NEW AND TRADITIONAL METHODS FOR THOROUGH DOCUMENTATION AND ANALYSIS OF ARCHITECTURAL FEATURES IN THE GREEK LANDSCAPE: A CASE STUDY FROM THE MAZI ARCHAEOLOGICAL PROJECT (WESTERN ATTICA)

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Περίληψη/Abstract

Μέχρι πρότινος, η επαρκής, ακριβής και υψηλής ανάλυσης αποτύπωση των αρχιτεκτονικών καταλοίπων που απαντώνται σε ολόκληρη την ελληνική ύπαιθρο δεν ήταν ένας άμεσα επιτεύξιμος στόχος για τα προγράμματα εντατικής επιφανειακής έρευνας. Η σχεδίαση μικρών, διάσπαρτων ευρημάτων είναι χρονοβόρα, ακόμη και για έμπειρο προσωπικό, και για μία διεξοδική αρχιτεκτονική αποτύπωση είναι απαραίτητα χωρικά δεδομένα υψηλής ακρίβειας που είναι δύσκολο να είναι προσβάσιμα σε απομακρυσμένα σημεία της υπαίθρου. Εξάλλου για την ολοκλήρωση της σχεδιαστικής αποτύπωσης ακίνητων ευρημάτων πολύ μεγάλων διαστάσεων, όπως οι οχυρώσεις, είναι αρκετά δύσκολο να διατεθούν πλήρεις αρχιτεκτονικές σχεδιαστικές ομάδες για ολόκληρες περιόδους έρευνας. Εν τούτοις, η τεχνολογική πρόοδος καθιστά δυνατή και ταυτόχρονα σύντομη και επαρκή την παραγωγή τρισδιάστατων αποδόσεων τόσο μικρών όσο και μεγάλων αρχιτεκτονικών στοιχείων με ακρίβεια και πιστότητα. Παρά ταύτα, η ψηφιακή καταγραφή δεν αποτελεί πανάκεια για την αποτύπωση ευρημάτων στις επιφανειακές έρευνες καθώς οι παραδοσιακές μέθοδοι παρέχουν ποιοτικώς διαφορετική πληροφόρηση και σε πολλές περιπτώσεις παραμένουν ίσως πιο σκόπιμες, ιδιαίτερα εκεί όπου η βλάστηση είναι πυκνή ή η διατήρηση των καταλοίπων είναι κακή.

Until recently, accurate, high-resolution, and efficient recording of architectural features encountered throughout the rural Greek landscape has not been a readily achievable goal for intensive pedestrian survey projects. Drawing small, scattered features is time-intensive, even for trained personnel, and proper architectural survey requires the acquisition of high-quality geodata that can be hard to come by in the remote countryside. On the other hand, drawing massive features, like fortresses, is sufficiently difficult to require independent architectural drafting teams entire seasons to complete. Technological advances, however, are increasingly making the production of precise and accurate 3D renderings of both small and large architectural features not only possible, but rapid and efficient. Nevertheless, digital recording is no “silver bullet” for feature recording in surveys. Traditional methods provide qualitatively different information and in many cases may remain more expedient, especially where vegetation is thick or preservation is poor.

Keywords: Photogrammetry, Pedestrian Survey, Architectural Documentation, Fortifications

Introduction

The Mazi Archaeological Project (MAP) is a diachronic regional survey operating in the tradition of Mediterranean landscape archaeology, under the auspices of the Swiss School of Archaeology in Greece and the Ephorate of Antiquities of West Attica, Piraeus, and the Islands of the Greek Ministry of Culture (Fachard *et al.* 2015; Knodell *et al.* 2016, 2017a). The project employs intensive and extensive pedestrian survey methods to investigate a small mountain plain at an important crossroads on the border between Attica and Boeotia (Fig. 1), and to thereby contribute to the scholarly understanding of borderlands, especially in terms of material and human history. The project has also invested considerable time and energy into investigating the benefits and costs associated with the integration of new methods in the recording of archaeological features into the day-to-day process of architectural documentation.

The purpose of this paper is to describe the rationale, methods, and results of MAP's feature recording program from the 2015 and 2016 field seasons. First, we distinguish our approach to feature recording from the usual systems employed by pedestrian survey projects. Then, we outline the ways in which digital methods created new possibilities for survey feature recording, for both large and small features, in the context of the MAP survey. Finally, we consider the drawbacks of digital approaches to feature recording, and argue that in many cases manual draftsmanship remains a superior method of illustration, which should not be wholly or uncritically replaced by digital tools.

