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Journal

UC Berkeley McCown Archaeobotany Laboratory Reports, 25

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Publication Date

1991-06-01

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INFORME: KK'ARANA

by M. Wright, H. Lennstrom, and C. Hastorf
University of Minnesota Archaeobotanical Laboratory Report #25
June, 1991

Introduction

The strategy selected for our first phase of paleoethnobotanical analysis has been 1) to analyze at least some samples from all areas, 2) to focus on domestic areas of the site, and 3) to work only with samples where information concerning cultural contexts, field notes, etc., were available. The samples selected from Kk'araña were completed during academic year 1990/91, when the lab plan was to sort approximately 30-40% of all samples from usable contexts (ie not mixed, disturbed, or undocumented). Because we had a larger number of completed botanical collection forms for this area, and because we were particularly interested in Kk'araña as a domestic area in the Tiwanaku urban center, but outside the ceremonial precincts, we elected to analyze a slightly higher percentage of samples from this area. Out of 71 samples for which we had sorted heavy fractions, light fractions and forms, we elected to sort 35 samples.

Samples were selected so that the subsample reflected the contextual range of the excavation area, and that some of each context type would be analyzed (ie a stratified random sample, stratified by cultural context).

Sample sizes for the 35 Kk'araña samples ranged from 4.8 to 9.6 liters (target value for a "full" sample was 8.0 liters), with a median of 8.0 liters and a mean of 7.6 liters. These make them among the best with regard to taking a standard full bag size (8 liters). This large and consistent bag size means that a wider variety of comparative descriptive statistics, such as ubiquity and diversity measures, can be used without fear of unreliable results due to the high correlation of these statistics with bag size.

Methods*Field methods*

Botanical samples were processed using a motorized flotation system, modified from the SMAP machine design first published by Watson in 1976. Because the charred materials have a lower specific gravity than water, they float on the water's surface and can pour off. Our machine is built from a 55 gallon oil drum as a water container, that is used to separate charred plant remains from the site matrix. Water is pumped into the system from below, and is moved upward in the drum by a submerged shower head. Inside the drum is a removable inner bucket, with a mesh bottom that the soil samples are poured into once it is partially submerged in the machine. The bottom mesh catches rocks, artifacts, and bones that do not float. This material that is caught is termed the "heavy fraction". It is dried, and the cultural material larger than 2 mm is removed and analyzed. In 1989 and 1990 we used brass cloth in the bottom of the inner bucket, with an aperture of 0.5mm.

The charred plant remains on the surface of the water are poured off through a spout into fine-meshed chiffon. This material, termed the "light fraction", was allowed to dry, and then packaged for shipment to the University of Minnesota's archaeobotany laboratory.

Approximately 20 samples were processed per day in the field. Each day we added 50 charred poppy seeds to a randomly selected sample to act as a check on the flot machine (see Wagner 1982, 1988). Poppy seeds are used in the Americas because they are not native (and hence will never occur in prehistoric deposits), and they are small in size (ca. 0.4 x 0.6mm). These features allow poppy seeds to act as a measure of the amount of small seeds that are lost or recovered. The average recovery rate for 1989-90 was 93.4% (46.7), indicating that most material from the samples was being recovered.

Laboratory methods

Analysis of the charred plant remains from the light fraction started with removing carbon, bones, and fish scales from the floated matrix (mainly modern plant roots and soil). Lab analysis was done using low power (6-25X) stereoscopic microscopes with fiber optic light sources. Trained lab personnel extracted the charred plant remains from the samples, and made some preliminary identifications of plant taxa. H. Lennstrom checked all charred material removed from the samples and also scanned the remaining matrix for any identifiable plant parts that might have been missed. In addition she was responsible for the final identifications made of the charred plant parts. The identifications were made with the aid of Dr. Hastorf's South American reference collection of seeds, pressed plants, tubers, and wood in the lab. Material from each flot was examined two times, systematically, under the microscope. For ease of sorting, the samples were split using 2mm, 1.18mm, 0.5mm, and 0.3mm geologic sieves, keeping materials of the same size together in a separate tray. All charred material greater than 2 mm was pulled and identified, while wood was not removed from the <2 mm portion of the light fraction, as it is known to be too small for identification purposes (Asch and Asch 1975). Other plant material down to 300 microns was collected and identified. In some cases, when charred plant remains were particularly dense, it was not possible nor necessary to examine the entire sample. We used experimental results from Lennstrom's (1991a) work with Peruvian flot samples which found that a 10-25% sub-sample could be used to represent the sample as a whole, if the sample contained several thousand plant fragments and had a total volume of over 0.5 liter of charred botanical remains. Samples were split using a riffle box, so that the sub-samples were divided without bias (Pearsall 1989).

Each sample was recorded on a data sheet, containing information on its provenience, type of sample, cultural context, volume of flot sample, amount of sample analyzed, counts of all the plant taxa that could be identified, and counts of those items that could not be identified. For recording, counts were chosen over weights as some of the seed taxa are very small, and their weights are negligible. Seed fragments and whole seeds were recorded by count. Material from the heavy fractions was identified in the same manner, and tallied on the same data sheet as the light fraction.

Information was transferred from the data sheets into data files on floppy disks that were then loaded onto the mainframe computer. The mainframe used is an IBM 4381 available at the University of Minnesota's St. Paul computer center. Data analysis was carried out using the SAS statistical package (SAS Institute 1985a; 1985b; 1985c; 1985d). This system was chosen for several reasons. First, it had the capability of managing a very large dataset, and provided the types of summary, parametric, and non-parametric statistics which were of interest.

Also, it had an attached graphics package that allowed the plotting of publication quality graphics, without having to transfer data to another system.

Sorting strategies for archaeobotanical material in the lab

Because time and money are always in high demand in the lab there are several different strategies that can be used when sorting and identifying archaeobotanical material to maximize data collection while minimizing time expended. Other considerations are the goals of the study at hand, the quality of the collection and recovery techniques used to retrieve botanical material, and the overall quality of archaeological information available for the interpretation of the materials.

Below are sorting schemes devised especially for flotation samples, where the study of domesticates is the main focus. Strategies 1, 2, 5, and 6 were all used with the Kk'araña materials.

Strategy 1: Complete sort

In the best of all possible worlds it is nice to be able to sort out and identify all prehistoric material from a sample. It is especially desirable because a single flot sample is already only a small sample of any given archaeological context, and one wants as complete a picture as possible. In our case, one would sort out, and identify all charred material, except <2mm wood, which is usually unidentifiable. All bones and other animal and artifactual materials are pulled out and given to appropriate specialists.

This type of strategy gives RATIO level data, with exact counts (and/or weights) entered onto the computer. Descriptive statistics such as RELATIVE PERCENTAGES, DENSITIES, UBIQUITIES, and DIVERSITIES can be generated from this type of data.

This strategy is the most labor intensive, and can be redundant when you work past the point of diminishing returns, ie, you get the exact same values by sorting entire sample that you would by making estimates based on some fraction of the whole (50%, 25%, etc).

Strategy 2: Sample splitting

In this strategy time is saved by splitting (by weight) some or all of the sample. It is usually done to one of the smaller fractions separated by the geologic sieves, eg, 100% of the material that is >2mm is sorted, while 50% of all material <2mm is sorted and all counts of the identified specimens are doubled. The decision to split a sample should be based on the following guidelines. The average amount of time spent on a sample is about 2 1/2 hours, including sorting and identifying light and heavy fractions, as well as material recovered from the sieves in the field. The two main factors that are considered are both the volume of the charred sample, and the density of the seeds. The desired amount of material to be sorted from each size fraction of the sample is enough to fill one of the sorting trays (in a thin layer, as when ready for sorting). If a brief scan of even this amount appears to contain hundreds of seeds, it should be split again. A rule of thumb that has proven effective for

the 1986 Pancán (Peru) material was never to let the sorted portion fall below 1.0g or 12.5% (Lennstrom 1991a). In these samples it was found that this was approximately the point of diminishing returns for very dense samples such as those from burnt stores of crops, where seeds and tuber densities per 6-liter of soil averaged in the thousands. That is, if at least these 12.5% or 1.0g of each size fraction was sorted the estimates of total densities and taxa diversity were found to be insignificantly different than if the whole sample had been sorted. We noted on the form which fractions were split, what percentage was sorted, and the weight of the material prior to sorting. Of course, special circumstances may occur, and less may be sorted without losing accuracy.

Trials with a 0.3mm geologic sieve show that very, very few seeds will pass through this mesh size. Another time saving measure in dusty samples is not to sort the material that is less than 0.3mm. If bones and fish scales are too numerous, they can be left in the remains while noting their occurrence and/or abundance can be put on the data sheet. If very small lumps are overabundant one can leave those <1.18mm (with no distinctive characteristics, such as a surface) in the remains.

As with the complete sort, one gets RATIO level data, and can generate RELATIVE PERCENTAGES, DENSITIES, UBIQUITIES, and DIVERSITIES. Because actual counts are estimated this type of data can be used in comparison with that of Strategy 1 with no conversion.

This method is a good time saver, especially for samples that are quite homogeneous. Drawbacks are that diversity may be lost, and rare species are either missed or overrepresented.

