THE ORIGINS OF STATE ORGANIZATIONS IN PREHISTORIC HIGHLAND FARS, SOUTHERN IRAN

EXCAVATIONS AT TALL-E BAKUN

by

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with contributions by

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CHAPTER 11

SOME PLANT REMAINS FROM THE 2004 EXCAVATIONS OF TALL-E MUSHKI, TALL-E JARI A AND B, AND TALL-E BAKUN A AND B

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Sixteen flotation samples from the sites of Tall-e Mushki, Tall-e Jari, Tall-e Bakun A, and Tall-e Bakun B in the Kur River Basin were submitted for analysis by Abbas Alizadeh of the Oriental Institute at the University of Chicago. Four of the samples were not further examined because they were so small.

INTRODUCTION

Archaeological surveys in the region found Paleolithic and Epipaleolithic occupations, and regional survey by Sumner and others trace occupation into the modern era (see, among others, Rosenberg 2003; Sumner 1972; Vanden Berghe 1952). The samples reported here represent the earliest ones recovered so far in the Kur River Basin. They date to the Mushki, Jari, and Bakun phases. The only other archaeobotanical work in the region concerns later phases (Banesh, Kaftari, and Qaleh) at Tall-e Malyan (Miller 1982); those results are brought into the discussion to put the present remains in context. Although the evidence reported here is meager, it provides a baseline for future research.

The first agricultural settlements in the Kur River Basin date to the Mushki phase. The type site is Tall-e Mushki, which dates to the end of seventh millennium B.C. Tall-e Jari (Jari phase) dates to the sixth millennium B.C.; Tall-e Bakun B (Shamsabad phase) and Tall-e Bakun A (Bakun phase) date to the mid-fifth to early fourth millennia B.C. Over this time span, occupied settlement, and presumably population as well, increased (see Miroschedji 2003: 21; Sumner 1972).

Today, the "natural" vegetation of the Kur River Basin would be oak steppe-forest on the slopes at the northwest end, with a shift to pistachio-almond steppe-forest on the valley floor and slopes to the southeast (Miller 1982; Zohary 1973). As early as the Banesh phase, human influence on the vegetation can be traced in the archaeobotanical assemblage of Tall-e Malyan (Miller forthcoming). Undoubtedly the initial farming activities and presumed year-round settlement of the Mushki and later occupations also had some effect on the plant cover.

One of the questions addressed by Alizadeh's project concerns the initial appearance of pastoral nomadism in the region (see, e.g., Alizadeh 2003). Recent re-analysis of the Tall-e Malyan charcoal assemblage suggested that pastoral nomads occupied the Kur River Basin in the mid-third millennium B.C. (Miller forthcoming). Initial results of the research reported here suggest that the pastoral component of the economy was relatively important (compared to, e.g., during the more urbanized Banesh and Kaftari periods). For the sites reported here, we do not yet know how we would distinguish a generalized agropastoral economy from one which has specialized (full-time) farmers and herders.

Another unanswered question for the Kur River Basin concerns the post-Pleistocene expansion of the Zagros forests. In particular, during the last Glacial, the cold dry steppe characterized by *Artemisia* and Chenopodiaceous shrubs dominated the vegetation of Zagros region (van Zeist and Bottema 1977). It is not clear how long after Holocene climate amelioration the woodland expanded to its current boundaries from refugia.

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METHODS

An Ankara flotation device was used for extracting the charred materials (A. Alizadeh pers. comm.). The heavy fraction was caught in a 1-mm mesh screen. The floating material was caught in two screens of mesh size 1 mm and 0.5 mm. When dry, the samples were transferred to film canisters. It was not clear from the labeling whether the multi-container samples were to be combined for purposes of analysis. There was time to do only one of each, so the proportion of sample analyzed is approximate (as is density information calculated for those samples).

Identifications were made with the help of comparative material housed in MASCA (some of which was collected by Miller while on the Tall-e Malyan project in the Kur River Basin), illustrations from other archaeobotanical site reports, and various published seed manuals. Miller checked the samples analyzed by Kimiaie (table 8).

Without going through all the arguments here (see Miller 1982, 1984b), it is likely that most of the charred seeds come from animal dung burned as fuel. For that reason, uncharred seeds are listed separately and are not included in calculations of the charred seed assemblage.

THE SAMPLES

A variety of deposits were sampled (table 4); they were mostly trashy or ashy deposits and pyrotechnic installations. Despite conscientious sampling by the excavators, the density of charred material is generally relatively low. This is partly a function of the way density is measured — as a ratio of the weight of charred material larger than 2 mm to sediment volume in liters. The overall average density for the three sites is 0.05 g/liter, with a range of 0–0.32 g/liter; this may be visualized as equivalent to about 4 or 5 cereal grains/liter of soil (table 8). This measure tends to under-represent wild and weedy seeds, as they are quite small. Calculation of the wild and weedy count per liter of sediment yields an overall average of about 19, range 0 to 86. Densities of wild seeds and charred material are not correlated.

