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# From Food and Fuel to Farms and Flocks: The Integration of Plant and Animal Remains in the Study of the Agropastoral Economy at Gordion, Turkey

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## **Keywords**

Gordion, botanical, agriculture

## **Disciplines**

Archaeological Anthropology | Biological and Physical Anthropology

## **Comments**

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## From Food and Fuel to Farms and Flocks

### The Integration of Plant and Animal Remains in the Study of the Agropastoral Economy at Gordion, Turkey

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#### CA+ Online-Only Material: Supplement A

The site of Gordion, Turkey, provides a case study of the integrated use of archaeobiological data. Associations between botanical and faunal remains suggest a continuum of land-use practices. At one end, high ratios of the seeds of wild plants versus cultivated cereal grains (calculated as count/weight) and high proportions of the bones of sheep, goat, and deer are signatures of a subsistence economy focused on pastoral production. At the other, low wild/cereal ratios along with high proportions of the bones of cattle, pig, and hare indicate an economy more focused on agriculture. Based on the millennium-long sequence analyzed, the most sustainable land use around the ancient settlement emphasized pastoral production; only during the wealthy Middle Phrygian period did high population support greater reliance on agriculture.

Since 6000 BC, subsistence economies across most of West Asia have been characterized by a mix of plant and animal domesticates. Initially, these agropastoral economies were based on cereals, pulses, sheep, goat, cattle, and pig. As other taxa were added to this mix, the range of domestic crops and livestock and the relative importance of different domesticated species varied over time and space. The alternation between economies more oriented toward pastoralism, characterized by mobility and extensive use of natural resources, and those oriented more toward agriculture, characterized by intensive extractive strategies in circumscribed areas, is one of the most pervasive themes in the history of this region. The last 20 years have witnessed remarkable advances in the separate study of archaeological plant and animal remains left by these societies and in our ability to reconstruct the pastoral and agricultural practices responsible for their deposition in ar-

chaeological sites. There have been fewer advances, however, in the integration of these archaeobotanical and archaeozoological studies into a coherent understanding of how these agropastoral economies worked as a whole. Excavation at Gordion, Turkey, has yielded an assemblage of plant and animal remains that together provide a rich interpretation of changing land-use strategies.

### The Nature of Archaeobiological Samples: Lessons from Tal-e Malyan

There are several reasons for slow progress in this area. First, assemblages of plant and animal remains may be small or nonrepresentative. At the site of Tal-e Malyan (ca. 3200–1000 BC), for example, five years of excavation succeeded in sampling only about 3 ha of the total site area of more than 200 ha (Summer 2005). These excavations, in turn, yielded only about 42 g of analyzed seed remains and about 80,000 analyzed animal remains. If the entire archaeobiological assemblage available for study is compared with the overall length of occupation of the site, it would be equivalent to averages of about two identified seeds per year of ancient settlement and a faunal sample of roughly 200 bones per year—hardly a robust foundation for a fully integrated reconstruction of the ancient agropastoral economy.

Even if there had been extraordinary preservation and total recovery of all the plant and animal remains from Tal-e Malyan, there was no reason to think that the goal of sample-by-sample integration of plant and animal remains was possible. Faunal and botanical samples from virtually any archaeological site are simply not comparable on many important levels. First, bones and plant remains do not necessarily reflect the same range of behaviors. While the bones at Malyan represented discard from the butchery and consumption of meat (Zeder 1991), the charred seed sample came primarily from animal dung burned as fuel (Miller and Smart 1984). At least in this and similar contexts, the animal bones from Malyan were a key to human diet, while the seed remains told us what the flocks and herds ate. Moreover, there is no particular reason to think that people dump their hearth sweepings in the same places that they dump their smellier trash, such as greasy bones and rotting meat scraps. Thus, the sources of our respective samples were different and reflected different aspects of daily life in the city. One characteristic shared by the Malyan bone and charcoal assemblages, however, is that both the animal bones and the charred plant remains entered the archaeological record as trash. An additional complicating factor is quantification. For example, each individual animal has a determinate number of bones, but plants produce an indeterminate number of seeds, making direct comparisons of the quantities of remains recovered from plant and animal taxa essentially meaningless.

Small numbers and size of samples, low recovery rates, and poor preservation are issues that cut across all subdisciplines