[Strategies 3 and 4, developed by Lennstrom and Hastorf (1989) for the University of Minnesota archaeobotany laboratory, were not used with the Wila Jawira materials]

Strategy 5: Complete sort >0.5 mm

After working with the 1986-90 Bolivian material we found that the samples were full of a lot of dust, minute unidentifiable charcoal fragments, taking approximately 6-7 hours each to sort. We felt this was too much time to spend on a single flot sample. We were also somewhat uncomfortable with material that was less than 0.5 mm (500 microns), as the bottom mesh inside the flot machine is only 0.5mm, and there is a possibility that anything smaller than that could be a contaminant from some other samples. This type of exchange through the "inner bucket" mesh is known to happen, as it occasionally happened with the modern poppy tracers when this mesh had too large an aperture in 1982-6.

Tests with the Bolivian material showed that the percentage of differing small taxa are not at all the same from sample to sample, so there is unfortunately no systematic way of calculating the amount of material that will be missed by not sorting material between 0.5 and 0.3 mm. At least there did not seem to be taxa that would be completely missed, except sometimes UNK 264 and 190. Taxa that are most likely to lose a substantial number of seeds in the final tally include are Small Poaceae, *Nicotiana*, and *Juncus*.

This strategy gives ratio level data, so that densities, relative percentages, diversity, ratios, and ubiquities can be generated, though small taxa may be underrepresented.

Strategy 6: Sample splitting, sorting only >0.5mm

This is a combination of strategies 5 and 2, where a fraction of the sample may be sorted, and no material less than 0.5 mm is checked. We used this procedure on extremely large, and dense samples. As with all the other strategies discussed here, ratio level data is obtained, and densities, relative percentages, diversity, ratios, and ubiquities can be calculated. Again, what will be lost are some of the small taxa, and some degree of accuracy.

Quantification of Samples from Kk'araña

In this section we report the different plant taxa recovered from the samples and three different quantification schemes used to help interpret the botanical remain (DENSITY, UBIQUITY, and RELATIVE PERCENTAGES). Density is expressed as the number of seeds (or seed fragments) per liter of site matrix. This standardizes the counts of material, so that samples of differing original volume can be compared (Pearsall 1989; Popper 1988). Also, each taxon can be considered independently, and density values seem least biased when comparing samples of different original soil volume (see Lennstrom 1991b).

Ubiquity is expressed as a percentage, and is calculated as the percentage of samples which contain each taxon (Hubbard 1975; Popper 1988). For example, if maize is identified in 10 of 30 samples it has a ubiquity value of 33%. The advantage of ubiquity scores is that each taxon is considered separately, and the amount of each does not affect the others. Also, the amount of each taxon in a sample does not affect the ubiquity value, so that 1 or 1000 of the same seed in a single sample carries the same weight.

The third quantification method we present is relative percentage (Popper 1988). These values are expressed as the percentage each taxon makes up relative to the number of items in an individual sample, and is displayed as a pie diagram. The advantage of this scheme is that all taxa can be considered simultaneously, and the relative proportions of taxa from different samples can be compared, regardless of the original volume of the sample, or the density of charred plant remains.

LIST OF PLANT TAXA:

Plant remains from the Wila Jawira botanical samples were commonly identified to the family level, and sometimes to genus. When referring to plants by scientific names authorities (initials) are usually cited when the taxon is first mentioned in the text. For example *Zea mays* L. indicates that Linnaeus named the species (for complete list see appendix) Genera (eg: *Chenopodium*) are always capitalized, and underlined, or italicized. The second part of the species name is also put in italics, or underlined, but is always lower case (*Chenopodium quinoa*). The addition of "spp." following the genus name indicates

that it might be represent by one or more species, but we cannot determine which one(s). When two species from the same genus are referred to in succession the genus is usually abbreviated to a single letter for the second species.

- Large (>1.18mm) *Chenopodium* spp. (seeds) Probably domesticates: either quinoa (*Chenopodium quinoa*) or cañiwa (*C. pallidicaule*). Food source.
- Small (<1.18mm) *Chenopodium* spp. (seeds) Possibly domesticates: either quinoa (*Chenopodium quinoa*) or cañiwa (*C. pallidicaule*). Food source
- Lumps (Unidentifiable charred plant fragments, in this case especially, they might be tubers or other fragments of domesticates.) Possible food source.
- Small Poaceae (seeds) Grass family. Possibly used as fodder, fuel, or in construction.
- Large Poaceae (seeds) Grass Family, likely *Stipa* spp. or *Festuca* spp. Possibly used as fodder, fuel, or in construction.
- Wild Leguminosae (seeds) Fabaceae-Bean family. Common weed, possible fodder.
- Verbena* spp. (seeds). Common weed.
- Plantago* spp. (seeds). Common weed, thrives on disturbed soils.
- Malvaceae (seeds) Mallow family. Common weed.
- Relbunium* spp. (seeds) A plant used in S. America for red dye.
- Rubus* spp. (seeds) Some types could have been used as a casual food source, or as medicines.
- Cyperaceae (seeds) Sedge family, often associated with wetlands. Many industrial purposes: mats, boats, roofing, etc.
- Cruciferae (seeds) Mustard family. Weeds, sometimes eaten as greens.
- Unknown 224 (seeds) Possibly a mint family.
- Potamogetonaceae (seeds) Pond weed family, associated with freshwater ponds, bogs and marshes.
- Cereus* spp. a type of cactus.
- Unknown 264 (seeds)
- Amaranthus* spp. (seeds) Usually a weedy annual; found in disturbed habitats, possible casual food source.
- Unknown 270 (seeds)
- Unknown 242 (seeds)
- Unknown 265 (seeds)
- Kaiña (seeds) This is an Aymara name, scientific name unknown.
- Nicotiana* spp. (seeds) These are likely of a type of tobacco which grows wild/feral in the area today, though we cannot distinguish them from more tropical domesticated species at this time.
- Sisyrinchium* spp. (seeds) Weed.
- Zea mays* (maize) kernels
- Zea mays* cob fragments
- Unknown 202 (seeds) Possibly Borage family (Boraginaceae)
- Unidentifiable seeds
- Tubers, (food) probably domesticated species, such as the potato
- Wood and twig fragments-Fuel, construction, tools.
- Wira Koa leaves - Aymara name, scientific name unknown. This herb is often burned as an offering to Pachamama today.
- Leaves-Type unknown.
- Dung-Fertilizer and/or fuel.

QUANTIFICATIONS

All samples together n=35

Average density of crop plants (#/liter of site matrix)

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0.25	0.01	0.83	17.27	0.00

Ubiquity of crop plants (# of samples containing taxon)

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
34%	6%	77%	100.0%	0%
(12)	(2)	(27)	(35)	

Context = ash lens (n=1)

Average density of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0.00	0.00	0.00	9.58	0.00

Ubiquity of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0%	0%	0%	100%	0%
			(1)	

Context= Burial (n=2)

Average density of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0.00	0.00	1.17	25.26	0.00

Ubiquity of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0%	0%	100%	100%	0%
		(2)	(2)	

Context= Fill (n=16)

Average density of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0.02	0.02	0.43	10.86	0.00

Ubiquity of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
13%	6%	69%	100%	0%
(2)	(1)	(11)	(16)	

Context= Midden (n=7)Average density of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0.37	0.02	0.70	20.85	0.00

Ubiquity of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
86%	14%	86%	100%	0%
(6)	(1)	(6)	(7)	

Context= Trash pit (n=3)Average density of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
1.94	0.00	1.69	35.95	0.00

Ubiquity of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
100%	0%	100%	100%	0%
(3)		(3)	(3)	

Context= Well (n=2)Average density of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0.00	0.00	0.64	13.15	0.00

Ubiquity of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0%	0%	100%	100%	0%
		(2)	(2)	

Context= Floor (n=3)Average density of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0.00	0.00	0.36	13.30	0.00

Ubiquity of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0%	0%	67%	100%	0%
		(2)	(3)	

Context= Plow Zone (n=1)Average density of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0.11	0.00	6.93	39.78	0.00

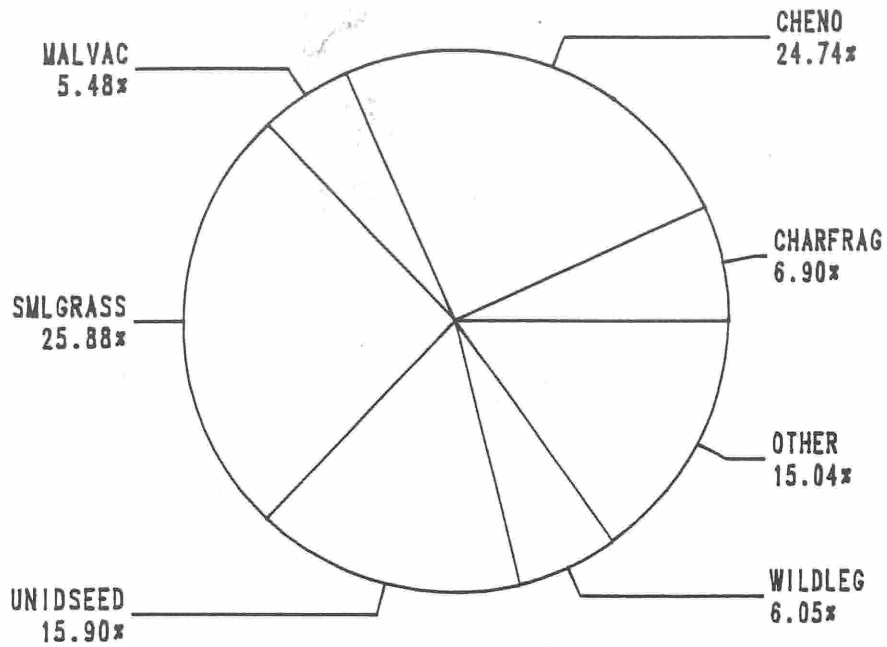
Ubiquity of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
100%	0%	100%	100%	0%
(1)		(1)	(1)	

Relative Percentages of entire plot sample contents. Relative percentages of different plant groups (eg; crops only, weeds only, identifiable materials only) can be generated from raw data. For pie diagrams see following sheets.

