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Agro-Pastoral Strategies and Food Production on the Achaemenid Frontier in Central Asia: A Case Study of Kyzyltepa in Southern Uzbekistan

Xin Wu
University of Pennsylvania

Naomi F. Miller
University of Pennsylvania, nmiller0@sas.upenn.edu

Pam Crabtree

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Keywords

Achaemenid, zooarchaeology, archaeobotany, Kyzyltepa, agro-pastoralism

Disciplines

Agricultural and Resource Economics | Agricultural Economics | Agronomy and Crop Sciences | Archaeological Anthropology | Asian History | Botany | Economic History | History of Science, Technology, and Medicine

AGRO-PASTORAL STRATEGIES AND FOOD PRODUCTION ON THE ACHAEMENID FRONTIER IN CENTRAL ASIA: A CASE STUDY OF KYZYLTEPA IN SOUTHERN UZBEKISTAN

By Xin Wu*, Naomi F. Miller** and Pam Crabtree***

**University of Pennsylvania & Beijing Normal University, **University of Pennsylvania Museum, ***New York University*

Abstract

This article discusses aspects of the agro-pastoral economy of Kyzyltepa, a late Iron Age or Achaemenid period (sixth–fourth century BC) site in the Surkhandarya region of southern Uzbekistan. The analysis integrates archaeobotanical and zooarchaeological analyses with textual references to food production and provisioning in order to examine local agro-pastoral strategies. Preliminary results suggest an economy that included both an intensive agricultural component, with summer irrigation of millet, and a wider-ranging market-oriented pastoral component that provided meat to the settlement.

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I. KYZYLTEPA PROJECT BACKGROUND AND RESEARCH QUESTIONS

The site of Kyzyltepa (N 38° 03' 16.6", E 67° 43' 16.4") is located near the modern town of Shurchi in the Denau region of the Surkhandarya Oblast in southern Uzbekistan (Fig. 1). Archaeologists and historians, following the Soviet tradition, usually refer to the region as northern Bactria;[1] southern Bactria lies south of the Amu Darya (Oxus river). Since the 1970s, Soviet scholars have conducted surveys and excavations at the site and in the surrounding area, during which architectural remains such as buildings, moats, and city walls were revealed. In 2010 and 2011, under the auspices of the Institute for the Study of the Ancient World (ISAW), New York University, and the Institute of Fine Arts of the Academy of Sciences of the Republic of Uzbekistan, a two-season survey and excavation was conducted at the site by an American-Uzbek Joint Expedition led by Xin Wu and Leonid Sverchkov. The broad goal was to elucidate the environmental, economic, and social conditions in the Kyzyltepa region following its annexation by the Achaemenid Empire (*c.* 550–330 BC). This contribution focuses on the plant and animal remains recovered from the site in order to begin to understand whether and how the changing political landscape affected local economic strategies. The study also considers the relations between mobile pastoralism and sedentary irrigation agriculture in Central Asia. The article illustrates an approach that integrates the study of plant and animal remains in a historical context.

I.1. Historical and archaeological background

We know little about the history of Central Asia before Alexander the Great's invasion, except that the region was subjugated by the Great King of Persia in the sixth century BC and became part of the Achaemenid Empire. Yet the Achaemenid period is a crucial time when Central Asia was dramatically transformed politically, socially, and culturally. It is during this time that the Parthians, Arians, Bactrians, Sogdians, Choresmians, Arachosians, and the various nomadic groups of the Saka people were first documented in historical texts.

[1] A number of French archaeologists, represented by Claude Rapin, however, believe that the region to the north of the Oxus River belonged to the territory of ancient Sogdia (Rapin 2007: 31; 2013).

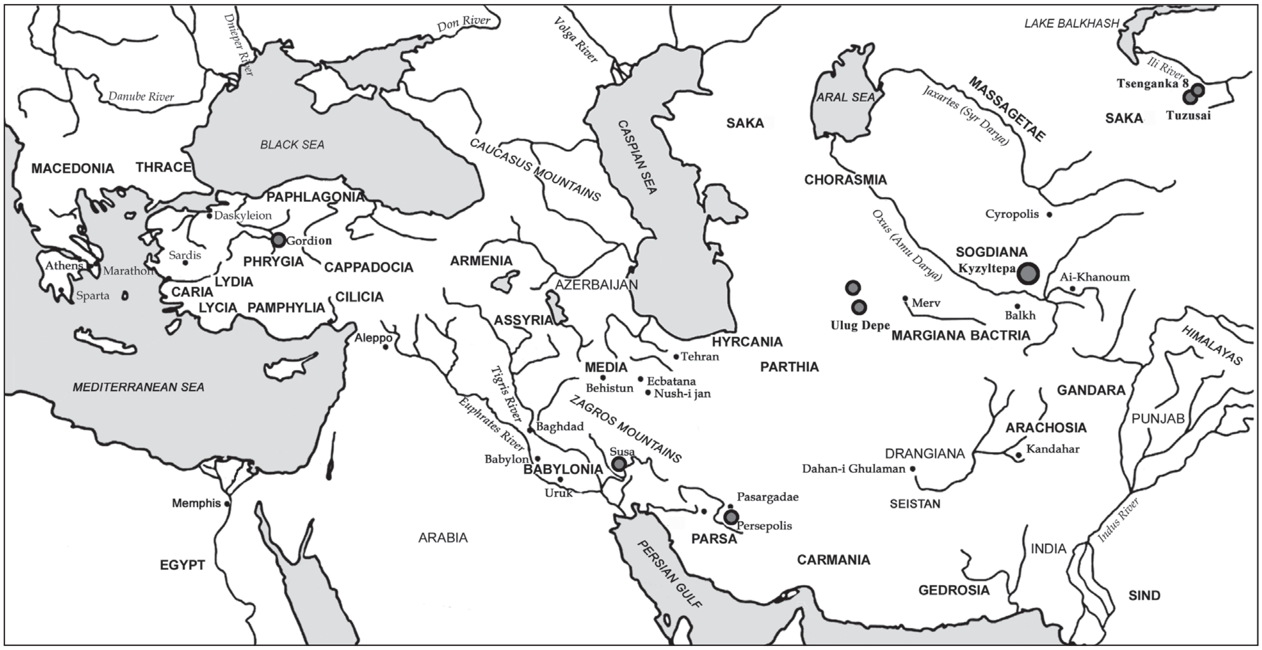

Fig. 1. A map showing Achaemenid period sites and sites mentioned in the article (marked by larger grey dots).

During this period societies in Central Asia started to adopt administrative tools and practices such as writing, coinage, and a large-scale, centralised taxation system, and the region's position in long-distance trade networks increased significantly in importance.

Investigations of the site conducted by former Soviet scholars in the 1970s and 1990s have led to the conclusion that Kyzyltepa is the biggest Iron Age site in southern Uzbekistan and Tajikistan, with an occupied area of about 20 ha. The site represents a large and unique urban settlement equipped with an elaborate citadel as well as a fortification system reinforced by a strong circumferential wall with a moat. The town was established before the Achaemenid period and occupied throughout the first half of the first millennium BC.[2] More than 10 smaller sites cluster around Kyzyltepa,[3] most of which were occupied contemporaneously. Excavation of two of the small sites, Kyzylcha 1 and 6, revealed remains of large houses, which the excavators interpreted as manors of the rich citizens of Kyzyltepa.[4] E. Rtveladze has identified Kyzyltepa as the capital of the region of Paretacene (or "Paretaka" or "Paretakena"), which Alexander the Great invaded during his campaign to Sogdiana in 328–327 BC.[5] In his latest work, Claude Rapin proposes that Kyzyltepa could be the ancient city of Gazaba, where Alexander met and married Roxanne, daughter of a Central Asia aristocrat.[6]

I.2. Current research and its significance

The two seasons of archaeological research at Kyzyltepa include photo-documentation of the site, topographic mapping, a geomagnetic survey, a surface survey of the site and its surrounding area, and seven test trenches, the depth of which ranges between 0.5 m and around 4 m. The work has provided renewed knowledge about the site, such as its topography, spatial organisation, the history of its occupation, and the development of its layout.[7] These new data make Kyzyltepa one of the best-known Achaemenid period settlements of Central Asia.

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2 Pugachenkova 1972: 47–49; 1973: 467–68; Pugachenkova and Rtveladze 1990; Rtveladze 1974: 82; Sagdullayev and Khakimov 1976: 24–30; 1978: 538; Khakimov 1972a: 55; 1972b: 286; Belyaeva and Khakimov 1973: 35–51.

3 Sagdullayev 1987: fig. 1; Stride 2005, V.5: figs. 27, 61.

4 Sagdullayev 1987: 6; 1989: 37.

5 Arrian, *The Anabasis of Alexander*, Book IV: 22.1; Rtveladze 2002: 133, 139. For a recent detailed study of the route of Alexander's campaign, see Rapin 2013.

6 Rapin, forthcoming.

7 Sverchkov *et al.* 2012, 2013; Sverchkov and Wu, forthcoming.

Sample A	750–690 cal BC	*c.* 0.20 g barley fragments
Sample B	800–760 cal BC	*c.* 0.10 g mixed barley and pulse fragments
Sample E	490–460 cal BC	*c.* 0.05 g mixed barley and pulse fragments
Sample F	910–810 cal BC	*c.* 0.20 g barley fragments
Sample G	840–790 cal BC	3 pieces (0.84 g) willow or poplar charcoal
Sample H	900–800; 810–780 cal BC	1 barley grain, 3 twiglets

Table 1. Calibrated radiocarbon dates from Kyzyltepa, 2-sigma.

In this article, we discuss archaeobotanical material excavated in the 2010 and 2011 seasons and zooarchaeological material excavated in 2011. The plant remains were analysed by Naomi F. Miller at the Museum of Archaeology and Anthropology of the University of Pennsylvania, and the 2011 bulk faunal samples by Pam Crabtree at the Center for the Study of Human Origins, New York University. Studies of archaeobotanical and zooarchaeological remains are relatively new in Central Asia. Although research on animals and plants from Central Asian sites has grown rapidly in the past decades,[8] most work has concentrated on the Bronze Age and earlier period sites[9] or on sites of northern Central Asia.[10] Publications on the Iron Age—especially Achaemenid period—sites from southern Central Asia are still rare or preliminary.[11] The north and south, despite shared ecological features, also differ notably. In the north, pastoralism is the predominant subsistence strategy; in the south, oasis-based irrigated agriculture is combined with steppe-based pastoralism. The archaeobotanical and zooarchaeological material from Kyzyltepa located on the very frontier between the irrigated agricultural land and the territory of the nomadic pastoralists illustrates an interface between the farming and herding systems of Eurasia in the Iron Age. Comparisons between the material from Kyzyltepa and the Iron Age material from Central Asia and elsewhere can offer important insights into the similarities and differences of these two systems across Eurasia. In addition to providing information on the social and economic life of Central Asia during the Achaemenid period, examination of the Kyzyltepa farming and herding systems can provide another perspective on the unique nature of the economic strategies that the Achaemenids employed to develop the arid lands on the empire's frontiers. Such examination would potentially also shed light on the roles that both the sedentary farmers and mobile pastoralists played within the longer-term regional transition to an agro-pastoral economy.