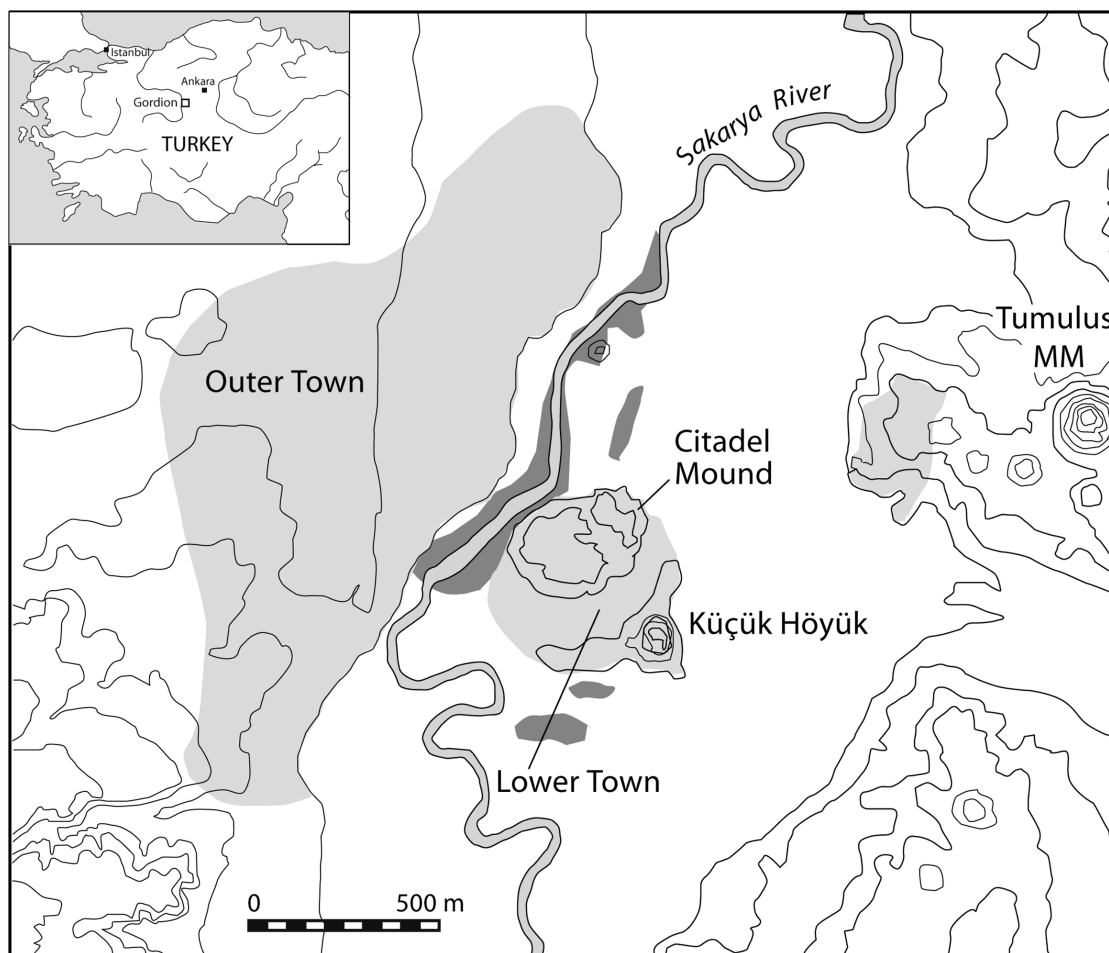


Figure 1. Map showing the maximum extent of Gordion during the Middle Phrygian period. Source: Voigt (2005, fig. 3.1).

in archaeology, but they are not an insurmountable obstacle for reconstructing ancient lifeways. We just need to be careful in drawing samples and interpreting their significance. Although our early goal of integrating plant and animal data on a sample-by-sample basis was not achievable, the underlying complementarity of plants and animals in the ancient agropastoral economy allows us to integrate the two data sets at a broader level of analysis.

Our more recent collaboration has been at Gordion in Central Anatolia. Home of the fabled but real King Midas and the place where Alexander supposedly cut the Gordian knot, the site yielded an unparalleled multiperiod sequence of archaeobiological remains. We can now apply our more sophisticated understanding to the study of our respective faunal and botanical samples and show how the agropastoral economy influenced and responded to sociopolitical circumstances at Gordion.

#### Gordion: Environmental Context and Social History

Gordion is located on the edge of the Central Anatolian steppe about 90 km southwest of Ankara along the Sakarya river near the present-day town of Polatlı (fig. 1; see also CA+ online supplement A for images of vegetation and landscape). Approaching the site from the highlands to the east and west, precipitation and tree cover decline with elevation. At 700 m, precipitation is sufficient for dry farming, but rainfall is particularly erratic in the valley bottom where Gordion is located. People have been farming and herding in this area for millennia, but until the recent construction of extensive government-sponsored irrigation works, the only truly viable economic strategy in the region has emphasized animal husbandry combined with precarious dry farming (Gürsan-Salzman 2005). While there have been no significant climate shifts over the centuries during which Gordion was occupied, we cannot completely exclude the effects of short-term cli-

mate shifts on agropastoral decision making over the history of the settlement. Aridity makes vegetation cover susceptible to degradation from human activities such as overgrazing, fuel cutting, and in modern times, deep plowing. Marginal conditions for agriculture and the historical importance of the interplay between herding and farming in this region make a long-term view of agropastoral economy over the course of occupation at the site of particular interest.

Gordion has a long history of excavation (Sams 2005). We joined the project in 1988, when Mary Voigt began directing the excavation under the continuing auspices of the University of Pennsylvania Museum. The project emphasized chronology and long-term patterns of society and land use. We rely primarily on Voigt's analysis of archaeological, textual, and archival data for the summary presented here (table 1; for overviews see Voigt 1994, 1997, 2005, 2007; Voigt and Henrickson 2000; Voigt and Young 1999; Voigt et al. 1997).

The settlement at Gordion experienced considerable change in its geopolitical position over time. During the Late Bronze Age, Gordion served as a minor center on the western edge of the Hittite empire (Yassihöyük Stratigraphic Sequence [YHSS] 9/8). By the end of the Early Iron Age (YHSS 7), the settlement was occupied by Phrygian migrants from southeastern Europe. By the late tenth century BC (Early Phrygian period, YHSS 6), it had become the political center of the Phrygian polity. A major rebuilding project begun at the end of this period was completed after a catastrophic fire swept through the center of the site. That destruction marks the boundary between the Early and Middle Phrygian periods (YHSS 5). The Middle Phrygian city saw substantial growth in size, wealth, and power: settlement extended over 1 square km, and the Phrygians constructed well over 100 burial tumuli that characterize the landscape to this day. YHSS 4 marks the arrival of the Achaemenids and Persian control (Late Phrygian period). Gordion may have had some governmental role during this time, and it was a center of trade and manufacture. Alexander the Great passed through Gordion in 333 BC, at

which time Gordion was a relatively prosperous town. Celtic mercenaries settled at this Hellenistic-era town midway through the Hellenistic period (YHSS 3), adding yet another cultural element to the already diverse population of Gordion.