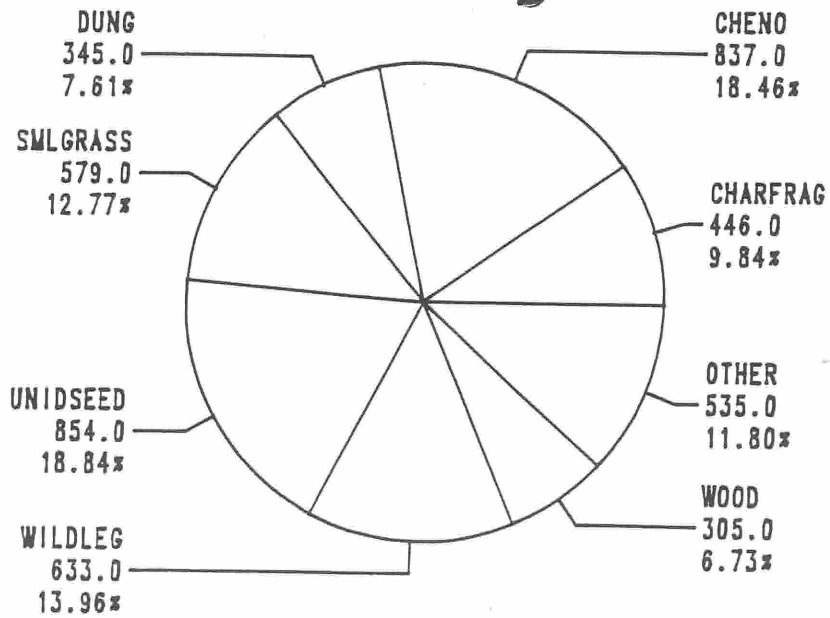
KK

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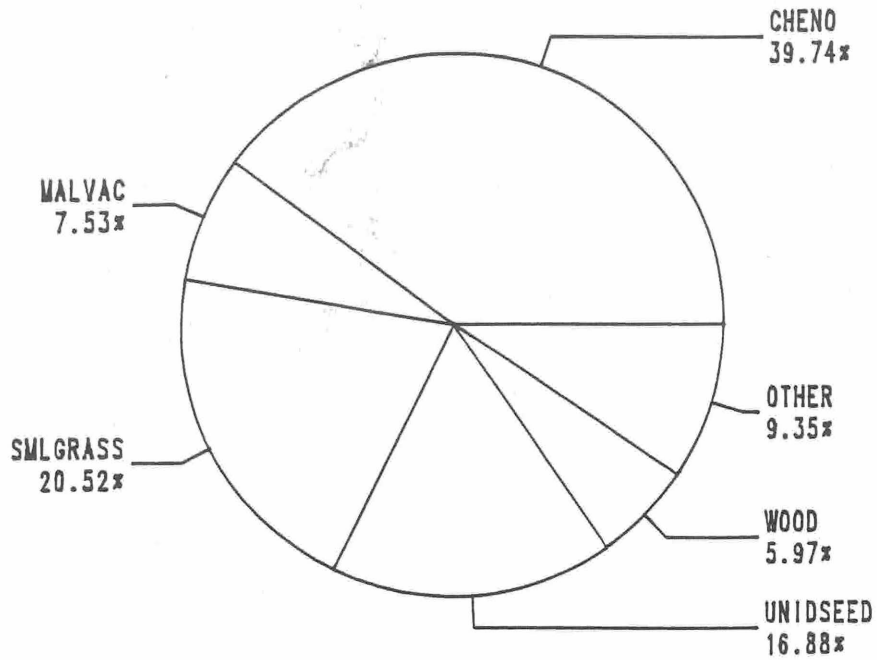
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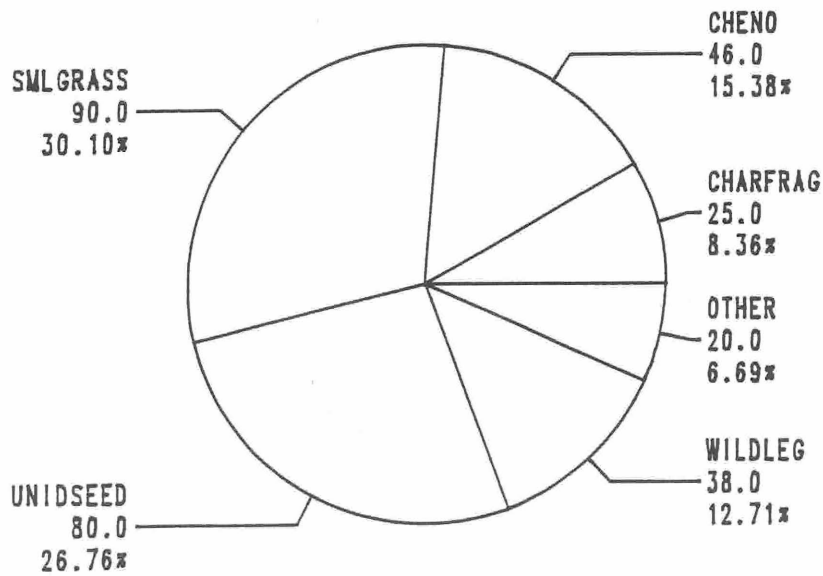
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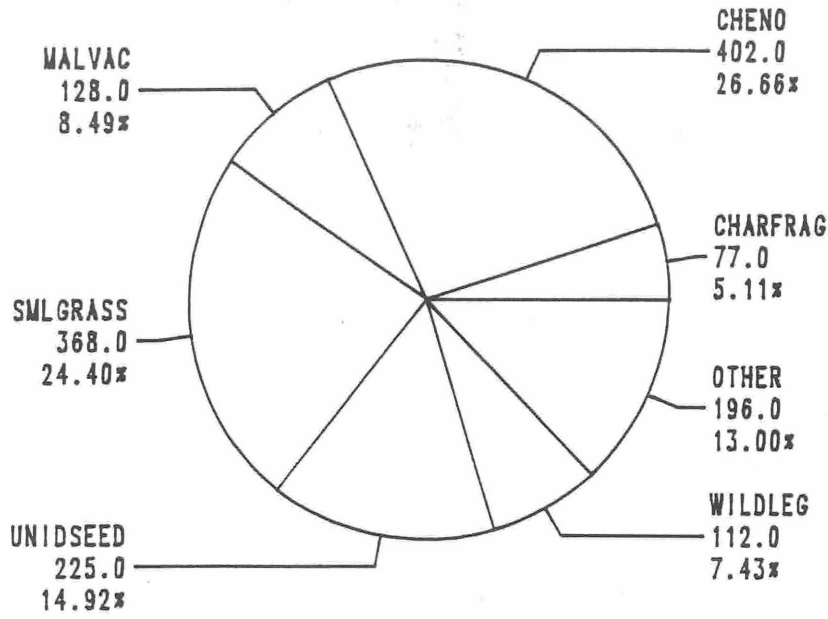
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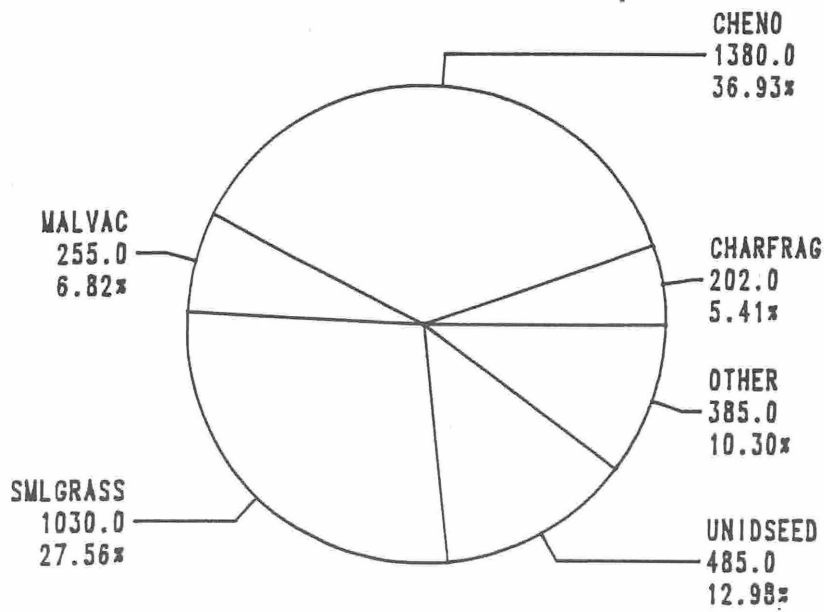


