Implications of Archaeological Palynology at Bethsaida, Israel

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ABSTRACT

Palynological research at Bethsaida, Israel, was designed to test conventional wisdom with respect to pollen preservation in Levantine site-context deposits, and to demonstrate the potential of palynological data to evidence behavioral interpretations. Control procedures that detected an error in the normal pollen-extraction process allowed us to fulfill the first objective. The latter objective was achieved by application of an interdisciplinary approach to pollen sample collection. This “strategic approach” integrates evaluation of the ways cultural patterns may be expressed in palynological data with an appreciation of the sampling opportunities exposed as site excavation proceeds. It thus combines archaeological and palynological expertise.

This study focuses on information from pollen samples dated by associated architecture to the late Roman Period occupation of biblical Bethsaida, Israel (ca. 30 A.C.) Behavioral interpretations of the pollen record suggest commercial flax production was a significant aspect of a conscious religio-economic policy Philip implemented in the tetrarchy he inherited from Herod the Great. We do not consider its interpretations to be the significant contribution made by the study, however. We suggest it is significant because it demonstrates the value of including specifically archaeological pollen studies as a regular tool for recovering behavioral information from Near Eastern sites. Further, because it suggests that failure to collect and curate pollen samples from such sites amounts to unethical destruction of a form of archaeological data.

INTRODUCTION

Palynological study of sediment samples recovered from archaeological sites in the Near East and Eastern Mediterranean basin has been attempted with varying degrees of success for at least three decades. Generally, the pollen records that have proved most interesting and valuable to archaeologists have either produced information on paleoenvironmental conditions predating the Bronze Age (e.g., Horowitz 1979:242-254; Galili et al. 1993; Baruch 1986), or are studies that allow identification of the activities associated with particular sorts of material culture (e.g., Weinstein-Evron *et al.* 1996; Horowitz 1996; Jones *et al.* 1998). Attempts to recover significant quantities of pollen from deposits associated with datable features and artifacts of the Bronze or Iron Age, such as from the floors of buildings or from midden deposits, have rarely produced useful information (e.g., Horowitz 1988-1989; Warnock and Pendleton 1995).

Conventional wisdom (e.g., Horowitz 1992: 79-82; Weinstein-Evron and Chaim 1989:23; Weinstein-Evron 1994) attributes the problem to poor preservation and selective preservation of particular pollen types. In addition, a body of experience and experimental evidence (cf. Birks and Birks 1987:188; Campbell 1991) identifies reasons for poor pollen preservation in the sorts of deposits that occur at terrestrial archaeological locales. Few archaeologists working in Bronze Age or more recent sites, then, have seen much reason to take pollen samples.

Conventional wisdom also identifies archaeological palynology as the province of “specialists”. We contend this perception is generally unproductive, and a more truly interdisciplinary perspective is required. Certainly, the extraction and analysis of pollen from sediment samples demands specialized expertise. But knowledge of the cultural significance of archaeological associations at a site and awareness of the value of behavioral reconstructions that might be supported by palynological data requires no less specialized archaeological training and expertise. Both forms of knowledge are important in determining research priorities, establishing field sampling strategies, organizing information, and recognizing the cultural implications of patterns of palynological data. By emphasizing the role played by archaeological expertise in this case study, we seek to document our position and to stimulate archaeological awareness that continued neglect of such interdisciplinary efforts ignores much of the data potential of excavated sites.

SAMPLING STRATEGY

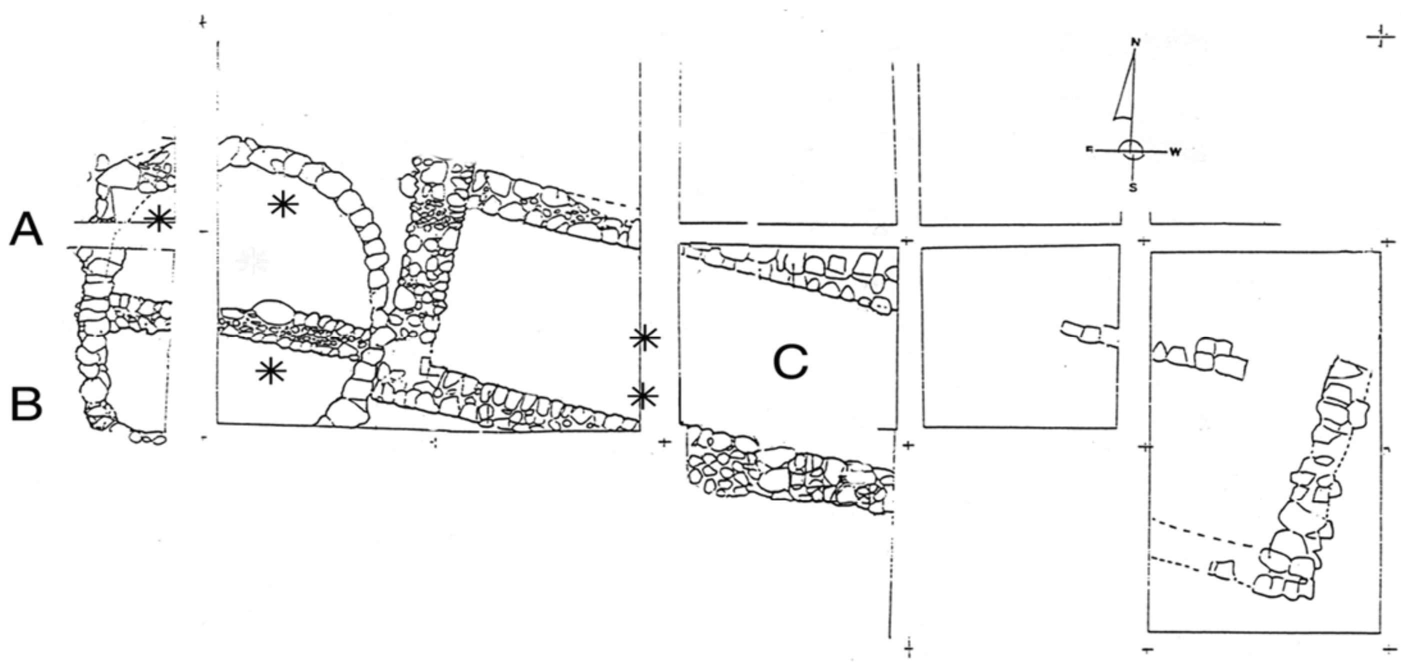
Sampling archaeological deposits for pollen is often perceived as a technical problem because some sorts of deposits have higher potential for yielding palynological data and than others. We maintain that such sampling is actually a strategic problem equivalent to deciding which parts of a site should be tested or excavated. While a person with more technical knowledge of pollen and palynology is better prepared to make technical sampling decisions, the basic sampling question is *why* a particular deposit or archaeological context should be sampled at all. If the goals of a sampling program are clear and specific, most other questions will answer themselves.