### Archaeobiological Analysis

The materials used for this report come from limited excavations conducted in 1988 and 1989 by Mary Voigt (1994). We include data from the phases YHSS 9/8 to 3, which correspond to the traditional designations Late Bronze Age to Hellenistic period. Although only a small percentage of the archaeological contexts sampled at Gordion, this deep stratigraphic sounding provides an excellent opportunity to examine agropastoral strategies over a nearly 1,500-year period of shifting geopolitical and socioeconomic fortunes at the site.

The botanical samples analyzed for this report primarily come from hearths and a variety of secondary and tertiary contexts (trash-filled pits, trash deposits, building collapse). The seed remains were extracted by flotation, and the wood charcoal was handpicked in the field. Some of the hearth material was burned in situ (and so is clearly fuel). In the absence of other indicators of function (such as burned store rooms or threshing floors), the rest of the charred material is presumed to be the redeposited contents of hearths or other pyrotechnic installations. It is not possible to ascertain the source of each seed. Charring narrows the possibilities, however, for seeds in occupation debris; for example, any particular seed might come from plant-processing waste intentionally burned as trash (see Hillman 1984) or accidentally charred food remains (e.g., Hillman 2000, 334–339). Seeds may burn incidentally because they were still attached to brush or woody plants burned as fuel. Dung burned as fuel also contains seeds that might be preserved; many wild plants spread through animal dung. Even cereal grains are sometimes incompletely digested and appear in dung (Anderson and Ertug-Yaras 1998; Bottema 1984, 211). As Hillman points out, after sieving and

Table 1. Summary of chronology and culture

Period	Date	Site function	Regional settlement	Status and function of area sampled	Cultural affiliation
Hellenistic YHSS 3	330–mid-2nd c. BC	Market town and small-scale political center	Increasing	Modest residential/domestic	Greek/Celtic
Late Phrygian YHSS 4	540–330 BC	Achaemenid outpost	Decreasing	Industrial	Phrygian/Persian
Middle Phrygian YHSS 5	800–540 BC	Capital of strong Phrygian state	High	Support of palace and modest residential area	Phrygian
Early Phrygian YHSS 6	950–800 BC	Center of local Phrygian polity	Increasing	Palace area	Phrygian
Early Iron Age YHSS 7	12th c. BC—950 BC	Immigrant settlement	Low	Modest residential/domestic	Phrygian and perhaps Indigenous
Late Bronze Age YHSS 9/8	1500–12th c. BC	Small center on edge of Hittite empire	Declining	Possible elite structure and exterior trash deposits	Indigenous

Table 2. Summary of flotation sample characteristics

Phase	YHSS 8/9	YHSS 7	YHSS 6	YHSS 5	YHSS 4	YHSS 3
No. flotation samples	32	66	5	15	53	32
Total volume floated (L)	252	527	38	108	518	331
Wild and weedy seeds (total no. per phase)	5,060	7,710	58	368	8,765	6,573
Wild/cereal mean	257	199	168	109	267	451
Cereals (total weight, g)	21.28	50.00	.44	4.07	40.63	16.18
Wheat ( <i>Triticum</i> ; all types, total weight, g)	6.32	24.07	.11	.81	11.44	5.34
Barley ( <i>Hordeum vulgare</i> ; total weight, g)	7.90	12.42	.13	1.53	18.33	6.31
Dung (sheep/goat pellets and other fragments; total weight, g)	.05	11.26	0	.05	3.50	1.72
No. samples containing dung	6	14	0	1	20	8
Seed/charcoal mean (g/g)	.17	.28	.07	.03	.21	.22

winnowing, crop-processing debris was probably sorted by size. Accidentally spilled food-crop plants would be cleaned of wild and weedy seeds. If brush fuel was used when seeds were ripe, such seeds would occur in concentrations. Individually, the Gordion samples have all size classes represented (pure crop remains from burned buildings are not included in this analysis). In addition, many samples have bits of burned dung, including identifiable sheep/goat pellets (table 2). It seems reasonable, therefore, to interpret the seed assemblage as primarily the result of dung burning even though we cannot assume that every seed arrived in dung (see also Charles 1998; for a critique of this approach, see Hillman, Legge, and Rowley-Conwy 1997).

A total of 114,723 animal bones were recovered during the 1988 and 1989 seasons at Gordion. This entire sample was processed at a basic level (i.e., recording the number and weight of bones by taxon) and reported in Zeder and Arter (1994). The 37,000-bone subsample discussed here (13,000 of which were identifiable to the taxonomic level of family or better) is derived from carefully selected stratigraphically secure contexts, primarily from trash-filled pits and other midden deposits and trash-rich deposits within building collapse. All deposits were screened. This subsample was analyzed in detail, with information collected on taxa, element, size, fusion and other age-related markers, and modification. Presumed nonfood-animal and nonmammalian remains are excluded from this discussion and in any case represent no more than 2%–5% of the identifiable faunal assemblage for any given archaeological phase.

