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INFORME: LOWER TIWANAKU VALLEY SURVEY SITES

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Introduction

Flotation samples were recovered from five sites in the lower Tiwanaku Valley survey area by Juan Albarracin-Jordan in 1990. These included one Formative period site, Allkamari (TLV 174 & 179), three from the Tiwanaku IV/V periods, Iwawe (TLV 150), Guaqui (TLV 55), and Obsidiana (TLV 109), and one Early Pacajes (LIP) site, Pukara (TLV 23).

The strategy selected for our first phase of paleoethnobotanical analysis has been threefold 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 these five sites were completed during the fall of 1990, when the lab plan was to sort approximately 30-40% of all samples from usable contexts (ie: not mixed, disturbed, or undocumented). Of the 165 samples floted from the 5 lower valley sites 53 samples were completed. This is approximately 40% of all usable contexts. Flotation forms containing vital cultural information were available for all the flots in the fall of 1990 so the selection of our subsample could be made using contextual information. Samples were selected so that our subsample represented the overall contextual content of each individual site, and that some of each context type would be represented.

Sample size (site matrix prior to flotation) was small and varied a great deal, with average bag sizes ranging from 1.1 liters at Iwawe to 5.1 l at Allkamari. This disparity causes distortion in quantification schemes, as some apparent differences may simply be a function of small and irregular sample sizes. Further, comparisons between this material and Tiwanaku habitation areas are difficult, as the latter averaged between 5 and 7 liters. For these reasons quantifications must be examined carefully, and DENSITIES are known to be more reliable than UBIQUITIES (Lennstrom 1991b).

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 be poured off. Our machine is built from a 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. 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 floted 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.

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 (Perú) 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 be 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 over represented.

(Strategies 3 and 4, designed for the University of Minnesota Archaeobotany laboratory (Lennstrom and Hastorf 1989), 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 UNK 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 under represented.

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.

Strategy 1 was used for all of the lower valley survey sites.

<u>Quantification of Lower Tiwanaku Valley Survey Site samples</u>

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.

<u>LIST OF PLANT TAXA:</u>

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 <u>quinoa</u> (*Chenopodium quinoa*) or <u>cañiwa</u> (*C. pallidicaule*). Food source.

Small (<1.18mm) *Chenopodium* spp. (seeds) Possibly domesticates: either <u>quinoa</u> (*Chenopodium quinoa*) or <u>cañiwa</u> (*C. pallidicaule*). Food source

Lumps (Unidentifiable charred plant fragments, possibly tubers or other fragments of domesticates.) Possible food source.

Small Poaceae (seeds) Grass family. Possibly used as fodder, fuel, or in construction. This may be derived from dung.

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. This may be derived from dung.

Verbena spp. (seeds). Common weed.

Malvaceae (seeds) Mallow family. Common weed. This may be derived from dung.

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.

Cereus spp. a type of cactus. This may be derived from dung.
Unknown 264 (seeds)
Amaranthus spp. (seeds) Usually a weedy annual; found in disturbed habitats, possible casual food source.
Unknown 265 (seeds)
Kaiña (seeds) This is an Aymara name, scientific name unknown.
Nicotiana spp. (seeds) These are likely of a type f tobacco which grows wild/feral in the area today, though we cannot distinguish them from more tropical domesticated species at this time.
Solanaceae (seeds) Nightshade family
Sisyrinchium spp. (seeds)
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.
Leaves-Type unknown.
Dung-Fertilizer and/or fuel.

QUANTIFICATIONS:

Allkamari n=11

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

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0.00	0.00	0.13	30.40	0.00

Ubiquity of crop plants (# of samples containing taxon)

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0%	0%	27.7%	100.0%	0%
		(3)	(11)	

Guaqui n=14

Average density of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0.90	0.00	0.73	9.36	0.00

Ubiquity of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
14.3%	0%	28.6%	78.6%	0%
		(4)	(11)	

Iwawe n=10

Average density of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0.00	0.00	0.29	4.04	0.00

Ubiquity of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0%	0%	20%	90%	0%
		(2)	(9)	

Obsidiana n=12

Average density of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0.00	0.13	0.18	49.01	0.00

Ubiquity of crop plants

	Large	Small	Domesticated

Maize	Tubers	*Chenopodium*	*Chenopodium*	Legumes
0%	25%	16.6%	91.7%	0%
	(3)	(2)	(11)	

Pukara n=6

Average density of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0.00	0.00	0.00	0.71	0.00

Ubiquity of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0%	0%	0%	16.7%	0%
			(1)	

Relative Percentages

On the following sheets are two types of pie diagrams displaying 1) different cultural contexts from each of the sites, and 2) a selection of individual flot samples from the five sites. In the context diagrams the "n" is the number of flot samples that went into the diagram. Caution must be used when comparing digrams with highly disparate "n" values, as increasing numbers of samples elevate the total seed counts, and nearly always increase the diversity of the chart contents.

INTERPRETATION OF LOWER TIWANAKU VALLEY SURVEY SITES

As noted in the introduction, the size of the samples from these sites was small, so the amount of plant material recovered was less than optimal for interpretation, and plant ubiquity scores should be viewed with caution, as it has been demonstrated that many are simply a function of sample size (Lennstrom 1991b).

Overall density of material from the lower valley sites was low, even when standardized to remove the bias of sample size. Mean numbers of charred items per sample ranged 6 to 190 (mean densities 4 to 100 items per liter). By comparison, sites at the urban core of Tiwanaku have mean numbers of items between 500 and 2500, and mean densities per liter between 85 and 450. It appears that the occupation intensity at these rural lower valley sites may have been less than in the core of the urban area. We suggest that that there may have been more space available to the residents of the rural areas so that activities were more dispersed, that these sites may not have been occupied year round, and/or that these sites were occupied for short periods of time.

Allkamari (Formative Period)

This site is interesting in that it is earlier than most of the material we have analyzed from the area, except Jim Matthews' TMV79. Maize and tubers are absent from the samples, and large *Chenopodium* is at a very low density (compared with other sites and time periods). In spite of the overall low

ALLK

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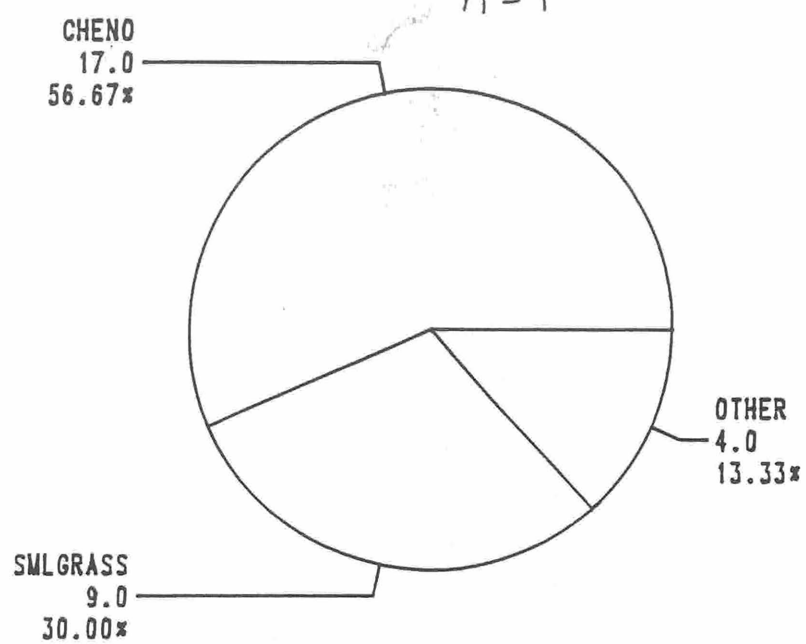

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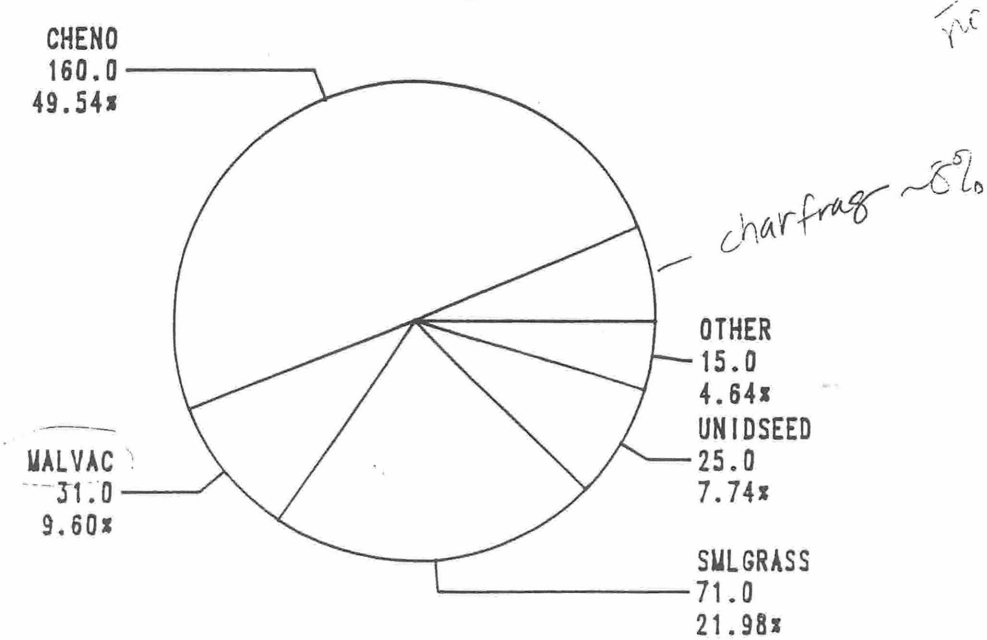

Mallow

Charfrag = lumps

Guaqui

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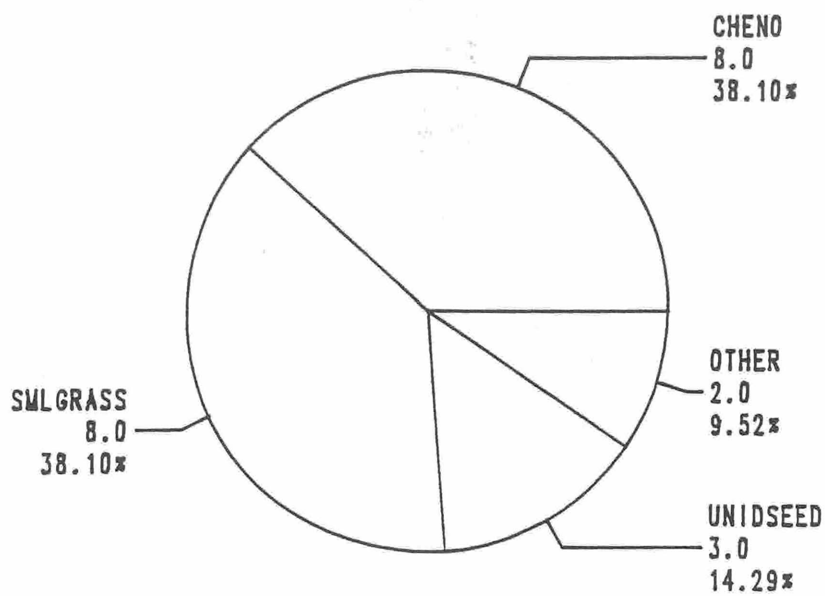