It is important to bear in mind that any generalizations about trends in these samples are unstable (i.e., they could be easily overturned with analysis of as little as one additional sample). Similarly, absence of any taxon may be the result of the small sample sizes.

Charcoal has not been examined for this report. Few pieces encountered are large enough to attempt identification.

NOTEWORTHY DEPOSITS AND ITEMS

TALL-E MUSHKI (FEATURE 4)

This sample from an oven has the highest density of charred material and is the only one with a lot of wood charcoal. It also has very few seeds. These characteristics suggest that it is the remains of a wood-fueled fire.

TALL-E JARI A (FEATURE 13)

This oven is unusual in that there is virtually no charcoal or cereal, but quite a large number of wild seeds. It suggests the remains of a dung-fueled fire.

TALL-E BAKUN A (LEVEL 4 IN SQUARES BB 27 AND BB 38)

These samples from a large trash deposit are relatively rich in charred remains, both seed and charcoal. Square BB 27 also had silicified awns of grasses, and some amorphous charred material (0.71 g > 2 mm and 0.21 g between 1 and 2 mm) that looks like digested masses of cereals; this could change the figures in table 8 for this sample. It would certainly change the wild:cereal ratio in favor of cereals. Both samples have some dung in them.

TALL-E BAKUN A (LEVEL 3 IN SQUARE BB 27)

Like Feature 13 at Tall-e Jari A, there is virtually no charcoal or cereal, but many wild seeds and some silicified awns. This sample presumably includes the redeposited remnants of a dung-fueled fire.

THE TAXA — CULTIGENS AND OTHER FOOD PLANTS

Cereals (large-seeded, cultivated grasses: six-row barley, einkorn, emmer, and bread or hard wheat), possible pulses (large-seeded legumes), almond, and possible pistachio are attested in these samples. Also in this section a tentatively identified seed of *Hippophae* is discussed.

CEREALS (POACEAE)

Hordeum vulgare var. *hexastichum* (six-row barley). In six-row barley, some of the seeds are twisted; charring could also cause twisting. In those samples with grains, twisting occurs. Tall-e Jari A and Tall-e Bakun A samples also show the more definitive evidence of internodes of six-row barley. It is also possible (even likely) that two-row barley was grown. (In principle, six-row barley has two twisted grains for each straight one.) In these samples, only about half the recognizable barley grains are twisted (table 5). One glume base was identified as wild barley (characterized by smooth dehiscence — the internodes separate cleanly). Barley occurs throughout the sequence as both grain and rachis fragments.

Triticum aestivum/durum (bread wheat/hard wheat). The grains of hard wheat can not be distinguished from those of bread wheat. A few such grains occur in Tall-e Bakun A. At Tall-e Jari, some of the shield-shaped internodes characteristic of bread wheat were seen.

Triticum dicoccum (emmer wheat). Emmer occurs both as grain and spikelet forks. Evidence of emmer occurs at the three sites.

Triticum monococcum (einkorn wheat). Both grain and spikelet forks recognizable as einkorn occur in the samples. Many einkorn spikelet forks were identified in Tall-e Bakun A samples (table 8).

Triticum monococcum/dicoccum (einkorn or emmer wheat). There are a few grains that can not be identified more precisely than einkorn or emmer. Similarly, many spikelet forks occur throughout the sequence that can not be further distinguished. Many half-spikelet forks were seen, and even whole spikelet forks frequently can not be determined because the distinguishing characteristics are quantitative (angle of fork and ratio of rachis scar to spikelet fork width).

Triticum sp. (wheat, not further distinguished). A few grains of wheat were identified. A few wheat internodes were found from a sample of Tall-e Jari A; they would probably be from *Triticum aestivum* or *T. durum*.

Cereal. A number of fragments of large-seeded cultivated grasses can not be further specified. With regard to wheat and barley in general, however, note that barley tends to be more drought-tolerant than wheat because it has a shorter growing season. Also, it is more likely than wheat to be fed to animals (threshing does not remove the indigestible glumes); this is particularly true of the straw, since wheat straw is less digestible than barley straw. Where both two- and six-row barley are grown, six-row is more likely to be irrigated. Also, because it has proportionally more protein, six-row barley is more likely to be fed to the animals, and two-row barley is more likely to be made into beer.

PULSES (FABACEAE)

In addition to some unidentified fragments, a one sample had a seed tentatively identified as *Pisum* (pea, although the large round-seeded *Vicia*/vetch can not be excluded). Archaeologically, pea is not very common and even wild vetches may have fairly large seeds.

