MONUMENTS IN SEARCH OF A LANDSCAPE

THE LANDSCAPE CONTEXT OF MONUMENTALITY IN LATE NEOLITHIC MALTA

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Abstract

From the mid-4th to the mid-3rd millennium BC, the Maltese archipelago was characterized by a dense concentration of monumental activity. Archaeological research has generally focussed on the monumental buildings themselves, paying less attention to the environment that surrounded these structures.

The present thesis is aimed at addressing this lacuna. The history of approaches to Maltese prehistory is reviewed, and it is argued that the neglect of the landscape setting is related to the practice of archaeology in a colonial context. Chapter 3 considers the physical characteristics and dynamics of the island environment. The landscape context of megalithic buildings is analysed using a Geographical Information Systems (GIS) model of the archipelago. Chapter 4 uses a bivariate approach, while Chapter 5 uses multivariate techniques. A number of environmental variables that influence site location are identified, and a model for the choice of monument location is proposed. It is demonstrated that the location of megalithic monuments was closely determined by windows of opportunity in the natural landscape. The resulting insights into the decision-making processes of this period contribute to a better understanding of the priorities and values of the builders. It is argued that megalithic monuments played an important role in transforming natural divisions in the landscape into cultural units of organisation.

The following chapters continue the analysis at a different scale, focussing on the buildings themselves. The organisation of architectural space and the deployment of images within these buildings are examined. It is argued that these spaces and images make ordered references to the island environment. This relationship may be better understood in the light of the landscape setting of the buildings. A fresh interpretative model for this evidence is proposed, where it is argued that these architectural forms may be better understood in terms of symbolic storage, movement and performance.

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1 Introduction

The boulder that opened like a book

As an undergraduate, I spent half my summers from 1989 to 1991 on the excavation of a Late Neolithic burial site in Gozo. The site consisted of a series of caves hollowed out of the hard, semi-crystalline coralline limestone that formed the Xagħra plateau. In those early seasons of the dig, it was often necessary to shift large boulders of limestone from collapsed cave roofs, and to heave them up from the excavation. To make the task easier, the larger boulders were broken up with a sledgehammer. On one occasion during a sweltering September, a particular boulder was proving more obstinate than most. A little procession of students from two countries took turns at hammering away at it. Outside the pit, Karmenu was watching with some amusement, as the perspiration flowed, and the boulder slowly got rounder and whiter, without so much as a crack. Karmenu must have been in his mid-fifties then. He worked as a gardener on another archaeological site nearby, and frequently came round to give a hand. He had spent most of his life on this plateau, and knew its rock intimately. Finally he made his way down into the pit, and was handed the sledgehammer. He bent down to squint at the boulder, then gave it two well-judged knocks. The boulder split down the middle and fell open 'like a book', to use a Maltese expression. He grunted with satisfaction, climbed out again, lit his pipe, and resumed his position as a spectator on the edge of the dig.

This incident first brought home to me a problem that I was to become preoccupied with later. For Karmenu, much of the activity that he witnessed on that excavation was rather curious. The concern with stratigraphic excavation, measurement and documentation was exotic and incomprehensible. Many of our explanations about the past that was being unearthed were likewise difficult for him to follow. Yet in spite of his innocence of archaeological practice and theory, when he cracked open that boulder he demonstrated access to a realm of understanding that we were barely aware of. Even more worrying was the imaginary scenario where we could actually meet the people whose remains we were digging up. I have a suspicion that much of our narratives would be as incomprehensible to them as they were to Karmenu. I also suspect that some of them would have shared his understanding of the properties and behaviour of the local rock. Karmenu belonged to a world very different from theirs, one where steel sledgehammers were available, for instance. Yet the range of knowledge and understanding of the prehistoric islanders may have had more overlap with Karmenu's than with that of many archaeologists. I cannot help thinking that, at least in some ways, his encounter with the people who had hewn out those chambers would have been more successful than most.

The problem

Why has the scientific construction of knowledge about the prehistoric inhabitants of the archipelago diverged so much from the concerns and questions of the communities that inhabit it today? Why did the knowledge and understanding assembled by archaeologists have so little overlap with Karmenu's? Chapter 2 will try to answer these questions by reviewing the history of approaches to Maltese prehistory. It will examine some of the circumstances that shaped these approaches over the past 400 years. We shall trace the parting of ways between scientific and popular knowledge of the past, which hardened during the 19th century. We shall see how the understanding of place and landscape became a less and less important part of archaeological explanations during the same period. This is related to wider issues in the way we understand the Maltese Neolithic. These issues are summarized here. Firstly, the influence of the archipelago's environment on cultural choices and decisions has not been studied. The basic factor of insularity has only been considered in so far as it provided an explanatory mechanism for cultural idiosyncrasy. The influence of the archipelagic context on strategies of exploitation, interaction, connectivity and interdependence remain largely unexplored. These considerations may have considerable implications for decisions about site location, and may consequently be useful in informing our understanding of those decisions. In addition to insularity, the geology and topography of the archipelago may also have imposed limitations and afforded possibilities that in turn shaped cultural strategies and decisions. Once again, these factors have been largely taken for granted in approaches to the Maltese Neolithic, and have never been subjected to systematic analysis. As a result, the remarkable monumental activity that took place during this period has been treated in isolation from its landscape context.

Earlier approaches to megalithic architecture have been largely dominated by technology and ritual. The possibility that these buildings had a role in articulating and mediating the islanders' construction of place remains to be explored.

Likewise, approaches to iconography have been dominated by traditional art-historical concerns. This is particularly true of the low-relief sculpture that is found in the monumental buildings of this period. These low-relief panels have generally been treated as individual works of art. The perception of these works as isolated objects has been subtly reinforced by their removal to museums for safe-keeping and exhibition. Little attention has been paid to their spatial setting inside the buildings where they were found, not to mention the possibility of any relationship with the environmental setting of the buildings themselves.

Research objectives

This thesis addresses some of these problems. It will examine the relationship between the Late Neolithic inhabitants of the Maltese archipelago and their physical environment. It will focus on some of the material properties of that environment, and the way the prehistoric inhabitants responded to the constraints and opportunities that it presented. The emphasis will be on monumental activity, partly because that is what we know most about at present, and partly because this may have played an important role in the way people organized the landscape. The result is a reading of this activity in terms of the physical environment of the archipelago. The specific research objectives are to:

1. Evaluate the specific characteristics of the island landscape, and their relationship to cultural processes, particularly monumental activity.

2. Conduct quantitative spatial analysis of the relationship between these characteristics and the location of Late Neolithic monuments.

3. Explore the role of monumental activity and imagery in ordering and representing this landscape.

4. Develop models for the cultural construction of the landscape during the period in question.

Rationale

This work is considered useful and timely for four main reasons.

1. A better understanding of the landscape context of monumental buildings in Late Neolithic Malta may shed new light on their role and purpose.

2. This understanding will also contribute to the formation of future research agendas for Maltese prehistory.

3. It can also inform cultural resource management models that are less site-centred and more aware of the value of the cultural landscape.

4. A greater focus on the relationship with the landscape may contribute to the creation of new narratives about the past, which are more meaningful and relevant to the people who inhabit that landscape today.

The theoretical context

Karmenu broke open that boulder in a period when cognitive archaeology and post-processual critiques of archaeological interpretation were entering the mainstream of debate. The decade that followed witnessed a growing recognition of the value and importance of more emic understandings of the past. Only a few years earlier, the perceptions and world-views of past societies were considered beyond the pale of serious archaeological research. By the 1990s, this had become one of the mainstream concerns of archaeological theory. This exciting and fertile debate continues. One issue that I find perplexing is the great divide that still separates archaeological research on one hand, and the presentation of the past to the public on the other. The results of archaeological research are too often incomprehensible to non-specialists like Karmenu. I have argued elsewhere (Grima 2002) that archaeological explanations that pay more attention to the experiences and perceptions of people in the past may also be more accessible and meaningful to people today.

The changing environment is one important connecting thread between the people that inhabit it in different periods. Particularly in non-industrial, non-literate societies, inhabiting a landscape requires an engagement with the properties of that environment, and the constraints and opportunities that it presents. Those properties transcend the boundaries of world-view, language and culture that may separate the inhabitants of that landscape of one period from those that inhabited the same place in another. The physical environment is an enduring frame of reference, and holds considerable promise as a platform of shared understanding across time. This basic fact underlies the very foundations of archaeological practice, and is implicit in the simplest of distribution maps. Material evidence is meaningful largely because of where it is found. We express spatial patterning in the evidence by plotting it against a spatial frame of reference that we know and recognize. This fundamental property of material evidence marks out archaeology, and may be observed throughout the history of the discipline, in some works more explicitly than others. At the etic end of the spectrum, archaeologists have simply used the spatial ordering of material evidence as a frame of reference, a grid of co-ordinates that provides useful pegs on which to organize their data. At the emic end of the spectrum, archaeologists have recognized that the way people in the past perceived and ordered the spaces that they inhabited is an important component of archaeological explanations.

During the last two decades, this new set of concerns has become central to the study of past landscapes. This change has been triggered by the growing recognition that the way the landscape is perceived by past societies may be highly culture-specific. Different ways of thinking about the landscape result in very different ways of organising it physically. This realisation led to a shift away from the generalizing models of spatial organisation that had been sought in the 1970's. The new challenge has become to try to retrieve these idiosyncratic cognitive systems from the material record. This problem has been approached from various directions. Renfrew's later work has focussed on the problem of developing a 'cognitive archaeology' (e.g. Renfrew 1994; Renfrew 1998). Richard Bradley's work has been a major contribution towards developing new approaches to prehistoric perceptions of the landscape. In particular, he has explored the way monumentality and art may have been used to create meaning and order in the landscape (e.g. Bradley 1993; Bradley 1997). Another important contribution has been that of Christopher Tilley and his colleagues (e.g. Tilley 1994), who has applied Merleau-Ponty's theory of phenomenology to the question of how past societies may have perceived the landscape. This approach has at times been criticized for being dominated by ethnocentric and visualist considerations, and also for lacking a clear, rigorous and testable methodology (Fleming 1999). The problem of quantification and testability is a thorny one for the study of past perceptions in general. The quantification and testing of landscape perception and experience has become an important objective of Geographical Information Systems (GIS) research (Llobera 1996). However results from this potentially exciting direction are still embryonic, and still primarily visualist in focus.

Different data-sets, different methods...

The research questions defined above encompass concerns that range from the economic to the ritual, and raise issues of landscape exploitation as well as cosmology. This agenda is less bewilderingly heterogeneous than it may at first appear. Over the past twenty years, there has been a growing recognition that the divide between a society's economic and ritual practices is often an artifact of the researcher. This is particularly true of the relationship between people and their environment. The constraints and opportunities presented by an environment are inseparable from people's understanding and perception of that environment. The properties of an environment are appropriated through cosmology and belief, which in turn orders the environment, and alters it in the process (Bradley 1993).

In this light, the series of questions that have been identified are different strands in a single tapestry. This is the cultural appropriation of the landscape of the Maltese archipelago during the Late Neolithic. The present attempt to reconstruct some fragments of this tapestry will therefore draw on different classes of evidence, which have more often been considered separately. These include evidence of the relationship between the archipelago and the outside world, spatial patterning in the landscape, monumental architecture, and iconography. These different classes of evidence have received varying degrees of attention. This treatment has largely dealt with each type of evidence separately, constructing a separate discourse on each. This lack of attention to context may in some cases have limited the resulting interpretations.

The present project aims to explore patterns across the different types of evidence that are available. In order to do so, a variety of methods will be required. Not all classes of evidence are suitable for quantitative analysis, and those that are may require different quantitative tools. The consideration of different types of evidence may be conducted at different scales.

...and different scales of analysis

The question of scales of analysis is a central one in archaeological methodologies (Flannery 1976; Clarke 1977; Fraser 1983; LaMotta & Schiffer 2001; Jones 2002). The scale at which a question is addressed may condition the type of patterning that is observed in the data, and may ultimately condition the results and how they are understood (Jones 2002, ch. 4). Variables in the landscape may display different patterns at different scales (Davidson 1979).

Evidence for the cultural construction of the Maltese Late Neolithic landscape may be analysed at the following, nested scales.

The regional context

The largest useful scale of analysis that is recognized here is the regional context of the archipelago. The relationship of the archipelago to the outside world is largely determined by the configuration of land and sea in this region. The channel between Malta and the nearest landmass, Sicily, is around 90 km wide. In other directions, the sea stretches away for much more daunting distances. This configuration must have played an important role in determining the options available to a prehistoric navigator. The micro-continent of Sicily evidently offered the safest destination to someone setting out from the Maltese archipelago. From the point of view of the archipelago, continental Italy lay beyond Sicily. To the Neolithic inhabitants of the archipelago, Sicily is likely to have represented the gateway to the outside world.

The archipelago

The archipelago constitutes a fundamental unit of analysis. A number of distinctive cultural characteristics that were co-extensive with the archipelago during the Late Neolithic make it clear that this geographic category was of key importance in the way the islanders organised and understood their world. The clearly defined boundaries of an island context have some practical advantages in the quantitative analysis of landscapes. Chapter 3 takes a closer look at the characteristics of the physical environment of the archipelago, and the processes that alter it over time. This will lay the foundation for the following chapters.

Individual islands

Within the archipelagic scale, the next logical sub-division may appear to be the individual island. On the other hand, it should be recalled that in archipelagic contexts, cultural units need not be co-extensive with geographic islands. At different moments, geographic islands may be broken into different cultural zones, while other islands, or parts of islands, may be brought together into other cultural zones (Broodbank 2000). Megalithic monuments have been found across both of the main islands of the archipelago. The well-attested presence of this culture on both islands makes it possible to consider the extent to which individual islands were used to construct different cultural zones.

The local region

The topography of the archipelago varies considerably. Resources and affordances vary significantly across the landscape, and may have exerted a considerable influence on the way space was organized and exploited. The dynamics of the physical environment are considered in Chapter 3. In Chapter 4, the distribution of monumental sites will be examined in relation to different resources in the landscape. Different resources and characteristics will be examined in turn, in order to establish which of these may have influenced decisions about where to locate monumental sites. This task is continued in Chapter 5, which will take all the landscape characteristics that appear to have a bearing on site location, and will examine them together. This should shed some light on the way decisions about site location were taken, which in turn should allow us some glimpses into the priorities and values of the builders, and the way they perceived and understood the island environment.

The siting of monuments

The properties of the sites on which megalithic complexes are built may also be examined. At this scale of analysis, a different set of considerations may determine the choice of site. The suitability of a specific site for a complex building may involve further decisions and choices that may be retrievable through analysis of site location. This will also form a part of the analysis in Chapter 4.

Architectural space

The relationship of a monumental building to the surrounding landscape is inseparable from the way space is organised within the building itself. The use of architectural space to articulate cosmological concerns is widely attested in ethnographic and archaeological contexts (Parker Pearson & Richards 1994b). The known corpus of Maltese megalithic monuments allows some analysis of regularities and differences in the way that they order space. This scale of analysis will be the focus of Chapter 6.

The ordering of images

The spatial organisation of monumental buildings may be analysed on a further level. This is the deployment of images within the buildings, and the internal structure of the images themselves. The ordering of these images in different parts of the architectural interiors is of course inseparable from the analysis of those spaces. This class of evidence is examined in Chapter 7.

Terminology and definitions

It is useful to define some basic terms before proceeding further.

In terms of chronology, the present thesis is primarily concerned with the period between circa 4,100 cal B.C. and circa 2,500 cal B.C., which has been variously referred to as the 'Chalcolithic Period', the 'Temple Period', or the 'Late Neolithic'. Due to the absence of any local evidence of metallurgy during this period, and due to the problematic nature of the term 'Temple', the term 'Late Neolithic' shall be used here. Presently the Maltese Late Neolithic is divided into three principal and two transitional ceramic phases, as proposed by John Evans, then revised, developed and refined by David Trump (Evans 1953; Trump 1966; Trump 2004).

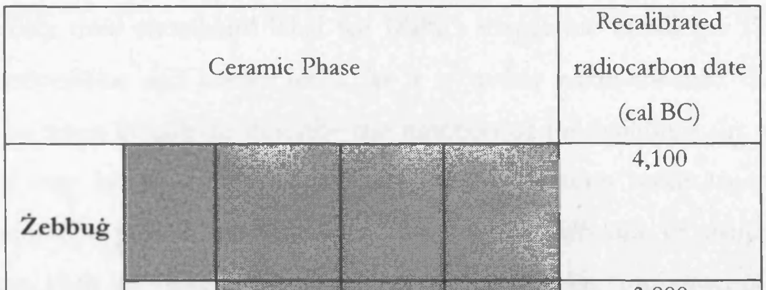


Figure 1. Late Neolithic ceramic phases, (after Trump 2004).

In the Maltese archipelago, two different classes of Late Neolithic monuments have been recognized. On one hand, there are funerary complexes that are largely rock-cut. On the other hand, there are megalithic structures built above ground level, usually referred to as 'temples' in the literature. The known sample of built megalithic sites is several times larger than the number of known funerary sites, and is more suitable for quantitative analysis. Much of the quantitative analysis conducted in the following chapters therefore focuses on the megalithic 'temples' built above the ground.

It has been noted on more than one occasion that the term 'temples' is problematic, carrying as it does a number of associations and assumptions regarding prehistoric belief-systems and associated practices (Pace 1996, 12; Turnbull 2002, 130). Alternatives such as 'poly-lobed structures' ('*strutture polilobate*') have sometimes been suggested (Di Salvo 1988), however the clumsiness of such terms has prevented them from becoming popular. Margaret Murray's elegantly neutral term 'apsidal building' (Murray 1923; Murray 1925; Murray 1929) also failed to gain popularity. The term 'temples' remains the most widely used shorthand label for Malta's megalithic buildings. This is only a matter of convention and convenience, as it is widely acknowledged that the term should not be taken literally to describe the function of the buildings. In spite of such awareness, it may be argued that continued use of the term tends to constrain our interpretations. The present analysis steers clear of the difficulty by using simple and neutral terms such as 'megalithic buildings' or 'megalithic monuments' instead of 'temples'. In order to avoid confusion, monumental sites with a funerary function, such as the Hypogeum at Ħal Saflieni, will be referred to specifically as 'funerary sites' or 'funerary monuments'.

The nomenclature that has been adopted to describe features within megalithic buildings is also problematic. The sub-circular chambers that characterise these buildings are widely referred to as 'apses' in the literature. Although the term does not do justice to the ambitious proportions of the chambers, it is retained here to avoid confusion. Likewise, subjective terms such as 'altar' or 'altar-like' will also be used sometimes.

In order to distinguish between different chambers within each building, the numbering system that John Evans (1971) followed is widely used. In the following chapters, plans and illustrations complement the verbal descriptions, and the use of numbering is avoided whenever possible.

2 Approaches to Maltese prehistory

Introduction

The creation of knowledge takes place in a social and historical context, and is inevitably shaped by it. In recent decades, there has been a growing awareness that in order to think critically about the models through which people understand their world, it is vital to recognize the political and social circumstances that shape scientific knowledge (e.g. Turnbull 2000). The construction of knowledge about the past is no exception. A sound understanding of the genesis of the models and ideas that we use to explain the past may therefore be useful in two ways. It is useful in the critical analysis of those ideas, and it may inform the development of new models. This chapter traces the emergence and development of some of the different approaches and ideas that have shaped today's perceptions of Maltese prehistory. The problems and issues that are identified will in turn shape the present research agenda.

The history of Maltese prehistoric research has already received considerable attention. The protagonists are well-known, and their endeavours have been very competently summarized elsewhere (Bartolo 1915; Evans 1959; Evans 1971; Bonello 1996; Gouder 1996). More recent enquiries into the development of Maltese archaeology (Vella & Gilkes 2001) have begun to explore the influence that modern circumstances have had on the creation of archaeological narratives. The present chapter is not a comprehensive survey of every contribution that has been made during the past five hundred years. Instead, it focuses on a selection of key works that are representative of the history of ideas on the subject, in order to understand how these have shaped our ideas about Maltese prehistory today.