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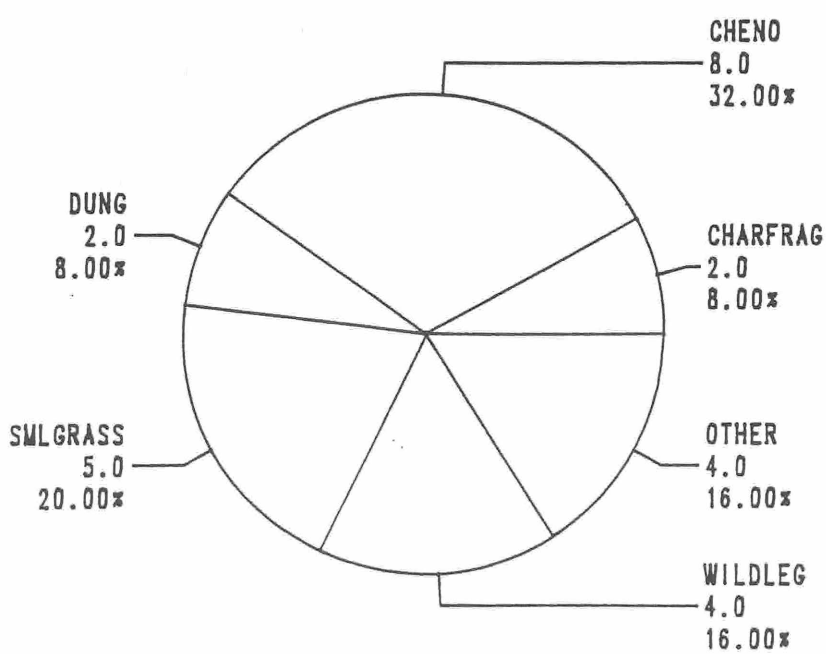

Guaqui

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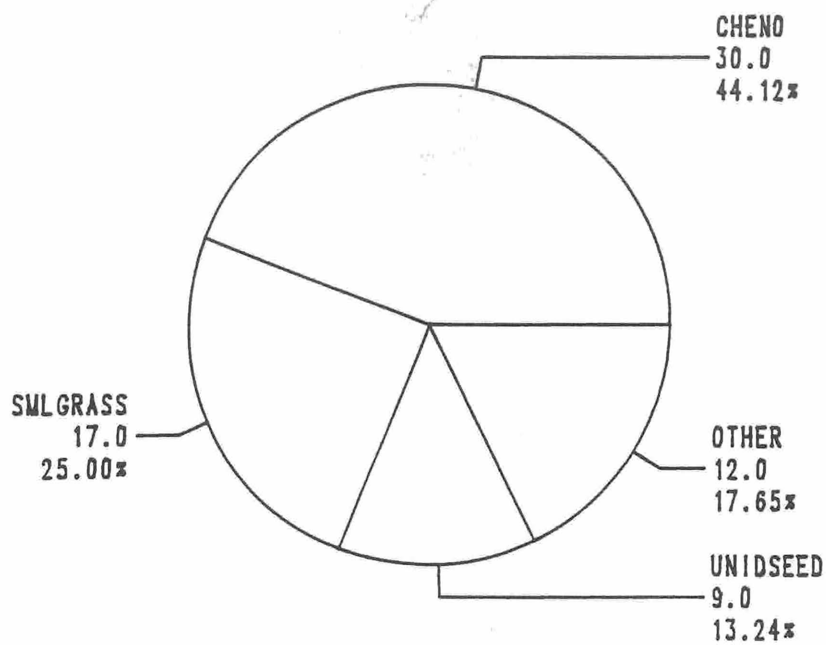

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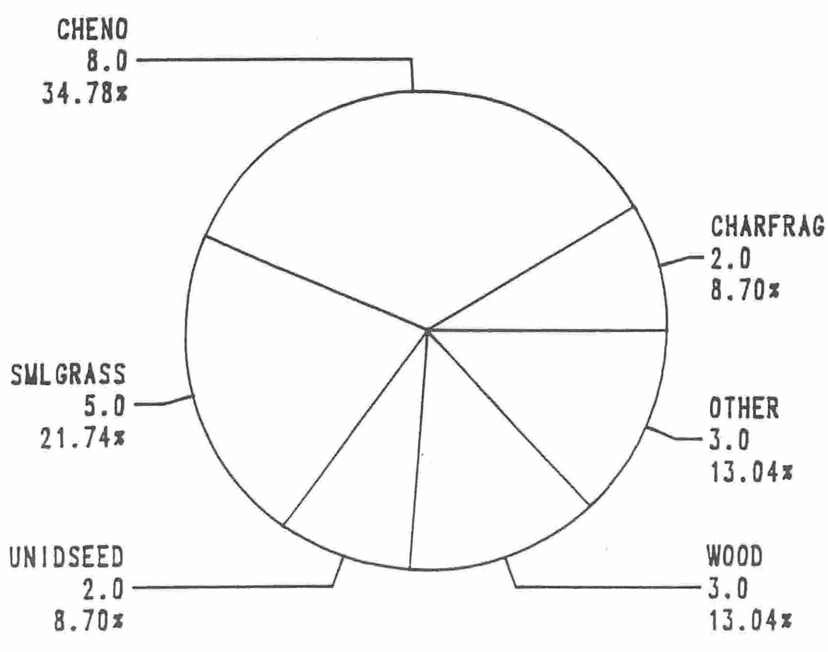

Guaqui

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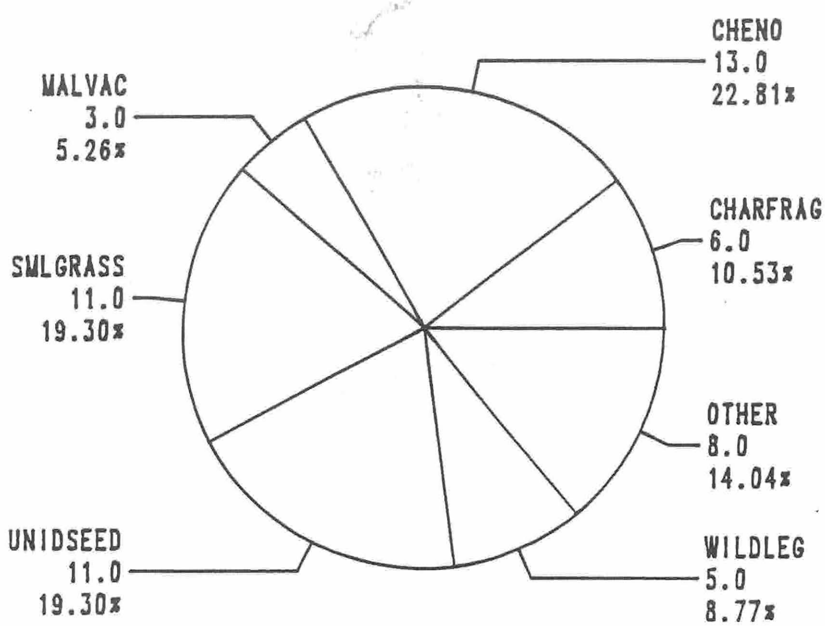

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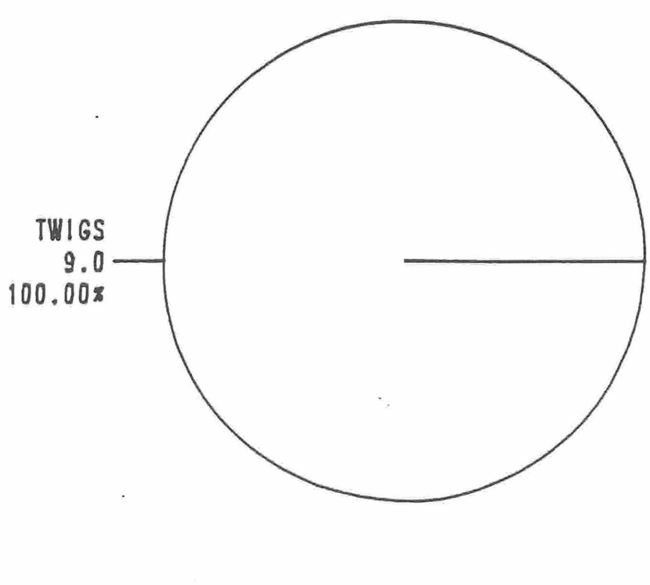
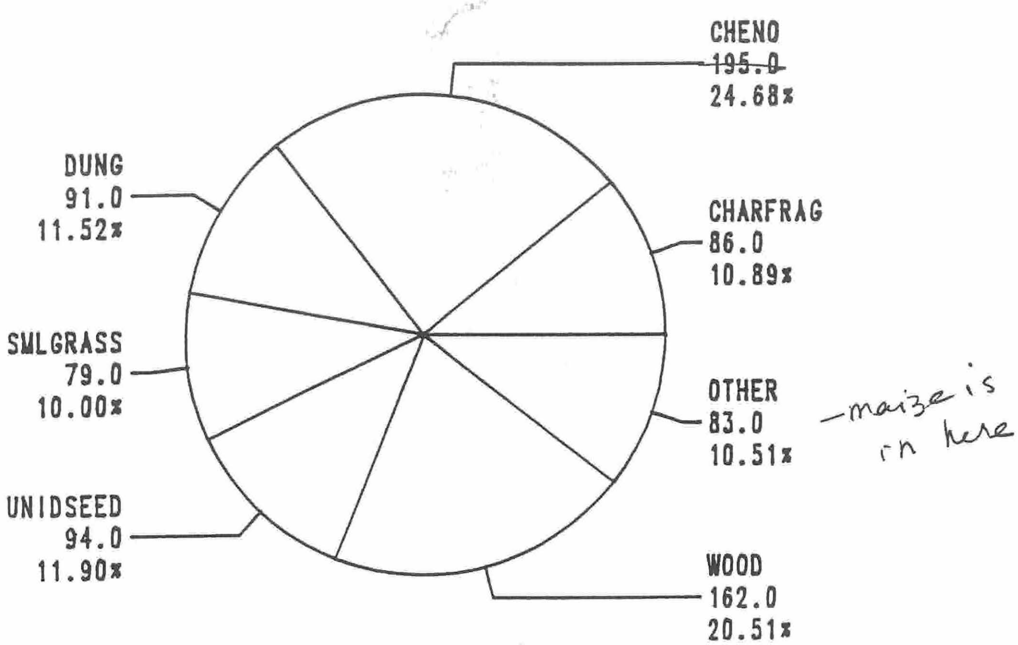


