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Naomi F. Miller

There are two main categories of built remains at Gordion: the settlement occupied intermittently from the Early Bronze Age to the War of Independence, and over 100 burial tumuli erected primarily during the Middle Phrygian period. Both categories are, in principle, protected by Turkish law, but part of the ancient settlement as well as most of the tumuli lie in deeply plowed and irrigated fields, and the damage has been considerable. Additional deterioration has been caused by natural forces: wind and water erosion, freezing and thawing, and root disturbance.

Plants grow almost anywhere, and they can impede or enhance the preservation of archaeological ruins. By managing the open-air archaeological site of Gordion as a very specialized kind of garden within the broader historical landscape, we solve several problems and create a variety of opportunities. I cannot say that all of our strategies are of proven value, but I present here some of the approaches I have used in collaboration with the Gordion conservation team led by Frank Matero.

Problems in 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 frequently disturb subsurface remains. Post-excavation preservation of exposed building levels needs to consider the deep- and shallow-rooted plants that can destroy or obscure architectural remains, although such consideration

is often absent in site management plans. The tumuli present a somewhat different problem: the roots generally are not deep enough to disturb the tomb chambers below, although erosion channels and overall surface erosion remain significant issues that need to be resolved.

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 site. There are three key goals that underlie this project: to understand the basic characteristics of plants that grow in the region; to maximize the diversity of the desirable species in the plant cover, thereby making it harder for the undesirables to grow; and to apply that knowledge to managing vegetation at the site. The surfaces of tumuli and unexcavated settlement mounds, where minimal intervention can have dramatic results with 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.

Even if a roof is erected over an excavated area, seeds will blow in and trash will accumulate, causing standing structures to suffer from fluctuating environmental conditions. Zero-maintenance, therefore, is a goal that can never be reached for open-air archaeological sites. The most effective management plan is one that utilizes local human and physical resources, and can be maintained and adapted by local authorities after the experts have left. I admit

that this part of our 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 site preservation, but also creates opportunities that go well beyond that narrow mission. The native steppe vegetation of central Anatolia has supported wildlife and domestic flocks for millennia. Biodiversity is high for an arid region, and the 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 both agricultural and urban development consume land that would otherwise support dense vegetation. The archaeological precinct provides a protected expanse of terrain that can serve as a refuge for rare and interesting plants. Admittedly, the beauty of the native steppe vegetation is subtle, and most people prefer to look at trees, but visitors can be guided into an appreciation of the central Anatolian steppe. With the native steppe established, environmental education can teach both schoolchildren and adults to value the biodiversity in their own backyard—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 inhabitants of Gordion.

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 an 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; and developing seed sources for native-plant gardening in the surrounding region.

In contrast to agricultural fields, which are brown for most of the year and a rather uniform green the rest of the time, the steppe vegetation is beautiful and varied year-round. In the archaeologi-

cal site as garden, certain areas can be “coded” to different levels of “wildness” that will create a visually varied plantscape that draws the viewer’s gaze to the visible archaeological remains.

We are quite intentionally *not* trying to restore the landscape to its “original” state, although archaeobotanical studies at the site have provided valuable information about the vegetation from the Late Bronze Age to the Medieval period (Miller 2010). In ancient times, for example, tasty pasture plants like *Trigonella* were more numerous, while today’s overgrazed pasture is filled with plants that have spines/prickles or chemical defenses that render them unpalatable. Even if we could use this information to re-create the types and proportions of plants, the vegetation cover has changed over time. Furthermore, Tumulus MM may have been bare in antiquity, either from grazing or intentional clearance: without vegetation, the surface reflects light so that the mound stands out in the viewshed for miles around, and this could well have been the desired effect.

No one type of plant can be said to be the best for the purpose of preservation (Table 17.1). Archaeological sites experience a variety of wind and weather conditions and are characterized by many different zones, while slopes face all directions with different moisture conditions on the upper and lower slope. But economic, scientific, and aesthetic concerns make the native steppe plants of central Anatolia particularly desirable. They have evolved in this environment and, once established, should not require watering or expensive care. The native vegetation also includes many perennial plants that stay green well into the summer or even year round.

