Wandering in the Labyrinth - Enhancing the Accessibility to the Minoan Past Through a Visitor-Sourced Approach

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Abstract. Arising on the island of Crete around 2700 BC, the Minoans are traditionally regarded as the first advanced civilization on the European continent in its modern meaning. The safeguarding of this primordial heritage faces multiple challenges. Besides extrinsic natural and anthropic threats, Minoan remains are also jeopardized by some of their own intrinsic properties. This paper aims to address two of these hazards: first, the preservation state of Minoan sites, leading to their restricted comprehension; secondly, their complex, "labyrinthine", architecture, further limiting this intelligibility but also challenging the physical access to the remains. The on-going research presented here intends to instrumentalize pathways as a solution to these drawbacks: it seeks to demonstrate that paths can not only be used as mobility vectors to guide and control visitors' movement but also, when context-aware, as interpretation media to improve on-site experience. Drawing upon phenomenological theories, this paper focusses in particular on the integration of the visitors' interaction with their surrounding as an innovative approach in the design of such well-informed paths. Based on the outcome of an original experiment conducted among 73 participants on the archaeological site of Malia, this study explores the possibilities of a combined qualitative and quantitative analysis of the visitors' movement in informing recommendations to increase the visitors' understanding and orientation abilities on site. The visitors-based approach discussed in this paper is only but one of the three axes to be combined in the general workflow advocated for the formalization of curated visitors' paths on Minoan archaeological sites.

Keywords: Archaeological site management · Minoan crete · Visitor behaviour · Human movement analysis · GPS-tracking · GIS spatial analyses

1 Introduction

1.1 Preservation vs. Presentation: Dichotomy or Complementarity?

One of the major challenges in the present-day cultural heritage management sector (CHM) is to find a proper balance between the imperatives of both preservation and

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presentation of archaeological and historical heritage sites: sites need to be open, displayed and explained to the large public while the impact of visitors' presence should be mitigated. This responsibility towards visitors has been progressively integrated in heritage discourse since the beginning of the postmodern era [1]. It was not until 2008, however, that the role of public communication and education in heritage preservation received an official international acknowledgement with the ratification of the ICOMOS Charter on the Interpretation and Presentation of Cultural Heritage [2]. This new paradigm in cultural heritage management stems from the belief, already expressed in the 1950s by Tilden, the "father of heritage interpretation" [3], that "through interpretation, understanding; through understanding, appreciation; through appreciation, protection" [4].

However, few archaeological sites show demonstrated concern for effective interpretation and communication strategies that could benefit their visitors. As noted by Williams, "it seldom articulates a holistic vision of the site, recognizing different voices or the complexity of visitors" [5]. One of the by-products of this deficiency is the lack of engagement of the visitors with archaeological sites. From Tilden's quote, one can easily understand this feeling of disconnection is likely to pave the way for neglecting attitude or misuse of those heritage places.

1.2 Through the Visitors' Eyes and in Their Shoes

To overcome these pitfalls, the present study advocates a visitor-centred approach. Such perspective used to be sceptically considered, or at least, undervalued by some scholars in the past because of the elusive character of the visitor experience and the difficulty of its conceptualization [6]. However, in the last two decades, visitors' spatial behaviour has started to receive more attention and has hence opened new venues for the quantitative study, and thus for a more objective approach, of the visitors' perception in heritage places. Arising from phenomenological theories and spatial cognition considerations, the movement of visitors can be interpreted as the expression of the interaction between the visitor and the cultural heritage space [7].

The study and understanding of general human mobility patterns covers a wide range of applications aimed at adapting different types of environment to a society's needs: from urban planning to traffic forecasting, or, to cite a much topical example, the tracking of the spread of biological and mobile viruses [8]. In the cultural sector in particular, the role of the visitors' behaviour in exhibition design and planning was acknowledged by museum institutions as early as the 1990s [9]. In parallel to these museum studies, there has been an ever-growing body of literature on recording techniques (from basic pen and paper, to complex satellite technologies) and analytic methodologies for tracking visitors' movement in heritage spaces [10]. However, most of these studies were mostly driven by economic agendas or primarily interested in the regulation of tourist flows.