We believe that, in general, archaeological deposits should be sampled with the objective of recovering pollen records of recognizable archaeological relevance. Normally, relevance will be identified by the relationship of the pollen record the samples might contain to the problems that justify the research design employed for the site. For example, if archaeological research interest is focused on a type of architectural feature at a site, the potential archaeological relevance of pollen records associated with that type of feature would focus the pollen sampling strategy. To ensure that potentially relevant samples are recovered, technical palynological knowledge must be systematically integrated with an awareness of the archaeological problems being explored and an understanding of the sampling opportunities presented by unusual or unique archaeological attributes of the site. This last information usually develops as excavation proceeds and the analysis of material culture is accomplished. Thus the pollen sampling strategy most appropriate for one site is not necessarily appropriate for another. Like the excavation strategy, it should be adapted to the nature of the archaeological record revealed during the course of the project. To explain the palynological sampling strategy undertaken at Bethsaida, Israel, then, we must explain the archaeological character of the site and the character of our research interests.


Sidon
Damascus
Mediterranean Sea
Tyre
Dan
Caesarea Philippi
Kedesh
Hazor
Benot Ya'Aqov
Prolemais
Capernaum
Bethsaida
Sea of Galilee
Via Maris
Jordan River
Jerusalem
Dead Sea

Excavations at Bethsaida have been underway since 1987. Though it is now located 2 km east of Lake Kinneret (Figure 1), and lies on the Golan side of the Sea of Galilee rather than on the Galilee side (where Bethsaida is reported in John 12:21), geological research strongly supports recognition of the mound of et-Tell as the Bethsaida of Jesus' ministry (Arav and Freund 1995; Arav and Freund in press; Arav et al. 2000; but see Nun 1998). Archaeological evidence identifies occupation of the site as far back as the 8th century B.C. -- long before Philip, son of Herod the Great, established a mint there and elevated it to the status of a *polis* during his tetrarchy of 4 B.C. - 34 A.C. The focus of research at et-Tell has been on demonstrating its identity as biblical Bethsaida and on exploring the evidence of its Iron Age and Early Roman Period occupations. The junior author's overall pollen sampling strategy for the site emphasizes recovery of multiple samples of any deposits that can be securely dated by their association with datable artifacts or by their stratigraphic relationship to deposits with such associations. Depending on which samples are ultimately analyzed and productive, this strategy will allow comparison of pollen records of differing antiquities and differing types of cultural associations.

The particular samples we report upon here were selected with respect to their potential to deal with two specific problems. The first problem was to obtain information that would help explain why samples of the deposits of Levantine sites have so often failed to yield sufficient pollen to support analyses. This problem required study of multiple samples of the same deposit, multiple samples of at least one contemporary but contextually distinctive deposit, multiple samples of at least one stratigraphically distinctive deposit, and one or more samples to provide control data. The second problem was related to Geyer's Master's thesis (1998). This work centers on the hypothesis that Philip sought development of his tetrarchy through policies that invoked the sort of integration of religious, economic and political institutions characteristic of the governance of Rome itself. This problem required recovery of pollen records from archaeological contexts which might incorporate evidence of the character of economic, political, or religious institutions during the period when the site was part of Philip's state.



Bethsaida provided opportunity to collect samples appropriate to both problems because it contains the remains of a temple arguably dedicated to the Roman Imperial Cult (Arav in press; Arav et al. 2000:55-56) where rituals would have been performed that reinforced political institutions. The identification of Julias' Temple, dated 30 A.C. by Strickert's analysis of Philip's coinage (1995), is supported by literary and archaeological evidence. An oval storage facility attached to the rear court of the temple (Arav 1995:16; Figure 2) incorporates a 0.9 m thick wall bisecting the feature on an east- west axis. This interior wall isolates a smaller southern unit (“the bin”) from a larger northern unit (“the granary”).