1. Feature Documentation in Intensive Pedestrian Survey

While photogrammetric modelling and RTK DGPS mapping for architectural documentation have been adopted with alacrity as part of the toolkits of Mediterranean archaeological excavations (Olsen *et al.* 2013; Roosevelt 2014), for the reconstruction of the physical landscape (Orengo *et al.* 2015), and at self-contained projects where the focus is the accurate architectural documentation of large structures (Sapirstein 2016), these techniques have not yet been brought to bear on the study of the ancient architectural landscape more broadly construed.

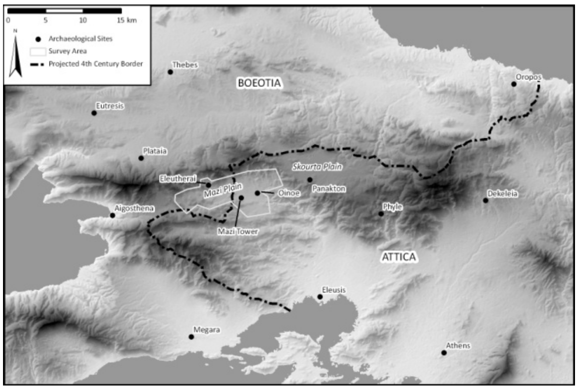

Figure 1 Mazi Archaeological Project survey region in the context of the mountainous Attic/Boeotian borderlands.

A common methodological dilemma confronted by Greek archaeologists involved in intensive survey projects is the problem of the "artefact-rich" environment (Caraher *et al.* 2006). However, less attention has been given to architectural features on intensive Mediterranean survey projects (an exception is the Saronic Harbors Archaeological Project, Tartaron *et al.* 2011; Clinton *et al.* 2014). The problem of how to manage the documentation and interpretation of a feature-rich landscape that is dense with ruined architectural structures (Fig. 2) has largely been left unexplored.

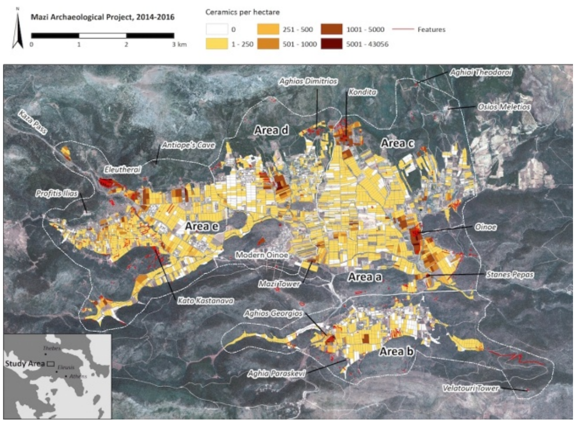

Figure 2 The quantity of features in the MAP survey represents a formidable assemblage of architectural ruins.

Features discovered during the process of fieldwalking in survey projects and previously known architectural monuments within survey areas have usually been documented on paper and in database entries, but physical recording has been limited to a few general photographs and rough sketches, which often do not include a precise scale and are not based on a proper architectural survey. This is understandable, given the limitations of time and effort archaeological teams face and the sheer quantity of ruined structures usually encountered during a season of exploring the landscape. Drawing small, scattered features is time-intensive, even for trained personnel, and proper architectural survey requires the acquisition of high-quality geodata that can be hard to come by in the remote countryside. Typical approaches to the issue have been either to treat features largely separately from the artefactual environment (Fachard 2016, 82–83) or to find a middle ground based on sketches, selective drawings, photography, and basic mapping (Berenfeld *et al.* 2016; Knodell *et al.* 2017b). On the other hand, drawing and planning massive features, like fortifications, is sufficiently difficult and time-consuming that independent architectural drafting teams require entire seasons to complete full documentation.

2. Documenting the Feature-rich Greek Countryside

At the Mazi Archaeological Project we have taken seriously the notion that architectural features encountered in field surveys should be recorded in greater detail than has become customary, and argue that in most cases a responsive combination of new technologies and traditional methods make this an achievable goal (see Douglass *et al.* 2015). During fieldwork in 2015 and 2016 MAP made extensive use of 3D recording to produce plans and elevations of several architectural features discovered during the survey. The features varied in size from the foundations of small structures to massive and well-preserved fortifications.