Objectives

The purpose of this chapter is twofold. The first is to examine the history of ideas about Maltese prehistory, and to consider some of the circumstances that have shaped these ideas. The second is to gain some insight into some of the characteristics and limitations of our understanding of Maltese prehistory today.

The history and development of research on Maltese prehistory is reviewed first. In the subsequent discussion, some outstanding concerns are identified. These concerns form the basis of the research agenda of the present thesis.

The genesis of Maltese prehistory

1500-1800: An island microcosm

The monumental buildings that were created during the Neolithic became durable features of the Maltese landscape. Many of them remained visible, sometimes even conspicuous, from their creation right until the present. As a result, over the centuries they have attracted the curiosity and interest of inhabitants and visitors alike. At Tarxien, there is clear archaeological evidence of the reutilisation of the Neolithic complex during the early Bronze Age, while at Tas-Silġ, the Neolithic structure was reused and elaborated throughout the Phoenician, Roman and Byzantine periods. Popular perceptions and interpretations of Maltese Neolithic ruins during medieval and early modern times have been largely lost. However the names of some of these sites are tantalizing reminders of the narratives that may have explained their presence, narratives that are irretrievably lost because they were only transmitted orally. The name of Ħaġar Qim, for instance, is probably medieval in origin. It is recorded in the early seventeenth century by Abela, who suggested the very plausible interpretation *'pietre sollevate'*, or 'standing stones' (Abela 1647, 99). The name of Ġgantija is even more evocative of popular beliefs about the origin of these buildings. Although Abela appears to be aware of this massive Neolithic structure, he does not refer to it as Ġgantija, but as El Eeyun [the springs] (Abela 1647, 119). In Ciantar's revised edition of Abela's *descrittione*, the reference to El Eeyun is repeated, however a further entry is added, referring to *'...un edificio, da' nazionali chiamato Torre tal Sgigant...'* [...a building that the locals call the Giant's Tower...] (Ciantar 1772, 341). The Bronze Age dolmen in Xagħra on Gozo is still known as the Ħaġra ta' Sansun/a [The rock of Samson or of the Samsoness]. Bartolo has furthermore interpreted a number of other toponyms as references to giants (Bartolo 1915, 12).

From the Renaissance onwards, a succession of systematic descriptions of the archipelago was written, and several of them were even printed and published. Documented references to megalithic monuments begin with these early descriptions. Jean Quintin makes passing references to the traces of an extensive structure that may be Borġ in-Nadur (Quintin 1536; Quintin 1980). A well-trained classical scholar, Quintin tried to correlate the material remains that he saw to the references to Malta in Ptolemy and other classical sources, not realizing that these were the remains of a much earlier culture.

Abela's descrittione

A far more detailed historical description of the archipelago was published by Gian Francesco Abela (Abela 1647), earning him enduring recognition as the father of Maltese historiography. His work continued to influence subsequent accounts for centuries after it had been written.

Abela was eminently suited for the task of describing the archipelago and its antiquities. Maltese by birth, he travelled widely as an ambassador for the Order of St. John, and was eventually promoted to the rank of Vice-Chancellor of the Order (Leopardi 1961). He received part of his education in Bologna, where he obtained a doctorate in both civil and canon law in 1607 (Ciantar 1772, viii; Leopardi 1961, 9). In Bologna he almost certainly familiarised himself with the collection of antiquities and curiosities formed by Ulisse Aldrovandi, which was then at the height of its fame. On his death in 1605, Aldrovandi had left this collection to the Senate of Bologna, who gave it pride of place in the Public Palace (Skeates 2000, 15).

These influences were to shape Abela's interpretation of the archaeology and the physical environment of the Maltese archipelago, which are best read against the background of the intellectual climate of his day. The first half of the seventeenth century has been identified as a period of fundamental change in the way knowledge was organized on the continent (Foucault 1970). Until then, observed resemblance was one of the fundamental principles on which interpretation was based. This approach was rooted in the belief that all things in nature were related through a web of imitation, sympathy and antipathy (Foucault 1970, 17-30). By the mid-seventeenth century, however, a new kind of rationality was emerging, characterised by measurement and order, as epitomised by Descartes and Linnaeus (Foucault 1970, 50-76).

The adoption of the emerging empirical and experimental culture was far from automatic. As Paula Findlen has demonstrated in her masterful study of scientific culture in early modern Italy (Findlen 1994), classical sources and models of knowledge continued to exercise considerable influence among men of letters throughout the 17th century. Cabinets of curiosities often played a central role in the defence of traditional models of knowledge in the face of the new experimental philosophies (Findlen 1994, 4-

7). Abela's lifetime straddled these important changes, yet many of the formative ideas that shape his interpretations were cast in a Renaissance mould. His position in the scientific culture of his day lay clearly in the tradition of men like Aldrovandi, who assembled their encyclopaedic knowledge around their equally encyclopaedic collections. The collection of antiquities that Abela formed in his casino was central to his project. Most of the illustrations in his *descrittione* represent objects in his own collection. His interpretative models likewise belong to this tradition. His explanation of fossils, for instance, closely follows that of Aldrovandi, who epitomised Renaissance thought based on observed similarities. Like Aldrovandi (quoted in Skeates 2000, 7), he believed that marine fossils were generated in the earth itself, and rejected the idea that they could have been the remains of actual organisms deposited by the sea (Abela 1647, 135). The contemporary scholars that he corresponded with and whose authority he cites are also indicative. The 'Signor de Peires' that he sent some fossil samples to in Aix (Abela 1647, 136) could only be Nicolas Claude Fabri de Peiresc, whose interest in humanist, arcane knowledge was an important influence on Kircher (Findlen 1994, 79; 228).

Interpretations of fossil remains are interesting here because they give us some notion of the depth of time conceivable to scholars in the 17th century. Abela's conviction that fossils were spontaneously generated by the rock was shared by many of his contemporaries. This belief rested comfortably with the notion that the earth was only a few thousand years old, which was expounded most famously by Abela's contemporary, Archbishop Usher (Oldroyd 1996, 49). The debate on whether fossils were impressions of living organisms had already begun in Abela's day, and was to rage through the 17th century (Oldroyd 1996). The realisation that fossils were in fact traces of organisms was to play an important role in the understanding of geological stratigraphy and the depth of geological time, which in turn was to reshape notions about the depth of prehistory and cultural time.

Abela inhabited a much younger universe, however, and his account of prehistoric sites was conceived accordingly. He gives brief descriptions of several megalithic sites, which he almost certainly inspected at first hand. He noted the similarities in building technique between megalithic complexes at Marsaxlokk, Ħaġar Qim, El Eeyun (Ġgantija) and Xewkija (1647, 21; 119). He also recognized that these buildings pre-dated the Phoenicians, Greeks and Romans. His interpretative model attributed these buildings to a race of giants which, he believed, had inhabited Malta after the Flood (1647, 145). This interpretation not only had the appeal that it explained the inordinate size of the megaliths used in the construction of these buildings, but was furthermore consistent with the written sources, from Homer to Pausanias. This conclusion seemed to be confirmed by sporadic discoveries of large rock-cut tombs (more likely to be from the Punic period) and large bones and teeth (probably Quaternary fossils from elephants and hippopotami (Lanfranco 1961, 61)).

Abela's *descrittione* is divided in two books. The first book is mainly taken up with a gazetteer of the archipelago, starting with the Maltese coastline, followed by the interior, duly divided into the uninhabited northwest of the island and the inhabited southeast, while Comino and Gozo are treated in separate sections. These erudite perambulations point out noteworthy sites of all kinds and from different periods. Etymological explanations of toponyms are interspersed with archaeological observations, legends and historical anecdotes. While the first book is organized spatially, the second book is temporally ordered. A historical account is given, divided into different periods, beginning with the giants who created the megalithic buildings.

To the modern reader, this may seem a rather disparate assemblage. What holds Abela's work together as a project, however, is that it created a comprehensive narrative for the island-state that was his home. All available knowledge and understanding about this distinct spatial and organisational unit was gathered together to give an account of the archipelago, from its rock foundations to the institutions of Abela's day. He assiduously applied the mainstream scientific culture of his time, making full use of the classical sources and the collection of material evidence. His remarkable achievement was that he reconciled these tools with the physical remains that he encountered in the landscape, the written records that he had access to as Vice-Chancellor, and the oral evidence that he gathered from the inhabitants, and wove a coherent narrative, where none before existed.

Ciantar and the Pauline apologists

Abela's work became a decisive influence on the writing of Maltese history and archaeology in the centuries that followed. Well over a century after the publication of the *descrittione*, a revised and expanded edition was published by Count Giovanantonio Ciantar (Ciantar 1772). In this new edition, Abela's text is left largely intact, and more often than not the arguments in the new insertions are consistent with the original text. Ciantar was one of several Maltese scholars who referred to themselves as the Pauline apologists, who not only affirmed that St. Paul's shipwreck took place in Malta, but also that it had invested the island with unique properties. By this time, the divergent opinions over the origin of fossils had blown into a full-scale polemic. Ciantar dedicated an entire new section to this subject, repeating Abela's arguments that many of these fossils were spontaneously produced within the rock itself, while conceding that some types could be petrified teeth (1772, 413). While discussing the different forms of these *glossopetre*, or 'tongue-stones', he describes one variety as tortuous and flame-like (1772, 412). It is tempting to think that this may be a reference to prehistoric lithics, which were often placed in the same category as fossil sharks' teeth by early antiquarians, because of their superficial resemblance (Skeates 2000, 7-8).

Ciantar also replicates the attribution of megalithic sites to a race of giants. At one point, it is also stated that these giants were in fact none other than the Phoenicians (1772, II.I.vii).

On top of the literary and material evidence of the existence of these giants, Ciantar adds an eyewitness account of a young man from Gozo 'of extraordinary stature' (1772, 447). In his description of Ġgantija (1772, 341), Ciantar also suggests that this structure may have been a temple, a term that was to become, and still remains, the standard shorthand label for the megalithic complexes of the Maltese Neolithic.

While Abela's notions of time-depth and prehistory are characteristic of the mainstream scientific culture of his day, it is difficult to claim the same for Ciantar when he defends Abela's ideas more than a century later. Throughout the seventeenth century, a succession of scholars had assembled a strong case for the organic origin of fossils (Scilla 1670; Steno 1958, discussed in Findlen 1994, 232-237), which paid particular attention to the Maltese evidence (Oldroyd 1996, 63). Leibniz continued to develop this case (Leibniz 1749, discussed in Oldroyd 1996, 87). Decades later, Ciantar's reaction was a lengthy refutation of the arguments of the 'moderni' (1772, 412-422). Ciantar re-affirmed that many of these fossil formations had been produced by the rock, which had acquired this extraordinary property when it was blessed by Saint Paul (1772, 424). Ciantar was evidently familiar with the scientific developments that had taken place since Abela's day, making frequent (and often derogatory) references to Scilla's work, and even referring to Leibniz (Ciantar 1772, 419). His erudition, however, appears to have been clouded by a passionate conviction that Paul's visit had infused the island with unique properties. What was at stake here was much more than an academic debate over a scientific detail. At stake was a whole system of beliefs about the past and the formation of the world as he knew it. On the basis of this system of beliefs, the Maltese islands were perceived to have a unique and privileged position, inseparable from the inhabitants' sense of identity. In hindsight, Ciantar was fighting a rearguard action to defend a system of knowledge that could still accommodate popular beliefs in a scholarly framework, where local knowledge still formed an important part of scientific culture. Within a few years, this bond was to be swept away forever.

An ambassador of the enlightenment

Fifteen years after the appearance of Ciantar's work, another important document was published, this time in Paris. This was the fourth volume of Jean Houel's *Voyage pittoresque des isles de Sicile, de Lipari et de Malte* (Houel 1787). Although only separated from Ciantar by a short space of time, this work is a very different account. It has been argued that the late 18th century was a period of change in western constructions of knowledge that was as significant as the changes that took place during the first half of the 17th (Foucault 1970, 217-249). These changes are very evident in Houel's *Voyage*. Engraver to the king of France, Houel was not only an accomplished artist but also a gifted writer with a well-rounded education. True to the title of his work, the text is organized as a journal of his travels and the sights that he encountered. Monuments are described as he encountered them, day by day. In Abela's description of the coastline it may only be inferred by the reader that the gazetteer is being compiled from a boat. When Houel describes how he sailed round the coast of Gozo, he dwells on the shifting weather conditions, and even shares his impressions, fears and musing during the journey (1787, 87-88). The observer is at the centre of this narrative. This emerges not only from the text, but also from the plates, and their position in the text. As noted earlier, most of Abela's and Ciantar's illustrations showed artifacts in their collections, inviting the viewer to experience the islands through the model of the museum, a formula that was characteristic of 17th century scientific texts (Findlen 1994, 117). Houel's illustrations offer a sharp contrast, taking the viewer out into the landscape, to experience its monuments and wonders in context. His plates capture the point of view of the observer, and are at pains to reproduce the original observer's experience for the viewer. The sub-headings that divide the text usually refer to a specific plate, with one section per plate. It is the text which supports the images, and not vice-versa. The title *Voyage pittoresque* is meant in the most literal sense.

The outstanding quality of the full-plate engravings makes this one of the finest of the published accounts of the Grand Tour. The images include a number of engravings of Maltese megalithic sites, and probably form the earliest known pictorial record of these buildings. Furthermore, their near-photographic quality increases their value as documents of the state of these sites in 1777, when seen by Houel. The megalithic circle at Xagħra, in Gozo, for instance, was heavily damaged during the 19th century. Houel not only engraved a view (1787, plate CCXLIX) and a plan (1787, plate CCLI, a) of the site, but also provided a written description with various measurements, where he is the first to note the megalithic technique of building with alternating 'headers' and 'stretchers' (Houel 1787, 78).

One of the invaluable documents is plate CCLX, in which he illustrates the largest of these complexes (Figure 2, overleaf). Although in the caption this site is enigmatically referred to as Tadarnadur Isrira, it is unmistakably recognizable as a view of Ħaġar Qim from the south (Evans 1971, 80). This is invaluable because it is perhaps the only illustration that exists of the site before its excavation in the early 19th century. It shows the depth to which the site was buried, as well as the state of the southern façade before the extensive excavation and reconstruction interventions of the 19th century (Stroud 2003).

Houel makes frequent comments on the geology of the islands. Here again the contrast with Ciantar is striking. He is the first to try to draw a geological map of the archipelago (1787, plate CCXLVII), which recalls the innovative 'mineralogical map' of France and southern Britain published by Guettard in 1751 (Oldroyd 1996, 72, fig 3.2). On the basis of observations made during his short stay, he observed, correctly, that the islands of Malta, Gozo and Comino were similar in composition, and concluded, also correctly, that all three had been created by the same processes, as parts of a single mass, and that they had once formed part of the sea-bed (1787, 74). While Ciantar invokes the occult influence of Saint Paul to explain geological phenomena such as the presence of fossils, Houel's explanatory model is based on processes occurring in deep geological time. An awareness of formation processes also informs his discussion of the so-called Gozitan 'alabaster', in which he observes stalactite-like formations, which could only have built up over a long period of time. He even tests its chemical properties, and explains that it produces vigorous effervescence when combined with acids (1787, 84-85).

Houel's awareness of formation processes in the natural environment also informed his reading of cultural processes. He observes that the bedding planes of the sedimentary limestone often resulted in the detachment of boulders in layers between 3 and 5 feet thick. He then observes how these boulders provided the ideal material for megalithic building (1787, 80; 99). The same argument is still generally accepted by archaeologists today (Evans 1971, 3).

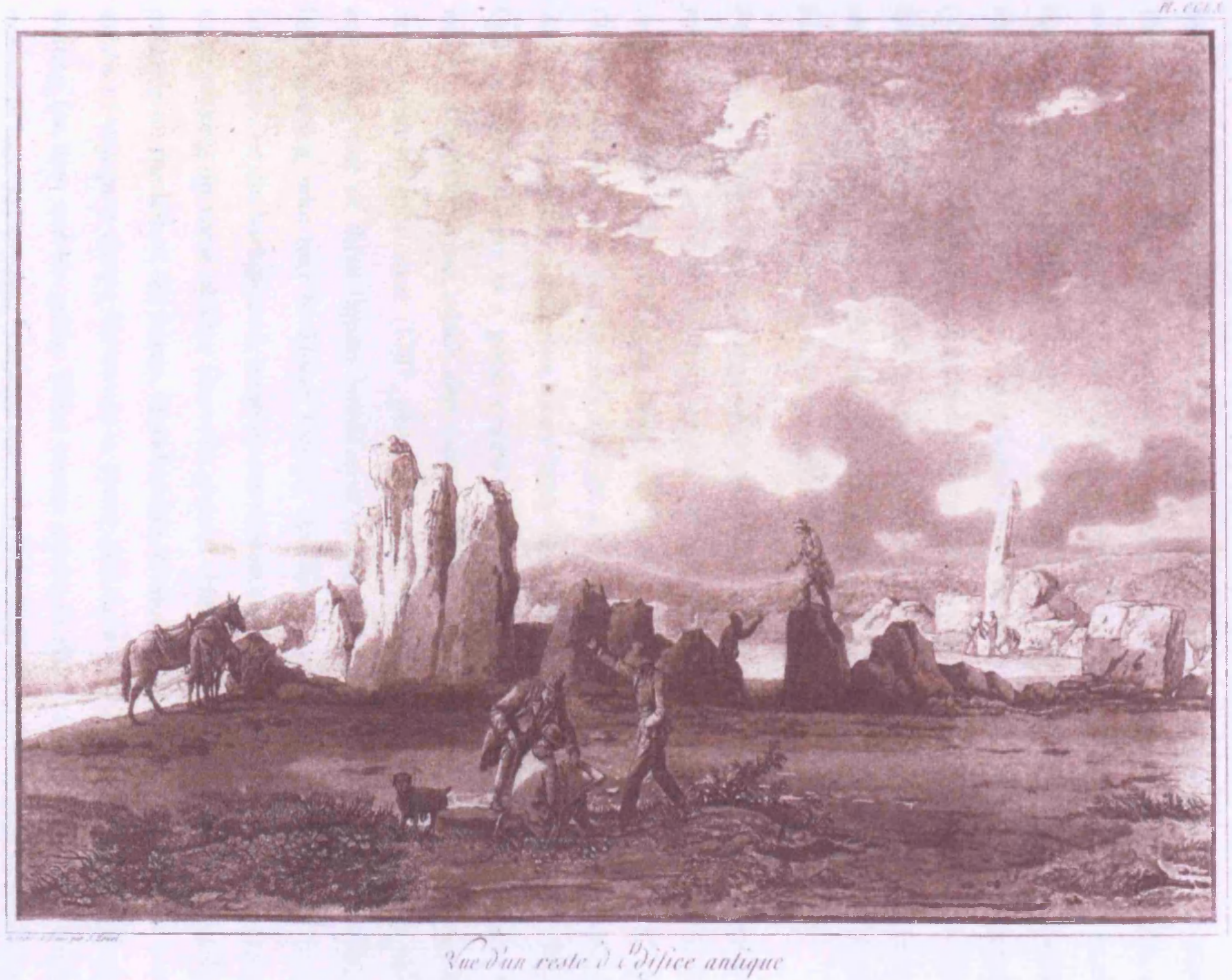


Figure 2. Houel's engraving of Ħaġar Qim (Houel 1787, Plate CCLX).

Houel's understanding of geological time made him acutely aware that the written sources could not always be taken literally, particularly in their accounts of the remote past. This critical approach also informed his interpretation of the megalithic complexes. Giants are banished from his narrative, and the megalithic complexes are attributed to the Phoenicians instead.