Though excavation had progressed through the temple floor to Bronze Age deposits below, a north-south baulk retained some of the fill of the temple’s central room (*naos*) and exposed its plaster floor in profile. Supra- and subfloor fill deposits were also present in an east-west baulk in the granary. Large portions of the cobblestoned plaster floors of both the bin and the granary were still intact at the beginning of the 1996 excavation season. Soundings Geyer excavated in the bin and granary produced Early Roman pottery (Rami Arav, personal communication 1998) and demonstrated that their floors, like the plaster floor of the temple, were also placed above a few centimeters of fine leveling fill superimposed upon a layer of coarse rubble fill. The architecture of the temple complex clearly indicates that the bin and granary were constructed at the same time as the temple's eastern, central and western rooms.

Samples of the floor plaster deposits from the granary, the bin, the temple *naos* and the cobble pavements of the bin and granary presumably trapped pollen at the time the complex was constructed. The rubble construction fill deposit and the fine-grained leveling fill deposit, however, might contain older pollen, and supra-floor deposits remaining in the baulks in the granary and the temple could incorporate younger pollen assemblages. If they yielded sufficient pollen for analysis, differences between the pollen records from a number of floor samples and a number of older or younger pollen records could provide evidence for both of the problems we wished to address..

Thirteen of the total of 27 samples collected from the temple precincts were selected for analysis plus one modern pollen rain sample to provide control data,

EXTRACTION STRATEGY

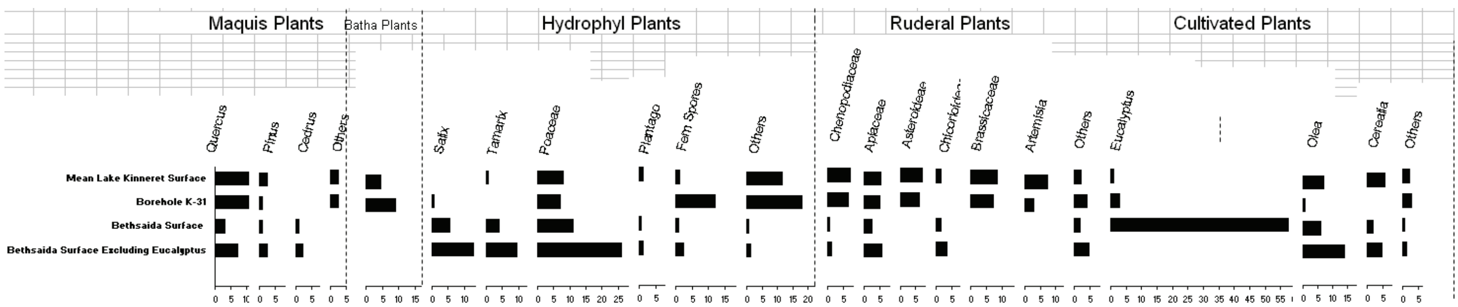
An attempt to use a conventional extraction technique (Schoenwetter 1996) yielded no or very few fossil pollen grains. To help assess whether certain samples might contain more pollen than others, we had added known quantities of an "exotic marker" (Faegri and Iverson 1989: 83) pollen type so the number of pollen grains that actually existed per cubic centimeter of sample could be calculated. Since none of the extracts yielded any of the marker pollen we had added, it was clear that the marker pollen had been discarded at some point in the course of the extraction process. It was likely that any fossil pollen the samples contained was also removed.

Because archaeological deposits from arid lands commonly contain significant quantities of carbonate compounds, the extraction procedures normally employed (e.g. Horowitz 1992:182-185) assume that calcium carbonate cements any pollen in the sample to silt- and clay-sized sediment particles. Hydrochloric acid is used at an early step in the procedure to dissolve the cement and defloculate the matrix. Organic cementing agents also occur, however. When we employed detergent solution and sodium hydroxide as defloculating agents instead of hydrochloric acid, sufficient pollen for analysis was successfully extracted from twelve of the thirteen samples (TABLE 1). Seven of the archaeological sediment samples so processed yielded as much pollen as the sample collected from the modern soil surface (>180,000 grains/cc). Longstaff and Hussey (1997) report that a different modification of conventional extraction procedure allowed successful recovery of pollen from Middle Roman through Late Byzantine deposits at Sepphoris.

Most of the samples that can be securely dated to the period of construction and use of Julias' Temple are of floor plaster. Some palynologists assume such samples contain pollen that was trapped while the plaster was wet (e.g., Weinstein-Evron and Chaim, in press), and it is not unlikely that pollen was introduced to the sample in the water used to make the plaster. But analyses of plastered or compacted earth floor samples from archaeological sites in the American Southwest have long suggested that floor samples commonly contain mostly pollen that has been trodden into the matrix during the floor's use-life. This is indicated by the correspondence of pollen spectra from floor samples and those from contemporary samples of alluvium in the same district (Schoenwetter and Eddy 1964), from the correspondence of regional vegetation indices in floor sample pollen spectra from contemporary buildings at sites hundreds of kilometers apart (Schoenwetter 1970), and from pollen record evidence for distinctive activity area patterns in samples collected from different portions of the floors of single rooms (Bohrer 1972). We find no reason to doubt that abundant, well preserved pollen in floor plaster samples reflects the period during which the floor was used.

ANALYSIS: THE MODERN POLLEN RAIN AND CONTAMINATED RECORDS

The pollen records of surface samples provide direct evidence of the way local vegetation patterns are reflected by the types and frequencies of preserved pollen. Thus surface sample data is commonly used to control paleoenvironmental interpretation of ancient pollen records. However, comparison of the pollen records of surface samples and ancient samples also provides evidence of the ways modern processes affecting pollen rain probably affected pollen rains at a particular locale in the past. Ideally, multiple surface samples should be analyzed to assess how well an individual fossil sample may represent the processes of pollen production, deposition or preservation. The situation at Bethsaida, however, allowed recovery of only a single surface sample. Though the control provided by a single surface sample is of questionable value, no alternative exists for this site at present.



