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Informe: Middle Tiwanaku Valley Survey Sites

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## INFORME: MIDDLE TIWANAKU VALLEY SURVEY SITES

H. Lennstrom, C. Hastorf, and M. Wright  
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University of Minnesota  
May, 1991

Introduction

Flotation samples were recovered from five sites in the middle Tiwanaku Valley survey area by Jim Matthews in 1990. These included one Formative period site, TMV 79, and sites four dating mainly to the Tiwanaku IV and V phases TMV 101, TMV 228, TMV 332, and TMV 558.

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 Tiwanaku and other area sites, and 3) to work only with samples where information concerning cultural contexts, field notes, etc., were available. At the close of the 1990 field season M. Wright returned to the U.S. with flotation samples from sites 79, 101, 332, and 558, and flotation forms from sites 79, 228, and 558. The samples selected from these five sites were completed during the fall of 1990, when the lab plan was to sort approximately 30% of all samples from usable contexts (ie: not mixed, disturbed, or undocumented). Given that we only had flotation samples and field notes for two of the middle valley sites (79 and 558) we selected approximately 30% of the usable samples from each. TMV 79 had 63 flots recorded, 49 of which were usable, and 14 were analyzed. From TMV 558 62 samples were available, 49 were usable, and 13 were analyzed. Samples were chosen so that our subsample represented the overall contextual content of each individual site, and that some of each context type would be represented (stratified random sample). Notes from TMV 101 and TMV 332 arrived too late in the academic year to be analyzed at this time, but may be sampled in the future. No samples from site TMV 101 were floted.

Sample size (site matrix prior to flotation) was small and varied a somewhat. Approximately half of the samples were 5.7 or 6.3 liters, while the remaining samples were only 2.3 and 2.5 l. The larger samples were more common from TMV 79 and the smaller from TMV 558. This disparity in sample size 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 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 material, 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 alot 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.

Strategies 1 and 2 were used for the samples from the middle valley survey samples.

### Quantification of Lower Tiwanaku Valley Survey Site samples

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, these might be tubers or other fragments of domesticates.) Possible food source.
- Small Poaceae (seeds) Grass family. Possibly used as fodder, fuel, or in construction. May also 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, possibly derived from dung.
- Verbena* spp. (seeds). Common weed.
- Malvaceae (seeds) Mallow family. Common weed. Also found in 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.  
 Cruciferae (seeds)- Mustard family (Brassicaceae), common weed in disturbed areas.  
*Potamogeton* spp. Pondweed, wetland plant.  
*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 265 (seeds)  
 Solanaceae (seeds) Nightshade family  
*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.  
*Zea mays* (maize) kernels  
 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:

TMV 79 (Formative) n=14

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

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0.00	0.03	0.07	370.0	0.00

Ubiquity of crop plants (# of samples containing taxon)

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0%	7.1%	57.1%	92.9%	0%
	(1)	(8)	(13)	

TMV 558 (Tiwanaku IV/V) n=13Average density of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
0.03	0.00	0.68	10.00	0.00

Ubiquity of crop plants

		Large	Small	Domesticated
Maize	Tubers	<i>Chenopodium</i>	<i>Chenopodium</i>	Legumes
7.7%	0%	53.8%	100%	0%
(1)		(7)	(13)	

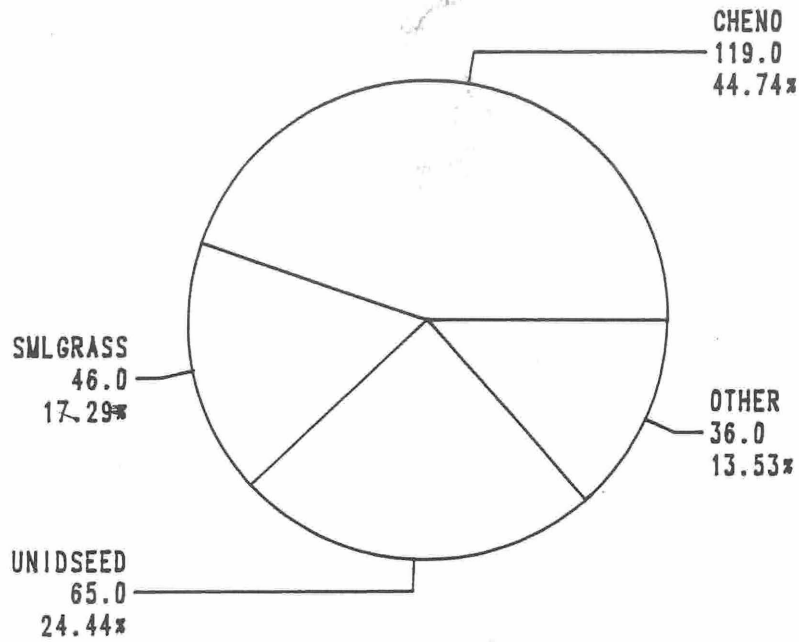
Relative Percentages

On the following sheets are two types of pie diagrams displaying 1) different cultural contexts and 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 diagrams 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.