TIW
KK'

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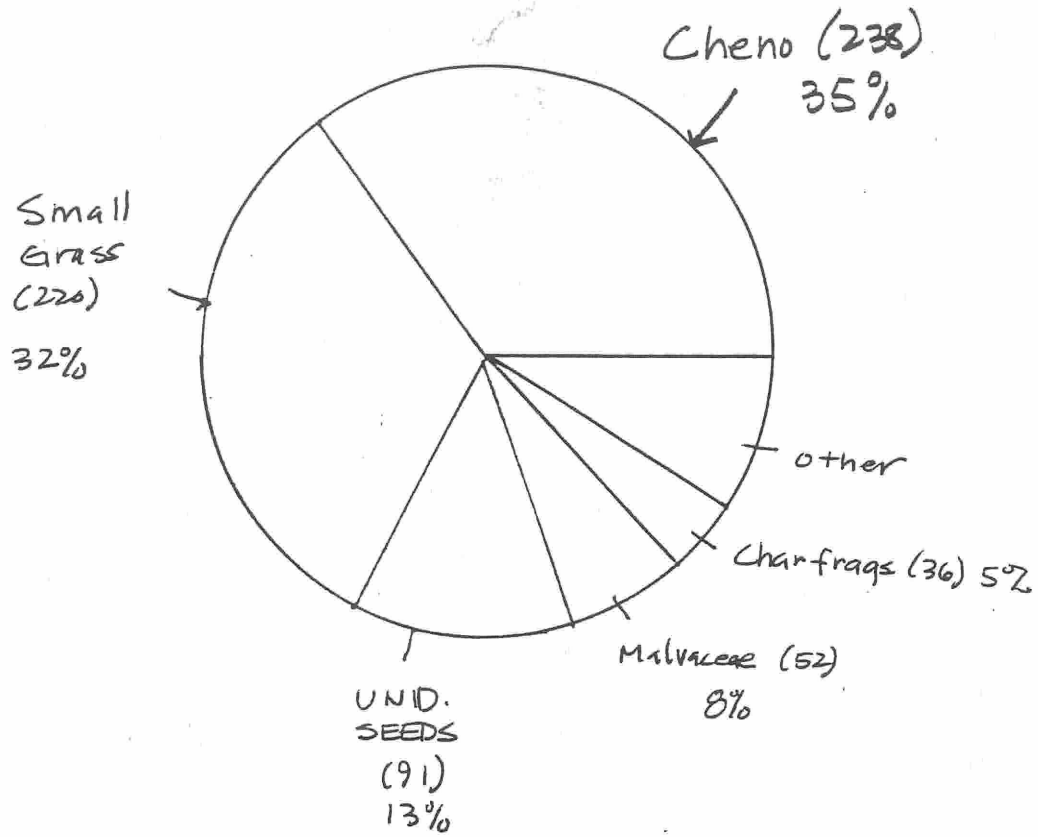


CONTEXT = FILL n=16



KK

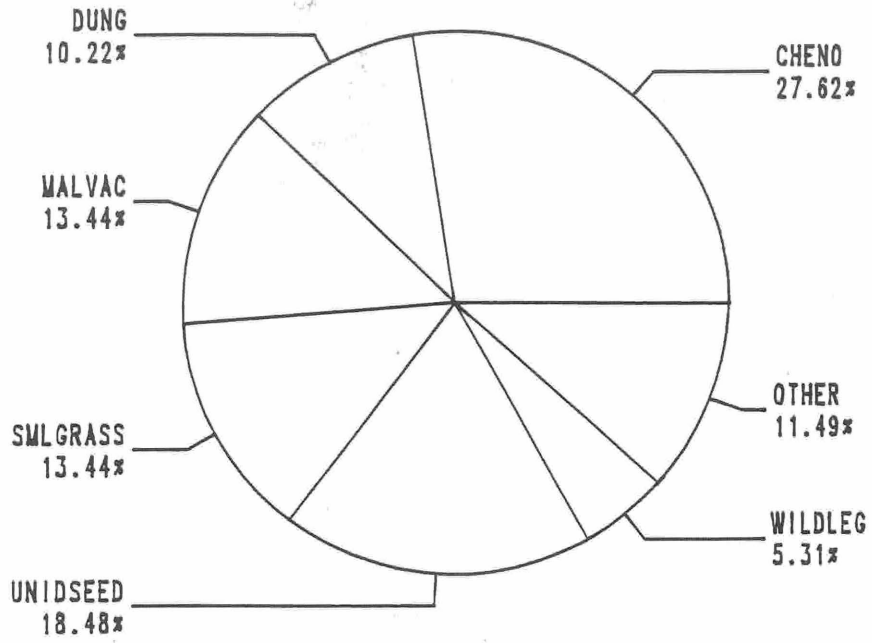
well fill
n=2



KK

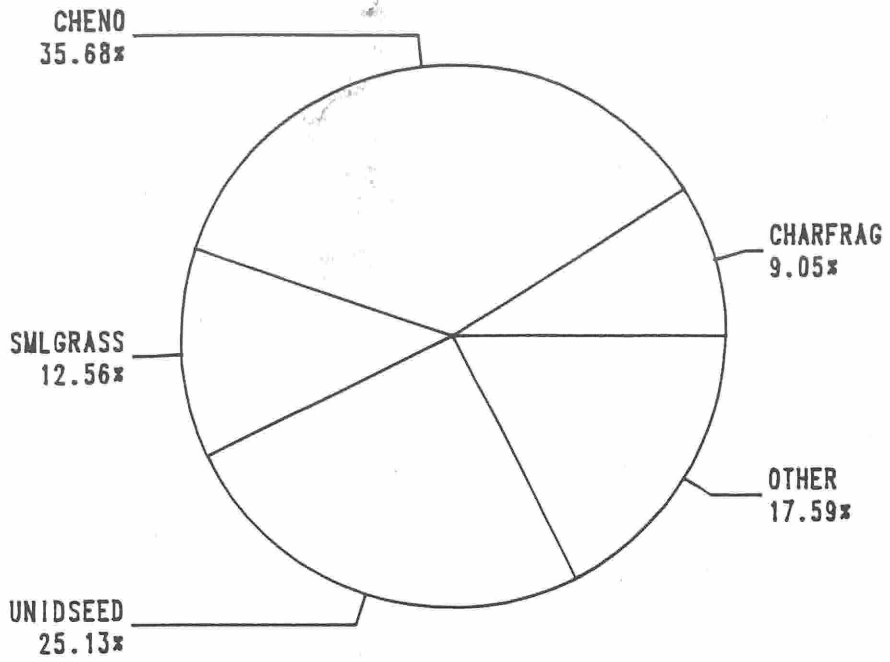
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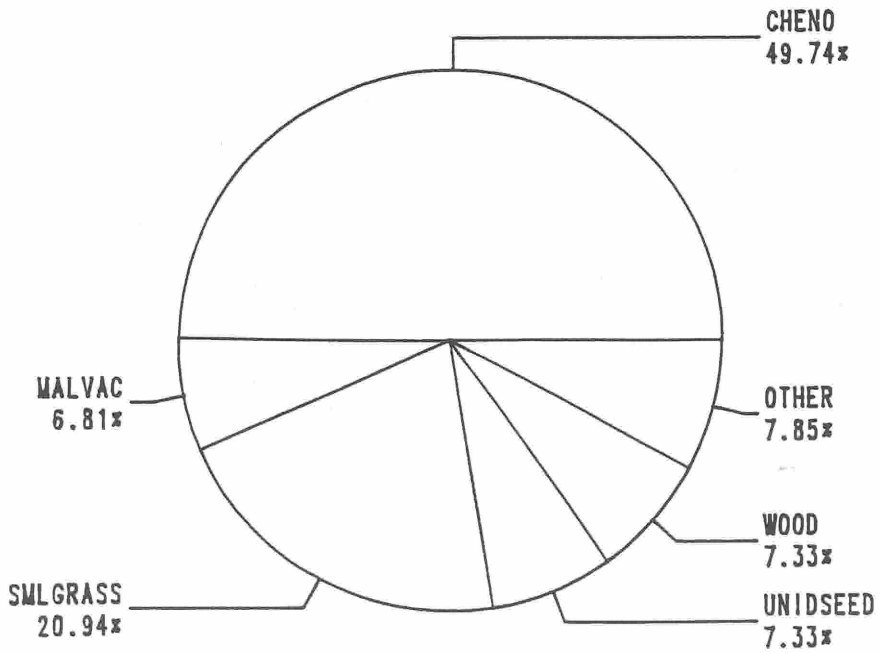