Distributions and preservation of pollen produced by modern vegetation in this district has been studied through analyses of samples collected at the surfaces of 14 boreholes from the deposits of Lake Kinneret (Horowitz 1969: 1979: 192-199). In Figure 3, the arithmetic mean of these pollen records is related to modern vegetation patterns. Not surprisingly, pollen of the ruderal flora adapted to the soils disturbed by human activities and pollen of hydrophyl plants adapted to the higher water tables of the valleys and shore of the lake make up the largest fractions of this pollen spectrum (40 % and 22.5 %respectively). Native maquis forest plants do not contribute significantly more pollen to the record (17.9 %) than cultivated plants (16.2 %) and both are better represented palynologically than the steppe-like, anthropogenic, batha flora.

The surficial pollen record from borehole K-31, collected near the NE shore of the lake (closest to Bethsaida) contains a significantly larger percentage of pollen of batha and hydrophyl plants, so a smaller percentage of ruderal and cultivated plants pollen. But it is not otherwise particularly distinct from the mean lake sediment surface pollen spectrum.

The surface sample from Bethsaida, also illustrated in Figure 3, was collected within a grove of *Eucalyptus* (Australian gum) trees to avoid areas of recent active surface disturbance. Its pollen record is heavily overrepresented by *Eucalyptus* pollen (57.5%) with a strong showing of the hydrophyl flora. This emphasis is seen more clearly in the Bethsaida surface sample pollen record exclusive of *Eucalyptus* pollen. Hydrophyl plants pollen dominates this spectrum (52.8 %), and that of cultivars (19.9%) is more common than pollen of either ruderal (16.4%) or maquis plants (11.6%).

Clearly, even allowing for the effects of local overrepresentation by *Eucalyptus*, the terrestrial surface sample captures and preserves the modern pollen rain differently from lacustrine surface samples. The proximity of a vegetation pattern seems to be the single greatest influence on lake-surface pollen spectra, but they are also significantly affected by the amount of territory occupied by relatively distant vegetation patterns. Thus pollen of maquis and cultivated plants accounts for a larger fraction of lacustrine pollen records than the pollen of batha plants. While plants of the immediate vicinity influence the terrestrial surface sample pollen record very strongly, the proximity of vegetation patterns has surprisingly little influence. Ruderal and batha vegetation occur closer to the sampling locus, but neither vegetation pattern is as well represented in the terrestrial surface pollen spectrum as the hydrophyl vegetation of the valley floor or cultivated vegetation.

Though reliance on a single terrestrial surface sample makes them tenuous, these relationships suggest three inferences that can be used to control interpretation of fossil pollen records from Bethsaida. First, pollen records from the terrestrial deposits of the site are likely to be quite strongly influenced by pollen dispersed in the immediate vicinity of the sampling locus. Second, samples from the site will probably provide and incomplete plant inventory, since terrestrial pollen samples are likely to incorporate fewer pollen types than lacustrine samples. Individually, the missing pollen types will probably only occur in low frequency; together, though, they may make up a significant fraction of the pollen record --as is the case for the various members of the hydrophyl flora illustrated on Figure 3 as “others”. Third, terrestrial pollen samples such as those from the site are likely to provide a poorer reflection of the proximity and regional extent of vegetation patterns than lacustrine samples. A pollen study oriented towards reconstruction of changes in the vegetation patterns of the district over the course of time, then, would be more securely approached through analysis of lacustrine than terrestrial samples.

Since *Eucalyptus* was only introduced from Australia in the 1880s, the occurrence of eucalyptus pollen in samples ostensibly dating to earlier times identifies modern pollen contamination of those spectra. Alternatively, the lack of eucalypt pollen in samples of ostensibly ancient deposits amounts to fairly strong evidence that they in fact contain pollen spectra deposited at the time the deposits were laid down (see also Weinstein 1979:182).

TABLE ONE

	Granary Floor Cobbles	Granary Floor Plaster	Bin Floor Cobbles	Bin Floor Plaster	Temple Supra Floor	Temple Floor Plaster
Eucalyptus	2.50%		1%		3.50%	
Quercus	4.50%	6.50%	6%	2%	5%	35%
Olea	3.50%	6.50%	3.50%	0.50%	3.50%	3%
Salix	7%	7.50%	5%	3%	25.50%	4%
Tamarix	9%	4%	7.50%	7%	13.50%	1%
Pistacia			1%		0.50%	
Pinus	4.50%		1%			
Cedrus			0.50%			
Poaceae	13.50%	31.50%	13.50%	17.50%	2.50%	3.50%
Hordeum	11.50%	9%	10%	4.50%	1%	0.50%
Triticum	2%	3%	2.50%	1%		
Linum		1.50%	8%	67%	11%	14%
Dipsacus	0.50%			0.50%		
Liguliflоreae	9.50%	13%	9.50%		7.50%	3.50%
Artemisia		2%				
Tubuliflorae	9%	7%	8%		0.50%	1%
Umbelliferae	9%	3.50%	14%		20.50%	27%
Chenopodiaceae		0.50%	1%		0.50%	2%
Sinopteridaceae	1%		0.50%	0.50%		0.50%
Impatiens		0.50%	0%		1%	
Plantago		0.50%	1.50%		0.50%	1.50%
Crucifereae			1.50%		2%	0.50%
Erodium	1.50%		0.50%			
Larea			0.50%			
Caryophyllaceae			0.50%			
Lillaceae			0.50%		0.50%	
Ephedra						
Caprifoliaceae	1.50%	0.50%	1.50%		1%	0.50%
Viscum						
Lemna	9%	3%	0.50%	0.50%	0.50%	0.50%
Papaver		0.50%				
Trapa	1%	0.50%				
Pollen Sum	200	200	200	200	200	200
Lycopodium	0	1	0	0	1	0
Concentrations	>180,000	180,000	>180,000	>180,000	180,000	>180,000
Intact	60%	36%	22%	16%	30%	26%
Crumpled	36%	56.00%	54%	66%	60%	60%
Broken	4%	8%	24%	18%	10%	14%
Aggregates	None	Tamarix-1 Olea-1 Papaver-1 Tubuliflor -1	Hordeum-1 Tubuliflor-1 Linum-1 Graminaea 1	None	Olea-6 Ligulif.-1 Quercus-2	Quercus-8 Linum-3 Olea-1
	Granary Floor Cobbles	Granary Floor Plaster	Bin Floor Cobbles	Bin Floor Plaster	Temple Supra Floor	Temple Floor Plaster