FRUITS, NUTS, TREE PRODUCTS

Pistacia/Rhus (pistachio or sumac, Anacardiaceae). A big fruit of *Pistacia* or *Rhus* was identified from Tall-e Bakun A. *Pistacia vera* L., *P. khinjuk* Stocks, and *P. eurycarpa* Yaltirik have been collected in the area. *Rhus coriaria* is a plant of Iran, but was not seen growing in the area by Miller. The seed seems a bit small for *P. khinjuk* or *P. eurycarpa*, which is why we propose sumac as a possibility.

Prunus sp. (almond, Rosaceae). The genus *Prunus* includes the stone fruits (e.g., plum, apricot, and peach) as well as almond. Many *Prunus* species are wild. A few nutshell fragments identified as almond are from a wild type. In the Kur River Basin, *Prunus kotschyi* (Boiss. and Hohen.) Meikle and *P. scoparia* Schneider are part of the natural vegetation.

Nutshell. In addition to almond, there were some small nutshell fragments. In the Kur River Basin, Miller (1982) noted that fresh specimens of smooth-shelled wild almond and wild pistachio could be distinguished by texture of the cross-section (almond is rougher-grained than pistachio) and thickness (almond is generally a bit thicker than pistachio); there has not been time to attempt this for this report.

Hippophae (seabuckthorn, Elaeagnaceae). A single seed that compares with *Hippophae rhamnoides* L. was seen. Miller collected a specimen from this shrub in the Kur River Basin. If the identification is correct, the presence of the seed would probably be incidental to use of the wood for fuel.

THE TAXA — WILD AND WEEDY PLANTS

The seeds or plant parts of wild and weedy plants comprise at least twenty families and include at least thirty-five genera. Most of the taxa occur rarely or in small numbers. With determinations only to family or genus, detailed discussions of habitat are not warranted. One Tall-e Jari A and three Tall-e Bakun A samples have more than 500 wild or weed seeds each (table 8). Virtually all the genera (and families) are plants of open ground, and most would be acceptable as fodder plants. Plant families that are common in the modern flora of the region include members of the Asteraceae, Brassicaceae, Fabaceae, and Poaceae.

Asteraceae (daisy family). Twelve seeds identified as Asteraceae family in the samples but one seed was determined as *Artemisia* (wormwood). *Artemisia* is a dominant plant in steppe zones of the Near East.

Boraginaceae (borage family). In addition to four charred *Heliotropium* (heliotrope) seeds, a few mineralized *Arnebia* were encountered. At archaeological sites in the Near East, members of this family are commonly found uncharred.

Brassicaceae (mustard family). Seeds in this category occur throughout the sequence in small numbers. All eleven *Alyssum* seeds come from a single Tall-e Bakun A sample. The distinctive siliques of *Euclidium* occur in Tall-e Jari and Tall-e Bakun A samples.

Caryophyllaceae (pink family). Two genera are positively identified, *Silene* and *Vaccaria*. *Vaccaria pyramidata*, a field weed, grows in the area.

Chenopodiaceae (goosefoot family). Many of the members of this family are salt-tolerant plants like *Suaeda*. Some *Suaeda* seeds were seen in the samples.

Cyperaceae (sedge family). These plants are common in moist ground, especially along the rivers, streams, and ditches in low-lying areas. Three genera were recognized in the samples, *Carex*, cf. *Eleocharis*, and *Scirpus/Cyperus*. *Cyperaceae* make a substantial contribution to the assemblage, but seeds of this family are difficult to identify, especially because modern comparative material was insufficient to warrant further work.

Fabaceae (pea, clover family). Several of the taxa grow in relatively moist areas, whether irrigated fields or along streams and ditches (e.g., medick/*Medicago*, clover/*Trifolium*, melilot/*Melilotus*). Others are typical of healthy steppe vegetation (e.g., many trigonel/*Trigonella*). *Astragalus*, which is likely to have "more than 1,000 species in Iran alone" (Lock and Simpson 1991: 43), occurs in a wide variety of habitats. At a count of 2,366, *Astragalus* is also the most numerous seed in the assemblage, especially in the Tall-e Bakun A samples. Many members of the pea family have nitrogen-fixing bacteria on their roots, though there is no evidence for intentional crop rotation until much later than these samples. More importantly, many of the small-seeded legumes are useful fodder plants (e.g., *Medicago*, *Trigonella*, *Trifolium*, *Melilotus*, and some *Astragalus*). In fact, along the Euphrates River (Miller 1997, 2002) and in Central Anatolia (Gordion; Miller laboratory notes), a decline in the seeds of these plants is an indicator of pasture decline, as the small-seeded legumes are preferentially eaten by the herds. In the Kur River Basin samples, it is numerous at Tall-e Jari and Tall-e Bakun A, but absent in the fourth–second millennium B.C. samples from Tall-e Malyan. In contrast, camelthorn (*Alhagi*) is avoided by most grazers other than camels, due to its spines.

It is frequently an indicator either of a deep water table or of agricultural disturbance, because it has a very long taproot. (The *Trigonella astroites*-type has a tuberculate surface.)

