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INFORME: AKAPANA EAST TWO

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Introduction

The strategy selected for our first phase of paleoethnobotanical analysis of flotation samples from Tiwanaku has been 1) to analyze at least some samples from all areas, 2) to focus on domestic areas of the site, and 3) to work only with samples where information concerning cultural contexts, field notes, etc., were available. The samples selected from those excavated during 1990 in the second domestic area east of the Akapana mound (AKE2) were analyzed during academic year 1990/91.

In the 1990/91 analysis, when contextual information was available to us for at least some of the samples, the lab plan was to sort approximately 30-40% of all samples from usable contexts (ie not mixed, disturbed, or undocumented). Aside from incomplete documentation, a serious problem for the samples from this area, our major limitation in 1990/91 was the lack of the botanical portion of the heavy fractions due to the untimely cessation of heavy fraction sorting at the end of the 1990 field season. Of the samples excavated from AKE2 in 1990, only 59 samples had notes, heavy fractions, and light fractions, although we had floated 92 samples from AKE2 during the 1990 field season. Of these 59, we selected 27 samples for analysis, a slightly higher percentage (46%) than average because of our particular interest in well-documented domestic areas. Samples were selected so that our subsample reflected the contextual range of the excavation area, and that some of each context type would be analyzed (ie a stratified random sample, stratified by cultural context).

Sample sizes for the 1990 AKE2 samples ranged from 5.0 to 8.0 liters with a mean of 7.3 liters and a median value of 7.2 liters. The target value for a "full" sample in 1990 was 8.0 liters, making these samples among the better with regard to taking a standard full bag size from the excavations that year. This generally large and consistent bag size means that a wider variety of comparative descriptive statistics, such as ubiquity and diversity measures, can be used without fear of unreliable results due to the high correlation of these statistics with bag size.

Methods

Field methods

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

and analyzed. In 1989 and 1990 we used brass cloth in the bottom of the inner bucket, with an aperture of 0.5mm.

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

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

Laboratory methods

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

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

Information was transferred from the data sheets into data files on floppy disks that were then loaded onto the mainframe computer. The mainframe used is an IBM 4381 available at the University of Minnesota's St. Paul computer center. Data analysis was carried out using the SAS statistical package (SAS Institute 1985a; 1985b; 1985c; 1985d). This system was chosen for several reasons. First, it had the capability of managing a very large dataset, and provided the types of summary, parametric, and non-parametric statistics which were of interest. Also, it had an attached graphics package that allowed the plotting of publication quality graphics, without having to transfer data to another system.

Sorting strategies for archaeobotanical material in the lab

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

Below are sorting schemes devised especially for flotation samples, where the study of domesticates is the main focus. Strategies 1, 2, 5 and 6 were used with the 1990 AKE2 materials.

Strategy 1: Complete sort

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

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

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

Strategy 2: Sample splitting

In this strategy time is saved by splitting (by weight) some or all of the sample. It is usually done to one of the smaller fractions separated by the geologic sieves, eg, 100% of the material that is >2mm is sorted, while 50% of all material <2mm is sorted and all counts of the identified specimens are doubled. The decision to split a sample should be based on the following guidelines. The average amount of time spent on a sample is about 2 1/2 hours,

including sorting and identifying light and heavy fractions, as well as material recovered from the sieves in the field. The two main factors that are considered are both the volume of the charred sample, and the density of the seeds. The desired amount of material to be sorted from each size fraction of the sample is enough to fill one of the sorting trays (in a thin layer, as when ready for sorting). If a brief scan of even this amount appears to contain hundreds of seeds, it should be split again. A rule of thumb that has proven effective for the 1986 Pancán (Peru) material was never to let the sorted portion fall below 1.0g or 12.5% (Lennstrom 1991a). In these samples it was found that this was approximately the point of diminishing returns for very dense samples such as those from burnt stores of crops, where seeds and tuber densities per 6-liter of soil averaged in the thousands. That is, if at least these 12.5% or 1.0g of each size fraction was sorted the estimates of total densities and taxa diversity were found to be insignificantly different than if the whole sample had 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 overrepresented.

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

Strategy 5: Complete sort >0.5 mm

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

Tests with the Bolivian material showed that the percentage of differing small taxa are not at all the same from sample to sample, so there is unfortunately no systematic way of calculating the amount of material that will be missed by not

sorting material between 0.5 and 0.3 mm. At least there did not seem to be taxa that would be completely missed, except sometimes UNK 264 and 190. Taxa that are most likely to lose a substantial number of seeds in the final tally include are Small Poaceae, *Nicotiana*, and *Juncus*.

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

Strategy 6: Sample splitting, sorting only >0.5mm

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

Quantification of Samples from AKE

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

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

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

LIST OF PLANT TAXA:

Plant remains from the Wila Jawira botanical samples were commonly identified to the family level, and sometimes to genus. When referring to plants by scientific names authorities (initials) are usually cited when the taxon is first mentioned in the text. For example *Zea mays* L. indicates that Linnaeus named the species (for complete list see appendix) Genera (eg: *Chenopodium*) are always capitalized, and underlined, or italicized. The second part of the species name is also put in italics, or underlined, but is always lower case (*Chenopodium quinoa*). The addition of "spp." following the genus name indicates that it might be represent by one or more species, but we cannot determine which one(s). When two species from the same genus are referred to in succession the genus is usually abbreviated to a single letter for the second species.