This paper focuses on the broad patterning discernible in our respective data sets. Our data give insight into the agropastoral economy that supported Gordion over the five occupation phases for which we have the largest samples. For the botanical sample, these patterns can be found in the ratio of wild seeds to cereals and in the shifting proportions of taxa represented in the wood charcoal from the site. For the faunal sample, we look to shifting proportions in both the major and minor taxa of food animals utilized by residents of the site over the five phases of occupation considered here. What we find when we look across our respective data sets are

marked and quite complementary patterns in the botanical and faunal samples that speak to both the shifting balance of agricultural and pastoral activities at Gordion and the spatial dimension over which they took place.

#### *Agropastoral Practices at Gordion*

Working under the assumption that the preponderance of charred seeds and plant parts recovered comes from animal dung burned for fuel, these remains are best seen as proxy evidence of animal, not human, diet. As such, they provide a natural avenue for the integration of botanical and faunal data. Specifically, the variety and ubiquity of wild taxa recovered from dung probably largely reflects grazing on pasture land, whereas the charred cereal remains probably reflect the grazing of animals on field stubble and the consumption of fodder crops. In an earlier study of archaeobotanical materials from sites along the Euphrates, Miller (1997) argued that the ratio of wild seeds to cereals reflects different pasturing regimes. The higher the wild/cereal ratio, the greater the importance of grazing for the diet of livestock, and lower ratios indicate a greater proportion of agricultural stubble supplemented by fodder. This measure, then, promised special insights into pastoral practices at Gordion over its various periods of occupation. The wild/cereal ratios from Gordion presented in table 2 and graphically represented in figure 2 were computed by dividing the seed counts of wild plants by the total weight of cereal grains in each sample. The average for each phase was then calculated.

There are marked shifts in this ratio over the five phases of occupation examined here. Most striking is the dramatic drop in the wild/cereal ratio in the Middle Phrygian period—a time when Gordion reached its maximum size, when settlement in the region was high (Kealhofer 2005), and when the 53-m-high tumulus MM was built for one of King Midas's predecessors (DeVries 2005).

In her Euphrates study, Miller (1997) also noticed some spatial and temporal correlations between the wild/cereal ratio and major meat species. In particular, strong wild-taxa representation was generally associated with high proportions of

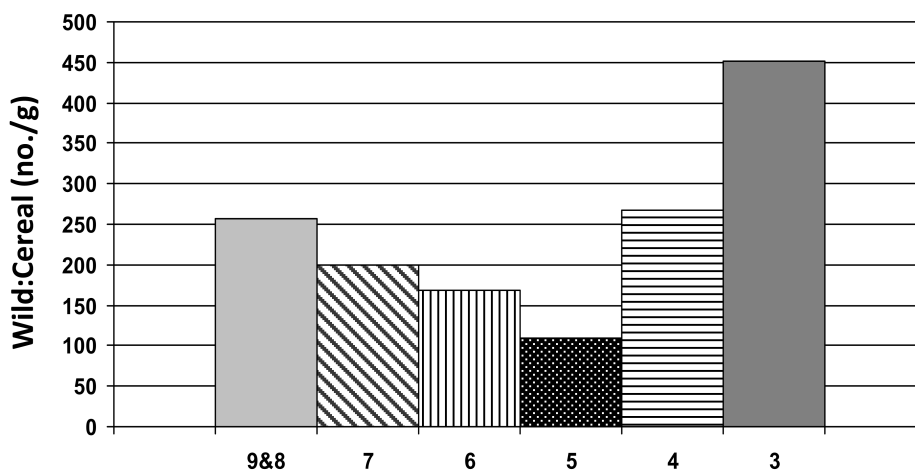


Figure 2. Average ratio of number of seeds of wild plants to weight in grams of cereal remains over six occupation periods (data listed in table 1).

sheep and goat, while higher cereal representation was associated with increases in cattle and/or pigs. A similar pattern is seen at Gordion.

The relative proportions of the major meat contributors to the Gordion diet—caprines (sheep and goats), cattle, and pigs—are calculated as relative percents based on unweighted raw counts of identified fragments per phase (fig. 3; table 3). While caprines always dominate in each occupation phase at Gordion, there is a clear and highly significant increase in the proportions of both cattle and pig (to a combined total of more than 40% of the major meat contributors) in the Middle Phrygian period.

Comparing the patterning in major meat contributors with the wild/cereal ratios (figs. 2, 3), we see that when the wild/cereal ratio rises, the proportion of caprines does, too; when the wild/cereal ratio falls—that is, when cereals become more important in the assemblage—cattle and pig do too. Thus, our botanical indicator of grazing corresponds to periods of higher caprine representation, and our indicator of pasturing on agricultural stubble and fodder corresponds to periods when cattle and pig are more important resources.

We can place these data along an agropastoral continuum that reflects the balance of agricultural and pastoral activities practiced by residents of the site. At one end, economic orientation toward pastoral production would be associated with more extensive herding practices that utilized noncultivated pasture and less use of cereals as fodder. This could mean that less of the land around the settlement was dedicated to agricultural production or that herders brought their flocks to more distant pasture. The archaeobiological signature of this practice would be high proportions of sheep and goat and high ratios of wild seeds compared with cereals.