The Vegetation Improvement Program on Tumulus MM

When erosion became a major issue in Turkey in the early 1990s, the authorities became concerned about conditions on Tumulus MM, which is across the street from the Gordion Museum in the village of Yassıhöyük. The tumulus dates to the Middle Phrygian period and is about 53 m high and 300 m in diameter (Young 1981). I suggested then that an uninterrupted cover of plants would slow wind and water erosion by reducing exposed bare ground; the

Table 17.1. Plants mentioned in the text.

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

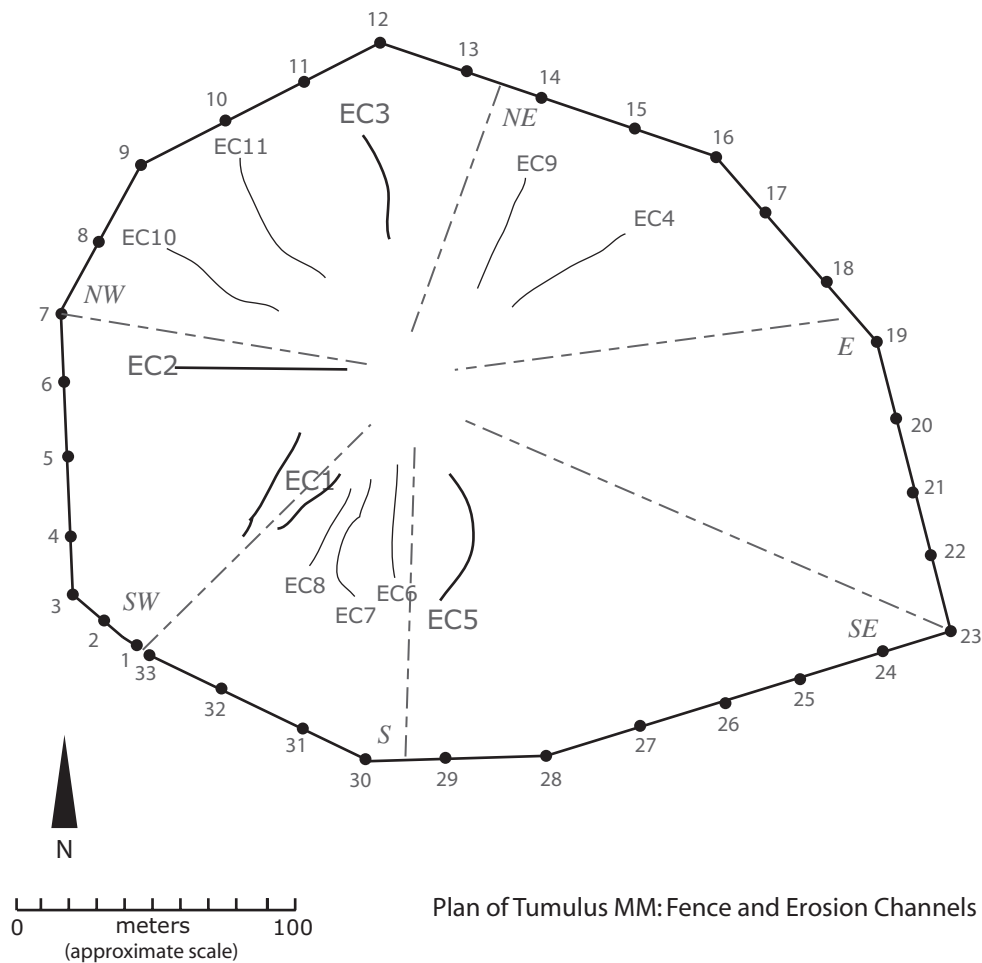


Fig. 17.1. Tumulus MM schematic plan, showing sectors and location of erosion channels. Source: author.

total amount of water flowing downhill would also decrease, as the roots absorb water and keep most of it in the aboveground biomass. When asked how to accomplish this, I suggested that a fence around the mound would keep keep flocks, tourists, and children off the mound (Miller 1994). In the spring of 1996, İlhan Temizsoy, director of the Museum of Anatolian Civilizations, arranged for the mound to be fenced (Fig. 17.1).

