



# Settlement location models, archaeological survey data and social change in Bronze Age Crete



Christine Spencer\*, Andrew Bevan

*Institute of Archaeology, University College London, 31-34 Gordon Square, London WC1H 0PY, United Kingdom*

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## ABSTRACT

This paper builds spatial models of Bronze Age settlement using published survey datasets from the Mirabello region in east Crete. Methodologically, we examine how point process modelling can account for uncertainties in legacy survey datasets, and thereafter can highlight patterns of both cultural change and continuity in Mirabello settlement. Comparison of fitted models over different chronological periods gives an insight, we argue, into the kinds of settlement and subsistence choices that lay behind settlement patterns, holding constant the broadly similar environmental constraints faced by inhabitants throughout the Bronze Age. Overall, the results suggest prehistoric preference for, and exploitation of, agriculturally favourable parts of the landscape, although contrasting emphases in different periods do emerge despite this unsurprising overall preference. Many of the analytical results prove robust to a sensitivity analysis which addresses commonplace uncertainties associated with settlement survey data. The results also dovetail well with previous archaeological interpretations of changing settlement and Bronze Age life in the Mirabello region. Survey datasets are also relatively common in other archaeological settings worldwide and we advocate for more widespread application of similarly formalised methods to them.

## 1. Introduction

This paper explores the degree to which multiple published survey datasets can be formally synthesised to reconstruct Bronze Age settlement patterns and to discern changing locational priorities through time. As a substantive case study, we consider three published Cretan surveys from the Bay of Mirabello. In what follows, we refer to the results from these and other moderately intensive field surveys from the 1970s to 2000s as ‘legacy data’ to indicate that, although they have involved knowledgeable specialists and careful methods, they have typically been published only as hard copy distribution maps and site-level summaries, rather than as artefact-scale collections and georeferenced digital databases. Without artefact-level distributions, there are limits to how much survey datasets can be interrogated for issues such as sampling bias and relative survey intensity, as well as surveyor judgements of site size, phasing and function, etc., but even so, legacy surveys are still extremely valuable records and constitute the bulk of the better-published evidence worldwide. They have also arguably not

received as much assessment and comparative analysis as they should. With these methodological goals in mind, this paper therefore re-purposes three well-published surveys of the Bay of Mirabello, Crete to build contrasting models of Cretan Bronze Age settlement in the Late Prepalatial (EM III-MM IA), Protopalatial (MM IB-II), Neopalatial (MM III-LM IB)<sup>1</sup> and Postpalatial (LM IIIA-IIIIB) periods, and thereby to discuss the relative significance of external and internal processes on the Bronze Age occupation history.

An explicitly diachronic study of survey data can highlight fluctuations between centralisation and fragmentation, variations in settlement size and overall demographic levels in different areas of the landscape. In this paper, we discuss the current state of Cretan research and how spatial simulation can address certain lingering challenges in using Cretan survey data. In particular, we examine how computational models can account for uncertainty in survey datasets, and we use this flexibility to highlight both change and continuity in the Mirabello system in relation to wider processes across Crete.

\* Corresponding author.

*E-mail addresses:* [christine.spencer.14@ucl.ac.uk](mailto:christine.spencer.14@ucl.ac.uk) (C. Spencer), [a.bevan@ucl.ac.uk](mailto:a.bevan@ucl.ac.uk) (A. Bevan).

<sup>1</sup> General chronological note. Neopalatial ceramic phases delineated in the survey data include MMIIIA, MMIIIB, LMIA and LM IB. It should be noted while the Neopalatial period generally started at the beginning of the MM IIIB period, there is certainly not enough known about regional coarseware pottery to differentiate between MM IIIA and IIIB in the surface material, and indeed even distinctions between MMIII and LMI should be treated with caution given the small proportion of the surface record upon which such distinctions are likely to have been made.

## 2. Research context

### 2.1. Bronze Age state formation

For over a century, Cretan archaeological research has worked with relatively well-established interpretive frameworks to understand Bronze Age social, economic and political organisation, largely based on the traditional convention that the prehistoric territories of Crete were centred around the major palaces of Knossos, Malia and Phaistos (Cherry, 1984, 1986; Renfrew, 1972; Schoep, 2001). Research has variously studied the extent of the palaces' socio-political and economic control through production and consumption patterns of material culture, written evidence from administrative records, and more recently, through the relative distribution of other Bronze Age sites across the island. Challenging these conventions are discoveries over the last few decades of similarly 'palatial' structures that appear and then fall out of use at different times and in a wider set of places across the island (Whitelaw, 2018), highlighting greater variability in the extent of palatial systems than first thought (Adams, 2006; Knappett, 1999; Schoep, 1999), and in the processes structuring regional settlement (Schoep, 2001; Whitelaw, 2004). Moreover, while the role of palaces within prehistoric society was traditionally thought to have remained relatively constant from their inception in the Protopalatial period onwards (Renfrew, 1972; Cherry, 1986), recent reassessments questioned the nature of political authority and the social interactions they supplanted prior to the palatial period (e.g. Driessen et al., 2002; Hamilakis, 2002; Whitelaw, 2004; Schoep, 2006), as well as whether socio-political transformations in the Bronze Age were gradual or rapid (Cherry, 1983; Schoep, 1999; Driessen, 2007; cf. Manning, 1997; Watrous, 2001; Whitelaw, 2012). The emphasis on urban centres as central places has not only left interpretive voids about the nature of society in pre- and post-palatial (and dramatically less urbanised) periods, but also in our understanding of the relative position of smaller sites and those more marginal settlement networks seemingly outside of direct palatial manipulation from central Crete, especially during the Middle Bronze Age.

