KOPAIC CULTURES, ECONOMIES, AND LANDSCAPES (KOCECOLA): PRE-EXCAVATION VEGETATION SURVEY, 2022

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INTRODUCTION

From June 1st through 21st, 2022, Prof. Michael F. Lane of the University of Maryland, Baltimore County (UMBC), conducted a structural (physiognomic) survey and taxonomic (floristic) census of the vegetation in several adjoining physical geographical (physiographical) zones within five kilometers of both the Late Bronze Age (Late Helladic) settlement of Aghia Marina Pyrghos (AMP) and the Late Helladic fortress of Glas in and around the northeastern Kopaic Basin of central mainland Greece. UMBC undergraduate students Tara Donovan, Michael Fischer, Alek Fredriksson, Abigail Kennedy, and Gabriella Lehmann assisted in the endeavor. The fieldwork program consisted essentially of plotting two transects across the physical landscape measuring the height and stage of succession of plants of different categories at regular intervals, followed by horizontal mapping and sampling of plant taxa at wider intervals representing different plant associations or their shared boundaries (apparent ecotones). Approximately 160 taxa, identified to the generic or specific level, were recorded and sampled. The elevations and plans are attached to the present report.

MATERIALS AND METHODS

The vegetation survey cleaved closely to the transects following during the post-MYNEKO soil survey of 2019 (see http://myneko.umbc.edu/documents/MYNEKO_2019_STUDY_SEASON_REPORT.pdf), so that both physiognomic structure and taxonomic samples could be compared directly with soil profiles. There were two transects, “1” and “2,” each of which consisted of several traverses on different bearings. Turning points on the traverses, which marked both the soil profile and taxonomic sampling loci, were located again (since 2019) with a single handheld Garmin HCx Global Positioning System (GPS) receiver, whose accuracy (2σ) was never less than ± 3 meters in the *x* and *y* dimensions. Coordinates were recorded in the Greek Geodetic Reference System of 1987 (GGRS-87). The 10-meter mapping intervals on the structural survey were measured with 50-meter or 100-meter fiberglass tapes carefully strung and back-sighted through the vegetation. No attempt to correct for slope was made, a difference that would have been within the margin of error of the GPS readings in most or all cases.

The height of the plants was measured directly with tape measures or two-meter folding rulers or estimated with either a horizontal equivalent length, using a ruler to turn the perceived height through 90 degrees and then measuring the actual length, or occasionally a clinometer built into a Brunton compass (where plant height = distance × tanθ + observer height). Only a few plants exceeded five meters in height, so foreshortening was negligible. The vertical structure of the vegetation was mapped on pro formas, following a method pioneered by Dansereau (1957; see also Gilbertson, Kent and Pyatt 1985: 64–5), whereby plants were designated according to whether they were herbaceous (no woody parts, largely single-flower), shrubby (woody and branching without a distinct trunk), arboreal (ditto but with a trunk), or cultivars (whether herbaceous or otherwise), each category further divided, as applicable, between deciduous and evergreen (or "other" in the case of herbaceous plants). Recording was made every 10 meters on the ground, representation of categories of plants on the interval judged by whatever was within ca. two meters (a two-arm span) of the locus. Only one instance of each category represented was recorded, though density of each representative was recorded as "continuous," discontinuous," "sparse," or "barren." The vertical scale for plant elevations (nor physical relief) on the pro forma was 10 times greater than the horizontal—i.e., 1 vertical meter for every 10 horizontal meters per interval—for the sake of accurate sketching and subsequent readability.

The taxonomic census consisted of two operations. The first was application of the minimum quadrat method of taxonomic quantification (see Gilbertson, Kent, and Pyatt 1985: 75–82). The quadrat applied was a one-meter square drawing frame (grid) divided into 25 20-centimeter squares with strings. All the different taxa observed within this frame were drawn in plan in their respective location (relative ground cover). The area of this quadrat was double at least once by placing the frame arbitrarily or conveniently adjacent to the initial area, turning thence around the unshared sides until no new taxa were observed in the frame. Prominent plants, such as bushes or trees, over which the frame could not be fitted, were indicated at the margins of the drawings, their offsets measured with a tape. A record of the taxa by Latin binomial (and parenthetical common English name) was facilitated by a prepared pro forma, based on prior observations in the region (see Briggs 1977; Gilbertson, Kent, and Pyatt 1985: 83—5)—although this proved quickly in need of written supplementation, given the specificity and diversity of taxa encountered. The second operation was the collection of parts of the stems, leaves, and flowering or seedy parts in paper envelopes that were marked with the collectors' names, date, locus designation, and provisional scientific binomial taxonomic identification. Such samples correspond to the types of parts specialists expect to recover in KOCECOLA excavations of AMP from 2023 onward. Identification in the field was achieved from investigators' prior knowledge, traditional field manuals (e.g., Polunin 1980; Polunin and Huxley 1987; Sfikas 1992, 1998), or the Seek or PlantNet cellphone applications where service was available (the two apps often being complementary, each have different strengths and weaknesses in identifying taxa). The plant parts samples were transferred to labeled plastic vials upon return to the staff house after fieldwork, and identifications were checked again at that time against standard references.