I.3. Chronology and dating

The remains from Kyzyltepa are divided into two main periods, early and late. Seeds from several of the 2010 samples from both phases were AMS-dated by Beta-Analytic, with results provided to 2-sigma (Table 1). The radiocarbon dates that have been determined so far lie mostly between 910 and 690 cal BC; one dates a bit later (490–460 cal BC). The radiocarbon dates for the samples are problematic because the ceramics and other archaeological evidence—including dendrochronological analysis of a wood sample from the dated deposits—and the architectural forms discovered at the settlement complex at Kyzyltepa area seem to be several centuries later.[12] Despite the early radiocarbon dates, therefore, Leonid Sverchkov (Institute of Fine Arts of the Republic of Uzbekistan), Xin Wu, and Nikolaus Boroffka (German Archaeological Institute)[13] think the excavated deposits date to the Achaemenid period (the early period) and slightly later (the late period or the early Hellensitic period), namely, the sixth to late fourth century BC. Given the relatively small sample size, this analysis combines the material from both periods.

I.4. Occupation history and function

Kyzyltepa has a citadel and a lower city. It is likely that the site functioned initially as a cultic centre because

8 E.g. Chang *et al.* 2003; MAFTUR 2012.

9 E.g. Charles and Bogaard 2010; Miller 2003; Moore *et al.* 1994; Spengler *et al.* 2014.

10 E.g. Frachetti *et al.* 2010; Spengler *et al.* 2013.

11 E.g. Herrmann *et al.* 1994, 1999.

12 The architectural forms of the houses at Kyzylcha 1 and 6 (Sagdullayev 1987: figs. 4–8) are comparable to those at the Achaemenid period sites Altin 10 in southern Bactria (Ball 1982: fig. 5.2) and Dahani Ghulaman in Iran Sistan (Scerrato 1966: figs. 2–3).

13 Sverchkov *et al.* 2013: 67.

its first monumental structure was a huge tower with a platform on the top that is reminiscent of a fire platform. Soon afterwards, a citadel was constructed around the tower platform. The lower town was an even later addition and was constructed towards the end of the site's occupation history. The citadel at Kyzyltepa represents the most monumental Achaemenid period structure excavated in the Surkhandarya valley. The site, together with its numerous satellites, formed the largest and most complex settlement system of the Achaemenid period in northern Bactria. It is thus assumed that Kyzyltepa must have served as a major administrative centre of the region; the site could have functioned as one of the most important nodes on the empire's north-eastern frontier.[14] We do not know whether the Achaemenids themselves resided in Kyzyltepa and managed the site and its surrounding areas or whether they delegated such power to the local aristocrats. The site suffered several episodes of destruction; it was finally destroyed at the end of the Achaemenid period and completely abandoned during the early Hellenistic period.

I.5. Kyzyltepa and its environs

The site of Kyzyltepa lies about 480 m above sea level. Two streams conjoin near the site. The climate is continental, with hot dry summers and cold winters. Annual precipitation is about 230 mm, falling mostly in the cooler months. The site is located in the Mirshade oasis on the alluvial fan of the Surkhandarya valley, which is a narrow river valley framed on the north, east, and south by three mountain chains. This topography has historically and ethnographically supported varying forms of transhumant and other types of pastoralism.[15] The Mirshade oasis was sparsely occupied during the Bronze Age; and the Bronze Age settlements are generally very small. The area thrived in the Achaemenid period, as testified by the large settlement system constituted by Kyzyltepa and its satellites. After the abandonment of Kyzyltepa, the oasis was free of settlements.[16] The site's prosperity during the Achaemenid period, which was exceptional in the area's occupation history, requires an explanation. An analysis of the plants and animal remains, which is presented in the following two sections, provides a key to the answer.

14 Wu, forthcoming, a, forthcoming, b.

15 Stride 2005 V.1: 144–45, 147–49.

16 Stride 2005 V.1: 173–74.

II. ARCHAEOBOTANICAL RESULTS

The excavators retrieved plant remains by hand and flotation. Hand-picked samples were dry-sieved at the site using agricultural sieves with 2 cm-mesh.[17] Manual flotation was carried out at the dig house. Soil volume was measured in a *c.* 10 litre bucket. Samples were first soaked in water to dissolve the hard clumps of earth. The muddy water was stirred to release the charred material; the muddy water with floating charred remains was then poured through two brass test sieves (with 0.5 mm- and 0.35 mm-mesh), which concentrated the charred material. The charred material was put into another basin filled with clean water to remove extraneous sediment, collected in the mesh, and dried. Mud at the bottom of the basin was discarded. The archaeobotanist has not visited the site, but in the laboratory, sorting and identification procedures followed practices outlined by Miller for Gordion, Turkey.[18]

A variety of cultivated and uncultivated plant taxa are attested in these samples. Some are of obvious economic value, but there are no pure crop samples. Seeds and/or plant parts of cereals, millets, pulses, fruits, and wild, segetal, and ruderal types occur. Wood charcoal has not been systematically examined, but some of the larger pieces have been identified.

II.1. The plants

II.1.1. Economic plants

Cereals. Six-row barley (*Hordeum vulgare* var. *vulgare*). The barley grains are fragmentary or poorly preserved, and therefore not measurable. Nevertheless, it is likely that most are of the six-row type, which is distinguished from the two-row type by the presence of asymmetrical grains and three-pedicel rachis segments.[19] Although six-row barley grain asymmetry is not easy to distinguish from symmetry due to charring, samples with relatively well-preserved grain had both straight and twisted examples. In addition, the rachis internodes that were well enough preserved to be determined had sturdy lateral pedicels. The grains are not rounded as would be expected of naked barley and therefore the crop was the hulled variety.

17 See Miller 2012.

18 Miller 2010: 73–75.

19 See Cappers and Neef 2012: 276.

Barley is typically planted in the autumn in order to take advantage of winter and early spring rain. It is relatively drought-tolerant, although six-row barley requires more moisture than the two-row type. Barley grain is eaten by both people and animals, and the stems and leaves are an excellent fodder, dry or fresh.

Bread wheat (*Triticum aestivum*). Species of free-threshing wheat—bread wheat and durum—cannot be distinguished by their grain alone, but the rachis internodes are distinctive. At Kyzyltepa, the wheat internodes range from long and slender to short and sturdy. Those with clear features are shield-shaped, and it is most likely that the wheat is *Triticum aestivum* rather than *T. durum*.[20]

Bread wheat, like barley, is typically planted in the autumn. Its growing season is longer than that of barley, so it is less tolerant of drought. Bread wheat threshes freely, so the grain is free of chaff after winnowing. It is therefore commonly preferred for food, as it needs less processing than either hulled barley or the glume wheats. The stems and leaves are tougher than those of barley, so it is not as good for fodder. Both six-row barley and bread wheat had been grown in central Asia since the Neolithic.[21]

Millets. Millets comprise a mixed group of small-seeded cultivated grasses from Asia and Africa. The two types found at Kyzyltepa are broomcorn millet (*Panicum miliaceum*) and foxtail millet (*Setaria italica*).[22] Broomcorn is recognised by its broad, short scutellum relative to the length of the grain and smooth lemmas, whereas foxtail has a narrow long scutellum relative to the length of the grain and the lemmas have papillae.[23]

Broomcorn millet (*Panicum miliaceum*). Sample B06 contains a lot of broomcorn millet. The glumes, which could be distinctive, have mostly not been preserved in the charred material (Fig. 2/a). One sample, B05 has quite a few uncharred, mineralised, smooth glume fragments from the same archaeological deposit as sample B06.

Foxtail millet (*Setaria italica*). Sample A contains a relatively high concentration of foxtail millet (Fig. 2/b). The papillae on the lemmas of a few of the seeds have been preserved. Some of the millet is clumped together in this sample.

Samples A and B06 may have some admixture of both broomcorn and foxtail, as the distinguishing characteristics of the scutellum are on a continuum. Nevertheless, most of the clearly identifiable specimens in A are foxtail millet and those in B06 are broomcorn. Millet rachises are almost never found because they are so fragile, yet one sample (B06) had two kinds of charred rachis fragments: very hairy ones of foxtail and slightly hairy ones of broomcorn. Found together with sample B06, which contained charred wood, barley, millet seeds, wild seeds, and dung, were a fragment from a grinding stone and fragments of cooking pots. Thus the area was probably used for food processing, and the rachises are most likely food-processing refuse.

Both broomcorn and foxtail millet were domesticated during the Neolithic and seem to have been first

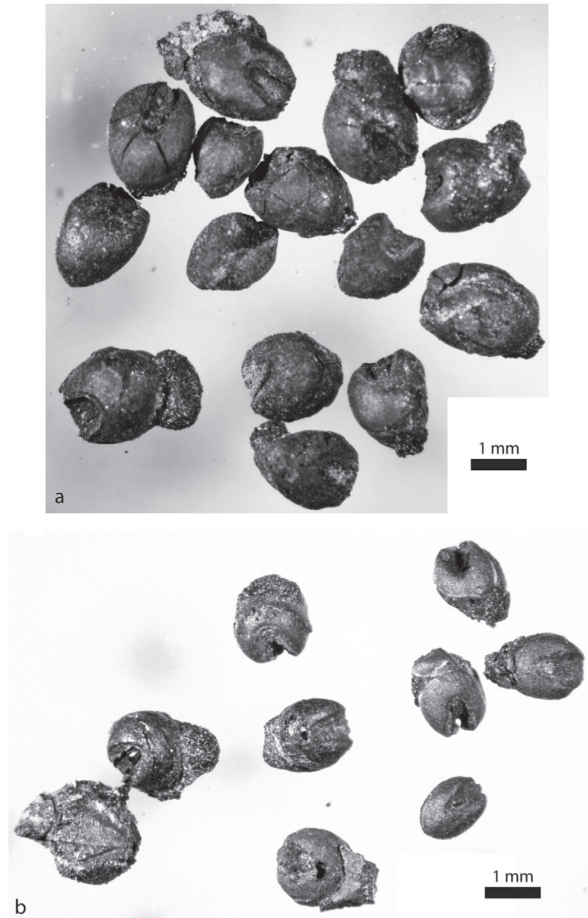

Fig. 2. Millet from Kyzyltepa: (a) Panicum miliaceum; (b) Setaria italica.