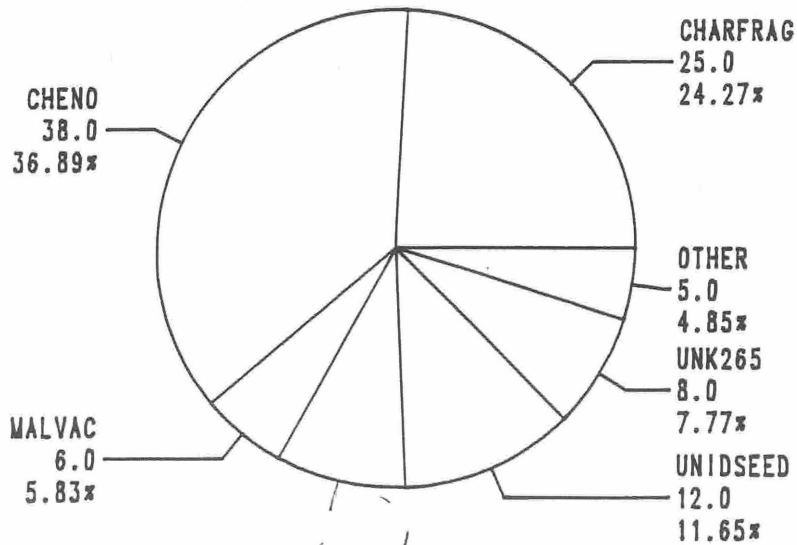


JAN 79

CONTEXT = FILL N=1



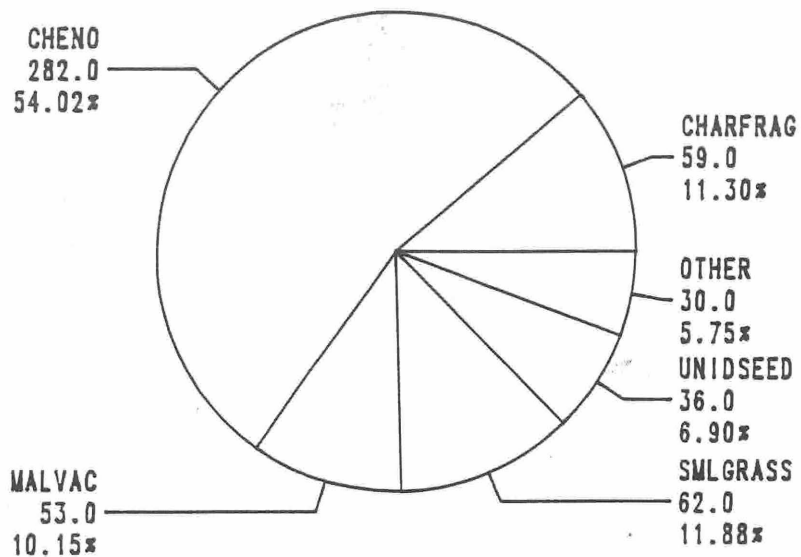
CONTEXT = HEARTH N=1



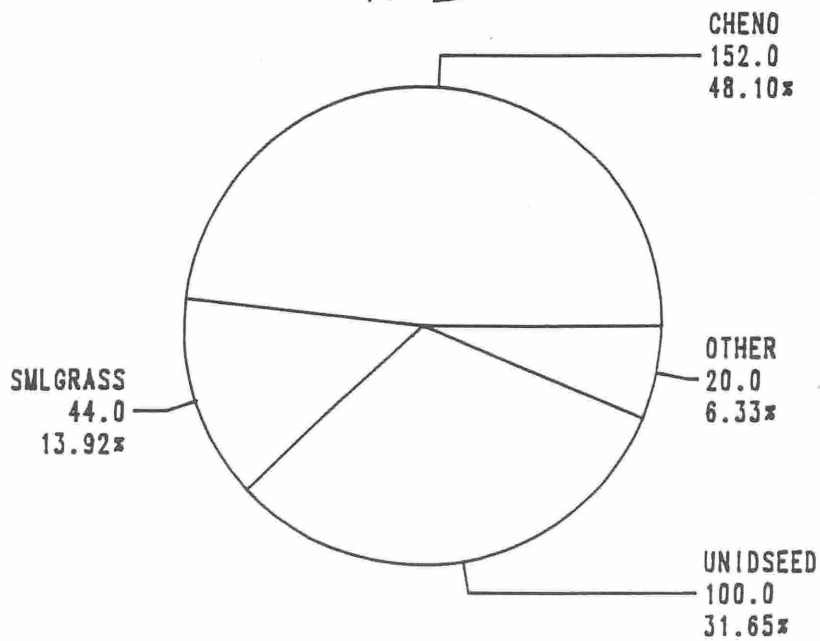
small grass (9) 8.742

TMV 79

OCCUPATION  
CONTEXT = INSIDE  
n=2



CONTEXT = OUTSIDE  
n=2

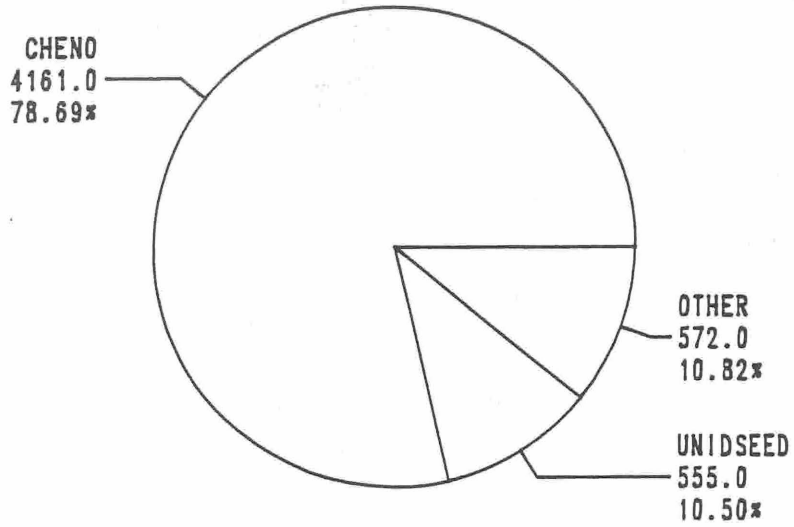


*Including Malvac*

TMV79

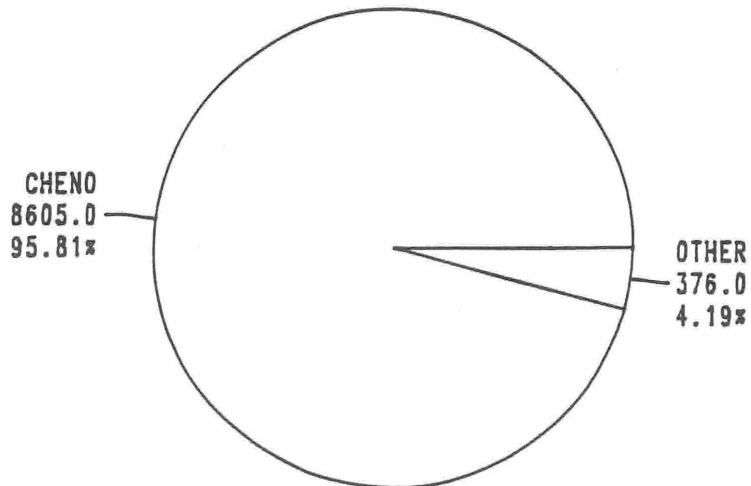
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N = 8



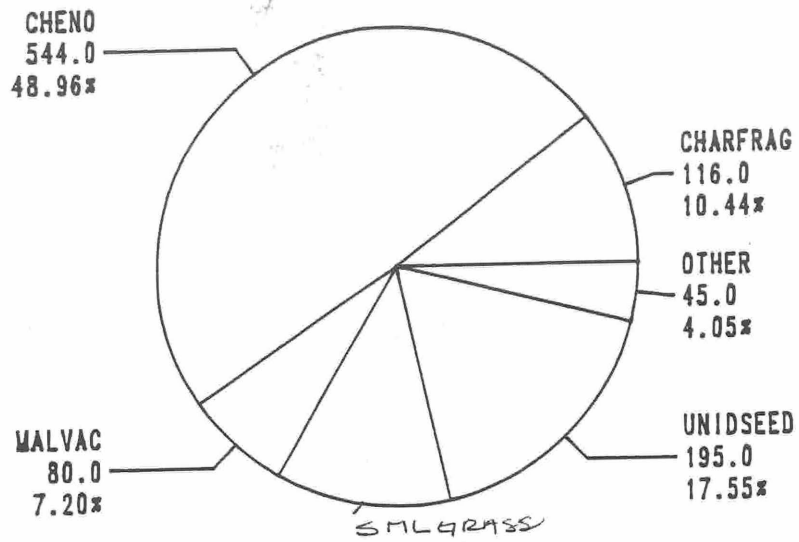
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N = 4