KK

SURFACE
CONTEXT = IN OR OUT n=3

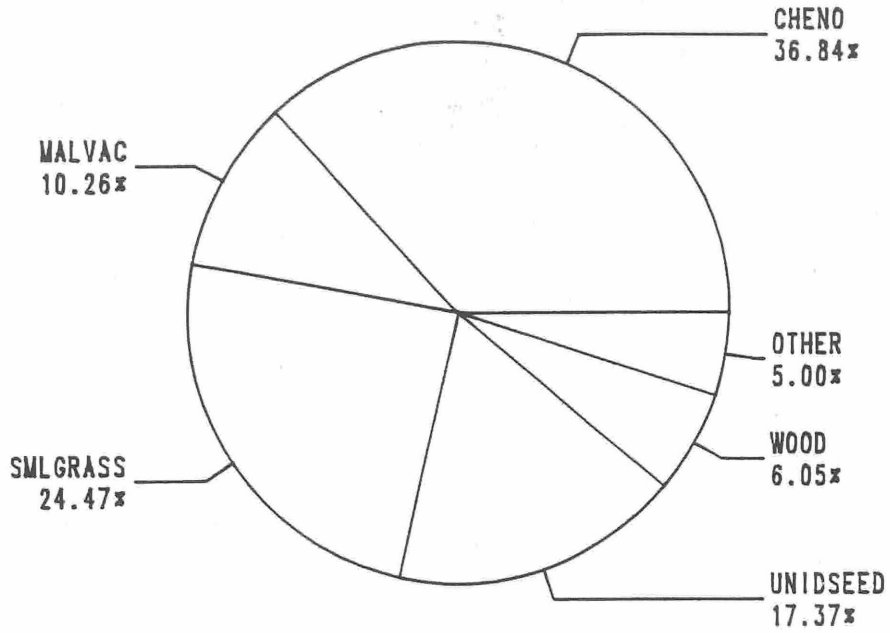


CONTEXT = INSIDE n=1



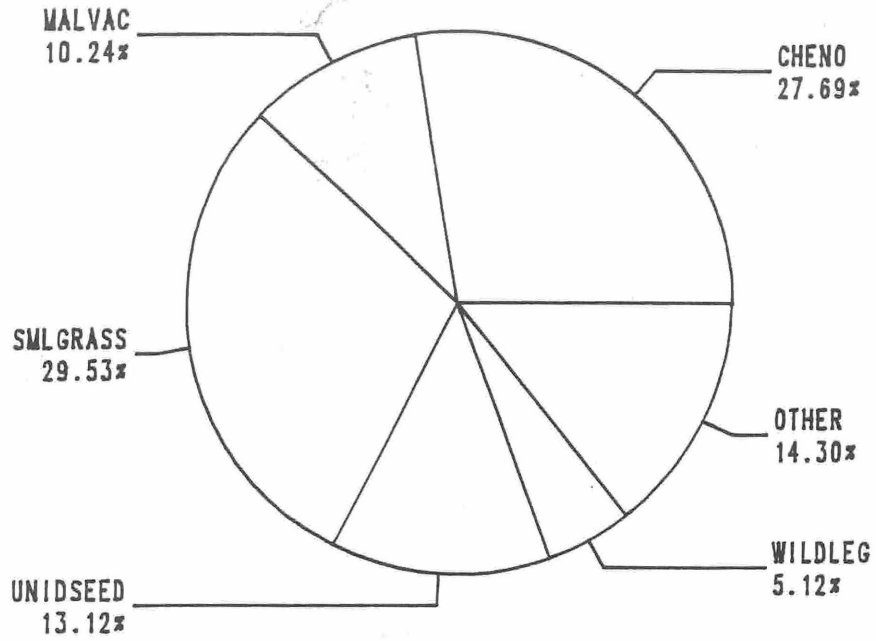
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CONTEXT = OUTSIDE n=1

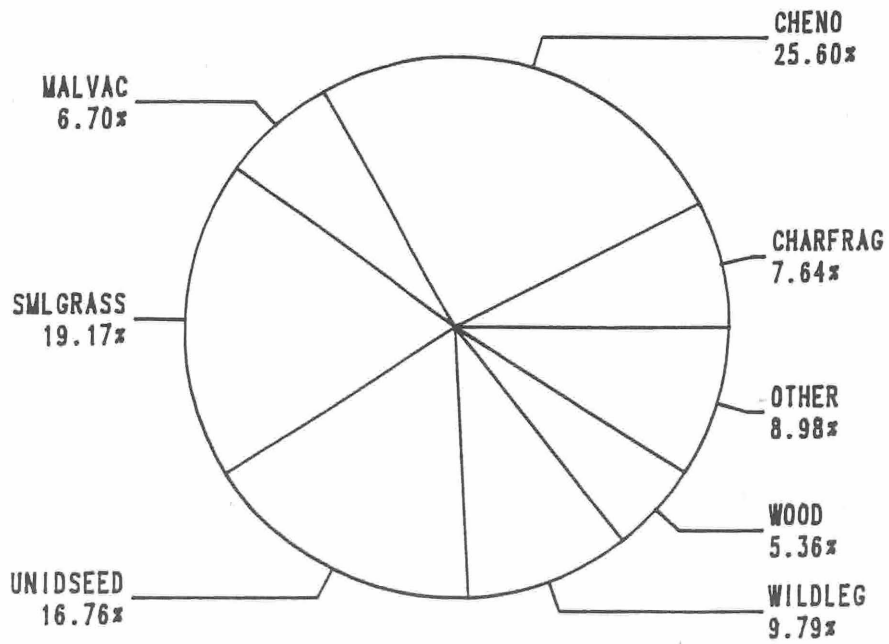


K'ARAÑA BURIALS

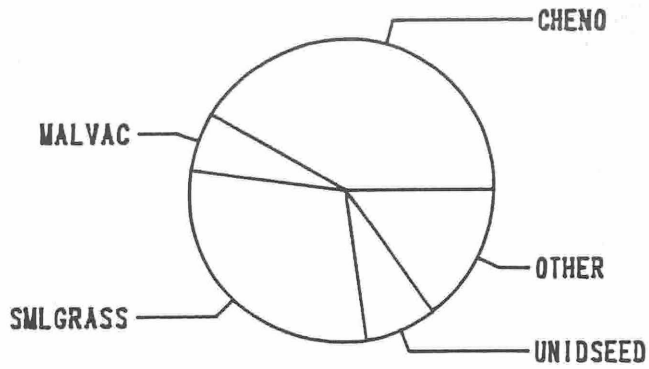
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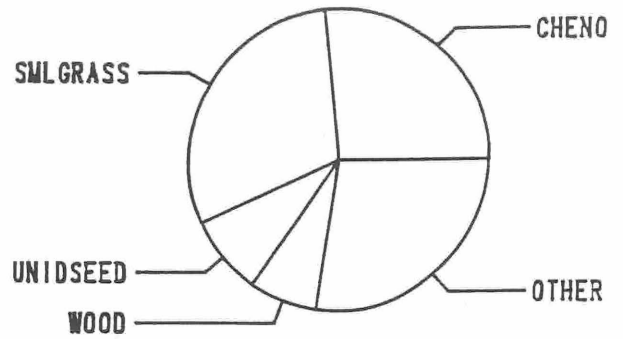


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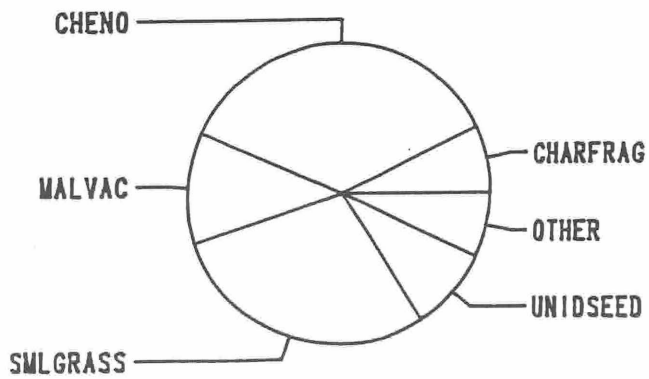
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MIDDEN

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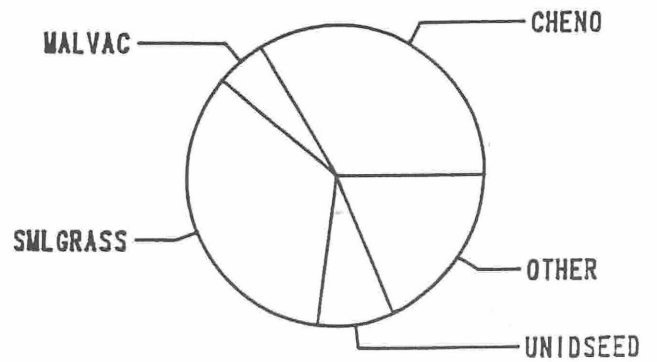
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MIDDEN

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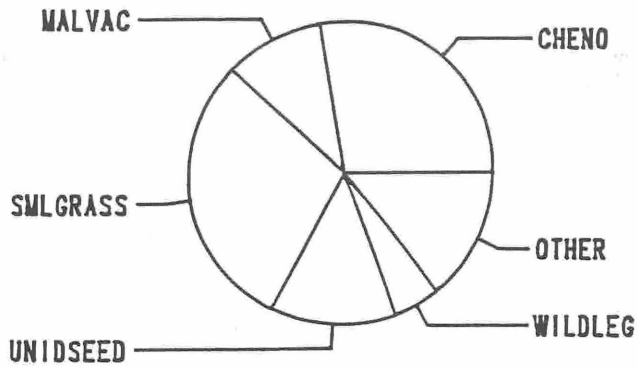
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HAI CULTURAL
PHIL

