ARCHAEOLOGICAL PALYNOLOGY AND CORRESPONDENCE ANALYSIS:
A CASE STUDY

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Introduction

Since 1970, other pollen analysts and ourselves have been examining pollen records recovered from the area locally known as the Transition Zone. This part of Arizona is formally recognized as a portion of the Mexican Highlands segment of the Basin and Range Province of North America (Hunt 1974). Though only a few of the larger archaeological sites of the Transition Zone are widely known (Tuzigoot, Montezuma's Castle, Tonto National Monument), the area was densely occupied from the mid-9th century until the last quarter of the 15th century. Sites representative of three major archaeological cultures, Hohokam, Sinagua and Salado, are well distributed through both lower elevation and higher elevation basins in this region, in addition to ancestral sites of the Pai- and Apache-speaking groups that occupied the area in the 18th and 19th centuries. Thanks to the data-gathering requirements of recent historic preservation law, many archaeological sites in the Arizona Transition Zone that would otherwise have been destroyed during the past two decades have been properly excavated and sampled for pollen analysis using protocols worked out for similar sites on the Colorado Plateau. These include analysis of populations of samples associated with various types of archaeological features and artifact assemblages in addition to stratigraphic sample sequences.

Study of the pollen records of samples from sites of the Transition Zone, however, has turned out to be frustratingly different from studies of site-context samples from the Colorado
Plateau to the north or the Sonoran Desert Grasslands to the southeast. In those areas, regular patterns of palynological variation can be recognized that suggest the paleoenvironmental contexts of site occupations. This has not been the case for site-context samples -- or even surface samples -- from the Transition Zone. Not too surprisingly, archaeological palynology has suffered from this result. Though many pollen samples have been collected and curated from sites in the area, relatively few have been analyzed.

An exception to this general rule are samples from sites in the Tonto Basin (Figure 1). SLIDE The lower elevations of this basin were submerged by the lake created to provide a reservoir when Roosevelt Dam was constructed in 1912, and many sites on the floodplain and lower terraces of Tonto Creek and the Salt River were drowned. A decision to raise the height of the dam in the mid 1980's, however, created the need to excavate a number of large sites of Salado Culture affiliation near the shore of the present lake and some smaller sites at higher elevations that were affected by rerouting and widening of a road along the west side of the basin. Most of these latter sites were occupied by earlier Hohokam culture peoples, and a few were successively occupied by Hohokam and Salado populations.

In this paper, we wish to report on the results of our use of correspondence analysis to study a variety of surface and fossil pollen records from the Tonto Basin. What we believe can be demonstrated is that application of this technique to surface samples allows recognition that the ways they reflect ecosystem relationships are too subtle to be discovered without multivariate statistics approaches. We will also show that correspondence analysis allows identification of distinctive pollen horizons in alluvial pollen sequences that can be confidently interpreted in
paleoenvironmental terms. When applied to site-context samples, correspondence analysis has proved no more effective at revealing the paleoenvironmental contexts of pollen records from Arizona Transition Zone sites than traditional forms of analysis. However, the patterns revealed by correspondence analysis provide the evidence for an explanation of that situation. Correspondence analysis demonstrates that in the Tonto Basin of the Arizona Transition Zone, at least, cultural activities have had such significant affects on the pollen rains trapped in site-context samples that palynological expression of climatic modifications and other sorts of ecosystem changes has been reduced below the level of statistical significance. Cultural systems and behavioral practices, however, have affected the spectra of site-context samples to the degree that correspondence analysis, linked to study of their associations with other aspects of the archaeological record, allows interpretation of much of their pollen record in terms of cultural activities.

Correspondence Analysis

The basic computational principles of correspondence analysis are very similar to those of principle components analysis, and both display the rows and columns of a data matrix in low-dimensional vector space. We have arbitrarily limited the analysis to two dimensions in this research. Correspondence analysis is superior to principle components analysis for pollen study, because it handles discrete data (i.e. counts) more effectively. Also, it produces plots of both the variables (pollen taxa) and the cases (samples). This allows the relationships of particular taxa or samples to be interpreted fairly easily. Generally, samples occupy a similar region of space as the
taxa which occur in high frequency within them, relative to the average values for all taxa and all samples in the dataset. One can thus determine which taxa influence the character of a sample or a sample cluster most significantly.