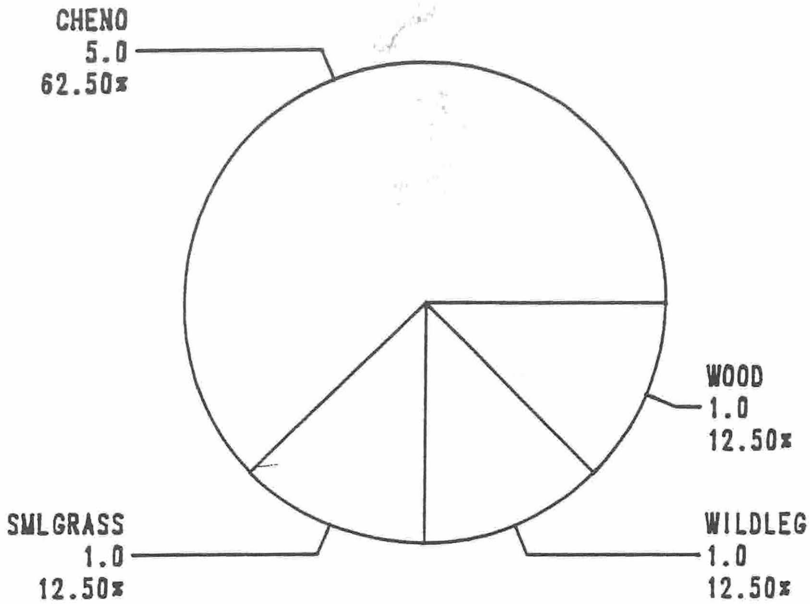
Guaqui

CONTEXT = TRASHPIT n=4



IWAWE n=1

CONTEXT = BURIAL



IWAWE

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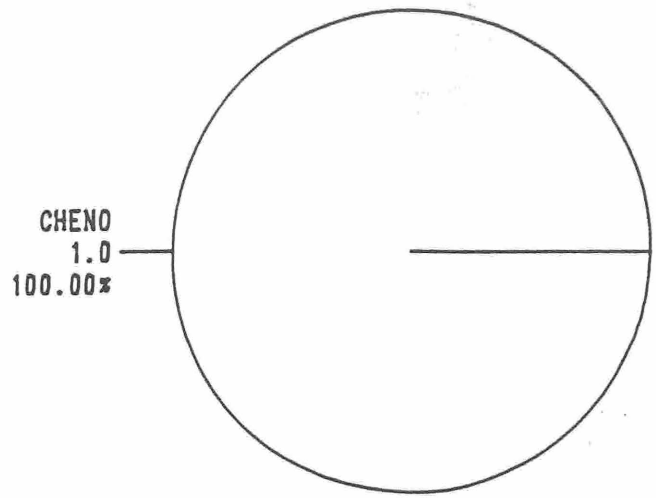

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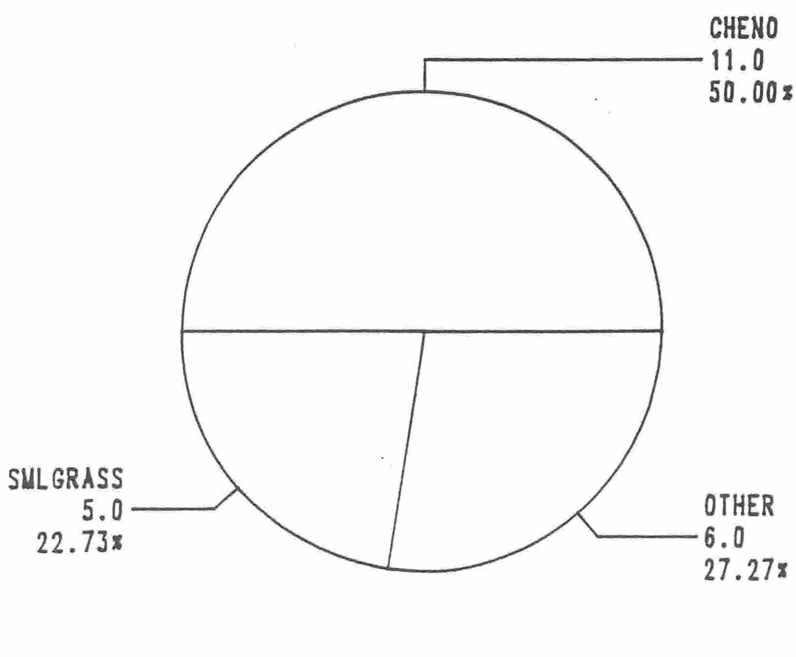

IWAWE

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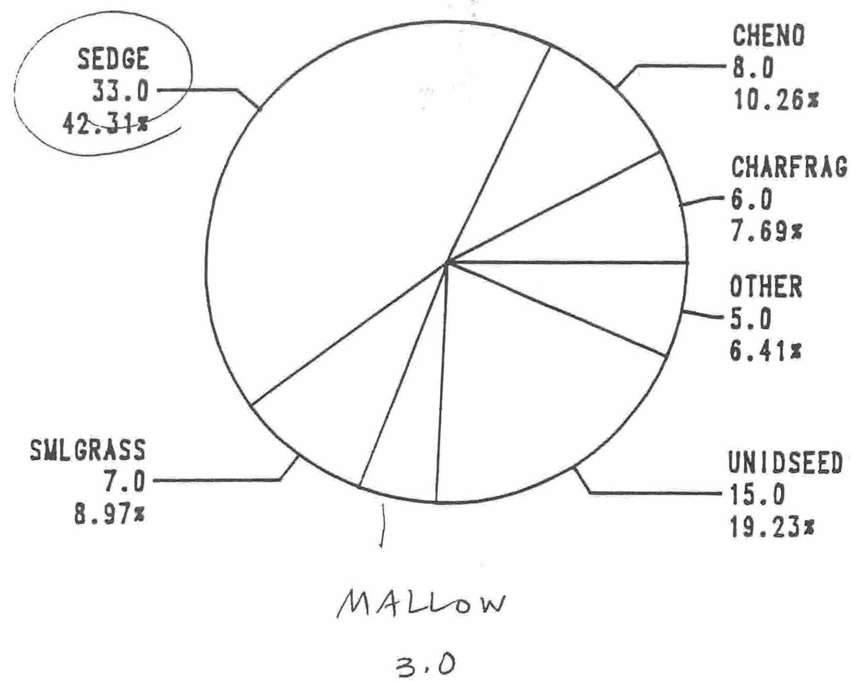

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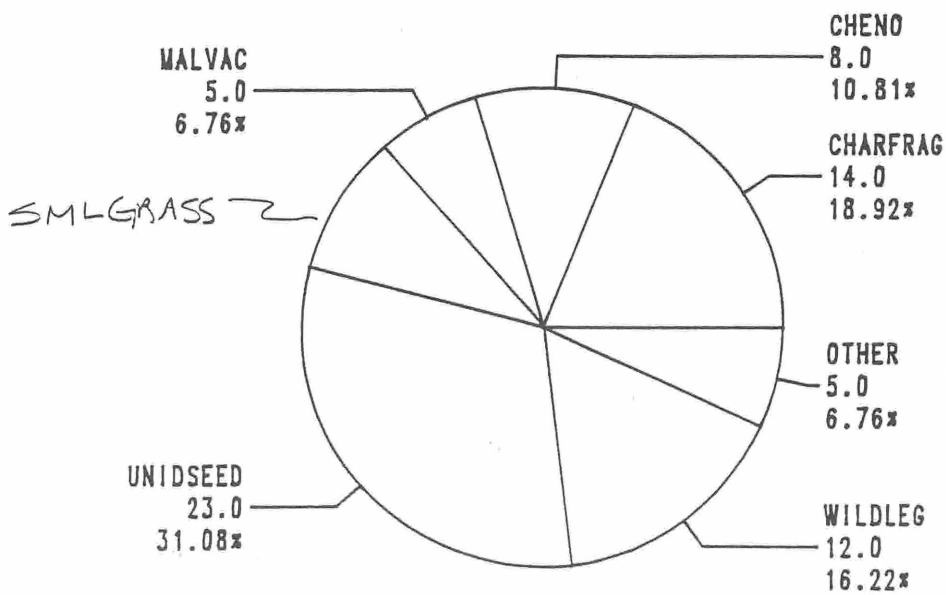
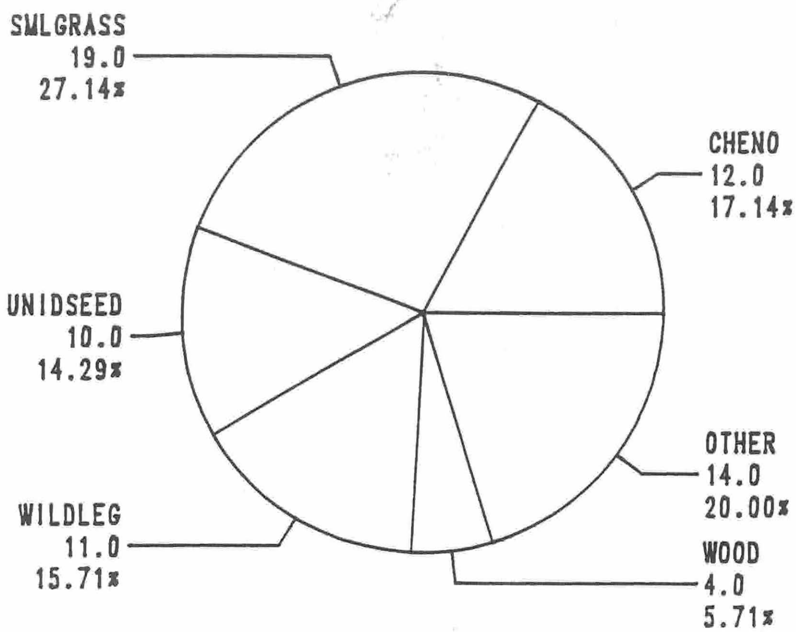


IWAWE

CONTEXT = TRASHPIT n = 2



OBSIDIANA

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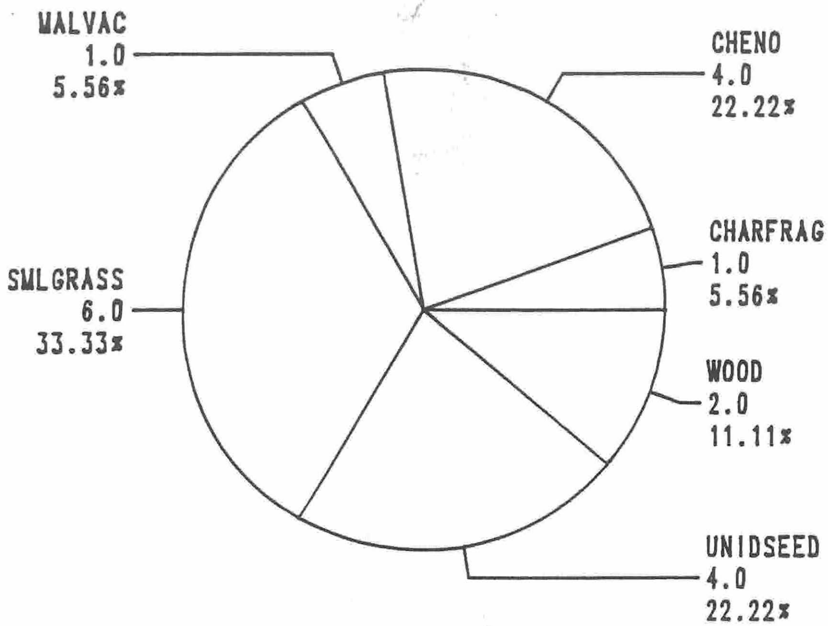