FLOTNUM = 5595



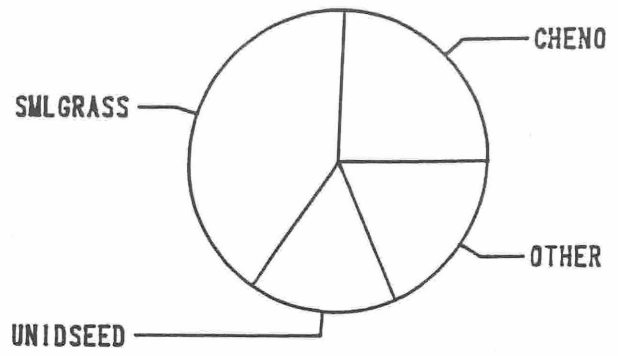
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CULTURAL FILL

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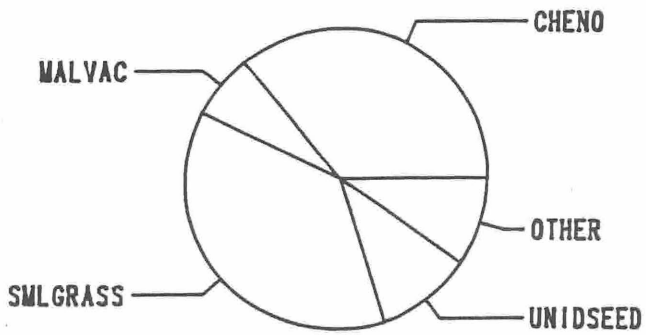
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BURIAL

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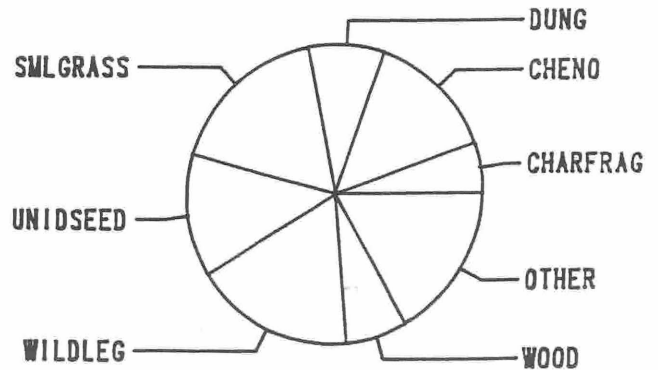
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MED. DENSITY
MIDDEN

FLOTNUM = 5618



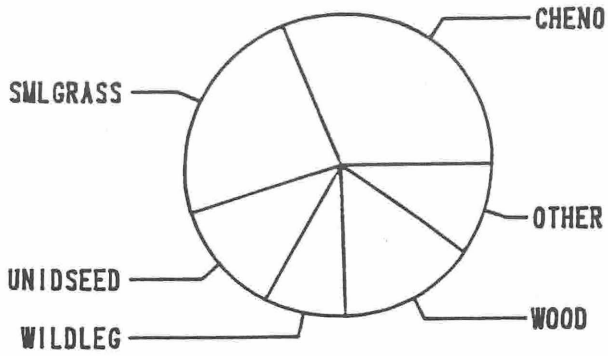
TIW-KK
cc = 437
Fill from well

FLOTNUM = 5621



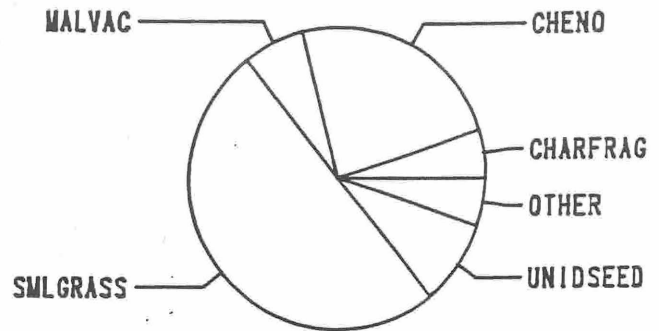
TIW-KK
MIDDEN PIT

FLOTNUM = 5624



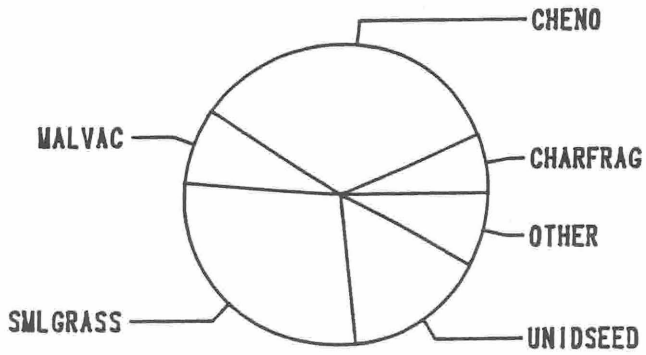
TIW-KK
CULTURAL FILL

FLOTNUM = 5637



TIW-KK
CULTURAL FILL

FLOTNUM = 5644



TIW-KK
ce = 437
Fill from well

INTERPRETATION OF Kk'ARANA PLANT REMAINS

In many ways, Kk'araña resembles the other domestic areas analyzed thus far at Tiwanaku (AKE and AKE2, but particularly the latter). There are comparable amounts of domesticates (maize, tubers and *Chenopodium*), both in terms of density and ubiquity, . The architectural and artifactual remains recovered from the area has led the excavator to interpret Kk'araña as a primary occupation zone. Our analyses confirm this interpretation. We find there are some important differences between the different cultural contexts found at Kk'araña, however, both in terms of relative percentages of taxa present and seed density. This is in contrast to an area like Chiji Jawira at Tiwanaku, which we have interpreted as a dumping ground, where all the different contexts look the same.

As with AKE and AKE2, the densest deposits occur in discrete trash pits. At Kk'araña, the trash pits were the densest context, followed by midden, and the samples from the floors and fill were somewhat less dense. The trash pits also show high proportions of probable fuel remains (wood, dung and perhaps small grass), as well as comparatively dense probable food remains (*Chenopodium*, lumps, and maize), the kinds of remains one might interpret as periodic cleaning out of a hearth or kitchen area. This relative "neatness" of the Tiwanakota (ie regular deposition of living/food debris in discrete pits) may represent a response to the more crowded conditions of urban life.

There was some confusion about the difference between "fill" and "midden" in the excavator's notes. Although the distinction was not always made clear on the forms, our analysis seems to suggest that midden represents some sort of dense occupation-related debris, where fill is less dense, and may represent 1) a mixture of occupation-generated material with post-occupational non-cultural (aeolian or alluvial) deposits, 2) post-occupational debris or dumping from other areas, or even 3) the results of degrading adobe construction materials (since the adobes are themselves full of sherds, bone, etc.). Fill and midden are both clearly distinct from trash pits, however. Trash pits represent discrete, clearly defined contexts : holes dug into other deposits and subsequently filled with ash and trash. Perhaps the excavator, Ann Helsley, can help us with our difficulties of interpretation.

The well fill more closely resembled the assemblage in the fill cultural context rather than trash pit, suggesting that it simply filled in with surrounding soil after use and abandonment rather than being used as a trash pit. The samples from burial contexts closely resemble those from the surrounding midden, suggesting the Tiwanakota buried their dead within the rest of the garbage, or that the surrounding midden filled in to the empty spaces after the burial. At the very least, this indicates a lack of special (charred) plant inclusions in the burials.

The floors look very much like the floors from other areas of Tiwanaku. Collectively the 3 floor samples are dominated by *Chenopodium* to a larger extent than any other cultural context at Kk'araña. Wood appears on the floors in larger relative quantities than in the other contexts as well. Comparing the inside of a structure floor to the outside of a structure floor, we find that the inside floor sample is less dense and "cleaner" than the outside sample. The inside floor is even more dominated by *Chenopodium*. The outside floor shows a higher proportion of unidentifiable seeds, probably indicating an area that is

more exposed to degrading factors like freezing, rain, heavy traffic, etc. These contrasts between inside and outside are very similar to those found in the Tiwanaku Mid-Valley site 79 excavated by Jim Mathews.

The plow zone sample is surprisingly dense, nearly as dense as the trash pit samples, suggesting it probably represents a mixture of cultural materials from below or from later dumping. In terms of relative percentages of species present, the plow zone most closely resembles midden contexts, but with fewer lumps and more dung. It would be helpful to analyze the cultural levels directly below this one in an attempt to assess how closely plow zone samples at Tiwanaku resemble what they overlay, and how they might be used more fruitfully in subsequent interpretations. Unfortunately that was not possible with this particular sample, which was labeled as coming from level 2 of its unit. Not only did we lack the light and heavy fractions of the samples from the levels below this one in that unit (ie levels 3 and 4), but there was no botanical collection form (and hence no contextual information) for level 3 in this unit. Level 4 was identified as sub-floor fill on its form, indicating that level 3 was most likely some kind of floor.