	Bin Fill	Temple Fill	Granary Baulk17	Granary Baulk19	S.Temple Supra Floor	S.Temple Plaster	Surface
Eucalyptus		4.50%			16.50%	3%	57.50%
Quercus	5.50%	7.50%		5%	6.50%	3.50%	3%
Olea	4%	5.50%	10.50%	4%	8.50%	1.50%	6%
Salix	6%	6%	13.50%	9%	14.50%	11%	5.50%
Tamarix	4%	4.50%	7%	13.50%	3%	2.50%	4%
Pistacia				0.50%			
Pinus	2.00%		0.50%				1%
Cedrus	1%						1%
Poaceae	18%	6%	16.50%	10.50%	1.50%	17.50%	11%
Hordeum	12%	4%	7.50%	10%		8.50%	1.50%
Triticum	1%		2%	2.50%		0.50%	0.50%
Linum	4.50%	3%	1.50%	1%	0.50%	3.50%	
Dipsacus			0.50%			0.50%	0.50%
Liguliflorae	20%	32.50%	9.50%	7.50%	9%	9%	1.50%
Artemisia			0.50%			10%	
Tubuliflorae	11%	2%	9.50%	5%	3.50%	3.50%	
Umbelliferae	4%	18.50%	5.50%	2.50%	25.50%	17.50%	2.50%
Chenopodaceae	0.50%		2.50%	7.50%			0.50%
Sinopteridaceae		1%	1%	1%	4.50%	1%	1%
Impatiens					0.50%	1%	2%
Plantago	2%	2.50%	1.50%	3%	2.50%		0.50%
Crucifereae	1.50%						
Erodium							
Larea	0.50%						
Caryophyllaceae				0.50%	0.50%		
Lillaceae	0.50%	2%		8%			
Ephedra	0.50%						
Caprifoliaceae	2%		1%			1%	
Viscum				0.50%			
Lemna		1%	2.50%	3.50%		2%	0.50%
Papaver			0.50%				
Trapa				0.50%	1.00%	2.50%	
Ophglossum				0.50%	1.50%	0.50%	
Pollen Sum	200	200	200	200	200	200	200
Lycopodium	0	1	17	22	1	6	1
Concentrations	180,000	180,000	>10,707	>8,148	180,000	30,000	180,000
Intact	36%	50%	30.00%	24%	44%	56%	
Crumpled	42%	30%	48.00%	70%	48%	36%	
Broken	12%	20%	22%	6.00%	8.00%	8.00%	
Aggregates:	Hordeum -1	Quercus-1 Olea-1 Linum-1 Liguliflorae -1	Tubuliflorae -1	Salix-1	Quercus-1 Olea-1 Salix-1 Umbelliferae -4	Quercus-1 Lemna-1 Salix-1	Eucalyptus -11
	Bin Fill	Temple Fill	Granary Baulk17	Granary Baulk19	S.Temple Supra Floor	S.Temple Plaster	Surface

Six of the 12 productive temple complex samples contain *Eucalyptus* pollen (TABLE I), so contamination of ancient spectra by modern pollen would at first appear to be a significant problem. But interpretation of fossil pollen records depends on the quantities of observed pollen as well as on the variety of observed pollen types. Consideration of the quantities of *Eucalyptus* pollen that occur in those six samples suggests that their degree of contamination is unlikely to affect interpretation. Three of the contaminated samples contain less than three per cent *Eucalyptus* pollen. The statistical significance of the contaminating pollen type in these samples is not greater than zero, since both values lie within the 0.05 binomial confidence interval for 200-count samples. Thus, in 95 cases out of 100, the interpretive effect of the observation of such small quantities of *Eucalyptus* pollen on the rest of the pollen spectrum is no greater than would be true if no eucalypt pollen had been observed at all. Two other samples contain 3.5 and 4.5 per cent *Eucalyptus* pollen. The effect of eucalypt pollen contamination of these two samples is statistically real, but it is too small to affect interpretation of the percentage values of prominent components of the pollen spectra. In short, five of the six ancient pollen records contaminated by modern pollen can probably provide secure information about statistically prominent features of the pollen spectra involved. So long as no attempt is made to interpret information derived from statistically insignificant pollen frequencies, and the data of the most intensely contaminated sample is excluded from the analysis, the effect of modern pollen contamination on the fossil pollen record will be quite limited.