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

Even though Tumulus MM had very little plant cover to begin with, many rare species survived out of the reach of animals. The fence has allowed these plants to repopulate the mound. Although there had been no obvious improvement in the vegetation cover by the summer of 1996, it was clear by the summer of 1997 that the fence had begun to work: the vegetation cover inside the fence was denser than what lay outside (Miller 1998, 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. 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 have established



Fig. 17.2a-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. Photos: author.

themselves even on the steepest part of the south slope. There are also differences from one year to the next: after the particularly harsh winter and spring of 2004, for example, the prolific annual wall barley (*Hordeum murinum*) was greatly reduced for several growing seasons.

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, probably *Amblyopyrum muticum*, which I had introduced into Erosion Channels 3 and 5 (EC-3, 5), but the burn did raise the issue of fire hazards. Unlike sections of the American prairie, which has adapted to periodic fires and which was maintained in its open state by the management practices of indigenous populations (see, e.g., Weiser and Lepofsky 2009), the absence of grazing had led



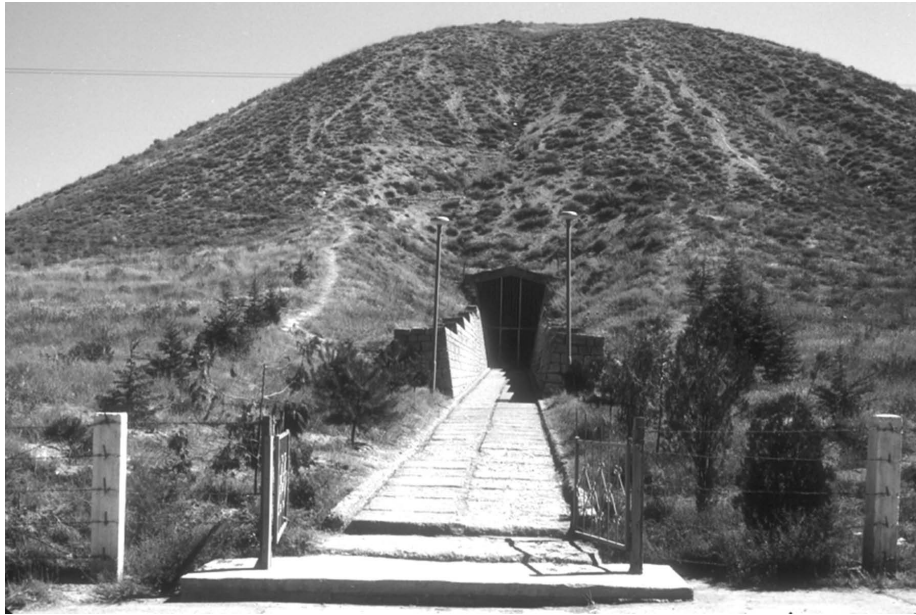


Fig. 17.3a–d. Erosion Channel 1: (a, top) 2000: brick “platform” and diversion channel visible; (b, bottom) 2006: regrowth; (c) 2007: new rows of mud-brick; (d) 2008: growth after one (drought) year. Photos: author.



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 Gordion project director, G.K. Sams, therefore 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 initiative was eliminated during the wet winter of 2001, but fire prevention remains a concern for site management here and elsewhere in Turkey.

With the successful recovery of the vegetation on Tumulus MM, it seemed appropriate to consider the introduction of controlled grazing. Hüseyin Fırıncoğlu, a range management specialist now retired from the Field Crop Research Center (Tarla Bitkileri Merkez Araştırma Enstitüsü), has been advising us since 2004. Although heavy grazing reduces biodiversity (Fırıncoğlu, Seefeldt, and Şahin 2007), Dr. Fırıncoğlu pointed out that moderate grazing would improve the plant cover (Fırıncoğlu et al. 2009), and advised us to use a mixed flock