The results of a correspondence analysis on two axes are often displayed in a horseshoe-shaped arch we are calling the correspondence analysis curve. But not all points fall along this arch; some are interior or central to the curve while other plot at its peripheries. Points also may plot in discrete clusters. In all instances, though, the closer one point plots to another, the greater their similarity. Conversely, the further one point plots from another, the greater their dissimilarity.

One disadvantage of correspondence analysis is that rare variables (in this case taxa that are rarely observed) tend to be treated as very distinct from common variables. The samples that contain rare variables are treated similarly. To reduce their influence in these analyses, rare taxa with similar ecology were lumped into groups (e.g. in a dataset where Alnus, Populus and Celtis were all rare they would be combined as a "Riparian Taxa" variable). If this was not possible, very rare taxa were excluded from the dataset. In our analyses of the surface samples and the alluvial samples datasets, Chenopodineae pollen was excluded if it became evident that its local overrepresentation in some samples skewed results too drastically.

Warren L. Kovach's computer program "Multi-Variate Statistical Package Plus (version 2.2b) was used for our analyses.

Surface Samples
Figure 2
Surface Samples: 200 Grain Counts

Taxa Plot

Xeric Taxa •
Mesic Taxa ■
Other Taxa •

Sample Plot

Samples •
To discover patterns that can be interpreted from an environmental perspective, we used correspondence analysis to examine the pollen of a suite of surface samples from Cherry Creek Basin, located a few miles east of the Tonto Basin. These samples come from an area in which vegetation and ecology is comparable to that of Tonto Basin and typical of much of the territory occupied by Hohokam and Salado settlements at lower elevations in the Transition Zone. It is less disturbed, however, and the 45 Cherry Creek samples offered a usefully large body of 200-grain count data and information on a subset of 23 samples for which counting had been continued to 400 grains.

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The upper diagram of Figure 2 is the taxa plot for the 200-grain count data set. Those taxa adapted to more xeric habitats (e.g. pollen of creosote bush and bursage) are plotted as circles, while taxa adapted to more mesic or cooler habitats (e.g. alder, walnut, mesquite, oak, pine) are represented by squares. Taxa that are not characteristic of either xeric or mesic habitats are plotted with white diamonds. Most of the taxa adapted to cool or mesic habitats cluster in the lower left quadrant of the diagram. Those adapted to xeric habitats do not form as tight a cluster, but three of the four occur in the lower right quadrant. One of the xeric taxa -- Larrea-- and two of the mesic taxa -- and Pinus ponderosa and Alnus -- plot in the cluster formed about the origin point of the two axes. This indicates that these taxa play only a very small role in the distribution of samples seen in the lower diagram.

The clusters seen in the bottom diagram are created as products of the sizes and distributions of the frequency values for the pollen taxa. Thus the samples in the cluster in the
Figure 3
Surface Samples: 400 Grain Counts

Taxa Plot
- Xeric Taxa
- Mesic Taxa
- Other Taxa

Sample Plot
- Samples
lower left of this diagram are the ones in which higher pollen frequencies for *Juglans*, *Celtis*, *Acacia* and *Quercus* pollen have a strong influence on the analysis, and those in the lower right cluster are the ones that are strongly influenced by high pollen frequency values for *Ambrosieae* and *Poaceae*.

**SLIDE**

A correspondence analysis of the smaller data set of 400 grain counts yielded comparable results (Figure 3). Again there is a tendency for the mesic taxa to plot to the lower left, and the xeric taxa to the lower right. The distribution of samples is also equivalent. All the 400 grain count samples plot in the same clusters as their respective 200 grain counts. This was important to discover, since 200-grain observations are the general rule for most of the site-context pollen samples from the area.