Another distinctive characteristic of Houel's narrative is his intense interest in people. This interest is a clear example of the emergence of an interest in people themselves as an object of study, which is one of the important changes that have been noted in the history of ideas during this period (Foucault 1970, 344-387). His acute observations still retain an astounding freshness. He comments on the natural beauty of Gozitan women (1787, 81), and has words of admiration for the sailors who brought him across from Gozo to Malta in adverse conditions (1787, 88). His meticulously illustrated observations on the dress and behaviour of women in different social groups (1787, 96; Plate CCLVIII) may in all fairness be termed ethnographic.

People also inhabit his engravings of megalithic sites. Beyond the ubiquitous function of providing a sense of scale, these people are interesting because of the way they are depicted. Their dress makes it clear that Houel was representing the Maltese and Gozitan country men and women that he admired so much. They are not squeezed uncomfortably into a corner, but move freely through the ruins. The engraving of Ħaġar Qim reproduced here is a good example (Figure 2). Two of the figures are shown wearing a distinctive hat, which also appears in another plate where Houel illustrates the dress worn by local men (1787, plate CCLI). In the foreground of the Ħaġar Qim engraving, one of these figures bends over in conversation with the person making a large drawing, who may be Houel himself. Another figure gestures at a feature in the landscape. In the background, more conversations are taking place. One group appears to be picking up some objects from the ground. Meanwhile, two saddled donkeys wait patiently on the left of the frame. Houel makes various references to using donkeys as a means of transport during his travels in Malta, and the ones we see here are presumably waiting for him and his guide. What comes across in these attentive images is a keen interest in local knowledge, however anecdotal. It is difficult to tell to what extent we are being shown a specific encounter with near-photographic precision, and to what extent artistic license is being exercised in order to give a sense of scale in the receding planes. What is more important, however, is that Houel chose to represent these figures and exchanges in this particular way. This becomes more significant when contrasted with the way people were to be represented on the same sites, four short decades later, as we shall see below.

The 19th century: The imperial yardstick

During the course of the 19th century, approaches to Maltese prehistory underwent a fundamental transformation. This transformation is inseparable from the political destiny of the archipelago during this period. The Order of Saint John was expelled by Napoleon while on his way to Egypt in 1798. Within months, the Maltese had risen against the French occupying forces. The assistance of Britain was requested to dislodge the French. By the end of the Napoleonic Wars, Britain had decided to consolidate its position in Malta, and to make it a permanent possession. This drastic alteration in the archipelago's destiny had deep repercussions on the subsequent development of its archaeology, and was responsible for three, closely related changes, which shall be considered in turn.

Frames of reference

A direct consequence of the retention of the archipelago by Britain was the progressive isolation of Malta from Sicily and the European continent. During the 18th century, travellers on the Grand Tour of southern Italy and Sicily had often visited the Maltese islands as a natural extension of the tour. As a result, descriptions and commentaries on Maltese archaeology often formed part of a larger work dealing with Italy and Sicily. Up till the end of the 18th century, Maltese archaeology was approached in its regional context as a matter of course. Sir Richard Colt Hoare's memoirs of his travels in Sicily and Malta in 1790 were among the last in this tradition (Colt Hoare 1817).

The new political scenario of the 19th century excised the study of the Maltese islands from its regional context. Hostilities during the Napoleonic Wars, the decline of the Grand Tour, and Malta's progressive integration into the communication networks of the British Empire all contributed to this change. The study of Maltese archaeology became a progressively more separate enterprise from that of Italy and Sicily.

The use of a different language to describe and publish Maltese prehistoric remains was to further cement this change. A growing proportion of reports and descriptions started appearing in English (Smyth 1829; Vance 1842; Rhind 1856). By the last quarter of the 19th century, the promotion of English had become a tenet of colonial policy in Malta. Government-funded archaeological publications were printed almost exclusively in

English (Eg. Caruana 1882; Caruana 1896a).

Several scholars on either side of the new linguistic and political divide between Malta and Sicily continued to exchange information. During the course of the 19th century, however, this became increasingly a matter of personal initiative rather than institutional collaboration.

Malta now formed a part of new networks of connectivity, which also re-moulded the point of view of the visitor. The islands became a staging post in Britain's 'Mediterranean corridor' to India, together with Gibraltar, Alexandria and Aden. With the introduction of steamers, Malta was developed as a coal-bunkering station, consolidating its role as an important port-of-call for shipping. The opening of the Suez Canal in 1869 further increased the proportion of east-west shipping calling at Malta. This altered relationship between Malta and the outside world created a new frame of reference in which the archipelago was perceived and understood. The repercussions were felt beyond the realms of politics and administration. These new networks of connectivity also influenced the way research was conducted and the way the Maltese islands were presented in the publications of this period. A stream of books, ranging from scientific works to popular guidebooks, now brought together disparate geographical areas by virtue of the fact that the British Empire had interests there. This tendency may be observed across various disciplines, from medicine, as in John Davy's *Notes and observations on the Ionian Islands and Malta* (Davy 1842), to natural history, as in Andrew Leith Adams' *Notes of a Naturalist in the Nile Valley and Malta* (Adams 1870). This trend persisted well into the twentieth century, and was even evident in popular works such as *Malta and Cyprus* (Peto 1927). Archaeology was no exception. This new frame of reference is epitomized in *Malta and Gibraltar Illustrated*, a popular publication that appeared in 1915. This profusely illustrated volume contained a series of papers on different aspects of life in the two British possessions, including a lengthy chapter on the history of the Maltese islands from its earliest inhabitants (Bartolo 1915) and a separate chapter by Themistocles Zammit on prehistoric remains in Malta and Gozo (Zammit 1915b). The same trend is also evident in publications about the administration and management of archaeological sites and museums. In 1932, as part of its 'survey of Empire museums', the Museum Association published a report on the museums of Malta, Cyprus and Gibraltar (Squire & Herdman 1932) followed by a directory of museums in British Africa, Malta, Cyprus and Gibraltar (Museum Association 1933).

The description and study of the Maltese islands as part of a series of imperial possessions, rather than as part of its regional context, is symptomatic of the subtle but far-reaching process of appropriation that had taken place. This process may be better understood in the context of 19th century imperialism. Benedict Anderson's (Anderson 1991) seminal study of imperial processes of appropriation in Southeast Asia is particularly instructive here. Anderson argues that the census, the map and the museum were powerful instruments in the hands of colonial administrators. These tools were used to create a new frame of reference that was imposed on subjected territories and peoples. Anderson persuasively argues that acceptance of these classificatory frameworks by subjects helped consolidate and naturalise the new imperial order (Anderson 1991, 163 ff.) One of the ways that maps are deployed is the creation of the 'map-as-logo':

> In London's imperial maps, British colonies were usually pink-red, French purple-blue, Dutch yellow-brown, and so on. Dyed this way, each colony appeared like a detachable piece of a jigsaw puzzle... each 'piece' could be wholly detached from its geographic context. In its final form all explanatory glosses could be summarily removed: lines of longitude and latitude, place names, signs for rivers, seas, and mountains, *neighbours* [original emphasis]. (Anderson 1991, 175).

The prising of the study of Malta from its regional context, and its treatment as part of a colonial series, has close parallels to the processes identified by Anderson, which could be seen at work in text books, museum displays, and the world exhibitions that were invented in this period (Mitchell 1988). Maltese archaeology was also influenced by these altered frames of reference. This influence shaped some of the explanatory and interpretative frameworks that were used to read the Maltese evidence, which will be considered next.

Interpretations

One of the myths that haunted British imperial archaeology in the 19th century was the idea of a Phoenician diaspora. This idea hinged on the widespread belief that the Phoenicians had reached Britain and settled there, long before the Roman occupation. Such views had adherents in some quarters well into the 20th century (Strickland 1925; Gayer 1939). This putative ancestry of the ancient Britons presented a tantalising opportunity to legitimise British imperial possessions, by providing a genealogy based on kinship. The search for Phoenician settlers and colonists became a recurring theme in the new possessions of the British Empire. The best-known example is perhaps the attribution of the ruins of Great Zimbabwe to the Queen of Sheba (Hall 1995). When Great Zimbabwe became an imperial possession in 1890, Cecil Rhodes started equipping expeditions to dig for evidence of Phoenician settlement (Hall 1995, 34). The conviction that the monumental architecture of Zimbabwe could only have been produced by white settlers reinforced and perpetuated western preconceptions of Africa as a 'dark sea of barbarism', and seemed to provide a convenient precedent for the renewed presence of white settlers and colonists (Hall 1995, 33).

Phoenician presence in Malta is well attested from the 8th century BC. As noted earlier, Houel mistakenly attributed prehistoric buildings to this culture. This view remained practically unchallenged throughout most of the 19th century (Smyth 1829; Caruana 1882). An isolated dissent was voiced by Henry Rhind in a memoir presented to the Archaeological Institute (Rhind 1856), questioning this attribution. However, the belief that these were Phoenician remains persisted as the prevailing opinion right until the end of the 19th century (Caruana 1896a). Caruana believed that these buildings had been produced using metal tools. The apparent absence of flint and stone tools further misled him into asserting that '...the islands of Malta, consequently, have not as yet a claim upon the existence of man in prehistoric ages' (Caruana 1896, 35).

In Malta, no less than elsewhere in the Empire, the debate on the Phoenicians had political ramifications. Malta's 19th century political status was somewhat exceptional. Apart from Ireland, it was practically the only British possession with a pre-existing Christian and predominantly European culture. This anomaly meant that the traditional rhetoric of benign domination, that worked so well elsewhere in the Empire, was more open to contestation here. In some ways, the debate on the Phoenician heritage became a mirror for this contestation. The Phoenician narrative became the connecting thread between the megalith builders and the modern inhabitants. This connection rested on two arguments. As already noted, one argument was that the Phoenicians were responsible for Maltese megalithic architecture. The complementary argument was that the modern Maltese inhabitants were essentially the unadulterated descendants of the Phoenicians. The principal evidence put forward to support this was linguistic. A number of scholars argued that modern Maltese had a greater affinity to 'Canaanite' or 'Phoenician' than to Arabic. This idea was already being linked to the archaeological evidence in the early 19th century (Smyth 1829, 295-6). By the late 19th century, it had acquired the proportions of a full polemic, about which entire volumes were written (Caruana 1896b; Preca 1904). For the literate part of the Maltese population, their origin as a nation rested on a firm belief in these two arguments, which gave them a primordial claim to civilization. This argument was summed up by Dr. Zacaria Roncali during a debate of the Council of Government:

> We have been a civilized people since very ancient times, and we were already civilized when another people, who now pretend to have mastered civilization, were in savagery. We have a civilization of which any people may be jealous. Behold our historic temples not to be found anywhere else in Europe... (quoted in Frendo 1979, 31).

Such arguments were however the preserve of an educated minority, never filtering through to the popular imagination. Megalithic monuments never became a popular symbol of nationhood in the way that classical temples had done in Greece (Sant Cassia 1993). To explore popular perceptions of prehistoric sites during the 19th century, it is useful to move on to what was happening on the sites themselves.

Presentation and re-presentation

A third transformation that took place during the 19th century was in the way Maltese prehistoric monuments were managed and presented. Until the 18th century, the preservation or otherwise of archaeological sites was very much the prerogative of the landowner. The owner's permission was sought before retrieving samples of antiquities from a site (Ciantar 1772, 387) or before making illustrations (Houel 1787, 92). Bonello (1996) has drawn attention to two accounts by travellers that give a valuable glimpse into the early management and preservation of archaeological sites. The first case was recorded by the Prince of Biscari in an account of his travels published in 1781 (quoted in Bonello 1996, 19). It concerns the Ġgantija site in Gozo, which presents an interesting example of co-existence between the preservation of a prehistoric site and other uses of the surrounding land. According to this account, the owner included a condition in the contract under which he granted the land in perpetual emphyteusis, expressly forbidding the disturbance of the site.

The other interesting case discussed by Bonello is the nearby Xagħra Circle. This Late Neolithic funerary site, surrounded by a circle of megaliths, was excavated during the 1820's by the Governor of Gozo, Otto Bayer (Smyth 1829). Part of the story of what happened after the excavation has been preserved by Prince Pückler-Muskau, who visited Malta in 1835, and published his memoirs in 1840:

> [It was] suggested that the government should buy the land, and that would have only cost a few hundred Spanish dollars. They offered the owner 100 less than he had asked for, and, as the price was not accepted, the deal did not come off. Now everything is destroyed, and as we got here today we found a number of people trying to break the last two pillars which were still there. Is not this vandalism? (quoted in

Bonello 1996, 21).

This extraordinary account is interesting for a number of reasons. Firstly, it suggests that, in spite of the early interest in the excavation of the site, its subsequent preservation appears to have remained a low priority. Secondly, this may be the earliest recorded instance where an attempt was made by the government to purchase an archaeological site in the Maltese islands in order to preserve it. Although the attempt failed, it heralded a new model for the management and protection of archaeological sites. By the end of the 19th century, the forceful acquisition of archaeological sites by government had established itself as the obvious course of action to protect important monuments.

Pückler-Muskau's account is interesting for a third reason. The deliberate destruction of the megalithic circle, which he witnessed at first hand, in broad daylight, is the only glimpse we have of the local reaction to these events. The contrast to the co-existence noted earlier at Ġgantija, only a couple of hundred metres away, is striking. At the Xagħra Circle, local interests appear to have construed the presence of an archaeological site as a threat, which they reacted to with vehemence. In Malta, there is no evidence of a tradition of deliberate destruction of megaliths for religious reasons, such as has been attested elsewhere (Chippindale 1990). The systematic destruction of the megalithic circle, and its subsequent transformation into a vineyard, probably had more pragmatic motives. The fact that this destruction occurred so soon after the excavation and the failed bid by the government to purchase the site suggests that it may have been, at least in part, a reaction to these events. Here the presence of these giants' stones were no longer the basis of a covenant with their local owner, as they were at Ġgantija. Instead, they had become a magnet for a procession of outsiders, who disturbed the flocks in the neighbourhood, dug big holes in the ground, carried away mysterious objects that had always lain there, and then tried to buy the land itself at a miserly price. In this light, the destruction of the last megaliths before the very eyes of a distinguished visitor acquires an almost theatrical air. The destruction of the megaliths was hardly required to accommodate a vineyard, so much so that even today, a dry-stone wall still traces the line where the circle once stood. The deliberate destruction of the site was more likely an act of resistance against the emerging order of things. The erasure of the site became the only way to protect local interests from this incursion, and from the fear of expropriation.

By the last quarter of the 19th century, the colonial administration had developed a very different attitude to the management and protection of archaeological sites. This transformation is evident across the Empire. In India, the establishment of the Archaeological Survey was a crucial turning point (Paddayya 1995). The Viceroy of India, Lord Curzon, who in so many ways was the epitome of late Victorian imperialism, summed up the emerging attitude to archaeological monuments:

> It is equally our duty to dig and discover, to classify, reproduce and describe, to copy and decipher, and to cherish and conserve (quoted in Anderson 1991, 179)

This new ethos is also evident in Malta's colonial administration. By the early 1880s, the forced acquisition of archaeological monuments, and the land on which they stood, had begun in earnest. The transformation in the role that had been assumed by government as protector, arbiter, and owner in the public interest is eloquently attested in Caruana's comments on the management of Ġgantija. This was the very same site where the Prince of Biscari, in the late 18th century, had been so impressed by the care of the owner to ensure that not a single stone was moved. A century later, Caruana, who as Librarian and as Director of Education was a key figure in the colonial administration of Maltese archaeology, had this to write:

> The late Marquis Desain, the proprietor of the place [Ġgantija], thoroughly ignoring the nature of the monument, with perfidious stubbornness, in spite of the remonstrances of Government, at whose expense these remains were cleared up, ordered the removal of these interesting details in his search for Greek vases (Caruana 1896a, 41-2).

Evidently, the threat of damage to prehistoric remains was not limited to ignorant peasants trying to cultivate the land, but could also come from those with an antiquarian interest. During a meeting of the Royal Archaeological Institute on the 6th of May 1896, Sir Benjamin Stone, a British M.P. '...remarked on the advisability of the Government taking steps to preserve these ancient and important ruins from the reckless hands of visitors' (Royal Archaeological Institute 1896, 192). The 19th century had transformed the perception of these sites, as well as attitudes to their proper management. From places of arcane and local knowledge, they had become repositories of information that the Government had a duty to protect, in the interest of the public and humanity as large. This transformation was accompanied by the progressive commoditisation of the experience of visiting these sites, making them increasingly accessible to outsiders. Decisions about what was done on and around these sites was prised from the hands of owners and local communities, and increasingly controlled by Government.

The attitudes that emerged in Malta during this period find parallels in the processes noted by Anderson in other imperial contexts. The expropriation of monuments was part of a process of progressive disembedding of these sites from the physical landscape and the local social fabric. Across the empires of the western powers, archaeological monuments were '...disinterred, unjungled, measured, photographed, reconstructed, fenced off, analysed, and displayed' (Anderson 1991, 179). The fencing off of sites afforded some protection from physical damage, and demarcated them as government property. Another effect of fencing was that it tended to excise sites from the surrounding landscape. This became the persistent paradigm for the care of archaeological monuments from the late 19th century and throughout the 20th. Malta was no exception. Land around archaeological sites was expropriated by Government, to the nearest field boundary where convenient, more often to an arbitrary rectangle. Massive, almost monumental, boundary walls and fences were built to enclose these arbitrary rectangles, completing the dislocation of the site from the landscape. Such enclosures were still being built as late as the 1970's, when a rectangular enclosure around Ħaġar Qim was erected. Time was supposed to stand still on the ground that was circumscribed in this way, as it was taken from the living cultural landscape and turned into a cultural commodity. These enclosures were as remote from the surrounding landscape as the military barrack complexes that were also spreading across the landscape during the 19th century. Both were outposts of a remote and powerful state, where decisions and behaviour was regulated by unfamiliar values.

Another source of information that sheds some light on 19th century attitudes to prehistoric sites is pictorial representation. One of the most comprehensive archaeological documents of this period is a set of 19 watercolour views of Ġgantija and the Xagħra Circle (Grima 2004). These were probably commissioned by the first Duke of Buckingham and Chandos from Charles Frederick de Brocktorff in 1828 (Bonello 1996, 22). Ġgantija is shown freshly cleared from debris, surrounded by spoil-heaps from the recent work. Bayer's excavation in the Xagħra Circle is shown open, with work still in progress. The figures that inhabit these images deserve some attention here. Their dress divides them into two distinct stereotypes. The local inhabitants are immediately recognizable, usually shown wearing their working clothes, and often barefoot. Outsiders visiting the site, on the other hand, are elegantly dressed according to the fashion of the day. They sport white trousers, blazers, top hats, and the occasional parasol for shade (Figure 3, overleaf).

The activities that these two groups are engaged in also present a sharp contrast. The attention of the elegant visitors is entirely focussed on the megalithic remains. Equipped with sketchbooks and measuring equipment, they inspect, discuss, measure and draw these remains. The native figures, on the other hand, are represented as indifferent to the megalithic monuments that tower over them. They show little engagement with these remains, and sometimes appear with their back to the monuments (Figure 3, centre; Figure 4, overleaf). These figures are very different from the native figures that inhabit Houel's representations of megalithic sites, which are only a few decades earlier. As noted above, Houel's natives are gesturing and explaining, recounting their narratives to attentive visitors (Figure 2). Such a relationship is rather less evident in the 19th century images, where local inhabitants are either not involved at all, or at most appear as workers on the excavation.

Figure 3. Ġgantija. Watercolour by C.F. de Brocktorff, 1828. National Library, Malta.

Figure 4. Xagħra Circle. Watercolour by C.F. de Brocktorff, 1829. National Library, Malta.

Figure 5. Xagħra Circle. Watercolour by C.F. de Brocktorff, 1829. National Library, Malta.