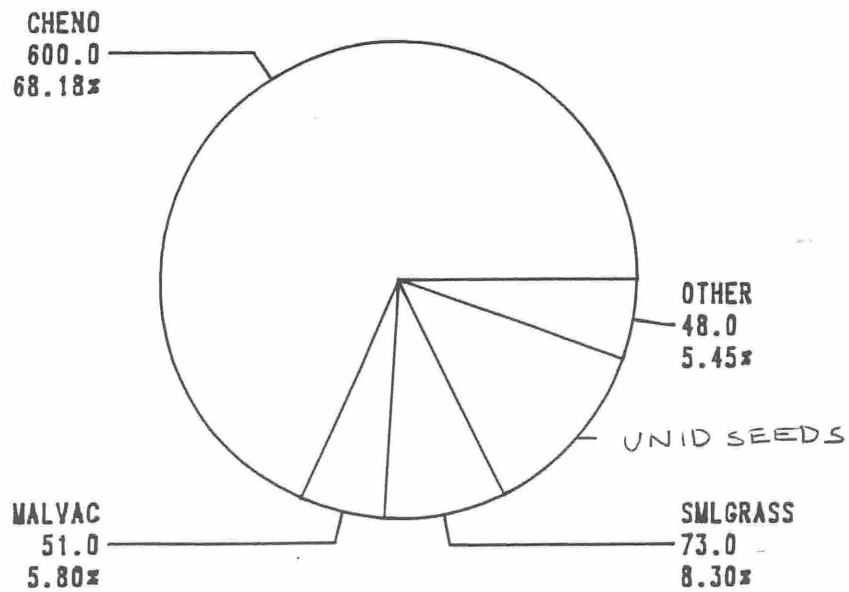
TMV 79  
N=7  
MINUS FLOT 5336

CONTEXT = OCCUPATION



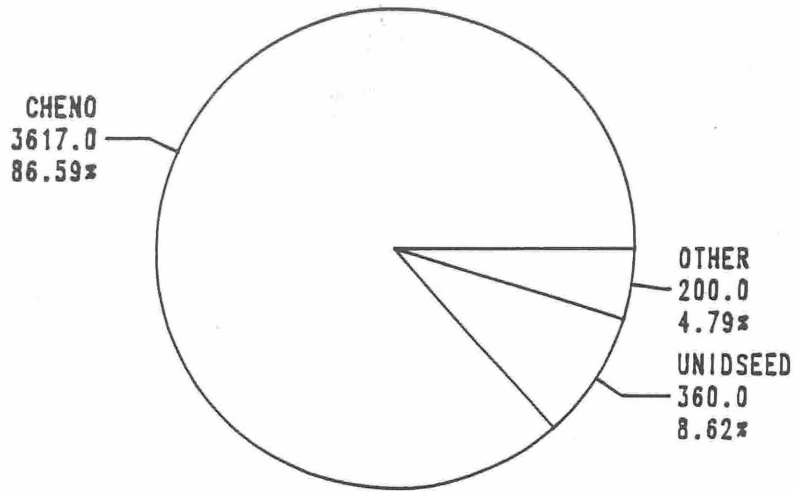
TMV 79  
N=3  
MINUS FLOT 5208

CONTEXT = TRASHPIT



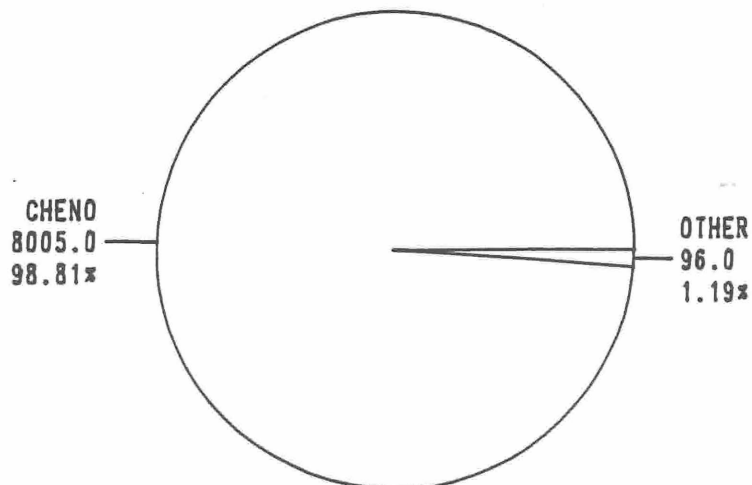
TMV79  
FLOT 5336 ONLY

CONTEXT = OCCUPATION



TMV 79  
FLOT 5208 ONLY

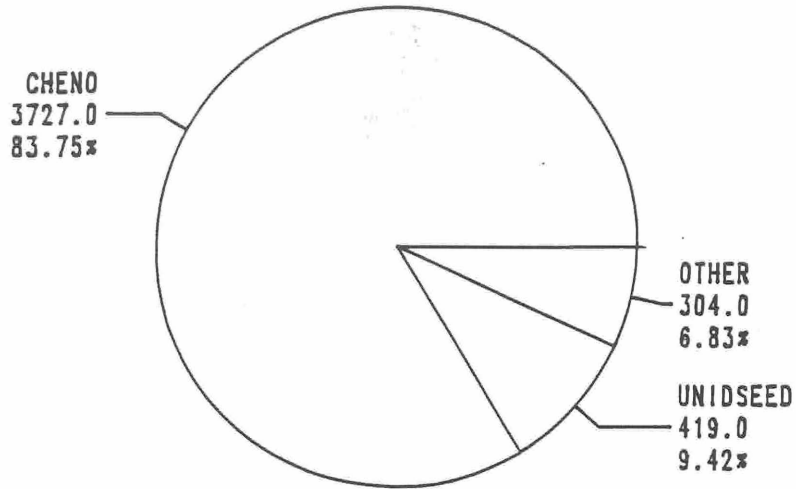
CONTEXT = TRASHPIT



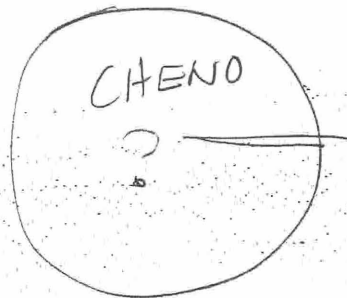