20 See Jacomet *et al.* 2006.
21 Charles and Bogaard 2010; Miller 2011b.
22 Hunt *et al.* 2008.
23 Neef *et al.* 2012; Nesbitt and Summers 1988; Lu *et al.* 2009.

grown in China by 5000 BC.[24] By the Iron Age (first millennium BC), broomcorn was grown across Eurasia. It had been cultivated in the Indus valley since Harappan times.[25] Both are warm-season plants that grow quickly, and may be harvested in as little as three months.[26] Although not an important crop today, villagers in the mountains of southern Uzbekistan grow it in gardens for porridge.[27] The discovery of millets at Kyzyltepa is particularly important, as it indicates summer irrigation.

Pulses. Pulses comprise a very small proportion of the Kyzyltepa remains: two whole and a few fragments of *Lens* (lentil), a single seed that is probably *Lathyrus* (grass pea), and some indeterminate fragments.

Fruit, nut, oil plants. A few fragments of grape seeds (*Vitis vinifera*), a stone fruit (*Prunus* spp.—cherry, plum, etc.), and nutshells were encountered. A single seed of flax (*Linum* cf. *usitatissimum*), probably the domesticated type, was also seen. The small numbers of these mostly fragmentary remains preclude firm conclusions about the economic role of fruits, nuts, and oil plants.

II.1.2. Wild and weedy plants

Seeds and plant parts of more than 40 species of wild plants from at least 20 plant families were recovered. Most of the identifications are only to the level of genus, which makes it impossible to know precise habitats; many of the genera are not determined with certainty (see Appendix). Most might have grown in fields or other disturbed areas, such as pastures. The comparative collection available to Miller includes plants of the southern Zagros and central Anatolia. Families of the most common types are discussed below. The rest of the types in the Appendix come from plant families that are represented by fewer than 20 seeds. "Wild" refers to plants that grow in uncultivated, relatively undisturbed areas, such as steppe, and "weedy" refers to ruderals and segetals that grow near settlements, along roads, and in cultivated and fallow fields. The comments are based on Miller's field experience at Gordion, Turkey, and information from the *Flora of Turkey*.[28]

Asteraceae (Daisy family). The most common type identified is *Centaurea*, a very complex genus with many species. *Cirsium*, *Koelpinea*, and *Scorzonera* are all herbaceous. *Artemisia* is either herbaceous or a sub-shrub that grows on uncultivated land. Three Asteraceae capitula (flower heads) were also seen.

Boraginaceae (Borage family). A number of seeds of *Heliotropium*, a small herbaceous genus with many species, were encountered.

Brassicaceae (Mustard family). Seeds of *Erysimum*, *Descurainia*, and *Lepidium*, and other unidentified members of the mustard family were seen in small numbers. Many of these types grow in ruderal (i.e. disturbed) areas. In addition, *Euclidium*, which has indehiscent siliques, was found; it, too, grows in ruderal areas, and is fairly common on archaeological sites in Central Asia.[29]

Amaranthaceae (Lamb's Quarters family). Seeds of several genera were identified: *Suaeda* is most numerous, but *Chenopodium*, *Salsola*, and an *Atriplex* bract were also seen. A small seed type characterised by a coiled embryo is most probably in the family, too. The Amaranthaceae includes the herbaceous genera identified here, but also woody types. Many are salt-tolerant, even to the point of growing on salt flats. They are an important component of the flora of the Turanian phytogeographic zone, which covers much of Central Asia.[30]

Cyperaceae (Sedge family). In addition to *Carex* and *Scirpus* seeds, there were some seeds of unidentified sedges and one stem fragment, recognised by its triangular cross section. Typically, sedges are wetland plants, and might grow in low-lying areas and along rivers, streams, and irrigation canals.

Fabaceae (Pea family). Representatives of the pea family found at Kyzyltepa include both spiny woody plants—*Alhagi* (camel thorn) and *Prosopis*—and herbaceous pasture plants— *Medicago*, *Trifolium* (clover), and *Trigonella*. The closely related, similar-seeded genera *Astragalus* and spiny *Astracantha* have hundreds of species that survive in a variety of habitats, which therefore cannot be easily characterised. Seeds, pods, leaves, and spines of camel thorn appear in these samples. The spines are round in cross section, straight, and taper at the tip. Camel thorn has been noted on several sites. Despite the thorns, it is collected as fuel and "grazed by camels, and no doubt by goats, sheep and

[24] Hunt *et al.* 2008, 2011; Zohary *et al.* 2012.
[25] Fuller *et al.* 2011; Jones *et al.* 2011.
[26] Cappers and Neef 2012.
[27] Pistrick and Mal'cev 1998.
[28] Davis 1965–88.
[29] E.g. at Anau North and Gonur; Miller 2003.
[30] Ovezliev *et al.* 1997, cited by Cywa 2011.

other animals when young".[31] The single *Prosopis* seed is not unexpected, given Kyzyltepa's location on an alluvial plain; *Prosopis* could be an indicator of "deep alluvial soils, especially those with shallow ground water".[32] There are not many identified seeds of the clover-like plants (*Medicago*, *Trifolium/Melilotus*, and *Trigonella*), but there are many in the category "small" Fabaceae, and these seeds are likely to be from these genera or other endemic steppe plants.

Poaceae (Grass family). Grasses are mostly plants of open ground. For the most part, they are easy to identify by family, but are difficult to identify by genus or species. *Aegilops* (goat-face grass) has recently been reclassified as a kind of wild wheat (*Triticum*). Several species grow in Central Asia, and they may be wild or weedy. The seeds are relatively large, and these samples also contain *Aegilops* glumes and glume bases. Single seeds of wild oat (cf. *Avena*) and *Phalaris* (canary grass) were seen. Two *Bromus* (brome grass) seeds were seen, as were two that were relatively long and thin which have been designated *Bromus sterilis*-type. The seeds of a common, small wild barley—*Hordeum* cf. *murinum*—were seen; this plant is fast growing and has awns that irritate the eyes of grazers, so it is common in overgrazed areas. The seed fragment designated *H. spontaneum*-type is too big to be *H. murinum*, and too thin and angular in cross section to be domesticated. *Poa bulbosa* (bulbous bluegrass), an important grass of the steppe, is represented by its propagules—bulblets—rather than seeds.

Sample A was filled with cultivated foxtail millet, but other samples have small flat seeds that compare with wild *Setaria*. Even less specific are a number of small millet-like seeds in sample B06, which are associated with very delicate hairy rachis fragments (Fig. 3/a, left), and may just be underdeveloped cultivated foxtail millet (i.e. *Setaria italica*).

Rubiaceae (Bedstraw family). *Galium* is a small herbaceous genus with many species. It is common in archaeological samples of West Asia.

Other plant parts. The *Papaver* (poppy) disk is about 2.8 mm in diameter; the shape is like *P. hybridum*, but it is rather small. In addition to identifiable plants and plant parts, there were various spines, leaves, phyllodes, twiglets, buds, and calyces. Very little can be done with these items.

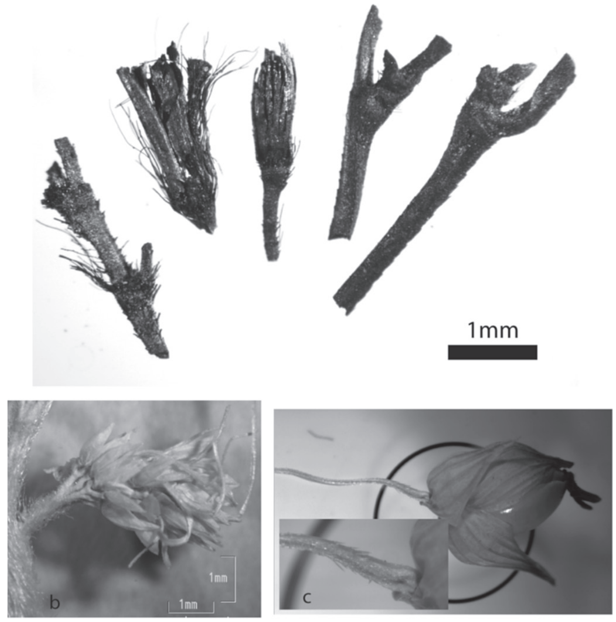

Fig. 3. Millet rachis fragments: (a) charred archaeological rachis fragments from sample B06. Three on the left resemble Setaria; two on the right resemble Panicum; (b) modern wild Setaria (note hairs); (c) Panicum miliaceum (note a few hairs) (photograph courtesy Xinyi Liu).

II.1.3. Wood charcoal

The main wood in the mountain forests of Uzbekistan is *Juniperus* (juniper), but *Fraxinus* (ash), *Salix* (willow), and *Populus* (poplar) also grow. The last three would be expected along streams.[33] At Kyzyltepa, several different types of wood charcoal were identified by comparison with modern woods and Schweingruber's wood atlas.[34] Charcoal was not examined systematically, but most of the identified pieces are ash wood. Wood is a bulky commodity, the transport cost of which is high. Wood fuel was therefore probably gathered within 50 km from the site.

In addition to ash, poplar/willow was seen as were uncertainly identified pieces of *Pistacia* (pistachio), juniper, and *Vitis* (grape) charcoal. In addition, two small pieces (*c.* 1 cm) of uncharred *Pinus* (pine) were seen.

[31] Townsend and Guest 1974: 502.
[32] Townsend and Guest 1974: 41.

[33] Vildanova 2006.
[34] Schweingruber 1990.

>50% above mean	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**B01**	**B04**	**B06**	**B08**	**B10**	**B11**	**B14**
High density overall	.	.	.	.	.	.	.	.	.	x	x	.	.	x	x
Charcoal (wt.)	.	.	.	.	.	.	.	.	.	x	x	.	.	x	.
Seed (wt.)	x	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Plant parts (wt.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Wild seed (count)	.	x	.	.	.	.	.	.	.	.	x	.	.	x	x
Millet (count)	x	.	.	.	.	.	.	.	.	.	x	.	.	.	.
Cereal (wt.)	x	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Dung (wt.)	.	.	.	.	.	.	.	.	.	x	x	.	.	.	x
Ratios															
Seed:Charcoal	x	.	.	.	.	.	.	.	.	.	.	.	.	.	x
Wild:Cereal	.	x	x	.	.	.	.	.	.	x	.	.	x	.	.

Table 2. Samples of unusually high density, seed:charcoal, and wild:cereal ratios.

II.2. Quantification

Most of the preserved plant material from Kyzyltepa is charred. In the absence of crop concentrations, the material is likely to be a combination of the incompletely burned remains of fuel and accidentally burned food remains. Between-sample composition is so variable that it is very difficult to make detailed comparisons in any meaningful way. It is also hard to see patterning, especially with so few samples from a narrow time range. Nevertheless, the assemblage as a whole can be characterised by major species, and the individual samples can be characterised with several ratios: density, seed:charcoal, wild:cereal (abbreviated from "wild or weedy":cereal), among others.[35] Samples with measures greater than 50% above the mean are singled out in the discussion below (Table 2).