3D architectural documentation in the field proceeded in three steps. First, team members prepared the subject by clearing vegetation and placing coded photogrammetry targets, spaced approximately 1–2 m apart, in the scene. Second, ground control points, which would be used to assess the accuracy of the photogrammetric model and to tie the model into geographical space so that orthophotos extracted from the models could be loaded seamlessly into the project GIS, were measured. Since datums were not available in most areas of the survey, fixed points were measured using a Leica CS25 RTK DGPS unit receiving correction data from the Metrica SmartNet through a SIM card. Third, photos were taken with a Nikon D7100 DSLR camera equipped with a Zeiss 18 mm f/3.5 lens in accordance with standard methods for archaeological photogrammetry, which have been described elsewhere (Olsen *et al.* 2013; Green *et al.* 2014; Sapirstein 2016). The camera was raised on a fiberglass boom for overhead shots when required (Sapirstein 2016, Fig. 3).

Figure 3 MAP team members documenting the Velatouri Tower using a fiberglass boom to raise the camera without the aid of a drone.

While archaeologists often use drones to record architectural features (Fernández-Hernandez *et al.* 2014), we chose to employ a predominantly terrestrial approach to photogrammetry in the field for a number of reasons. First, given the number of features involved and their remote locations, we felt that the limited battery life and unwieldiness of most commercial drones would have hindered the pace of our recording and therefore compromised our mission to be both thorough and comprehensive in the documentation of survey features. Second, since most features we needed to record were not large and did not stand above a few meters, the use of a drone would not have made recording faster or more effective (although there were exceptions: see section 2b below). Finally, most drones that are within the budget of the average field project do not support a payload that would allow them to carry cameras ideally suited to photogrammetric recording, i.e. cameras with large sensors and interchangeable lenses (Shortis *et al.* 2006). For detailed architectural recording of ruined features, then, drone-based photogrammetry is not always ideal (Sapirstein and Murray 2017).

2.a Small Features in the Landscape

The majority of architectural features encountered in the MAP survey area comprise the foundations of small structures, which are usually recorded in a summary fashion by field survey projects because the time it would take to draw and survey them in detail is not merited by the information that they provide. The typical dataset that results from feature recording in the context of survey projects is therefore usually made up of quick snapshots and rough sketches. As Figures 4a and 4b demonstrate, neither product provides much meaningful information to the researcher hoping to study the feature-rich landscape. Two-dimensional photographs of poorly-preserved foundations taken from ground level are usually difficult to parse from the point of view of an architectural historian, and sketches by inexpert field team members are not done to scale and do not accurately represent the construction materials and their organisation.

One of our goals at MAP was to consider how much effort and time it would require to enhance the typical workflow for feature recording in survey projects using digital methods beyond photography. In experiments in the field during the 2015 season, the MAP team documented the foundations of small structures that are typical of features encountered throughout the Greek landscape in the field in approximately twenty minutes. This amount of time is not significantly more than is usually required for team members to sketch, photograph, geolocate, and take notes on a feature, but the result is a 3D model and georectified orthophoto that provide a clear view of the feature that is much easier to understand and analyze than sketches and photographs (Fig. 4c; see www.maziplain.org for other examples). The recording process included clearing vegetation, placing targets, measuring control points, and shooting photos.

Since the amount of time needed to document small features using photogrammetry and DGPS was not significantly more than the time that a survey team would usually require to sketch, take notes on, and photograph a small feature, we believe that building such recording processes into survey workflows should be considered a viable option for projects like

MAP. The benefits of doing so are, in addition, analytically valuable. Photogrammetry and detailed mapping produce metrically accurate, interactive models of architectural remains that are more valuable for study than snapshots and sketches. Georectified orthophotos generated from such recording techniques can be useful for analysis in a variety of ways. For example, they can be pulled directly into a project GIS, taking the place of simple polylines or polygons that usually serve as placeholders for such features in the geospatial containers of survey projects. In addition, architectural historians can study the orthophotos side-by-side, allowing them to see clearly the development or nuances of local construction techniques and materials without visiting hundreds of features in sequence.