In one watercolour of the Bayer excavation, two workers stand at the edge of the pit (Figure 5). Although employed on the dig, their body language is more of observers than participants. No-one is listening to them now, as they lean on their picks and wait for the next instruction. In those figures, we can already recognize the role that Karmenu was to perform on the same spot, some 160 years later.

As argued in greater detail elsewhere (Grima 1998), the new way that these stereotypes are represented speaks of a structure of information, knowledge and power that was forming around these monuments. The audience for whom these watercolours were intended was very much like the educated visitors that appear in these images. These figures invite the viewer to join them in their appreciation of the archaeological remains. The native figures, on the other hand, are shown as uninterested and ultimately incapable of sharing the knowledge of these visitors. In portraying the relations around these sites in this way, these images themselves became instruments that reinforced the relations between the different groups, by re-affirming and normalizing the exclusive connoisseurship that had developed around the sites.

The 19th century: some conclusions

A variety of transformations that occurred during the 19th century has been considered. The creation of knowledge and narratives around these sites shifted from a more locally-based knowledge to a more global frame of reference. Popular explanations of megalithic remains, which until the 18th century had formed a part of the scholar's narrative, now became irrelevant. New modes of behaviour and bodily practices on these sites were also being invented. Here again, imported canons of how to encounter these sites displaced indigenous ones. Site management practices embodied the transformation in a legally tangible form. The relationships of owner and tenant were swept aside, as the state assumed responsibility and ownership, in the public interest. The consequences of this practice went further, dislocating the sites from their very landscape. Too large to be carried into the museum, they effectively had a museum built around them. These legal, physical and conceptual transformations were to have a lasting influence during the century that followed.

The 20th century: The recognition of prehistory

Culture sequence and chronology

During much of the 20th century, questions of culture sequence and chronology attracted considerable attention and often drove research agendas. The turn of the century brought new and exciting developments. As already noted, the view that Maltese prehistoric buildings had been built by the Phoenicians persisted right till the end of the 19th century, while dissenting opinions such as Rhind's were largely ignored. The idea that these remains represented a much older, prehistoric culture only gained broad acceptance in the early 20th century.

Arthur Evans, who inspected the megalithic complexes in 1897, rejected the Phoenician attribution, and used stylistic comparisons to argue they could even predate Mycenaean culture (Evans 1895; Evans 1901). Around the same time, a German scholar, Albert Mayr, reached the same conclusion (Mayr 1901; Mayr 1908; Stöger 2000). Late the following year, the astonishing discovery of a unique site was to confirm and popularise this new understanding. The Ħal Saflieni Hypogeum yielded a wealth of evidence of this newly-recognized prehistoric culture (Zammit 1910; Bradley et al. 1912). The creation of a national museum in the same period made these new discoveries accessible to a much wider public.

The excavation of a minor megalithic complex at Santa Verna, in Gozo, began to frame new questions of chronology and culture sequence, and attempted to answer these through stratigraphic excavation (Ashby et al. 1913). The excavation of the newly discovered megalithic complex at Tarxien presented a rare opportunity to address these questions (Zammit 1916; Zammit 1917; Zammit 1920; Ashby 1924; Zammit 1930). This was followed by the excavation of a number of smaller megalithic complexes (Zammit 1929).

Following the hiatus caused by the Second World War, prehistoric research in Malta received fresh impetus when the Secretary of State for the Colonies approved funding for a comprehensive survey of Maltese prehistoric remains (Evans 1971, v; Vella & Gilkes 2001, 372). This survey generated fresh research on questions of culture sequence and chronology, that were addressed through a programme of sondage excavation across a number of megalithic sites (Evans 1953; Evans 1959; Evans 1961). This work also tied the development of megalithic architecture to the emerging culture sequence. The results of the Survey (Evans 1971) are still the key reference work on Maltese prehistory.

The excavation of Skorba between 1961 and 1963 provided the opportunity to test, refine and extend the culture sequence that Evans had proposed (Trump 1966). This excavation also provided more material for radiocarbon dating, giving some indications of the absolute dates of the ceramic sequence (Trump 1966, 48). With re-calibration, the dating of this sequence was pushed further back in time (Renfrew 1973), producing the chronology that is accepted today.

Race, culture history, and diffusionism

An equally prevalent concern throughout the first half of the 20th century was the cultural and racial origin of the prehistoric inhabitants. European prehistory during this period was dominated by culture-historical models that often sought racial explanations for differences in material culture. The models invoked to explain the Maltese evidence were no exception. One of the new scientific tools that promised to shed light on the enigma of the prehistoric islanders was physical anthropology. The early twentieth century was characterized by considerable faith in cranial indices based on very limited measurements, and it was perhaps inevitable that these methods were brought to bear on the Maltese evidence. Skulls from prehistoric, Phoenician, and early modern contexts were duly measured and classified (Bradley 1912). Living examples of the modern inhabitants were also sampled (Dudley Buxton 1922). This research was partly driven by a conviction that the cranial measurements of the modern Maltese population could shed light on the early colonisation of the archipelago. Variations in the skull dimensions of the modern inhabitants were explained in terms of a succession of waves of colonisation and domination.

The Second World War brought about a sharp reaction against this line of investigation, which disappeared from the research agendas for the Maltese Neolithic. After more than half a century, these questions may now be revisited on a sounder footing. The revolution in DNA research, coupled with the large sample of very well-preserved skeletal remains from the recent Xagħra Circle excavation, promise exciting developments in the coming years.

Meanwhile, the concern with tracing the source of the prehistoric culture of the archipelago persisted, though after the Second World War the debate became more focussed on the material culture. The material culture of Late Neolithic Malta continued to be compared with that of the Bronze Age Aegean, which was believed to be an important source of cultural influence (Zammit & Singer 1924; Evans 1959, 82-83, 162-165). This diffusionist model became untenable when recalibrated radiocarbon dating showed that the Maltese evidence was in fact several centuries earlier than its purported source of inspiration in the Aegean (Renfrew 1973).

Monumental architecture

The most conspicuous material remains from Late Neolithic Malta were of course the monumental megalithic buildings. As noted earlier, the sheer massiveness of their construction made them durable features in the landscape, and captured the attention of early antiquarians. The complexity and sophistication of the buildings ensured that they continued to attract the interest of researchers throughout the twentieth century. Four main issues attracted research and debate during the 20th century. These are building technology, labour organisation, the development of their architectural form, and the purpose they were built for.

The technology employed in the creation of these buildings has attracted considerable attention (Ceschi 1939; Tampone et al. 1987; Tampone et al. 1991; Xuereb 1999). The sheer size of some of the megaliths used in the structures has often invited the question of how these were moved into position. Another long-standing debate is that of how and to what extent the buildings were roofed. These buildings have sometimes been described as hypaethral, that is wholly or partially open to the sky (Bradley 1912, 44). On the other hand, the corbelling in some parts of the buildings is generally accepted as a reliable indication that some areas of the buildings were roofed over. This raises the question of how the roofing was executed. The case has been made for the use of stone (Ceschi 1939), as well as for lighter, organic materials (Trump 1966). Both solutions are physically possible (Xuereb 1999).

The mobilisation and specialization of labour that was required for these building projects has also attracted considerable discussion. (Blouet 1967; Renfrew 1973; Turnbull 2002; Clark 2004).

Another focus of 20th century research has been the question of the development of these architectural forms. The plan of the buildings consist in sub-circular spaces, referred to as 'apses' in the literature, arranged around one or more central courts, in configurations that become more complex in the later examples (Evans 1959; Evans 1971; Trump 1983). The plan of the buildings has prompted various explanations, which shall be examined in greater detail in Chapter 6. One suggestion is that it is anthropomorphic, and that it echoes the form of the figurines and statues often found in these buildings (Zuntz 1971). This interpretation appears unlikely because firstly, it does not account for the development of this plan across time, and secondly, it presumes a bird's eye view of the plan, which is very different from the actual experience of moving through these buildings.

Another, more recent approach to the plan of these buildings has been the application of Space Syntax and Access Analysis. This showed that these buildings are characterised by internal partitioning and sub-division of space, which becomes increasingly elaborate with time, culminating in the Tarxien phase. It has been suggested that this may be an indication that access to the inner reaches was being more carefully controlled, in a social climate of increasing rivalry within and between groups (Bonanno et al. 1990).

One characteristic of all these 20th century debates is that, partly because of the nature of the questions being posed, they have focussed on the buildings themselves. Meanwhile, the landscape context of these buildings has received very little attention. The pioneer excavators of the 19th and early 20th century occasionally allowed themselves some rumination on the landscape setting while writing their reports (Caruana 1896a; Bradley 1912; Ashby et al. 1913; Zammit 1929). Paradoxically, these observations became less and less frequent during the 20th century, as the study of these buildings became increasingly site-centred, encyclopaedic, and dislocated from their landscape setting.

Belief-systems and cult

The known evidence for the Maltese Late Neolithic has been inevitably skewed towards the monumental and the funerary. Domestic contexts are very ephemeral in comparison, and their detection in the archaeological record is consequently much more difficult (Trump 1966; Malone et al. 1988). As a result, one of the issues that attracted most interest during the 20th century was the belief-systems of the Neolithic inhabitants. The rich repertoire of human representations further fuelled this interest (Zammit & Singer 1924; Zuntz 1971).

Apart from megalithic buildings, there was another type of site that left a durable impression in the material record. This was the funerary complex. The discovery of the multi-level burial complex at Ħal Saflieni revealed the remains of thousands of individuals and associated artifacts (Zammit 1910; Bradley et al. 1912; Zammit 1925).

A group of five Neolithic tombs was excavated west of Żebbuġ in 1947 (Baldacchino & Evans 1954). These separate tombs containing multiple inhumations were recognized as an earlier form of burial than the main complex at Ħal Saflieni. Żebbuġ eventually became the type-site of the first phase of the Maltese Late Neolithic. A comparable series of rock-cut tombs was excavated on the Xemxija plateau in 1955 (Evans 1971, 112-116).

Another important excavation took place between 1987 and 1994, re-investigating the funerary complex at Xagħra that Bayer had partially excavated in the 19th century. This excavation has generated a new wave of research and debate (Bonanno et al. 1990; Stoddart et al. 1993; Malone et al. 1993; Malone et al. 1995a; Malone & Stoddart 1998). This research has focussed on the themes of death-cult and of monumentality in an island context.

Iconography

An astounding repertoire of Late Neolithic images has survived. These range from wall painting and low-relief sculpture to stone and ceramic representations in the round (Pace 1996). The high quality of workmanship that they often display has given them a central place in 20th century narratives of the Maltese Neolithic. During the 1990s, a succession of exhibitions was organized on the theme of Maltese prehistoric art.

Throughout the first half of the 20th century, interpretations of these images were dominated by narratives of fertility. The use of spiral motifs in pottery decoration, wall painting, and low-relief sculpture was widely interpreted as a reference to cyclic regeneration (Zammit 1925; Zammit 1930), while the perceived obesity of some of the figurines was read as a conflation of feminine fecundity with the fertility of the earth (Zammit & Singer 1924; Zammit 1930).

During the second half of the twentieth century, the mainstream archaeological interpretations became increasingly prudent, while the fertility narrative persisted in the realm of popular guidebooks and magazine articles. Early in the 1990s, the discovery of new variations in the style and composition of anthropomorphic representations (Stoddart et al. 1993) underlined the fact that current understanding of these images is still very limited. Partly as a consequence of this, the readings that have been put forward within mainstream archaeology have been very cautious. These have been characterized by a more empirical approach, which seeks to identify basic characteristics such as 'abstract' and 'representational' categories (Stoddart & Malone 1996; Pace 1996). These issues will be considered in greater detail in Chapter 7.

The goddess movement

One of the late 20th century responses to Maltese Neolithic representations has been so widespread and vocal that it deserves separate treatment here. This is the burgeoning interest expressed by the 'goddess movement', which draws its inspiration from feminist archaeology in general and the work of Maria Gimbutas and her followers in particular (Meskell 1995). This movement has come to inhabit a space at the fringes of scholarly research, which may be described as a popular re-appropriation of the past. Its largest following is in the USA, but its appeal is international. The Maltese Late Neolithic has become an important reference point for this movement, and even a place of pilgrimage (Rountree 1999; Rountree 2002). The narratives of the Maltese Neolithic that are predicated by this movement are often highly idealised. One recurrent theme in these narratives is that of an 'earth-honouring' society. (Rountree 1999 204-208). This interest in the relationship with the environment has however remained highly abstract. Paradoxically, the literature generated by this movement has only paid superficial attention to the ways this society inhabited the landscape. In this regard, the scope of these narratives shares some of the blind spots of mainstream research on the Maltese Neolithic.

Spatial analysis

It has been noted that issues that concern the broader landscape have been relatively neglected in the study of Maltese prehistory. We now turn to consider some of the contributions that have been made at this scale of analysis. The Late Neolithic monuments of the Maltese Islands have played a minor but interesting role in the history of archaeological spatial analysis. In 1 973, they were added to a number of case studies where Colin Renfrew proposed chiefdom territories on the basis of Thiessen polygons drawn around monumental sites (Renfrew 1973, 147-166). This idea was revisited in 1979, when a more sophisticated method for postulating territories around sites was proposed. This interesting method, named the XTENT model, used the Maltese evidence as a case-study in order to define a methodology (Renfrew & Level 1979, 153-158).

The brief history of quantitative spatial analysis of the Maltese Neolithic landscape is completed by a recent PhD dissertation. This proposed an interesting variation of the territories postulated by Renfrew in 1973. It suggested that the 'central places' of territories may have been burial complexes rather than megalithic sites. Once again, the proposed alternative territories were drawn using Thiessen polygons, only this time they were projected around burial sites (Hayden 1998).

Palaeoecology

Another effect of the bias towards monumental and ceremonial contexts has been that research on the reconstruction of the prehistoric environment has tended to be somewhat sporadic. Many of the samples that have been used to make inferences on the environment came from monumental or ceremonial sites (Trump 1966; Helbaek 1971; Pike 1971a; Schembri 1995). Meanwhile the sample of human skeletal remains from this period has increased dramatically with the recent excavation of the funerary complex in Xagħra. The opportunities presented by this class of evidence to make inferences on subsistence strategies is producing very interesting results (Pike 1971b; Duhig 1995; Richards et al. 2001). Environmental processes and characteristics are considered more closely in the next chapter.

Approaches to insularity

A recent study of the political context of Maltese archaeology during the late 19th and early 20th century (Vella & Gilkes 2001) has shown how archaeological agendas were often deeply influenced by the prevailing political climate. Maltese prehistoric research was inevitably overshadowed by the deterioration of relations between Britain and Italy, and the outbreak of the Second World War. Some of the key figures determining research agendas in Maltese archaeology, such as Wheeler and Ward-Perkins, had served as soldiers, and their views continued to be coloured by this experience after the war (Vella and Gilkes 2001, 372-4). A sense of rivalry and mistrust between British and Italian archaeology continued to haunt Maltese prehistory till independence in 1964 (e.g. Evans 1959, 27). Even today, the level of collaboration and exchange between researchers working on the prehistory of Malta and that of nearby Sicily is still lower than one might expect, and there is still a vague sense of belonging to different traditions of research.

This divergence of research traditions left its mark on the prehistoric narratives that were constructed during this period. In particular, it may have contributed to the persistent isolationist tradition in the interpretation of Late Neolithic megalithism.

A fundamental characteristic of the Maltese landscape is its insularity. Approaches to the Maltese Neolithic have recognized this fact in different ways, and to varying degrees.

During recent decades, the idea of the island as a cultural laboratory (Evans 1977) has been deeply influential. With the development of radiocarbon dating and recalibration, diffusionist explanations of the emergence of Maltese megalithism as an offshoot from the Aegean Bronze Age were no longer tenable (Renfrew 1973). Since then, interpretations of cultural processes in Late Neolithic Malta have tended to be markedly isolationist.

The idiosyncrasy of the monumental megalithic architecture that characterized Late Neolithic Malta has often been explained in terms of geographical and cultural isolation. The Maltese archipelago has been identified as one of the most remote island groups of the Mediterranean (Patton 1996, 104), though this assertion has been qualified (Held 1989, 79). The comparison of Neolithic Malta to Easter Island (Renfrew 1973) reinforced the idea that Malta was culturally isolated during this period, even though the Maltese islands are incomparably less remote (Broodbank 2000, 19). As a result of this isolationist tendency, the communities responsible for the megalithic monuments that were built between the late fourth and early third millennium BC are generally considered to have had limited or sporadic contact with the outside world (debate reviewed in Robb 2001). In an interesting variation of this theme, it has been proposed that competition in the construction of Maltese megalithic monuments replaced competition in the pursuit of exchange with the outside world, once again linking ritual elaboration to economic, political and ideological isolation (Stoddart et al. 1993, 17).

More recent contributions have put this issue in a different perspective. In a study of prestige and ritual behaviour in Malta, Sicily and Sardinia, it has been persuasively argued that the inhabitants of the archipelago maintained strong links with the outside world throughout the period when megalithic complexes were being built (Hayden 1998). Another recent re-interpretation of the evidence has furthermore proposed that the idiosyncrasy of the megalithic complexes was a deliberate construction of difference, through which the islanders sought to identify and distinguish themselves from outsiders (Robb 2001). This interpretation follows other recent contributions on island contexts elsewhere, exploring the idea of insularity as a cultural construct (Gosden & Pavlides 1994; Broodbank 2000). As Broodbank has argued, insularity may be '…a domain of active social contention and manipulation…', while the significance of the sea as obstacle or medium may also be culturally constructed (Broodbank 2000, 17). In the interpretation proposed by Robb, the megalithic architecture that characterized Late Neolithic Malta was deeply engaged in the construction of insularity as identity and difference, inseparable from geographical knowledge and cosmological values (Robb

2001, 195-196). The latest contribution on this theme has once again underlined the fundamental importance of the physical reality of the island context in order to understand Maltese prehistory (Malone & Stoddart 2004).

Discussion

The above review has traced some of the encounters with Maltese prehistory over the past four centuries. It did not set out to give an exhaustive account, but selected some key contributions that are representative of the history of ideas about the Maltese prehistoric evidence. Present-day attitudes to Maltese prehistory are the result of this stratification of ideas. In this sense, this genesis of Maltese archaeology is an archaeology of our ideas of prehistory today. One of the reasons that this is useful is that an understanding of how this knowledge has been built allows us to spot the joints and cracks more readily. The discussion below identifies some of the outstanding concerns that emerge from the above review. These concerns form the basis for the present research agenda.

Disjuncture between popular and scientific knowledge

During the 18th century, a disjuncture occurred between popular and scientific knowledge. This ended the continuum between popular readings of megalithic monuments and scientific interpretations that had been present in the works of Abela and Ciantar. This disjuncture was completed in the 19th century. Popular interpretations were to make a comeback towards the end of the 19th century, but only in the domain of the folklorist eager to capture these accounts before their disappearance (Stumme 1904; Magri 1925; Magri 1994). The study of popular knowledge as a matter of curiosity in itself only confirmed its new status of irrelevance. In the new order of things, popular readings no longer had any contribution to make to scientific accounts of the past. There was little or no exchange of ideas across these two types of knowledge, which now existed in parallel but separate worlds. In Chapter 1, we noted how the moment Karmenu cracked that boulder at Xagħra was a brief encounter between these two worlds. The nature of that encounter was to a large extent prescribed by two centuries of archaeological practice. As a result, it was more difficult for his range of insight to enter the archaeological narrative, and more difficult for him to understand those narratives.

The problem of the divide between scientific knowledge and indigenous knowledge is being addressed by a relatively young discipline, the Sociology of Scientific Knowledge (SSK). Turnbull among others has highlighted the costs of the segregation between these two systems of knowledge that too often prevails, and has made the case for more open, organic approaches that permit a more creative interaction between these different ranges of understanding (Turnbull 2000).