1.3 Bridging the Gap with Visitors' Paths

From this brief literature review, Chrysanthi [7, 11, 12]'s research was pioneering in specifically applying the study of visitors' spatial behaviour to archaeological sites, and for the purpose of interpretation planning. The benefits of the visitor-centred approach

she advocated in her PhD thesis [11] is twofold. On the one hand, it allows for multiple readings and understandings of the archaeological space. On the other hand, it provides insights to design presentation strategies at a conceptual and practical level, including context-informed walking paths respectful of the visitors' interests, their preferences and their emotional experience.

Indeed, in combination with other interpretative strategies such as information panels, visitors' itineraries constitute the main vehicle through which archaeological remains are displayed to the public. Despite their mention as "formalized walking tours" in the ICOMOS Charter on Interpretation and Presentation of Cultural Heritage the potential of visitor's paths as an interpretative tool has been so far largely under-investigated. While visitors' circulation paths are traditionally regarded as a preventive conservation strategy to monitor visitors' flow on fragile archaeological sites, this paper argues that curated paths may also be instrumentalized as an active interpretation medium to stimulate optimal cultural heritage experiences.

2 Methodology

2.1 Background and Case Study

The Minoan civilization flourished on the island of Crete between ca. 2700 – 1450 BCE. Besides their great age, the remains of this brilliant protohistoric civilization are characterized by their vulnerable fabric and their relatively poor state of preservation, not only threatening their safeguarding but also limiting their visibility. The legibility of Minoan ruins is further hindered by the labyrinthine architectural layout of their monumental court-centred buildings, commonly called "palaces". Considering these characteristics, already outlined by Platon in 1961 [13], there is a crucial need for proper interpretation supports and Minoan sites therefore offer an optimal environment for the development, implementation and evaluation of our innovative methodology aimed at designing curated paths. The archaeological site of Malia was selected as the main case study of this research for its historical importance, as it is the third largest "palace" on the island, and because of the variety of its preservation and presentation infrastructure.

Malia is located in a coastal plain on the north-east coast of central Crete. The settlement, occupied from the Early Minoan II period (around 2700 BCE) until the Late Minoan IIIB period (around 1200 BCE), saw the construction of a court-centred building ('palace') and several administrative, industrial and housing quarters during its long history. There were also port installations and cemeteries to the north close to the seashore. This northern section as well as some residential quarters are located outside the fenced area that is accessible by the public. To accommodate the almost 80 000 annual visitors [14], a master plan aimed at the valorization of the site was designed by M. Schmidt of the French School at Athens in close concertation with the Greek Archaeological service in 1985 and implemented in the early 90s. It entailed landscaping interventions, the construction of visitors' amenities and an exhibition centre, the installation of orientation and identification panels, the re-roofing of earth-based remains using protective shelters and some stabilization and restoration work [15]. Contrary to the 1990s conservation interventions, which have been punctually replaced when severely damaged, the presentation supports have been left as they were, despite their gradual decay.

2.2 Data Collection

The visitor data were collected over a period of nine days spread over two field sessions: the first in late August 2018 (three days of pilot tests conducted with archaeology students) and the second in late September (six days). Attention was paid to two crucial parameters during the survey.

The first was diversity: visitors with the most diversified profiles regarding age, gender, origin and companionship were preferably approached. Of course, the dataset could have certainly benefited from longer study seasons, but it became impossible to expend it due to time constraints. Potential sources of bias in the dataset hence need to be acknowledged before further detailing the methodology:

- Some visitors profiles will be misrepresented because of the restricted schedule of the survey (in particular, families with children avoid the September period which falls outside the school holidays, while it is the predilection holiday period for retired people).
- Some visitor types will be absent from the dataset due to the context of the visit. In particular, visitors accompanied by a tour guide were not surveyed since they usually have a tight-schedule, which would not have allowed them to participate in the entire experiment.
- The representation of nationalities will be biased too because of some language barriers, further detailed later in this section.

