11100	4200
OBSERVER	CS	CS	SH	TP		TP		TP	BK	BK

SITE	12401	12401	12401	12401	12401	12401	12401	12401	12401	12401
FEAT #										
ROOM	1A	1B	1B	1B	1B	1B	2	2	2	2
LEVEL										
CONTEXT	10 - 15	10 - 15	0 - 5	5 - 10	10 - 15	15 - 20	0 - 5	5 - 10	10 - 15	15 - 20
PICEA										
PINUS	1	8	0			1	2	1	3	5
JUNIPERUS	9	13	1				5	11		10
QUERCUS			2				55	29	2	8
FRAXINUS							6	9		
ULMUS										
ACACIA							9	3		
cf. MIMOSA										
BETULA		3								
ALNUS										
SALIX	1							4	3	1
POPULUS										
JUGLANS									1	2
CHENO AM	91	101		16		2	61	101	60	48
ARTEMISIA	15	4								
HI SPINE	30	21	8			1	16	30	22	8
LO SPINE	49	18	1				10	21	8	
LIGULIFLORAE		7								
GRAMINEAE		7	1				41		99	119
LEGUMINOSAE TYPE	14	23	4						7	
TRIBULUS										
cf. TIDESTROMIA										
ONAGRACEAE	1								2	1
SPHAERALCEA			2							1
LABIATAE										
UMBELLIFERAE	1									
SOLANACEAE										
POLYGONACEAE									2	
TYPHA (latifolia)	4		2							
CYPERACEAE										
EPHEDRA N	2									
EPHEDRA T										
SARCOBATUS							1			
YUCCA									3	
AGAVE							2			
PLATYOPUNTIA										
CYLINDROPUNTIA									1	
CLEOME										
CUCURBITA										
GOSSYPIUM										
ZEA			1			3		2	4	
UNKNOWN			1					1		
INDETERMINATE										
TOTAL POLLEN GRS.	251	211	62	16		6	217	228	221	201
POLLEN/cc SAMPLE	2300	2100	1100	400		300	4100	2100	1200	1500
OBSERVER	BK	TP	SH	TP		SH	RM	RM	CS	CS