Density of charred material is an indicator of the source and integrity of a deposit. For example, the charred material from a hearth with a high density of remains is likely to be *in situ*. The material in low-density mixed deposits is likely to consist of the redeposited charred material that constitutes the "background noise" from settlement activities like cooking, heating, and some craft production. By the density measure, the most "intact" samples are B04 (Unit 3, rm 2, on the citadel, near a fireplace, late period), B06 (from Lot 323, pre-citadel or the earliest occupation level, perhaps an area for food preparation or other functional space that was burnt down in a big blaze), B11 (Lot 121, a refuse pit in Trench V, late period), and B14 (pit 2, a pit for ash next to a furnace in a metallurgical workshop in Trench VII, early period). Density is calculated as weight in grams per litre of deposit of charred material greater than 2 mm per litre of deposit.

One of the few reported sites from mid-first-millennium Central Asia comparable to Kyzyltepa is Tuzusai.[36] Tuzusai is later (*c.* 410 BC–AD 150) and in a different environment zone, but cultivation creates its own niche. It is apparent that the crop and food types are broadly similar: both sites have six-row barley, bread wheat, foxtail and broomcorn millet, and grape. In addition, Kyzyltepa has a few pulses, and Tuzusai has naked barley as well as the hulled type. Although millet was found at both Tuzusai and Kyzyltepa, the cultivation of the crop had different roles in the local agricultural strategies. Tuzusai is in an area with summer rainfall, so millet was grown more for risk reduction than for crop intensification as at Kyzyltepa.[37] Seed weights are not available for Tuzusai, so the seed:charcoal and wild:cereal ratios discussed below use available West Asian examples.[38]

Insofar as intentional burning of vegetal material tends to be for fuel, charred plant remains in trash deposits are likely to represent fuel remains. Archaeological context and internal sample characteristics may suggest more complex interpretations. This is particularly the case for catastrophically burned structures and contents. Remains of woody plants such as wood, thorns, buds, and leaves, are most non-problematically interpreted as fuel; in areas where dung is burned for fuel, many seeds are likely to have come from that source. As a first approximation for fuel use, the seed:charcoal ratio has proved to be a useful way to

35 Miller 1988; Miller and Marston 2012.

36 Spengler *et al.* 2013.

37 Miller, forthcoming.

38 Miller and Marston 2012.

compare dung vs. wood. It is calculated as the weight of seeds and seed fragments greater than 2 mm divided by the weight of wood charcoal greater than 2 mm, effectively a cereal:charcoal ratio. Thus, this ratio may omit useful information if small seeded plants like millet were grown for fodder and comprise a significant component of the assemblage. Regardless, the median seed:charcoal ratio for these samples is 0.06, which is comparable to sites in the steppe forest of West Asia where a mix of dung and wood fuel were burned.[39]

In the rainfall agriculture zones of Anatolia and along the upper Euphrates, the wild:cereal ratio has proved to be a useful measure of ruminant grazing vs. foddering.[40] The wild:cereal ratio is calculated as the number of seeds of wild or weedy plants divided by the weight of cereal greater than 1 mm. Since millet may pass through even a 1 mm mesh, this ratio could omit useful information where millet is a significant component of the assemblage, but a sample would have to have many millet grains to affect the weight of the "cereal" variable.

II.3. The samples

No samples have pure crop remains and few of the excavated contexts are burnt, yet all samples with seeds have at least some wood charcoal. It is most likely that the seeds and wood were burnt under similar circumstances. Household rubbish deposits include daily hearth rake-outs as well as uncharred sweepings. Therefore, the bulk of the charred elements in these deposits is likely to be from fuel remains. The contexts of the deposits are consistent with household rubbish.[41]

Some samples are very easily explained as spent fuel. For example, Sample B04 is close to a fireplace and has much wood charcoal. Camel thorn seeds, pods, leaves, and spines along with many silicified grass stem fragments suggest brush fuel was used, and a seed embedded in charred dung provides a good argument that dung provided supplementary fuel too. Other samples that are most readily explained as mixed fuel remains are Samples B, C, D, E, G, H, B10, B11, and B12.

Some samples may have spilled food remains in addition to fuel. Samples F and B01 contain amorphous charred material that compares well with experimentally burned starchy "porridge" remains (Julia McLean and Katherine M. Moore provided Miller with these materials); B08 and B09 porridge includes testa remains that are consistent with hulled barley. Sample B06 has charcoal, weed seeds, and broomcorn millet as well as millet rachis fragments (Fig. 3) and some charred dung fragments, and thus is most likely a mixture of fuel and food or crop-processing by-products. Sample A contains a lot of millet and barley.

One sample (B05) may have millet-processing debris. Sample B05 came from an unfloated 5 x 5 x 5 cm chunk of soil. The remains were largely smooth, uncharred, probably mineralised, glume fragments (<2 mm) mixed with sediment. The only seeds in the sample were two charred *Panicum*. If the glume fragments are also from *Panicum* they might be a by-product of millet processing. It is plausible that the charred and uncharred items resulted from a single depositional event, because the charring effects in an open fire can be very variable.[42] In a charring experiment, Julia McLean[43] used a hand-held infrared pyrometer to take temperature readings in a natural fire and found very variable temperatures within centimetres.

Sample B07 may be associated with metalworking. B07 contains a lot of wood charcoal, and also scattered in the deposit are copper/bronze fragments and slag and bones. These varied remains are likely to be remnants of fuel from metalworking. If so, they may have been brought to the site as charcoal rather than wood. In contrast, despite coming from a pit next to a furnace for metalworking, Sample B14 is unlikely to be the rake-out from the furnace, since smelting requires charcoal, not wood, brush, or dung.

B13 and B14 have relatively little obvious fuel (i.e. wood charcoal); they also have cereals, wild/weedy seeds, plant parts, and dung.

II.4. Summary of archaeobotanical remains

Flotation samples at Kyzyltepa typically consist of wood charcoal and charred seeds, plant parts, and some dung fragments. At least three types of wood have been identified: ash, willow or poplar, and juni-

39 Miller and Marston 2012.

40 Miller 2010; Miller and Marston 2012.

41 Although many archaeobotanists argue against dung fuel as a significant source of charred seed remains in the West and Central Asian setting (see e.g. Wallace and Charles 2013), this is not the place to discuss this point.

42 Cappers and Neef 2012: fig. 94.

43 Personal communication.

per. Spiny plants like caper and camel thorn are well attested, and there are a variety of wild and weedy plants, such as grasses, sedges, small mustards and legumes, and other wild plants. The cultivated plants are primarily the West Asian domesticates (barley, bread wheat, lentil, grape, possibly flax) along with broomcorn and foxtail millet.

Dry farming is generally unsustainable with an annual precipitation of less than 250 mm.[44] Even when average precipitation is adequate, irrigation enhances crop security in areas of erratic climate. It is therefore almost certain that the Kyzyltepa barley and wheat were cultivated with supplementary irrigation. Supplemental irrigation increases yield and stabilises it from one year to the next.[45] Furthermore, concentrated demand for water in the spring might require a large-scale irrigation system.[46] The discovery of millets at Kyzyltepa indicates summer irrigation. Whether for food, fodder, or both, millet cultivation in this summer dry zone represents an intensification of land use as it increases production on the same amount of land.

III. ZOOARCHAEOLOGICAL RESULTS

This section describes the identification, analysis, and interpretation of 5353 animal bones and fragments, 1238 of which were identified to species or higher order taxa that were recovered from the 2011 excavations at Kyzyltepa.[47]

III.1. Materials and methods

The animal bones were collected by hand when encountered during excavation. In general, the bones were evenly distributed throughout the excavated deposits, with a few particularly rich samples from fills of an open-air platform, or the lower tier platform of the citadel (room/space 2, units 2 & 3, late period) in Trench I, and from fills of pits in areas near the citadel but in the lower town (late period), such as a pit (Lot 415) in Trench VI, and a pit (Lot 123) in Trench V. A significantly larger number of the bones are from deposits associated with the late period, when the site reached its greatest size (and presumably population). Alternatively, the late period material was buried more rapidly and was, therefore, better preserved. It could also be for both reasons. The material from the 2010 excavation was not recorded by locus; it is thus difficult to assess the spatial distribution of the bones.

The bones were identified using the comparative collection at New York University's Department of Anthropology. The initial sorting of the assemblages was carried out by advanced undergraduate students and the final identification and recording of the animal bones were completed by Crabtree. Animal bone measurements were taken following the recommendations of von den Driesch.[48] Estimates of ages at death for the domestic mammals were recording using both epiphyseal fusion of the limb bones[49] and dental eruption and wear.[50] Equid species were identified using dental remains following Eisenmann.[51] The animal bones were also examined for traces of butchery, burning, and bone working. The collection was recorded using the FAUNA program, a specialised data manager for archaeozoology.[52] The data will be published on the Alexandria Archive Institute Website (http://alexandriaarchive.org/), which allows open context publication of archaeological data.

III.2. Species identified

The counts of the species identified are shown in Table 3. Although the 2011 excavation season produced a larger number of identified animal bones, the patterns of animal use seen in the 2010 and 2011 assemblages are quite similar. The Kyzyltepa faunal assemblages are dominated by the remains of domestic caprines, including both sheep (*Ovis aries*) and goats (*Capra hircus*). The ratio of sheep to goat bones is just over 2:1 in both assemblages (Table 3). Sheep and goat bones are followed by those of domestic cattle (*Bos taurus*), pig (*Sus scrofa*), horse (*Equus caballus*), donkey (*Equus asinus*), and camel (*Camelus* sp.). The assemblage is typical of Iron Age assemblages in the Middle East,

44 Oweis and Hachum 2006: 58.
45 Oweis and Hachum 2006: 60.
46 Oweis and Hachum 2006: 66.
47 Dr Norbert Benecke (DAI) has kindly allowed us to include the identifications he made on the material from the 2010 season.
48 Driesch 1976.
49 Silver 1969.
50 Payne 1973; Grant 1982.
51 Eisenmann 1986.
52 Campana 2010; see also Crabtree and Campana 1987.