Besides the diversity, obtaining visitors' consent was another critical point. The rare opportunity to contribute to a participatory study that was interested in their opinion probably explains the high participation rate of visitors (reaching almost 95%).

The tracking of the visitors' movement was performed by means of four handheld Garmin eTrex touch 35 (interval time: 2 s; accuracy reading: 4 m) in order to collect good resolution data. Participants were given the GPS at the entrance of the site. They were asked to carry it with them whether in their hand, their bag or their pocket to avoid touching it so that the device could record both visitors' moves and stops. Participants were also assigned with the mission of taking pictures as they would normally do whether with their camera or smartphone. The collection of the pictures was aimed at informing visitors' decisions to stop or slow down in particular areas of the site. This method appeared to us as the least intrusive.

At the end of their visit, participants were asked to fill in a questionnaire specifically designed for the purposes of the study. It was translated into five languages (French, English, German, Italian, and Greek). It is beyond the scope of this paper to develop the conceptual framework behind the creation of this original questionnaire but it is worth briefly describing its outline. The survey started with some basic demographic questions about the visitors' profile and their level of knowledge of Minoan civilization prior to their visit to Malia. Following these, the questions were structured in a way that would allow visitors to express their views on four main axes:

1. What they learned and understood from the ruins;
2. What they valued the most and the least;

3. What they would advise for future management decisions;
4. Their degree of satisfaction from both a cognitive perspective based on quality evaluation and from an affective perspective based on mood evaluation.

2.3 Data Processing

The answers of the questionnaires were converted into numeric values for enabling standard statistical analyses performed in IBM's Statistical Package for Social Sciences (SPSS Statistics 22). The GPS data were converted from a GPX XML format to shapefiles (Geographic Coordinate System: GCS_WGS_1984) to enable a series of spatio-temporal analyses performed on ArcGIS and presented here below.

3 Preliminary Results

This paper strictly focusses on the characterization of the visitors' spatial behavior as given by the analyses conducted within ArcGIS. A more detailed and comprehensive study combining the outcome of the spatial analyses together with the results of the statistical processing of the questionnaires and the georeferencing of the pictures taken by the survey participants will be published elsewhere (Table 1).

Table 1. Metadata of the experiment conducted in Malia

Data type	Quantity recorded
GPS track	66
Questionnaires	73
Pictures	813

3.1 Density Analyses

We first conducted line density analyses of all the visitors' tracks. The aim was to try visualizing overlapping visitor movement in order to identify some patterns. As shown by the heat map (see Fig. 1a), the data were classified according to a color ramp: from dark blue indicating lower values of density to dark red indicating higher values. From Fig. 1a, we can see how the visualized outputs allow to immediately emphasize the areas with increased accessibility and/or attraction, and those, on the contrary, failing to attract visitors and/or remaining inaccessible to them.

Alongside the line density analyses, we also conducted point density analyses. The main difference between a point density analysis and a line density analysis lies in the presence of a time component only in the first case. Instead of characterizing visitors' flow, the heat map obtained through the point density analyses thus enables to detect those areas on the site where visitors stopped or slowed down (see Fig. 1b). In other

words, while line density analyses can inform the accessibility potential and /or the "attraction power" of specific Points of Interest (POI), point density analyses are helpful for defining the "holding power" [16] of those POI, that is to say the ability of these POI in holding the interest of a visitor for a certain time, as discussed later on in this paper. By comparing the two heat maps, some differences appear in the distributions of the higher density values. For instance, we can observe on Fig. 1b a higher density of points to the south of the south-wing of the palace (framed in white). This corresponds with one of the rare resting areas on the site where a bench is located under a tree.