Large (>1.18mm) *Chenopodium* spp. (seeds) Probably domesticates: either quinoa (*Chenopodium quinoa*) or cañiwa (*C. pallidicaule*). Food source.

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

Lumps (Unidentifiable charred plant fragments, in this case especially, they might be tubers or other fragments of domesticates.) Possible food source.

Small Poaceae (seeds) Grass family. Possibly used as fodder, fuel, or in construction, or present in dung burned as fuel

Medium Poaceae (seeds) Grass Family. Possibly used as fodder, fuel, or in construction
Large Poaceae (seeds) Grass Family, likely *Stipa* spp. or *Festuca* spp. Possibly used as fodder, fuel, or in construction.
Wild Leguminosae (seeds) Fabaceae-Bean family. Common weed, possible fodder, or present in dung burned as fuel.
Verbena spp. (seeds). Common weed.
Malvaceae (seeds) Mallow family. Common weed.
Relbunium spp. (seeds) A plant used in S. America for red dye.
Rubus spp. (seeds) Some types could have been used as a casual food source, or as medicines.
Cyperaceae (seeds) Sedge family, often associated with wetlands. Many industrial purposes: mats, boats, roofing, etc.
Cruciferae (seeds) Mustard family. Weeds, sometimes eaten as greens.
Unknown 224 (seeds) Possibly a mint family.
Potamogetonaceae (seeds) Pond weed family, associated with freshwater ponds, bogs and marshes.
Cereus spp. a type of cactus. Also possibly present in dung burned as fuel.
Unknown 264 (seeds)
Amaranthus spp. (seeds) Usually a weedy annual; found in disturbed habitats, possible casual food source.
Unknown 270 (seeds)
Unknown 242 (seeds)
Unknown 265 (seeds)
Kaiña (seeds) This is an Aymara name, scientific name unknown.
Nicotiana spp. (seeds) These are likely of a type of tobacco which grows wild/feral in the area today, though we cannot distinguish them from more tropical domesticated species at this time.
Zea mays (maize) kernels
Zea mays cob fragments
Domesticated legume (bean).
Solonaceae (seeds) Nightshade or Potato family.
Unknown 202 (seeds) Possibly Borage family (Boraginaceae)
Unidentifiable seeds
Tubers, (food) probably domesticated species, such as the potato
Wood and twig fragments-Fuel, construction, tools.
Wira Koa leaves - Aymara name, scientific name unknown. This herb is often burned as an offering to Pachamama today.
Leaves-Type unknown.
Dung-Fertilizer and/or fuel.

QUANTIFICATIONS

All samples together n=27

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

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0.87	0.02	1.16	23.90	<0.01

Ubiquity of crop plants (# of samples containing taxon)

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
41%	7%	96%	100%	4%
(11)	(2)	(26)	(27)	(1)

Samples by Cultural Context

Context= Fill (n=14)

Average density of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0.11	0.05	0.97	16.97	0.00

Ubiquity of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
43%	14%	100%	100%	0%
(6)	(2)	(7)	(7)	

Context= Midden (n=2)

Average density of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0.00	0.00	0.29	16.43	0.00

Ubiquity of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0%	0%	100%	100%	0%
		(2)	(2)	

Context= Occupation (n=3)

Average density of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0.14	0.00	1.24	21.71	0.00

Ubiquity of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
33%	0%	100%	100%	0%
(1)		(3)	(3)	

Context= Rooffall (n=1)

Average density of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0.00	0.00	0.80	24.00	0.00

Ubiquity of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
0%	0%	100%	100%	0%
		(1)	(1)	

Context= Trash pit (n=7)

Average density of crop plants

Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
3.08	0.00	1.81	40.80	0.02

Ubiquity of crop plants

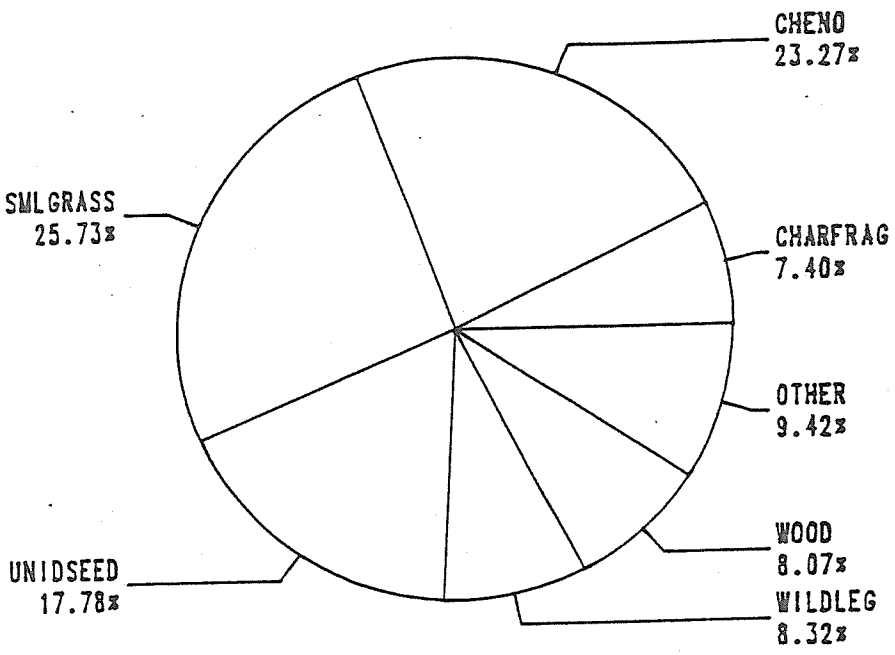
Maize	Tubers	Large *Chenopodium*	Small *Chenopodium*	Domesticated Legumes
57%	0%	86%	100%	14%
(4)		(6)	(7)	(1)

