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Gordion: Managing an Open-Air Archaeological Site as a Garden

Naomi F. Miller

University of Pennsylvania, nmiller0@upenn.edu

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Gordion: Managing an Open-Air Archaeological Site as a Garden

Abstract

Vegetation cover is managed to enhance the preservation of the archaeological ruins at Gordion, Turkey. We use our knowledge of the habits and growth cycles of the native vegetation to determine which plants should be encouraged or discouraged to grow in the excavated. For the surfaces of tumuli and unexcavated settlement mounds, minimal intervention can have dramatic results for remarkably little effort, and can be thought of as parkland. In particular, fencing to keep animals and children off the biggest mound allowed the vegetation cover to improve rapidly, so there is much less erosion. The excavated area with exposed architecture requires more active intervention and maintenance, as in a garden. The roots of some plants harm the standing structures, but others protect the ruins. In particular, we have planted the shallow-rooted perennial, *Poa bulbosa*, on the soft caps of the masonry walls exposed by excavation.

With a metaphor and practice of open-air archaeological site as garden, we are not trying to restore the vegetation to some hypothetical earlier state. Rather, as a garden evolves and changes over the year and from year to year, the program at Gordion aims to use the resilience of the native vegetation to highlight and protect specific archaeological remains, like wall stubs, as well as the traces of ancient landscape that remain, and that have formed part of the viewshed and environment of all peoples since the tumuli were constructed over 2500 years ago.

Keywords

Gordion, historic preservation, archaeological site management, archaeological site conservation, archaeology

Disciplines

Archaeological Anthropology | Biodiversity | Botany | Cultural Resource Management and Policy Analysis | Environmental Education | Historic Preservation and Conservation | History of Art, Architecture, and Archaeology | Landscape Architecture | Natural Resources and Conservation

Comments

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In central Anatolia, the ancient settlement mounds at Gordion and over one hundred burial tumuli in its environs have characterized the landscape for more than 2500 years. There are two main categories of archaeological remains in the region: the settlement and associated fortifications, discontinuously occupied from the Early Bronze Age to the War of Independence, and the tumuli dating mostly to the Middle Phrygian period (Voigt 2005). In principle, both categories are protected by Turkish law, but part of the ancient settlement as well as some of the tumuli lie in deep-plowed irrigated fields. Protecting those sites requires political will.

The monuments that are visible today and the lands between them have been the setting of life and work for the region's inhabitants since Phrygian times. Ultimately, the goal of the conservation project is to preserve the character of the entire historical landscape, which is threatened by agricultural and urban development. This paper focuses on protected sites whose primary enemies are natural forces: wind and water erosion, freezing and thawing, and root disturbance. It focuses on using the interaction between plants and the ancient built environment to the benefit of both, as one might in a garden.

Managing an open-air archaeological site as a very specialized kind of garden solves several challenges and creates a variety of opportunities. Plants will grow almost anywhere. A site-management plan can take advantage of this fact of nature, and use

plants to enhance the preservation of archaeological ruins. A variety of activities that serve this goal are being applied at Gordion. I cannot say that all are of proven value, but I present some of the approaches I have used and in collaboration with the Gordion conservation team led by Frank Matero.

Challenges

Preservation

To dig is to destroy, so ordinarily the best way to preserve a site is to leave it unexcavated. Even so, deep-rooted plants disturb subsurface remains. Post-excavation preservation of exposed building levels needs to deal with deep- and shallow-rooted plants that can destroy or obscure architectural remains. Tumuli present a somewhat different problem. Root penetration is less problematic; although there is some mound construction data that might be lost, the roots generally are not deep enough to disturb the tomb chambers below. The concerns, rather, are erosion channels and overall surface erosion.

At Gordion, we are working with nature rather than against it, using our knowledge of the habits and growth cycles of the native vegetation to determine which plants should be encouraged or discouraged to grow in particular parts of the ancient sites. There are three key goals that underlie this project: to understand the basic and easily observed

characteristics of the plants that grow in the region; to maximize the diversity and cover of the desirable species, thereby making it harder for the undesirables to grow; to apply that knowledge in managing vegetation on the site. The surfaces of tumuli and unexcavated settlement mounds, where minimal intervention can have dramatic results for remarkably little effort, might be thought of as parkland. Excavated areas with exposed architecture can also benefit from effective use of vegetation cover, but require more active intervention and maintenance, as in a garden.

Funding

Even if a roof is erected over an excavation, seeds and trash will blow in and standing structures will suffer from everchanging environmental conditions. Zero-maintenance, therefore, is a goal that can never be reached for open-air archaeological sites. Solutions that depend on imported or expensive technology may work in the short-term when funding for exciting new projects is available. A more financially sustainable model would be one that develops local human and physical resources and (this is the hard part) a plan that can be maintained and adapted by local authorities after the experts have left. I admit that this part of the plan at Gordion remains unproven, but many of the villagers at Gordion already are experienced farmers and gardeners who understand the regional climate and soils. With orientation and some training, a local labor force could be developed.

Opportunities

Actively managing plantings and vegetation has a direct benefit for the site

preservation, but also creates opportunities that go well beyond that narrow mission.

Ecological restoration

The native steppe vegetation of central Anatolia has supported wildlife and domestic flocks for millennia. For an arid region, biodiversity is high, and healthy steppe has a solid cover of plants that prevents erosion, absorbs light and heat from the sun, and helps maintain the water table. Overgrazing is one problem, but agricultural and urban development both eat up land that would otherwise support dense vegetation. The archaeological precinct provides a protected expanse of terrain that can serve as a refugium for rare and interesting plants.

Education

Admittedly the beauty of the native steppe vegetation is subtle, and most people prefer to look at trees. Visitors can be guided into an appreciation of the central Anatolian steppe. With native steppe established, environmental education directed at schoolchildren and adults, can teach people to value the biodiversity in their own backyard, both for its ecosystem "services," its potential economic and aesthetic values, and as a way to begin to understand the daily lives and surroundings of the ancient people of Gordion.