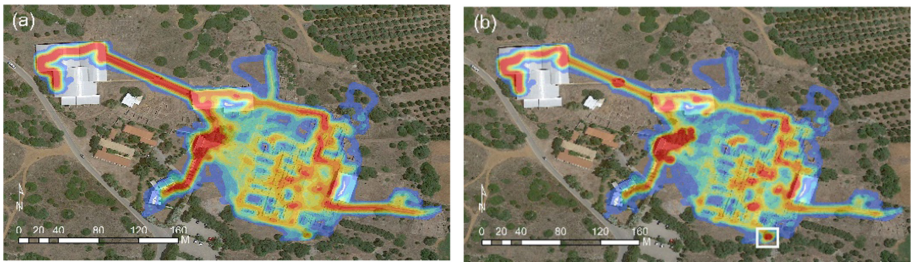

Fig. 1. Density maps overlapping an aerial picture of the site of Malia (© Google Earth): (a) Heat map showing the results of the line density analysis; (b) Heat map showing the results of the point density analyses (Color figure online)

3.2 Linear Directional Mean

The intention behind the calculation of the linear directional mean of the recorded tracks was to understand the direction of visitor flows in some selected areas on the site. Figure 2 proposes an insight in the general direction followed by visitors on the busiest passageways and the narrowest ones within the ruins of the palace.

In order to assess the potential impact of visiting Minoan sites prior to a tour at Malia, we conducted a new set of linear directional mean analyses discriminating between participants visiting a Minoan site for the first time and participants already familiar with similar sites. These comparative analyses revealed that visitors who had already been to other Minoan sites prior to their visit to Malia (65% of them) were most likely to start their visit by turning east towards the court-centered building, the most emblematic expression of Minoan architecture and a focal point of the Minoan town. The difference in the itinerary (starting whether to the north or to the east) followed by visitors who discovered Malia and hence a Minoan site for the first time was not significant.

4 Interpretation

These two types of spatial analyses can be performed to answer a plethora of questions related to interpretation planning purposes. They can also leverage other spatial analyses. For the sake of this paper, we limit the interpretation of the visualization of the dataset to test the following three hypotheses.

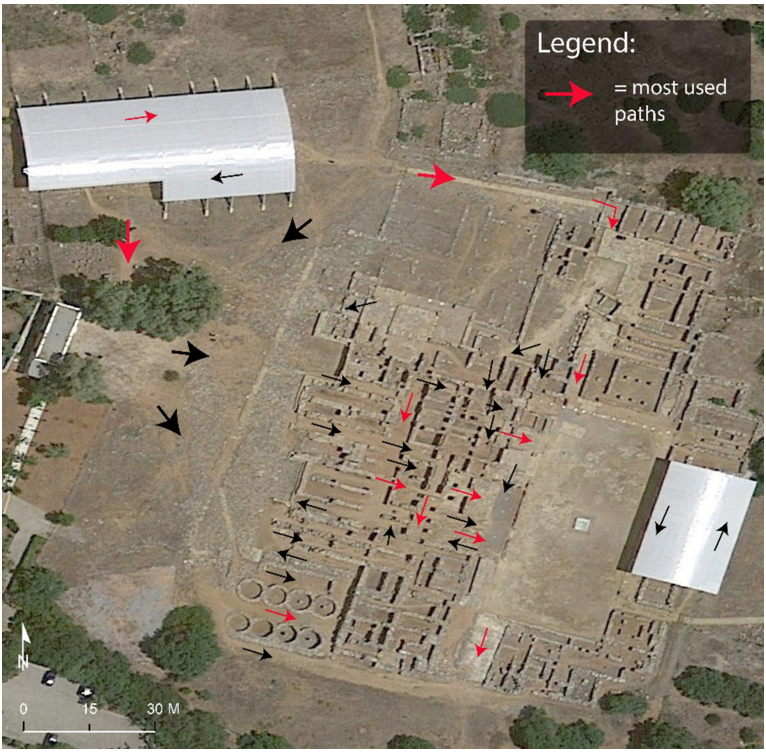

Fig. 2. Aerial picture of Malia (© Google Earth) overlaid with the outcome of the linear directional mean analyses.