Transect 1 ran from the top of Folies, the easternmost peak of the Mytikas ridge, ca.0.75 km west of the town of Akraifnio, westward along the ridge to a rise called Spitharia, then traveled downslope into a shallow saddle, northward down a steeper slope to an upland alluvial–colluvial plain nested between Mytikas, Ftelia, and Melano (western Ptoion range) and thence down a *rema* (seasonal stream), moving back and forth between the inside and outside of its bends, until it emerged on the ancient alluvial fan. Transect 2 ran from the colluvial terrace below the scarp (Pleistocene lake shore) ca. 1.25 kilometers east of Glas, an area known as Chouni, northward and gradually upward for several hundred meters to ascend into the rough tableland of Nisi, within one kilometer to the south of AMP, firstly on a concave and then convex slope, and finally turning east to run for several hundred meters toward the summit of Pyrghos (currently occupied by the LARCO nickel mine's spoil heap). Thus, several physiographic zones were traversed, from rocky ridge to upland plan to several landforms surrounding the *rema* and onward to alluvial fan, colluvial terrace, and locally mid-altitude rocky tableland (Figure 1).

RESULTS

TRANSECT 1

The mountain ridge was dominated by evergreen oak associations, predominantly, if not exclusively, kermes (*Quercus coccifera*), interspersed with evergreen mastic (*Pistacia lentiscus*) and, to a lesser extent, deciduous terebinth (*P. terebinthus*) and evergreen mock privet (*Phillyria angustifolia*), almost all reduced to shrub status both by current goat browsing and undeveloped soils no deeper than 30 centimeters (Figure 2). In only one place did a mastic plant attain the status of a tree in relatively deep soil. A stray stalk of hulled cultivated barley (*Hordeum vulgare*) was observed, presumably seeded by a bird that had fed in the cultivated plain below. The steep north slope descending from the saddle between Folies and Spitharia was characterized by essentially the same association, albeit with more of the dominant woody plants attaining tree status both because soils were deeper where sediment had accumulated between linear limestone outcroppings and because of greater opportunity for shelter against weather stressors. One instance of holm oak (*Q. ilex*) was observed among the evergreen oaks this slope.

The plain was dominated by wheat, barley, and oats in rotation, evident both in the plant associations and from the account of informant farmers on site. Soils in the upland valley possessed topsoil (A) horizons between ca. 1.3 and 2.5 meters deep. During the soil survey in 2019, the humic subsoil (B) horizon of one locus, close to the top of the *rema,* yielded a few small shards of eroded pink-fabric ceramic at a depth of about 2.0 meters. Continuing northward, the top of the *rema* was deeply incised into alluvial sediment and full of brambles(*Rubus* sp.), terebinth, and cypresses (*Cupressus sempervirens*). As the *rema* opened up farther downstream between Ftelia and Melano, the bench at the confluence with a lesser *rema* from the east and the terraces on the *inside* of bends were planted with olives (*Olea europaea* cultivated). Stands of goatgrass (*Aegilops geniculata*) among the planted trees were common. Soils here were shallower and less developed than in the plain above, possessing A horizons ca. 1.0 to 1.2 meters deep and B horizons characterized by a high quantity of gravel (> ca. 15%), probably the Pleistocene substrate, although they appear to be well drained. Pits had been dug into the subsoil to plant the olives. Profiles sampled on the *outside* of bends were very shallow, hardly more than 0.2 meters, although the incised adjacent embankments showed that soils a meter or more thick had formed at times. At one such location, near the confluence of the two *remata,* the base of a black-glazed bowl with a brownish paste was discovered, which has good Classical comparanda from nearby Ristona (Ure 1913), about 30 kilometers away. It most likely had been washed there. Given that it appeared not to have traveled far, since it was neither abraded nor badly eroded, its probable, though conjectural, point of origin is the southwest facing slope above it, a steep terrace now cultivated with olives. There is a more level area at the top of this slope that would have been suitable for a building. Unfortunately, for the preservation of architectural remains, heavy machinery has been introduced lately to level parts of the terrace for orchards. Below the confluence, the valley narrowed again, and the streambed became clearly incised. The dominant plants were mastic and terebinth, with some mock privet and stray olives (likely old cultivars). Noteworthy was the predominance of holm oak along the course of the *rema.*

As the streamed entered and incised the old alluvial fan just above the plain (ancient lakebed), the vegetation gave way to that of old cultivated fields. These contained tall growths of such grasses as goatgrass, smilograss (*Piptatherum miliaceum*), and wild oats (*Avena fatua* and *A. sterilis*), diverse thistles, including carline (*Carlina carymbosa*), spiny bear's breeches (*Acanthus spinosa*), and prominently, especially on the flank of Ftelia, where the substrate contained more stones, false bisabol or ferula (*Opopanax chironia,* Dioscorides' "Heracles' all-heal"). Soils in the alluvial itself fan were loamy with a gravel layer at the bottom of the A horizon, ca. 1.5 to 2.0 meters deep. The *rema* continued to be lined with holm oak as it approached the perennial stream descending from Kokkino to Souvli.