*****

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

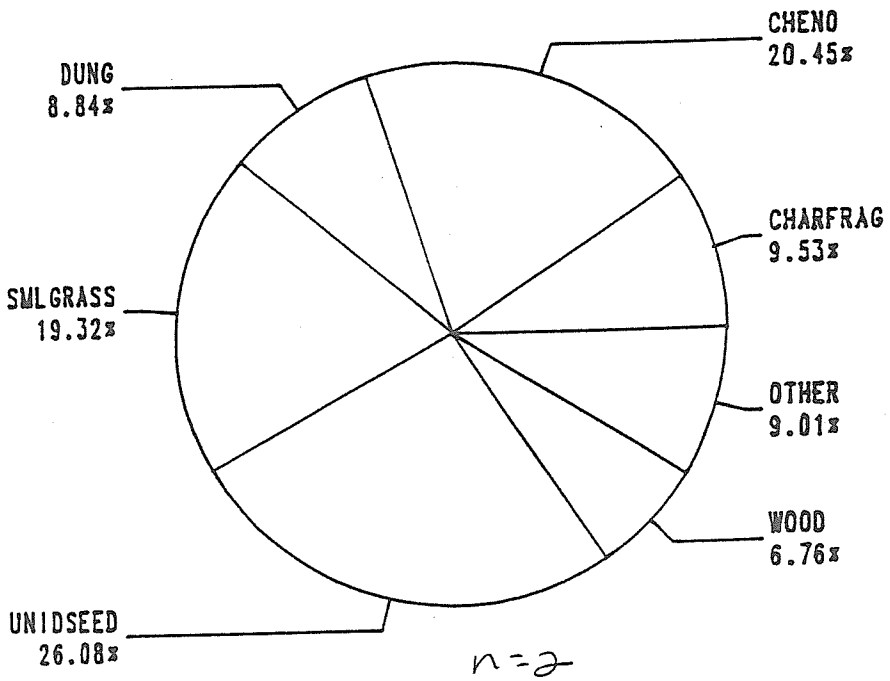
AKE-2 1990

CONTEXT = FILL



n=14

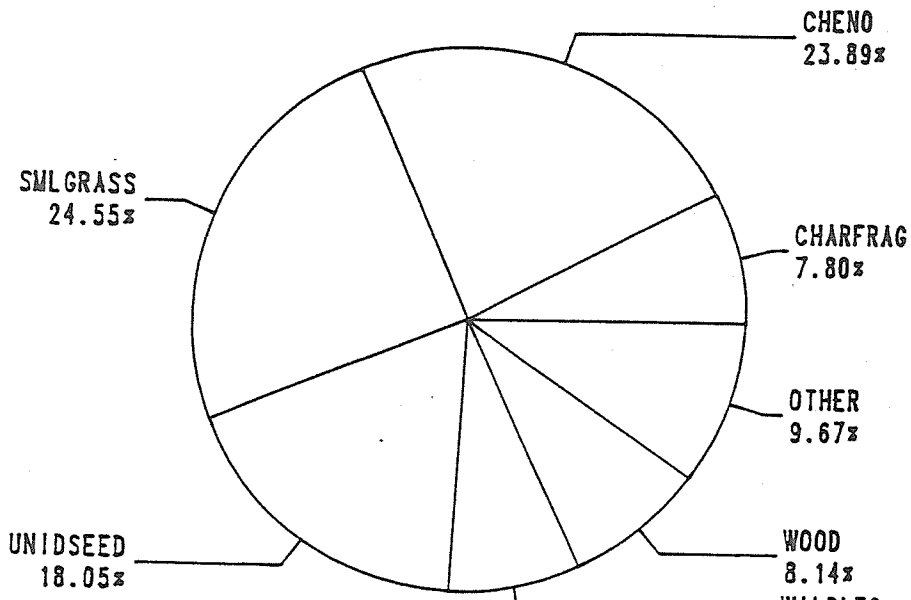
CONTEXT = MIDDEN



n=2

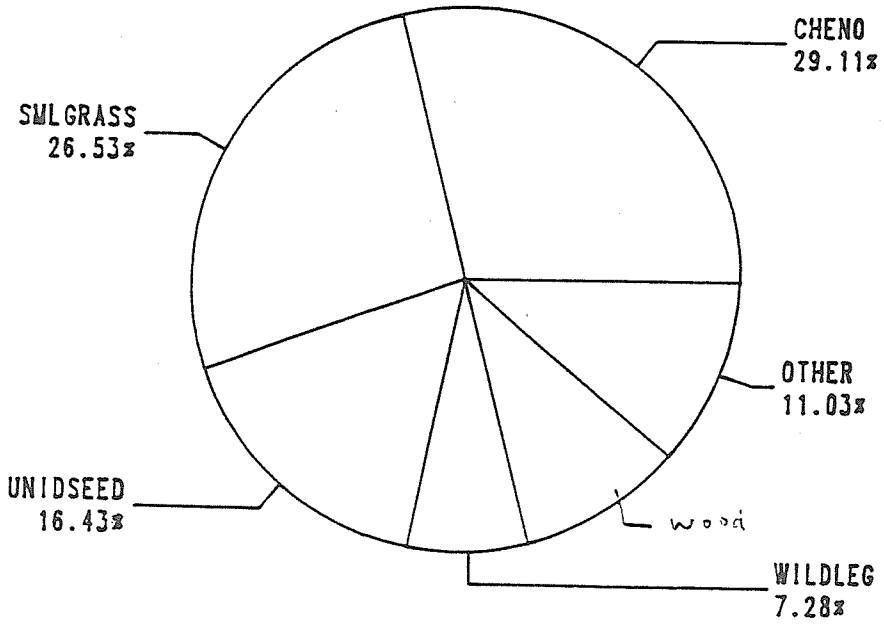
JKE-2 1990

CONTEXT = OCCUPATION



n=3

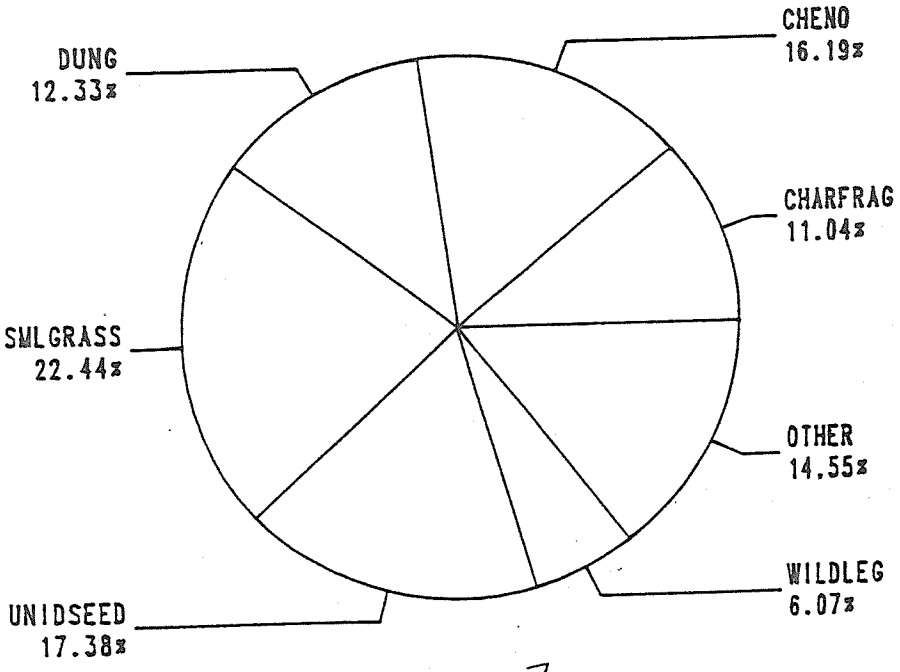
CONTEXT = ROOFFALL



n=1

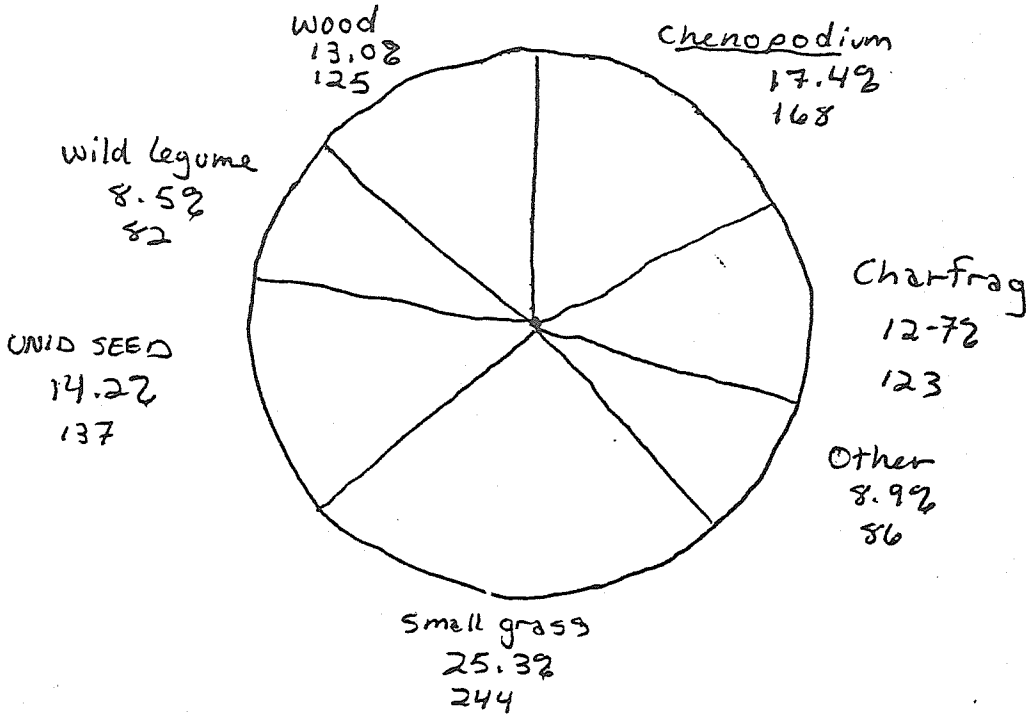
HKE-2 1110

CONTEXT = TRASHPIT

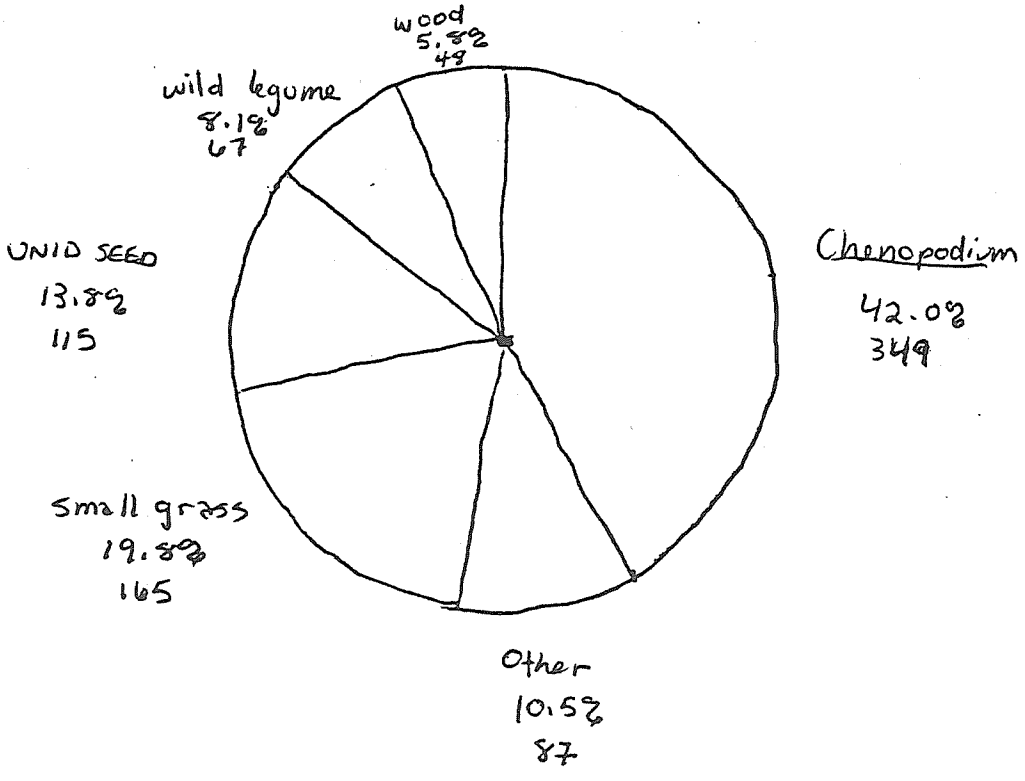


n = 7

CONTEXT = INSIDE n=2



CONTEXT = OUTSIDE N=1



INTERPRETATION OF AKAPANA EAST TWO PLANT REMAINS

When comparing the samples from AKE2 to those from the other excavation areas at Tiwanaku, we have assumed that AKE2, Kk'araña, Chiji Jawira, and AKE 1989 samples are all more or less comparable in date, while the stratigraphically deeper AKE 1990 samples are somewhat earlier than the others. In terms of crop and fuel density, the AKE2 samples seem to fall in between the samples from Kk'araña and those from the 1990 excavations at AKE, with the notable exceptions of high maize and grass