Fig. 17.3c (above), d (below)



of about 45 sheep and 5 goats (for the woody vegetation) for about a week. If done at the end of September, all the seeds of the spring and summer-flowering plants will have dispersed, especially the perennial grasses we are trying to encourage. This controlled grazing actually enhances seed set, as the hooves of the sheep and goats bury the seeds, and the dung provides fertilizer. In addition, grazing limits some of the excess vegetative matter, and so reduces the fire hazard. Our success with this program has been spotty, in part because the shepherds were reluctant to promote grazing in an area that they thought harbored snakes. But in 2009 Ayşe Gürsan-Salzman introduced us to a shepherd who was willing to cooperate. 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 1997, the three deepest erosion channels constituted one of our most pressing problems: EC-1, EC-3, and EC-5 (Fig. 17.2). The force of water flowing in the channels is great enough to move stones. In collaboration with Kurt Bluemel, an expert in ornamental grasses and landscaping, we decided to line two of the channels with mud brick. The first year's experiment focused on EC-3 and EC-5, which were very successfully treated by using mud brick to slow and absorb the torrents that flow down the mound during heavy rains (Miller and Bluemel 1999). The mud brick 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 growth of vegetation around the channels. That first year we used seeds of fast-growing annual grasses: wall barley, which already grew at the site, and cf. *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 create continuous sluices in the side channels with a brick platform in the center. This approach effectively prevented seedlings from establishing themselves. In June of 1999, Miller documented the work that had been carried out in EC-1, and since almost no plants were growing in the heavily bricked channel, permission was granted to rearrange some of the bricks in EC-1 to allow plants to become established. In 2006 bricks were laid in the erosion channel above the tomb entrance (EC-1) in horizontal rows; after two years had passed, the bricks were no longer visible, and vegetation is slowly establishing itself over much of the channel (Fig. 17.3).

Another ongoing problem has been erosion on either side of the entrance to the tomb. Sometime in the 1990s, several channels which have since filled in were dug to divert water from the entrance. In 2003 the authorities decided to cut back the earth along the entrance to the tomb, and subsequently added impermeable cement gutters next to the walls lining the entry. After two years, both gutters silted up near the tomb antechamber, so the problem clearly has not been solved. Despite our interventions, the south side (at the right, as one faces the entrance) is particularly problematic since it is bare of vegetation.

An important part of the vegetation improvement program involves monitoring any changes that occur, thereby allowing us to assess our various interventions (mainly the fence, but also the bricks and minimal addition of seeds). The vegetation survey was begun in 1998, and has been conducted nearly every year since then.

In order to assess our progress, it is important to know what is growing on the mound at any given time. To that end, I developed a system for making vegetation transects that was 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 (SW, NW, NE, E, SE, and S) based on dominant vegetation just inside the fence. I then assembled 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, I set the hoop down every 15 paces (approximately 10 m) and listed the plant taxa visible within them. I also estimated slope and percent of area covered by plants, noting whether they were just vegetative, in flower, fruit, or dry. On a separate chart, I noted types in the vicinity of the hoop but not actually within it.

The north side is clearly 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, the prevalence on the lower slopes of spiny 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, favoring the survival of these anti-pastoral types (Fırıncıoğlu et al. 2009). In nearly all years, over 100 species of plants have been recorded within the hoops (over 100 m²), with rainfall serving as a key variable in observed biodiversity from one year to the next.

Tumulus MM: Problems and Opportunities

From the perspective of both preservation and finance, 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, thereby reducing maintenance costs and fire hazards. The improved vegetation is tremendously valuable for ecological restoration in that it provides a seed bank for the immediate vicinity and for potential expansion of improved rangeland, gardens, and other projects, such as the Citadel Mound.

Up to now, the vegetation project has provided no direct economic benefit to the village of Yassihöyük. We hoped that our methods would 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 over-

grazing reduces the fodder plants and encourages the spiny and inedible plants. We also hoped that 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,

Because we are trying to preserve a historical landscape for posterity, the other tumuli require just as much attention. The smaller tumuli do not appear to have the same erosion problems as those on Tumulus MM, but they are still 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 positive ramifications for ecological restoration, education, tourism, and economic development.