Figures 4a-c Products of different methods of recording features encountered in the landscape as demonstrated by MAP's iterative documentation of feature c_016, the foundation of a small rectangular structure.

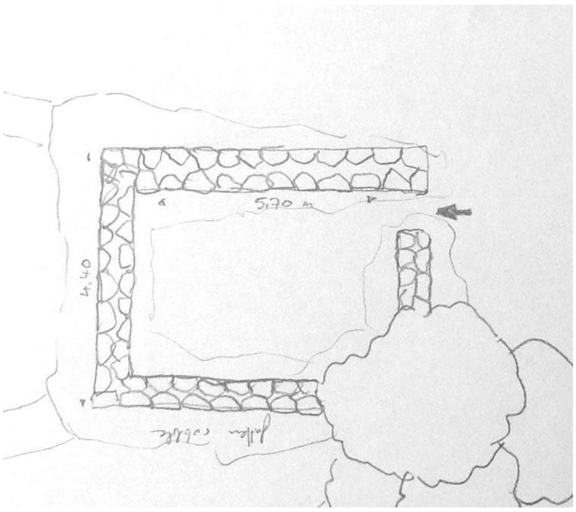

Figure 4a Rough sketch drawn by extensive survey team.

Figure 4b Feature photo facing east.

Figure 4c Top plan generated from a photogrammetric model and surveyed to 1.5 cm accuracy.

2.b Large Structures and Fortifications

A significant number of large stone towers, Byzantine churches, and fortification walls fall within the MAP survey area. These include the Classical/Hellenistic fortifications of Eleutherai and Oinoe, the Frankish tower at Kondita, the churches of Aghia Paraskevi and Agioi Theodoroi (among many others), and the remains of several self-standing Classical/Hellenistic towers, most notably the relatively well-preserved one at the Velatouri hill (Fig. 5).

Figure 5 Snapshot of the 3D model of the Velatouri Tower.

Due to their large size and the height of standing remains, the majority of these features have proven difficult to plan and draw properly (e.g. Ober 1985, plate 5 for Eleutherai, compared to Figure 6, the plan generated in MAP's 2016 field season). In the case of the fortress at Eleutherai, the generation of a stone-by-stone plan of the entire structure was not only challenging, but effectively impossible, prior to our project's use of computational assistance. This is primarily because the towers stand to such a formidable height that surveying them using the regular methods of architectural draftsmanship (that is to say, scaling the towers in order to measure datums and dimensions) is too dangerous and cumbersome to attempt.

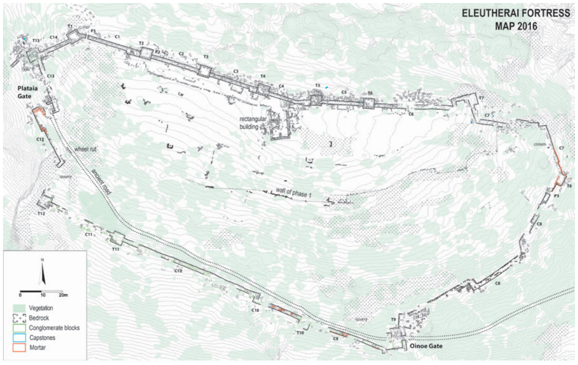

Figure 6 A new stone-by-stone plan of the fortress of Eleutherai.

Using a combination of drone and terrestrial photogrammetry, the MAP project has generated complete and detailed 3D models of these features which will provide useful analytical proxies during study seasons, freeing project staff up to spend more time thinking about the architecture as opposed to repeatedly visiting remote structures or spending additional study seasons drawing features in the field. At the same time, we wish to emphasize that electronic representations of architectural features are not necessarily interchangeable with architectural drawings by trained draftspersons, which present interpretative and analytical data that a "raw" photo recording cannot provide. We explore questions of how to weigh decisions about which sort of recording is best in the remainder of this paper.