Hypothesis 1: High density areas correspond to the so-called Points of Interest. Since interpretation supports are expected to target the most remarkable archaeological features that should attract visitors' attention, these supports should correspond to the POIs revealed by the heat map.

If we overlay the heat map with the location of the interpretation media (see Fig. 3), this hypothesis seems to be true in the case of information boards and most identification signs. However, some exhibits are still completely missed out by visitors (such as the Kappa quarter sign framed in white on Fig. 3).

These conclusions can be further specified using two other indicators often used in museum studies to identify where production of meaning takes place [17].

Firstly, we can calculate the frequency rate, or "attraction power" of each existing interpretation support by creating a buffer zone around them, intersecting this buffer with the visitors' tracks and then dividing the number of intersected tracks by the total number of recorded tracks (66). Considering the unavoidable GPS inaccuracies, this measure actually provides us less with a clear idea of the attraction power of the implemented interpretation strategies than with an indication of their maximum visibility or accessibility potential for visitors.

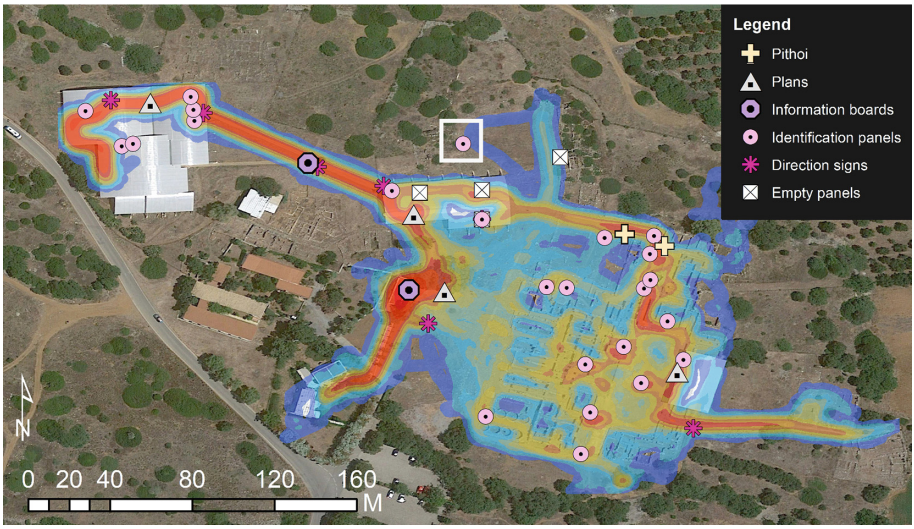

Fig. 3. Aerial picture of Malia (© Google Earth) overlaid with the line density results and the location of the interpretation infrastructure.

Secondly, the efficiency of the site exhibit equipment can be assessed by measuring their "holding power", that is to say the average time spent by visitors around each interpretation medium, applying and automating the following workflow: 1) creating a buffer zone around each exhibit; 2) using GPS track points rather than track lines, defining the entry and exit time of each track within the buffer based on the time code; and 3) with all the data, running a standard frequency analysis in SPSS. This "holding power" can also be measured by overlaying the location of the interpretative infrastructure with the outcome of the movement suspension analysis based on clustering techniques (Fig. 4). Such an analysis, aimed at detecting the location of visitors' stops, also allows to identify new and crowdsourced Points of Interest, thus far overlooked by site managers, but that would be worth integrating in site planning decisions.

The presence on the heat map of high density values in areas other than those targeted by the interpretation supports already gave an initial ideal of these POIs (see Fig. 3). The on-going processing of the images captured by visitors should help the accurate identification of these POIs before conducting Hotspot analyses.