values, which are higher at AKE2 than at either. This finding makes sense, since the AKE2 excavation area is located further from the ceremonial core than AKE (on the other side of the canal-like depression) but not as far out as Kk'araña. The difference in maize density (0.87 for AKE2, 0.39 for AKE 1990, and 0.25 for Kk'araña) is striking, particularly since the differences in maize ubiquities are far less significant (41% for AKE2, 48% for AKE 1990, and 34% for Kk'araña). AKE2 has substantially less dense and less ubiquitous tuber remains than earlier/deeper AKE 1990 samples; in this they are more like the Kk'araña or AKE 1989 samples, which are comparable to AKE2 in date. Although the density is low, the AKE2 samples have the highest ubiquity of domestic legume remains of any excavation area at Tiwanaku. This figure is misleading, however, since it represents domestic legumes in only one sample -- the high ubiquity value is a function of the small number of samples.

The probable fuel remains (wood, grass and dung) at AKE2 are comparable in density to the AKE 1989 samples, with the exception of grass which is denser at AKE2. The relatively low density of dung (average of 9.86 fragments per liter of soil matrix) makes the AKE2 samples more similar to the same period samples from AKE 1989 (8.86) rather than the deeper, earlier AKE 1990 samples, where dung was far denser (33.06). This trend may represent a decrease in the importance of dung as a domestic fuel source in the later period (upper strata), or at least a change in its deposition, since the density of dung remains at the later period Chiji Jawira samples (Chiji Jawira is not a domestic area) are strikingly high as well (87.75). The fuel remains at AKE2 are, however, more ubiquitous than at the other domestic areas (AKE 1988/89/90 and Kk'araña). In terms of ubiquity, the AKE2 fuel remains most closely resemble Chiji Jawira, which we have interpreted as in part a large garbage dump. This would seem to indicate the residents of AKE2 were less "neat", or deposited less discretely their fuel remains than those at the other domestic areas at Tiwanaku.