# TMV79 OCCUPATION

CONTEXT = UNKNOWN WHETHER  
INSIDE OR OUTSIDE

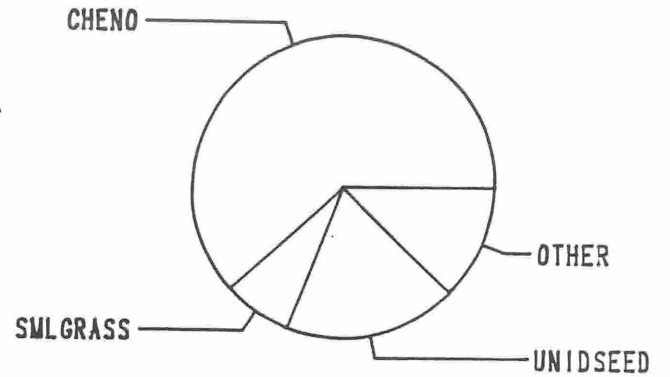
N = 4



FLOT = 5208

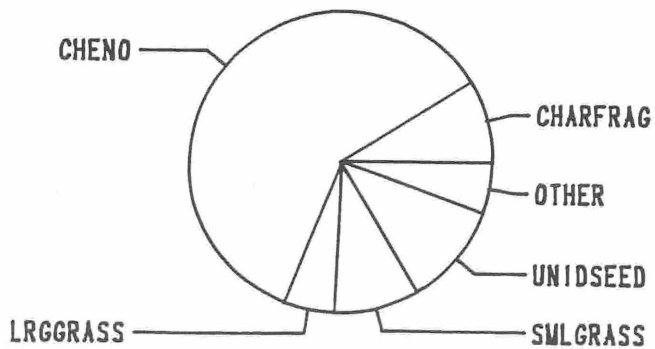


FLOTNUM = 5209



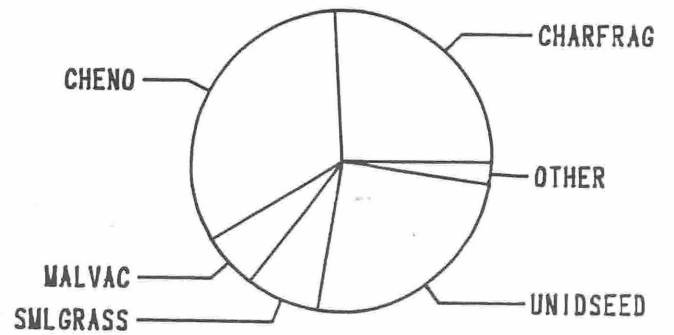
TMV79  
RUBBISH PIT

FLOTNUM = 5210

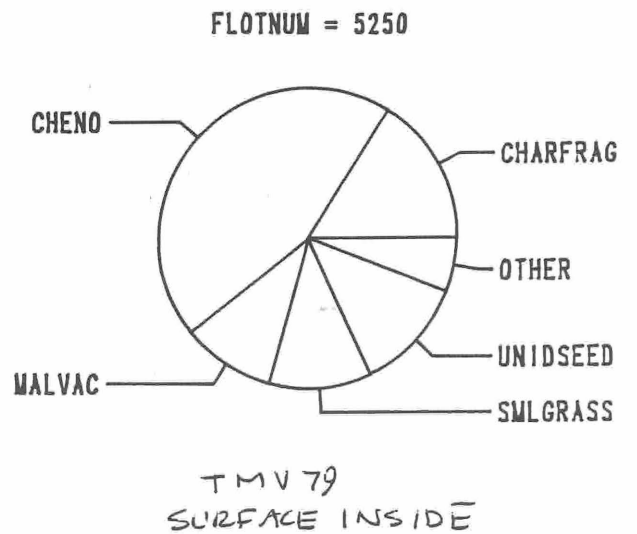
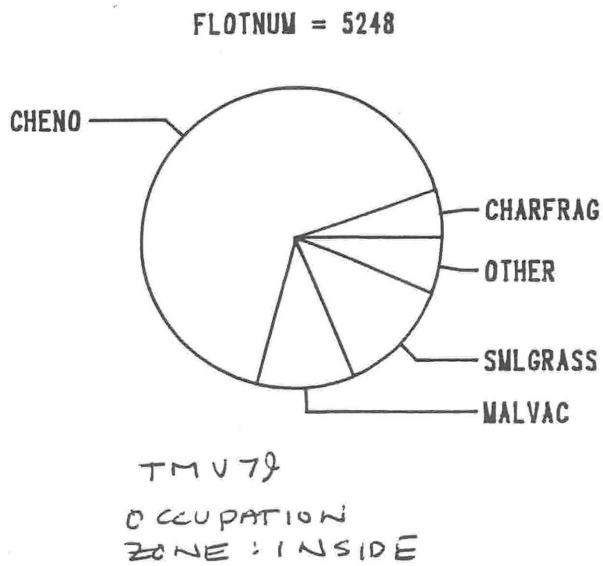
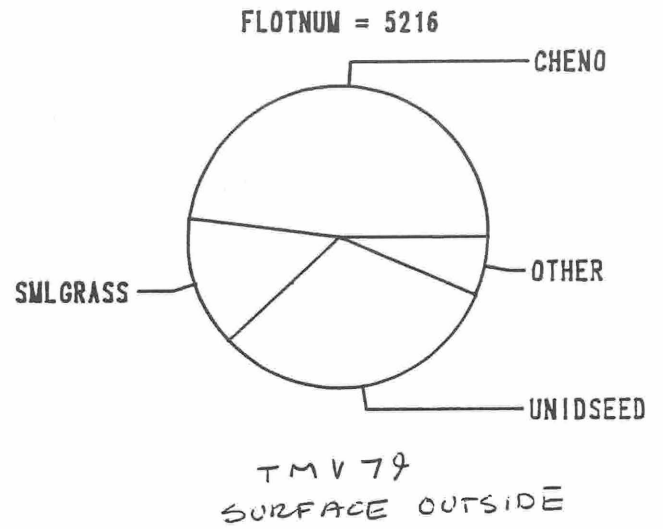
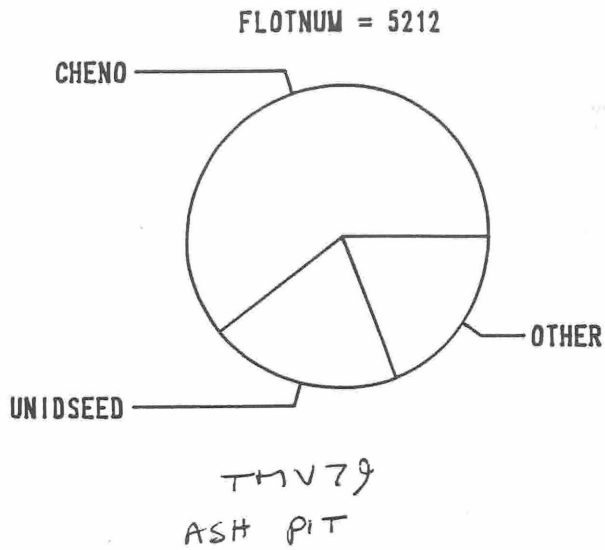