At the other end, orientation toward the settlement would be associated with more intensive agricultural practices that

kept animals closer to home and fed them on harvest stubble and cultivated grain and straw. The archaeobiological signature of this practice would be lower wild/cereal ratios and higher proportions of cattle and pig, animals with higher water requirements than caprines. These assemblage characteristics imply a greater emphasis on the agricultural component of the agropastoral system in terms of area under cultivation and livestock that either contributed to agricultural production or at least did not compete for land needed for agriculture. As likely draft animals, cattle meet this criterion. And while free-ranging pigs might threaten agricultural fields, sty-bound pigs transform household refuse into useful food for urban dwellers (Zeder 1991, 1998).

#### *Spatial Dimensions of Agropastoral Economy*

Two other food animals—deer and hare—offer the opportunity to examine the spatial continuum of shifting agropastoral practices at Gordion. Although neither species ever makes a major contribution to Gordion diet, it is interesting that shifts in the percentages of deer and hare seem to correspond to changing proportions of caprines relative to cattle and pig and in the wild/cereal ratio (fig. 4; table 3). Periods when deer are better represented relative to hare correspond to periods of higher caprine utilization and a high wild/cereal ratio. Conversely, periods when hare are prominent correspond to the periods of higher cattle and pig proportions and better representation of cereals in animal diet.

While deer may have been more plentiful near the site in earlier periods, when population density was lower in the region (as in the Early Iron Age, YHSS 7), it is likely that red deer (the predominant cervid species in the Gordion assemblage) were hunted some distance from Gordion in higher-elevation pine forest. So it would seem that in periods when

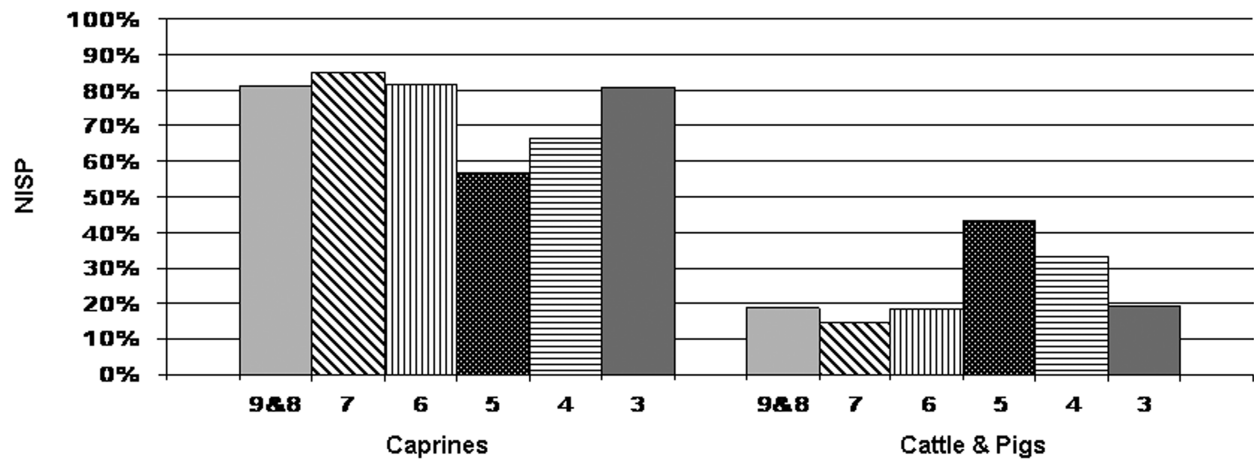


Figure 3. Percentage of major food animals over six occupation periods.

there is a more extensive land use focusing on steppe-forest or forest grazing, people were also engaged in hunting deer. On the other hand, when the economic orientation swung in favor of intensive agricultural production closer to home, trapping hares in nearby fields became worthwhile. After all, while the larger meat package provided by a deer (with stags weighing up to 140 kg) might make it worthwhile to travel some distance to hunt and transport back a deer, no one would go 50 km to catch a hare, and so it is more likely that hares represent activities conducted closer to home.

Patterning in the proportions of species represented in wood charcoal recovered from the site provide additional insight into the spatial dimensions of agropastoral activities

through time. Although the primary source for charred seeds has been interpreted as remnants of dung burning, the most common fuel throughout the sequence was wood. We can measure the relative importance of wood and dung fuels by examining the ratio of seeds to charcoal. This ratio is computed by dividing the weight of seeds and charcoal larger than 2 mm. At sites on the treeless Syrian steppe, ratios are between 0.8 and 3.8 (Schwartz et al. 2000, 446), and at Malyan (Zagros montane woodland), it is less than 0.2 (data in Miller 1982, table 6.3). Ratios of seed/charcoal are similarly low in the Gordion flotation samples (up to 0.3; Miller 1999; table 2), strongly suggesting that dung fuel merely supplemented wood fuel throughout the sequence.