Lamiaceae (mint family). An only tentatively identified member of the family present in the samples is *Ziziphora*, an inconspicuous genus.

Liliaceae (lily family). *Bellevalia* and *Polygonatum*, both tentatively identified, are spring-flowering plants.

Papaveraceae (poppy family). A few *Papaver* (poppy) seeds were seen; there is a possible confusion with the genus *Roemeria*. Poppies are much more common plants, however.

Poaceae (grass family). Grasses comprise a relatively important part of the assemblage. The most numerous grass taxon occurs in all three sites, the tentatively identified *Brachiaria* (1,126 seeds). The tiny seed is distinctive and compares reasonably well with *B. eruciformis* collected near Tall-e Malyan. Although some members of the genus are "useful forage grasses, [*B. eruciformis*] is apparently not of any account as a fodder" (Bor 1968: 472). The single *Hordeum* has a relatively large seed, like that of *H. spontaneum*, the annual barley that is the wild ancestor of *H. vulgare*. The only large-seeded *Hordeum* noticed by Miller in the Kur River Basin is *H. bulbosum*, a perennial type.

Polygonaceae (knotweed family). *Polygonum* (knotweed) and *Rumex* (dock) usually grow in moist areas. Only one of each was encountered.

Primulaceae (primrose family). A single tentatively identifed *Androsace* seed was seen. *Androsace* is an inconspicuous plant of steppe vegetation in Turkey; it was not seen during fieldwork at Tall-e Malyan.

Ranunculaceae (buttercup family). *Ceratocephalus* is another inconspicuous plant (i.e., it is about 5–10 cm high); a total of two were seen in two Tall-e Bakun A samples.

Rubiaceae (bedstraw family). *Galium* (bedstraw), relatively common at the later site of Tall-e Malyan, is a varied genus that includes annuals and perennials, plants of fields and uncultivated ground.

Scrophulariaceae (mullein family). Two Tall-e Bakun A samples have concentrations of *Veronica*. It is a small herbaceous plant.

Solanaceae (nightshade family). The only member of this family encountered was *Hyoscyamus*, with two seeds from a Tall-e Bakun A sample.

Sparganiaceae (bur-reed family). *Sparganium*, only tentatively identified in two Tall-e Bakun A samples, is a plant of moist ground. In that regard, and in being a monocot, it is similar to the sedges.

Verbenaceae (verbena family). A single *Verbena* seed was tentatively identified.

Zygophyllaceae (caltrop family). A single tentatively identified *Peganum* seed was seen. Nowadays, *Peganum harmala* grows on vast areas of overgrazed pasture throughout the Near East. In the Kur River Basin, it is particularly common on occupation mounds, notably Tall-e Malyan. It tends to become more common in Near Eastern archaeobotanical assemblages dating to the third millennium B.C. and later, probably because it is an indicator of pasture decline (Miller 1991).

ANALYSIS

Although no definitive results are possible with the small number of samples analyzed, a few observations based on various characteristics of the assemblages may be made: ratios (density, seed:charcoal, wild:charcoal), proportions of major taxa and groups, and presence or absence of select taxa.

DENSITY

Density was mentioned in the section on samples, above. The main conclusion is that although the density of charred material is not great, it is not negligible, either. That is, further work will be rewarded. Ordinarily, wood charcoal would be expected to be the primary source of charred material, especially in a region presumed to have been covered with steppe-forest vegetation. The average density per liter of charred material larger than 2 mm, 0.05, is not directly comparable to Tall-e Malyan, where charred material was sorted to a much smaller mesh size — 0.84 mm. All things being equal, one would expect the raw density measures to be higher at Malyan, as indeed they are (with ashy/trashy deposits typically averaging over 4 g/liter, Miller 1982: 212). The difference is so much greater, however, it is fair to say the assemblage under discussion here has less material. On the other hand, it has many more seeds: Where Malyan totaled about 189 seeds from over 1,200 liters of soil in 99 samples (Banesh) and 2,473 seeds from over 1,200 liters of soil in 90 samples (Kaftari), here we have 6,811 from approximately 225 liters of soil in 12 samples.

SEED:CHARCOAL, WILD:CHARCOAL RATIOS

The seed to charcoal ratio can be calculated in different ways, but it can only be calculated for samples with measurable charcoal in the denominator. If one counts seed and charcoal weights of material larger than 2 mm, the ratio effectively measures cereal:wood charcoal. One can also calculate the number of wild and weedy seeds to the weight of wood charcoal. If it is reasonable to think that most of the seeds come from dung burned as fuel, then both these measures provide a means of monitoring dung fuel use relative to wood fuel. Here again, comparisons to Tall-e Malyan are instructive.