TMV79  
OCCUPATION ZONE

FLOTNUM = 5211

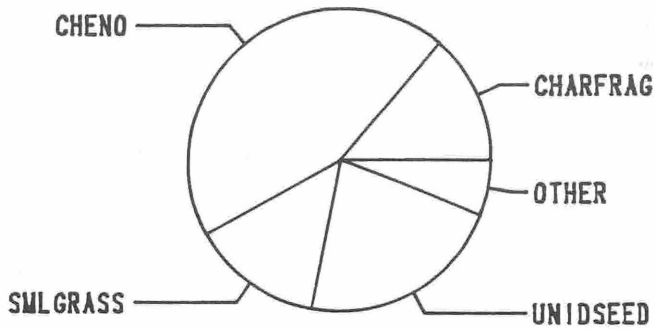


TMV79  
? WALL SLUMP



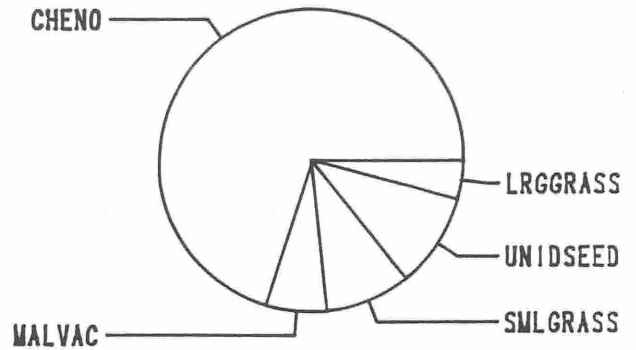


FLOTNUM = 5255



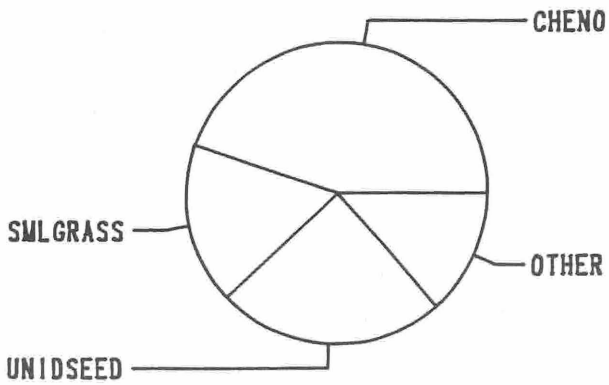
TMV 79  
OCCUPATION  
ZONE

FLOTNUM = 5290



TMV 79  
ASH PIT

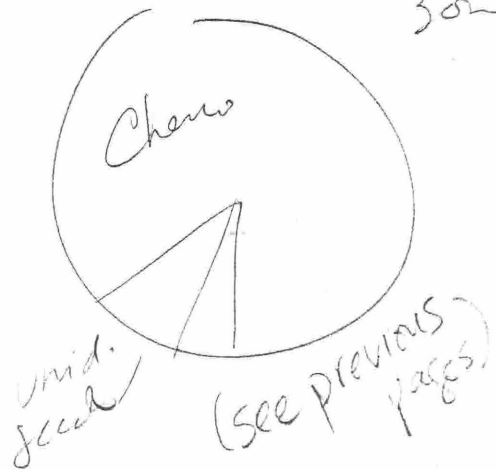
FLOTNUM = 5332



TMV 79  
CULTURAL FILL

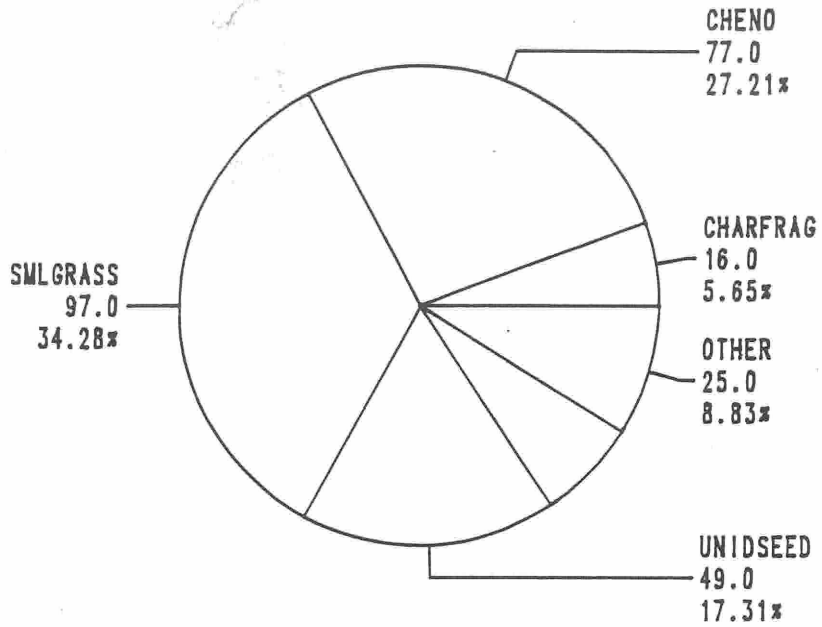
5336

MISSING OCC  
ZONE



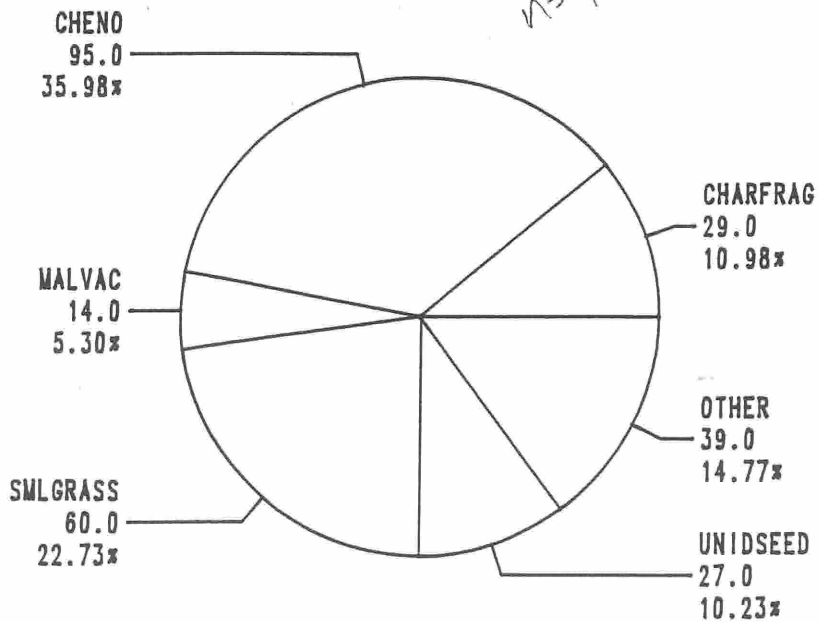
TMU558

INSIDE  
CONTEXT = OCCUPATION *n=3*