Table 3. Counts and weights (g) of identifiable bones

Species	YHSS 8 and 9		YHSS 7		YHSS 6		YHSS 5		YHSS 4		YHSS 3		Total	
	NISP	Weight	NISP	Weight	NISP	Weight	NISP	Weight	NISP	Weight	NISP	Weight	NISP	Weight
Cattle <sup>a</sup>	277	12,305	339	8,207	195	4,651	352	8,846	341	9,116	105	3,110	1,609	46,235
Donkey/horse	81	3,151	30	786	12	367	8	148	48	1,523	27	731	206	6,706
Sheep <sup>a</sup>	103	1,107	176	1,648	80	1,056	106	1,093	111	469	55	2,182	631	7,555
Goat <sup>a</sup>	44	322	131	1,262	41	292	88	789	95	259	42	1,047	441	3,971
Sheep/goat <sup>a</sup>	1,669	7,861	2,332	9,739	1,179	5,695	808	4,027	1,215	7,053	960	1,556	8,163	35,931
Pig <sup>a</sup>	146	1,232	118	751	96	825	414	3,513	371	2,840	145	815	1,290	9,976
Deer <sup>a</sup>	9	186	198	6,078	16	695	6	272	7	136	6	475	242	7,842
Hare <sup>a</sup>	21	40	9	16	21	52	53	107	29	54	9	13	142	282
Dog/wolf	14	64	22	112	9	42	5	17	5	35	10	35	65	305
Fox	3	5	15	43	2	2	6	6	1	1	2	3	29	60
Carnivore	0	0	11	24	1	1	3	3	1	3	1	1	17	32
Rodent	1	4	0	0	3	3	2	8	1	4	1	1	8	20
Bird <sup>a</sup>	9	14	13	16	22	36	37	101	70	134	37	38	188	339
Reptile <sup>a</sup>	6	8	43	155	7	12	0	0	6	10	1	2	63	187
Amphibian	1	1	3	3	0	0	0	0	0	0	0	0	4	4
Fish <sup>a</sup>	13	21	17	23	6	12	13	14	13	40	22	23	84	133
<b>Total</b>	<b>2,397</b>	<b>26,321</b>	<b>3,457</b>	<b>28,863</b>	<b>1,690</b>	<b>13,741</b>	<b>1,901</b>	<b>18,944</b>	<b>2,314</b>	<b>21,677</b>	<b>1,423</b>	<b>10,032</b>	<b>13,182</b>	<b>119,578</b>

<sup>a</sup>Likely food taxa.



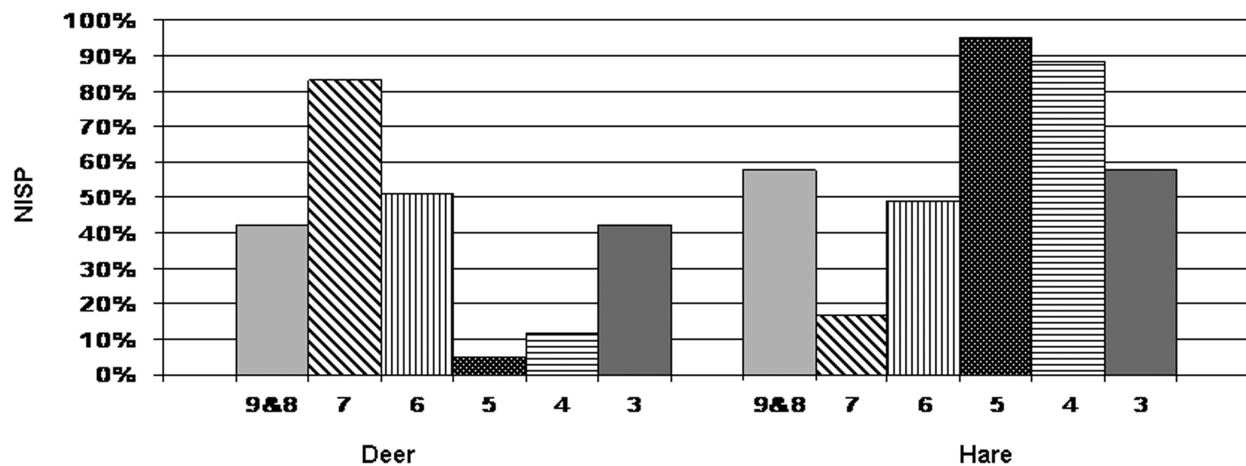


Figure 4. Percentage of deer relative to hare over six occupation periods.

Proportions of different taxa represented in wood charcoal from the site are shown in figure 5 and table 4. Based on the present distribution of woody vegetation, it is likely that scrubby juniper and oak trees grew within 10 km of the settlement, stands of timber-quality juniper grew about 20 km away, and closed-canopy pine forest began about 30 km away. The scrubby juniper grows slowly, and its primary value would have been for fuel. Oak can grow back from stumps, and acorns would have had value for animal and even human consumption. One might expect that fuel cutting would eventually eliminate juniper. The category “other” includes types that grow in secondary forest. Thus, the decline in juniper and corresponding increase in oak and other woody species used as fuel could be explained by a combination of transport cost and local deforestation. Relatively high oak percentages during the agriculturally oriented Middle Phrygian period could reflect coppicing or other attempts to manage fuel supplies that grew close to the settlement. Except for the Early Phrygian YHSS 6, pine percentages follow the other agropastoral indexes: during periods characterized by high proportions of caprines, wild seeds, and deer, people engaged in more extensive agropastoral pursuits and ranged farther away from Gordion and the Sakarya river toward uncultivated pasture and more distant pine forest. The building program of the Early Phrygian period may partly account for the spike in pine during YHSS 6; trimmings from massive pines cut for beams might have been brought back to the citadel and burned for fuel. Unfortunately, we cannot exclude the simplest explanation, chance variations and small sample size, for fluctuations in the proportions of pine.