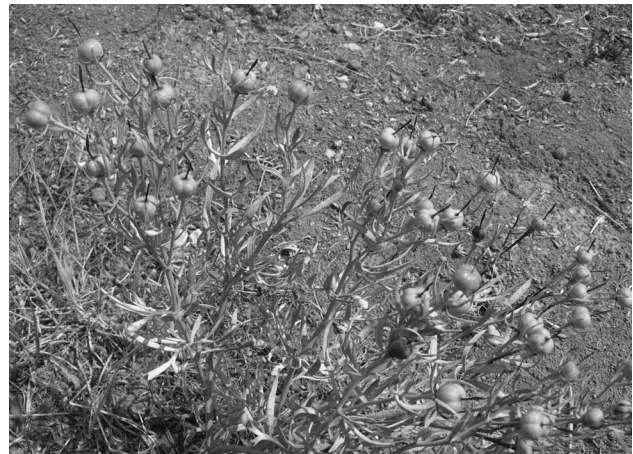
To Plant or Not to Plant

When we began the project, my own fantasy was to use masses of bright red poppies to line the bare spot on Tumulus MM where children used to slide down the mound. More seriously, visitors and team members frequently ask what we planted on Tumulus MM to make it so green, and the answer is: very little. Before we learned that the fence was sufficient treatment for most of the protected enclosure, we assumed that we would have to plant seeds or transplant seedlings in the bare areas. To that end, we carried out several experiments in various places: sowing seeds directly, growing seedlings from seeds, transplanting clumps of grasses, and putting seeds in mudballs that were subsequently set in the ground. In order to reduce the impact on the already stressed native vegetation, we did 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 the ripest seeds get dispersed in place in the course of harvesting. For transplants, we also chose common types. For the most part, we harvested the fenced tumulus and Citadel Mound.

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 (Fig. 17.4). Some annual wall barley,



a



b



c

Fig. 17.4a-c. Some plants mentioned in the text: (a) *Nigella arvensis*, (b) *Peganum harmala*, (c) *Stipa arabica*. Photos: author.

cf. *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. Most perennials are much harder to grow from seed, as we discovered 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 perennial grass *Poa bulbosa* (bulbous bluegrass) (see Citadel Mound, below). 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).

Digging up plants in the wild or at 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 do not 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 the area above the entrance to MM, we successfully transplanted *Stipa arabica*, *Festuca ovina* (sheep fescue), *Melica ciliata* (melic), and *Poa bulbosa* to appropriate spots on the Citadel Mound. We have had less luck with *Stipa holosericea*, and the perennial brome-grasses, *Bromus tomentellus* and *B. cappadocicus*. Although the transplants are sturdy, the clumps do better with supplemental watering if the winter is dry.

When we began the erosion control program on Tumulus MM, I considered incorporating seeds into

the mud-brick that lined the erosion channels to give the plants a headstart. Some years later, Frank Matero told me that elders of the Santa Clara and San Ildefonso pueblos put seeds in mudballs against insect predation, and this seemed like a possible solution to our plant propagation problem. For us, the mudball technique allows us to set out the seed in the dry season, when we are at the site (see Miller 2006 for mudball production demonstration). The mudballs seem to work best for the large perennial grasses, especially *Stipa arabica* and *Festuca ovina*. For annuals such as Medusa-head grass and rock jasmine, simply planting seeds works just as well or better.

The Citadel Mound

Plants can and do grow almost anywhere on open-air archaeological sites, obscuring the ruins completely or emerging from cracks in the masonry. In either case, root damage will work against the long-term preservation of the 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. Tourists visiting Gordion see the remains of the royal precinct, destroyed by a catastrophic fire in about 800 BC (DeVries et al. 2003). The clean stratigraphic break marks the beginning of the Middle Phrygian period, the heyday of tumulus construction.

In 1992 I suggested that one way to reduce below-ground water damage to the ruins was to encourage perennial tufted grasses to grow in the excavated rooms, in the hope that they would crowd out the deep-rooted plants. This meant a change in what had become standard procedure: vegetation management in the fenced area of the Citadel Mound had consistently been limited to weeding in the central excavated area in early June. Yet the seeds of grasses that we would like to encourage (*Stipa arabica*, melic, sheep fescue) ripen in June and July, so the unintended result of this schedule was that just when the potentially valuable plants have focused their energies on reproduction, we prevented them from spreading by seed. At the same time, one of our deep-rooted pests, Syrian rue, was not affected at all, because it flowers, fruits, and seeds prolifically during the summer; in fact, its growth was actually

encouraged, since any competition was effectively removed. Starting in the mid-2000s, G. Kenneth Sams directed the weeders to spare the large perennial grasses. The result is that melic has established itself on several north-facing scarps, and *Stipa arabica* is also beginning to spread (Fig. 17.5).