In looking at the samples by cultural context, we find that, like the other domestic areas at Tiwanaku, the densest contexts overall are the trash pits. The next most dense context at AKE2 is occupation, followed by fill, and midden being even less dense. This is in contrast to the samples from Kk'araña, where the midden deposits are denser than fill. This may represent an inconsistency in the labeling of cultural contexts between different excavators. (Query to Chris Begley : how did you differentiate fill from midden?)

At AKE2, fill and occupation are quite strikingly similar in their relative percentages, and different from midden. In terms of crop remains, the occupation contexts appear to have a little more food than the fill, with the exception of tubers. The midden contexts appear more diverse without a clear domination by any one taxon. There are more unidentifiable seeds in the midden contexts, perhaps representing more trampling or disturbance. The rooffall context is similar in relative percentages to the fill and occupation contexts, though with fewer unidentified lumps (charfrags).

The trashpit context has by far the highest density of maize on the entire site (3.08 fragments per liter). This figure is somewhat misleading, because it is skewed by the extremely high density of one sample, a sort of "cache" of maize cob fragments from one pit. When this sample is removed from the analysis, the maize density drops to 0.37. While still significantly denser than the other cultural contexts within AKE2, it is not strikingly more than the maize densities at the other excavation areas within Tiwanaku (AKE89 = 0.31, AKE90 = 0.39, Kk'arańa = 0.25). The trashpits at AKE2, like those at the other domestic areas, contain the densest food remains, with the exception of tubers, which appear at AKE2 only in the fill samples. The fuel remains are also extremely dense in the trashpits, perhaps representing the remains of repeated hearth cleanings.

The single sample with the cache of cob fragments has a similarly skewing effect on the kernel:cob ratio for AKE2. With this sample included, the ratio is 0.2 : 1, which would indicate that the maize is entering the site still on the cob. Without the sample with the cache of cob fragments, the ratio is 2.56 : 1, a figure comparable to the samples from AKE 1988/89, and one we interpret to indicate that maize is entering the site in a more processed state at this time, off the cob. This may represent a higher dependence on acquisition of processed foodstuffs, as opposed to self-sufficient production or procurement on the cob. What this cache of cob fragments might represent is unclear, but the figures from the rest of AKE2 would indicate that corn cobs are not a major fuel source.

A comparison of inside occupation samples versus outside shows less striking differences at AKE2 than at other excavation areas where such an inside/outside comparison was possible. At AKE2, there is more *Chenopodium* outside, with a lower relative percentage of charfrags and wood, but otherwise inside and outside are quite comparable. Although the number of samples is too small to draw any firm conclusions, it appears that similar activities are happening inside and out, with the possible exception of quinoa/cańiwa processing, which appears to be an outside of walled structure activity.