#### Implications for Middle Phrygian Agropastoral Economy at Gordion

All of the patterns highlight the Middle Phrygian as an anomalous period of agricultural intensification within a region

whose environmental constraints strongly favor pastoral production. As noted above, this is the time when Gordion reached its maximum size as the leading center in a well-populated region. With recent redating by DeVries et al. (2003), we now recognize Middle Phrygian Gordion as capital of a powerful Phrygian polity that engaged in diplomatic relationships with Assyrians and Greeks. The preceding Early Phrygian elite precinct and surrounding settlement had been destroyed in a catastrophic fire, and over the ruins of the citadel, the Gordionites covered an area of several hectares with a layer of sediments at least 2 m thick, which was a huge investment of corporate labor. On top of that enormous clay cap, they constructed a new complex of massive public buildings that followed the plans of the earlier structures; the clean clay used for much of the cap may have been the backdirt from large-scale hydraulic works (Marsh 2005). In addition, Gordion expanded out beyond its citadel and its adjacent lower town to include a vast outer town that extended over more than 1 km of occupation (fig. 1). Kealhofer’s (2005) survey suggests that an agricultural population in the hinterlands of Gordion also reached an all-time high.

The combined archaeobiological data highlight the key changes in the agropastoral economy that accompanied the expanding role of Gordion in the region. Compared with all other archaeological phases, both before and after, it is the Middle Phrygian period, when Greek and Assyrian sources report that Gordion served as the home of King Midas and the capital of the Phrygian state, that the settlement reached its maximum size and complexity and highest population density; botanical and geomorphological indicators for irrigation suggest agriculture intensified in this period, too. When Gordion was either a smaller center or during times of reduced or declining regional population, all archaeobiological indicators point to a more extensive agropastoral system weighted more heavily toward far-ranging pastoral production

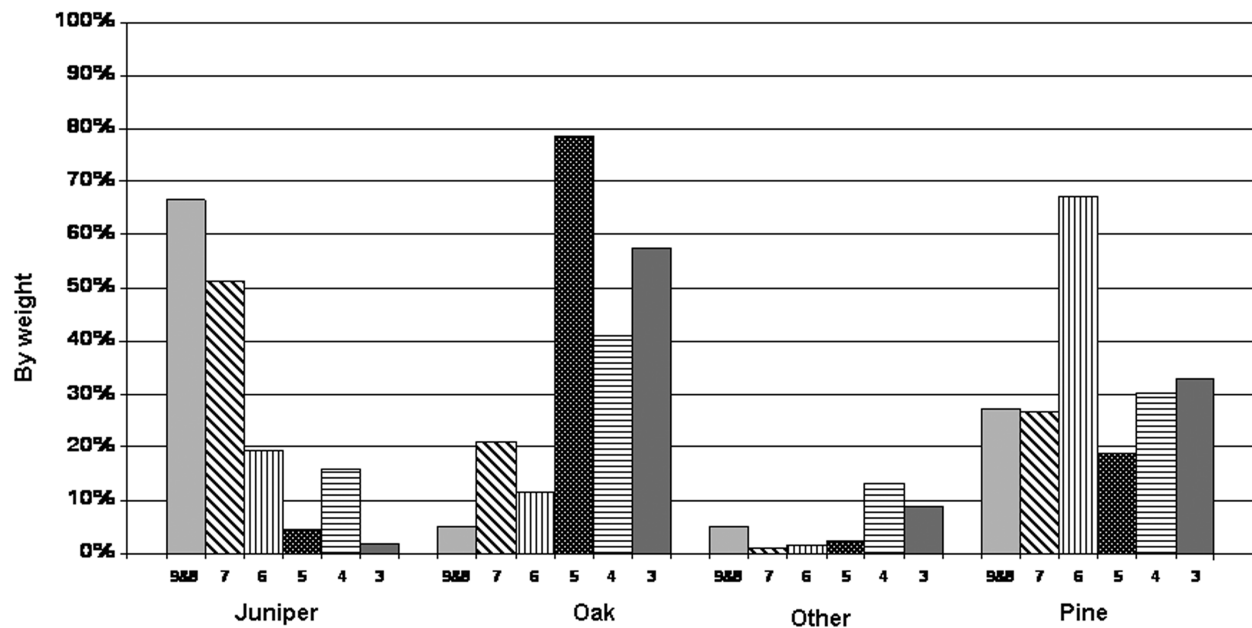


Figure 5. Percentage representation of wood charcoal over six occupation periods.

supplemented by dry farming (fig. 6). Therefore, our integrated archaeobiological data sets indicate that after Phrygian political and economic dominance waned, the anomalously intensified agricultural economy of Middle Phrygian Gordion reverted to its more normal and likely more sustainable extensive agropastoral character.

### Modern Lessons from the Agropastoral Economy at Ancient Gordion

Our integrated findings may well provide a lesson for present-day agropastoral strategies in the Sakarya valley. In the mid-1990s, new pumping stations began to bring irrigation water to parts of the region for the first time, neutralizing some of the risk of dry farming in this area of marginal rainfall and

making farming more profitable. Subsidized by government programs, villagers began to invest more heavily in cattle. Pigs, of course, are no longer an option in this predominately Muslim region. The winter and spring of 2007, however, was one of the driest years on record (Polatlı Meteorology Station). Cattle fodder was hard to come by, and the villagers of Yassıhöyük sold most of their cows, replacing them with sheep and goat (Zekeriya Ütgu, personal communication). The pastoral economy essentially transformed itself overnight with the emphasis quickly reverting to the herding of sheep and goat. Based on our archaeobiological results, the only surprise was how quickly villagers were able to respond to the drought by totally retooling their pastoral activities. However, the larger issue of the sustainability of the more intensive irrigation-based agriculture in this region remains in doubt. Certainly, the lessons of the past suggest that such an agri-