APPENDIX: RAW DATA
CODES USED FOR WILA JAWIRA COMPUTER INPUT:

IDNO = This is used for identification in the botanical lab
 SITE
 CUADRA
 NIVEL = level
 SPECIMEN = the bag number assigned in the field
 UNIDAD1 = The North unit designation
 UNIDAD2 = The East unit designation
 RASGO = feature
 FLOTNUM = The flot number assigned in the field
 FLOTVOL = Volume of sample in liters (as collected in the field)
 LFPICK = Weight of carbon sorted out of the sample
 COLLTYPE = whether sample is BULK (101) or PINCH (102).
 Screen material (1/4") is 201
 CULTCONT = Three digit code for cultural context of sample. Check
 raw data sheet for definitions. This information is taken
 directly from tags on samples and/or field notes.
 CARD/CRD/CRDNO/CARDNO = These are for data loading (ignore).
 BOXSIZE = Size of storage box used for sample
 YEAR = Year sample collected

Taxa names refer to different identifiable plant parts:

LRGCHENO = *Chenopodium* spp. L. seeds larger than 1.18 mm
 SMLCHENO = *Chenopodium* spp. seeds smaller than 1.18mm
 LUMP = Unidentifiable fragment of charred plant tissue
 SPOACEAE = Small Grass family seeds (Poaceae)
 LPOACEAE = Large Grass family seeds (Poaceae)
 WILDLEG = Wild seeds from the Bean family (Leguminosae or
 Fabaceae)
 SCIRPUS = *Scirpus* spp. L. Seeds of tortora reeds
 VERBENA = *Verbena* spp. L.
 PLANTAGO = *Plantago* spp. L.
 MALVACEA = Mallow family (Malvaceae)
 RELBUN = *Relbunium* spp. Hook.
 MPOACEAE = Medium Grass family seeds (Poaceae)
 RUBUS = *Rubus* spp. L.
 CYPERAC = Sedge family (Cyperaceae)
 CRUCIFER = Mustard family (Cruciferae or Brassicaceae)
 UNK224 = Unknown seed #224
 POTAMOG = Pondweed, *Potamogeton* spp. (Tourn) L.
 CEREUS = *Cereus* spp. Mill.
 UNK264 = Unknown seed #264
 MODPOPPY = Modern poppy seeds added as check on flot machine
 AMARANTH = *Amaranthus* spp. L.
 UNK270 = Unknown seed #270
 UNK242 = Unknown seed #242
 COMPOSIT = Sunflower family (Compositae or Asteraceae)
 UNK265 = Unknown seed 265
 LABIATAE = Mint family
 KAINYA = Aymara name, scientific name unknown
 UNK261 = Unknown 261
 JUNCUS = *Juncus* spp. L.

CARYOPHL = Caryophyllaceae (Pink family)
UNK266 = Unknown 266
SOLANAC = Solanaceae seeds (Nightshade family)
NICOTIAN = *Nicotiana* spp. L.
SISYRING = *Sisyrinchium* spp. L.
ZEAKERN = *Zea mays* L. kernels
ZEAEMBR = *Zea mays* embryos apart from kernels
COBCUP = *Zea mays* cob and cob fragments
CAPSICUM = *Capsicum* spp. L. Chili peppers
DOMLEGUM = Domesticated legumes exact genus unknown
POLYGON = Polygonaceae (Knotweed family)
OXALIS = *Oxalis* spp. L.
UNK202 = Unknown seed 202 (probably Borage family, Boraginaceae)
OENOTHER = *Oenothera* spp. L.
LSOLANAC = Large seeds of Nightshade family, possibly *Solanum* spp.
UNK271 = Unknown 271
UNK235 = Unknown 235
PORTULAC = *Portulaca* spp. L.
UNK201 = Unknown 201
TRITHORD = *Triticum* spp. L. (Wheat) or *Hordeum* spp. L. (Barley) both introduced by the Spanish from the Old World
CACTUS = Cactaceae, exact genus unknown
UNK279 = Unknown 279
UNIDSEED = Seeds too poorly preserved to identify to family level
TUBER = Domesticated tubers, exact taxon not identifiable
WOODCT = Count of wood fragments
WOODWT = Weight of wood fragments in grams
TWGBRNCH = Twig and branches (showing nodes)
STALK = Stalks
DUNG = Animal dung, type undefinable
LLAMADNG = Camelid dung
CUYDUNG = Cuy dung
WIRAKOA = Aymara name, leaves used in *Pachamama* rituals
LEAVES = Leaves, exact taxon unknown
TRITRACH = *Triticum* spp. or *Hordeum* spp. rachis
SORTTYPE = Number refers to sorting strategy used in the laboratory, see preceding pages
FAUNAL = 0= No bones or fish scales; 1= Bones and/or fish scales present

KK'arana

0	3	5	I	D	N	C	S	P	U	U	F	F	L	L	C	C	L	S	S	L	P	M	M	C	
3	N	T	R	E	E	D	A	A	S	N	V	I	A	Y	O	A	E	E	U	E	E	L	P	E	A
5	O	E	A	L	N	1	2	O	M	L	K	E	E	T	D	O	O	P	E	E	G	S	A	O	A

1	3733	TIW	KK	11	23175	N8564	E4940	6	5644	8.0	0.19	101	437	1	6	127	25	110	1	16	.	.	.	2	2	.	.	2	.	.	.	2	2		
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4	3736	TIW	KK	3	22581	N8566	E4940		5569	5.0	0.01	101	200	1	3	50	6	38	4	1	.	.	8	.	.	1	.	.	2						
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8	3745	TIW	KK		24389	N8568	E4940	10	5596	6.4	0.30	101	598	1	11	200	20	225	10	39	.	3	78	7	.	2	14	.	1	3	2				
9	3750	TIW	KK	4	22556	N8572	E4940		5573	5.0	0.73	101	210	1	11	300	39	350	4	46	.	10	56	13	.	1	51	0	1	.	4	6	2		
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M	A	C	L	C	NS	C	D	OL	P	T	U	T	L	TPS
O	M	O	A	A	SI	ZZ	AO	P	ES	O	R	N	W	L
D	A	U	M	U	B	K	J	R	U	O	C	S	E	E
P	R	N	N	P	N	I	A	N	U	Y	N	L	O	Y
O	A	K	K	O	K	A	I	K	N	O	K	A	T	R
D	P	N	2	S	2	T	N	2	C	P	2	N	I	E
B	P	T	7	4	I	6	A	Y	6	U	H	6	A	
S	Y	H	O	2	T	5	E	A	1	S	L	6	C	

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7	.	.	.	7	3	4	30	.	5	0.04	.	.	1	.	.	1	.	1	S	90
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2	48	.	.	2	3	4	14	.	14	0.10	4	.	1	.	.	5	.	S	90	
3	3	4	7	2	3	0.02	5	.	S	90	
4	3	4	9	5	.	S	90	
5	3	4	80	5	.	S	90	
6	3	4	9	5	.	S	90	
7	3	4	11	5	.	S	90	
8	48	.	2	3	4	80	.	4	0.03	5	.	S	90	
9	3	0	4	14	.	7	0.05	5	.	S	90	

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          S          C C L S          S L          P M M C
          U U F F O U R M P P W S V L A P C R P
          C E N N L L L L L G L O O I C E A L R O Y U U O C U
O I S A I I D D A S T T P H T C C H H L C C C D R B T A L C U E I K A R K
B D I D V M A A S N V O C S P N R N N M A A E U N G E U A U A E 2 O U 6 R
S O E A L N 1 2 O M L K E E T D O O P E E G S A O A N E S C R 4 G S 4 D

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KK

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25	3798	TIW	KK	014	27803	N8566	E4948	5556	8.0	0.11	101	620	1	.	80	5	17	.	7	.	.	4	1	2		
26	3799	TIW	KK	015	29685	N8566	E4948	45 5696	8.0	0.23	101	330	1	2	69	18	25	2	8	.	1	.	6	1	2		
27	3800	TIW	KK	004	24320	N8566	E4930	8 5598	7.2	2.24	101	412	1	11	340	343	174	13	198	.	14	.	50	6	.	8	42	.	4	2	
28	3801	TIW	KK	005	24453	N8568	E4948	15 5661	8.0	1.69	101	412	1	6	235	9	105	10	135	.	4	.	11	4	.	1	32	.	2	2	
29	3802	TIW	KK	002	23245	N8568	E4950	5676	8.0	0.44	101	360	1	.	110	10	120	2	23	.	2	.	26	3	.	3	15	2	.	2	2
30	3803	TIW	KK	003	24347	N8568	E4950	5606	6.4	0.52	101	298	1	4	118	99	100	3	39	.	4	.	49	3	.	3	23	.	8	2	
31	3804	TIW	KK	004	27929	N8568	E4950	24 5610	7.2	0.32	101	350	1	.	140	3	93	1	12	.	.	39	.	1	2	2	
32	3805	TIW	KK	004	26985	N8570	E4948	20 5683	9.6	0.70	101	598	1	6	185	57	143	9	73	.	9	.	50	2	.	1	24	.	6	2	
33	3806	TIW	KK	003	23155	N8570	E4950	5669	8.0	0.86	101	240	1	3	128	75	115	7	80	.	2	.	20	9	.	1	28	.	1	3	2
34	3807	TIW	KK	004	23166	N8570	E4950	5620	8.8	0.63	101	240	1	5	158	36	113	5	48	.	5	.	42	1	.	3	1	2	.	2	2
35	3808	TIW	KK	008	22677	N8572	E4944	5691	8.0	0.24	101	620	1	.	133	3	71	.	9	.	.	22	1	2	2