Dislocation from the regional context

In the 19th century, the disjuncture between popular and scientific knowledge became closely tied to another process. This was the dislocation of the Maltese islands from their regional frames of reference. It has been noted how the imperial network created a new frame of reference, which also shaped approaches to Maltese prehistory. A new type of visitor assembled a new type of knowledge, in a new language. The understanding of the past through the reading of prehistoric monuments became an activity for outsiders, from which the communities living closest to these remains were often excluded.

In a subtler way, archaeological research was also influenced by these disjunctures. It has been noted how the new, anglocentric frames of reference of the 19th century shaped the geographical scope of many researchers. In the 20th century, the political divide between Britain and Italy may have contributed to the downplaying of Late Neolithic interaction between Malta and Sicily. The tendency to seek Aegean rather than Sicilian parallels, which persisted until radiocarbon dating, may be better understood against this background.

Dislocation from landscape context

Another dislocation that has been noted is the decontextualisation of Maltese megalithic sites from the surrounding landscape. The 19th century paradigm for the protection of a site was based on the excision of its ownership from the surrounding landscape. This arbitrary definition of an area as an archaeological monument was an unintended de facto declaration that the remaining landscape had no archaeological value. This form of management has been deeply adversarial (cf. Strang 1999) in its approach to the traditional users of the landscape.

This model for the management of archaeological monuments has persisted to the present. Following independence, mass tourism became a pillar of the Maltese economy, and the archaeological site as visitor attraction became an urgent necessity. As late as the 1970s, a massive rectangular enclosure was being built around Ħaġar Qim, following the time-honoured formula that had been invented in the 19th century. Inscription of Maltese megalithic sites in the UNESCO World Heritage List has encouraged a tendency to embed the value of these sites in superlative descriptions, similar to 'the oldest/the biggest' storylines discussed by Mizoguchi (Mizoguchi 1997, 158; Mizoguchi 2000, 328). Such narratives are frequently associated with commoditisation for tourist consumption. Ironically, in the Maltese context these paradigms of global value and significance have often been set up or perceived to be in opposition to local interests, reinforcing the tendency towards adversarial management.

Such management practices further cemented the disjuncture from indigenous communities and local systems of knowledge. The physical dislocation of sites from their landscape, usually through enforced expropriation, created the perception that they were outposts of government interference. The transition from a colonial government to an independent Maltese government did not alter this perception. As noted by Anderson (1991, 183), the governments of freshly-emancipated colonies often adopted and perpetuated the models left behind by their former rulers. The management of Maltese archaeological sites bears out this assertion. The perceived consecration of these sites to tourism, meanwhile, consolidated their perception as places that were primarily of interest to foreigners.

Decontextualisation of archaeological narratives

The research agendas that have dominated Maltese prehistory are also marked by a dislocation between sites and their landscape context. The tendency to treat monuments in isolation from their landscape is not, of course, a trait that is particular to Maltese archaeology. It has been noted that this tendency has characterized the archaeology of European prehistoric monuments until fairly recently (Watson 2001a, 296).

Research on Maltese Late Neolithic monumental sites has largely focussed on the buildings themselves, paying little attention to their surroundings. The main exceptions that have been noted were Renfrew's early efforts to model the organisation of the landscape on the basis of monument distribution (Renfrew 1973; Renfrew & Level 1979). The fact that these models have remained so influential for three decades is in itself a tribute to their originality and usefulness. In the light of subsequent research elsewhere, it is now possible to revisit these models and to identify some limitations.

When the XTENT model was proposed, it was claimed that this new method

> … owes little to classical central place theory of the geographers (Lösch 1954; Christaller 1933 [Christaller 1966]). It is an alternative approach to the question of human spatial organisation, making none of the assumptions about 'economic man' and his behaviour (many of them no doubt entirely valid) underlying central place theory (Renfrew and Level 1979, 146).

In hindsight, however, it has become very clear that the XTENT model shares some of the most serious blind spots of central place theory. The most fundamental of these is the assumption that sites such as megalithic monuments are 'central places' that should be located at the centre of their hypothetical 'territory'. Another important assumption is that these sites are located in an ideal isomorphic and infinite plain, or in geometric terms, a Euclidean plane. In other words, this model took no account of the influence of landscape characteristics on site distribution. Paradoxically, Christaller was taking care to avoid precisely this problem when he presented the relatively uniform landscape of southern Germany as his case study (Christaller 1966). The 'distorting' effect of landscape variation on territorial definition was also taken into account by geographers early on in the development of Site Catchment Analysis (Chisholm 1962). In the following chapters, it will be argued that in the Maltese islands, such considerations are fundamental, because of the variability of the landscape as well as the basic fact of insularity. In hindsight, it may be said that the Maltese islands were a singularly unsuitable place to use in order to develop and illustrate the XTENT method. What the Maltese case illustrates very well is how the universal generalizing models that were sought in the 1970s often have difficulty in coping with local variability, and how their explanatory power is seriously diminished as a result.

The dislocation of 'art objects'

One final example of some of the disjunctures in the study of Maltese prehistory is the treatment of 'art', which shall be examined more closely in Chapter 7. The high levels of craftsmanship that are evident in the ceramics and sculpture of the Maltese Late Neolithic have attracted considerable attention. Much of this attention has been phrased in art-historical terms. Objects have often been considered as individual 'works of art' in their own right, and have been treated in isolation as a result. The low-relief sculpture that is found in some of the megalithic complexes is the most drastic example. Low-relief panels have largely been exhibited, described and discussed in isolation from their spatial setting. Their merit as artistic masterpieces has dominated the debate, leaving little room for the way they were spatially ordered and experienced.

Conclusions

The series of disjunctures and dislocations outlined above are all inter-related. The creation of archaeological understanding is inseparable from the social context in which it occurs. The practices of archaeological investigation and site management that have been outlined were recognisably modelled on the mainstream paradigms of their period. They often became inseparable from the values that were driving research in the Maltese colonial context. This array of global and local processes went far to create a sound foundation for the understanding of Maltese prehistory. Inevitably, it also had its limitations, some of which have been the focus of the present chapter. Such limitations are of course easier to recognize from the vantage point of the present. Standing as we do on the shoulders of the many giants who have made sterling contributions to Maltese prehistory, we are now better placed than ever to begin to address some of these lacunae.

The research questions pursued in the following chapters will be driven by the concerns that have been outlined above. What role did the landscape play in Late Neolithic Malta? What was the relationship between monumental architecture and the surrounding landscape? How was the landscape organized, and how did different communities interact across that landscape? And what more may we learn about the use of Late Neolithic images and representations by considering them in their spatial context? To address these questions, it is useful to begin with a consideration of the physical environment of the Maltese archipelago.

3 Dynamics of the physical environment

Introduction

The Maltese environment has been shaped by a complex interplay of natural processes and human activities. The issues and questions raised in the previous chapter are, to a large extent, tied to the relationship between the Late Neolithic inhabitants and this environment. A useful point to begin addressing these questions is to consider the key characteristics of the physical environment, and the processes that have changed it over time. A sound grasp of these processes is useful for a number of reasons. Two of the more fundamental reasons may be noted here. First, the physical environment defined the constraints and opportunities facing the prehistoric inhabitants. An understanding of the processes that altered this environment over time, and the time-scales over which they took place, will make it more clear which elements of the environment may have been different from the conditions that may be observed today, and which elements have remained largely unchanged. A second reason is that the dynamics of the physical environment, through human as well as natural agencies, may also determine which parts of the prehistoric material record are destroyed or preserved, as well as the circumstances in which they are discovered. This may in turn determine when patterns in the known evidence may be representative of the original patterns, and when they may be misleading artifacts of selective preservation or discovery.

The dynamics of the physical environment

Location

The Maltese archipelago lies in the central Mediterranean, about 90 kilometres from the south-eastern tip of Sicily (Figure 6). The small islands of Lampedusa and Linosa lie some 120 km to the west. The nearest point of the African coast is over 300 km away. In an easterly direction, the open sea stretches away for over 600 km. The nearest landmass is Sicily, the largest island in the Mediterranean, a micro-continent in its own right.

Figure 6. Location of the Maltese archipelago.

Configuration

The present day surface area of the archipelago totals 316 km^2. The archipelago is made up of two principal islands, namely Malta (246 km^2) and Gozo (67 km^2), and a number of minor ones. The archipelago is aligned on a NW-SE axis. The south-western coast of both the principal islands is generally linear and dominated by cliffs, while the northern coast of Gozo and the north-eastern coast of Malta are more indented.

Geology

The geological stratigraphy of the archipelago has received considerable attention since the 19th century (Earlier work reviewed in Pedley et al. 1976). The archipelago is composed of a sedimentary sequence of limestones and marls, which formed on the seabed during the Tertiary. The varying depth and conditions under which the different formations in the sequence took shape resulted in a considerable variety in their properties. In turn, these properties have had a decisive influence on the topography of the archipelago. In simple terms, the geological sequence is made of three less durable formations, sandwiched between more durable formations at the top and at the bottom of the sequence. The lowermost formation that is visible is Lower Coralline

Limestone, which is characterized by its durability. The next formation is the much softer Globigerina Limestone, widely exploited in building and sculpture because of its workability. Above this lies the Blue Clay formation, which is of critical importance for the hydrology of the archipelago, because it is the only impermeable layer in the sequence. The Blue Clay is followed by the Greensands formation. The entire sequence is capped by the harder Upper Coralline Limestone formation.

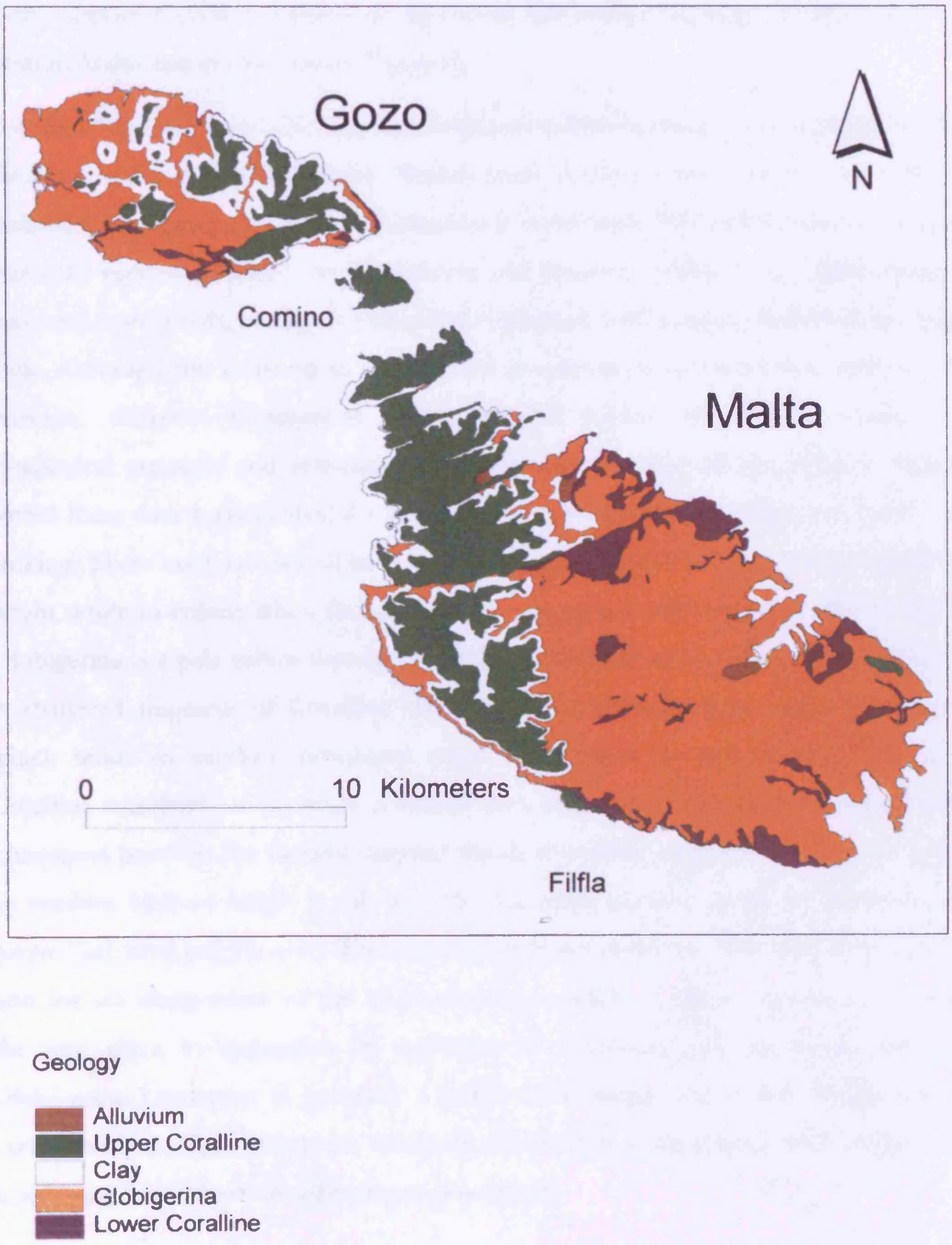


Figure 7. Schematic map showing surface geology (Based on Pedley 1993).

The thicknesses of the sedimentary deposits vary considerably across the archipelago (Pedley et al. 1976). As a result of this factor together with widespread faulting and erosion, different formations in the geological sequence are exposed on the surface in different parts of the islands. Lower Coralline Limestone outcrops over relatively small areas, particularly near the coastline in southern and eastern Malta, and in southern Gozo. Globigerina Limestone forms the greater part of the surface geology of the islands. It outcrops over most of south-eastern Malta, and predominates in western Gozo. Upper Coralline Limestone makes up the surface geology of most of north-western Malta and eastern Gozo (Figure 7).

Coralline Limestone and Globigerina Limestone present a sharp contrast in appearance, hardness, texture, and workability. Within each of these classes, there is considerable variability of characteristics. Each formation is composed of different strata or members that may vary considerably in appearance and strength. Different Coralline members may vary from a soft, chalky consistency to extremely hard semi-crystalline or crystalline rock. Although the variation in the physical properties of Globigerina is generally less extreme, different Globigerina members still display considerable variation in mechanical strength and resistance to weathering. In spite of the internal variation within these two main classes, the fundamental contrasts between them are rather more striking. These contrasts would have been readily apprehended in prehistory. Coralline is bright white in colour when freshly broken, turning grey with exposure to weathering. Globigerina is a pale yellow that deepens with weathering into a variety of honey shades. A shattered fragment of Coralline could easily cut through flesh, unlike Globigerina, which tends to produce powdered edges when impacted and broken. The harder Coralline members are far more common than the more friable ones. Lower Coralline Limestone presents the hardest material that is abundantly available on the archipelago. In modern Maltese usage, it still provides the most popular simile for hardness, *iebes żonqor* ([as] hard [as] żonqor). The Lower Coralline Limestone cliffs that drop vertically into the sea along much of the south-western coastline of the archipelago are perhaps the best place to appreciate its resistance to weathering (House et al. 1961, 26). Globigerina Limestone is generally a much softer stone, and it may be ground and carved with far less effort. Its tendency to develop a hard crust with exposure to weathering is another very advantageous property.

Topography

The topography of the archipelago is closely controlled by geological structure, faulting and erosion (Dewdney 1961). The combination of these factors has created a highly fragmented landscape (Bowen-Jones & Dewdney 1961a). Different geological formations outcrop in different parts of the archipelago, giving them their distinctive topography. The variable resistance to erosion of the different geological formations has resulted in highly selective erosion patterns. Where Globigerina Limestone outcrops, it forms the gently rolling plains that characterise south-eastern Malta and part of southern Gozo. Upper Coralline Limestone outcrops form the perched plateaux that dominate western and northern Malta, and most of Gozo. The edges of the Upper Coralline outcrops are characterized by steep slopes that form with the slumping of the underlying clay. Erosion and faulting act on this essentially horizontal stratigraphy to create a more rugged relief. Pleistocene valley systems have furthermore incised deep wadis through the limestone formations. In Gozo, erosion of the Upper Coralline Limestone has created a number of hills capped with islands of Upper Coralline, surrounded by steep clay slopes that descend to the Globigerina formation that often forms the valley beds. Another important factor that has shaped the islands' topography is faulting.

Faulting

The archipelago is located in a tectonically active region, which has resulted in a series of dramatic fault systems (Illies 1981; Alexander 1988; Dart et al. 1993). One of the systems has broken up north-western Malta into a series of horsts and grabens, which form a succession of parallel and sharply defined ridges and valleys. The two channels that separate Malta from Comino and Comino from Gozo are two further grabens created by the same system, which were submerged by rising sea levels. Another faulting system has created the vertical cliffs that today characterize the south coast of Gozo and the south-western coast of Malta. This is also the reason why Malta is basically wedge-shaped, descending from the high ground along the precipitous cliffs along the south-western coast, to the gently-sloping north-western coastline.

This faulting is believed to have largely taken place in deep geological time, when the sedimentary sequence that forms the geology of the archipelago was still being deposited during the Tertiary (Dart et al. 1993). There is however some limited evidence suggesting minor tectonic movement as recently as the Holocene (Illies 1981, 155-158, Hunt 1996, 102).

Tectonic processes may also affect the relative sea level through the raising or subsidence of landmasses. These processes have taken place over hundreds of thousands or even millions of years, and it is often difficult to measure their effect during the last few thousand years. A number of different indicators are being used in different parts of the Mediterranean to overcome this difficulty, and to give more precise indices of the resulting regional variations in relative sea level during the Holocene. Biological indicators are proving very helpful. Fossils of lithophagous (literally 'stone-eating') mussels that bore into the rock have been used to date the submergence of the coast at Capo Palinuro, on the Tyrrhenian coast of Italy (Antonioli & Oliverio 1996). In the ancient harbour of Marseilles, barnacles attached to the Greek and Roman harbour works have been used to reconstruct the ancient waterline. Together with other evidence, this indicator suggested a local rise in relative sea level of about 1.5 m during the past 5,000 years (Morhange et al. 2001). Another important indicator that is partly the result of biological activity is the formation of notches along the waterline of carbonate coastlines. The notches are formed primarily by boring organisms that live along the waterline (Focke 1978; Rust & Kershaw 2000). Along the coastline of Northwest Sicily, such notches are clustered between the modern sea level and 5 m above it. It has been suggested that these notches formed when the rise in sea level decelerated around 6,000 years ago and came into equilibrium with the rate of tectonic uplift in this area, resulting in a stable relative sea level. Subsequently uplift overtook sea-level rise, and perched these notches above the waterline (Rust & Kershaw 2000; Antonioli et al. 2003).

In the Maltese context, changes in relative sea level during the last few thousand years are still poorly understood, and the lines of investigation that have just been noted remain to be explored. The apparent submergence of the man-made, possibly prehistoric, 'cart tracks' at Birżebbuġa is often cited as evidence of a change in relative sea level. It remains unclear whether this is the result of tectonic movement or a rise in sea level. In any case, the net change in relative sea level suggested by this submergence is in the order of less than 5 metres.

Isostatic changes in sea-level and eustatic rebound

Recent work has refined the current understanding of the changes in sea level caused by the melting of the polar ice-caps. Melting is believed to have been rapid from around 20,000 BP to around 6,000 BP, when it slowed down drastically. A closely related factor is the rebound of continental plates as the weight of the melting ice-sheets diminished. Naturally, this also became less significant after 6,000 BP. In the Mediterranean, the rise in relative sea level caused by the two factors during the last 6,000 years is believed to have been in the order of about three metres (Lambeck 1996; Fleming et al. 1998; Lambeck & Bard 2000). Consideration of the bathymetry of the seabed around the Maltese archipelago suggests that changes in relative sea level of this order of magnitude could not have caused notable alterations to the coastline (Figure 8). Over half the coast of the archipelago consists of cliffs that drop vertically into the sea, often descending vertically to depths of over 20 metres below the present day sea level. These parts of the coast are not altered significantly by a change in sea level of a few metres. Even along the less precipitous parts of the coastline, such as the north-east coast of Malta, the waterline is often determined by dramatic geological features such as fault-lines, drowned valleys, or collapsed karst caves (Paskoff & Sanlaville 1978).