In 2004 I recommended that we schedule two cuttings per year: one for tourists, and one in mid-summer to remove the most numerous undesirable summer-seeding 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 weaken the plant, and greatly reduces the spread of new plants from seed.

Preservation through Vegetation Management: The Terrace Building Soft Cap Project

In 2006 we began a more active intervention program on the Citadel Mound. Frank Matero wanted to try using a soft cap to protect the wall stubs based on historic preservation practice in Great Britain (see Lee, Viles, and Wood 2009). The goal was to see if the Turkish equivalent of a sod layer on top of the wall stubs would insulate them by reducing intra-annual fluctuation of moisture and temperature. My task was to identify both appropriate and inappropriate species in the native vegetation, collect seeds, and give the conservation team some basic understanding of the botanical issues. I also wanted to demonstrate that an archaeological site is and should be regarded as a living thing, in a very real sense.

The conservation team laid geotextile on top of the wall stub dividing Terrace Building units 1 and 2 and covered it with a 5–10 cm layer of clean earth (Keller and Matero 2011). The wall top was divided into four sections: one-third was covered with transplanted *Poa* clumps, one-sixth with a *Poa* seed mix, one-sixth with *Poa* mudballs, and one-third was left as a “no treatment” control area, and covered with stone. Over the next few years, maintenance involved removing undesirable plants from the wall (especially orache), and leaving those that are not harmful (Fig. 17.6).

A variety of plants appropriate for this experiment already flourish in the Citadel Mound. *Poa*



Fig. 17.5a–c. Citadel Mound: (a, top) 2005, view east across Terrace Building to Citadel Gate (modern scaffolding), Tumulus MM, and other tumuli; (b) 2006, view west across Terrace Building; (c, opposite page) 2006, John Marston investigating melic growing on a north-facing slope near the Citadel Gate. Photos: author.



Fig. 17.5c.

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 also short, shallow-rooted plants that grow easily on wall stubs, such as *Scabiosa* sp., *Alyssum* sp., rock jasmine, and wall barley. We collected seeds of rock jasmine, in particular, 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 thrive under different conditions were put in mudballs (sheep fescue, feathergrasses, and perennial brome-grasses). Only some of the sheep fescue sprouted, but it did not survive the drought of 2007 and the trampling by workers in the area. Despite two years of drought in 2008 and into 2009, the Medusa-head grass re-

seeded itself, but has not thrived due to competition from many other plants. After three years, the *Poa* clumps are well established and successfully prevent undesirable plants from moving in. The seeded area has produced a number of widely spaced tufts. The *Poa* mudballs did not work well at all, and other plants have taken root in the control area.

The Soft Cap Project has demonstrated the value or worthlessness of various approaches in the relatively arid central Anatolian plateau. Even if *Poa* did nothing to insulate against moisture and temperature fluctuation, it kept undesirable (i.e., deep-rooted) plants at bay. Over the next few years, the conservation team will extend the Terrace Building soft cap experiment to the other wall stubs, and they have begun a similar project on top of the Early Phrygian Gate, which had a cracked cement capping. *Poa* seeds are easy to collect, and the plain surrounding the Citadel Mound is covered with *Poa* clumps that can be responsibly harvested. The *Poa bulbosa* clumps transplanted to the wall stubs could also be interspersed with seeds from a variety of short annuals with shallow roots to colonize the inevitable cracks between the clumps.

Citadel Mound: Problems and Opportunities

In many places, *Poa* is already doing a good job of keeping larger plants out of the excavated structures. As with Tumulus MM, a cover of slow-growing perennial grasses whose delicate roots descend less than about 20 cm from the surface would go a long way toward protecting the ruins below. Some plants, notably Syrian rue, have deep roots (encountered during excavation as deep as about 3 m). Others, especially the musk thistle (*Carduus nutans*) and orache, are undesirable because they produce so many seeds. Inhibiting the growth of these three types could be accomplished by cutting and removing them at appropriate times. An early June cutting could be followed by a second one when the plants (Syrian rue and orache especially) are flowering or going to seed, which would prevent new plants from establishing themselves.