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M A C L C N S C D O L P T U T L T P S
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D A U U M U B K U J R U O C S E E C P M O O U N O U R U I C U C I W H G A U I L I D R F O
P R N N P N I A N U Y N L O Y A A O S L C L X N O L N N T N T A N A D T O O B S M Y R E T U T A X
O A K K O K A I K N O K A T R K E B I E R Y A K T A K K U K H C K R S U O O R T D A D A A R N T U S Y
O P N 2 2 S 2 T N 2 C P 2 N I I E M C C G D G L 2 H N 2 2 L 2 O T 2 D E B D D N A U D U K V A C Y N I E
B P T 7 4 I 6 A Y 6 U H 6 A A N R B U U U N O I O E A 7 3 A O R U 7 N E E C W C L N N N O E C L P A Z A
S Y H O 2 T 5 E A 1 S L 6 C N C N R P M M O N S 2 R C 1 5 C 1 D S 9 O D R T T H K G G G A S H E E L E R

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24	.	1	3	4	151	.	19	0.13	1	.	24	5	.	M	90	
25	3	4	6	5	1	S	90			
26	50	.	.	2	3	4	50	.	9	0.05	6	5	1	S	90			
27	.	4	6	.	11	3	.	.	.	6	3	4	402	.	80	1.47	2	.	181	6	1	M	90			
28	.	5	.	2	1	1	3	4	226	.	107	1.13	6	.	20	.	.	2	.	5	.	M	90			
29	.	7	.	1	2	3	4	90	.	10	0.08	5	1	S	90				
30	.	2	.	5	1	5	3	4	150	.	36	0.45	.	34	5	1	M	90				
31	48	3	4	66	.	23	0.17	5	1	S	90				
32	1	1	3	4	125	.	40	0.35	3	.	10	.	.	.	5	1	M	90				
33	.	3	1	3	4	115	.	31	0.42	1	.	8	.	.	.	5	1	M	90				
34	.	3	.	.	1	1	3	3	4	105	.	22	0.21	1	5	1	S	90					
35	1	3	4	25	.	8	0.05	2	5	.	S	90				

NOTE: THE PROCEDURE PRINT USED 0.12 SECONDS AND 84K AND PRINTED PAGES 1 TO 2.
 NOTE: SAS USED 212K MEMORY.

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 TAPE AND DISK IO CHARGES @ \$0.84 PER 1000 IO'S..... \$0.47

CULTURAL CONTEXT CODES FOR USE WITH 1986-1991 WILA JAWIRA MATERIAL:

Surface and sub-surface modern disturbance:

- 000 General surface collection
- 010 Humus root zone, do NOT combine in analysis
- 020 Plowed surface collection
- 021 Plowed surface-shovel scraped
- 030 Fallow/harvested surface collection
- 031 Fallow/harvested surface-shovel scraped
- 040 Natural/wild surface collection
- 050 Plough zone
- 060 Excavated surface collection
- 061 Shovel test
- 070 Modern wall or rock pile
- 080 Humus root zone, okay to combine in analysis w/level below
- 090 Modern burned area
- 091 Modern animal burial
- 092 Modern human burial
- 093 Modern archaeological excavation pit
- 094 Modern archaeological excavation backdirt
- 095 Looter's pit
- 096 Looter's backdirt
- 099 Disturbed, details unspecified

Wall:

- 100 Possible wall
- 110 Rock wall, unmortared
- 120 Pirka wall
- 121 Outside supportive lip
- 122 Inside supportive lip
- 125 Rock wall, single course wide
- 126 Fill/mortar from wall
- 130 Dressed stone wall
- 140 Rock wallfall
- 141 Adobe wallfall
- 142 Rock and adobe wallfall
- 143 Rock roof fall
- 144 Adobe roof fall
- 145 Rock and adobe roof fall
- 150 Wallfall, do NOT combine in analysis
- 160 Wall trench fill
- 161 Wall trench
- 162 Wall plaster, slumped off
- 163 Wall plaster facing
- 170 Retaining wallfall
- 180 Wallfall, okay to combine in analysis w/level below
- 190 Adobe/ mudwall
- 191 Stone foundation of adobe wall
- 192 Adobe and rock wall
- 193 Roof fall

Midden; culturally deposited:

- 200 Low density midden
- 201 Low density midden-primary deposition

202 Low density midden-secondary deposition
210 Medium density midden
211 Medium density midden-primary
212 Medium density midden-secondary
220 High density midden
221 High density midden-primary
222 High density midden-secondary
230 Low density midden with ash
231 Low density midden with ash-primary
232 Low density midden with ash-secondary
240 Medium density midden with ash
241 Medium density midden with ash-primary
242 Medium density midden with ash-secondary
250 High density midden with ash
251 High density midden with ash-primary
252 High density midden with ash-secondary
260 Plough zone derived from midden
270 Midden interspersed w/natural deposition
280 Midden interspersed w/wall slump
291 Cut below midden deposit
297 Midden w/charcoal
298 Midden-details unspecified
299 Midden-stratified

Cultural Surfaces; "use" surfaces and their deposits:

300 Surface
301 Surface inside structure
302 Surface outside structure
310 Occupation zone, matrix deposited during use
311 Occupation zone, matrix deposited during use-inside
312 Occupation zone, matrix deposited during use-outside
313 Dense occupation zone
314 Occupation zone w/disturbed, burnt "jacal"
320 Activity area
321 Metal processing area
322 Food processing area
323 Ceramic production area
324 Storage area-burnt in situ
330 Floor contact (material on floor surface)
340 "Crusty", compact surface
341 Cut associated w/compact surface
342 Compact surface inside structure (true floor)
343 Compact surface outside structure
344 Clay floor inside structure
350 Paved floor
351 Paved floor inside structure
352 Paved surface outside structure
360 Rock subfloor/ cobble drain construction
370 Occupation zone with roof or wallfall
380 Plough zone derived from occupation zone
390 Possible occupation zone

Features; culturally deposited:

400 General

- 410 Pit fill
- 412 Pit fill-midden
- 413 Pit fill-gravel
- 414 Pit fill-natural matrix w/artifacts
- 415 Pit fill-ash
- 416 Pit fill-clay
- 417 Pit with camelid bones
- 418 Pit with cuy bones
- 419 Ofrenda de llama
- 420 Hearth (in situ burned area w/well defined limits)
- 421 Hearth cut
- 422 Ephemeral in situ burned area (not associated w/clear cut)
- 423 Hearth-stone and adobe lined
- 424 Burned area of floor-inside
- 425 Oven
- 430 Subfloor drainage canal
- 435 Fill from inside canal
- 437 Fill from well
- 440 Stairway
- 450 Other firing feature
- 451 Burned clay concentration-NOT in situ
- 460 Ash deposit (not a clear lens or pit)
- 470 Posthole fill
- 471 Cut of posthole
- 480 Stone fill (cultural) purpose unclear
- 490 Possible feature
- 496 Ceramic offering
- 497 Relleno de llama
- 498 Fill from inside of ceramic vessel
- 499 Fill from bell-shaped pit

Burials:

- 500 Burial in subfloor-primary
- 510 Burial in subfloor-secondary
- 520 Burial in midden-primary
- 530 Burial in midden-secondary
- 540 Burial in patio-primary
- 550 Burial in patio-secondary
- 560 Burial in wallfall
- 580 Animal Burial
- 591 Cut below burial
- 592 Burial in natural matrix w/artifacts
- 593 Burial in capped, collared cist tomb
- 594 Burial in belled-pit tomb
- 595 Burial in ceramic vessel
- 598 Burial, details unspecified

Fill; purposefully deposited, but that contains artifacts unrelated to location:

- 600 Human dumped natural matrix w/artifacts
- 601 Rapid-water deposited matrix w/artifacts
- 602 Long-term erosion-deposited matrix w/artifacts
- 603 Decomposing bedrock w/artifacts
- 604 Soil with artifacts-not specified as cultural or natural

- 610 Midden used as fill
- 620 Cultural fill
- 621 Cut below fill
- 622 House construction fill inside house
- 623 House construction fill under house
- 624 Rocky fill (purposeful)
- 625 Gravel fill (purposeful)
- 626 Fill between floors
- 627 Fill over floor
- 650 Naturally deposited soil, sterile
- 670 Culturally deposited matrix w/few artifacts
- 680 Fill from possible ceramic production zone
- 690 Possible fill
- 699 Gravel fill as foundation of raised field

Lenses; thin deposits (cultural deposits, natural deposits or reworking of cultural deposits):

- 700 Ash lens, grey-white ash
- 710 Gravel lens
- 720 Charred lens-black
- 730 Natural matrix lens, water deposited
- 740 Organic stain

No good evidence for interpretation of depositional history:

- 900 Undifferentiated soil
- 910 Undifferentiated rock
- 920 Locus unexcavated
- 999 Mixed locus or information lost or incorrect-check notes before analysing

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