Table 4. Wood charcoal percentages

Phase	YHSS 8/9	YHSS 7	YHSS 6	YHSS 5	YHSS 4	YHSS 3
No. samples	13	52	16	8	71	36
Total weight of samples >2 mm long (g)	117.96	362.58	42.52	173.03	365.59	211.68
Weight identified (g)	75.61	183.80	28.57	53.73	235.86	118.56
Oak ( <i>Quercus</i> , %)	5.26	21.13	11.66	78.69	41.04	57.46
Pine ( <i>Pinus</i> , %)	27.13	26.72	67.17	18.72	30.05	32.64
Juniper/conifer ( <i>Juniperus</i> , %)	66.71	51.23	19.50	.46	15.76	1.02
Other (%) <sup>a</sup>	.90	.92	1.68	2.12	13.16	8.88

<sup>a</sup>Includes ash (*Fraxinus*), pear/hawthorn (*Pyrus/Crataegus*), elm (*Ulmus*), poplar or willow (*Populus/Salix*), and a few indeterminate types.

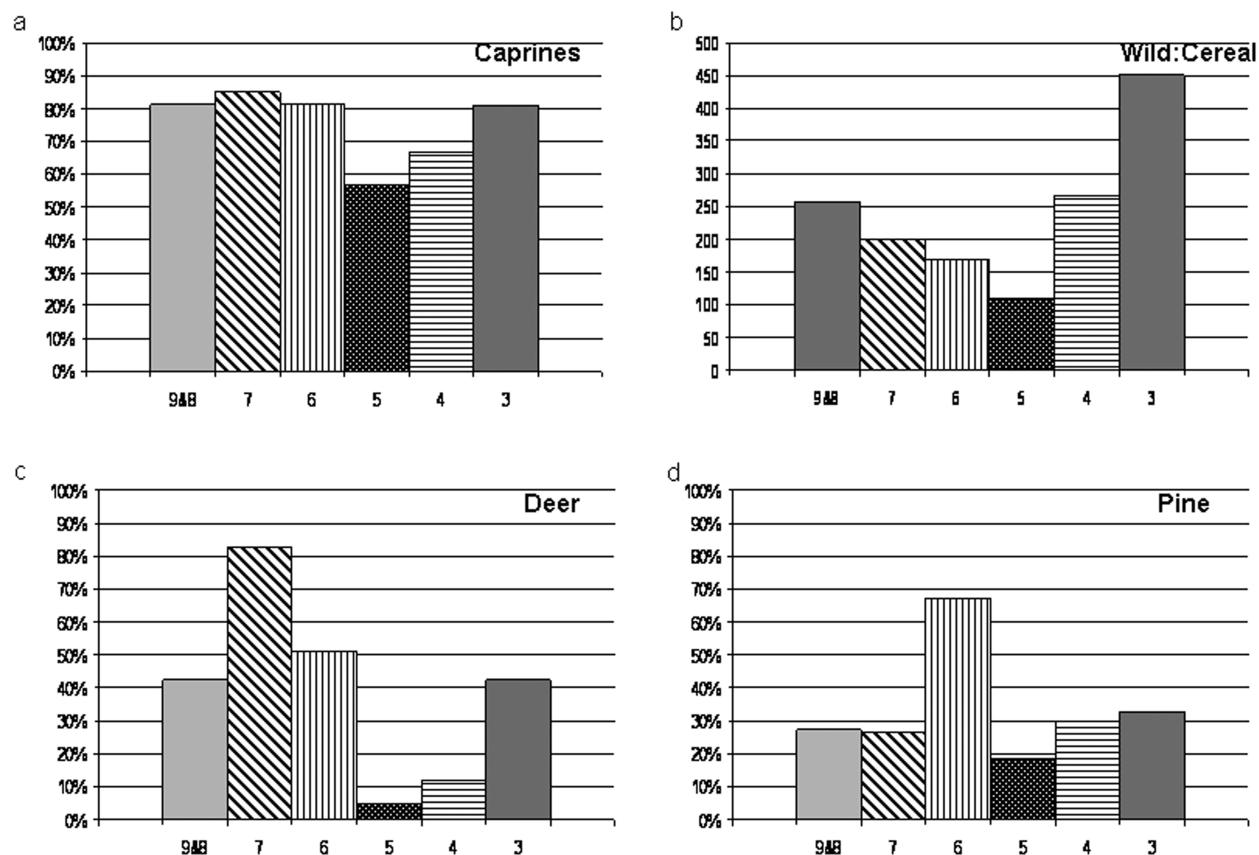


Figure 6. Comparison of (a) caprines, (b) wild/cereals, (c) deer, and (d) pine over six occupation periods.

cultural system, even with modern technology, is not optimal for the region and that other alternatives, perhaps focusing on the region's long-standing involvement in pastoral production, might provide a more productive and sustainable alternative in the long run.

## Conclusions

We hope we have demonstrated the value of using an integrated archaeobiological approach to understand inherently integrated agropastoral economies. As archaeologists, we understand the importance of specific archaeological provenience for functional interpretations of ancient settlements and social interpretations of ancient societies. Clearly, there is a lot more to be learned from this remarkable data set about environment, economy, and society at ancient Gordion.

Despite the differences in the excavated deposits and the changing nature of Gordion itself (table 1), integration of these two data sets can take place at the metalevel of broad temporal and spatial patterning. If we keep our focus on this higher level of integration rather than trying to directly compare our basically noncomparable data sets, the potential for bringing together plant and animal remains to draw signifi-

cant conclusions about agropastoral economy is very promising indeed.

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