Economic development and local buy-in

In addition to the indirect touristic benefits of mound and site stabilization, the area that can be protected and managed with minimal labor input could serve as engine for economic development: ecotourism (not just archaeological tourism, but also bird-watching, botanizing, etc.); a dairy industry based on the improved rangeland combined with the reintroduction and development of Anatolian stock varieties; developing seed

sources for attractive endemics that would be great for native-plant gardening in Turkey.

Aesthetics

In contrast to most agricultural fields, which are brown for much of the year and a uniform green the rest of the time, the steppe vegetation is beautiful and varied year-round. In the archaeological site as garden, certain areas can be "coded" to different levels of "wildness" to create a visually varied plantscape that draws the viewer's gaze to the visible archaeological remains.

Archaeobotanical and botanical considerations

We are quite intentionally *not* trying to restore the landscape to some "original" state. Archaeobotanical studies at the site do provide many hints about the vegetation from the Late Bronze Age to the Medieval period (Miller 2010). For example, in ancient times, tasty pasture plants like *Trigonella* were more numerous, while today's overgrazed pasture is filled with plants that have spines and prickles or chemical defenses that render them unpalatable. Even if we could use the archaeobotanical information to specify the types and proportions of plants, there is no justification for privileging one time period over another. Furthermore, it seems likely that Tumulus MM was bare in antiquity, either from grazing or intentional clearance. Without vegetation, the surface reflects light, making the mound highly visible for miles (Fig. 1).

What plants are best for the purpose of preservation? No one type is best. Archaeological sites experience a variety of wind and weather conditions and are characterized by many different zones—slopes face all directions with different moisture



Fig. 1. Tumulus MM, 1988 (top), 2002 (bottom)

conditions from top to bottom. Biodiversity is therefore not merely a fashionable concept. A large number of species can ensure that at least some plants will grow, in a dry year or a wet one, a cold year or a hot one. Economic, scientific, and aesthetic concerns make the native steppe plants of central Anatolia particularly desirable. They have evolved in this environment, and, once established, do not require watering or expensive care. For tumuli and the park-like environment we might want to see, the native vegetation includes many perennial plants which stay green well into the summer or year round. Therefore, even when the spring wildflowers are gone, there should be some green. For the Citadel mound, desirable plants include a more restricted range of types that serve specific functions, both practical and aesthetic, but within these constraints, the native flora provides diverse solutions.

Vegetation Improvement on Tumulus MM

Tumulus MM, which is across the street from the Gordion museum in the village of Yassihöyük, dates to the Middle Phrygian period. It is about 53 m high and 300 m in diameter (Young 1981). When erosion became a major political issue in Turkey in the early 1990s, the authorities became concerned about conditions this prominent archaeological monument. I suggested then that an uninterrupted cover of plants would slow wind and water erosion by reducing exposed bare ground and the total amount of water flowing downhill; plant roots are a physical barrier to water flow and the water they take up moves into the aboveground biomass. When asked how to accomplish this, I suggested a fence would keep flocks, tourists, and children off the mound, allowing plants to grow unhindered (Miller 1994). In the spring of 1996, Dr. İlhan Temizsoy, director of the Museum of Anatolian Civilization, arranged for the mound to be fenced (Fig. 2).

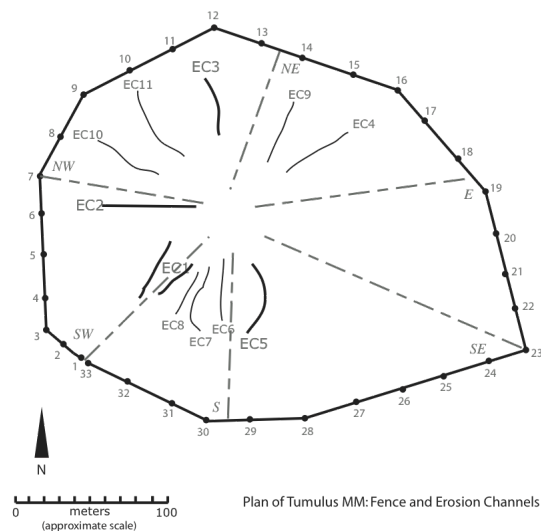


Fig. 2. Tumulus MM schematic, showing sectors and erosion channels

The vegetation management program on the great tumulus is intended to improve overall plant cover; reduce the depth and number of erosion channels; control the flow of mud from the largest channel, which is above the tourist entrance to the tomb chamber. Annual vegetation survey allows us to monitor our progress and anticipate problems.

Preservation through vegetation improvement
 Even though Tumulus MM had very little plant cover to begin with, many rare species survived under the cover of spiny and unpalatable shrubs. The resulting seed bank has allowed these plants to repopulate the mound. Although there had been no obvious improvement in the vegetation cover by the summer of 1996, by the summer of 1997, it was clear that the fence had begun to work; the vegetation cover inside the fence was denser than that outside the fence (Miller 1998, 1999, 2000). Within a few years, the shallowest erosion channels nearly disappeared under new growth. There were clear differences in plant taxa depending on slope and aspect, yet after a few more years, plants began to recolonize the harsher south side, although the vegetation remains sparser than on the well-watered north. Since 2005 slender tufts of feathergrass are establishing themselves on the steepest part of the south slope. I have also recorded differences from one year to the next, depending on weather and which plants were particularly abundant or rare the previous year. For example, after the particularly harsh winter and spring of 2004, the prolific annual wall barley (*Hordeum murinum*), was greatly reduced for several growing seasons.