To avoid the problem of samples with no charcoal, the calculation for Tall-e Malyan was done as a seed/(seed + charcoal) ratio, with a range of 0 to 0.66; there was about a ten-fold increase between Banesh and Kaftari times. The Malyan wild:charcoal ratios are about 0.17 (Banesh) and 2.28 (Kaftari) (Miller laboratory notes). The differences between the Banesh and Kaftari samples are taken to indicate an increased use of dung fuel relative to wood caused by deforestation (Miller 1982), as both large seeds and wild seeds showed the same trend relative to charcoal.

The seed/(seed+charcoal) ratios of the Tall-e Mushki, Tall-e Jari, and Tall-e Bakun samples (table 8) generally fall within the range characteristic of Tall-e Malyan, which might suggest similar habits of fuel use in those earlier periods. There does seem to be some change over time, however: the seed to charcoal ratios of Bakun tend to be higher than those of the earlier sites, especially if small samples are given less weight (table 6). The wild seed:charcoal ratios in the Mushki, Jari, and Bakun samples generally are substantially higher compared to Malyan, which might suggest a much less forested environment than during the Malyan occupation. To clarify this issue, the wild: cereal ratio is useful.

WILD:CEREAL RATIO

At Tall-e Malyan, the proportion of wild:seed > 2 mm, which is a rough approximation of wild:cereal, is never more than 250 and is usually quite a bit less. In the eleven samples for which this measure can be calculated, the comparable figures are almost all over 300 (and the wild:seed > 2 mm ratio is even higher). This suggests that sending animals out to graze was more important in earlier times than at Malyan.

BARLEY:WHEAT RATIO

At Tall-e Malyan, the proportion of barley to wheat was about 13 to 1 (Miller 1984a). In the samples reported here, it is substantially less (overall about 0.93). Combined with the wild:cereal ratios, this suggests that foddering of animals was less important in earlier times than at Malyan (see Miller 1997 for discussion).

TAXA OF NOTE

Given the small number of samples and the fact that some taxa occur in small numbers and/or only a few samples, presence/absence is not meaningful for most types. Some families and genera stand out as being particularly numerous, however.

The most important wild plant families in the assemblage are the grasses, legumes, and sedges. More than half of the wild seeds come from a single sample — Tall-e Bakun A, Level 4, Square BB 27. Even if this sample is removed from consideration, these three families dominate. It is not possible to say what proportion of the landscape was covered with plants of these families, but it is likely that the grasses and legumes grew mostly on open dry ground and the sedges grew in moist swales or along watercourses. The proportions of seeds more likely reflect a combination of such factors as animal diet preferences (hence the large amount of legumes), seed production (sedges are quite prolific seed producers and live in places animals congregate, and so might have disproportionately strong representation), and of course, presence in the landscape (grasses may have been the dominant form in the lightly wooded and open areas).

With or without the richest Tall-e Bakun A sample, the small-seeded legumes, *Astragalus*, *Trigonella*, and *T. astroites*-type, and the very small-seeded grass, cf. *Brachiaria*, are the most numerous genera (and species). The legumes are all good fodder plants; if the grass seed is *Brachiaria eruciformis*, its presence in large numbers is hard to explain.

There are a few taxa that almost certainly are associated with agricultural disturbance: 1 *Vaccaria*, 14 *Alhagi*, 1 *Avena*, and 77 *Lolium*. All these occur only in Tall-e Bakun A samples (as does the single cf. *Peganum*, an indicator of overgrazing; table 7). Given that the population levels of the Bakun phase in the Kur River Basin were not surpassed until the late third-millennium Kaftari phase, perhaps evidence for the importance of agricultural production will be supported by further research.

DISCUSSION

Several key features of the assemblages reported here give a glimpse of the landscape and vegetation in the Kur River Basin between the seventh and fourth millennia B.C. In particular, we suggest the following interpretation which should be tested after additional evidence can be brought to bear:

- Relatively open terrain (at most scattered trees): low charcoal densities are not a result of preservation problems, because wild seeds are numerous.
- Relatively arid conditions (trees limited by climate and pre-existing cover, not deforestation; grazing more important than cultivation of fodder).

These two observations and interpretations support the view that the post-Pleistocene expansion of the Zagros woodland was not yet complete, which would suggest:

- Agropastoral economy emphasizing grazing over farming, at least compared to later periods. As the samples come from settlements, the material does not speak directly to the question of nomadic pastoralism.

The picture is not so simple, because in a very arid climate one might not expect to see six-row barley as a prominent crop without irrigation. On the other hand, if low labor- and land-intense animal husbandry was so important, would irrigation also be part of that system? The total number of cultigens, including barley, is low, so the interpretations are very much still open.

Of necessity, we have had to treat the samples as a single temporal unit. Future research will help determine if the Tall-e Bakun A occupation saw increased disturbance of the vegetation when settled population was higher than it had ever been by examining taxa indicative of agriculture and increased use of dung fuel.