	NISP (2011)	NISP (2010)	NISP (Total)
Domestic mammals			
Sheep/goat	718	398	1116
Sheep (*Ovis aries*)	118	32	150
Goat (*Capra hircus*)	48	15	63
Cattle (*Bos taurus*)	213	116	329
Pig (*Sus scrofa*)	33	10	43
Horse (*Equus caballus*)	8	4	12
Donkey (*Equus asinus*)	12	4	16
Camel (*Camelus* sp.)	1	3	4
Dog (*Canis familiaris*)	5	9	14
Cat (*Felis catus*)	1	–	1
Domestic/wild mammals			
Equid	52	47	99
Domestic birds			
Chicken (*Gallus gallus*)	3	9	12
Wild mammals			
Goitered gazelle (*Gazella subgutterosa*)	8	5	13
Wild sheep (*Ovis* sp.)	–	3	3
Wild boar (*Sus scrofa*)	1	–	1
Onager (*Equus hemionus*)	–	1	1
Wolf (*Canis lupus*)	–	1	1
Corsac fox (*Vulpes corsac*)	5	1	6
Hare (*Lepus* sp.)	1	–	1
Wild birds			
Goose (*Anser* sp.)	10	3	13
Duck (*Anas* sp.)	1	–	1
Total	1238	662	2900

Table 3. Animal species identified in the 2010 and 2011 faunal assemblages from Kyzyltepa; the 2010 specimens were identified by Norbert Beneke (NISP: Number of identified specimens).

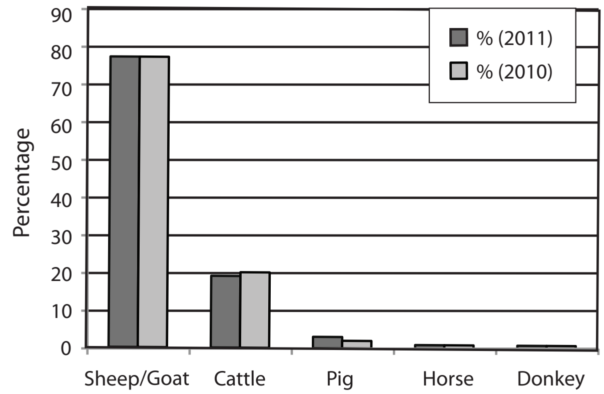

Fig. 4. Species ratios for the large domestic mammals—cattle, sheep/goat, pig, horse, and donkey—from the 2010 and 2011 excavation seasons at Kyzyltepa (data source: Table 3).

which are generally dominated by caprines, followed by smaller numbers of cattle and other domesticates. Commensal species including dog and a single cat bone were also identified, as were small numbers of domestic chicken bones; we did not fine-screen the deposits and therefore bird bone might be underrepresented in this assemblage.

Species ratios for the most common large domestic mammals are shown in Figure 4. The vast majority of the domestic mammal bones are from sheep and goat, followed by smaller numbers from cattle. Pig bones are quite rare. Only a small number of the equid remains could be assigned to species. Bones of donkeys (domestic asses, *Equus asinus*) outnumber those of true horses (*Equus caballus*), which is fairly typical for this period. A single bone of an onager (*Equus hemionus*) was identified. If we can assume that most of the unidentified equid bones represent horses and donkeys rather than onagers, then these species are somewhat more common than pigs in the faunal assemblages. Domestic chickens and wild geese have been identified from both the 2010 and 2011 faunal assemblages.

Ageing data for the sheep and goat mandibles (N = 27) show that caprines of all ages were present at Kyzyltepa, from suckling animals to elderly individuals with heavily worn teeth (Fig. 5), but a majority of the animals were culled in the later first, second, and third years of life (stages C, D, and E, ages over 6 months to 3 years). This culling pattern would be consistent with a husbandry pattern based on milk-production, meat-production, and/or herd security.[53] It is inconsistent with the specialised production of commodities such as wool and hair. Since the majority of the caprines are market-age animals, they could have been supplied by pastoral specialists (see discussion below), but the presence of very young and very elderly animals suggests that at least some of the sheep and goats may have been raised in and around the site. The older animals may represent breeding stock and/or animals that were kept for small-scale wool and hair production.

[53] Payne 1973; Redding 1984.

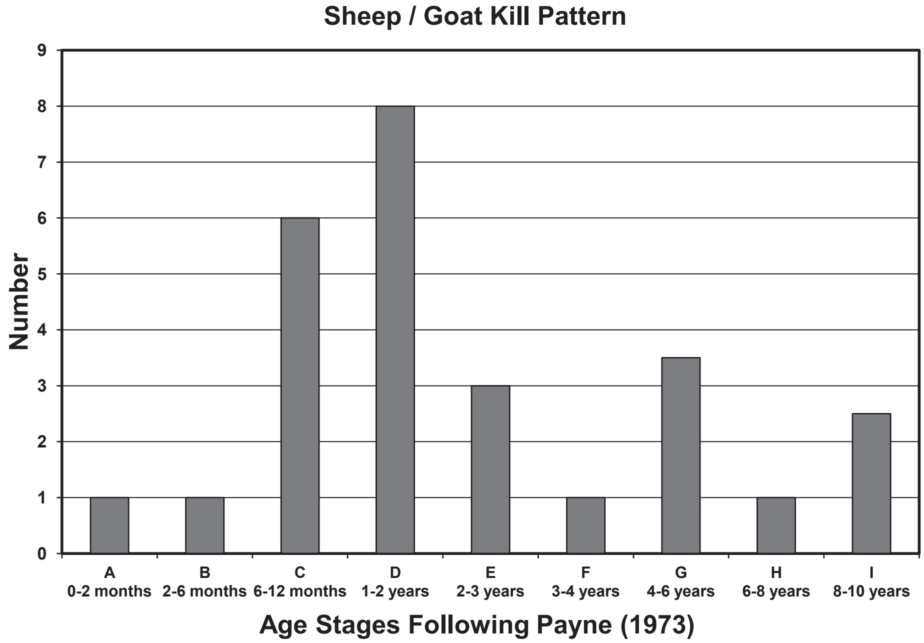

Fig. 5. Mortality profile for the sheep and goat mandibles from the 2011 excavation season at Kyzyltepa.

Both the 2010 and 2011 faunal assemblages include a diverse range of wild mammals and birds, although the numbers of these animals are quite low. The most common wild mammal is the goitered gazelle (*Gazella subgutterosa*), comprising 1% of the identified faunal material (eight bones from the 2011 assemblage and five from the 2010 assemblage have been identified). Although modern gazelle populations have declined markedly in Uzbekistan, goitered gazelles ordinarily occupied desert and semi-desert areas throughout the country, as well as foothills, mountain valleys, and plateaux. Bones of the corsac fox (*Vulpes corsac*) were also identified in both the 2010 and 2011 assemblages. The corsac is native to the steppes and semi-deserts of Central Asia. They are relatively slow runners and may have been hunted for their pelts. Small numbers of bones from other wild animals have also been identified in both assemblages. They include wild sheep (*Ovis orientalis*), wild boar (*Sus scrofa*), wolf (*Canis lupus*), onager, and a single bone that appears to be from a hare (*Lepus* sp.). Uzbekistan lies on a major north–south flyway, and the presence of bones of wild birds should come as no surprise. Bones of wild geese (*Anser* sp.) were recovered in both 2010 and 2011. A single crane (*Grus grus*) bone was found in the 2010 collection, and a single duck (*Anas* sp.) element was found in the 2011 assemblage.

III.3. Summary of zooarchaeological results

Most of the animal bones recovered from Kyzyltepa come from food animals, whether wild or domesticated. Numerically, caprine bones dominate the food remains, with about twice as many from sheep as from goat.[54] Sheep may have been kept for both meat and wool, while goats were probably kept for both meat and milk. Cattle bones are less numerous but still significant, especially since individual animals would have provided more meat and milk than caprines. Pig and chicken are present in small numbers. Wild animals are represented by ungulates, equids, hare, and both migratory and resident water birds. By bone count, the primary food mammals are domesticates, but the relatively few bird bones are about evenly split between domestic and wild. Among the non-

[54] The animal bone material recovered from the 2012–13 excavations at the Iron Age site of Tuzusai, Kazakhstan, and analysed by K. Lyublyanovics (2015: 506) also yielded a sheep-to-goat ratio of 2:1.

food animals represented, most are domestic work animals providing transport, traction, and protection (horse, donkey, oxen, and camel), but pelt-bearing wolf, corsac fox, and even hare appear. The dogs may have been useful for hunting and herding, and cats would have protected grain stores. The bulk of the animal bone remains comes from domestic animals. The steep valleys and hillsides would have been most suited for browsing goats, as this area does not seem to have been exploited for hunting. The presence of wild animals such as goitered gazelle, onager, and corsac fox indicates that the inhabitants of Kyzyltepa were making use of the steppe, desert, and valley areas that were well beyond the areas suitable for agriculture.

III.4. Comparisons with other sites

While there are not many detailed faunal analyses from Iron Age sites in Central Asia, the faunal remains from Ulug-depe in Turkmenistan[55] and the sites of Tuzusai and Tsenganka 8 in Kazakhstan[56] provide some interesting comparisons with the Kyzyltepa material. The species identified at Ulug-depe and their relative importance mirror Kyzyltepa rather closely. Sheep and goats were the most common domestic mammals identified at Ulug-depe, followed by cattle. Other domestic mammals included horses, donkeys, and dogs. The Iron Age inhabitants of the site also raised chickens and probably pig. They supplemented animal husbandry by hunting gazelles, wild sheep, wild goats, foxes, and possibly wild boars.

More detailed faunal information is available for Tuzusai and its adjacent site Tseganka 8 in Kazakhstan, which was excavated by Chang and her colleagues.[57] Quantitative data indicate that both assemblages were dominated by the remains of caprines (sheep and goats), followed by cattle and horses.[58] Smaller numbers of camel, donkey (domestic ass), and dog bones were also identified. Chang *et al.* argue that the diversity of the animal assemblage points to sedentary, village-based animal husbandry. They note that mobile pastoralists are more likely to specialise in a single type of animal, since different species have different water and pasturage requirements. In addition, they argue that the relatively high number of cattle would argue against mobile pastoralism, since cattle do poorly in dry, mountainous regions.

The ageing data for sheep and goats from Tuzusai and Tseganka 8 included evidence for neonatal and juvenile animals, suggesting that the animals were present at the site throughout the year. At Kyzyltepa the presence of neonatal, young juvenile, and juvenile animals (animals aged 0–2 months, 2–6 months, and 6–12 months) also indicate that at least some of the herds were present in and around the site throughout the year. These animals may have been grazed in areas around the site that were not suitable for agriculture. Some may also have grazed on the stubble in the fields, but many of the caprines at Kyzyltepa were culled between 1 and 2 years of age, which is appropriate for meat. The animals could have been provided by local residents who specialised in pastoralism or by pastoral nomads, but to prove this hypothesis we would need isotopic data.

The biggest difference between the Kyzyltepa faunal collection and assemblages from the sites in Kazakhstan is seen in the hunted animals. The Iron Age hunters in Kazakhstan focused on woodland animals such as red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), and wild pig (*Sus scrofa*), while the Kyzyltepa hunters preyed on open-steppe animals including the goitered gazelle and the onager.