There has been an intense focus on the nature of political organisation in Bronze Age Crete from the very beginnings of Aegean archaeology and arguably a renewed emphasis from the late 1970s onwards (Cherry, 1978, 1983, 1984). In his study on Protopalatial state formation, for example, Knappett (1999:616) charts the shift in Minoan archaeology from use of the term 'civilisation' to use of the term 'state', noting nonetheless a continuing obsession with the origins rather than the character of these political units. Others note that as there is no direct evidence for a state in Bronze Age Crete (i.e. declarative ruler iconography or writings, deciphered written records of central administration), we have been forced to build inferences from landscape evidence, architecture and material culture alone. As a consequence perhaps, Cretan research has instead focused on redefining the state to include these caveats (Cunningham and Driessen, 2004: 106): rightly or wrongly, we have blurred the idea of how any Minoan state(s) may have operated in the past to match the blurriness of our present-day understanding, taking present uncertainty for past ambiguity. Even so, there is clearly some form of centralised organisation and integration of capital, and the overall idea of political life being in some way manifest on the ground, and on the pots, has remained very important, with numerous studies using stylistic similarities in material culture to demarcate territories (Knappett, 1999), to suggest diverse exchange networks (Whitelaw et al., 1997; Sbonias, 1999; Wilson and Day, 2000) and/or settlement patterns (Driessen, 2001; Haggis, 2002) and to changing administrative practices (Schoep, 1999, 2012; Knappett, 2012; Relaki, 2012; Sbonias, 2012).

More precisely, Cretan studies using survey data have reconstructed the socio-political organisation of different Cretan regions under this assumption that the spatial organisation of sites in some way mirrors the political organisation of society (Driessen, 2001: 56). Thus, the explosion of settlements in the Protopalatial period is largely seen as

part of the emergence of a palatial system (Nowicki, 1999; Sbonias, 1999), and an observed decline in overall site numbers in the subsequent Neopalatial period as a process of nucleation, and a further concentration of power at a limited number of palaces, indeed conceivably with overall political authority concentrating at Knossos (Amato et al., 2014: 131; Cunningham and Driessen, 2004; Whitelaw, 2018). Although any political hierarchy probably requires "some form of hierarchical [spatial] ordering" (Bevan, 2010: 28, see also Cherry, 1986; Cadogan, 1994; Cunningham, 2001; cf. Manning, 1995; Knappett, 1999; Adams, 2006 who distinguish different kinds of power), this ordering is dependent on the scale and form of the interaction. While discussions of political power have loomed particularly large in studies of Bronze Age Crete, other demographic and/or economic factors, operating at scales independent of or parallel to political systems, could have had influenced the distribution of settlements within a region (Reid, 2007; Müller-Celka et al., 2014; Whitelaw, 2018).

Computational simulation has both strengths and weaknesses as a contribution to archaeological understanding, but at its most useful, it allows us to model *our understanding* of how settlement systems are spatially ordered, and how they can reflect certain human prioritisations in the wider environment which might relate to fundamental issues such as day-to-day subsistence. Surprisingly, while interpretative associations between sites and particular landscape features are common in Cretan regional studies, quantitative attempts to address these relationships are rarer (although see Bevan and Wilson, 2013; Déderix, 2017; Fernandes et al., 2012; Knappett and Ichim, 2017; Paliou and Bevan, 2016). Arguably, this slow development stems from a patchy set of surveys with different recovery biases and from individual sites' inherent chronological and functional uncertainties. That said, the Mirabello region has been especially favoured by three high quality surveys – Vrokastro, Kavousi and Gournia – that offer one of the best case-study areas anywhere on the island and therefore are the focus of what follows. These surveys were conducted in the late 1980s and early 1990s using similar field methods and immediately adjacent to one another, thereby encouraging their integration into a single dataset (see also Gaigernot-Driessen, 2016 for study of later periods). We characterise them nonetheless as 'legacy' surveys not with the intention of diminishing their contribution, but only to stress that sites are the main unit of recording and publication, and there is no easy opportunity to assess artefact-scale issues of site size, function and definition.

Taking these surveys as a yet under-explored opportunity, we apply a point process modelling approach to explore correlations between site locations and key exogenous environmental influences (what statistically would be known as *first-order* trends) while also modelling endogenous forces of attraction/repulsion between sites (aka *second-order* trends e.g. Baddeley et al., 2016). Such correlative models are not meant immediately to imply cause-effect relationships, but they do encourage further speculation about human locational priorities and kinds of social-spatial organisation in the landscape. In this we would argue the approach adopted here is in step with arguments in favour of seeing social processes operating at multiple scales, and change as occurring not only through top-down models of static palatial entities (Cherry, 1986; Schoep, 2002), but also via local human ecological circumstances (Hamilakis, 2002; Haggis, 2002; Schoep and Knappett, 2004; Whitelaw, 2004).

### 2.2. Setting and survey in the Mirabello

The Mirabello region is defined by a large embayment on the eastern end of Crete, beyond the Lasithi mountains, and is positioned on the northern side of the island's narrowest north-south point (the isthmus of Ierapetra). As such, it has arguably always exhibited elements of both affiliation with and autonomy from politically 'core' areas of central Crete, and has acted as both bridge and barrier to wider Cretan island interaction. Viewed in terms of off-island contacts

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