The samples reported here extend our evidence for agriculture and environment in the Kur River Basin to periods preceding the Banesh and Kaftari phase settlement at Tall-e Malyan. The most potentially significant finding is that the arboreal vegetation in earlier times seems to have been less than during the third millennium, despite the fact that population densities were lower and people had not had as much time to adversely affect the vegetation through their farming and fuel-cutting practices. To reconstruct vegetation cover, we would have to be able to distinguish the influences of environmental factors (e.g., climate and pre-existing vegetation) from economic ones (e.g., land clearance, fuel-cutting). It is premature to reach conclusions about the timing of post-Pleistocene expansion of the woody vegetation and the degree of human interference with the natural vegetation. Additional sampling will not unequivocally answer these questions, but would nevertheless enhance our understanding of the ancient landscape.

Table 4. List of Samples and Comments of the 2004 Seed Collections

Site, Square (Sq.) or Trench (Tr.)	Total Number Film Canisters	Stratigraphic Information	Deposit Type
Tall-e Bakun A, Sq. BB 27	6 (1 done)	Level 3	Large Garbage Dump
Tall-e Bakun A, Sq. BB 27	4 (1 done)	Level 4 (basal)	Large Garbage Dump
Tall-e Bakun A, Sq. BB 38	5 (1 done)	Level 3	Large Garbage Dump
Tall-e Bakun B, Stratigraphic Tr.	1	Level 2 (basal)	Ashy Layer
Tall-e Jari B, Tr. 1	1	40 cm above Sterile	Ashy Layer
Tall-e Jari A, Stratigraphic Tr.	1 (not done)	Feature 7	Fire Pit
Tall-e Jari A, Stratigraphic Tr.	1	Feature 9	Oven/Kiln
Tall-e Jari A, Stratigraphic Tr.	1 (not done)	Feature 9	Ashy Layer
Tall-e Jari A, Stratigraphic Tr.	1	Feature 9	Oven
Tall-e Mushki, Stratigraphic Tr.	1 (not done)	Level 6	Ashy Deposit
Tall-e Mushki, Stratigraphic Tr.	1	Level 16	Extensive Ashy Layer
Tall-e Mushki, Stratigraphic Tr.	1	Level 17	Extensive Ashy Layer
Tall-e Mushki, Stratigraphic Tr.	1	Feature 4	Oven
Tall-e Mushki, Stratigraphic Tr.	1	Feature 7	Burnt Patch with Ash
Tall-e Mushki, Stratigraphic Tr.	1	Feature 12	Large Oven
Tall-e Mushki, Stratigraphic Tr.	1 (not done)	Feature 14	Ashy Lens

Table 5. Twistedness of Barley Grains

Sample	Twisted	Straight	Indeterminate
Tall-e Mushki, Feature 4	0	0	1
Tall-e Mushki, Feature 7	0	0	1
Tall-e Jari A, Feature 9	1	1	5
Tall-e Bakun A, Sq. BB 27, Level 4	8	5	3
Tall-e Bakun A, Sq. BB 38, Level 4	3	8	20
Total	**12**	**14**	**30**

Table 6. Average Seed/(Seed+Charcoal) > 2 mm

Tall-e Mushki, n=5	0.01
Tall-e Jari, n=3	0.26
Tall-e Bakun, n=3*	0.43

* One Tall-e Bakun sample has no seed or charcoal > 2 mm

Table 7. Comparison of Wild and Weedy Taxa Attested for Tall-e Mushki, Tall-e Jari, and Tall-e Bakun with Those also Found at Tall-e Malyan and Seen Growing in 1974–1978 (Miller 1982, field observations)