Correspondence analysis of the Cherry Creek modern surface sample datasets, then, suggests that sample clusters can be recognized which are influenced by higher frequency values for the pollen of plant taxa that reflect adaptation along a higher-to-lower effective moisture gradient. Samples that plot to a cluster whose position along the correspondence analysis curve is a response to higher frequency values for mesic taxa are best interpreted as indices of a relatively mesic local environment. Alternatively, samples that plot to a cluster responsive to higher frequency values for xeric taxa are best interpreted as indices of a relatively xeric local environment.

**Waters' Profiles**
Figure 4

Waters Profile One

Taxa Plot
- Xeric Taxa
- Mesic Taxa
- Economic Taxa
- Other taxa

Sample Plot
- Samples
Upstream from Roosevelt Lake, the Tonto Basin is drained by a braided stream that flows between the high banks of a deeply incised floodplain. The headward downcutting and lateral erosion that continues today was not initiated until some decades after the creation of the lake. It has been so extensive in the past 30 years, however, that very little floodplain alluvium is now available for study or for recovery of pollen sample sequences. Michael Waters, the geomorphologist engaged to study the Tonto Basin before further elevation of the lake, directed us to three alluvial profiles he believed would provide a pollen sample sequence that extended from the period of Hohokam occupation prior to 1100 AD through the period following Salado occupation after 1450 AD to quite recent historic times. One of the three profiles was destroyed by an unseasonal flood before it could be sampled, but pollen records were obtained from Water's Profile One, believed to be oldest and temporally controlled by two radiocarbon dates, and from Water's Profile Three, believed to be youngest.

Profile One is presently located in one of the drier floodplain habitats. It now supports only sparse grass and a few Asteraceae shrubs. Profile Three, on the other hand, is located in one of the wetter habitats. It supports a dense growth of mature Populus and some Prosopis and is only a few tens of meters from a spot with sufficient permanent water to allow growths of Cyperaceae and Typha.

PROFILE ONE (FIGURE 4)

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The distribution of the taxa on the first two axes is displayed in the upper diagram. Symbol designations are the same as before, with the addition of a triangle for the economic taxa.
Figure 5
Waters Profile Three

Taxa Plot
- Xeric Taxa
- Mesic Taxa
- Other Taxa

Sample Plot
- Samples
group (Zea, *Carnegia* and *Cylindropuntia*). As can be seen, there is very good separation between the xeric, mesic, and economic taxa.

The lower diagram reveals that the samples are distributed along the first two axes in four clusters. The cluster of samples at the upper left have the highest values for xeric pollen taxa and we interpret these samples as reflections of the occurrence of relatively xeric paleoenvironmental conditions at this locale. The cluster of samples at the upper right of the figure have the highest values for economic pollen. We interpret them as reflections of prehistoric cultivation at or near the sampling locus. The next cluster to the left has high values for taxa adapted to mesic floodplain habitats (*Alnus, Salix, Prosopis*). They are interpreted as identifiers of relatively mesic paleoenvironmental conditions. The fourth cluster contains the surface sample from the profile; samples of this cluster are therefore interpreted as identifiers of paleoenvironmental conditions neither more mesic nor more xeric than occur at the sampling locus today.

**PROFILE THREE (FIGURE 5)**

We next undertook a correspondence analysis of Waters' profile 3, excluding Chenopodinnae pollen and pollen of rare taxa that could not be grouped. The two samples from the top of the profile (0 and 10 cm) were excluded from the analysis because of extreme surface bioturbation.

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The upper diagram shows that the distribution of xeric and mesic taxa is not as disjunct in this data as that of Profile One, though the xeric and mesic taxa do separate along the horizontal
axis. The lower diagram shows that the correspondence analysis segregates the samples of this profile into five clusters, but three are arrayed along the vertical axis and one cluster is represented by a single sample. While it is fairly clear that the samples that cluster at the lower right of the diagram index the occurrence of relatively mesic conditions, the other clusters must be interpreted as indices of distinctive, less mesic, paleoenvironmental conditions. Thus the analysis indicates less environmental variability during the period in which the sediments of this profile were deposited, and supports recognition that it has not always been located in the mesic habitat we see today.