3. Comparison of Traditional and 3D Recording Techniques

One way of comparing new and traditional methods is a simple measure of investment of time. How much faster and more efficient is 3D recording? While it is generally assumed that the adoption of digital methods increases the pace at which the documentation will proceed, detailed discussion and quantification of the precise drawbacks and advantages of 3D and traditional recording is not present in the existing literature. Figure 7 represents one attempt to estimate the rough savings in labour and costs based on approximate time needed to generate architectural drawings using manual and photogrammetric methods. These figures assume that the goal of recording is simply to document the presence and extent of features, rather than to interpret or generate final products for publication and dissemination. Estimates in Figure 7 are based on rates of hand-drawing Late Bronze Age buildings by the architectural documentation team at the Saronic Harbors Archaeological Research Project, while estimates for photogrammetric recording are based on work at MAP in the summers of 2015 and 2016. By comparing the time required to draft a pen and ink plan of architectural features with efficiency figures from recording using 3D methods, we demonstrate that the 3D recording method has the potential to be at least three times as efficient in the majority of cases, and therefore might free up significant time for analysis of architecture in the field.

Nonetheless, our experience shows that photogrammetric feature recording is often not a suitable option for the recording of features discovered during field survey. At MAP, this was true in cases where vegetation was especially thick or impossible to remove, or when complex renderings, such as sections through standing structures, were required. One of the most important lessons learned from our work in the Mazi plain is that clearing vegetation is often the most time-consuming part of 3D recording in survey projects.

Vegetation must be cleared from a feature before it can be photographed for the purposes of digital modelling not only for the obvious reason that the vegetation obscures the architecture, but also because branches, leaves, and grasses blow in the wind, moving around and therefore changing the composition of the scene across the photo set. This variation will interfere with structure-from-motion software, which works by matching pixels in photographs taken of the same subject from different positions and therefore should be avoided to ensure jobs will be processed successfully in the lab. Because survey projects are designed in part to rediscover ruins that have been forgotten in the landscape for centuries or millennia, the remains encountered in a survey are often badly overgrown.

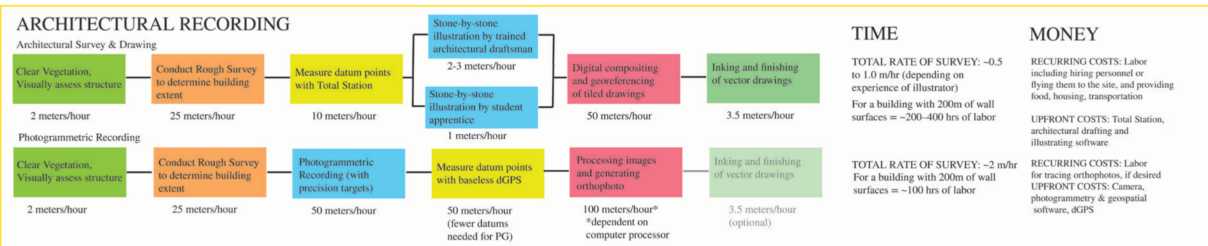

Figure 7 An attempt to quantify labour and cost savings that go along with the adoption of digital architectural recording.

Survey teams seeking to integrate photogrammetric recording into their research design must take into account the labour and time that will be needed to clear weeds and shrubs. Moreover, in some cases, this requires a special authorisation, as well as the approval of the local Fire Department.

Terrestrial photogrammetric modelling is also not an ideal way to record structures that are particularly poorly preserved, with large gaps in the architecture between which grassy fields or other "blank" zones intervene. Once again, the processing software struggles to stitch together architectural elements that are separated by vegetation that has few distinguishing features and that blows around in the wind. Especially large features of this nature might be more successfully recorded using UAV (drone) photography, although the resolution of the models will suffer depending on the camera and elevation of the flight.

In some cases it is simply easier and faster for an architect or trained illustrator to draw structures that are heavily overgrown or discontinuous by hand. At MAP, for example, an early Christian basilica in the settlement at Eleutherai is enshrouded in thick vegetation, including not only undergrowth but also trees (Fig. 8). Because the structure was quarried in early modern times and is extensive in size it presents an inconvenient subject for terrestrial photogrammetry even in the best of circumstances, since the large open spaces of the aisles and areas of robbed stone would hinder efficient stitching of the model, unless special preparation of the site with many coded targets were undertaken. In the case of the documentation of the basilica, it was obvious to the MAP team that a trained architectural draftsperson could draw an accurate and thorough plan of the architecture in less time than it would take to prepare the site for photogrammetric recording and to conduct the photography (Fig. 9).

Figure 8 Remains of an early Christian basilica at the settlement Eleutherai, which was too overgrown to be a suitable target for photogrammetric recording.