Fire hazard. Sometime between the summers of 1998 and 1999, a carelessly discarded cigarette burned a large swath of

the vegetation of the northeast sector of the mound. The area was immediately recolonized by an annual grass, *Amblyopyrum muticum*, which I had introduced into Erosion Channels 3 and 5 (EC-3, -5). Nevertheless, the burn raised the issue of fire hazard. Unlike sections of the American prairie, which is adapted to periodic fires and which was maintained in its open state by the management practices of indigenous populations (see, e.g., Wieser and Lepofsky 2009), the absence of grazing had led to an accumulation of dry plant matter. Both Remzi Yılmaz, our foreman, and a grass specialist with whom I spoke, Musa Doğan, felt that fire would damage the roots of the perennial grasses and retard vegetation recovery. The project director, G. K. Sams purchased a weed-whacker to cut a swath several meters wide along the inside and the outside of the fence in the fall of 2000. The wet winter of 2001 and subsequent inertia have eliminated this initiative.

Grazing. With the dramatic recovery of the vegetation on Tumulus MM, it became appropriate to consider the introduction of controlled grazing. Hüseyin Fırıncıoğlu, a range management specialist now retired from the Field Crop research center (Tarla Bitkileri Merkez Arastırma Enstitüsü) has been advising us since 2004. Although heavy grazing reduces biodiversity (Fırıncıoğlu et al. 2007), Dr. Fırıncıoğlu pointed out that moderate grazing would improve the plant cover (see Fırıncıoğlu et al. 2009). He advised us to use a mixed flock of about 45 sheep and 5 goats (for the woody vegetation) for about a week at the end of September. At that time, all the seeds of the spring and summer-flowering plants will have dispersed, especially the perennial grasses we are trying to encourage. Moderate grazing actually enhances seed set, as the hooves of the sheep

and goats bury the seeds, and the dung could provide some fertilizer. In addition, grazing might keep down some of the excess vegetative matter, and so reduce the fire hazard.

Finally, it is important to demonstrate that the landscape preservation project is not intended to keep modern people from productive use of the land. Rather, project has shown that proper management can quickly have a positive effect on rangeland. In 2004 some shepherds did bring their flocks to the mound; aside from a few dung pellets, there was no noticeable change in the vegetation. This program was suspended for a few years, as the shepherds were afraid of snakes. For the record, I always encounter tortoises on Tumulus MM, yet in more than ten years of monitoring, I have seen only one shed snake skin (and no snakes). In 2009, ethnoarchaeologist Ayşe Gürsan-Salzmänn and site foreman Zekeriya Utgu arranged with a more willing shepherd to bring his mixed flock onto the mound in October. His cooperation has come at an opportune time, because a fairly large shrub, Pamirian winterfat (*Krascheninnikovia ceratoides*), has been growing unchecked on the mound since the 1996. Despite being a relatively minor constituent of the pastureland, it is becoming prominent on the tumulus. The herder, who now keeps goats, told me that the animals only eat it when there is nothing else available. Therefore, beginning in 2013, he will graze his herd on the mound for a couple of days in January, too.

Erosion channels. In 1997, the three deepest erosion channels constituted one of our most pressing problems: EC-1, EC-3, and EC-5. Plants could not establish themselves on the bare soil. A solution was devised in collaboration with Kurt Bluemel, an expert in ornamental grasses and landscaping. Since



Fig 3a–c. Looking down Erosion Channel 3. (a, above left) 1997, mud brick; (b, above right) 1999, with post 12 in background, seeded annuals visible; (c, right) 2002, bare surface largely gone.

the force of water flowing in the channels is great enough to move stones, Miller suggested that mudbrick might work to line the channels. Bluemel agreed, and suggested how they should be set (Fig. 3). The first-year experiment focussed on EC-3 and EC5, which were very successfully treated by using mudbrick to slow and absorb the torrents that flow down the mound during heavy rains (Miller and Bluemel 1999). The mudbrick in question came from a village structure that had been disassembled; the owner was happy to provide the bricks for free as long as we hauled them away. After the initial positioning in 1997, we sowed seeds of annual plants in spaces between

horizontal rows of bricks, which set the stage, a few years later, for the vegetation immediately surrounding the channels to move in. That first year, we put some seeds of fast-growing annual grasses: wall barley, which already grew on the site, and *Amblyopyrum muticum*, which did not.

In 1998, both the fence and the bricks proved so successful, that the Museum of Anatolian Civilizations asked us to develop a plan for the more problematic area above the entrance, EC-1. That channel covers a much larger area, which meant that it was unrealistic to line the channel as we had done on EC-3. Moreover, machinery or even hand-carrying so many bricks would displace the soft soils and struggling plants of the mound surface. Ideally, bricks would be set in horizontal bands, with the lower ones acting as steps for the work higher up. Leaving a meter or more between rows would keep labor costs down and leave open ground for plants to colonize.

Such plans must, of course, involve all key area stakeholders, and the museum authorities thought it better to line the side channels with contiguous rows of bricks, and put a brick platform in the center of the channel. This approach effectively prevented seedlings from establishing themselves. In June, 1999, Miller documented the work carried out in EC-1 during the fall of 1998, and since almost no plants were growing in the heavily bricked channel by June, 1999, permission was granted to remove some of the bricks in EC-1. In 2006, Richard Liebhart and Zekeriya Utgu set bricks across EC-1 following Kurt Bluemel's original suggestion for that area. They laid bricks in the erosion channel above the tomb entrance in horizontal rows. After two years, the bricks were no longer visible, and vegetation slowly began establishing itself over much of the channel (Fig. 4).

Mud control over the entrance. An ongoing problem is erosion on either side of the entrance to the tomb. Sometime in the 1990s, several channels were dug to divert water from the entrance. After a few years, they filled with sediment. In 2003 the authorities decided to cut back the backdirt pile along the entryway to the tomb. They then put cement gutters next to the walls lining the entry. After a couple of years, both gutters silted up near the tomb antechamber, so the problem clearly has not been solved. Despite our interventions, the south side (right as you face the entrance) is particularly problematic as it is bare of vegetation.