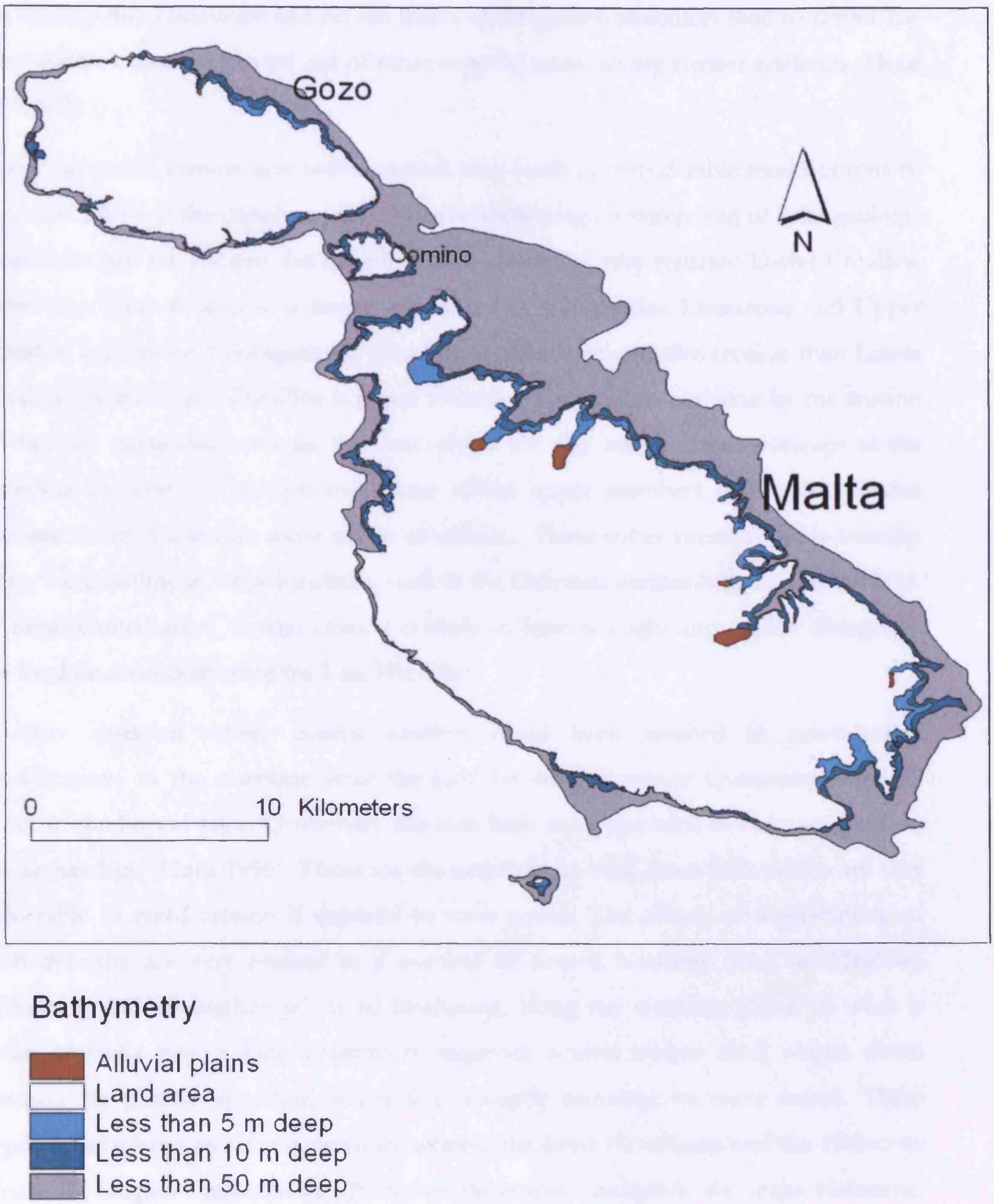


Figure 8. Bathymetry.

Erosion & sedimentation

Processes of erosion and sedimentation are closely controlled by geology and topography. Erosion is most evident in the more perched, karst environments that form on the Upper Coralline Limestone plateaux, the exposed outcrops of the plastic clay deposits, and the deeply-incised storm-water courses. The low-lying plains that form on the Globigerina Limestone and on the floors of the graben structures tend to favour the deposition of material eroded out of more exposed areas having steeper gradients (Hunt 1996,108).

In coastal zones, erosion and sedimentation may result in considerable modifications to the coast. Most of the coastline of the Maltese archipelago is composed of solid geology. More than half the present-day waterline is composed of very resistant Lower Coralline Limestone. The remainder is largely composed of Globigerina Limestone and Upper Coralline Limestone. Globigerina is more vulnerable to progressive erosion than Lower Coralline, while Upper Coralline is prone to mass wastage when undercut by the erosion of the soft strata that underlie it. Areas where the clay marl stratum outcrops at the waterline are few and exceptional. Some of the upper members of the Globigerina formations are somewhat more prone to erosion. These softer members only outcrop along the coastline in a few locations, such as the Delimara peninsula in southeast Malta. In these limited areas, coastal erosion is likely to have wrought appreciable changes in the local environment since the Late Neolithic.

Another situation where coastal erosion could have resulted in considerable modifications to the coastline since the Late Neolithic is where Quaternary deposits occur in the littoral zone. Quaternary deposits have been recorded at various points on the archipelago (Hunt 1996). These are characterized by terra-rossa beds which are very vulnerable to rapid erosion if exposed to wave action. The effects of wave-cutting of such deposits are very evident in a number of coastal locations, such as Magħlaq, Ċirkewwa, and tal-Imgħarrqa. At tal-Imgħarrqa, along the northern shore of what is today Mellieħa Bay, a Late Quaternary sequence several metres thick slopes down towards the present shoreline, where it is abruptly truncated by wave action. These deposits have been tentatively dated to between the latest Pleistocene and the Holocene (Pedley & Hughes Clarke 2002, 52). Before the marine transgressions of the Holocene, these deposits evidently extended much further across the graben that today forms Mellieħa Bay. The evidence that is presently available suggests that within this graben, marine erosion and transgression during and since the Neolithic may have been significant. However, such locally dynamic situations are the exception. Erosion of the more resistant geological formations that form most of the Maltese coastline is much slower, and may only account for minor changes since the Late Neolithic.

Sedimentation has altered some parts of the coastline considerably. Parts of the coast, particularly the north-eastern coast of Malta, are characterized by deep inlets and natural harbours. These were formed by the submergence of graben formations and valley systems that took place when sea levels rose between the late Pleistocene and early Holocene. The inner ends of several of these formations provided favourable conditions for the deposition of water-borne sediments. As a result, the landward end of several drowned valleys was transformed into an alluvial plain during the Holocene. Examples of such plains include Marsa, Burmarrad, and Pwales on Malta, and on a much smaller scale, the Mġarr ix-Xini valley in Gozo. In the largest two examples, at Marsa and Burmarrad, coastal advance in the order of two or three kilometres since the beginning of the Holocene is plausible. The boundaries of these dynamic zones are usually sharply defined by the steep flanks of the valley system within which they form. These are the areas of most rapid coastal change since the Late Neolithic. The large watersheds that drain into the Marsa and Burmarrad basins may be contrasted to the small watershed that drains into Mellieħa Bay. This difference had a direct impact on the sedimentary budgets of the different locations, and may have contributed to a prograding (i.e. advancing) coastline in the case of Burmarrad and Marsa, and marine transgression in the case of Mellieħa Bay.

Soil and vegetation

There is a considerable literature on the soil and vegetation of the archipelago, summarised in a recent synthesis of earlier work (Schembri 1996). Only some of the most salient points are mentioned here. The properties of soils that form in the Maltese landscape are closely related to the properties of their parent rocks. Soil types have been classified by Lang (1961), using the Kubiena system. Three of the most wide-spread soil-types that were identified develop on different geological outcrops.

The soils on the karst landscapes on the Upper Coralline Limestone plateaux are dominated by terra soils. These relic soils that are believed to have formed during the Pleistocene, when the plateaux may have had some woodland or scrubland cover (Schembri 1996). Molluscan evidence from the Xagħra plateau suggests that by the Żebbuġ phase, the plateaux presented a sparsely-vegetated, open landscape not very different from the conditions that may be observed today (Schembri 1995, 342).

The slopes that descend from the Upper Coralline plateaux to the Globigerina plains are dominated by carbonate raw soils (Lang 1961). These often lie on steep slopes that require terracing in order to permit cultivation (Lang 1961, 94).

The plains on the Globigerina outcrops and in the graben basins in northern Malta are characterized by xerorendzinas. The properties of these soils, together with the low gradients where they usually occur, provide favourable conditions for agriculture without requiring the extremely labour-intensive building and maintaining of terraced fields.

Hydrology

The hydrology of the archipelago may have changed somewhat during the last 6,000 years. Conditions in the Mediterranean are believed to have undergone a gradual process of aridization during the Neolithic (Grove & Rackham 2001), although this may have been less critical in the central Mediterranean than in the eastern and western basins (Grove and Rackham 2001, 145). The availability of fresh water may also have been affected by human agency. The intensive extraction of water from the perched water tables in recent times may have reduced the volume of water held and released by the aquifers. However, some general observations that may be made about the hydrology of the archipelago today also held true during the Late Neolithic. Partly as a consequence of the small size of the archipelago, the annual rainfall varies widely from one year to the next (Mayes 2001). Dependence on precipitation suggests that during the Late Neolithic, the archipelago was no less vulnerable to periodic drought than in more recent periods (Trump 1976). The archipelago has no rivers or reserves of surface water, and the valley system that drains the islands of rainwater runoff runs dry during the summer. Groundwater reserves were therefore vital to make the islands habitable. The geological structure of the islands consists mostly of a succession of porous limestones that retain a body of fresh water at sea level, which across most of the archipelago lies deep beneath the ground. There is however one layer of impervious clay in the sedimentary sequence, as noted earlier in this chapter. Where the clay layer is present, it creates another, perched aquifer (Newbery 1968). Water escaping from the edges of this aquifer forms the major springline, supplying a large number of perennial springs. In areas where the clay formation is absent, such as south-eastern Malta, springs are dependent on minor springlines in the Globigerina Limestone (Pedley et al. 2002, 72), and are relatively rare. In such areas, there is a much heavier dependence on the curation of seasonal surface run-off water and on its storage for the drier summer season.

Although the geological structure of the island had such an important bearing on the storage of freshwater and the formation of springs, until quite recently these processes were poorly understood. Early modern descriptions of the archipelago pay considerable attention to its hydrology, allowing us a glimpse of how this was understood (Abela 1647; Houel 1787). In the mid-17th century, the extraction of water from the sea-level aquifer was described as a recent innovation, suggesting that it had remained largely untapped until then (Abela 1647, 128). In the same account, the existence of the sea-level aquifer was (erroneously) explained as the result of water being driven up through the rock by winds blowing over the sea (Abela 1647, 129). As late as the last quarter of the 18th century, well-educated men still believed that spring water was formed by condensation in the rock (Houel 1787, 75). The role of the clay formation in the creation of a perched water table was only understood and explained correctly in the mid-19th century (Spratt 1852).

The presence of springs loomed large in the inhabitants' mental topography. The naming of places after springs is another indication of the importance they held for the islanders across different periods. A large number of Maltese place-names still in use today are medieval in origin. Many other extinct medieval place-names have been preserved in late medieval and early modern written documents (Wettinger 2000). Several hundred of these place-names make references to hydrology. The distribution of the toponyms allows a valuable glimpse of how the hydrological landscape was perceived and organized during the medieval period (Figure 9). In those parts of the islands where the clay formation is present, toponyms that refer to an *għajn* (spring), are common (Appendix 3). Where the clay formation is absent, *għajn* toponyms are exceptional, while *bir* (cistern) toponyms are widespread (Appendix 4). In the absence of springs, the alternative strategy to ensure a supply of fresh water throughout the year was to collect rainwater in rock-cut cisterns, for use during the dry summer months. The place-name evidence shows how closely the choice between these two strategies was dictated by the geological structure of the archipelago. The same relationship is also borne out by archaeological evidence of these strategies from different historic periods.

The known medieval hydrological toponyms are a very useful index of the pre-modern hydrology of the island. They predate the drastic modifications that have taken place in the modern period. Furthermore, a toponym that refers to a spring is likely to indicate a source of water that was significant, accessible, and in use for a considerable length of time. Many springs are known to have run dry, even within living memory (Mario Vassallo, personal communication). As many springs are barely documented, medieval hydrological toponyms are becoming one of the best available indices of the hydrology of the archipelago during earlier periods.

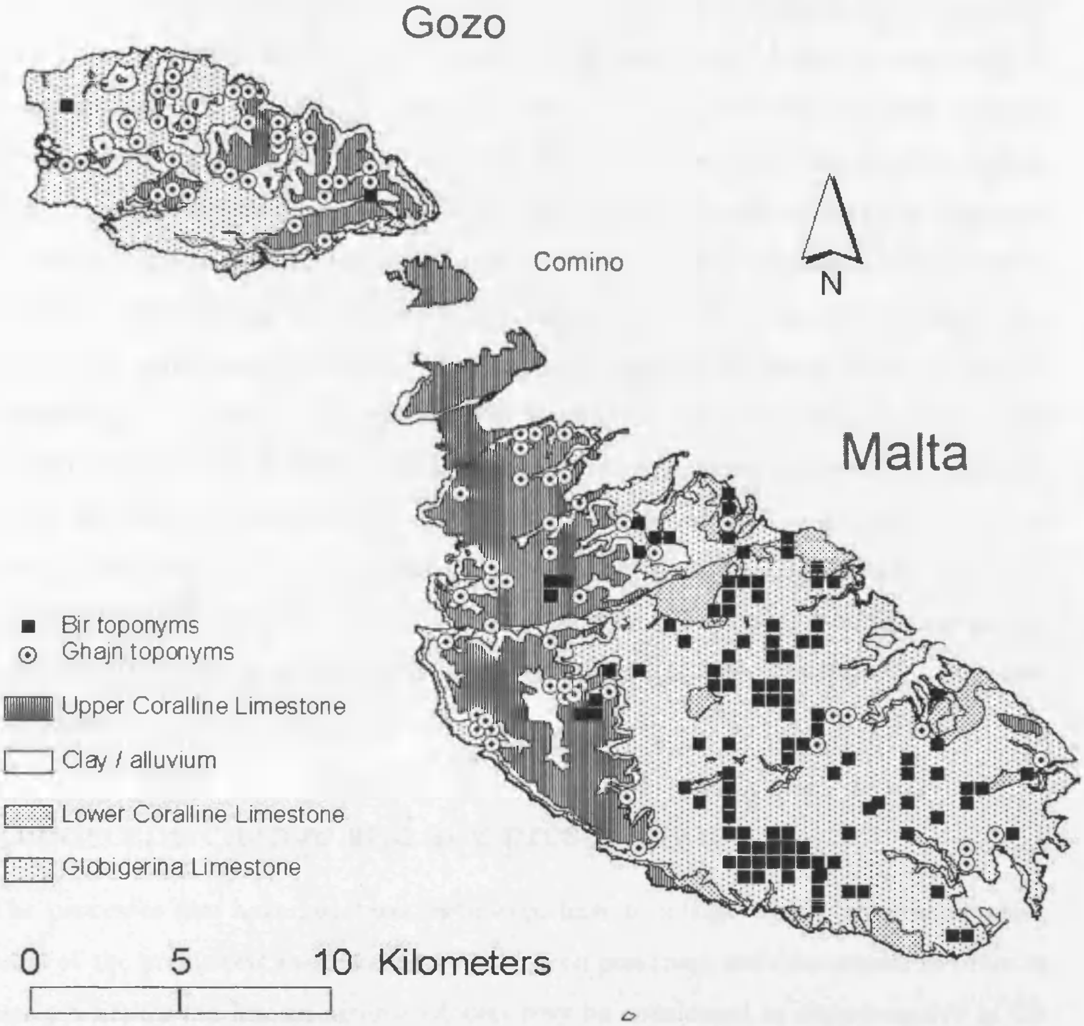


Figure 9. Approximate location of hydrological toponyms (Based on Wettinger 2000).

Human activity

Human activities have played an important role in modifying the Maltese landscape. Agricultural exploitation, building and quarrying, dredging and land reclamation have all contributed to the reshaping of the environment. The impact of these activities on prehistoric site preservation is considered in the next section. Of these activities, the one that has had the most extensive effect on the landscape is agriculture. The small extent of the archipelago and the often high population density has resulted in an intensive exploitation of the landscape. Since the early modern period, the population of the archipelago has registered rapid growth (Blouet 1967), increasing the pressure on land. In the late 16th century, regulations were laid down stipulating how soil should be created by mixing stone and refuse, and how to construct new fields by building terrace walls (Blouet 1967). In the mid-17th century, it was estimated that enough land to produce some 16,000 *salme* (5 *salme* = circa 1 ton) of grain was devoted to grain cultivation on the island of Malta, of which only a half was sown each year. A third as much was cultivated in Gozo. (Abela 1647, 138). Abela's account of the archipelago was revised by Ciantar a little more than a century later. Ciantar preserved much of Abela's text intact, only making alterations and new insertions where it appeared necessary. The account of agricultural production is one of the tracts that Ciantar chose to rewrite extensively. He records how agricultural productivity had increased because of the growth in population. Public spaces and previously uncultivated land were now brought under the plough (Ciantar 1772, 406). The cultivation of cash crops such as cotton during this period also helped to make the costs of improving marginal land less prohibitive. An eye-witness account of the laborious process of converting barren and rocky land to make it suitable for cotton production has been recorded by a late 18th-century visitor (Houel 1787, 93).

Landscape change and site preservation

The processes that have just been considered have to a large extent determined which parts of the prehistoric material record have been preserved and discovered. In order to assess whether the known sample of sites may be considered as representative of the original population, it is useful to consider it against the background of the dynamics of the landscape.

Our present knowledge of the material record of Late Neolithic Malta is rather uneven. Many monumental sites have survived in an extraordinary state of preservation, only compromised in part by the efforts of early antiquarians. Funerary sites are also well represented in the material that is known at present. Domestic contexts, on the other hand, have proved extremely elusive, primarily because domestic huts were built using much lighter methods of construction than those employed in monumental architecture (Trump 1966; Malone et al. 1988)

The enduring and conspicuous nature of monumental sites when compared to domestic buildings has resulted in a heavily biased repertoire of evidence. This problem should not, however, be allowed to obscure the fact that the remarkable survival of a considerable number of monumental buildings is also one of the great strengths of the evidence, which may present valuable opportunities for the researcher. Monumental sites and the relationships between them remain our best evidence for gaining insights into the socio-spatial organization of this period. This potential was fully recognized by Renfrew (Renfrew 1973; Renfrew & Level 1979), and has received further attention more recently (Hayden 1998). Before revisiting this line of investigation, it should be useful to try to establish whether the known sample of monumental sites is representative of the overall picture, and to what extent it may have been distorted by selective destruction and discovery of sites. Clarke's fundamental categories of pre-depositional, depositional, post-depositional, and retrieval processes (Clarke 1973) provide useful pegs for a discussion of the known sample. Some of the characteristics and processes that may have influenced the deposition, preservation, and retrieval of the sites will be considered in turn.