Taxa*	Tall-e Mushki	Tall-e Jari	Tall-e Bakun	Tall-e Malyan	Kur River Basin, 1974–1978 Fieldwork
Artemisia			x		[Not Seen]; Steppe
Heliotropium			x		*H.* cf. *rotundifolium*; Irrigated Fields
cf. *Alyssum*			x		*A. linifolium*; Dry Fields
Euclidium		x	x	x	*Euclidium* ("crucif A")
Silene	x			x	*S. conoidea*, *S. spergulifolia*; Weed
Vaccaria			x	x	*V. pyramidata*; Weed
Suaeda	x	x	x		[Not Seen]; Frequently Steppe, Saline
Carex	x			x	*C. divisa*; Irrigation Ditches, High Water Table
cf. *Eleocharis*			x		[Not Seen]; Moist Areas
Scirpus/Cyperus	x	x	x	x	*S. holoschoenus*, *C. longus*; Along Streams and Ditches
cf. *Alhagi*			x		*A. camelorum*; Dry Fields (and steppe)
Astragalus	x	x	x	x	*A. hamosus*, *A. kotschyanus*, *A. campylorrhynchus*, et al.; General
Medicago			x	x	Irrigated Fields, Moist Areas
Trifolium		x	x	x	*T. fragiferum*; Irrigated Fields, Moist Areas
Melilotus		x	x	x	*M. indica*; Irrigated Fields
Trigonella	x	x	x		*T. foenum-graecum*, *T. monantha*; Irrigated Fields, Moist Areas
cf. *Ziziphora*		x	x		[Not Seen]; Steppe
cf. *Bellevalia*			x		[Not Seen]; Early Spring Bulb
cf. *Polygonatum*			x		[Not Seen]
Papaver		~~x~~	x		*P. macrostomum*; Irrigated Fields
Aegilops			x	x	*A. crassa*; Dry Fields, Other Areas
Avena			x	x	*A.* cf. *byzantina*; Weed
cf. *Brachiaria*	x	x	x		*B. eruciformis*
Eremopyrum	x	x		x	*E. bonapartis*; Wild, Irrigated Fields
Hordeum (large)			x	x	*H. bulbosum*; Perennial
Lolium			x	x	*L. perenne*; Moist Areas (fields, other)
Setaria		x		x	*S. verticillata*; Irrigated Fields, Streams, and Ditches
Polygonum		x		x	*P. aviculare*, *P. equisetiforme*, *P. lapathifolium*; Ditches, Irrigated Garden, Grove
Rumex			x	x	*R. crispus*, *R. dentatus*, *R. conglomeratus*; Irrigated Alfalfa, Grove
cf. *Androsace*			x		[Not Seen]; Steppe
Ceratocephalus			x	x	*C. falcata*; General
Galium			x	x	*G. ceratopodum*, *G. humifusum*, *G. tricornutum*; Weed
cf. *Veronica*		x	x		*V. anagallis-aquatica*, *V. campylopoda*, *V. persica*; Irrigated Fields, Moist Areas
Hyoscyamus			x	x	*H. pusillus*, *H. reticulatus*; Uncultivated, Ditches
Sparganium			x		*S. erectum*; Streamside
cf. *Verbena*		x			*V. officinalis*; Streamside
cf. *Peganum*			x		*P. harmala*; Uncultivated, Overgrazed Steppe

* Note that different species of a genus can have very different ecological requirements, so the specific information listed here is for general reference only.

Table 8. Plant Remains from Tall-e Mushki, Tall-e Jari A and B, and Tall-e Bakun A and B

SITE	Tall-e Mushki	Tall-e Mushki	Tall-e Mushki	Tall-e Mushki	Tall-e Mushki	Tall-e Jari A	Tall-e Jari A	Tall-e Jari B	Tall-e Bakun B	Tall-e Bakun A	Tall-e Bakun A	Tall-e Bakun A
PROVENANCE	Layer 16	Layer 17	Feature 12	Feature 7	Feature 4	Feature 9	Feature 13	-160 cm	Level 2	Level 4, Sq. BB 27	Level 4, Sq. 38	Level 3
Type of Deposit	Ashy	Ashy	Oven	Ash Patch	Oven	Oven	Oven	Ashy	Ash	—	1 of 5	1 of 6
Soil Volume (liters)	21	14	25	7	11	35	28	10	31	46	28	20.17
Seed > 2 mm	0.04	0.02	0.01	+	+	0.03	0.02	0	0	0.62	1.02	0
Charcoal > 2 mm	0.27	0.36	0.23	0.38	3.57	0.02	0	0.12	0.02	1.15	0.98	0
Misc. > 2mm	0	0	0	0	0	0	0	0	0.02	+	0.08	0
Wild and Weedy	240	15	3	20	12	271	1641	0	18	3974	608	773
Density, > 2 mm/liter	0.01	0.03	0.01	0.05	0.32	0.00	+	0.01	+	0.04	0.07	0.00
Seed:Charcoal	0.15	0.06	0.04	+	+	1.50	N/C	0	0	0.54	1.04	N/C
Wild:Charcoal	889	42	13	53	3	13550	N/C	0	900	3456	620	N/C
Wild:Cereal	4800	214	150	1000	N/C	2085	N/C	N/C	N/C	3613	313	N/C
Seed/(Seed+Charcoal) g/g	0.13	0.05	0.04	+	+	0.60	1.00	0.00	0.00	0,35	0.49	N/C
Density, Wild/liter	11	1	0	3	1	8	59	0	1	86	22	38
CULTIVATED, ETC. (WEIGHT/GRAMS)												
Hordeum vulgare	+	+		+	+	0.07		—		0.28	0.37	
Triticum aestivum/durum										0.01	0.03	
Triticum dicoccum	+	0.01		+						0.05	0.21	
Triticum monococcum	+	+		+	+					0.02	0.15	
T. monococcum/ dicoccum			0.02									
Triticum sp.	+	0.02				+	+				0.25	
Cereal, indet.	0.05	0.04		0.02	+	0.06	+		+	0.74	0.93	
cf. *Pisum*										0.03		
Pulse, indet.						+	+			0.03		
Pistacia/Rhus, no. (grams)											1 (0.04)	
Prunus (almond)			+							0.02		
Nutshell		0.02	+			+			+	+		
cf. *Hippophae* (no.)				1								
WILD & WEEDY (COUNT)												
cf. *Artemisia*												1
Kur Asteraceae-1										1		
Asteraceae, indet.	6			2	1					2		
Heliotropium										4		
cf. *Alyssum*										11		
Brassicaceae, indet.					2	5	5			17	2	8
Silene	1											
Silene/Gypsophila				1								
Vaccaria										1		
Caryophyllaceae, indet.							1				1	
Suaeda			1			3	4			38		31
Chenopodiaceae, indet.						2						
Carex		1					2					