Vegetation monitoring: vegetation survey

An important part of the vegetation improvement program involves monitoring the changes that occur over, allowing us to assess our intervention (mainly the fence, but also the bricks and minimal addition of seeds). The vegetation survey was begun in 1998; the irregular polygonal shape of the fence made it possible to produce a plan of the area, and nearly every year since then a vegetation survey has been conducted.

In order to assess our progress, it is important to know what is growing on the mound now. To that end, I developed a system for making vegetation transects inspired by Masters (1997). Superficial inspection showed that the vegetation cover changes depending on slope and aspect, so I numbered the fence posts and divided the mound roughly into six sectors based on dominant vegetation just inside the fence: SW, NW, NE, E, SE, and S. I made a ring of garden hose that encircles an area of about one square meter (3.54 m circumference). Starting from one post in each sector (chosen partly to be not too close to the previous transect, and partly to avoid major erosion channels and the steepest slope), I set the

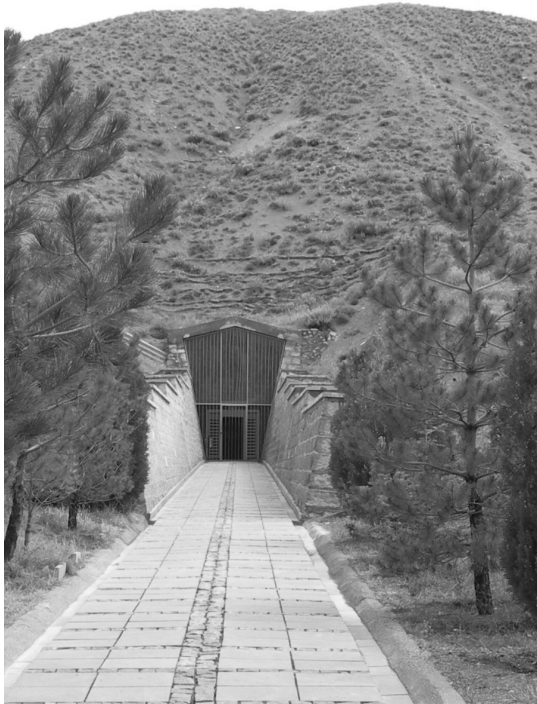
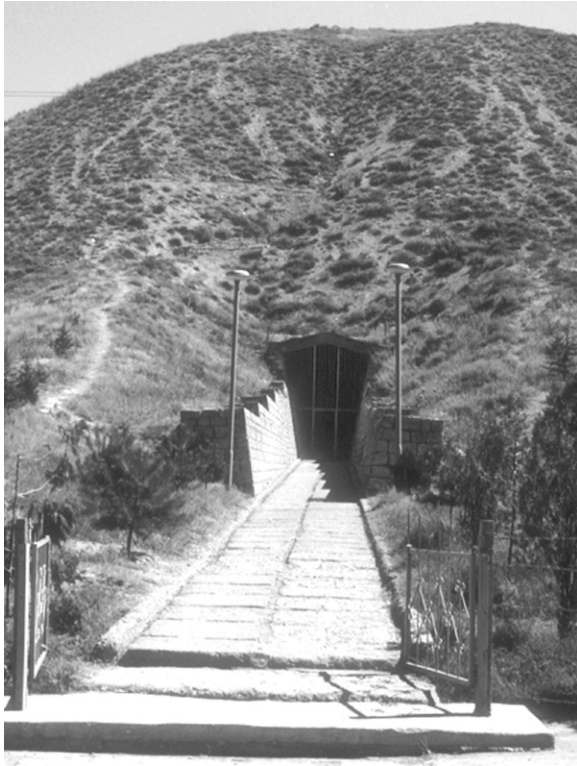


Fig. 4. Erosion Channel I, (a, upper left) 2000; (b, upper right) 2006; (c, lower left) 2007; (d, lower right) 2012

hoop down every 15 paces (approximately 10 m) and list the plant taxa seen within. I also estimate slope and percent of area covered by plants, noting whether they are just in leaf, in flower, in fruit, or dry. On a separate chart, I note types in the vicinity of the hoop but not actually within it.

The north side is more favorable to plant growth than the south, and run-off makes the lower slopes substantially wetter than the upper ones. Some of the present distribution of plants has probably been affected by the history of grazing. For example, on the lower slopes, the prevalence of spiny plants or unpalatable plants such as thistles (*Onopordum anatolicum* and *Carduus nutans*), wall barley, and Syrian rue (*Peganum harmala*), reflects the fact that grazing was most intense towards the base of the mound, which favored the survival of these anti-pastoral types (see also Firincioğlu et al. 2009). In nearly all years, over 100 species of plants have been recorded within the hoops (over 100 sq. m.), with rainfall proving to be a key variable in observed biodiversity changes from one year to the next.

Tumulus MM: Challenges and Opportunities

From the perspective of both preservation and economics, minimal intervention using locally available labor and materials proved extraordinarily effective in creating a dense plant cover on the tumulus. The native perennial grasses produce less biomass because they grow slowly, reducing maintenance costs and fire hazard. The improved vegetation has tremendous value for ecological restoration, by providing a seed bank for the immediate vicinity and possible future expansion of improved rangeland,

gardens, and other projects, like the Citadel Mound.

From an educational and outreach perspective, there have been a few lost opportunities. For example, in 1997 I produced text for signage, translated into Turkish by Elif Denel, explaining to visitors why Tumulus MM is fenced, but as of 2012, no sign has been erected. In 2000, Richard Liebhart and I produced a self-guided tour of the inside and outside of Tumulus MM, which we gave to the Yassihöyük museum, also translated by Dr. Denel. In addition, I have produced several publications about the work: a brief contribution to the "Cutting Edge" column of the *Anthropology Newsletter* (Miller 1998), a popular article about the project in both Turkish and English for *Arkeoloji ve Sanat* (Miller 1999), and another one in the Penn Museum member magazine, *Expedition* (Miller 2000). The recently expanded Yassihöyük museum has no posted information about the native vegetation or the restoration project.