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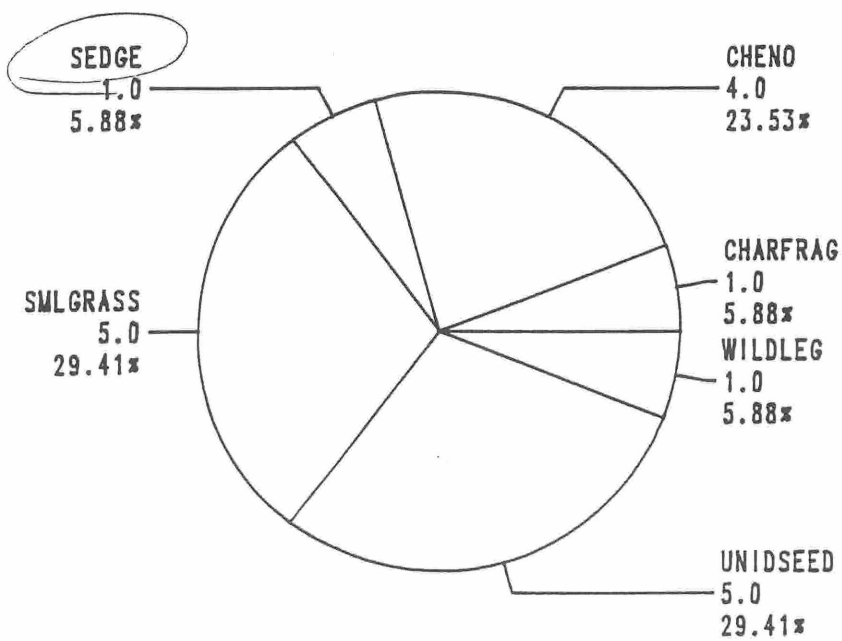
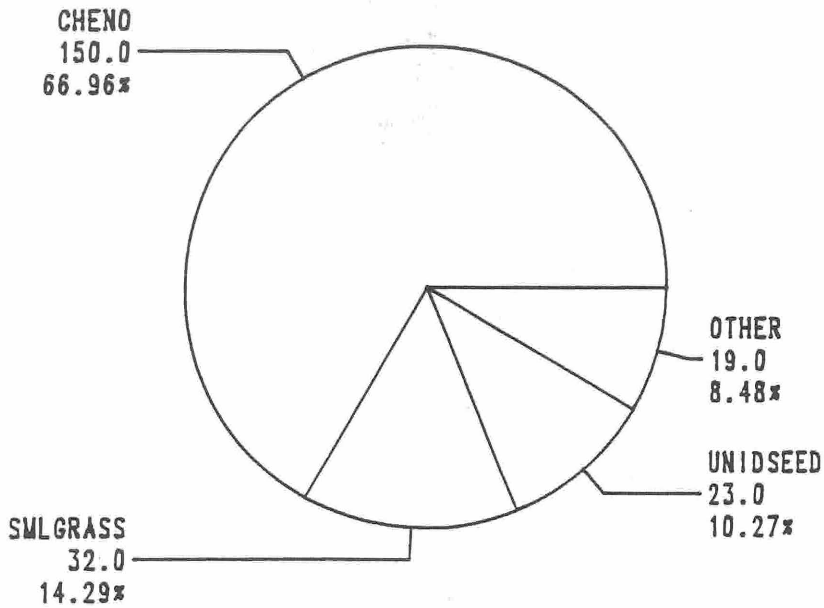


OBSIDIANA

n=1

CONTEXT = HEARTH



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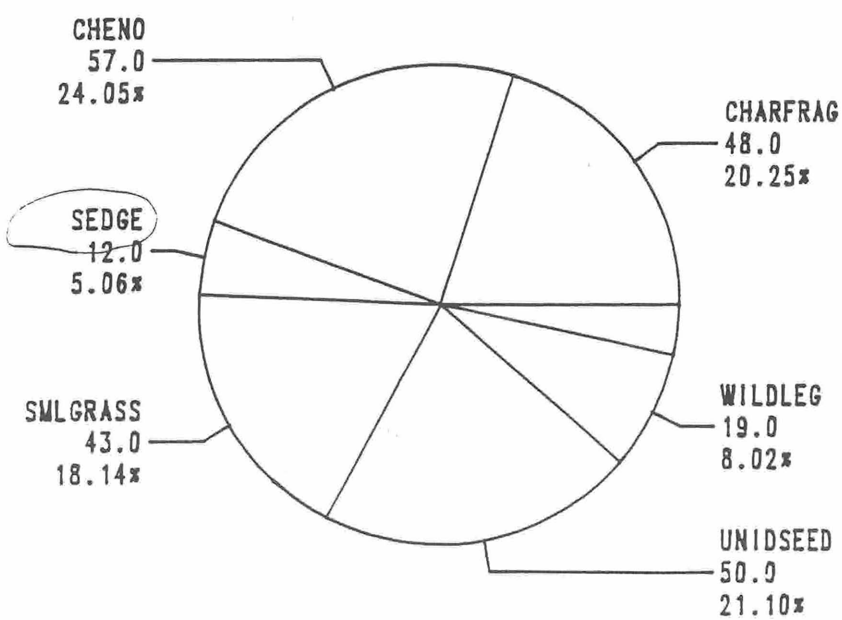
n=2

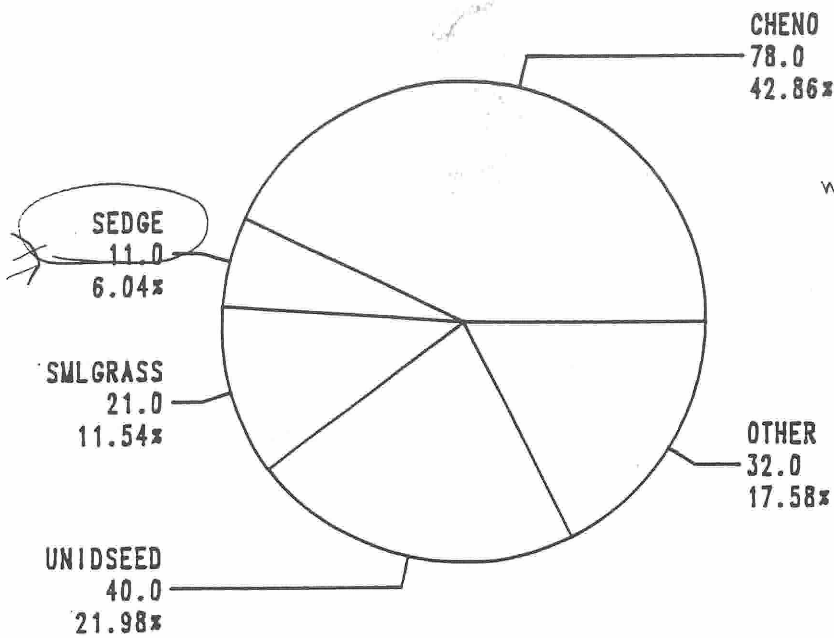


OBSIDIANA

Ofrenda n=1 (llama)

CONTEXT = PIT

w/ stone cero



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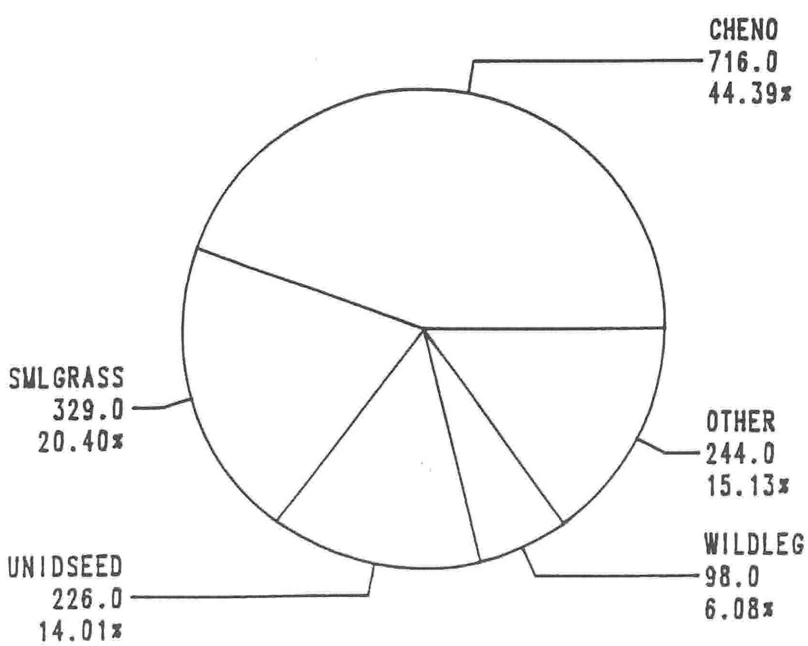
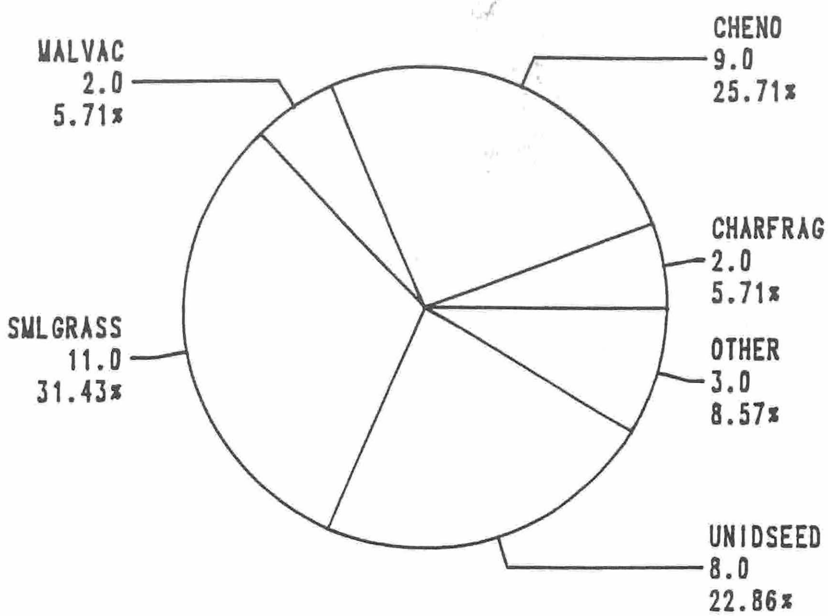