RESULTS (FIGURE 6)

When the samples are graphed in the sequential order identified positions, the outcome of these analyses suggests temporal variations in the floodplain's effective moisture regimen and an episode of use of the Profile One locale for prehistoric cultivation. The presence of Cerealia and Erodium pollen through much of the Profile Three sequence indicates it was laid down subsequent to prehistoric occupation of the basin, as do the comparable presence of these taxa in the upper half metre of Profile One. The radiocarbon date obtained at 40 cm depth in Profile One supports this dating. Although this Figure 6 suggests almost all the Profile Three samples postdate those of Profile One, the bottom half metre or so of the latter and upper half metre or so of the former may well have been deposited at the same time.

The shift to more mesic conditions prior to the time the Profile One locale supported a Salado field, paleoclimatically induced modifications of the pollen record. The shift to more mesic conditions
Figure 7

Sampling Proveniences Combined

Taxa Plot

Xeric Taxa
Mesic Taxa
Other Taxa

Sample Plot

Archaeological Samples
Surface and Near surface Archaeological Samples
Surface Samples (200 grain counts)
Waters Profile One Samples
encountered in the top 60 cm of the Profile Three sequence, however, more likely reflects the rise in local water table that occurred with the creation of Roosevelt Reservoir downstream.

**Archaeological Sites**

Having shown that correspondence analysis allowed recognition of clusters of samples that were strongly influenced by frequency values for pollen taxa adapted to distinctive ecosystem conditions, we turned to the correspondence analysis of samples from archaeological sites. About four-fifths of the pollen records for this analysis were observed and published by Suzanne Fish, who was the pollen analyst employed by the archaeological projects investigating a number of Tonto Basin sites. Other records were observed and published by Gish, and yet others are unpublished records produced at Arizona State University during the course of supervised student research. The 167 sample data set used for the analysis was recovered from 9 Hohokam sites, 15 Salado sites, 5 sites at which cultural affiliation is yet unclear, and 1 site from which samples from both Salado and Hohokam occupations were obtained. It incorporates surface samples, samples from checkdam sites, samples from field same component of a site, samples from different components at the same site, and samples from the same type of component at different sites.

Figure 7 illustrates the results of correspondence analysis of a dataset composed of the 200-grain count surface samples from Cherry Creek, the samples from Profile One, and all the archaeological site-context samples. The lower diagram demonstrates that the three sorts of samples have overlapping distributions, and do not form clusters. There is a tendency, though, for the distribution of the Profile One samples to overlap with the surface samples more than with the
Figure 8

Archaeological Samples

Taxa Plot
- Xeric Taxa
- Mesic Taxa
- Other Taxa

Sample Plot
- Samples
archaeological site-context samples. In part, this is explained by the information displayed in the upper diagram. The distribution of xeric taxa is not segregable from the distribution of the mesic taxa, and neither the xeric nor mesic taxa have as much influence on the positioning of site-context samples on the lower diagram as they influence the positions of surface and profile samples. What is thus documented by the correspondence analysis of this dataset is that the indices of paleoenvironmental conditions, the mesic and xeric taxa, are not meaningful for interpretation of the archaeological site-context pollen records, though they are meaningful for interpretation of the surface or alluvial pollen records.

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This was illustrated even more forcefully by our next correspondence analysis of the site-context samples (Figure 8). The distribution of the xeric and mesic taxa is not only meaningless in relation to formation of clusters of samples, it is irrelevant to all those samples which are located in the upper right and lower right quadrants of the lower diagram. Clearly, then, the pollen records of the site-context samples contain so little information about paleoenvironmental context that it cannot be palynologically expressed in the ways it is expressed in alluvial profile samples. It has long been recognized that site-context samples pollen records incorporate two forms of information: that which reelects the operation of ecosystem variables upon the regional vegetation, and that which is a product of human behavior that affects the distribution, deposition and preservation of pollen grains. Clearly, information about the ecosystem lacks expression in the archaeological site-context dataset, and thus patterning that exists in this data is a product of
Archaeological Samples

Selected Archaeological Site
Samples with Cultural 
Association Plot

Hohokam Sites
Site 13  +
Site 46  x
Site 51  –

Hohokam and Salado Site
Site 50  ■ (Salado)
or  + (Hohokam)

Salado Sites
Schoolhouse Site ♦
Pinto Point Site ○
Bass Site ▲
the cultural systems and cultural institutions of the Hohokam and Salado populations that lived at these sites.