Up to now, there has been no direct economic benefit to the village from the vegetation project. Our methods could demonstrate the value and relative ease of restoring grazing lands by letting over-grazed pasture rest for a few years. The native steppe vegetation is naturally rich in edible pasture grasses and legumes, yet overgrazing reduces the fodder plants and encourages the spiny and inedible plants. In addition, the mound could serve as a seed bank for the development of a local nursery business if native plant gardening becomes as popular in Turkey as it is in the United States.

The aesthetic values of healthy steppe might easily be underrated, yet it is a pleasure to see the feathergrass waving in the breeze. Many people ask, if this is what the mound looked like in antiquity. My honest answer is "who knows, but I doubt it." Because when

the mound was bare, not only could it be seen for miles, but it practically shone from the reflection of sunlight off its white surface. But today is a different time with different values. One thing that archaeobotanical research has shown, however, is that a key indicator of healthy steppe, *Trigonella*, was relatively less common by the medieval period (Miller 2010). Yet, within the fenced area, I have seen nearly 150 different species, including five species of *Trigonella*.

By itself, Tumulus MM is of some interest, but essentially it is a very large pile of dirt. Because we are trying to preserve this historical landscape for posterity, the other tumuli, too, need some attention. The smaller tumuli do not appear to suffer the erosion problems that are faced by Tumulus MM. Rather, they are threatened by plowing and irrigation. Much of what we have learned about restoring the native vegetation on Tumulus MM can be applied to them as well, if the authorities allow the intervention. Should that happen, there could be a positive ramifications for ecological restoration, education, tourism, and economic development.



Fig. 5. Erosion Channel 2, (above) 1996, (left, top to bottom) 1998, 2000, 2009, 2012

To Plant or Not to Plant

When we began the project, several people jokingly suggested we plant kudzu. My own fantasy was to have masses of bright red poppy bloom in a line on the bare spot where the children used to slide down the mound (Fig. 5). More seriously, visitors and team members ask what we planted on Tumulus MM, to make it so green. The answer is: not much. Before we learned that the fence was sufficient treatment for most of the protected enclosure, we assumed we would have to actually plant seeds or transplant seedlings on the bare areas. To that end, we have carried

out several experiments in various places: sowing seeds directly, growing seedlings from seeds, transplanting clumps of grasses, and putting seeds in mudballs. In order to reduce the impact on the already stressed native vegetation, we do not want to collect seeds or dig up whole plants on a massive scale from the wild. Harvesting seeds of common plants does not hurt the local populations, because in the course of harvesting the ripest seeds get dispersed in place. For transplants, we also choose common types. For the most part, we harvest the fenced tumulus and Citadel Mound.



a



b



c



d

Fig. 6. Some plants mentioned in the text: (a) Syrian rue (*Peganum harmala*), (b) love-in-a-mist (*Nigella arvensis*), (c) featherglasses (*Stipa lessingiana*), (d) Medusa-head grass (*Taeniatherum caput-medusae*)

Sowing seeds

In some bare areas there is a pressing need for new vegetation that will keep undesirable plants from moving in, and in such situations a variety of common annuals with easily collected seeds have proven useful. Some annual wall barley, *Amblyopyrum muticum*, and a few other types sprinkled between the rows of bricks to stabilize the soil surface in EC-3 and EC-5 did their job. In various places we have been able to spread *Androsace maxima* (rock jasmine), *Taeniatherum caput-medusae* (Medusa-head grass), and *Nigella arvensis* (love-in-a-mist), among others (Fig. 6). Most perennials are much harder to grow from seed, as we discovered the same year, when we planted some *Stipa arabica* (feathergrass) on Tumulus MM over EC-1: none sprouted. We have had some luck with the seeds of the small perennial grass, *Poa bulbosa* (bulbous bluegrass). This grass is particularly useful because its leaves and inflorescences are short, it has shallow roots, is very common, and grows prolifically on flat areas (see Citadel Mound, below).

Producing seedlings

Remzi Yılmaz tried growing a variety of the large perennial grasses over the winter of 1999/2000 in planting cells provided by Kurt Bluemel. In over 1000 cells, none sprouted, so we temporarily stopped trying to grow perennials from seed.

Transplanting perennial grasses

Digging up plants in the wild or in the site will open the area to colonizers of bare ground (i.e., plants that thrive in disturbed areas, which tend to be invasive annuals that we don't want). Part of a large grass clump can be pulled from the ground, broken into smaller clumps (say, 2- 3- cm), leaving a healthy, if somewhat smaller, plant in place. We have had our greatest successes with

transplanting clumps of perennial grasses. After an initial failure in 1997, when we transplanted three *Stipa arabica* plants from the Citadel mound to above the tomb entrance we have successfully transplanted *Stipa arabica*, *Festuca ovina* (sheep fescue), *Melica ciliata* (melic), *Poa bulbosa*, to appropriate spots. We have had less luck with *Stipa holosericea*, and the perennial brome-grasses, *Bromus tomentellus* and *B. cappadocicus*. Although the transplants are sturdy, if the winter is dry, the clumps do better with some supplemental watering.

Mudballs

When we began the erosion control program on Tumulus MM, I had thought about collecting seeds to put in mudbrick for the erosion channels. This idea was inspired by "The Growth House," a drawing by Charles Simonds (Hallmark 1982). Some years later, when Frank Matero told me that elders of Santa Clara and San Ildefonso pueblos put seeds in mudballs against insect predation, it seemed like a possible solution to our plant propagation problem: the seeds should be in the ground and watered between the fall and spring, but we are not there to tend to the plants. The mudballs seem to work best for the large perennial grasses, especially *Stipa arabica* and *Festuca ovina*. For annuals, like Medusa-head grass and rock jasmine, simply planting seeds works just as well or better.