Table 8. Plant Remains from Tall-e Mushki, Tall-e Jari A and B, and Tall-e Bakun A and B (*cont.*)

SITE	Tall-e Mushki	Tall-e Mushki	Tall-e Mushki	Tall-e Mushki	Tall-e Mushki	Tall-e Jari A	Tall-e Jari A	Tall-e Jari B	Tall-e Bakun B	Tall-e Bakun A	Tall-e Bakun A	Tall-e Bakun A
PROVENANCE	Layer 16	Layer 17	Feature 12	Feature 7	Feature 4	Feature 9	Feature 13	-160 cm	Level 2	Level 4, Sq. BB 27	Level 4, Sq. 38	Level 3
WILD & WEEDY (COUNT) (*cont.*)												
Kur Cyperaceae-1										22		
Kur Cyperaceae-2										19		
Kur Cyperaceae-3										1		
Cyperaceae, indet.	55	7		1		2	11		1	112	13	174
cf. *Eleocharis*										1		
Scirpus/Cyperus			1							24		
cf. *Alhagi*											14	
Astragalus					1	9	100		12	1885	331	40
Medicago radiata											2	
Medicago										4		
Trifolium/Melilotus							2			6	1	
Trigonella astroites-type		3			3	9	540					41
Trigonella	9					19	360		1	358	38	97
Fabaceae, indet.	1						80		2	280	117	67
Kur Lamiaceae-1										3		
cf. *Ziziphora*						3				1		
cf. *Bellevalia*										8		
cf. *Polygonatum*										2		
cf. *Papaver*						8				14		3
Aegilops											15	
Avena											1	
cf. *Brachiaria*	167			7	5	165	352			364	6	60
Eremopyrum		3				1						
Hordeum (large)										1		
Lolium cf. *remotum*										41		
Lolium										3	25	8
Setaria						2						
Kur Poaceae-1										60		12
Kur Poaceae-2							142			349		104
Kur Poaceae-3										1		
Kur Poaceae-4												5
Poaceae, indet.	1	1		1		17	11			47	31	
Polygonum							1					
Rumex										1		
cf. *Androsace*										1		
Ceratocephalus										1		1
Galium										3	8	
cf. *Veronica*							7			151		84
Hyoscyamus										2		
Kur unknown-1, cf. *Sparganium*										14		19

Table 8. Plant Remains from Tall-e Mushki, Tall-e Jari A and B, and Tall-e Bakun A and B (*cont.*)

SITE	Tall-e Mushki	Tall-e Mushki	Tall-e Mushki	Tall-e Mushki	Tall-e Mushki	Tall-e Jari A	Tall-e Jari A	Tall-e Jari B	Tall-e Bakun B	Tall-e Bakun A	Tall-e Bakun A	Tall-e Bakun A
PROVENANCE	Layer 16	Layer 17	Feature 12	Feature 7	Feature 4	Feature 9	Feature 13	-160 cm	Level 2	Level 4, Sq. BB 27	Level 4, Sq. 38	Level 3
WILD & WEEDY (COUNT) (*cont.*)												
cf. *Verbena*						1						
cf. *Peganum*										1		
Kur unknown-2										1		
Kur unknown-3										1		
Unknown			1	8		25	23		2	118	3	18
PLANT PARTS												
Euclidium Silique						2				1		
Aegilops glume Base						2				1	9	
Hordeum vulgare var. *hexastichum* Internode						1				2		
Hordeum vulgare Internode/Glume Base Fragments			1			2				4		
Hordeum (wild) Glume Base										1		
Triticum aestivum Internode						7						
T. aestivum/durum Internode						3						
T. dicoccum Spikelet Fork						1					6	
T. monococcum Spikelet Fork										9	96	
T. monococcum/ dicoccum Spikelet Fork	40	15	47		1	2				129	447	15
Straw Culm Node						3						
Straw Spike Base											1	
Silicified Awns										+		+
Fruit Skin-*Prunus* (almond?)						+						
UNCHARRED SEEDS												
Arnebia cf. *decumbens*										5		
Arnebia (other)				1						1		
Suaeda (modern)					12							
Cyperaceae (silicified)						2						
Ficus						2						
Androsace		2										
Solanum (tan)										8		
OTHER												
Uncharred cf. Dung > 2 mm (grams)										0.03		
Charred Dung > 2 mm, g											0.01	
Charred Rodent Dropping (no.)											2	