Consideration of the depositional environments of those spectra which are contaminated by eucalypt pollen and those which are not provides some useful insight into pollen sampling field procedure. Four of the six contaminated samples were collected 3-5 cm within the baulk that bisected the temple *naos* and the other two were collected from the interstices between the cobblestones of freshly-swept and -scraped pavement surfaces. The baulk and the pavement had been exposed in previous seasons and were positioned to collect wind-blown trash. Alternatively, two of the five samples that reveal no evidence of modern pollen contamination were collected during the course of test excavations from newly exposed surfaces, and two others were collected from within a baulk that was protected from exposure to wind-blown trash. The fifth sample lacking evidence of modern pollen contamination was a floor plaster sample that was collected in the form of solid chunks of flooring.

The distribution of *Eucalyptus* pollen in the samples suggests that modern pollen contamination may extend more deeply below a long-exposed surface than is generally believed probable. Clearly, it is advisable to collect sediment samples for pollen study immediately upon their exposure, or from freshly-scraped surfaces within days of their exposure, rather than recover them weeks or months later.

ANALYSIS: THE FOSSIL POLLEN RECORDS

Three of the 13 archaeological samples subject to the modified extraction process were collected from the coarse rubble fill beneath the temple. Pollen was not successfully extracted from the deepest sample, and the other two yielded only 4.5 and 6.5 per cent of the pollen that occurs in other samples (TABLE I). Since the quantity of pollen in the samples from the rubble stratum decreases with depth, it seems likely that the rubble fill itself contained little or no pollen originally, and the pollen it now contains in upper samples has sifted down from the deposit which caps it.

The two samples collected from the leveling fill deposit superimposed on the rubble fill did not yield statistically comparable pollen spectra (TABLE1). The sample collected 4 cm below the plaster floor of the bin contains significantly more Poaceae (grass), Asteroideae (aster-like) and *Hordeum* (barley) pollen, while the sample collected 4 cm below the plaster floor of the temple *naos* contains significantly more Chicoriodeae (dandelion-like) and Apiaceae (carrot family) pollen. The former sample contains eight pollen types not observed in the latter, while the latter sample contains two pollen types not observed in the former. Since the leveling fill deposit was laid down as a unit, these contrasts in the pollen spectra cannot be attributed to deposition of the pollen at different times or to contrasts in local floras. It seems most likely that they reflect differences in pollen sources. Such sources could have been highly localized. For example, they could result from pollen inadvertently distributed during the course of ceremonies or other activities in the temple precincts prior to installation of the floors.

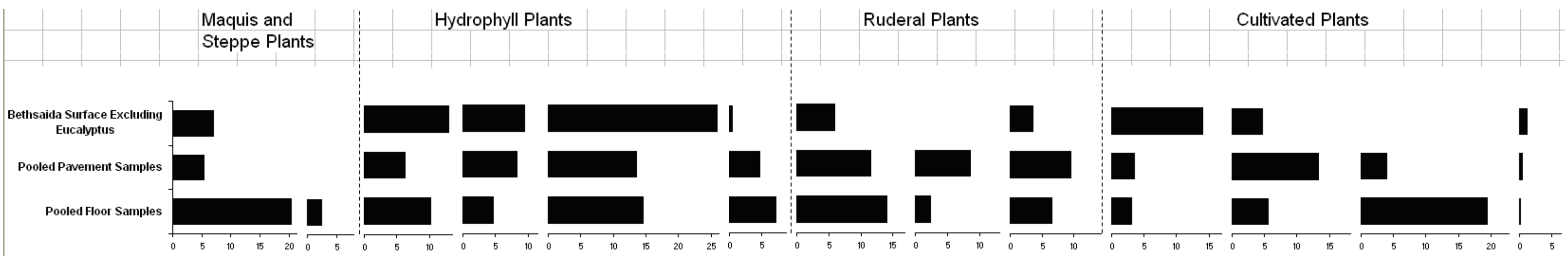
Pollen spectrum variability is also characteristic of the four floor plaster sample pollen records (TABLE 1). *Linum* (flax) pollen is quite strongly overrepresented in the bin floor plaster pollen sample; *Quercus (oak)* pollen dominates one of the floor plaster samples from the temple *naos,* while *Artemisia* (sagebrush) pollen is overrepresented in the other; and Poaceae pollen is the predominant type in the granary floor plaster sample. The pollen record of the less contaminated floor contact deposit sample from the temple *naos* is another expression of this pattern, as it is overrepresented in Apiaceae and *Salix* (willow) pollen.

Since the samples were collected within a few meters radius, their varied palynological character cannot be easily explained as a response to temporal or spatial distinctions or differences in the original sediment source. It is also unlikely that they reflect seasonal differences in pollen rains trapped in the wet floor plaster when it dried. Given their provenance in structures with distinct cultural functions, we prefer to explain their palynological differences as products of activity area differences involving manipulations of pollen-bearing materials.

Viewing the pollen record from this perspective, one might seek to reconstruct, for example, the behavior patterns responsible for a greater occurrence of flax pollen in one sample and grass pollen in another. Each reconstruction of this sort would, however, constitute no more than a plausible hypothesis supported by the evidence of a single pollen record. It would also require the weak assumption that the pollen spectrum of any given sample was only influenced by one particular sort of cultural activity. In any case, such reconstructions would be inappropriate outcomes for this research, since Geyer's research problem centered on reconstructing the *customary* activities which took place in the temple complex precincts, rather than specific behavioral events.