Citadel Mound

The ancient settlement of Gordion includes the central Citadel Mound, a lower town with two mounds that were part of the ancient defenses, Kuştepe and Küçük Höyük, and an extensive outer town (Voigt 2005). Tourists to the site today are most likely to visit the remains of the royal precinct in the

Citadel Mound, which was destroyed by a catastrophic fire in about 800 B.C. (DeVries et al. 2003). A clean stratigraphic break marks the beginning of the Middle Phrygian period, heyday of tumulus construction.



Fig. 7. Citadel Mound: Terrace buildings to east and tumuli (upper) and to west

Plants can and do grow almost anywhere (Table 1). On open-air archaeological sites, they may obscure the ruins completely, or picturesquely emerge from cracks in masonry. In either case, root damage will work against the long-term preservation of the structures. Depending on the location and attributes of a plant, it may either hurt or protect standing or buried structures. The character of the vegetation itself, and how its components interact with each other, will determine the positive or negative effect of plants on the

ruins. Until the mid-2000s, vegetation management in the fenced area of the Citadel Mound was limited to hiring women to weed in the central excavated area of the site at the beginning of June. In 1992, I suggested that one way to reduce below-ground water damage was to get encourage perennial tufted grasses to grow in the excavated rooms, in the hope that they would crowd out the deep-rooted plants. The grasses I thought worth encouraging (*Stipa arabica*, melic, sheep fescue) ripen in June, so the unintended result of this schedule is that just when the plants have put all their energy into seed production, we keep them from spreading. At the same time, one of our deep-rooted pests, Syrian rue, is not hurt at all; it flowers, fruits, and seeds prolifically during the summer, and so is actually encouraged, as any competition is effectively removed. Starting in the mid-2000s, G. Kenneth Sams directed that the weeders spare the large perennial grasses. The result is that melic has established itself on several north-facing scarps, and *Stipa arabica* is beginning to spread, too (Fig. 7). (Though an improvement over the old system, this new system is being reevaluated as of 2012.)

In 2004, I recommended that we schedule two cuttings/year, one for tourists, and one in midsummer to remove the most numerous summer-seeding undesirable plants. In particular, the Syrian rue and orache (*Atriplex cf. lasiantha*) should be cut when the seed pods are forming. Since fruiting is the most energy-demanding part of a plant's life cycle, cutting at that point will not kill the plant, but it would greatly reduce the spread of new plants from seed. A small experiment in selective cutting was begun in 2004 in the Clay Cut, but it lasted only a year (in 2005, there was no money to weed in that part of the site).

Table 1. Plants mentioned in the text

Latin binomial	English common name	Attributes	Usefulness
<i>Alyssum</i> sp.	alyssum	inconspicuous annual	tumuli, excavated, wall stubs
<i>Amblyopyrum muticum</i>	none	tall annual grass	tumuli
<i>Androsace maxima</i>	greater rock jasmine	inconspicuous annual	tumuli, excavated, wall stubs
<i>Asperugo procumbens</i>	German-madwort	sprawling annual	bad for excavated and surrounding area
<i>Atriplex</i> cf. <i>lasiantha</i>	orache	invasive annual, deep spreading root	bad for excavated and surrounding area
<i>Bromus tectorum</i>	cheatgrass	medium annual grass, prolific seed production	tumuli, scarps; fast-growing, but should decline under stable conditions
<i>Bromus tomentellus</i> , <i>B. cappadocicus</i>	bromegrass	tall tufted perennial grass	tumuli, scarps
<i>Carduus nutans</i>	musk thistle	tall biannual, deep taproot, prolific seed production; avoided by grazers	bad for excavated and surrounding area
<i>Descurainia sophia</i>	herb sophia	tall annual, prolific seed production	tumuli, roots not very deep, but too tall
<i>Festuca ovina</i>	sheep fescue	medium tufted perennial grass	tumuli, excavated, north-facing scarps
<i>Hordeum murinum</i>	wall barley	short annual grass; avoided by grazers	tumuli, excavated, wall stubs
<i>Krascheninnikovia ceratoides</i>	Pamirian winterfat	large woody perennial	may need to be controlled on tumuli
<i>Melica ciliata</i>	silky spike melic	medium tufted perennial grass	tumuli, north-facing scarps
<i>Nigella arvensis</i>	love-in-a-mist	medium annual	tumuli, excavated
<i>Onopordum anatolicum</i>	thistle	tall biannual, deep taproot, prolific seed production; avoided by grazers	tumuli
<i>Peganum harmala</i>	Syrian (wild) rue	deep rooted woody perennial, prolific seed production; avoided by grazers	bad for excavated and surrounding area
<i>Poa bulbosa</i>	bulbous bluegrass	short tufted perennial grass	tumuli, excavated, wall stubs
<i>Scabiosa</i> sp.	scabious	many species, some small annuals	tumuli, excavated, wall stubs
<i>Stipa arabica</i> , <i>S. holosericea</i> , <i>S. lessingiana</i>	feathergrass	tall tufted perennial grass	tumuli, south, west-facing scarps
<i>Taeniatherum caput-medusae</i>	Medusa-head grass	medium annual grass	tumuli, excavated
<i>Trigonella</i> sp.	fenugreek	small annual; excellent pasture plant	tumuli, excavated

*Preservation through vegetation management:
Terrace Building soft cap project*

In 2006, we began a more active intervention program. Frank Matero wanted to try using a soft cap to protect the wall stubs based on the experience of historic preservation practice in Great Britain (see Lee et al. 2009). The goal was to see if the Turkish equivalent of a sod layer on top of wall stubs would insulate them by reducing intra-annual fluctuation of moisture and temperature. The conservation team has carried out most of the work, discussed in annual reports on file in the Gordion project archive(?). The botanical contribution, discussed here, is to identify both appropriate and inappropriate species in the native vegetation, collect seeds, make some mudballs, and give the conservation team some basic understanding of the botanical issues. After one such session, Kelly Wong commented that she now understood that an archaeological site is a living thing.