CONTEXT = PIT

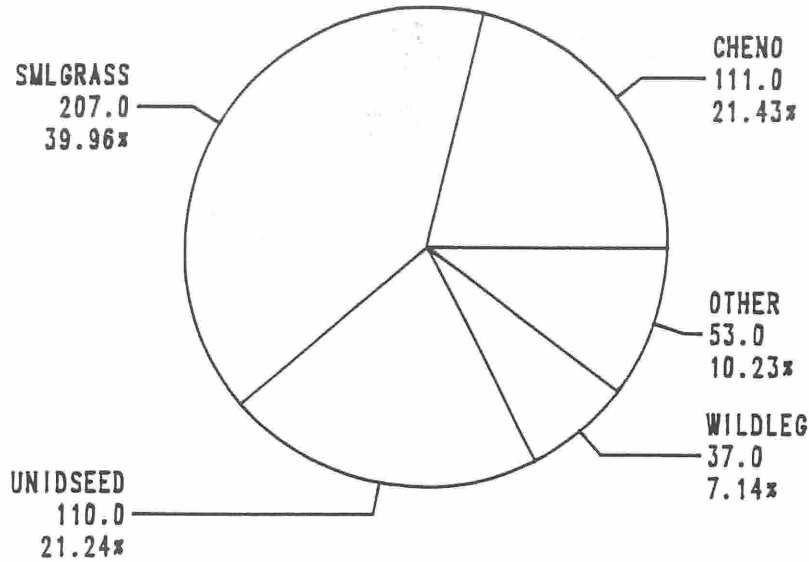
*n=4*



TMV 558

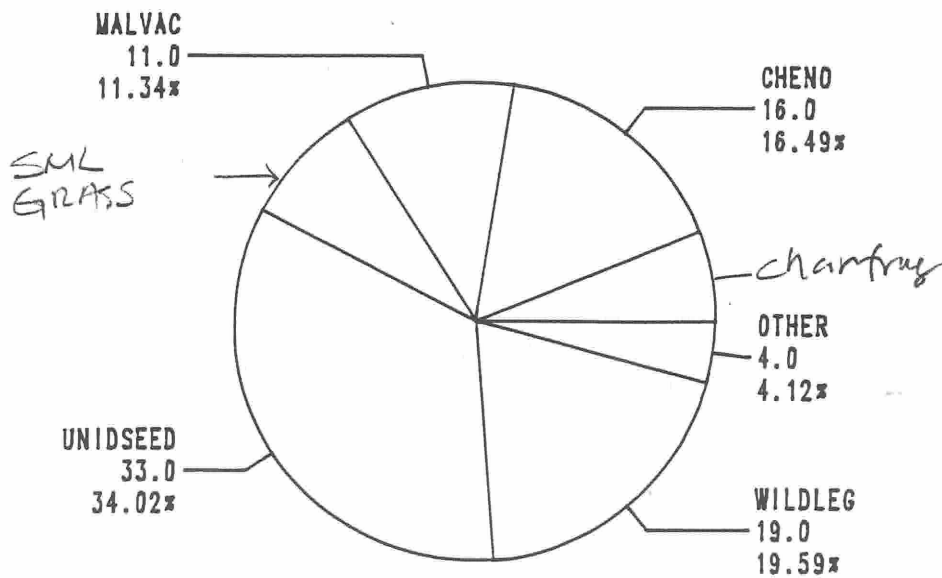
CONTEXT = FILL

n=2



CONTEXT = HEARTH

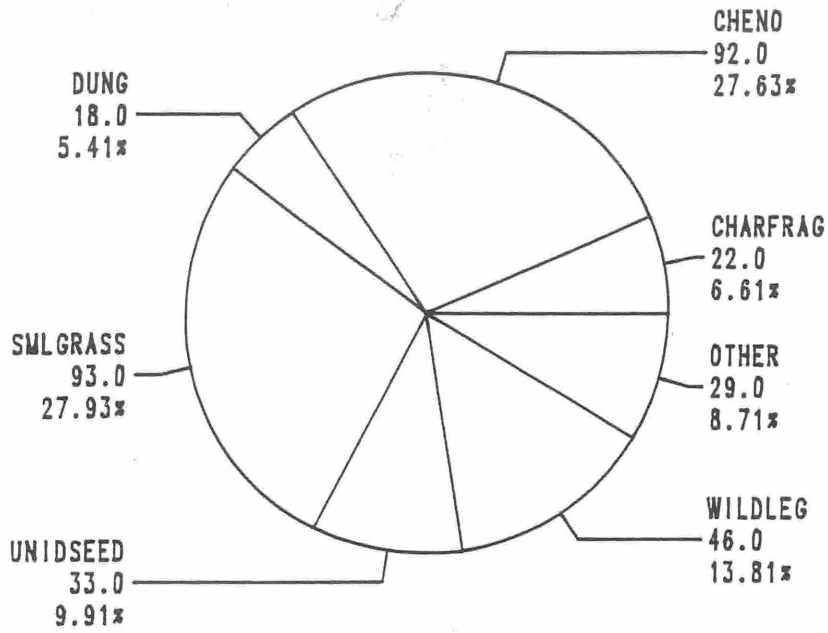
n=1



TNV 55%

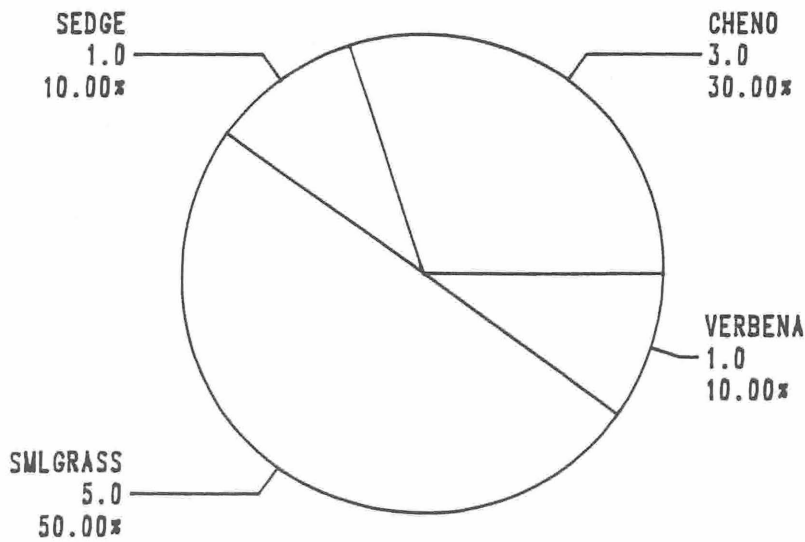
CONTEXT = BURIAL

n=1



CONTEXT = CANAL

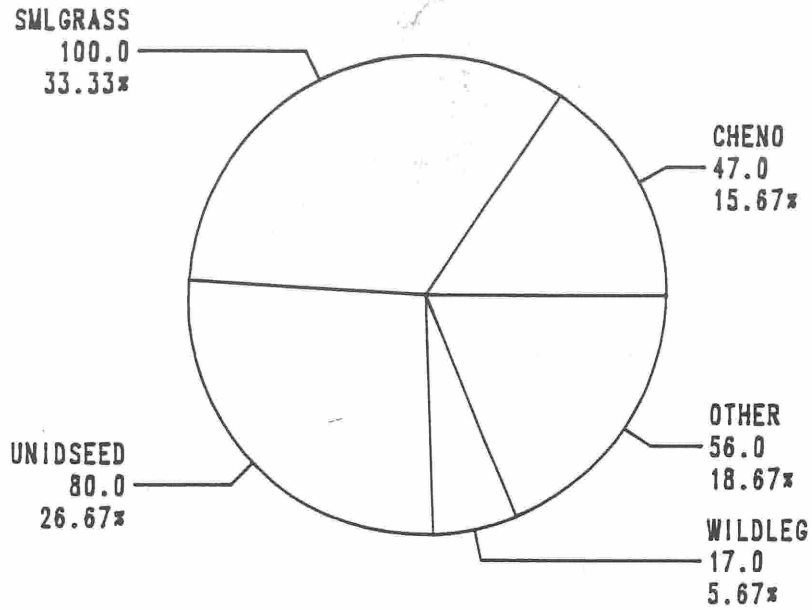
n=1

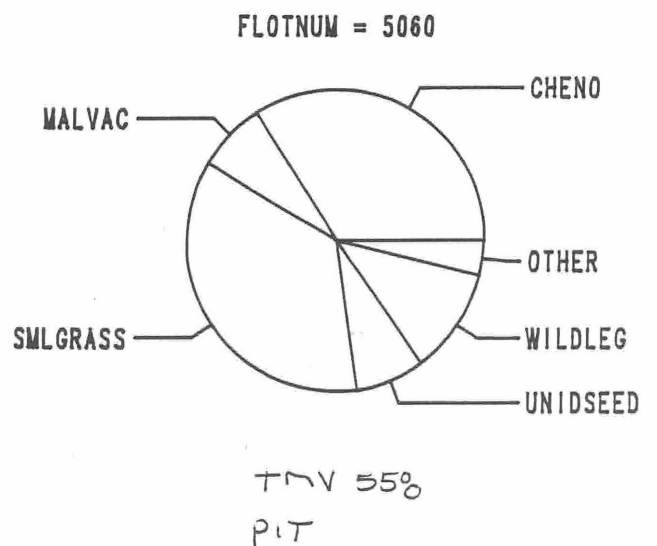
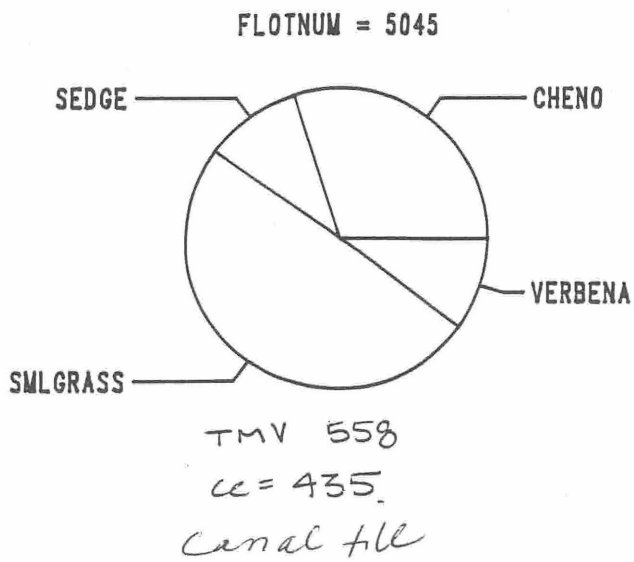
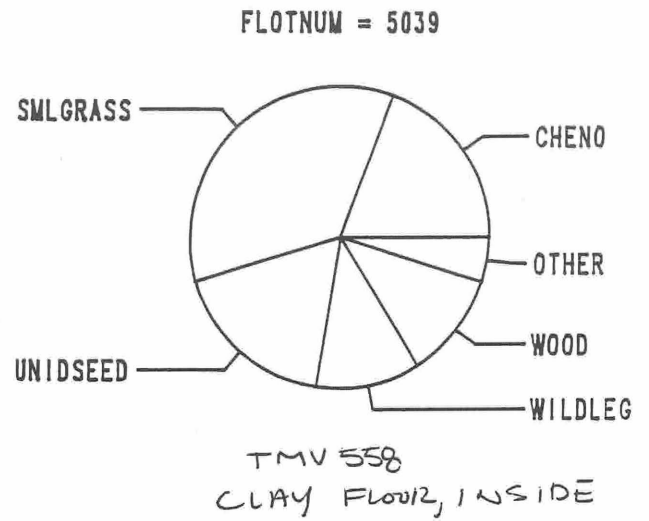
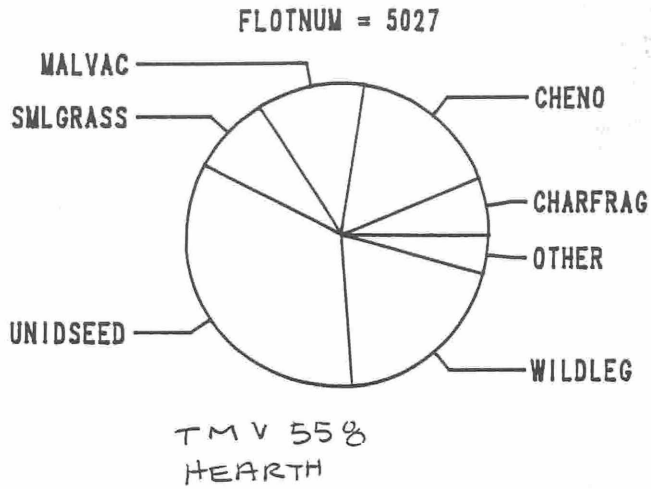