PUKARA

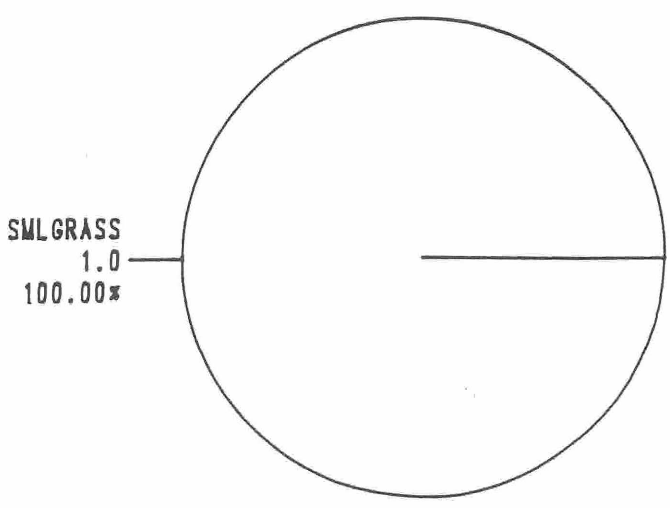
CONTEXT = BURIAL

n=1



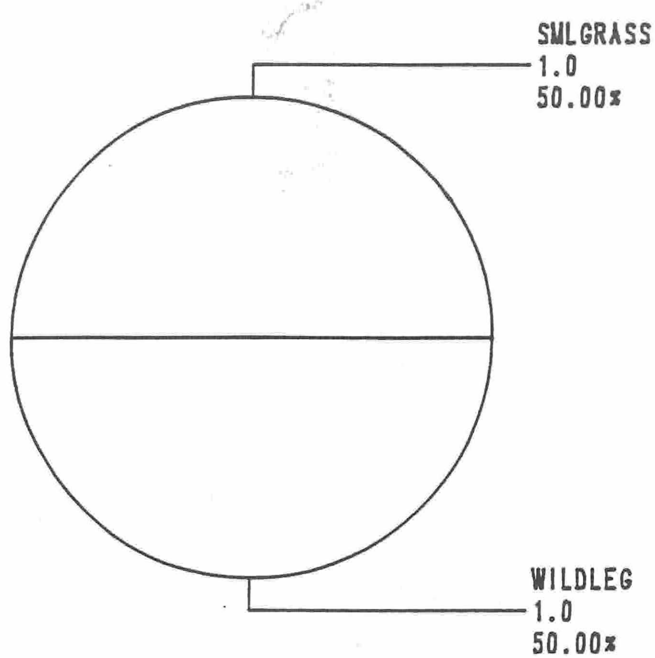
CONTEXT = CANAL

n=1

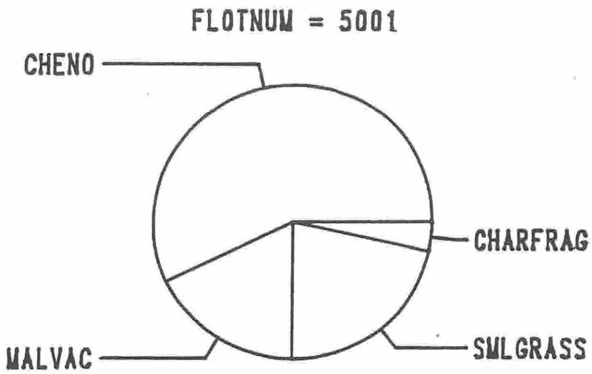


PUKARA

CONTEXT = OCCUPATION   n= 4



% by flotation samples



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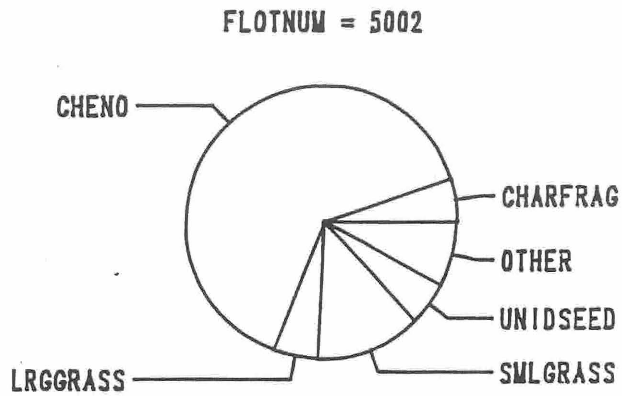
OCCUPATION ZONE



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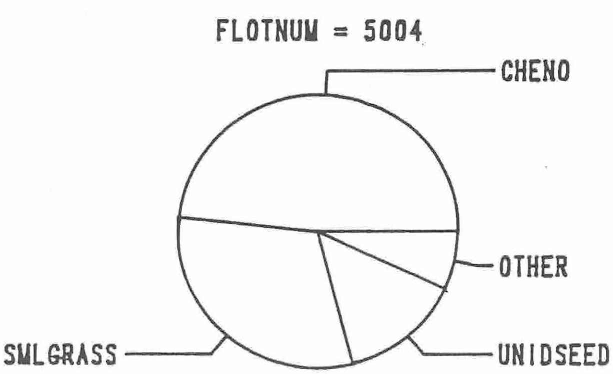

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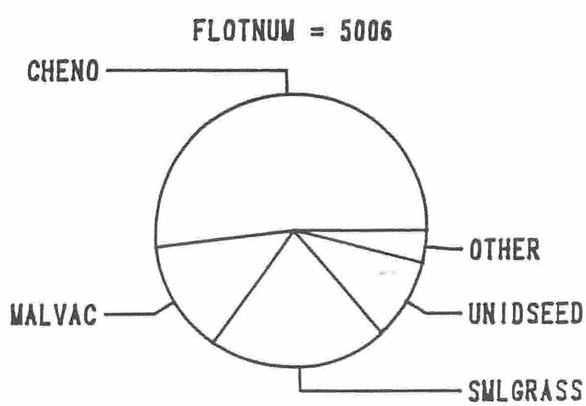
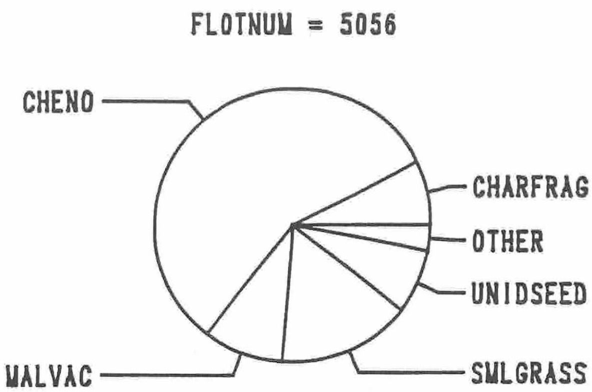
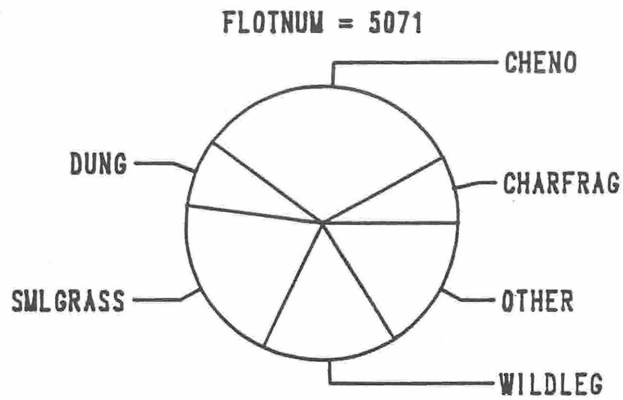