The lower diagram of this figure demonstrates that the archaeological site-context samples form an almost continuous distribution. The nine samples at the extreme left of the diagram form a separate cluster, however. The associations of the nine samples that form this cluster are particularly interesting. With one exception, these samples were collected from the surface at their respective archaeological sites or from prehistoric agricultural terraces at depths less than 10 cm below the modern surface, and are the only samples in the dataset with such associations. It would appear that these samples form a cluster because they actually did not trap the pollen they contain during the period the sites were occupied or the agricultural terraces in use. The exceptional sample, which came from the floor deposit of a field house structure, seems likely also to have been deposited subsequent to occupation.

Though this result suggests that correspondence analysis might be a technique archaeologists could employ to distinguish the relative antiquity of site-context samples, we believe that in this case the reason it has that value is more interesting than the affect itself: The samples that are not members of this cluster apparently illustrate the various forms of impact of occupation on local pollen rain, while the samples that are members of this cluster illustrate the palynological affect of a site's release from such impact.

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The lower diagram of Figure 9 displays the distribution of samples from the three Salado sites with the greatest number of samples, the three Hohokam sites with the greatest number of
Figure 10

Archaeological Samples

Taxa Plot
- Collection and Cultivation Taxa
- Long Distance Transport Taxa
- Chenopodiinae
- Other Taxa

Surface Architecture:
Plaza and Floor Samples Plot
- Surface Architecture: Floor Samples
- Surface Architecture: Plaza Samples
samples, and the one site that contains both Hohokam and Salado occupations. Clearly, the samples from Salado and Hohokam sites have almost wholly distinct distributions. It is also clear that the separation is not specific to individual sites; samples from the Schoolhouse, Pinto Point, and Bass sites are dispersed throughout the Salado cluster and samples from the three Hohokam sites are similarly dispersed throughout the Hohokam cluster. Nor is the separation due to some geomorphic variable such as elevation. Though most of the Salado samples were recovered on the lower terraces of the basin and most of the Hohokam samples were recovered from higher elevation locales, both components were sampled at Site 50 (squares). The distributions of samples from this single site also do not overlap. More sites could be included on this diagram, but a greater number of site symbols presents a more confusing image. The separate distribution of Hohokam and Salado samples is also evident on a diagram that includes all sites.

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The upper diagram of Figure 10 provides some insight into the cause of the separate distributions of Hohokam and Salado site pollen records. Realizing that the Hohokam sites plotted to the lower left of the correspondence analysis curve and the Salado sites plotted to the lower right, we assessed the distribution of pollen taxa to determine which were most influential in establishing the tendency of a sample's pollen spectrum to be located in those areas of the curve. The upper diagram illustrates the fact that very few pollen taxa control the tendency of sample pollen records to be located in the lower right part of the correspondence analysis curve, and only one taxon, Chenopodinae, ever occurs in sufficient frequency to be influential. The
most influential taxa that affect the positioning of samples in the upper right quadrant are here labelled "Cultivated and Collected". These are pollen of cultivars and field weeds (Zea, Kallestroemia, Sphaeralcea and Boerhavia) and the pollen of Cactaceae that provide edible flower buds and fruit (Cylindropuntia, Platyopuntia and Cereus). It is clear that the majority of taxa effect the positioning of archaeological site-context samples in the upper left quadrant of the correspondence analysis curve, since no taxa are influential in the positioning of records in the lower left portion. Amongst the former group we have illustrated the positions of Ephedra, Pinus, Artemisia and Quercus. These are all taxa that must have reached sites through long distance transport.