Deposition

Monumental buildings were by definition created as durable and conspicuous structures. The choice of materials, the size of the architectural components, and the sheer scale of these buildings have ensured that they became enduring features of the landscape, not easily obliterated. The life histories of these buildings while still in use also have implications for what entered the archaeological record. A high proportion of the known sites are evidently multi-phased accretions of different building events (Stoddart et al. 1993). For about a thousand years, between the mid-4th and the mid-3rd millennium BC, there is evidence of new additions being built in and around existing structures, in projects that became increasingly ambitious. There is some evidence of re-utilisation of the same architectural elements in successive building events. The partial abandonment or dismantling of some of the earlier structures as new ones were raised remains a possibility, however the available evidence is ambiguous on this point. On the other hand, the general preference to preserve and add onto existing structures is well attested on all the larger megalithic complexes, namely Ġgantija, Ħaġar Qim, Mnajdra and Tarxien, and several smaller ones, such as Skorba or ta' Ħaġrat. The accretionary nature of these buildings meant that throughout the period that they were in use, they tended to grow in extent and sheer mass, and consequently to leave an even more conspicuous imprint in the archaeological record.

Funerary sites were also monumental and durable in their conception. The more modest rock-cut chambers of the Żebbuġ phase (Baldacchino & Evans 1954; Malone et al. 1995a) developed into extensive rock-cut complexes during the millennium that followed, such as the ones at Saflieni, Santa Lucija and Xagħra (Zammit 1910; Bradley et al. 1912; Stoddart et al. 1993; Malone et al. 1993).

Domestic sites present a sharp contrast. The limited evidence that is known at present suggests that these used mud-brick walls on a dry-stone footing, possibly roofed in organic materials that may have sometimes been supported by a central pillar (Malone et al. 1988).

Preservation and destruction

In spite of their scale and massive construction, the monumental buildings could be obliterated by a variety of different processes. Natural processes could be responsible for collapse over eroding coastlines, inundation under a rising relative sea level, or burial under deep sedimentation. Anthropogenic processes could erase sites through the reorganisation of landscapes for agricultural purposes, and through urbanisation. Each of these possibilities will be considered in turn.

Coastal erosion and mass wastage

During the 20th century, at least three instances were recorded where coastal processes have wholly or partially erased a Neolithic megalithic building. When the Xrobb l-Għagin Temple was excavated in 1914, part of the structure had already disappeared over the cliff-edge (Evans 1971, 26). The site has since been progressively obliterated, and no definite trace could be located at the time of writing. The Għajn Żejtuna temple along the shoreline of Mellieħa Bay, investigated in 1934, is also believed to have been destroyed by coastal processes (Evans 1971, 29). A less understood site recorded on the cliff-edge at ta' Lippija (Trump 1972) may also have been a temple complex. In the case of Għajn Żejtuna, it is quite possible that a rise in relative sea level may have contributed to the site's destruction.

Sedimentation

Notwithstanding the generally thin soil cover, in some areas burial under deep sedimentation is physically quite possible. The plains of Burmarrad, Marsa and Xemxija as well as several valley-beds all contain deep sedimentary deposits. These areas tend however to be poorly suited for a massive monumental building. All the megalithic complexes from this period that are known in Malta are built on bedrock, which was essential to guarantee the structural stability of their ambitious vaulting. The exposure to the violence of storm-water courses would have further discouraged monumental building in areas that are now deeply buried under sediment.

On the other hand, the existence of domestic contexts within these plains is a distinct possibility. In situations where the Neolithic surface of the plain lies buried underneath subsequent deposition, domestic structures may remain well-preserved, if difficult to detect.

Agriculture

Destruction through human activity has probably been the gravest threat to the survival of prehistoric evidence. Transformation of the landscape for agricultural purposes has been extensive. Hillsides in particular have been re-moulded into level terraces with cuttings and dry-stone retaining walls. This process could obliterate even substantial buildings by quarrying them to provide material for terrace retaining walls.

The impact of this intensification on prehistoric monuments is well illustrated by the Xagħra Circle. This site was documented in the late 18th (Houel 1787) and early 19th century (Smyth 1829), when it was still in an excellent state of preservation. The land where this site is located is exposed and marginal in agricultural terms. One of the Brocktorff watercolours of the site allows us a plausible glimpse of how prehistoric monuments on marginal land survived in the early modern economic landscape. It shows a goatherd with his flock, resting at the foot of the megaliths at the entrance to the Circle. The use of such land for grazing did not require an investment in its transformation, and does not appear to have posed a threat to megalithic remains. In periods of increased pressure on land, however, even more marginal environments were pressed into service for agricultural production. This intensification continued into the 19th century, in spite of the decline in cotton production. As noted in Chapter 2, the Xagħra Circle was destroyed shortly after its excavation in the early 19th century (Bonello 1996), and subsequently transformed into a vineyard by cutting a series of trenches into the bedrock, to allow the vines to take root (Malone et al. 1995a).

Several other instances of extensive damage to megalithic buildings to improve the suitability of land for agriculture have been recorded. At Tarxien, the systematic destruction of the higher parts of the complex to create a level field is very evident (Zammit 1916, 128-129). During his investigations of ta' Ħaġrat, tal-Qadi and Buġibba, Zammit was to record similar accounts of recent damage (Zammit 1929). At Skorba, cultivation of the fields that had been formed over the megalithic remains had completely obliterated parts of the building (Trump 1966, 3).

While the obliteration of megalithic sites by agricultural activity is quite possible, such a possibility should be qualified with three observations. First, in the examples that have just been noted, the sites in question were only partially damaged in spite of being used for agricultural purposes. In all these cases, a substantial part of the structures and deposits were preserved within the agricultural landscape, and remained visible enough to allow their detection. Second, there are several instances of megalithic structures that were left relatively intact even when surrounded by fields. Ħaġar Qim and Ġgantija, which are among the earliest of the Maltese megalithic sites to be recorded (Abela 1647) are two examples (though it should be added that the active protection of the remains at Ġgantija by the landowner as far back as the early 19th century, noted in Chapter 2, is somewhat exceptional). Third, intensification of agricultural activity appears to have reached unprecedented levels in the early modern period, increasing progressively between the 17th and the 20th century. During this period, the improvement of marginal land became an attractive proposition. The impact on archaeological sites must have been considerable. On the other hand, this period also witnessed the emergence of antiquarian interest in megalithic sites, and the steady development of archaeological recording. Even as the sites came under this new threat, they were being recorded, described, and eventually even preserved.

There is less reason to be optimistic about the preservation of domestic contexts on agricultural land. The Għajnsielem huts are instructive in this regard. The section of the huts that survived had been preserved beneath the width of a dry-stone rubble wall. The remainder of the huts had been destroyed by ploughing (Malone et al. 1988). The same is likely to be the case in most areas where shallow soils are still under intensive ploughing, such as the rolling plains on Globigerina outcrops. On the other hand, a fieldwalking survey of an E-W transect 1km wide conducted across northern Gozo as part of the same project detected several scatters of Neolithic ceramics in more marginal environments that have generally been less intensively exploited. The preservation of settlement evidence may therefore vary considerably in different environments, which must of course be taken into account when reading the distribution patterns that emerge.

Urbanisation

Another anthropogenic process which has been responsible for the obliteration of a significant proportion of the surface area of the archipelago is urbanisation. Since the 17th century, a dense conurbation has been radiating out from the harbour area around Valletta, to cover no less than 20% of Malta's surface area by the end of the twentieth century. The intensification of this building activity in the late 19th and throughout the twentieth century coincided with an explosion of interest in Maltese prehistoric sites. As a result, one of the highest concentrations of known Neolithic sites on the island is in the heart of this conurbation. The three megalithic sites at Kordin, the extensive complex at Tarxien and the underground funerary complex at Ħal Saflieni are all located within less than two kilometres of each other. In the case of the Ħal Saflieni hypogeum, four houses were actually built over its upper level, concealing the site completely, before it was brought to attention in 1902 when water cisterns were being dug for the overlying houses. The megalithic structure discovered at tar-Raddiena in 1986 during the construction of a new bypass (M.A.R. 1987) is also located within the same conurbation.

Quarrying

The extent and intensity of quarrying activity in Malta led one 19th century observer to compare the Maltese landscape to a 'stone-cutter's yard' (Faulkner 1820, 4). Quarrying has totally erased any evidence of earlier activity from many parts of the islands. In 1911, a cave which had been used for Neolithic burial was discovered after it was cut through by a Globigerina Limestone quarry (Tagliaferro 1911).

Quarrying for stone materials was by no means restricted to the cutting of bedrock. Monumental buildings which had fallen out of use represented attractive concentrations of conveniently worked masonry, which could be taken for re-use with far less effort than was required to cut stone from the living rock. Such activity is widely documented on Maltese sites, well into the modern period (Zammit 1916, 128-129).

Retrieval

Retrieval is the third important filter between past activity and the known material record (Renfrew 1979: 152; Fraser 1983, 235-261).

The sheer massiveness of some of the Maltese Neolithic monuments ensured that they remained conspicuous features of the landscape throughout the five millennia since their creation. As noted in Chapter 2, several medieval toponyms made references to these landmarks. From the 16th century onwards, these sites even captured the attention of scholars and travellers, and entered the written descriptions of the period.

Some of the anthropogenic causes of destruction noted earlier also played a critical role in the discovery of less conspicuous sites. As already noted, the agricultural intensification and urbanisation that characterised the period from the 17th century to the 20th was contemporary with the emergence of a growing interest in archaeological remains. This early interest often ensured the preservation of these sites even as they came under new threats. As a result, it has made a critical contribution to the formation of our present knowledge of prehistoric monuments.

If the recognition of megalithic buildings over time is plotted as a graph, the importance of this early work will become readily appreciable (Figure 10). The recognition of sites over time has been discussed by Fraser (Fraser 1983, 240-246). Fraser's definition of 'recognition' as the moment when a site first appears in print was followed when drawing up Figure 10 (see Appendix 1). The resulting curve closely followed the three-stage model discussed by Fraser. During the first stage, roughly from the mid-16th century to the mid-19th century, the number of sites recorded in print increases very slowly. Fraser's second stage may be recognized between the mid-19th and the mid-20th century. During this period, there was a fourfold increase in the number of recorded megalithic sites. The leap in recognition was the result of a combination of factors. Firstly, megalithic monuments gained wider recognition as a distinct type. Secondly, the processes of agricultural intensification and urbanisation already noted contributed to the unearthing of sites. Thirdly, during the same period a more effective framework was developed for the legal protection and scientific investigation of archaeological discoveries.

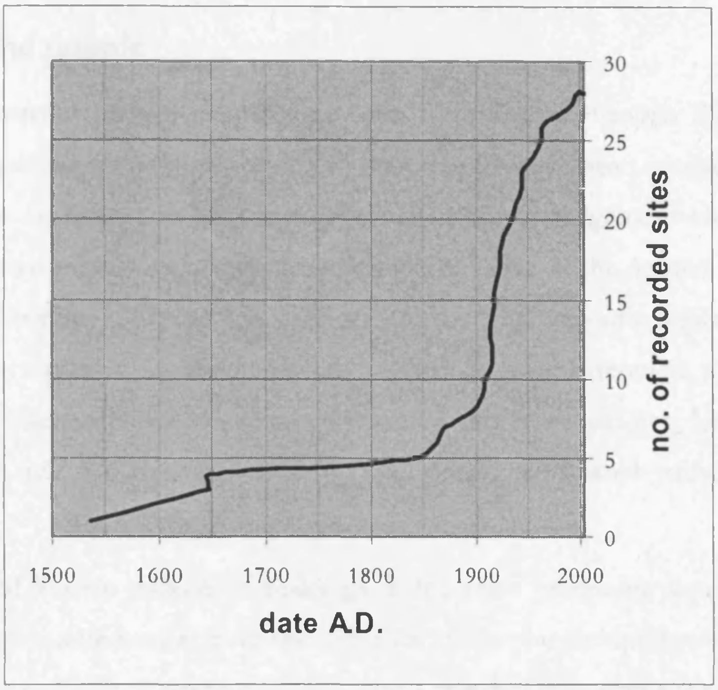


Figure 10. Number of recorded megalithic sites, plotted against date.

The third stage, from the middle of the 20th century to the present, is characterized by a sharp levelling off in the number of newly recognized sites. In Fraser's model, it is suggested this stage is reached when the number of recognized sites is nearing the limit of potentially recognizable sites (Fraser 1983, 243). One of the stated premises of the model is that the fieldwork techniques remain unchanged. The curve of Maltese megalithic site recognition suggests that discoveries of new sites will be few and far between. The situation may change again if suitable new fieldwork techniques are brought to bear on the question. The ever-improving panoply of remote-sensing tools may yet find useful application in this regard, and may set a new threshold for the recognition of less conspicuous, minor or buried sites.

Such a development could also help correct the acute paucity of domestic contexts from this period. It may be argued that the recognition of Maltese Neolithic domestic contexts is still in the first stage of Fraser's model. These contexts were only recognized for the first time during the relatively recent excavation of Skorba (Trump 1966). The design of appropriate strategies for the detection of such contexts will undoubtedly add to the repertoire of known sites.

Assessing the sample

The sites known at present are the ones that have filtered through the processes of deposition, preservation and retrieval that have just been considered. These considerations are useful to help form a better-informed judgement on the extent to which the known sample may be considered representative of the original population. In the case of domestic contexts, it is very evident that the presently published sample is unsuitable for statistical analysis, nor does it allow detailed inferences about Neolithic demography. The sample of secure funerary sites is more encouraging, however it is still on the small side for statistical analysis, and should be treated with prudence (see Appendix 6).

The sample of known megalithic buildings is the most promising as a representative sample of the monumental activity that went on across the archipelago during the Late Neolithic (Appendix 2). A practical way to assess whether the sample is representative is to control for different processes that may have destroyed, concealed, or revealed parts of the original corpus of monumental sites. An examination of the distribution pattern of the known sites may give some useful indications of whether the known distribution has been appreciably biased by these filters.

In spite of the extent and intensity of some of the potentially destructive processes that have been noted, the general distribution of sites does not show any distinct biases that may be related directly to them. Areas where megalithic buildings are most conspicuously absent often consist in extensive stretches of garigue where human disturbance in historic times has been relatively limited, and where any megalithic structure would be quite conspicuous. The Rabat-Dingli uplands are the clearest example. In this part of the landscape, any suggestion that the apparent absence of megalithic buildings is the result of selective destruction or retrieval would appear implausible. Conversely, it has been noted that a considerable density of megalithic sites has been recorded in the extensive conurbation around the Valletta harbour region, where one would expect the destruction of Neolithic evidence to be most thorough. Agricultural and building activity has evidently contributed at least as much to the discovery of sites as it has to their destruction or concealment.

The effects of natural processes on the known sample may be examined in the same way. One possibility is that sites in the coastal zone were more liable to destruction by the more dynamic environment. If this were the case, one possible effect would be that the sample of known monumental sites would under-represent sites in the coastal zone. In actual fact, however, the sample shows a preference for coastal areas, which will be examined in Chapter 4. Once again this observation suggests that the known distribution pattern is not an artifact of selective preservation or retrieval.

Site destruction and preservation: conclusions

In synthesis, while it is very probable that a number of monumental megalithic sites have been destroyed or remain undiscovered, the distribution of the known sample of megalithic sites may be treated as a reliable indicator of the original distribution. In spite of its limitations, the available sample of megalithic sites appears to have considerable potential to allow testing for meaningful patterning. With adequate control for the processes of selective destruction that have been discussed, the available sample may be treated as representative of the distribution of the total number of such sites during the Late Neolithic.

Conclusions

The present chapter has outlined the processes that shape and change the physical environment of the Maltese archipelago. The processes that have been discussed form the basis of the quantitative spatial analysis of sites in relation to their landscape environment, which will be conducted in the next two chapters.

4 Exploring the landscape context of monumentality: a bivariate approach

Introduction

The present chapter and the following one examine the location of monumental sites in the landscape, using quantitative methods. A GIS database is used for the intensive analysis of spatially correlated information, using statistical tools.

The analysis is divided into two basic stages. In this chapter, the first stage examines different variables in the landscape that may have influenced human activity during the period under consideration. This is done using bivariate procedures, that is, the possible influence of each variable on site location is examined and tested separately.

The analysis is then developed in Chapter 5, using multivariate techniques to examine the interaction between several variables at once.

Objectives

The objectives of the present chapter are to:

1. address some general theoretical and methodological issues in the quantitative assessment of landscape variables, and of their relationship to site location;
2. define the different landscape variables that will be used in the analysis;
3. explore the relationship between different landscape variables and megalithic sites;
4. identify which of these variables have a relationship with site location;
5. propose processes and mechanisms through which these variables influence site location.

Theoretical considerations

Site-site and site-landscape relationships

The existing literature on the spatial analysis of archaeological site location is voluminous and varied. It employs a wide range of approaches and methods that have often been borrowed from the kindred disciplines of economic geography, statistics, and spatial analysis. These methods may be divided into two fundamental categories (Kvamme 1988, 339). The first category consists of methods that analyse spatial relationships between sites. The second category consists of methods that examine relationships between site locations and the characteristics of the environment. Prior to the present work, only the first type of analysis had been applied to Maltese Neolithic sites. Central-place models using Thiessen polygons (Renfrew 1973; Hayden 1998) and X-tent models (Renfrew & Level 1979) fall into this category. One of the principal objectives of the present work is to introduce the second type of analysis to the study of Maltese Neolithic monuments.

The distinction between the two types of analysis mentioned raises a further point. The available data set of sites is inevitably incomplete. The results that are produced when it is interrogated for site-site relationships and for site-landscape relationships are not all equally robust. Tests that were originally designed for complete data-sets, such as for instance the generation of Thiessen polygons around individual sites to establish putative 'territories', provide less robust results than statistical tests that assess correlations between the known sample of sites and variables in their environment. The discovery of a single, previously unknown site may completely transform the geometry of the Thiessen polygons of the surrounding sites. On the other hand, the addition of a new site to the data-set is unlikely to cause a significant change in the relationship between the sample and the environment. This distinction is important for another reason. In the case of some very poorly preserved sites, there is often some ambiguity whether to treat them as part of the sample of megalithic complexes that follow a clearly recognizable type. Once again, this ambiguity has a more serious impact on the results of the first type of test than the second. For these reasons, the results of statistical examination of site-environment relationships are likely to be generally more robust than models based on site-site relationships.

Site data collection

It has been pointed out that the way the data on sites is acquired has important theoretical consequences(Woodman & Woodward 2002). A method that is widely used in North American predictive models is to capture the data through the intensive survey of a sample of the landscape under study. In other contexts, the use of previously accumulated site data may be more appropriate. An important difference between these two strategies is that only the first measures site frequency. As a result, the first method permits inferences on the absolute likelihood of a particular land parcel containing a site, while the second only permits statements on the relative chances of different land parcels containing a site, with no absolute measure of what that likelihood is (Woodman & Woodward 2002, 23-24).

The present analysis is based on site data that falls clearly into the second of these categories, because it has been accumulated over centuries. No attempt is made to calculate what proportion of the original sample this may represent, or to arrive at absolute figures for the chances of a land parcel having contained a site. The favourability of specific land parcels as site locations may therefore only be expressed in relative terms.

Method

The procedures used here were selected or designed to investigate decision-making processes by humans in the past. This basic concern has shaped the methodology used, in three ways. It informs

1. the choice of environmental variables that are considered useful for examination;

2. the sequence in which different questions are posed;

3. the different scales of analysis at which evidence is interrogated.

Scales of analysis

The scale at which analysis is conducted has an important bearing on the result obtained. A range of different scales of analysis is required to examine patterns at different scales (Fraser 1983, 53). These may be based on natural boundaries in the landscape, or arbitrariliy defined.

The limited extent and physically bounded nature of the archipelagic context has interesting methodological implications. Firstly, it presents the researcher with a scale of analysis that would evidently have had some relevance in prehistory. In the study of sites located in more extensive landscapes, the definition of the area to be included in the analysis is often arbitrary and contentious. The physically bounded nature of small islands, on the other hand, presents a distinct unit. After taking into account issues of coastal change, and without disregarding the importance of cultural strategies which may fragment or aggregate islands into smaller or larger organisational units (Broodbank 2000), it may be said that the archipelago as a whole and the individual islands that constitute it are useful scales of analysis, which were also meaningful during the period under consideration.