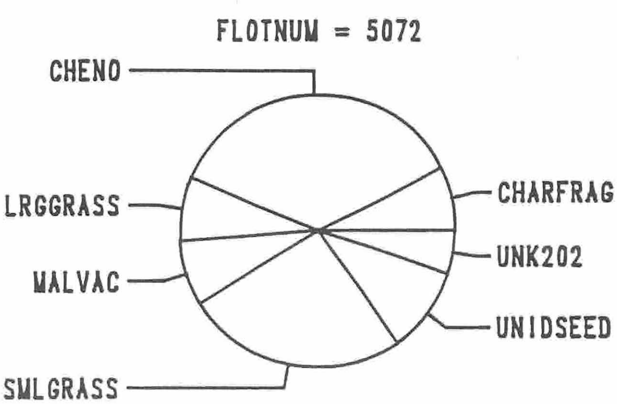
ALLK:
FLOOR CONTACT



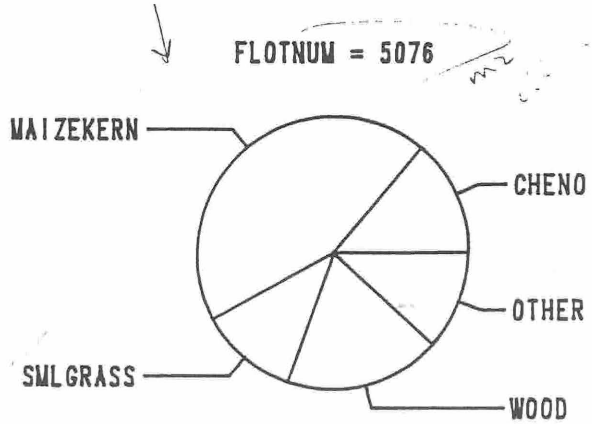
ALLK
occupation zone



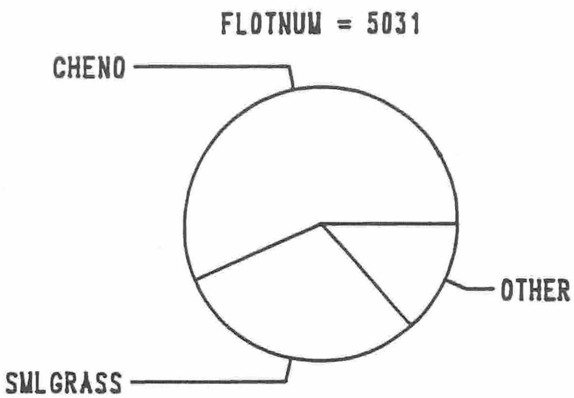
GUAQUI
BURIAL



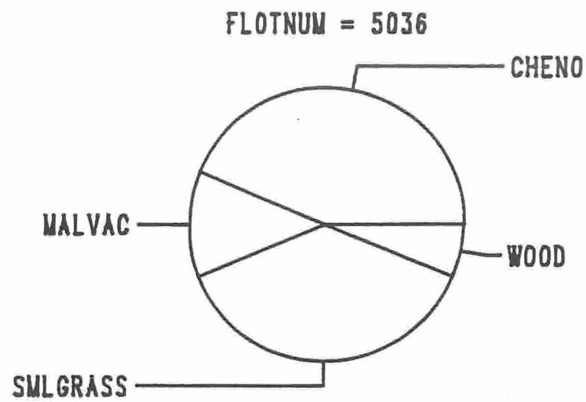
ALLK: OCCUPATION
ZONE



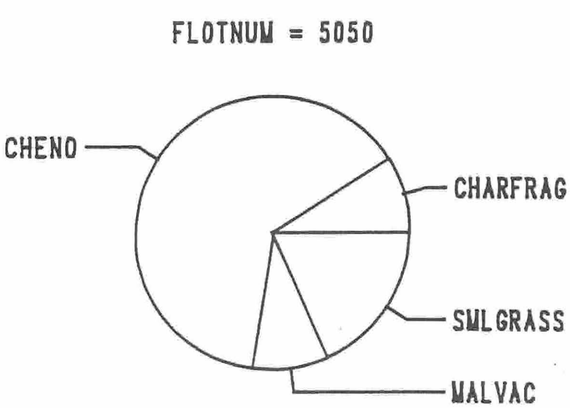
GUAQUI
MIDDEN PIT



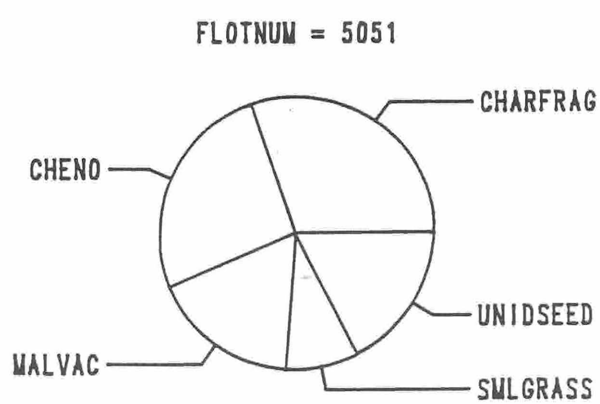
ALLK
SOIL W/ARTIFACTS



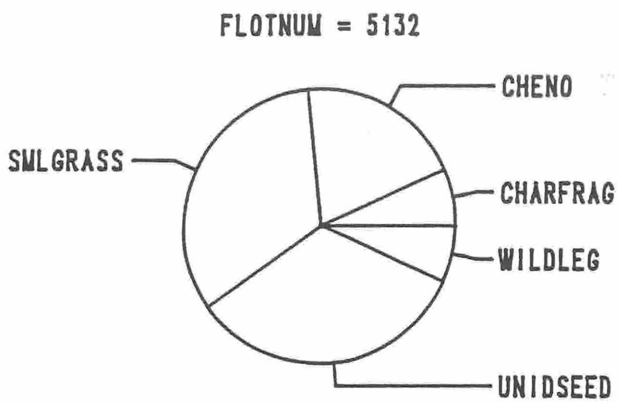
ALLK
OCCUPATION
ZONE



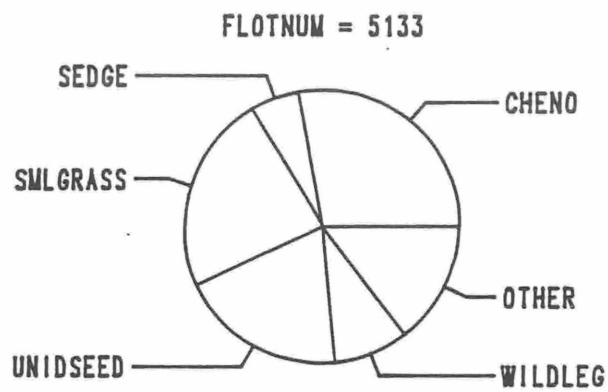
ALLK
OCCUPATION ZONE



ALLK
POSSIBLE
OCCUPATION
ZONE



OBSIDIANA
CULTURAL FILL



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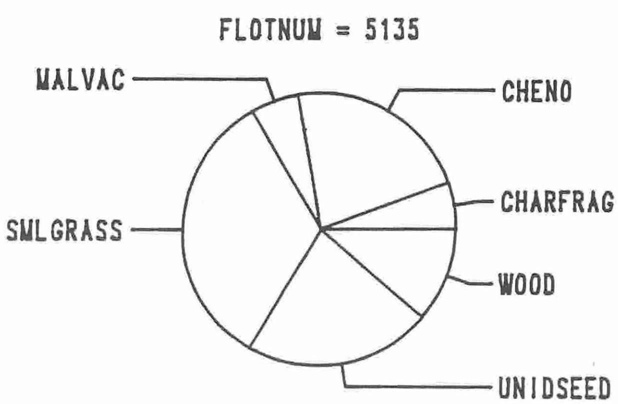
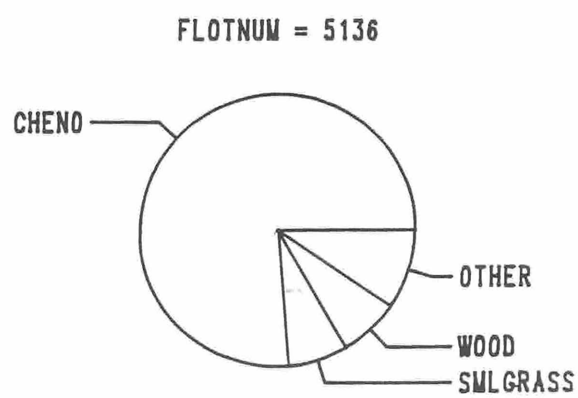
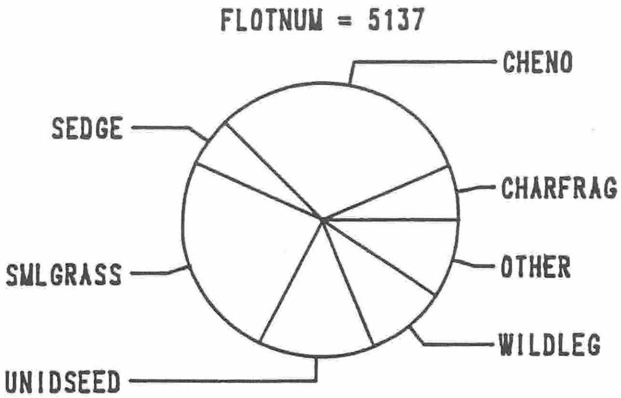
MIDDEN PIT



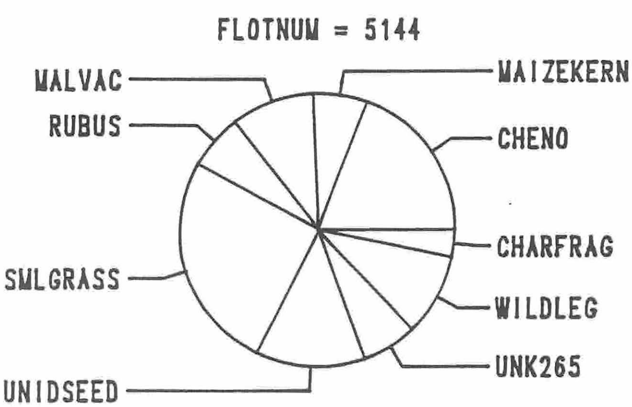
OBSIDIANA
BURIAL



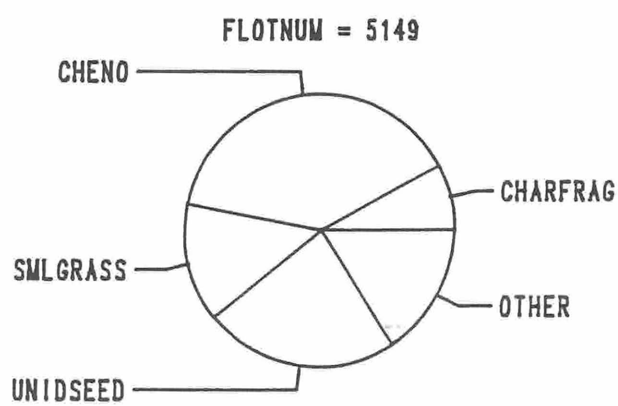
OBSIDIANA
MIDDEN PIT



OBSIDIANA
MIDDEN PIT



GUAQUI
FLOOR INSIDE



GUAQUI
MIDDEN PIT

density of charred remains at the site there is a significantly high mean density of small *Chenopodium*, as there is at TMV79. This leads us to suggest that this may have been a major source of food at this time, and that the size of the seeds had not yet undergone the selective pressure at work during the later Tiwanaku IV and V periods. Tubers and maize may not have been utilized as extensively as at later times.

The two major types of cultural contexts represented at Allkmari include occupation debris, and some apparent fill. Examination of the relative percentage charts by context show that both contexts are somewhat similar, and that the samples are dominated by *Chenopodium* and small grasses. Individual samples show the same trends, though there is a good deal of variation in the amounts of these two taxa, and the inclusion of other small-seeded weeds such as mallow (Malvaceae), large grass, and some charred fragments of unidentifiable plant tissue. The samples recorded likely represent the same type of occupation activities.

Guaqui (Tiwanaku IV/V)

This site contains denser material than the earlier formative site. It stands out from all the other lower valley sites with its high average density of maize, and higher density of large *Chenopodium*. There are also denser remains of possible fuel sources, such as wood, grasses, and dung. This is the only lower valley site that contained maize. It may be that this site had better access to maize than others, given its proposed status as a regional center.

Examination of the site by context shows that (as at Allkamari and many other Tiwanaku sites), the samples are dominated by *Chenopodium* and small grass, but that there is a good deal of variability. It appears that the occupation areas, trash pits, and middens look fairly similar with a wide variety of taxa present, in somewhat equal proportions. Samples from fill and the ash lens appear to be somewhat less diverse, with sparser remains, possibly the result of fewer activities represented.

Turning to the individual samples from different contexts we find that in spite of the elevated average densities of maize and large *Chenopodium* these two taxa are actually very restricted in distribution. As with many of the other sites in the area, food remains are found most often in trash or ash pits. At Guaqui, all of the maize remains were kernels and kernel fragments that occurred in a single trash pit in rasgo 3 of N482 E513 (Flot 5076). Chenopodium is spread more widely, though there is an especially dense concentration in a trash filled pit in N486 E509 (Flot 5236). We conclude that habitation areas in this peripheral area were "neat", as are those at the heart of the urban core, where burned plant refuse, especially foods, were at least partially cleaned up and redeposited into trash pits.

Yet not all pits may have been used for garbage. Flot 5266 was nearly clean of charred plant remains, containing only 9 twigs. The burial from Guaqui is like others from the Tiwanaku valley sites in that it does not appear to contain intentionally charred plant remains.

Iwawe (Tiwanaku IV/V)

Interpretation of the samples from Iwawe are more problematic than some of the others as they come from one 2 X 2 meter unit in the occupation area, with two others from surrounding canal areas. Because there is limited exposure it is difficult to understand what each level might have been spatially associated with.

Domesticates are sparse at the site of Iwawe, as they are in most of the lower valley sites. Less fuel remains (wood, grass, dung) were found than at the other two Tiw IV/V sites from the lower valley. Remains of tubers and maize are lacking, and both sizes of *Chenopodium* are lower than Guaqui and Obsidiana. It may be that this site had less inhabitants, was more dispersed than the others, or that it was not occupied for as long a period.

Within the cultural contexts represented at Iwawe the same pattern of denser, more diverse remains holds for the occupation zone and the trash pits, whereas the burial and fill have few remains likely derived from sources other than the activity represented. The hearth appears to contain some unique, *in situ* material, including a high concentration of sedge seeds. This may indicate the use of tortora as fuel or fire starter. The samples from the canal is virtually empty, as was expected, suggesting that debris from the occupation area was limited in extent, and that household refuse was not dumped in these areas.

Obsidiana (Tiwanaku IV/V)

Like the other lower valley sites Obsidiana contains somewhat scant domesticate remains, though small *Chenopodium* and tubers are more common than elsewhere. Dung, and especially grass remains are common, while wood density is second only to Guaqui. This may indicate that occupational intensity or duration was greater than some of the other sites, or that Obsidiana residents had better access to these resources. Sedge appears to be widespread across the site, and might be linked in some way to manufacture of goods--considering the high concentrations of obsidian at the site (?).