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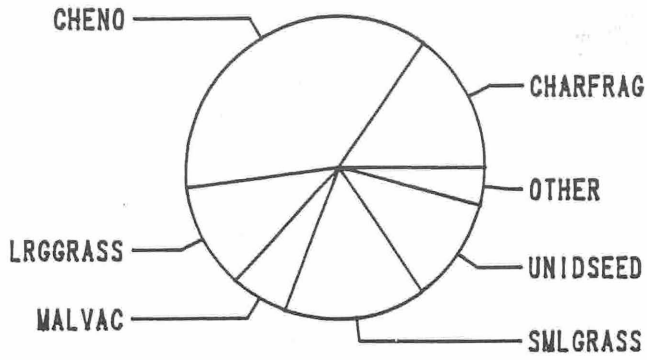
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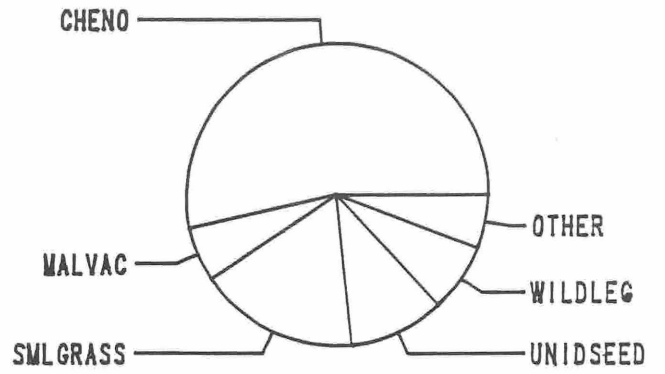


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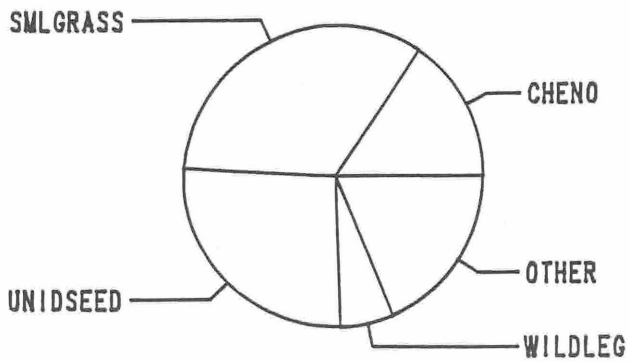
TMV 558  
PIT

FLOTNUM = 5013



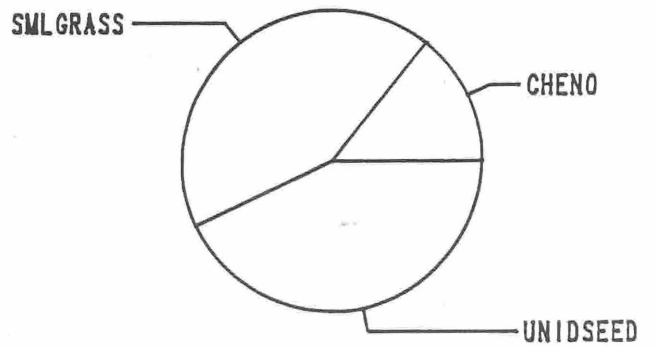
TMV 558  
PIT

FLOTNUM = 5019

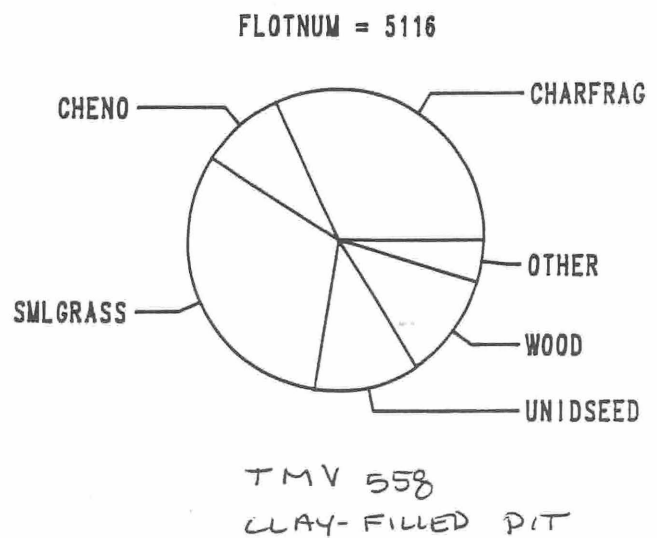
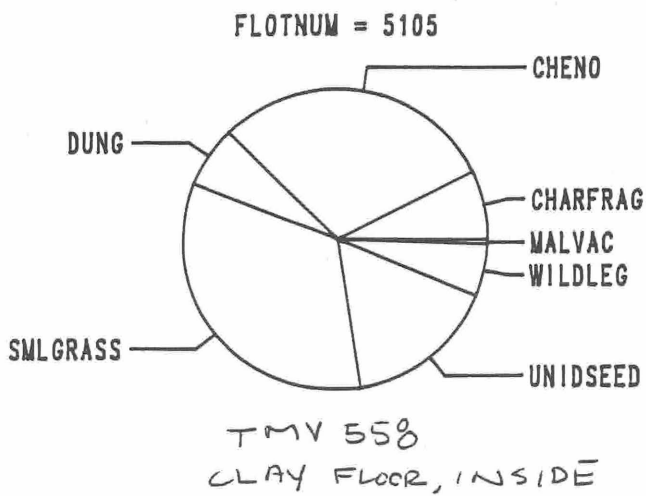
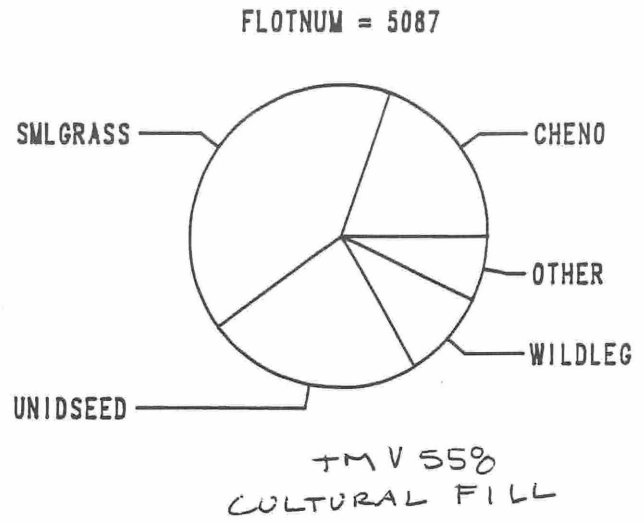
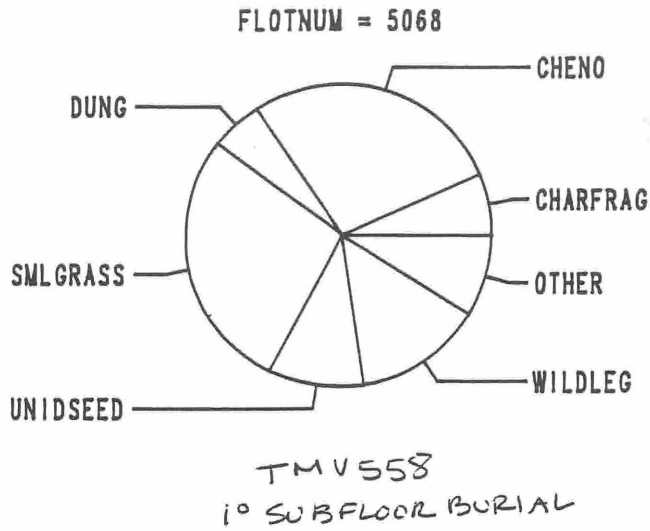


TMV 558  
MIDDEN-FILLED PIT

FLOTNUM = 5025



TMV 558  
SURFACE INSIDE  
STRUCTURE





## INTERPRETATION OF MIDDLE TIWANAKU VALLEY SURVEY SITES

As noted in the introduction, the size of the samples from these sites was unequal, 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 middle valley sites was sufficient to instill confidence in the quantification of the samples. Mean numbers of charred items per sample for the two sites was 609 (mean density ca. 150 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. Mean numbers of items per sample from the lower valley sites are substantially less, due to the use of small collection bags for flots. It appears that the occupation intensity at these rural lower valley sites may have been less than in some of the core urban areas. We suggest 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 a shorter period of time.