The experiment, devised Sarah Stokely and Kelly Wong, proceeded as follows: Geotextile as laid on top of the party wall between Terrace Buildings 1 and 2 and covered with a 5–10 cm layer of clean earth. The wall top was divided into four sections: one third covered with transplanted *Poa* clumps, one-sixth with a *Poa* seed mix, one-sixth *Poa* mudballs, and one third a "no treatment" control area (covered with stone). Over the next few years, maintenance has involved removing undesirable plants from the wall (especially orache), and leaving ones that are not harmful (Fig. 8).

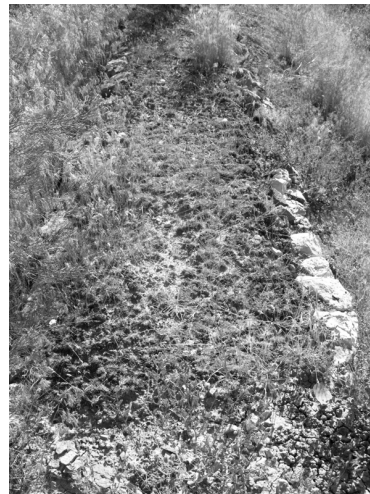
A variety of plants appropriate for this study already thrive in the Citadel Mound. *Poa bulbosa*, an inconspicuous perennial grass that forms small, short clumps and already grows profusely on site was the obvious candidate for the "sod." There are short, shallow rooted plants that volunteer on wall stubs (*Scabiosa* sp., *Alyssum* sp., rock jasmine,



a



b



c

Fig. 8. Terrace Building 2 experiment, *Poa* clumps in foreground (a) 2007, (b) 2008, (c) 2009

and wall barley. We have especially collected seeds of rock jasmine for the wall tops because it is inconspicuous and grows well on shallow exposed soil. For the sediment banked against the stub, we added seeds of the somewhat taller Medusa-head grass, an attractive annual that could help stabilize the soil quickly without causing root damage below. For the flat area within the room, a variety of medium-tall perennial grasses that grow thrive under different conditions were put in mudballs (sheep fescue, feathergrasses, and perennial brome-grasses). Only some of the sheep fescue sprouted (runoff from the slope might have created optimal conditions), but it did not survive the drought of 2007 and trampling by workers in the area. Despite two years of drought in 2008 and into 2009, the Medusa-head grass reseeded itself, but eventually failed due to competition from many other plants. After three years, the *Poa* clumps were well-established and successfully kept undesirable plants from moving in. The seeded area produced a number of widely spaced tufts, the mudballs for *Poa* did not work well at all, and other plants took root, and the control area also had other plants.

The soft cap project has proven successful in the relatively arid central Anatolian plateau. Even if *Poa* did nothing to insulate against moisture and temperature fluctuation, it keeps undesirable (i.e., deep-rooted) plants at bay. The conservation team has been using this technique on will be other wall stubs, as well as on top of the Early Phrygian gate (Keller and Matero 2011). *Poa* seeds are easy to collect, but if it is important to have immediate results, the plain surrounding the Citadel Mound is covered with *Poa* clumps that could be mined responsibly. In order to not disturb the soil surface too much, harvesters could take many small clumps, so that the remaining clumps can infill. The *Poa bulbosa* clumps

transplanted to the wall stubs could also be seeded with a variety of short annuals with shallow roots to colonize the inevitable cracks and bare ground between the clumps.

Citadel Mound: Challenges and Opportunities

The Citadel Mound plant problems go well beyond the exposed wall stubs. The excavated rooms and other flat areas are still cut every year. In many places, *Poa* is already doing a good job keeping larger plants out. As with Tumulus MM, a cover of slow-growing, perennial grasses whose delicate roots descend less about 20 cm from the surface would go a long way to protecting the ruins below. Some plants, notably the Syrian rue, have deep roots (encountered during excavation as far down as about 3 m). Others, especially the musk thistle (*Carduus nutans*) and orache are big seed producers which are undesirable. Removal or discouragement of these three types could be emphasized with appropriate timing of cutting and removal of plants. Early June cutting could be followed up with cutting when the plants (Syrian rue and orache especially) are flowering or going to seed. That would prevent new plants from establishing themselves.

Collapsing profiles at edge of excavated area. Because none of the soil has in situ archaeological remains, more active intervention could improve the aesthetics of the site. On the collapsing profiles, the tall perennial grasses could be planted (in small clumps), and even watered, until they are established. These plants are not invasive (unlike the annuals like *Descurainia sophia*, orache, *Asperugo procumbens*, *Bromus tectorum*). Therefore, in the unlikely event that they did spread to the wall stubs, it would be easy to

control their growth. These plants could be massed, and help visually define the site and direct the visitors' gaze. Melic and sheep fescue grow well on north-facing slopes, and feathergrass (*Stipa arabica*) has been spreading on south-facing slopes. Two other perennial feathergrass species grow in the region, as do two perennial species of brome grass.

Top of the Citadel Mound (including backdirt from old excavations). Today, the primary plants are ones avoided by the animals (notably the perennial Syrian rue and the annual wall barley. If we want the visitor circuit to include the trenches from the Battle of the Sakarya, it might be nice to restrict grazing, and see if there is a way to use plants to demarcate those trenches. Reducing the Syrian rue would conveniently also reduce the spread of new plants to the area below.