The collapsing baulks at the edges of the excavated area are still a problem, and more active in-



Fig. 17.6. Terrace Building 2 experiment, 2007. *Poa* clumps in foreground, seeded and mudballed in middle ground, “no treatment” in background. Photo: author.

tervention would improve the aesthetics of the site. Tall perennial grasses could be planted in small clumps on the collapsed profiles, and even watered, until they establish themselves. These plants are non-invasive, unlike annuals such as *Descurainia sophia*, orache, *Asperugo procumbens*, *Bromus tectorum*; and in the unlikely event that they did spread to the wall stubs, it would be easy to control their growth. If these plants were massed, they would also effectively direct the visitor’s gaze toward key areas of the site. Several types of plants are ideal for this purpose: 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.

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, and protect the unexcavated areas. An uninterrupted cover of shallow-rooted species is the best way to achieve these goals. The general principle is that the roots of densely growing plants will take in water from precipitation and return it to 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.

Open-air Archaeological Site as Garden

Because the site is open-air, any long-term management plan must have a major botanical component. It would help if we started thinking of the open-air archaeological site as a specialized kind of garden with several management zones, each with its own problems and solutions. At sites in naturally wooded regions, like the Athenian Agora, preservationists must contend with trees (see Mauzy 2006); at Gordion, we are fortunate that the region’s natural vegetation is steppe. Our goal is to establish a non-natural collection of relatively shallow-rooted native plants, mainly grasses, whose slender roots do not go very deep; 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 spread into areas where one does not want them. 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 plantings are set in order to get the full benefits of their low maintenance cost. With site as garden, long-term management will clearly need the practical experience of gardeners and botanists, although villagers can be trained to take care of the grounds, thereby providing additional income for them.

Native Steppe Plant Demonstration Area on 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 its flora, not just the artifacts and ruins of Gordion. Yet the sad truth is that most of our tourists come in groups and have neither the time nor inclination to inspect plants as they walk around. I therefore considered the idea of developing a garden on the grounds of the Gordion Museum in Yassihöyük, and in 2006, when Mecit Vural, a botanist from Gazi University, visited the site, we were able to make this idea a reality. A plot measuring about 5 x 10 m was set aside, and 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, and during the summer I collect seeds and make some mudballs to be set out later in the year. Our foreman, Zekeriya Utgu, and Dr. Vural distribute the seeds and mudballs, and transplant some larger specimens as well. Dr. Vural has provided explanatory signage, and I have prepared a one-page flyer that could be distributed to museum visitors. The out-of-pocket cost has been minimal—primarily trucking in the gypsum, and buying some animal dung fertilizer.

Conclusions

Although I have used the metaphor of archaeological site as garden, it is not my intention 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, such as wall stubs, as well as the traces of ancient landscape that have formed part of the viewshed 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 for other parts of Turkey. Several archaeological sites in Turkey already have programs in place that share some features with our goals for Gordion. The Kerkenes project, for example, has a strong program promoting ecologically sustainable development within the context of the archaeological project (Kerkenes and Ehrhardt n.d.). The Çatalhöyük project is a leader in integrating the preservation of an open-air archaeological site with its cultural landscape and local development issues (Orbaşlı 2004). Finally, the Bin Tepe cemetery at Sardis, 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, however, is actively incorporating the native vegetation into their overall management strategy.

One of the most exciting aspects of the conservation work on the Tumulus MM and the Citadel Mound is its wide-ranging 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 cultural landscape (Miller 2011). Farming and herding are part of that landscape, as are the natural flora and fauna. Increasingly, Turkish as well as foreign tourists will look for both cultural and natural attractions, and archaeologists will need to work collaboratively

with villagers, museum officials, and specialists in historic preservation if a successful site management plan is to be formulated. What we have undertaken at Gordion represents the beginning of that process.

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