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EASTO DATA SET

IDNO	SITE	CUADRA	NIVEL	SPECIMEN	UNIDAD1	UNIDAD2	RASGO	FLOTNUM	FLOTVOL	LFPICK	COLLTYPE	CULTCONT	CARD	LRGCHENO	SMLCHENO	LUMP	SPOACEAE	LPOACEAE	WILDLEG	SCIRPUS	VERBENA	PLANTAGO	MALVACEA	RELBUN	MPOACEAE	RUBUS	CYPERAC	CRUCIFER	UNK224	POTAMOG	CEREUS	UNK264	CRD	MODPOPPY	MODUMBEL	AMARANTH
3846	TIW	AKE2	003	25267	N7940	E5644		5538	7.2	0.49	101	620	1	6	112	32	60	2	31	.	1	.	12	3	.	1	3	.	.	.	.	.	2	.	.	.
3847	TIW	AKE2	003	25084	N7942	E5648		5452	8.0	1.08	101	620	1	7	80	11	38	2	47	.	.	.	8	1	4	.	5	.	.	.	.	.	2	.	.	.
3695	TIW	AKE2	2	23603	N7942	E5652		5165	8.0	0.35	101	620	1	9	110	15	150	1	38	.	2	.	12	2	.	.	8	.	.	.	.	.	2	.	.	2
3696	TIW	AKE2	2	23612	N7942	E5654		5166	6.4	0.11	101	690	1	4	36	5	48	.	6	.	.	.	8	.	.	1	.	.	.	.	.	2	2	.	.	.
3697	TIW	AKE2	2N	23620	N7942	E5654		5172	7.2	0.21	101	627	1	1	87	6	115	1	32	.	.	.	14	1	.	2	3	.	.	.	.	2	2	.	.	.
3780	TIW	AKE2	3	23661	N7942	E5656		5350	8.0	0.58	101	627	1	5	52	7	122	.	30	.	1	.	14	4	.	.	.	.	.	.	.	4	2	.	.	2
3698	TIW	AKE2		23634	N7942	E5656	6	5205	8.0	1.21	101	415	1	15	280	282	440	13	152	.	4	.	24	8	.	4	61	.	.	.	.	12	2	.	.	.
3848	TIW	AKE2	003	23854	N7944	E5652		5244	7.2	1.05	101	342	1	3	55	21	56	2	42	.	.	.	11	1	3	.	1	.	.	.	.	.	2	.	.	.
3699	TIW	AKE2	2	22486	N7944	E5652		5168	8.0	0.57	101	627	1	7	110	51	150	6	.	.	4	.	20	5	.	1	13	.	.	.	2	7	2	.	.	.
3700	TIW	AKE2	2	22359	N7944	E5654		5164	6.4	0.39	101	600	1	10	360	162	232	1	115	.	.	.	24	4	.	.	28	.	.	.	.	8	2	.	.	.
3701	TIW	AKE2	3	22373	N7944	E5654		5311	8.0	2.43	101	627	1	12	200	121	412	.	166	.	4	.	40	4	.	.	24	.	.	.	.	12	2	.	.	8
3703	TIW	AKE2	4E	23689	N7944	E5654		5241	8.0	0.75	101	302	1	14	335	28	165	3	67	.	3	.	26	2	.	3	9	2	.	.	.	3	2	.	.	1
3704	TIW	AKE2	4W	23707	N7944	E5654		5240	5.0	0.45	101	193	1	4	120	14	113	.	31	.	1	.	15	2	.	.	.	.	.	.	1	6	2	.	.	.
3702	TIW	AKE2	3W	22480	N7944	E5656		5170	6.4	0.13	102	627	1	4	112	51	172	4	60	.	.	.	20	8	.	.	8	.	.	.	.	4	2	.	.	.
3705	TIW	AKE2	5	23670	N7944	E5656		5220	8.0	0.87	101	626	1	12	168	105	260	4	20	.	.	.	8	.	.	.	24	.	.	.	.	4	2	.	.	.
3706	TIW	AKE2	3	23909	N7944	E5658		5282	7.2	0.39	101	298	1	3	200	95	184	.	45	.	.	.	16	4	.	.	.	.	.	.	.	8	2	.	.	16
3707	TIW	AKE2	3	23747	N7946	E5650		5341	6.4	0.53	101	342	1	10	100	102	188	4	40	.	4	.	8	4	.	.	12	.	.	.	.	12	2	.	.	.
3709	TIW	AKE2	3	22322	N7946	E5654		5169	6.4	0.28	101	620	1	12	148	6	176	.	13	.	.	.	12	.	.	.	32	4	.	.	.	.	2	.	.	.
3708	TIW	AKE2		22272	N7946	E5654	1	5345	7.2	0.08	101	415	1	.	18	3	33	.	7	.	.	.	5	1	.	.	2	.	.	.	.	1	2	.	.	.

UNK270	UNK242	COMPOSIT	UNK265	LABIATAE	KAINYA	UNK261	JUNCUS	UNK248	CARYOPHL	UNK266	SOLANAC	NICOTIAN	SISYRINC	ZEAKERN	ZEAEMBR	COBCUP	CAPSICUM	DOMLEGUM	CRDNO	POLYGON	OXALIS	UNK202	OENOTHER	LSOLANAC	UNK271	UNK235	PORTULAC	UNK201	TRITHORD	CACTUS	CARDNO
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UNIDSEED	TUBER	WOODCT	WOODWT	TWGBRNCH	STALK	DUNG	LLAMADNG	CUYDUNG	WIRAKOA	LEAVES	TRITRACH	SORTTYPE	FAUNAL	BOXSIZE	YEAR	LRGLUMP	SMLLUMP	PHASE	UNK279	PEDUNCLE
58	2	34	0.33	4	.	3	.	.	1	.	.	5	.	M	90	0	32		.	.
15	.	69	0.92	4	.	1	.	.	.	.	.	5	1	M	90	2	9		.	.
72	.	28	0.25	1	.	.	.	.	.	.	.	1	1	S	90	0	15		.	.
35	.	4	0.04	.	.	.	.	.	.	.	.	1	.	S	90	2	3		.	.
90	.	14	0.11	.	.	.	.	.	.	.	.	1	1	S	90	0	6		.	.
56	.	29	0.41	1	.	.	.	.	.	.	.	1	1	M	90	2	5		.	.
360	.	125	0.90	5	.	147	.	.	.	.	.	2	1	L	90	12	270		.	.
52	.	95	0.95	.	.	13	.	.	.	.	.	5	1	M	90	4	17		.	.
100	.	39	0.35	1	.	6	.	.	.	.	.	1	1	M	90	6	45		.	.
345	.	36	0.25	2	.	31	.	.	.	.	.	2	.	M	90	4	158		.	.
195	.	243	1.73	10	.	9	.	.	.	.	.	2	1	L	90	1	120		.	.
115	.	44	0.44	4	.	.	.	.	.	.	.	1	1	M	90	3	25		.	.
70	.	41	0.41	.	.	5	.	.	.	1	.	1	1	M	90	0	14		.	.
160	.	11	0.09	2	.	1	.	.	.	.	.	2	.	M	90	0	51		.	.
120	3	47	0.77	.	.	114	.	.	.	.	.	2	1	M	90	0	105		.	.
280	.	67	0.33	.	.	101	.	.	.	4	.	2	1	M	90	4	91		.	.
85	.	29	0.47	1	.	.	.	.	.	.	.	2	1	M	90	1	101		.	.
84	.	16	0.19	2	.	3	.	.	.	.	.	2	1	M	90	1	5		.	.
22	.	6	0.01	.	.	.	.	.	.	.	.	1	1	S	90	1	2		.	.