IV. TEXTUAL EVIDENCE AND ARCHAEOBIOLOGICAL RESULTS FOR ANIMALS AND CROPS IN BACTRIA AND SOUTHERN CENTRAL ASIA

Contemporaneous written sources alluding to food production, consumption, and distribution during the Achaemenid period help to put the archaeobiological data from Kyzyltepa into its particular historical context. Meanwhile, the study of plant and animal remains from Kyzyltepa verifies, supplements, and questions the information derived from the textual sources. These sources include primarily administrative documents in the Elamite language from Iran (e.g. the Persepolis Fortification texts) and in Aramaic language allegedly from Afghanistan (i.e. the Aramaic Documents of Ancient Bactria, or ADAB) and textual

[55] MAFTUR 2012: 26.
[56] Chang *et al.* 2003.
[57] Chang *et al.* 2003.
[58] Lyublyanovics 2015: 506.

records of classical authors.[59] A comparison of the identified plant and animal taxa from Kyzyltepa and those recorded in the ADAB from Afghanistan shows a close parallel. The texts, dating to the late fourth century BC,[60] mention domestic animals, including animals such as cattle, sheep, goats, chickens, and geese, and animals that were used for transport, such as horses, donkeys, and camels. A provision list for a person named Bayasa, presumably the governor of Bactria or a person of very high status from there, contains the names and quantities of commodities that were distributed to him from Bactria's central economic institution when he travelled from Bactria to a place called Varnu—less than a couple of hundred kilometres from Kyzyltepa on the other side of the Amu Darya River in northern Afghanistan.[61] The list distinguishes different categories of domestic animals: for example, "sheltered bovine", "calf", and "grazing bovine" for cattle, and "sheltered sheep", "lamb", and "grazing sheep" for sheep.[62] These distinctions suggest a range of animal husbandry practices in Bactria, for example, whether the animals were pastured or stabled, and the distinction of the different age groups. The documents also mention the distribution of dairy products such as cheese and sour milk,[63] which also must have been produced at Kyzyltepa.

The discovery of bird bones from Kyzyltepa merits special mention. In the Achaemenid period, bird consumption was often associated with high social status. For example, geese were highly valued; fattened geese and goslings were standard fare at the royal table and were considered suitable as a royal gift.[64] A number of Elamite tablets from the Persepolis Fortification archive show that *ippur*, identified as geese, were an important component of the poultry supplied to the royal table.[65] The consumption of other types of fowl, as attested in the Persepolis Fortification texts, is also limited to the royal table, with very few telling exceptions (birds as a form of gift were given as extra rations to workers). Wouter Henkelman has observed that "within the institutional household economy centered on Persepolis, ducks, geese etc. were not intended as a staple commodity for workers, and not even used for the more regular bonus rations etc.".[66]

The Aramaic documents of ancient Bactria also mention geese as provisions to Bayasa and distribution of rations to geese (perhaps as fodder).[67] The geese from Kyzyltepa appear to be wild, but this does not conflict with the fact that geese were a valued food item. The appearance of wild geese at Kyzyltepa is especially tantalising since in the Elamite texts, a bird named *ippur* (probably goose) is in several cases contrasted with another type of bird, *kuktikka*, which Henkelman suggests is wild fowl (including wild ducks and geese) caught by fowlers, kept in captivity, and guarded and fed for a short period before being consumed at the king's table.[68]

According to classical authors, chicken was also consumed at the Persian king's table. Nevertheless, the Persepolis Fortification texts do not explicitly mention chicken; unless it is mentioned, but the bird's name in Elamite has not been recognised. A bird referred to as *šudabah* on the tablets from the archive, that was also a prestigious food item for the royal table, could refer to chicken, but the identification is not yet definite.[69] Put in this perspective, the attestation of geese and chicken as part of the provision to Bayasa in the Aramaic documents of ancient Bactria[70] is consistent with the recipient's high social status. The discovery of actual chicken bones at Kyzyltepa is significant, for it suggests that the birds were raised locally in Bactria. The consumption of chicken at Kyzyltepa further suggests that the settlement could have served either as a residence for some high-status people or as a base for supplying such birds to high-status people.

The role of wild mammals is less explicit in written sources. Texts by Greek authors suggest that wild animals such as gazelle and deer were provided for the Persian king's table.[71] Although consumption of gazelle is not explicitly mentioned in the Persepolis

59 Henkelman 2005: 139; 2010.
60 Naveh and Shaked 2012: 33–34.
61 For the identification of Varnu, see Naveh and Shaked 2012: 20–21.
62 Naveh and Shaked 2012: 178, 181.
63 Naveh and Shaked 2012: 178, 181.
64 See Henkelman 2010: 742.
65 Henkelman 2010: 681, 685, 714, 715, 720, 736, 741–44, 746, 748.
66 Personal communication.
67 Naveh and Shaked suggest that the rations for geese were in fact rations for their caretakers (2012: 27, 29, 33–34, 178, 195, 203, 205, 206, 210), evidence from the Persepolis Fortification archive shows that provisions were indeed distributed to geese and other animals as fodder (e.g. Henkelman 2010: 736).
68 Henkelman 2010: 744–46.
69 Henkelman 2010: 750.
70 Naveh and Shaked 2012: 178.
71 Henkelman 2010: 685–86.

Fortification archive, in ADAB an entry in the list of supplies, distributed presumably by Bactria's central economic institution, may refer to "wild animals of the mountain" (*gari-datika*).[72] If such identification is correct, it could mean that wild animals also formed part of the official food distribution system in Bactria during Achaemenid times. The Kyzyltepa assemblage, with its clear evidence of goitered gazelle, provides confirmation of the consumption of game animals in Bactria.

Many of the food and fodder plants mentioned in the Bactrian documents are attested at Kyzyltepa: wheat, barley, millets, and stone fruits (species of *Prunus*), as well as processed flour. Millet was given to servants and slaves and, therefore, was probably considered a low-status food. In addition to food, the texts mention barley and straw for fodder. The amount of barley and millets disbursed is usually given in the texts, but not that of wheat. Meanwhile, the documents mention the allocation of different grades of flours—finest (*smyd*), fine or "white" (*hwry*), and ordinary (*dmy*). The finer grade flour was distributed to higher-status people and to the temple for ritual purposes; the lower grade was reserved for ordinary people.[73] Because wheat is not quantified, Naveh and Shaked postulate that, "the sequence of three types of grain (i.e., barley, wheat, and millets) is a mere linguistic topos, and that wheat was not actually grown or used."[74] The presence at Kyzyltepa of bread wheat and six-row barley rachis fragments, together with unspecified straw culm nodes and silicified awns, demonstrates that these crops were indeed grown and consumed in Bactria and southern Central Asia. The fact that wheat is not quantified, like barley and millet, in the allocation lists is perhaps because wheat was distributed only in the form of flour.

Preliminary results from the analysis of archaeobiological samples, combined with the administrative documents from ancient Bactria, give a snapshot of vegetation, agro-pastoral production, hunting practices, and diet from the Achaemenid Empire's Central Asian frontier. Kyzyltepa is situated right next to the southern- and westernmost of a series of historical transhumant routes that descend from the mountains embracing the Sukhandarya Valley.[75] Its position between settled agricultural communities and pastoral specialist groups encourages us to consider the roles that these different communities played in Kyzyltepa's animal economy.

In general, Achaemenid period food production in southern Central Asia included two seemingly opposite characteristics: both extensive and intensive land use. It is clear that caprines were an important component of the food supply, whether raised by the inhabitants of Kyzyltepa specialised in animal husbandry or by non-resident pastoral specialists. Yet, the Achaemenid Empire saw an expansion of agricultural production and development of irrigation networks, including qanat building; tapping into groundwater, qanats provide dependable year-round water flow.[76] With regard to intensive agriculture in southern Central Asia, one might expect most crops to be irrigated; irrigation is especially necessary in the Surkhandarya region, given its relatively low rainfall. Kyzyltepa is at the edge of the rainfall agriculture zone. The charred archaeobotanical assemblages support the inference that even the winter crops at Kyzyltepa were irrigated. Six-row barley is more water-demanding than the two-row type, and bread wheat, too, may be associated with irrigation.[77] Seasonal droughts characterise the region and the summer crops, such as the millets, would therefore have been irrigated too. Several of the wild plants, most notably the sedges (Cyperaceae), are a further indication of moist soil conditions, perhaps along uncultivated stream sides or the edges of irrigation channels.

Comparison of the plant and animal remains with those from other sites permits a preliminary assessment that puts agro-pastoral practices at Kyzyltepa in perspective. The study of plants and animals from other Central Asian Iron Age sites provides useful information that allows us to situate Kyzyltepa within its particular regional scope and potentially within the longer-term regional transition to agro-pastoralism; the methodology used for interpreting the archaeobiological material from Gordion in central Anatolia would be particularly useful because it can offer a more nuanced understanding of the relations between the natural ecological environment and agro-pastoral practices at Kyzyltepa. Gordion has one of the few

[72] Naveh and Shaked 2012: 217.
[73] Naveh and Shaked 2012: 33–34.
[74] Naveh and Shaked 2012: 34.
[75] Stride 2005, V.5: fig. 45.
[76] Even before the Achaemenid period, irrigation agriculture and steppe pastoralism seem to have coexisted and are archaeologically represented by low-density fortified settlements in Iron Age Khorezmia (Negus Cleary 2013).
[77] E.g. Helbaek 1972.

Gordion YHSS phase	YHSS 8/9	YHSS 7	YHSS 6	YHSS 5	YHSS 4	YHSS 3	YHSS 2	YHSS 1	Kyzyltepa
Approximate dates	1500–1200 BC	1200–950 BC	950–800 BC	800–540 BC	540–330 BC	330–150 BC	1st–5th cent. AD	13th–14th cent. AD	
No. flot. samples	32	78	21	43	108	118	26	19	14*
Seed:Charcoal (median)	0.17	0.28	0.07	0.03	0.21	0.22	0.04	0.06	0.06
Wild:Cereal (mean)	210	171	133	150	236	337	300	775	1716
% Sedge (Cyperaceae)[1]	6.3	7.8	5.8	14.9	16.1	12.2	28.4	27.8	7.7
% Caprines[2]	81	85	82	57	67	81	no data	79	78
Sheep/Goat	2.34	1.34	1.95	1.20	1.17	1.43	no data	1.26	2.38
Caprine, pig, cattle total	2239	3096	1591	1768	2133	1307	no data	872	1701
Identified sheep, goat total	147	307	121	194	206	1072	no data	95	213

1 Relative to wild seed count total
2 Relative to total bone count of caprines, cattle, and pig

*Table 4. Comparison of some basic measures at Gordion and Kyzyltepa. Gordion data from Miller 2010, Marston and Miller 2012, Zeder and Arter 1994. Shaded figures show which variables are most similar to those of Kyzyltepa. * Excludes porridge sample B08.*

site reports with integrated results for archaeobiological remains. Although the specific historical and ecological circumstances differ, both settlements date to the sixth-fourth centuries BC and there are some basic similarities in environment and agro-pastoral practices: winter-sown cereals, domesticated animals outnumbering wild ones, seasonal variation in precipitation. There are differences in the situations of the two sites, but at least the results from Gordion are reported in a similar way (Table 4). In addition, the long Gordion sequence provides a picture of a range of possible agro-pastoral strategies and how they may change over time.