Since a conservative approach seemed appropriate, we began our analysis by excluding all of the data of the sample that incorporates a sizable quantity of *Eucalyptus* pollen from consideration. Second, we pooled the ostensibly contemporary data of the four floor plaster samples and the temple floor contact sample into one data set (N= 1,000 observations) and the data of the two pavement samples into a second data set (N=400 observations). Such sets provide the statistical advantages of larger pollen counts and normalize the variability of the individual samples. Third, we restricted interpretation to palynological data patterns within the sets that have both statistical strength and floristic credibility.

By this standard, there are 13 pollen types which are sufficiently well represented



to provide interpretable information: *Linum* (flax), *Hordeum (barley)*, *Triticum* (wheat), *Olea* (olive)*, Salix* (willow), *Tamarix* (tamarisk or salt cedar), *Lemna* (pondweed), Poaceae (grass), *Quercus* (oak), *Artemisia* (sagebrush), Apiaceae (carrot family) and Chicoriodeae and Asteroideae (two subdivisions of the sunflower family, frequently referred to as Liguliflorae and Tubuliflorae). Figure 4 provides a comparison of the frequencies of these pollen types in the surface sample, the 400-grain pooled pollen spectrum for the pavement samples, and the 1,000-grain pooled pollen spectrum of the floor and floor contact samples.

Ruderal plants pollen types -- Asteroideae, Chichorioideae, and Apiaceae -- contribute significantly less to the pooled floor samples pollen spectrum (23%) than the pollen of hydrophyl plants --*Salix, Tamarix, Lemna* and Poaceae -- (30.6%) or the pollen of cultivated plants -- *Linum, Hordeum* and *Olea* --- (28.1%).

The pollen records of the samples from the bin and granary pavement layer (TABLE I) are statistically comparable with respect to all but one of the significant pollen frequencies (*Lemna*), though one sample incorporates eight pollen types that the other does not. Since they do not display the variability seen in the floor plaster samples, and were recovered from a stratigraphically superior position, they may represent a distinctive, younger, horizon. Moreover, the pooled pollen spectrum for these samples (Fig. 4) is in most ways quite different from that of the floor samples. The pooled pollen frequency value for the hydrophyl pollen types (32.9%) is somewhat larger than that of the ruderal group (29.5 %), and both groups make up a significantly higher fraction of the spectrum than the cultivar group pollen types (21.3%).

INTERPRETATIONS

Comparison of the terrestrial and lacustrine surface sample data suggests that the spectra of Figure 4 are less likely to reflect vegetation patterns than to reflect conditions that led to the dispersal of pollen in the immediate environs of the sampling loci. Pooling the data of multiple ostensibly contemporary samples to reduce variability, and focusing attention on the 13 pollen types that are expressed in statistical strength, should allow better recognition of those pollen groups and pollen types that reflect activity patterns customarily performed in the temple precincts. In particular, we would expect them to reflect customary cultural practices that would introduce cultivated or ruderal plants to the temple precincts.

The temple was dedicated to Julias, who had usurped the position of Demeter, goddess of harvests, in this Hellenized part of the Roman Empire (Ferguson 1970: 93). Given this context, we suggest that higher frequencies of cultivar pollen types in the pooled spectrum of the floor samples is appropriately interpreted as the product of collected tithes or politically motivated donations to the Cult of Rome.

It is tempting to interpret the frequency values for individual cultivar pollen types as reflections of the economic importance of those crops or the intensity of their production. This would be facile, however, without consideration of the way in which pollen of the crop plants would have been distributed on the tithed crop or transported to the temple. For example, olive is an anemophilous (wind-pollinated) plant. Its abundant pollen is known to cling to the fruit through the harvesting process and become incorporated in oil pressed from the harvested olives (Weinstein-Evron and Galili 1996). The small quantity of olive pollen in the floor spectrum suggests that if the olive harvest was tithed at all, it was presented to the temple in the form of ceramic jars of olive oil rather than bags or baskets of olive fruit.

Alternatively, flax is a zoophilous (insect pollinated) plant which does not disperse much pollen beyond the confines of its flowers. The large quantity of flax pollen in the floor spectrum argues that significant numbers of flax plants were transported to the temple precincts during their flowering period. Flax plants intended for linen production are harvested when the plants flower. Sheaves or bundles of the harvest are then retted to isolate the fiber (called tow), which is spun into thread. The flax pollen frequency strongly suggests it was tithed as it came from the fields, before further processing.

Palynological evidence for the tithing of flax harvests is one the bases of Geyer's (1998) argument that flax production was an integral and significant feature of the religio-political economy of Philip's first century tetrarchy. He argues that as the *pax romana* curtailed piracy and encouraged international trade, flax and linen from the eastern provinces would have become significant to the global economy of the Roman

Empire. Geyer believes that the palynological evidence for flax production explains Bethsaida’s promotion to polis status, provides justification for Philip’s improvements of the road that linked Bethsaida to the port of Acco/Ptolemeus via the Damascus road, and documents Philip's successful development of a secure politico-economic position in the Roman world.

Though species of these families occur in many vegetation patterns, the plants that produce the ruderal pollen types of the pooled spectra (Cichorioideae, Asteroideae and Apiaceae) are typically identified as indicators of anthropogenic habitats -- particularly fallow fields and pastures (Vorren 1986:13). In Israel, they are also common members of the batha flora, though they do not represent it in modern pollen rain spectra as well as *Sarcopoterium, Asphodelus, Ephedra* and a few other pollen types (Weinstein 1979:194). The batha flora, however, is also anthropogenic, since it replaces cleared maquis forest (Zohary 1962) . We can be sure that anthropogenic habitats were no less prevalent during the first century than is true today, since archaeological and historical evidence of regional population densities is also supported by palynological evidence of intensified cultivation (Baruch 1986; 1990). The prominence of ruderal flora pollen types in the pooled floor samples pollen spectrum could thus be reasonably interpreted as the product of a strongly managed landscape in the immediate vicinity of the site during its first century occupation and/or a very disturbed surface in the temple precinct.