The cluster formed by the Salado samples in the lower right portion of the correspondence analysis curve, then, is in general composed of those samples in which Chenopodinnae pollen is a locally overrepresented taxon and taxonomic diversity is low, while the cluster formed by the Hohokam samples in the lower left portion of the curve is in general composed of those samples in which Chenopodinnae pollen frequency values have a more normal distribution and, as a result of the release of constraint, taxonomic diversity is somewhat greater. In regional archaeological palynology literature, local overrepresentation of Chenopodinnae pollen is widely recognized to be a product of local soil surface disturbance. The inference that the surfaces of Salado sites were more severely disturbed and those of Hohokam sites were less disturbed is consistent with two conclusions that can be drawn from the character of the archaeological record. On the one hand, Salado sites were more populous -- especially those large sites that produced the majority of Salado pollen samples included in this analysis. On the other hand, Hohokam sites are
characterized by wattle and daub semi-subterranean dwellings fronting upon common work areas, while Salado sites are characterized by suites of masonry rooms, earthen platform mounds and ceremonial plazas encompassed by a compound wall.

The lower diagram of Figure 10 compares the distribution of samples from the floors of Salado rooms with those from plaza use surfaces at Salado sites. When the distribution of taxa that is illustrated in the upper diagram is considered, it is clear that most of the room floor samples are differentiated by values for Chenopodinneeae pollen -- and the reduced variety of taxa -- that is best interpreted as a product of local overrepresentation. When we considered the question of why contemporary plaza surface samples would be less affected than rooms, we recognized that the floors of the rooms lay within walled and roofed spaces, where pollen deposition would be limited. Alternatively, the surfaces of plazas were open spaces where deposition of more regional pollen rain could be expected. This is consistent with the greater influence of long-distance transported pollen taxa in the plaza surface samples. The distinctive artifactual inventories of some rooms document their use for a range of cultural functions. This also is suggested by the range of pollen records from floor samples. Those which plot to the upper right contain sufficient quantities of the cultivated and collected taxa to suggest a cultural function related to manipulation of those plants. Those which plot furthest to the upper left contain sufficiently less Chenopodinneae pollen and a sufficiently wider range of taxa to suggest another sort of atypical function or, perhaps, identify rooms that were occupied for longer periods of time than typical rooms.

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Figure 11

Archaeological Samples

Taxa Plot
- Collection and Cultivation Taxa
- Long Distance Transport Taxa
- Chenopodiinae
- Other Taxa

Subsurface Architecture and Storage Feature Samples Plot
- Storage Feature Samples
- Subsurface Architecture Samples
The upper diagram of Figure 11 reiterates the distribution of taxa that was illustrated on the last figure, but the lower diagram contrasts the distribution of samples from rooms with specialized storage facilities and those from pithouses. Some Salado rooms can be confidently recognized as storage rooms on the basis of specialized architecture. In particular, some rooms contained earthen pedestals that supported large basketry or ceramic granaries, and other rooms contained large pit features and/or lacked the hearths typical of normal domestic rooms. Pollen samples from storage rooms came from a range of provenance contexts, including the upper surfaces of granary pedestals and the basal fills of ceramic storage vessels and storage pits.

Although there is some overlap between the plotting locations of room floor (see Figure 10) and storage features, those from room floors tend to be distributed in the lower central and lower right portions of the correspondence analysis curve, while samples from storage facilities tend to be distributed in the upper right portion and form a tighter cluster. There is very little overlap between the distributions of samples recovered from pithouse contexts and those from storage facilities, even though it is clear from the archaeological record that the same plants were cultivated and stored by both cultural populations and some of the storage facility samples come from pit contexts. The storage facility or pithouse samples which occur as extreme outliers, then, contain atypical pollen records which may be indices of atypical behavior patterns. The pithouse sample which falls to the extreme right, for example, or the storage facility sample which falls outside the cluster formed by the other samples far to the left. In fact, we know the latter sample derives from an atypical archaeological context. While other granary pedestal feature samples were located within rooms, this one had been constructed on an elevated plaza.
Conclusions