Three broadly defined signatures for agro-pastoral regimes were found at Gordion based on bone counts of major food animals, the wild:cereal ratio, and the percentage of seeds of moisture-loving plants.[78] The wild:cereal ratio varied with the proportion of caprines relative to cattle and pig. When caprines were most important, herds were grazed on pasturelands and cultivation focused on dry-farmed cereal production (Table 4: YHSS 8/9, 7, 6, 3). A fairly intensive agricultural regime focused on cereal farming, cattle and pig husbandry, feeding animals with cultivated plants or on field stubble, and some irrigation of some crops, as evidenced by a relatively low wild:cereal ratio, low caprine percentages, and many sedges, which are plants of moist ground (YHSS 5); and a system that combined wide-ranging pasturing of caprine herds, cereal farming, and irrigation of summer crops—cotton, millet, and rice—prevailed in the mediaeval period (YHSS 1) at Gordion.

YHSS 4 is contemporary with Kyzyltepa, yet its assemblage least resembles that of Kyzyltepa. Rather, the Kyzyltepa assemblage is similar to that of mediaeval Gordion (YHSS 1) in three key aspects: an increased emphasis on year-round agricultural pursuit is relatively strong; the amount of sheep and goat relative to cattle and pig combined with a high wild:cereal ratio indicates a strong pastoral component to the local economy. The two millet samples—one from the earliest level and the other from the latest—show that summer irrigation was practised. Cultivation of millets is also attested in the Aramaic documents of ancient Bactria, which mention that millets were distributed for sowing from June to July.[79] Overall, the assemblage from Kyzyltepa is similar to Gordion's during the mediaeval period, where there was intensive irrigation of summer crops.

Herd composition reflects economic strategies: milk production (many females, especially sheep), meat or fibre production (many castrated males; sheep for wool, goats for hair);[80] food security (many females, with a mix

78 Miller *et al.* 2009; Miller 2010, 2011a.

79 Naveh and Shaked 2012: 199, 205. Distribution of seeds for sowing may have occurred in the same season as canal digging in Bactria, but this is not yet certain (2012: 115).

80 The Persepolis Fortification archive does not mention wool and dairy products (Henkelman 2005: 139), but Henkelman (2008: 84) believes that wool and wool products must have been essential for the Persepolis economy. The Aramaic documents of ancient Bactria do record the distribution of cheese and sour milk (Naveh and Shaked 2012: 178, 181).

of sheep and goat).[81] Often considered the poor man's cow, goats survive on poorer pasture than either sheep or cattle. They are commonly kept for dairy production, rather than for meat, even though the fat content of their milk is lower than that of sheep. The age and species composition of the Kyzyltepa assemblage supports the view that the settlement's meat was provided by pastoral specialists who raised animals for market rather than by subsistence farmers or herders selling spare animals. In the market, lamb and mutton might be preferred over goat for their higher fat content.[82] The high proportion of market-age sheep (1–3 years old) suggests that some of the animals may have been purchased from pastoral specialists for meat consumption; on the other hand, the presence of a few older sheep in the bone assemblage may indicate that the inhabitants of Kyzyltepa also kept some animals for wool production. These old animals, together with a few very young sheep and goats, would have been kept close to the settlement, at least for part of the year. Present evidence does not suggest that a consignment system, as might have been practised to keep institutional herds in the Persepolis area, operated at Kyzyltepa.[83]

V. CONCLUSIONS AND FURTHER QUESTIONS

We can imagine an open landscape of fields and pasture, with some trees along streams or in groves. Flocks of sheep and goat would graze mainly on uncultivated pasture. Needing surface water, cattle (and pig) may have been kept closer to home. Fields of winter-growing barley and wheat would have been harvested by summer, and millet, lentil, and garden crops would have grown in the summer. The extent of the irrigated fields is not revealed by archaeobotany. Some of the charred wild seeds as well as domesticates may have come from animal dung burned as fuel. Barley is by far the most common cereal in these samples, but may have come from burnt dung rather than burnt food stores. Grape would have added some sweetness to the diet, and wild game from the uplands would have added some variety. The uplands also provided wood for fuel, and could have been the summer pasture grounds.

The faunal assemblage shows that the people of Kyzyltepa practised sheep, goat, and cattle husbandry. All of these species had arrived as domesticates during the Neolithic. Chicken appears to be a relatively minor food item but its consumption could have had important social significance. Pig is rare. The animal bones from the pre-Achaemenid Iron Age levels at Ulug Depe show a notable growth in the number of chicken and pig/wild boar; the consumption of such animals at Kyzyltepa indicates the continuation in the broadening of the food repertoire in Central Asia since the early Iron Age. Horses, donkeys, camels, and oxen would have been raised for transport and traction. Some of the sheep and goats may have been supplied by mobile pastoralists. Food from domestic livestock was supplemented by the hunting of a range of wild birds and mammals of which goitered gazelles were the most numerous. Some animals were most likely to have been hunted for their pelts.

The Kyzyltepa samples examined so far do not include any new cultigens, but they are important for opening a window on the agriculture of a poorly known area and period. The cultivation of summer and winter crops shows a year-round commitment to agriculture that reflects a relatively intense cultivation regime that included both risk reduction and production enhancement strategies, and millet cultivation at Kyzyltepa provided a way to extract more food from the same amount of land. This intense cultivation regime is probably a consequence of the Achaemenid domination in Central Asia, which both required and accommodated the intensification of agricultural production and expansive land use. In other words, the Achaemenid administration in Central Asia must have significantly stimulated the economic growth of the region, which led to the expansion of settlements. The collapse of the Achaemenid imperial power and subsequently its support to the local economy could have been the key factor for the decline of Kyzyltepa. If the collapse of Achaemenid imperial power resulted in a breakdown of the organisational and physical requirements for maintaining the agricultural infrastructure, it might explain the decline of Kyzyltepa as well as the occupation history of the whole Mirshade oasis—the appearance of the large settlement system at Kyzyltepa and its immediate vicinity during the Achaemenid period and the absence of sites in the area thereafter.

The archaeobiological data from Kyzyltepa illustrate an economy that is based on the integration of

[81] Redding 1984.
[82] deFrance 2009; Falconer 1995; Zeder 1991: 38, 162.
[83] See Henkelman *et al.* 2006.

herding and farming and that has a strong pastoral component. The material offers another perspective for understanding the function of the site, which was established on a new foundation at the empire's very frontier zone. The site, which was probably a major node on the Achaemenid road network, could also have served as a frontier base for the Achaemenid regime to interact with the nomadic pastoralists or to expand further its boundaries into their territory.[84] The heavy pastoralist component of the economic strategy at Kyzyltepa offers clues about the pattern of interaction between the sedentary population and mobile societies. It recalls a peculiar administrative practice that Achaemenids employed to engage with the agro-pastoralists in the Zagros region in western Iran. As Henkelman has described it,[85] the Achaemenid economic institution at Persepolis exchanged grain for livestock from local pastoralists by spending its agricultural surplus to acquire animals to meet the demands for sacrifice and other uses. The exchange involved gifting and counter-gifting between the Great King and the local tribes; and it was based on a fixed rate established upon agreement made annually between the two sides. The exchange might have taken place at the empire's storehouse or at a certain place where the mobile pastoralists lived or gathered.[86] If this proposition were indeed correct, we may imagine that Kyzyltepa was one of such gathering places, but more evidence would be needed to address this issue.[87] Relevant to the discussion would again be the question of who the true power-holder was at Kyzyltepa: the administrator of the Great King or the local leader representing the interests of the pastoral societies?

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[84] Wu, forthcoming, b.
[85] Henkelman 2005: 159–65.
[86] Henkelman 2005: 164.
[87] We are grateful to Christopher Tuplin, University of Liverpool, for drawing our attention to Henkelman's study on the subject. Other possible exchanging places may include Talashkan Tepa I in southern Uzbekistan; Wu, in preparation, Chapter V.

X. Wu
Department of the History of Art, University of Pennsylvania
3405 Woodland Walk
Philadelphia, PA 19104
USA
and
Institute of History
Beijing Normal University
No. 19, Xin Jie Kou Wai St., Hai Dian District
Beijing 100875
P.R. China
wuxin@sas.upenn.edu

N.F. Miller
University of Pennsylvania Museum, Near East Section
3260 South Street
Philadelphia, PA 19104
USA
nmiller0@sas.upenn.edu

P. Crabtree
Department of Anthropology
New York University
New York 10003
USA
pc4@nyu.edu

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APPENDIX

Kyzyltepa botanical samples

Flotation sample	**A***	**B***	**C***	**D**	**E**	**F***	**G**	**H**	**B01**	**B04***	**B06***	**B08***	**B10**	**B11***	**B14**
Trench	II	II	II	IV	IV	IV	I	I	I	I	III	III	V	V	VII
lot, other information									Unit 3, fl 3	Unit 3, rm 2	323	312	119	121	pit 2
Volume, litre or bucket	⅓ bkt	1 bkt	1 bkt	1 bkt	1 bkt	1 bkt	½ bkt	1 bkt	12	n/a	10	12	8	4	6
Volume sample, cc	20	10	10	2	20	25	5	15	5	50	100	5	7	50	125
Charcoal >2, wt.	0.25	0.20	1.05	0.14	1.28	1.39	1.23	2.28	0.91	6.33	5.26	1.04	0.69	4.73	0.64
Seed >2, wt.	0.58	0.03	0.07	0.02	0.09	0.07	0.03	0.02	0.13	0.06	0.29	0.11	0.01	0.17	1.08
Misc. plant parts >2, wt.	.	.	.	.	+	.	.	.	+	0.01	0.12	.	0.01	0.01	0.96
Seed:Charoal	2.32	0.15	0.07	0.14	0.07	0.05	0.02	0.01	0.14	0.01	0.06	0.11	0.01	0.04	1.69
Wild	33	234	146	5	124	102	7	2	39	164	279	8	49	126	301
Wild:Seed	57	7800	2086	250	1378	1457	233	100	300	2733	962	n/c	4900	741	279
Wild:Cereal	46	5850	3650	500	1378	1457	350	100	229	3280	996	28	4900	969	324
Cultivated, food															
Hordeum, wt.	0.61	0.04	0.04	0.01	0.06	0.03	0.02	0.02	0.11	0.03	0.28	0.18	0.01	0.09	0.64
Triticum aestivum/durum, wt.	.	.	.	.	0.01	.	.	.	.	.	.	0.11	.	0.02	0.15
Cereal, wt.	0.11	+	.	.	0.02	0.04	+	+	0.06	0.02	.	.	.	0.02	0.14
Cereal porridge, wt.	.	.	.	.	.	.	.	.	.	.	.	0.26	.	.	.
Panicum	.	.	.	.	.	.	+	1	9	19	2093	.	2	.	.
Setaria and equivalent	1526	9	.	.	.	1	.	.	.	1	.	.	.	.	3
Setaria/Panicum	6	.	.	.	.	.	.	.	.	15	.	.	.	.	.
Poaceae-millet-like, flat	.	.	.	.	.	.	.	.	.	.	89	.	.	.	.
Poaceae, in glumes, hairy pedicel	.	.	.	.	.	.	.	.	.	.	80	.	.	.	.
cf. Lathyrus, no. (tot. wt.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Lens, wt.	.	0.02		.	.	+	.	.	.	.	+	.	.	0.02	.
Pulse, wt.	.	.	0.01	.	0.02	0.02	.	.	.	.	.	.	.	+	0.02
Prunus, wt.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.
Vitis, wt.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+
Linum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Nutshell, wt.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.
Wild or weedy															
cf. Artemisia	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Centaurea	.	.	.	.	1	1	.	.	.	.	.	.	.	1	22
cf. Cirsium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1