All of my suggestions are based on the presumption that managing the vegetation within the confines of the site can, in the long term, reduce labor costs, improve the aesthetic and intellectual experience for visitors by delineating or de-emphasizing some features, and protect the unexcavated areas. An uninterrupted cover of shallow-rooted species is the best way to reach these goals. The general principle is that the roots of densely growing plants will take in the water from precipitation and bring it back up into the aboveground biomass. Shallow rooted perennials with sod-like form have the additional advantage of keeping undesirable (i.e., deep-rooted) plants from taking root. Perennials grow more slowly than annuals, which reduces the amount of potentially flammable biomass that needs to be removed each year. Up to now, we have just been intervening in fairly small areas. Selective weeding is one way to change the vegetation:

remove or cut the undesirables, especially when they are flowering or just before they go to seed, and protect the plants we want. At this point we know enough to actively encourage some plants by sowing seeds, placing mudballs, and transplanting grasses in an ecologically responsible way.

Open-air archaeological site as garden

Because the site is open-air, any long-term management of the site must have a major botanical component. It would help if we started thinking of the site as a specialized kind of garden. In that garden, there are several management zones, each with its own problems and solutions. The goal is to develop a non-natural collection of relatively shallow-rooted plants. We are fortunate that the natural vegetation of the region is steppe. Grasses have slender roots that do not go very far below the surface (typically, the taller the grass, the deeper the root mass, from about 2 cm to a maximum of about 50 cm). Other perennials, and some annuals, have deep spreading roots, or deep tap roots. A good reason to reduce the populations of those plants even in areas where they are not harming the underlying ruins is that they produce seeds that blow onto areas where you don't want them. Generally, perennials tend to grow slowly, produce seeds and grow less plant matter. By gradually shifting the standing biomass (i.e., living plants) to slow-growing perennials and non-invasive annuals, the undesirable plants will decline in proportion.

One implication of the site as garden is that the requirements of the living plants must be taken into account. Perennial plants take many years to establish themselves. Any management plan should involve minimal disruption to the soil surface once the plants have begun to grow in order to get the full maintenance of their low maintenance cost.



Fig. 9. Yassihöyük museum garden, 2010

Archaeological sites are usually disturbed in the top 50 cm or so, anyway, so it is really only the deeper rooted plants that are problematic. With site as garden, long-term management will need the practical experience of gardeners and botanists becomes relevant. Villagers can be trained to take care of the grounds, thereby providing additional income for them.

Native Steppe Plant Demonstration Area in the Yassihöyük Museum Grounds

As an archaeobotanist, my hope is that visitors to the site will develop an appreciation for the beauty of the landscape and the diversity of the flora of its flora, not just the artifacts and ruins of Gordion. Yet the sad truth is that most tourists to the site come in groups and have neither the time nor inclination to walk around looking at plants. I therefore considered the idea of developing a garden on the grounds of the Gordion Museum in Yassihöyük—I already had some experience with native-plant gardening at the excavation headquarters, where I maintain a few small plots. In 2006, when Mecit Vural, a botanist from Gazi University, visited the site, we were able to make this idea a reality, beginning with a plot measuring about 5 x 10 m (Fig. 9). At the

urging of Dr. Vural, we arranged for gypseous soils to cover an equivalent area adjacent to the original one the following year. For this ongoing project, maintenance is minimal: I selectively weed the plot for a few hours over the course of a few days in June. In the summer I collect some seeds and make some mudballs to be set out later in the year. Zekeriya Utgu and Dr. Vural distribute the seeds and mudballs, and transplant some larger specimens as well. Dr. Vural has provided some signage, and I have prepared a one-page flyer (translated into Turkish by Dr. Gürsan-Salzmänn) that could be distributed to museum visitors. The out-of-pocket cost has been minimal—primarily trucking in the gypsum, buying some animal dung fertilizer, and covering some travel and incidental expenses.

We hope to improve and expand the garden. they might begin to develop the understanding to make wiser decisions about appropriate land use.

Conclusions

With a metaphor and practice of open-air archaeological site as garden, we are not trying to restore the vegetation to some hypothetical earlier state. Rather, as a garden evolves and changes over the year and from year to year, the program at Gordion aims aims to use the resilience of the native

vegetation to highlight and protect specific archaeological remains, like wall stubs, as well as the traces of ancient landscape that remain, and that have formed part of the viewshed and environment of all peoples since the tumuli were constructed over 2500 years ago.

Beyond the immediate benefits for erosion control, biodiversity preservation, rangeland improvement, and ecotourism development at the site, much of what we have learned has potential applications elsewhere in Turkey. Several archaeological projects in Turkey already have programs in place that share some features with our work at Gordion. The Kerkenes project, for example, has a strong program promoting ecologically sustainable development in the context of the archaeological project (Kerkenes n.d.). The Çatalhöyük project is a leader in integrating the preservation of an open-air archaeological site, its cultural landscape, and local development issues (Çatalhöyük 2004). Bin Tepe, with dozens of tumuli threatened by the expansion of olive production, has historic landscape preservation issues most similar to ours; their education program is a model well worth duplicating (CLAS n.d.). None of these projects is actively incorporating the native vegetation as part of their overall management strategy.

One of the most exciting aspects of the conservation work on the outside of the Midas Tumulus and the Citadel Mound is that it has significance even beyond the successful conservation of one of the major archaeological sites of Turkey. Developing Gordion as a tourist destination can only be enhanced by treating the archaeological resources—the settlement and surrounding tumuli—as part of a working landscape (Miller 2011). Farming and herding are part of that landscape, but the natural flora and

fauna are also of great value. Increasingly, tourists (both Turkish and foreign) will expect to see both cultural and natural attractions. Archaeologists will have to work collaboratively with villagers, museum officials, and specialists in historic preservation of a successful site management plan is to be formulated. What we have undertaken at Gordion represents the beginning of that process.

Acknowledgments

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