Our study of pollen records from the Tonto Basin suggests that using correspondence analysis as a pattern search technique has as much archaeological value in the desert basins of the Arizona Transition Zone as it has in temperate Europe. Correspondence analysis of a suite of 45 surface samples allowed us to identify sample clusters that reflect vegetative adaptations along a higher to lower effective moisture gradient. Directly comparable patterns were observed when correspondence analysis was applied to the pollen records recovered from two alluvial profiles, thus identifying the sequential arrangement of pollen records indexing episodes when relatively more mesic floodplain conditions occurred, episodes when effective moisture conditions similar to those of today existed, and episodes when relatively more xeric conditions occurred (Figure 6). There are few clues to the absolute dating of the effective moisture curve so defined, but it is clear that the period of Salado occupation of the Tonto Basin was essentially coincident with at least the early part of a period of higher effective moisture values than occur at the same floodplain locale today. Further, the correspondence analysis produced evidence which suggests that both more xeric and more mesic conditions episodes have occurred in the Tonto Basin since the introduction of Old World floristic elements, though the mesic episode may be an artifact of construction of the dam which now captures the water of Tonto Creek in Roosevelt Lake.

Correspondence analysis of the samples collected from archaeological site-context deposits produced two independent lines of evidence to show that any patterned relationships revealed among such pollen records are products of behavioral, rather than paleoenvironmental, conditions.
Though they were recognized through their archaeological associations rather than by clusters along the correspondence analysis curve, correspondence analysis allowed recognition of patterns in the archaeological site-context dataset that suggest specific behaviors and lifeways. Perhaps the most significant and surprising of these is the clear differentiation of pollen records from Hohokam and from Salado cultural contexts. Basically, the Hohokam horizon samples totally lack of any of the palynological indices of behavior patterns evidenced in the Salado horizon samples. This suggests Salado lifeways were sufficiently different that they affected both cultural and background pollen rains to a wholly unexpectable degree, and provides support for the thesis that Hohokam culture represents a very different adaptation to the Tonto Basin environment.

Correspondence analysis of the archaeological site-context samples also proved archaeologically valuable as a means of identifying attributes of the Salado palynological record that allow differentiation of storage facilities and rooms that were principally used for storage from rooms with other cultural functions. Also, to allow identification of archaeological proveniences in which typical or atypical effects on the pollen record are indicated, suggesting typical or atypical patterns of behavior.

We believe correspondence analysis will yield additional behavior pattern reconstructions as additional pollen samples are analyzed from other sites in the Tonto Basin, and as the relationship of kinds of pollen records and kinds of artifact assemblages is more fully explored. It is clear from what has been accomplished so far, however, that correspondence analysis can be archaeologically valuable as a means of enhancing understandings of the lifeways of an area's
prehistoric occupants. The separate distributions of Hohokam and Salado site-context pollen records along the correspondence analysis curve, for example, strongly suggests that the cultural practices of the earlier Hohokam population had a wholly different affect on pollen deposition and preservation than the later Salado population. So different that almost all samples from Hohokam sites lack significant frequency values for pollen taxa that are typically found in significant frequencies in Salado site-context pollen records. Hohokam residential areas seem to have been utilized in surprisingly different ways, their food storage behavior patterns seem to have been quite different, and the impact of their culture on the Tonto Basin environment was very distinctive.

This study, however, has been purposefully undertaken on the entire known set of Tonto Basin site-context pollen records. The correspondence analysis of subsets of that database, supplemented by additional pollen records from other sorts of Hohokam and Salado cultural contexts, seems likely to prove even more useful as a means of identifying patterns of palynological data that can be interpreted as indices of ancient behavior patterns and lifeway systems. The primary objective of this effort was to explore the potential of correspondence analysis to uncover data patterns that would allow recognition of paleoenvironmental contexts and recognition of behavioral patterns relevant to an understanding of the prehistory of the Arizona Transition Zone. We believe some of that potential has been well evidenced by the results of our work, and we urge wider application of correspondence analysis in archaeological palynology.