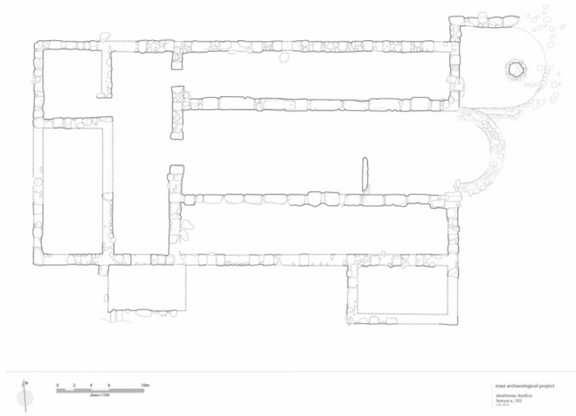

Figure 9 A basilica drawn using established methods of architectural drafting.

In some cases, then, recording features by hand will remain more effective and more efficient than digital recording for purely logistical reasons. Regardless of these considerations of efficiency, should digital recording always be the "first" option, with paper draftsmanship implemented only when conditions render digital recording inexpedient? This is a question that can only be answered after a careful consideration of the fundamentally different kinds of thinking both methods require archaeologists to undertake and the different kinds of products that they generate.

Drawing features by hand requires the archaeologist to approach the subject using different cognitive engines than the ones used by archaeologists recording features with cameras and drones. The process of digital recording is largely one of making the correct technical decisions. How many photos must be taken, and at what distance from the subject? How many scale bars or control points should be included in the scene? Is the lighting correct, or should photography be delayed until conditions are more favorable? Making these decisions does not require the recorder to look at or think carefully about the subject as an architectural feature.

The process of drawing, by contrast, requires both the technical expertise of a draftsperson and the analytical skills of an experienced architectural historian. Drawing is a process of careful interpretation and editing and therefore provides information of a qualitatively different value than 3D and 2D products that result from digital recording methods. While both approaches are designed to, at the most basic level, provide an accurate representation of what exists for the archive of the archaeological record, the process of manual recording on site requires the draftsperson to make decisions about what to include and what not to include. These drawings therefore carry interpretive value in addition to representing the dimensions and characteristics of features as they are encountered in the landscape.

Architectural draftsmanship is, then, a qualitatively different approach to recording and therefore cannot be replaced by digital methods in any substantive way, even though digital methods may often provide expedient tools for recording information in certain circumstances. There is no way to quantify the deep knowledge that a draftsperson gains about a subject during the hours often required to draw a feature. This investment in time often yields an understanding of a feature's materiality, embeddedness in its landscape, and relationships with nearby structures that cannot be achieved during the brief time that a photogrammetry expert will spend taking photographs and GPS points.

Our experiences confirm the notion that digital recording techniques can increase the speed and efficiency of feature documentation practices in intensive survey projects. The judicious application of these techniques will in many cases allow survey projects to create unprecedentedly rich and high-resolution data archives of the built ruined landscape. However, digital methods are not suitable for all recording tasks that feature documentation teams will encounter in a diverse architectural landscape. Furthermore, the process of digital recording does not replicate the process of drawing. Survey teams should think carefully about the implications that all-digital recording processes may have on the depth and quality of their knowledge of the built environment. The key to the proper deployment of tools and methods will always remain the experienced judgment of experts and team members, without programmatic or dogmatic adherence to a single approach to feature recording.

Conclusions

The approach to architectural feature recording and presentation taken at MAP represents a step forward in Mediterranean survey methods. Creating 3D models of major architectural monuments allows team members to study these remote, often difficult-to-reach features from anywhere, and in many cases from vantage points which would be difficult to reach otherwise. In addition, the use of photogrammetric recording can enhance the quality of recording for small features scattered throughout the landscape without costing field teams significantly in terms of time and labour expenditures. In some cases, however, traditional drawing techniques remain preferable, especially when architectural remains are poorly preserved or heavily overgrown. Moreover, these different methods record qualitatively different information, since drawing is an interpretive act. Survey projects outfitted with the equipment and personnel to integrate both methods can reasonably expect to create an unprecedentedly thorough documentation of architecturally rich landscapes without stretching either budgets or the investment of labour.

References

Berenfeld, M., Dufton, J. and Rojas, F. 2016. Green Petra: archaeological explorations in the city's northern Wadis. *Levant* 48(1): 79-107.