Looking at the individual cultural contexts recorded at Iwawe we see a similar pattern of samples that are dominated by *Chenopodium* and small grass. As with other valley sites, dense and diverse remains were recovered from trash pits and occupation areas, while fill and the burial contains sparse remains.

The trash pits individually show a high degree of variation in their content. In two of the five there are particularly dense grass seeds, suggesting that trash is not thoroughly mixed prior to deposition in the pits, and that they likely represent individual events of primary trash deposition.

The hearth has a dense concentration of *Chenopodium*, suggesting the remains of a cooking accident. The pit, containing a camelid and a stone kero, appears to be an offering, but does not contain the same sorts of plant remains as the large ofrena atop the Akapana mound (ie: no tubers, maize, dense wood). Instead, it appears that the plant remains in the offering were simply included by chance, by using soil from the occupation area at hand.

Pukara (Early Pacajes/ Late Intermediate Period)

This site contained the sparsest remains of all the sites in study region of the Wila Jawira project. Crop remains are limited to very few small *Chenopodium*. Fuel remains, such as wood and dung do not occur, and grass seeds are rare. Most of the taxa recorded are wild weedy species, such as mallow (Malvaceae) and wild legumes.

The remains from the occupation area and the burial are very similar, and those from the samples recorded as occupation do not look like any of those from the four other lower valley sites. It may be that this area was not inhabited like the others. It might have been a special purpose/occasion site, such as a field house. The fact that the burial contains denser plant remains suggests that perhaps there was more actual occupation near the burial (it is not close to the areas recorded as "occupation"), and that the occupation at the site was fairly localized.

The terrace sample, as those from the canal at Iwawe, are nearly devoid of charred remains.

This material either represents a different type of site, or activity than those others. As it is the only site from this period it is difficult to assess the representativeness of the remains. It may be that settlement type changed after the collapse of the Tiwanaku state, or that this is simply an anomalous finding.

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 Brassicaeae)
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.

UNK248 = Same as *Rubus* spp.
CARYOPHL = Caryophyllaceae (Pink family)
UNK266 = Unknown 266
SOLANAC = Solanaceae seeds (Nightshade family)
NICOTIAN = *Nicotiana* spp. L.
SISYRINC = *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 seed 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

Juan's Raw Data

OBS	IDNO	SITE	CUADRA	NIVEL	SPECIMEN	UNIDAD1	UNIDAD2	RASGO	FLOTNUM	FLOTVOL	LFPICK	PHASE	COLTYPE	CULTCONT	CARD	LRGCHENO	SMLCHENO	LUMP	SPOACEAE	LPOACEAE	WILDLEG	SCIRPUS	VERBENA	PLANTAGO	MALVACEA	RELBUN	MPOACEAE	RUBUS	CYPERAC	CRUCIFER	UNK224	POTAMOG	CEREUS	UNK264	CRD	MODPOPPY
1	3642	ALLK		5	201	N473	E519		5072	5.0	0.01	FORM	102	310	1	.	14	3	10	3	.	.	.	.	3	.	.	.	.	.	.	.	.	.	2	.
2	3643	ALLK		9	243	N473	E519		5056	5.0	0.03	FORM	102	310	1	2	35	5	10	1	1	.	.	.	6	.	.	.	.	.	.	.	.	.	2	.
3	3644	ALLK		8	171	N475	E517		5006	5.0	0.04	FORM	102	330	1	4	23	1	11	.	.	.	.	.	7	.	.	.	.	.	.	.	.	.	2	.
4	3645	ALLK		4	123	N475	E519		5036	5.0	0.01	FORM	102	310	1	.	7	.	6	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	2	.
5	3646	ALLK		5	231	N475	E519		5004	5.7	0.04	FORM	102	310	1	.	14	.	9	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	2	.
6	3648	ALLK			160	N477	E517	1	5051	5.0	0.01	FORM	102	390	1	.	6	7	2	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	2	.
7	3647	ALLK		7	167	N477	E517		5031	5.7	0.01	FORM	102	604	1	.	17	1	9	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	2	.
8	3649	ALLK		3	108	N477	E519		5078	5.0	0.01	FORM	102	310	1	.	7	1	10	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	2	.
9	3650	ALLK		3A	113	N477	E519		5050	4.4	0.03	FORM	102	310	1	.	7	1	2	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	2	.
10	3651	ALLK		4	210	N477	E519	2	5002	5.0	0.03	FORM	102	310	1	.	25	2	5	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	2	.
11	3652	ALLK		7	218	N477	E519		5001	5.0	0.01	FORM	102	310	1	1	15	1	6	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.	2	.
12	3654	GUAQ		4	138	N482	E513		5269	1.3	0.02	T4/5	102	342	1	.	1	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
13	3655	GUAQ		7	152	N482	E513	3	5076	1.8	0.11	T4/5	102	412	1	2	4	.	5	.	1	.	.	.	1	1	.	.	.	.	.	.	.	.	2	.
14	3656	GUAQ			71	N484	E511	1	5276	1.3	0.09	T4/5	101	700	1	.	8	.	8	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
15	3657	GUAQ		3	87	N484	E511	3	5071	2.1	0.01	T4/5	101	598	1	8	.	2	5	.	4	.	.	.	.	.	.	.	1	.	.	.	.	.	2	.
16	3658	GUAQ		2	116	N484	E513	2	5114	1.6	2.79	T4/5	101	415	1	5	38	3	50	1	7	.	.	.	2	.	.	.	4	.	.	.	1	.	2	.
17	3660	GUAQ			113	N486	E509	2	5236	2.3	0.25	T4/5	101	412	1	5	116	78	15	1	17	.	1	.	.	.	.	.	6	.	.	.	.	.	2	.
18	3659	GUAQ		7	137	N486	E509		5144	1.0	0.01	T4/5	102	342	1	.	6	1	8	.	3	.	.	.	3	.	.	2	.	.	.	.	.	.	2	.
19	3661	GUAQ			104	N486	E511	3	5102	1.8	0.01	T4/5	101	298	1	.	8	2	5	1	.	.	1	.	1	.	.	.	.	.	.	.	.	.	2	.

OBS	AMARANTH	UNK270	UNK242	COMPOSIT	UNK265	LABIATAE	KAINYA	UNK261	JUNCUS	CARYOPHL	UNK266	SOLANAC	NICOTIAN	SISYRINC	ZEAKERN	ZEAEMBR	COBCUP	CAPSICUM	DOMLEGUM	CRDNO	POLYGON	OXALIS	UNK202	OENOTHER	LSOLANAC
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	2	.	.
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18	.	.	.	.	2	.	.	.	.	.	.	.	.	.	1	1	.	.	.	3	.	.	.	.	.
19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.

OBS	UNK271	UNK235	PORTULAC	UNK201	TRITHORD	CACTUS	UNK279	CARDNO	UNIDSEED	TUBER	WOODCT	WOODWT	TWGBRNCH	STALK	DUNG	LLAMADNG	CUYDUNG	WIRAKOA	LEAVES	TRITRACH	PEDUNCLE	SORTTYPE	FAUNAL	BOXSIZE	YEAR
1	.	.	.	.	.	.	.	4	4	.	.	.	.	.	.	.	.	.	.	.	.	1	1	S	90
2	.	.	.	.	.	.	.	4	5	.	.	.	.	.	.	.	.	.	.	.	.	1	1	S	90
3	.	.	.	.	.	.	.	4	5	.	1	0.02	.	.	.	.	.	.	.	.	.	1	1	S	90
4	.	.	.	.	.	.	.	4	.	.	1	0.01	.	.	.	.	.	.	.	.	.	1	.	S	90
5	.	.	.	.	.	.	.	4	4	.	.	.	.	.	.	.	.	.	.	.	.	1	1	S	90
6	.	.	.	.	.	.	.	4	4	.	.	.	.	.	.	.	.	.	.	.	.	1	1	S	90
7	.	.	.	.	.	.	.	4	1	.	1	0.01	.	.	.	.	.	.	.	.	.	1	1	S	90
8	.	.	.	.	.	.	.	4	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	S	90
9	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	S	90
10	.	.	.	.	.	.	.	4	2	.	1	0.02	.	.	.	.	.	.	.	.	.	1	1	S	90
11	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	S	90
12	.	.	.	.	.	.	.	4	3	.	.	.	.	.	.	.	.	.	.	.	.	1	.	S	90
13	.	.	.	.	.	.	.	4	1	.	8	0.08	.	.	1	.	.	.	.	.	.	1	1	S	90
14	.	.	.	.	.	.	.	4	3	.	1	0.01	.	.	.	.	.	.	.	.	.	1	1	S	90
15	.	.	.	.	.	.	.	4	1	.	1	0.01	.	.	2	.	.	.	.	.	.	1	.	S	90
16	.	.	.	.	.	.	.	4	26	.	145	2.15	1	.	41	.	.	.	4	.	.	1	1	M	90
17	.	.	.	.	.	.	.	4	52	.	6	0.04	4	.	49	.	.	.	1	.	.	1	.	M	90
18	.	.	.	.	.	.	.	4	4	.	.	.	.	.	.	.	.	.	.	.	.	1	.	S	90
19	.	.	.	.	.	.	.	4	2	.	3	0.03	.	.	.	.	.	.	.	.	.	1	.	S	90

	IDNO	SITE	CUADRA	NIVEL	SPECIMEN	UNIDAD1	UNIDAD2	RASGO	FLOTNUM	FLOTVOL	LFPICK	PHASE	COLLTYPE	CULTCONT	CARD	LRGCHENO	SMLCHENO	LUMP	SPOACEAE	LPOACEAE	WILDLEG	SCIRPUS	VERBENA	PLANTAGO	MALVACEA	RELBUN	MPOACEAE	RUBUS	CYPERAC	CRUCIFER	UNK224	POTAMOG	CEREUS	UNK264	CRD
0	3662	GUAQ		4	23	N504	E554		5175	1.3	0.01	T4/5	102	310	1	.	6	4	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2
1	3653	GUAQ		5	34	N504	E554	1	5149	1.6	0.03	T4/5	101	412	1	.	25	5	9	.	1	.	.	.	3	1	.	.	1	.	.	.	.	.	2
2	3663	GUAQ		5	36	N504	E554	2	5228	1.6	0.00	T4/5	101	343	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
3	3664	GUAQ		1	63	N529	E563	1	5266	1.0	0.04	T4/5	102	410	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
4	3666	GUAQ		10	90	N529	E563		5158	1.8	0.01	T4/5	102	620	1	.	28	2	16	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	2
5	3665	GUAQ		6	79	N529	E563		5155	1.3	0.01	T4/5	102	620	1	.	2	1	1	.	.	.	1	.	1	1	.	.	.	.	.	.	.	.	2
6	3671	IWAW			185	N475	E525	11	5319	1.6	0.03	T4/5	101	420	1	1	7	6	7	1	1	.	.	.	3	.	.	.	33	.	.	.	.	.	2
7	3672	IWAW			218	N475	E525	13	5293	1.0	0.01	T4/5	101	412	1	1	4	.	9	1	10	.	.	.	2	.	.	.	.	.	.	.	.	1	2
8	3667	IWAW			84	N475	E525	2	5260	0.8	0.01	T4/5	.	598	1	.	5	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2
9	3673	IWAW			100	N475	E525	5	5297	1.0	0.01	T4/5	101	412	1	.	7	2	10	.	1	.	1	.	1	.	.	.	.	.	.	.	.	2	2
0	3669	IWAW		11	149	N475	E525		5196	0.8	0.01	T4/5	102	300	1	1	1	7	5	1	8	.	.	.	.	.	.	.	2	.	.	.	.	.	2
1	3670	IWAW		12	172	N475	E525	9	5318	1.0	0.01	T4/5	102	300	1	.	2	2	.	.	2	.	.	.	4	.	.	.	.	.	.	.	.	.	2
2	3668	IWAW		19	235	N475	E525		5198	1.0	0.01	T4/5	102	620	1	.	11	1	5	.	1	.	.	.	1	1	.	1	.	.	.	.	.	.	2
3	3674	IWAW		9	124	N475	E525		5188	1.0	0.02	T4/5	102	300	1	.	4	5	2	.	2	.	.	.	1	.	.	.	.	.	.	.	.	.	2
4	3676	IWAW			251	N558	E550		5298	1.3	0.00	T4/5	101	435	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
5	3675	IWAW		5	229	N588?	E550		5296	1.8	0.01	T4/5	101	435	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
6	3686	OBS			209	N390	E456	1	5112	1.3	0.02	T4/5	101	420	1	.	150	.	32	.	7	.	1	.	2	5	.	.	2	.	.	.	.	1	2
7	3687	OBS			104	N440	E476	1	5233	2.1	0.18	T4/5	101	412	1	.	400	11	130	4	35	.	.	.	8	7	.	.	16	.	.	.	.	6	2
8	3677	OBS			115	N440	E476	3	5135	2.1	0.01	T4/5	101	598	1	.	4	1	6	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	2