However, there is no greater probability that this pollen was deposited in the vicinity of the sampled loci through natural than through cultural processes. We have thus chosen to interpret the large quantity of ruderal habitat pollen types in the pooled floor samples spectrum in activity area terms. Historical sources suggest the cultural institution most consistently and regularly performed within the precincts of Imperial Cult temples was the sacrifice of sheep and cattle. We suspect these pollen types were introduced to the temple on the fleeces and hides of animals which had grazed in fallow fields and pastures before being brought for sacrifice.

The pooled pollen spectrum of the pavement samples differs from that of the floor samples in its somewhat higher frequency of pollen of hydrophyl plants and in its significantly lower frequency of pollen of cultivated plants -- particularly flax pollen. There is also less inter-sample variability. We have suggested that this characteristic justifies separating the two pooled spectra as indices of conditions occurring at different times. If so, the younger spectrum suggests a change in tithing patterns prior to the temple's abandonment.

CONCLUSIONS

We recognize that the behavioral interpretations offered above are not unassailable. For one thing, our interpretations require the debatable argument that pooling pollen records to normalize palynological response to behavioral variability allows us to interpret statistically significant features of pooled spectra as evidence of *customary* patterns of human behavior. For another, these interpretations require acceptance of the archaeological arguments that date and identify the Imperial Cult temple at Bethsaida. They also require the assumption that evaluation of alternative interpretations of assemblages of pollen grains may be informed by the cultural function(s) reconstructed for the provenance of the sample, just as evaluation of alternative interpretations of a ceramic or lithic assemblage may be informed by the cultural context from which it was recovered. We are also quite aware that alternative behavioral interpretations of these data may be argued. The observed quantities of flax pollen, for example, might be a reflection of the retting process rather than represent tithe presented to the temple.

We are neither concerned nor distressed by this situation for two reasons. First, equifinality is a common feature of archaeological reconstructions of human behavior and culture. Though our interpretations are based on palynological data, which is yet familiar only to a minority of archaeologists, we recognize our behavior pattern reconstructions as testable cultural hypotheses. They are thus basically archaeological in character.

Second, one of our main research goals has been fulfilled whether the behavioral reconstructions we have offered are valid or are not. The issue here is the potential of site-context palynological data to support behavioral interpretation. We believe the most significant product of our research is its demonstration that archaeologically relevant pollen records can probably be recovered from more types of archaeological deposits at Eastern Mediterranean and Levantine sites than is generally acknowledged.

We do not wish to minimize the difficulties involved. Rational sampling strategies require both the palynologist's familiarity with the sorts of research limitations that may be encountered in the pollen laboratory and the archaeologist's expert awareness of the site's potential to yield palynological information of archaeological relevance. Once a body of palynological data has been obtained, its interpretation demands knowledge of both probable natural and probable cultural effects on the distributions and preservation of pollen types. Few archaeologists are trained or experienced with respect to the palynological problems involved. And few palynologists have the sort of archaeological training and experience that equips them to recognize the greater significance of some archaeological problems than others, or the field clues that identify archaeological site potentials as excavation proceeds. Thus the development of strategies for obtaining and prioritizing samples of archaeological relevance and value cannot normally be a problem left entirely to either the palynologist or the archaeologist.

Further, as in this case, pollen recovery may require development of extraction procedures suited to the specific deposits that exist at a particular site, and analysis may require a sufficient number of samples for assessments of variability. The supervisory archaeologist must be willing to support, or at least share, the labor and expertise costs involved. He or she, and/or the field supervisors, must also be prepared to accept responsibility for training crew members in appropriate sample recovery techniques and such logistical details as the supply of necessary equipment, packaging for sample shipment and curation, etc.

Our study is not the first to demonstrate the utility of pollen analysis as a means of recovering evidence of customary behaviors. We are aware, however, that similar studies will not become “normal” to archaeological research in this region and most others until archaeologists come to realize that archaeological palynology is a form of research that generates a type of archaeological evidence. We have presented this research in an effort to convince our readers that strategic collections of site-context pollen records can produce legitimate forms of culturally significant information. Since we continue to develop the technical ability to extract the pollen they contain, failure to recover and curate samples that are the sources of archaeological pollen records is no less a violation of ethical archaeological practice than purposeful destruction of any type of artifact or any other sort of archaeological record information.

ACKNOWLEDGMENTS

We wish to acknowledge the assistance of Drs. Rami Arav, Richard Fruend, Joel Gerboff, Vaughn Bryant Jr., Kevin Carroll and, especially, Mina Weinstein-Evron. We take responsibility for all of the interpretations presented here, sometimes in spite of their best efforts.

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FIGURE CAPTIONS

Figure 1. Bethsaida and some ancient roads. Solid lines represent attested routes. Dotted lines represent reconstructed routes.

Figure 2. Plan of the Roman Period temple at Bethsaida. Asterisks identify sampling locations.

Figure 3. Surface sample pollen spectra from Lake Kinneret and Bethsaida.

Figure 4. Pooled fossil pollen spectra from Bethsaida compared to the modern pollen record.

TABLE CAPTION

Table I. Bethsaida Pollen Observations.