Caraher, W., Nakassis, D. and Pettigrew, D. 2006. Siteless Survey and Intensive Data Collection in an Artifact-rich Environment: Case Studies from the Eastern Corinthia, Greece. *Journal of Mediterranean Archaeology* 19(1): 7-43.

Clinton, M., Murray, S. and Tartaron, T. 2014. 'GIS in Action: Analyzing an Early Bronze Age Coastal Landscape on the Saronic Gulf', in *Physis: l'environnement naturel et la relation homme-milieu dans le monde égéen protohistorique*. Edited by G. Touchais, R. Laffineur and F. Rougemont, pp. 103-110. Aegaeum 37. Leuven: Université de Liège.

Douglass, M., Lin, S. and Chodoronek, M. 2015. The Application of 3D Photogrammetry for In-Field Documentation of Archaeological Features. *Advances in Archaeological Practice* 3(2): 136-152.

Fachard, S. 2016. A decade of research on Greek fortifications. *Archaeological Reports* 62: 77-88.

Fachard, S., Knodell, A. and Banou, E. 2015. The 2014 Mazi Archaeological Project (Attica). *Antike Kunst* 58: 178-186.

Fernández-Hernandez, J., González-Aguilera, D., Rodríguez-González, P. and Mancera-Taboada, J. 2014. Image-based modelling from unmanned aerial vehicle (UAV) photogrammetry: An effective, low-cost tool for archaeological applications. *Archaeometry* 57(1): 128-145.

Green, S., Bevan, A. and Shapland, M. 2014. A comparative assessment of structure from motion methods for archaeological research. *Journal of Archaeological Science* 46: 173-181.

Knodell, A.R., Fachard, S. and Papangeli, K. 2016. The 2015 Mazi Archaeological Project: Regional Survey in Northwest Attica (Greece). *Antike Kunst* 59: 132-152.

Knodell, A.R., Fachard, S. and Papangeli, K. 2017a. The 2016 Mazi Archaeological Project: Survey and Settlement Investigations in Northwest Attica (Greece). *Antike Kunst* 60: 146-163.

Knodell, A. R., Alcock, S. E., Tuttle, C., Cloke, C. F., Erickson-Gini, T., Feldman, C., Rollefson, G. O., Sinibaldi, M. and Vella, C. 2017b. The Brown University Petra Archaeological Project: Landscape Archaeology in the Northern Hinterland of Petra, Jordan. *American Journal of Archaeology* 121(4): 621–683.

Ober. J. 1985. *Fortress Attica: Defense of the Athenian Land Frontier, 404–322 B.C.* Leiden: Brill.

Olsen, B.R., Placchetti, R.A., Quartermaine, J. and Killebrew, A.E. 2013. The Tel Akko Total Archaeology Project (Akko, Israel): Assessing the suitability of multi-scale 3D field recording in archaeology. *Journal of Field Archaeology* 38(3): 244-262.

Orengo, H., Krahtopoulou, A., Garcia-Molsosa, A., Palaiochoritis, K. and Stamati, A. 2015. Photogrammetric re-discovery of the hidden long-term landscapes of western Thessaly, central Greece. *Journal of Archaeological Science* 64: 100-109.

Roosevelt, C. 2014. Mapping site-level microtopography with Real-Time Kinematic Global Navigation Satellite Systems (RTK GNSS) and Unmanned Aerial Vehicle Photogrammetry (UAVP). *Open Archaeology* 1(1): 29-53.

Sapirstein, P. 2016. Accurate measurement with photogrammetry at large sites. *Journal of Archaeological Science* 66: 137-145.

Sapirstein, P. and Murray, S. 2017. Best Practices in Archaeological Photogrammetry. *Journal of Field Archaeology*, 42(4): 337-350.

Shortis, M.R., Bellman, C.J., Robson, S., Johnston, G.J. and Johnson, G.W. 2006. Stability of zoom and fixed lenses used with digital SLR cameras. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences* 36: 285-290.

Tartaron, T. Pullen, D., Dunn, R., Tzortzopoulou-Gregory, L. and Dill, A. 2011. The Saronic Harbors Archaeological Research Project (SHARP): Investigations at Mycenaean Kalamianos, 2007-2009. *Hesperia* 80(4): 559-634.