	MODPOPPY	AMARANTH	UNK270	UNK242	COMPOSIT	UNK265	LABIATE	KAINYA	UNK261	JUNCUS	CARYOPHL	UNK266	SOLANAC	NICOTIAN	SISYRINC	ZEAKERN	ZEAEMBR	COBCUP	CAPSICUM	DOMLEGUM	CRDNO	POLYGON	OXALIS	UNK202	OENOTHER	LSOLANAC	UNK271	UNK235	PORTULAC	UNK201	TRITHORD	CACTUS	UNK279	CARDNO
0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4
1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4
2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4
3	48	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4
4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4
5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4
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7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4
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2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4
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4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4
5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4
6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4
7	.	2	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4
8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4

	UNIDSEED	TUBER	WOODCT	WOODWT	TWGBRNCH	STALK	DUNG	LLAMADNG	CUYDUNG	WIRAKOA	LEAVES	ITRACH	TRDUNCLE	PERTTYPE	SOFAUNAL	BOXSIZE	YEAR
0	4	.	2	0.01	.	.	.	.	.	.	.	.	.	1	.	S	90
1	15	.	3	0.01	.	.	.	.	.	.	.	.	.	1	1	S	90
2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	S	90
3	.	.	.	.	9	.	.	.	.	.	.	.	.	1	.	S	90
4	8	.	1	0.01	.	.	.	.	.	.	.	.	.	1	1	S	90
5	1	.	2	0.01	.	.	.	.	.	.	.	.	.	1	.	S	90
6	15	.	.	.	4	.	.	.	.	.	.	.	.	1	1	S	90
7	4	.	3	0.01	.	.	.	.	.	.	2	.	.	1	1	S	90
8	.	.	1	0.01	.	.	.	.	.	.	.	.	.	1	1	S	90
9	6	.	1	0.01	.	.	2	.	.	.	.	.	.	1	1	S	90
0	10	.	.	.	.	.	.	.	.	.	.	.	.	1	.	S	90
1	11	.	.	.	.	.	1	.	.	.	.	.	.	1	1	S	90
2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	S	90
3	2	.	.	.	.	.	1	.	.	.	.	.	.	1	.	S	90
4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	S	90
5	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	S	90
6	23	.	.	.	.	.	.	.	.	.	.	.	.	1	.	S	90
7	100	1	4	0.03	10	.	7	.	.	.	.	.	.	1	1	S	90
8	4	.	2	0.01	.	.	.	.	.	.	.	.	.	1	1	S	90

OBS	IDNO	SITE	CUADREA	NIVEL	SPECIMEN	UNIDAD1	UNIDAD2	RASGO	FLOTNUM	FLOTVOL	LFPICK	PHASE	COLLTYPE	CULTCONT	CARD	LRGCHENO	SMLCHENO	LUMP	SPOACEAE	LPOACEAE	WILDLEG	SCIRPUS	VERBENA	PLANTAGO	MALVACEA	RELBUN	MPOACEAE	RUBUS	CYPERAC	CRUCIFER	UNK224	POTAMOG	CEREUS	UNK264	CRD	MODPOPPY
9	3684	OBS			100	N452	E486	1	5136	1.0	0.13	T4/5	101	412	1	.	65	2	6	.	.	.	.	.	.	.	.	.	3	.	.	.	1	.	2	.
0	3683	OBS			156	N462	E498	1	5226	1.3	0.05	T4/5	101	417	1	.	78	5	21	.	9	.	.	.	2	.	.	.	11	.	.	.	.	1	2	.
1	3682	OBS			164	N462	E498	2	5224	1.6	0.06	T4/5	101	300	1	.	57	48	43	.	19	.	1	.	3	.	.	.	12	.	.	.	.	1	2	.
2	3678	OBS			171	N462	E500	1	5111	2.1	0.01	T4/5	101	412	1	.	65	8	39	.	5	.	1	.	1	1	.	.	5	.	.	.	.	.	2	1
3	3688	OBS		3	188	N464	E498	2	5133	2.3	0.20	T4/5	101	412	1	2	141	24	120	1	45	.	3	.	2	2	.	.	28	.	.	.	.	20	2	.
4	3679	OBS		4	56	N508	E488		5140	1.8	0.00	T4/5	102	300	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
5	3680	OBS		4	26	N510	E488		5132	2.1	0.01	T4/5	102	620	1	.	3	1	5	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
6	3685	OBS			19	N510	E500	2	5137	1.6	0.06	T4/5	101	412	1	2	41	9	34	.	13	.	.	.	3	1	.	.	8	.	.	.	.	2	2	.
7	3681	OBS		3	32	N510	E500		5079	2.1	0.01	T4/5	102	620	1	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	2	.
8	3690	PUK		4	93	N215	E547		5261	1.3	0.01	EPAC	102	311	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
9	3693	PUK		2	150	N478	E440	1	5095	2.1	0.01	EPAC	102	435	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
0	3689	PUK		4	156	N478	E440		5215	1.6	0.00	EPAC	102	310	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
1	3691	PUK		2	43	N525	E537		5268	1.6	0.00	EPAC	102	310	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
2	3694	PUK		5	65	N525	E537		5104	1.6	0.01	EPAC	102	301	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
3	3692	PUK		1	120	N687	E500	1	5275	2.1	0.01	EPAC	101	598	1	.	9	2	11	1	1	.	.	.	2	.	.	.	.	.	.	.	.	1	2	.

OBS	AMARANTH	UNK270	UNK242	COMPOSIT	UNK265	LABIATAE	KAINYA	UNK261	JUNCUS	CARYOPHL	UNK266	SOLANAC	NICOTIAN	SISYRINC	ZEAKERN	ZEAEMBR	COBCUP	CAPSICUM	DOMLEGUM	CRDNO	POLYGON	OXALIS	UNK202	OENOTHER	LSOLANAC	UNK271	UNK235	PORTULAC	UNK201	TRITHORD	CACTUS	UNK279	CARDNO	UNIDSEED	TUBER	WOODCT	WOODWT	TWGBRNCH	STALK	DUNG	LLAMADNG	CUYDUNG	WIRAKOA	LEAVES	TRITRACH	PEDUNCLE	SORTYPE	FAUNAL	BOXSIZE	YEAR
9	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	6	0.11	.	.	.	.	.	.	1	.	.	1	1	S	90
0	.	.	.	.	2	.	.	.	.	.	.	4	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4	40	.	8	0.04	.	.	.	.	.	.	1	.	.	1	.	S	90
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4	50	1	2	0.01	.	.	.	.	.	.	.	.	.	1	.	S	90
2	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4	7	.	2	0.01	.	.	.	.	.	.	.	.	.	1	.	S	90
3	1	.	.	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4	100	1	.	.	4	.	5	.	.	.	.	.	.	1	1	S	90
4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	S	90
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7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	S	90
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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/artfacts
602 Long-term erosion-deposited matrix w/artfacts
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

REFERENCES

Asch, Nancy and David Asch
1975 Plant remains from the Zimmerman site--Grid A: A quantitative perspective. In, the Zimmerman Site, edited by M. K. Brown, pp.116-120. Reports of Investigations 32. Illinois State Museum, Springfield.

Hastorf, Christine A. and Virginia Popper
1988 Current Paleoethnobotany. University of Chicago Press, Chicago.

Hubbard, R. N. L. B.
1975 Assessing the Botanical Component of Human Palaeo-Economies. Bulletin of the Institute of Archaeology (London) 12: 197-205.

Kolata, Alan L.
1986 The Agricultural Foundations of the Tiwanaku State: A View from the Heartland American Antiquity 51(4):748-762.

Lennstrom, Heidi A.
1991a Intrasite Spatial Variability and Resource Utilization in the Prehistoric Peruvian Highlands: An Exploration of Method and Theory in Paleoethnobotany. PhD dissertation, University of Minnesota.

1991b Preliminary Comparison of Wila Jawira Crop Remains: Tiwanaku, Lukurmata, and Valley Survey Sites. Archaeobotany Laboratory Reports 20, University of Minnesota.

Lennstrom, Heidi A. and Christine A. Hastorf
1989 Archaeobotany Lab Manual. Archaeobotany Laboratory Reports 13, University of Minnesota.

Pearsall, Deborah M.
1989 Paleoethnobotany. Academic Press, San Diego.

Popper, Virginia
1988 Selecting Quantitative Measurements in Paleoethnobotany. In, Current Paleoethnobotany, edited by C. Hastorf and V. Popper, pp. 53-71. University of Chicago Press, Chicago.

SAS Institute Inc.
1985a SAS Users Guide: Basics, Version 5 Edition. SAS Institute Inc., Cary.

SAS Institute Inc.
1985b SAS Users Guide: Statistics, Version 5 Edition. SAS Institute Inc., Cary.

SAS Institute Inc.
1985c SAS/GRAPH User's Guide, Version 5 Edition. SAS Institute Inc., Cary.

SAS Institute Inc.
1985d SAS Introductory Guide, 3rd Edition. SAS Institute Inc., Cary.

Wagner, Gail
1982 Testing Flotation Recovery Rates. American Antiquity 47: 127-132.

Wagner, Gail

1988 Comparability among Recovery Rates. In, Current Paleoethnobotany, edited by C. Hastorf and V. Popper, pp. 17-35. University of Chicago Press, Chicago.

Watson, Patty J.
1976 In pursuit of Prehistoric subsistence: A comparative account of some contemporary flotation techniques. Mid-Continental Journal of Archaeology 1: 77-100.