Considering these interpretations, it can be argued that the assessment of visitors' spatial behavior can advise the implementation of interpretation supports and their orientation as well as the installation of much appreciated resting areas to enhance both the site understanding and comfort of visitors.

Hypothesis 2: Visitors' behavior is respectful of the safeguarding of the site.

By overlaying the heat map with the location of the modern pathways and dissuasive fences, we can observe that visitors tend to respect the security perimeters defined by these measures to keep them away from the most fragile remains. However, it is striking to notice that in some areas where the height of the walls is rather low, visitors might still step on them (Fig. 5).

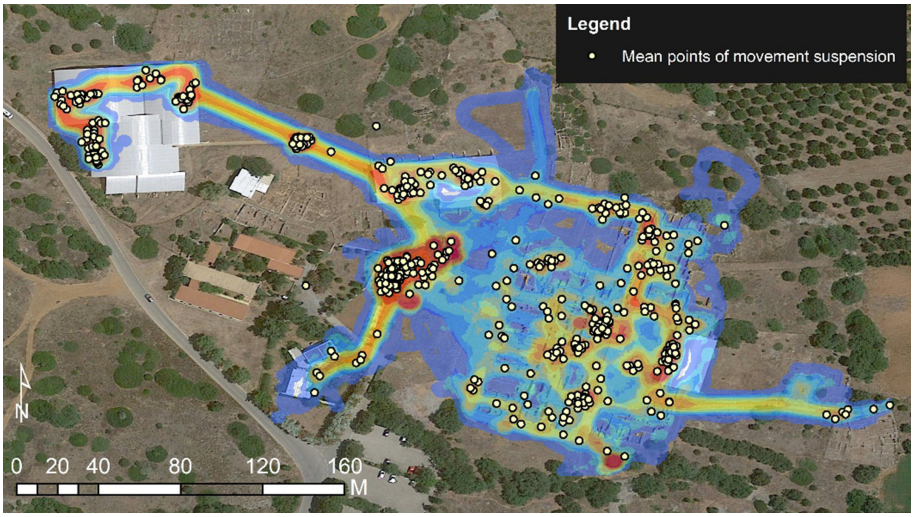

Fig. 4. Aerial picture of Malia (© Google Earth) overlaid with the point density results and the location of the clustered points of movement suspension.

We can thus argue that the assessment of visitors' spatial behavior can also be used as a detector of visitors' misbehavior that can help prevent anthropogenic damages to the archaeological fabric.

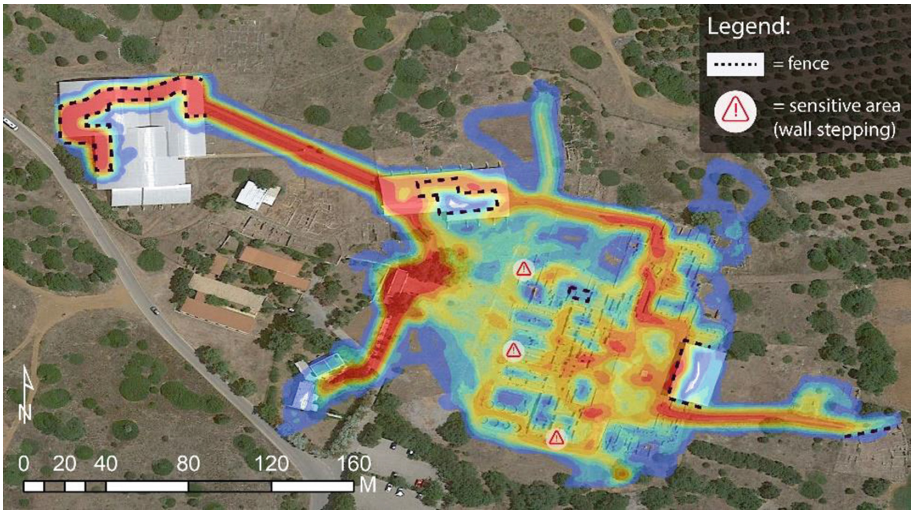

Fig. 5. Aerial picture of Malia (© Google Earth) overlaid with the density results and the location of fences and areas endangered by wall climbing.