TMV 79 (Formative period)

The samples from this site are fairly low in density of charred plant remains, and like many of the other sites, are dominated by *Chenopodium* and small grass seeds. Domesticated plants are rare, except for extremely high proportions of small *Chenopodium*. This pattern is similar to that discovered at the lower valley site of Allkamari, which also dates to the Formative period. Material that may have been used as fuel, such as grass, wood, and dung are also at low densities at this site, again hinting at low occupation intensity.

Examination of the botanical remains from the different contexts at TMV 79 demonstrate that the dense *Chenopodium* remains are not in all areas, but are primarily from the occupation debris and the trash pits. The hearth and fill contain higher proportions of other types of seeds, including Mallow (Malvaceae), Unknown 265, and unidentifiable wild seeds. More detailed analysis of the occupation zone and the trash pits shows that the dense *Chenopodium* is actually from a single location (see flots 5336 and 5208 in N506 E504). A comparison of the three samples from this unit suggest that the *Chenopodium* was probably put into the trash pit intentionally, and that it contaminated the occupational debris above. On the other hand, the fill below (flot 5216) does not appear to have been affected by the *Chenopodium*-dumping activity..

The other occupation zone and trash pit samples, when considered without the two dense samples (flots 5336 and 5208) have more diverse remains, with smaller proportions of *Chenopodium* and higher amounts of wild plants such as mallow (Malvaceae) and small grasses.

An examination of occupation areas inside structures as opposed to those outside demonstrates that they are somewhat similar, though the debris inside is more diverse, and the area outside shows more unidentifiable seeds, possibly due to trampling, or exposure to the elements.

The hearth and fill samples look similar to the other areas of the site, though the densities of material are lower. It may be that this material moved into these areas from denser areas of the site by post-occupational activities, and that their presence in these contexts does not relate directly to the activities that produced them.

TMV 558 (Tiwanaku IV/V)

Like most of the other Tiwanaku area sites, the samples from TMV 558 are dominated by small grasses, and especially, *Chenopodium*. Large *Chenopodium* is more common in this later site than TMV 79. This site also had one sample that contained maize. These data may suggest that these crops were more available during this later phase. Small *Chenopodium* is at a fair to low density compared to other contemporary areas of the site of Tiwanaku that are closer to the Akapana mound. In comparison to TMV 79, possible fuel remains, such as wood, grass, and dung are more plentiful, but still less than in urban contexts. Tubers were not recovered from any of the samples.

In this site there is some similarity between the different contexts. Most of them are fairly diverse in content. The hearth, fill, pit and trash pit have relative proportions of taxa that are similar, as are the densities of materials. One exception is fill from the canal, which is almost empty. This is as expected, as it is not a habitation area. The burial from this site, like others in the region, seems to suggest that that bodies were commonly buried in areas that were middens. Very often the burial samples contain not only dense plant remains but dung as well.

The sample from the pit (not labelled trash/ash pit) looks fairly similar to the trash pit sample, and may also have been filled with garbage.

Individual samples demonstrate the wide range of diversity from the site, suggesting that single groups of contexts contain the remains of a diverse range of activities, and that specialized activity areas (at least for plants) are rare in the samples we analyzed.

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.

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  
CUSDUNG = 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



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          S          C C L S S L P M M C
          P U U F F O U R S S L P M M C
          C E N N L L 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 T T P H T C C H L C C D R B T A L C U E I K A R K
D I D V M A A S N V I A Y O A E U E E L P E A C B E B R F 2 M E 2 C
B N T R E E D D G U 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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20 3763 TMV 79 219 N506 E502 4 5212 2.3 0.06 FORM 101 415 1 1 53 4 4 2 1 . . . . 2 . . . . . 2
21 3766 TMV 79 400 N506 E502 7 5338 2.6 0.01 FORM 101 423 1 . 38 25 9 4 1 . . . . 6 . . . . . 2
22 3753 TMV 79 11 505 N506 E502 5290 6.3 0.17 FORM 101 415 1 20 450 . 60 28 . . . . 43 . . . . . 2
23 3764 TMV 79 6 293 N506 E502 5248 6.3 0.01 FORM 101 311 1 2 150 12 29 4 3 . . . . 24 . . . . . 1 . 2
24 3754 TMV 79 9 416 N506 E502 5250 5.7 0.12 FORM 101 301 1 . 130 47 33 11 . . . . 29 . . . . . 2
25 3761 TMV 79 217 N506 E504 3 5208 2.3 0.30 FORM 101 415 1 5 8000 38 16 16 . . . . . . . . . . 2
26 3757 TMV 79 5 144 N506 E504 5336 6.3 0.37 FORM 101 310 1 17 3600 96 60 13 . . . . . . . . . . 2
27 3765 TMV 79 6 264 N506 E504 5216 5.7 0.01 FORM 101 302 1 2 150 1 44 3 . . . . 13 . . . . . 2

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M A C L C N S C D O L P T U T L T P S
O M O A A S I I Z Z A O P E S O R N W L C W R E O B
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 A 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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20 . . . . . 2 . . . . . 1 . . . . . 3 . . . . . 4 18 . 1 0.01 . . . . . 1 1 S 90
21 . . . . . 8 . . . . . 3 . . . . . 4 12 . . . . . 1 1 S 90
22 . . . . . . . . . . 3 . . . . . 4 67 . . . . . 1 1 S 90
23 . . . . . . . . . . 3 . . . . . 4 1 . 5 0.05 . . . . . 1 1 S 90
24 . . . . . . . . . . 3 . . . . . 4 35 . 6 0.04 . . . . . 1 1 S 90
25 . . . . . . . . . . 3 . . . . . 4 16 1 9 0.08 . . . . . 2 1 M 90
26 . . . . . 3 . . . . . 3 . . . . . 4 360 . 7 0.05 . . . . 21 . . . . . 2 1 M 90
27 . . . . . . . . . . 3 . . . . . 4 100 . 1 0.01 . . . . 1 . . . . 1 . 1 S 90

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NOTE: THE PROCEDURE PRINT USED 0.11 SECONDS AND 84K AND PRINTED PAGES 1 TO 2.

NOTE: SAS INSTITUTE INC.  
 SAS CIRCLE  
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 CARY, N.C. 27512-8000

APPROXIMATE ACCUMULATED JOB COST, AT NORMAL UNIVERSITY RATES  
 CPU CHARGES @ \$72.50 PER MINUTE..... \$0.84  
 TAPE AND DISK IO CHARGES @ \$0.84 PER 1000 IO'S..... \$0.53  
 CARDS READ @ \$1.00 PER 1000 CARDS..... NA\*  
 LINES PRINTED @ \$0.75 PER 1000 LINES..... NA\*  
 CARDS PUNCHED @ \$8.00 PER 1000 CARDS..... NA\*  
 TOTAL COST ..... \$1.37  
 \* THESE RESOURCES ARE CHARGED, BUT THE VALUES ARE NOT  
 AVAILABLE AT THIS TIME

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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