*Notes on some samples:
Sample A. Upper ancient surface, phase II of late period. About half (10 cc) of the flotation residue consisted of vitrified fragments, perhaps from melted phytoliths.
Sample B. Surface below that of Sample A, phase I of late period.
Sample C. Surface below that of Surface B, phase I of late period.
Sample F. Upper layer, late period.
Sample B04. Dung fragments included one with an embedded grass seed. Also many silicified grass stem fragments.
Sample B06. Earliest level.
Sample B08. Outdoor surface, same as B09.
Sample B11. Identified charcoal is ash (*Fraxinus*).

Flotation sample	A*	B*	C*	D	E	F*	G	H	B01	B04*	B06*	B08*	B10	B11*	B14
Koelpinea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Scorzonera-like	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Asteraceae, indet.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Heliotropium	3	.	4	.	.	15	.	.	1	4	9	.	.	10	9
cf. Descurainia	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Erysimum	1	.	.	.	.	2	.	.	.	.	.	.	.	.	.
cf. Lepidium		.	1	.	.	.	.	.	.	.	.	.	.	.	.
Brassicaceae, indet.	1	1	.	.	.	.	.	.	2	.	12	.	.	5	.
cf. Capparis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
cf. Vaccaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Chenopodium	.	.	.	.	2	3	.	.	.	.	.	.	.	6	.
cf. Salsola	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.
Suaeda	2	7	5	2	12	9	3	.	1	34	6	.	4	5	3
Chenopodiaceae-coiled embryo	.	71	20	.	.	.	.	.	.	.	.	.	.	.	4
Chenopodiaceae, indet.	3	.	.	.	.	.	.	.	2	8	14	1	1	3	.
cf. Carex	3	34	2	.	.	.	.	.	.	3	.	.	.	25	25
Scirpus	.	.	.	.	.	.	.	.	.	.	17	.	.	1	.
Cyperaceae indet.	4	3	.	.	1	.	.	.	1	10	4	.	.	2	.
Alhagi	.	3	4	1	89	6	2		14	53	6	.	.	12	52
Astragalus	.	.	7	.	.	.	.	.	.	.	5	.	.	.	.
Medicago	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1
Prosopis	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Trifolium (in calyx)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Trifolium/Melilotus	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.
Trigonella	1	3	6	.	.	1	.	.	.	1	7	.	4	13	5
Fabaceae indet	2	70	70	.	1	42	.	1	.	.	10	.	34	.	1
Ziziphora	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Lamiaceae, indet.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Ornithogalum-type	.	1	.	.	.	.	.	.	.	.	.	1	.	.	.
Liliaceae, indet.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	2
cf. Malva	.	.	.	.	.	.	.	.	.	.	2	.	.	.	1
Papaver	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.
Aegilops	.	4	1	.	.	.	.	.	1	.	5	.	.	.	.
cf. Avena	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Bromus sterilis-type	.	.	2	.	.	.	.	.	.	.	.	.	.		.
Bromus	.	1	.	.	.	.	.	.	.	.	1	.	.		.
Hordeum cf. murinum	.	9	.	.	1	1	.	.	.	.	1	.	.	1	.
Hordeum spontaneum-type	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Phalaris	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Poa bulbosa bulblet	.	.	.	.	1	2	.	.	1	.	4	.	.	.	2
Poaceae indet	2	15	17	1	.	.	.	1	5	22	106	5	1	3	58
cf. Setaria, small	.	.	1	.	2	3	.	.	1	.	.	1	.	.	.
Setaria viridis/verticillata	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Portulaca	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.

Flotation sample	**A***	**B***	**C***	**D**	**E**	**F***	**G**	**H**	**B01**	**B04***	**B06***	**B08***	**B10**	**B11***	**B14**
Adonis	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.
Ceratocephalus	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Galium	.	3	.	1	5	1	1	.	.	.	33	.	.	19	4
Veronica	1	.	.	.	1	1	.	.	.	2	.	.	.	.	.
Thymelaea	.	2	.	.	.	1	.	.	.	.	.	.	.	2	.
Verbena	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Unidentified seeds	10	6	3	.	8	10	.	.	10	24	30	.	3	16	103
Plant parts															
Asteraceae capitulum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Euclidium silique	.	1	3	.	.	3	.	.	.	.	2	.	1	.	6
Brassicaceae, silique	1	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Capparis spine	.	.	.	.	.	.	.	.	.	.	.	.	.	1	
Caryophyllaceae capsule	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Atriplex bract	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Cyperaceae stem frag.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Alhagi leaf	.	.	.	.	1	.	.	.	1	4	23	.	1	7	151
Alhagi pod segment	.	.	.	.	2	+	.	.	2	2	.	.	.	1	7
Alhagi spine	.	.	.	.	.*	.	.	.	.	5	8	.	.	1	50
Fabaceae calyx	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
Papaver disk	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aegilops glume base	+	.	.	.	.	.	.	.	1	.	8	.	.	.	.
Aegilops glume	.	.	.	.	.	.	1		.	.	.	.	.	.	.
Hordeum/Triticum rachis frg	.	.	.	.	.	.	.	.	.	.	.	.	.	.	61
H. hexastichum internode	9	.	.	.	.	.	.	.	.	.	.	.	.	.	221
Hordeum internode	.	1	2	.	.	.	.	.	1	1	20	.	.	4	46
Hordeum rachis base	.	.	.	.	.	.	.	.	.	1	.	.	.	.	12
Triticum aestivum glume base	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
T. aestivum glume base, robust	.	.	.	.	.	.	.	.	.	.	.	.	.	.	36
T. aestivum glume base, slender	.	.	.	.	.	.	.	.	.	.	.	.	.	.	54
Triticum rachis basal collar	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Poaceae culm node	.	17	.	.	1	1	.	.	1	.	6	.	.	.	144
Poaceae, hairy slender rachis frg	.	.	.	.	.	.	.	.	.	.	41	.	.	.	.
Poaceae, misc rachis frags	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13
Other															
Dung (sheep/goat pellet #, wt.)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7 (0.10)
Dung fragments unspec. (wt.)	.	.	+	0.02	.	.	.	.	.	0.10	0.08	.	.	.	.

Other samples, not floated	**B04a**	**B04b**	**B05**	**B07***	**B09***	**B12***	**B13***
Trench	I	I	III	III	III	V	VII
lot, other information	Unit 3, rm 2	Unit 3, rm 2	323	304	312	121	pit 2
Volume, litre or bucket	n/a	n/a	0.125	n/a	200	n/a	50
Volume sample, cc	1	50	1	100	15	10	20
Charcoal >2, wt.	0.02	15.83	0.07	30.5	0.74	1.45	0.83
Seed >2, wt.	0.08	.	.	.	1.18	0.72	0.71
Misc. plant parts >2, wt.	.	.	.	.	.	.	1.13
Cultivated, food							
Hordeum, wt.	0.06	.	.	.	1.17	0.48	0.48
Triticum aestivum/durum, wt.	.	.	.	.	0.01	0.04	0.12
Cereal, wt.	.	.	.	.		0.05	0.05
Cereal porridge, wt.	.	.	.	.	0.92	.	.
Panicum	.	.	2	.	.	.	.
cf. Lathyrus, no. (tot. wt.)	.	.	.	.	.	4 (.06)	.
Lens, wt.	.	.	.	.	.	0.01	.
Pulse, wt.	.	.	.	.	.	0.05	.
Vitis, no. (tot. wt.)	.	.	.	.	.	1 (+)	.
Wild or weedy							
cf. Alhagi	.	.	.	.	.	.	5
Fabaceae, indet	.	.	.	.	.	1	.
Poaceae, indet	.	.	.	.	.	.	1
Galium	.	.	.	.	.	1	1
Unidentified seeds	.	.	.	.	.	.	1
Other							
Dung (sheep/goat pellet, wt.)	.	.	.	.	.	0.09	.
Dung fragments unspec. (wt.)	.	.	.	.	.	.	0.54

Sample B02, B03. Two pieces of pine, rectangular in cross section. Uncharred, they look modern, but their context is ancient. B02 is about 10 x 12 x 98 mm and B03 is about 11 × 11 × 85 mm.
Sample B07a, b. Ashy area on top of citadel wall. There were two containers for this sample (ca. 100 cc, ca. 200 cc). The smaller container was labeled "washed," and the larger one does not appear to have been washed/floated. For B07a, of the 20 pieces examined, 16 were ash (*Fraxinus*, representing about 90% of the examined pieces, 3 possibly pistachio (*Pistacia*) and 1 juniper (*Juniperus*). In a separate vial were some small pieces of juniper. For B07b, large chunks of ash (*Fraxinus*) were identified (10 pieces), and the general aspect of the remainder of the sample looked similar. The sample represents only a small portion of the charcoal from this archaeological context. Scattered in the deposit are also copper/bronze fragments and slag and bones. These varied remains are likely to be remnants of fuel from metalworking. If so, they may have been brought to the site as charcoal, rather than wood.
Sample B09. Outdoor surface, same as B08. Coarse-sieved. Similar to >2 mm fraction of B08.
Sample B12. Same as Sample B11. Coarse-sieved; similar to the >2 mm fraction of B11.
Sample B13. Same as Sample B14. Coarse-sieved similar to the >2 mm fraction of B14.