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

20 3710 TIW AKE2 2   23601 N7946 E5656   5173 8.0 1.03 101 412 1  6 112  21  205   .  73 .  4 .  14  4 . 1  5  . 3 3 .  5 2 52 .  .
21 3711 TIW AKE2     23749 N7946 E5656 8 5358 8.0 4.25 101 415 1 45 944 979 1600 43 348 . 32 . 216 40 . . 72 96 . 8 .  . 2  . . 88
22 3849 TIW AKE2 004 29014 N7946 E5658   5543 8.0 0.47 101 627 1  7  77   3   50  .  60 .  1 .   9  . 1 .  1  . . . .  . 2  . .  .
23 3712 TIW AKE2 3   23876 N7946 E5658   5285 8.0 1.12 101 415 1 24 540 215  740 10 190 .  8 .  44 36 . 8 44  . . . . 32 2  . . 12
24 3713 TIW AKE2 6   22269 N7946 E5660   5316 6.3 0.14 101 298 1  1  32  15   39  .   7 .  . .   2  1 . .  .  . . . .  . 2  . .  .
25 3850 TIW AKE2 006 22326 N7946 E5660 2 5162 7.2 0.33 101 412 1  5  50  21   30  .  48 .  . .   8  1 . .  2  . . . .  . 2 45 .  .
26 3714 TIW AKE2 6   22279 N7946 E5660 2 5348 7.2 2.26 101 415 1  5 300  77  200  2  60 .  6 .  17  1 . . 18  1 . . .  . 2  . .  .
27 3851 TIW AKE2 002 25024 N7948 E5652   5354 8.0 0.34 101 627 1  4  63   2   22  .  31 .  . .   4  1 . .  2  . . . .  1 2  . .  .

      C   L             C       N S       C D           O L     P   T          U            T         L      T S                P
      O   A             A     S I I Z Z   A O    P      E S     O   R          N            W         L C W  R O   B      L   S     E
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  N N P   N I A N U N Y N     L O Y A A   O S L C L X N O L N N T N T A A      D T  O  O    B S       M Y R E T T A X      G   L P N U
  K K O   K A I K N K O K     A T R K E   B I E R Y A K T A K K U K H C R      S U  O  O    R T     D A D A A R T U S Y    L   L H K N
O 2 2 S   2 T N 2 C 2 P 2     N I I E M   C C G D G L 2 H N 2 2 L 2 O T D      E B  D  D    N A     U D U K V A Y N I E    U   U A 2 C
B 7 4 I   6 A Y 6 U 4 H 6     A A N R B   U U U N O I O E A 7 3 A O R U N      E E  C  W    C L     N N N O E C P A Z A    M   M S 7 L
S 0 2 T   5 E A 1 S 8 L 6     C N C N R   P M M O N S 2 R C 1 5 C 1 D S O      D R  T  T    H K     G G G A S H E L E R    P   P E 9 E

20  7 . .  4 . . . . . . .  . . . . .    . . . 3 . . . . . . . . . . . . 4   85 .  83 0.90  3 .     . . . . . . . 1 1 M 90  4  17  . .
21 17 . . 43 . 1 . . . . .  32 . . 3 8   1 . . 3 . . . . 1 . . . . . . . 4 1202 . 302 2.79 17 . 1117 . . . 8 . 2 1 L 90 29 950  . .
22  . 1 .  . . . . . . . .  . . . . .    . . . 3 . . . . . . . . . . . . 4   45 .  37 0.38  4 .     2 . . . . . 5 . L 90  0   3  . .
23 12 8 .  3 . 1 . . . . .  . . . . 1    . . 1 3 . . . . . . . . . . . . 4  702 .  91 0.98  3 .   252 . . . 4 . 2 1 L 90 15 200  . .
24  . . .  . . . . . . . .  . . . . .    . . . 3 . . . . . . . . . . . . 4   21 .  11 0.10  1 .     1 . . . . . 1 1 S 90  0  15  . .
25  . . .  1 . . . . . . .  . . . . .    . . . 3 . . . . . . . . . . . . 4   55 .   8 0.18  . .     6 . . . . . 5 . S 90  2  19  . .
26  . 2 .  . . 1 . . . . .  . . . . . 140 . . 3 . . 1 . 7 . . . . . . . 4   90 .  60 0.51 60 2   262 . . . 2 . 1 1 M 90  7  70  . .
27  . . .  . . . . . . . .  . . . . .    . . . 3 . . . . . . . . . . . . 4   12 .  22 0.22  2 .     . . . . . . 5 . M 90  2   0  . .
NOTE: THE PROCEDURE PRINT USED 0.11 SECONDS AND 148K AND PRINTED PAGES 1 TO 2.

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      SAS CIRCLE
      PO BOX 8000
      CARY, N.C. 27512-8000

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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
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