Hypothesis 3: Visitors intuitively follow ancient circulation patterns

This hypothesis can be tested by overlaying the heat map with the location of known and assumed ancient street networks, derived from archaeological evidence [18] and

space syntax studies [19]. From the visualization of the dataset, it appears that our initial statement needs to be nuanced: for example, the original west entrance to the "Palace" seems ignored by most visitors (as framed in white on Fig. 6).

We can thus argue that the assessment of visitors' spatial behavior can provide valuable insights into the visitors' perception of the integrity and authenticity of a site.

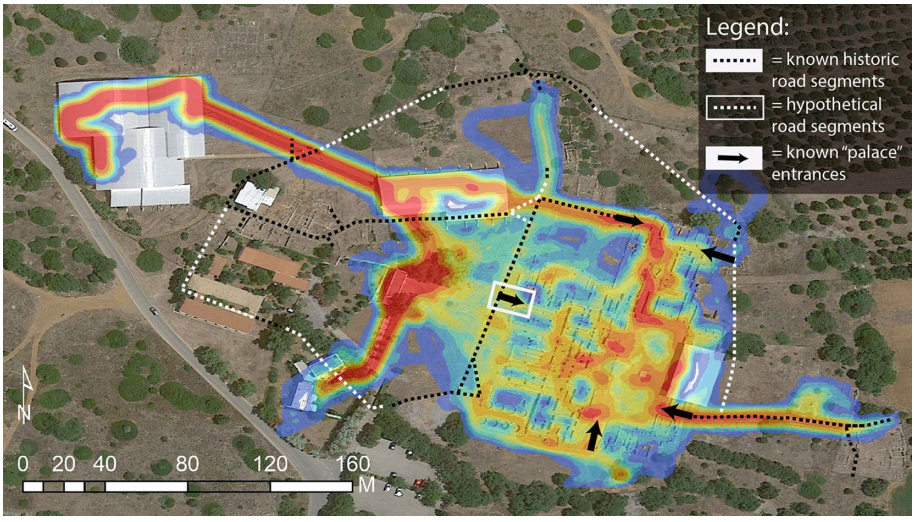

Fig. 6. Aerial picture of Malia (© Google Earth) overlaid with the density results and the location of known and hypothetical historic circulation paths

5 Conclusion and Future Perspectives

The main conclusions to infer from our hypotheses can be summarized as follows:

- Regarding hypothesis 1, spatial analyses based on visitors' tracked movements in Malia have demonstrated that some interpretation media are not optimally used while new ones could be added to the overall management plan;
- Regarding hypothesis 2, spatial analyses confirmed the efficiency of the current preventive conservation measures. However, special care should be afforded to sensitive passages with high values of visitors' flows such as low-preserved walls or narrow passages between high-preserved walls;
- Regarding hypothesis 3, spatial analyses stressed the need to provide visitors with more circulation instructions, on the one hand, and the ancient circulation patterns with more visibility, on the other hand.

Of course, these results need to be completed by further exploring the spatial data and by cross-referencing them with the two other types of data collected, namely visitors' pictures and the answers from the questionnaires.

In conclusion, this study has argued that visitors-sourced data bring a valuable approach in the creation of well-informed, secured and enjoyable itineraries on site. We defend this approach as complementary to two other types of assessment: that of ancient circulation patterns, on the one hand, and, on the other hand, that, diagnostic, of the fragility of the remains. In this way, we claim that curated visitors' paths could be used as effective and sustainable measures for the management of archaeological sites since they could bridge the gap between preservation and presentation duties.

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