TRANSECT 2

The first three sampling loci of the second transect fell in two fallow fields and another planted in the past year with young olives (Figure 3). The A horizons on the terrace of Chouni were between 1.5 and 2.0 meters deep, coming down on a dense gravel layer, as in the alluvial fan (above). However, they tended to be silt loams or silty clay loams, and those closest to the scarp contained many rock fragments. The fallow was sparsely vegetated with various thistles, chicory (*Cichorium pumilum*) and plants of the same family (e.g., *Rhagadiolus stellatus*), poppies (*Papaver rhoeas*), vetches (*Vicia* spp.), and, in stonier areas, Jerusalem sage (*Phlomis fructicosa*). Ascending onto the tableland and toward the summit of Pyrghos, the soils became suddenly thinner, ranging in depth from about 0.30 to 0.75 meters before arriving on bedrock. These soils, however, were not only deeper than those on the rocky Mytikas ridge, but they also had a clearly developed lower topsoil (A2) horizon in places. The dominant vegetation was evergreen oak, although with a greater mixture of kermes with holm, particularly in places with deeper soils and sheltered by surrounding outcroppings and landforms. Notably less abundant than farther south were mock privet and species of the mastic–terebinth genus (*Pistacia*). Wild olive (*O. europaea*) was well represented. Indeed, whereas the mean number of taxa (genera or species) per square meter on the top and slope of the Mytikas ridge (Folies to Spitharia) was approximately 3.8, it was about 7.0 on the tableland of Nisi, surpassed at any locus only by a mean of 8.25 in the fallow field's ecotone at the foot of Nisi.

The structure of the observed plant associations and their constituents can be seen in Figures 4–22. The plants depicted in the quadrats and their legends are supplemented with a list of taxa observed both in late November 2022 and late March 2023, when certain perennial herbaceous plants had either emerged from the ground or were in bloom and thus identifiable for the first time.

CONCLUSIONS

The plant communities within five kilometers of both AMP and Glas are diverse, despite the trend toward intensive monocultures for modern markets, and offer various both cultivated and uncultivated resources. At different points of the current (if ending) climatic optimum, the potential of these resources could have been lesser or greater, though, except for a couple of observed escaped exotics, the overall taxonomic composition is unlikely to have changed much. Thus, even if the mountain's top and slopes were intensely browsed by ovicaprids, they could have provided crimson dye (Ancient Greek *ertis* or *kremnos*), attested in Mycenaean Linear B records (*e-ti-we*), mastic resin for cooking, incense, and medicine, terebinth resin for cooking, medicine, waterproofing coating or sealant, and possibly aromatic or even comestible oil (perhaps evident in Linear B *ki-ta-no,* if translated *kirtanon* = Ancient Greek *kritanos;* Merousis 2016). The resin of the false bisabol lower down on rocky and well drained foot-slopes and plain may have been sued for medicine, its genus name, *Opopanax,* meaning "juicy cure-all." While it seems unlikely that the rocky bench and terraces mid-course in the main *rema* of Transect 1 were cultivated with staple grains, it is possible that the south-facing slopes were planted for tree crops, as today, or vines, such as one finds now on the well drained alluvial fan of Souvli. Hence, the fragment of a Classical bowl found near the confluence of the *remata,* could have belonged to an outbuilding, itself possibly with a infield garden, while the main building of the farmstead could have been in the upland plain, where grain is grown today. Perhaps it is represented by the ceramic discovered in the B horizon there. It would also have been conveniently located near browsing land and sources of tinder and firewood. It should be noted, however, that *no* scatters of artifacts were observed on the transect in either the plain or on the stream banks that would suggest the immediate proximity of habitation. Nor does it seem that the tableland of Nisi needed to have been relegated to grazing and browsing as it is today. Although it is unsuited to the cultivation of staple crops, the presence of a considerable number of wild olives suggests that it could have been used for the cultivation of olives too, especially where soils are relatively deep and drained.

The vegetation has not just provided a set of samples from a broad range of different strata and stages of succession, but it has also provided snapshots of their typical associations at different altitudes and different soil and water conditions and, by implication, a glimpse of individual taxa's ecological limiting factors. Hence, the data collected and organized by the team in 2022 can provide comparanda useful not just for identification at the level of individual taxa but also at the level of assemblages, especially those to be recovered in excavation from 2023 onward that reflect either ecological associations or deliberate collections with inadvertent inclusions (e.g., weeds among crops).

Finally, aside from the limited functionality of both Seek and PlantNet in the telephonic circumstances, the former proved better suited than the latter for quick identification of shrubs and trees, given its dynamic image-matching algorithm, especially those with distinct flower, fruits, and leaves, the latter was indispensable in identifying herbaceous plants, especially those not in bloom and particularly grasses (Poaceae family). PlantNet's wiki-database also ranks identifications by probability, which encourages one to examine alternatives, research them more, or collect further comparison samples.

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