Some relationships with the landscape are only apparent at a more local scale of analysis. For example, when examining the relationship of site location to height above sea level, a test based on the broader region may suggest that there is no preference for higher or lower locations. If the analysis is run again, this time comparing site elevation to the height of the ground in the local environment, a different result may be obtained (Fraser 1983). In the present case, a 1 km radius around the site was used, as explained later in this chapter.

Sampling

Another practical consequence of the limited geographical extent concerns the sampling strategy adopted here. A high proportion of the published examples of spatial analysis of landscape variables tend to cover larger areas, which are often arbitrarily defined. A standard practice in such large areas is to compare the characteristics of sites to the characteristics of a random selection of other points in the landscape (referred to as 'non-sites' in most of the literature, as discussed below). Such reliance on random sampling is generally necessitated by two, related constraints. Firstly, the sheer size of the populations involved may mean that datasets are too large and unwieldly to be treated in their entirety. Secondly, the capture of data from the entire landscape may be prohibitively labour-intensive. The reliance on a random sample, however, sacrifices one of the great methodological opportunities that is presented by GIS and statistical software (Kvamme 1990a, 368-370). With the aid of these tools, the manipulation and interrogation of vast amounts of information has become far easier than ever before. In a geographically circumscribed context such as the present example, the analysis of the entire landscape is therefore a realistic objective. This has quantitative as well as qualitative advantages over random sampling.

Quantitatively, the use of the entire population of values from the entire landscape may result in more robust results than a random sample. Methodological problems such as those caused by spatial autocorrelation may be aggravated by certain sampling strategies (Kvamme 1988, 351-353; Kvamme 1990a, 377-379). The inclusion of the entire population in one-sample testing has the important advantage that it avoids the issue of drawing independent samples from the population (Kvamme 1990a, 378).

The treatment of an entire body of spatially correlated data also represents a qualitative leap forward. Spatially correlated data may be communicated in the form of maps, in a way that is impossible when analysing abstract, numeric values in tabular form. The facility with which complex spatial patterns may be visually expressed is one of the key advantages of GIS, a characteristic that facilitates the visual exploration of data (Wheatley and Gillings 2002, 142-145). Another fundamental characteristic of visual representations of landscape variables is their potential to convey more faithful approximations of past knowledge of the landscape than random samples of numeric values. For these reasons, the methods used here have been selected and developed to permit the quantitative analysis of the entire landscape.

Units of analysis

The basic unit of analysis that was used throughout the GIS-based work presented here is a parcel of land measuring 50m square. The size of land parcel used in comparable exercises typically varies between 10m square and 200m square, depending on the size of the area under study. For areas of a comparable order of magnitude to the present case, a 50m square grid cell is often used (Warren & Asch 2000, 14). This unit of analysis allows a fairly good resolution without becoming computationally unwieldly. The combined area of the different islands in the archipelago adds up to around 316 sq km. As each square kilometre is broken down into 400 grid cells, this translates into over 120,000 cells, even when the smaller islands are omitted. The 50m square grid cell has the further advantage that it has an order of magnitude comparable to the larger megalithic complexes that are central to this analysis. Such a similarity in order of magnitude is desirable for practical methodological reasons (Kvamme 1990a, 372). During the analysis, the cell containing a site is itself treated as the site (Kvamme 1988, 326). If cell and site had very different orders of magnitude, this would result in some loss of clarity in the results, and complicate their interpretation (Allen 2000).

Horizontal distance and cost distance

Several of the variables under consideration are based on distance from a feature or resource. Distance may be represented in different ways. The simplest way is to create a theme showing the horizontal distance from different features. This method of course ignores the variability of the ground, and the consequent variability in the effort required to move across different types of terrain. A more faithful way of representing the effort required to move across the landscape is a 'cost surface' (Van Leusen 1999; De Silva & Pizziolo 2001; Wheatley & Gillings 2002). The basic principle of cost surfaces is that they calculate a value for the effort required to move across each parcel of land, which is weighted for factors that influence movement, such as the slope of the ground. This method makes it possible to represent the effective cost distance between two points, providing a more realistic approximation of the effort required to travel between them than a map that simply shows horizontal distances. Some methodological issues concerning cost surfaces are considered more closely below. In the present analysis, surfaces showing horizontal linear distance as well as cost surfaces were created to represent variables based on distance. These surfaces were created for the two main islands of the archipelago, excluding the smaller islands. Analyses were run using both types of surface, and the results compared. In this manner, the two types of surface that were generated could be controlled against each other. This procedure makes it possible to explore patterns in the evidence more critically. Useful insights into the nature of an observed relationship may be obtained by noting whether it is stronger when using horizontal distance or cost distance.

Slope and cost

The literature on cost surfaces is considerable, and there is an ongoing debate on how these may be made more faithful to the landscapes they represent, by introducing more sophisticated algorithms (Van Leusen 1999; Bell & Lock 2000; De Silva & Pizziolo 2001; Wheatley & Gillings 2002; Bell et al. 2002).

Slope is one of the most widely used variables to determine the cost of moving across the landscape. On the terrain that is encountered on the Maltese archipelago, beaten paths tend to form along frequently trodden routes. It is a reasonable supposition that such paths would have likewise formed along prehistoric routes. The resistance to movement offered by such paths is generally uniform, varying only as a factor of slope.

An issue that has been pointed out repeatedly in the literature on cost surfaces is that cost does not vary in direct proportion to the angle of slope. A simple adjustment that is often used to correct this discrepancy is to convert the effective angle of slope into its tangent, which is equal to the change in height over horizontal distance travelled. Bell and Lock recommend using Tan (1°) as base cost, to avoid division by 0 (Bell & Lock 2000, 88).

Direction of movement and anisotropy

Another issue that is repeatedly pointed out in the literature is that the slope of the terrain should not be adopted uncritically as the cost-surface. This is because the resistance to movement offered by a slope varies according to the direction of movement. In the extreme case where movement is perpendicular to the line of steepest slope, the movement effectively takes place on the level. An anisotropic cost surface is required to deal with this problem, by taking into account the direction of movement. In the present instance, the following procedure was followed.

The direction of movement towards each variable was generated first. This was done in ArcView 3.2 by modifying a simple but ingeneous procedure that was proposed to assess directionality in a viewshed (Wheatley & Gillings 2000, 20-22). A layer is created showing horizontal distance from the points of origin, or 'source theme'. The values in this layer are then inverted, to produce a layer with values that increase nearer to the source theme. This is then used as a 'surrogate DEM' to produce an aspect layer, which effectively provides the direction from the nearest point in the source theme to any point in the landscape. This broadly corresponds to the direction of travel from the source theme to reach different points in the landscape. This may be compared to the aspect of the terrain. Where the two are perpendicular to each other, the direction of travel is along the slope rather than across it, and the cost of traversing that slope needs to be modified accordingly. A further factor should be considered at this point, and is dealt with next.

Return-to-base cost

An issue that is sometimes treated under the heading of anisotropy (Wheatley & Gillings 2002, 151-158) and sometimes treated as a separate issue (Bell & Lock 2000, 89-92) is the question of whether movement is up or down a slope. In the present analysis, the principal concern is the cost distance between places that were chosen as site locations, and different resources in the landscape. The cost distance to, as well as from, the resource is a contributing factor to the effective, return-to-base cost. It has been suggested that an isotropic cost surface model is adequate to calculate the return-to-base cost (Wheatley & Gillings 2002, 162). This appears unsatisfactory, because it fails to taken into account whether a slope lies across or parallel to the direction of movement, as discussed above. The algorithm preferred here is one that corrects for this factor, producing an anisotropic surface of effective slope, while at the same time not distinguishing between journeys up or down that slope, in order to represent both legs of the journey.

The following equation was therefore used to calculate the effective cost of moving across each cell, taking into account the three issues that have just been outlined:

$$\frac{\text{Tan}\{(\sqrt{[\text{Cos (Aspect of terrain} - \text{direction of travel)}]^2}) \times \text{Slope of terrain}\}}{\text{Tan }(1^{\circ})}$$

The entire procedure was repeated for each landscape variable for which a cost surface was required, using map algebra.

Nominal scale and ratio scale variables

For statistical purposes, the landscape variables considered in this chapter may be divided into two types, which are best addressed using different techniques. The first type consists of variables measured at the nominal scale, while the second type consists of variables measured at the ratio scale. The distinction between these different levels of measurement is discussed by Shennan (Shennan 1997, 8-12).

In the present analysis, relationships with discontinuous variables measured at the nominal scale are tested with a χ^2 (chi-squared) test. The surface geology of site locations is tested in this way, and so is their aspect.

Continuous variables measured at the ratio scale may provide additional information about the nature of their relationship to site location. An appropriate test is therefore one that makes use of this additional information. A Kolmogorov-Smirnov (henceforth K-S) is therefore more suitable than a Chi-squared test. K-S testing compares the cumulative distribution curves of the two variables under consideration, and determines the statistical likelihood of a given deviation between the two curves. In this manner, the test may determine whether intuitive observations of preferences for certain variables are based on a statistically significant relationship. The basic principle of K-S testing and some if its archaeological applications are explained by Shennan (Shennan 1997, 57-61). For the values in the present instance, the most appropriate tables are those given by Miller (Miller 1956, 113), using the Kolmogorov approximation (Kim & Jennrich 1973, 84-86).

Random sampling versus total sampling

Variables such as slope, elevation, or distance from a resource are all measured at the ratio scale. It has become a routine part of any site location analysis to test whether such variables are a significant influence on site location. Such tests have mostly relied on statistical comparison of site locations to a random sample of non-site locations in the landscape. Reliance on random sampling may contribute to a less statistically robust result, particularly with variables that display a high degree of spatial autocorrelation. The problem may be avoided by using tests that do not rely on random sampling, but use the entire population (Kvamme 1990a). When dealing with continuous data, a K-S test is ideal for this purpose.

The one-sample K-S test makes it possible to use the entire population that is being considered, rather than a random sample of points in the landscape. This is statistically desirable because a total sample makes the test more robust. Computationally, however, it requires the manipulation of much larger amounts of data than a random sample. This computational requirement made the use of the K-S test prohibitively labour-intensive for landscape analysis, until the development of GIS software. GIS has made the manipulation of large amounts of spatial data computationally simple, and the calculation of variables such as slope may now be performed with ease for the entire landscape (Kvamme 1990a, 370).

A further reason for adopting the method just described is that it is particularly well-suited to small island environments, or other clearly circumscribed regions. Taking advantage of the very distinct boundaries of the territory, it assesses decisions and choices by comparing site locations to the entire range of possibilities that were available.

Categorising continuous data

K-S tests are based on a comparison of the cumulative distributions of the variables being compared. In order to submit a continuous variable like 'elevation' to such a test, a recommended procedure is to divide the variable into ranges (Hodder & Orton 1976, 226-229). GIS is ideally suited to perform this operation (Kvamme 1990a, 370). To continue with the example of elevation, the grid cells representing the landscape may be 'binned' or grouped according to the elevation range that they fall within. The number of sites within each of these ranges may then be compared to the number of cells in that range.

All the continuous variables were subjected to this 'binning' procedure as part of the bivariate analysis. 'Binning' or grouping into ranges effectively reduces the information to a more manageable form. If the size of the groups is too large, it may result in the loss of critical information and hide patterning in the data. The general rule applied in the present analysis was to divide continuous variables into ten equal ranges. Where it was evident that sites were clustered in a particular range, this was sub-divided further in order to attain a higher resolution.

The multivariate analysis in the next chapter will to an extent control for the possibility that the grouping into ranges may have hidden some patterns in the data, because the multivariate analysis is conducted on a cell-by-cell basis.

Software

The following software was used. ArcView 3.2 was used as a GIS platform. The extensions used were Spatial Analyst, Spatial Tools, XTools, and Cost Distance. The bivariate K-S tests were conducted in Excel. For the multivariate analysis in the next chapter, SPSS 10 was used.

Defining landscape variables

The variables that were chosen for analysis are those which may plausibly have influenced site location. These include considerations of topography, geology, and hydrology. When taking decisions about how the data-sets representing these variables should be assembled and categorized, the guiding principle was that the categories used should as far as possible approximate categories that would have been appreciable in the Neolithic. In the case of geological categories, for instance, distinctions between geological members that can only be detected using a microscope are not taken into account. Likewise, the consideration of hydrology does not include the Mean Sea Level Aquifer (MSLA). The MSLA is located deep beneath the ground, and its exploitation is recorded in the mid-17th century as a recent innovation (Abela 1647, 128). In spite of its importance in the modern period, its presence is unlikely to have influenced site location during the Neolithic.

The different variables that are used in the analysis are defined here.

Geology

For the present analysis, a simplified geological map was derived from the Geological Map of the Maltese Islands (Pedley 1993). This was manually digitised in Autocad and imported to ArcView. In the simplified version, no distinction was made between the different members that make up each formation. That is, all the members making up the Globigerina formation were treated as a single category, and the same was done for Lower Coralline Limestone and Upper Coralline respectively. There is room for debate regarding the extent to which the different members of each formation were recognized as meaningful categories during the Late Neolithic. However, the differences between formations are generally more significant than internal variation within formations.

Topography

Topography is a basic characteristic of any landscape. Two key variables of topography are the elevation above sea level, and the angle of slope. Partly because of the availability of data, these variables form a standard part of most GIS-based landscape analysis. In the Maltese landscape, these variables are considered important because they largely determine which parts of the landscape are more likely to lose their mantle of soil cover to erosion, and which areas are more favourable for the accumulation of soil deposits. In the present analysis, the Malta Environment and Planning Authority (MEPA) 50m Digital Elevation Model (DEM) was used to generate grid themes for elevation, slope and aspect in ArcView. The MEPA DEM was created using a 'natural neighbourhood' algorithm, after this was identified by experiment as the one that performed best in the Maltese landscape (Carol Agius (MEPA Mapping Unit), personal communication, 2002). The grid theme for aspect was modified by defining slopes of less than 3% as level. Grid cells having a slope steeper than 3% were divided into four categories, according to the cardinal direction nearest to the direction of slope. That is, grid cells having an aspect between NE and NW were defined as North-facing, and so forth for the other three cardinal directions.

Plain boundaries

The values for slope and elevation of individual cells may be tested for influence on site location patterning. A further scale of analysis may be required to interrogate this data. One of the intrinsic properties of landscapes is that the properties of adjacent points or land parcels are often closely related (Kvamme 1990b, 285). For instance, in a plain one would naturally find a large number of adjacent cells that have a very low value of slope and a very similar elevation value. This is known as spatial auto-correlation. For the purposes of statistical analysis, this represents a significant problem, because it violates one of the basic assumptions on which the design of most statistical tests is based. This issue is treated separately below. Apart from being a statistician's nightmare, however, spatial auto-correlation is one of the fundamental properties of landscapes. Worked into the analysis, it may represent an opportunity to observe patterns in past human decisions at a different scale of analysis. One of the most conspicuous instances of spatial autocorrelation in the Maltese landscape is the occurrence of discrete plains in different parts of the archipelago. The properties of these plains were discussed in Chapter 3. Comparison of the value of variables at site locations to the values that obtain in the landscape generally may only detect patterns at the scale of individual cells. A different scale of analysis is required to detect relationships between site location and features composed of aggregations of cells, such as a plain (Allen 2000, 102). Such relationships may have a very significant influence on past human decisions on site locations. In order to test this possibility, a new variable was defined accordingly. A new layer ('theme') was created in ArcView to represent plains. These were defined by three criteria. Plains were defined as (1) low-lying zones that provided favourable conditions for the accumulation of soil, (2) having a gradient not exceeding 5 %, and (3) extending for more than 1 sq km. The boundaries of the areas fulfilling these criteria were defined on the basis of the slope map created in ArcView, controlled against printed contour maps, slope maps (Bowen-Jones & Dewdney 1961b) and soil maps (Lang 1961). Six areas in Malta and one in Gozo were found to fulfil these criteria. These were digitised manually in Autocad and imported to ArcView as shapefiles. While this may appear to be a fairly arbitrary definition, it corresponds closely to the natural compartmentalization of the landscape described in Chapter 3. Along most of their length, the boundaries of these plains as defined here correspond to distinct topographic boundaries such as breaks of slope, faultlines and valley systems. Cursory examination of the relationship of monumental location to these zones suggested a preference to locate monumental sites close to plain boundaries. Further grid themes were created in order to test this possibility. A theme was created for horizontal distance from plain boundaries, using the ArcView distance function, and another theme was created for cost distance from plain boundaries, using the equation described earlier in this chapter (Page 87-88).

Coastline

The definition of the coastline is fundamental to the analysis, not only because it was itself one of the variables to be examined, but also because it defined the boundaries of the analysis for several other variables. In Chapter 3, several processes that have modified the coastline since the Neolithic were identified. These are recalled in turn, and their treatment in the GIS model described.

Anthropogenic alterations to the coastline since the early modern period are well documented. Land reclamation projects and the building of wharves and breakwaters have artificially added several hectares to the archipelago. These modifications are for the most part recognizable, and they have been deleted from the model.

An important contributing factor is change in relative sea level. As discussed in Chapter 3, the details of the interplay of local tectonic movement with global changes in sea level are still poorly understood. When the present-day coastline is compared to the 5m isobath, it is immediately clear that the two lines coincide along much of their length, particularly along the cliffs around the coast of Gozo and along western Malta. In areas where the gradient of the seabed tends to be less steep, such as the creeks and bays of eastern Malta, the distance of the 5m isobath from the coastline rarely exceeds 50m. The implication is that even if it is assumed that the relative sea level has risen by 5m, the change in the configuration and extent of the archipelago would still be minimal. The analysis of the relationship with the coastline was run using the present coastline. As a control, the analysis was run again with the 5m isobath defined as the coastline. No divergence in results was noted.

Sedimentation and erosion were identified as locally significant causes of coastal change in those areas where the coastline was composed of unconsolidated deposits. The areas where this change has been most significant are the floodplains that form where valley systems meet the sea. The upper reaches of these valley systems allow some general observations to be made about their section, which may be used to extrapolate crude models of the configuration of these valleys before they were buried in sediment. Once again, the principal purpose here was to estimate the order of magnitude of change to the coastline that may have occurred since the Late Neolithic, and to control for the impact of such change on the present model. The test of the relationship between site location and the coast was run again, with the areas of likely progradation 'emptied', in order to control for the impact that such a change may have on the model. Once again, no significant change could be observed in the result. This suggests that, for the purposes of quantitative analysis of the landscape at the scale of the entire archipelago, the coastal change that may have occurred since the Neolithic is not of a significant order of magnitude.

Access to the sea

One of the key variables that may determine site location in a coastal or island context is the relationship with the sea. Proximity to, or accessibility of, the sea is an almost standard feature of GIS-based landscape analysis of coastal zones. In an island context, this is considered fundamental. The relationship between Late Neolithic monumental sites in Malta and the sea has never received thorough study or systematic testing. In two early contributions, it was noted that temple complexes are often located near sheltered creeks and bays (Caruana 1896a; Zammit 1929, 5). This possible relationship has however received only scant attention in the discussion of the role and purpose of these buildings. In one consideration of this issue, it has been argued that the site of the megalithic complex at Mnajdra may have been chosen because of the proximity of sheltered embarkation points (Cottinelli 1988, 115). As this study was limited to only two sites, namely Ħaġar Qim and Mnajdra, it could make no useful generalizations about the relationship of the known corpus of sites to the sea. In a broader treatment of the question, it has been pointed out that '...most of the temples on Malta are located within easy distance of the coast, or else in strategic locations close to main valleys that also lead down to the sea', and that coastal areas '...act as natural frontier zones linking an island's interior with maritime resources and the external world' (Pace 1996, 5).

Notwithstanding these important observations, the possibility of such a relationship receives scant attention in the prevailing models for the emergence and purpose of monumental activity. One reason for this is that it is difficult to extract generalized and meaningful principles that were followed in the choice of all or even most of these sites' locations. Looking at the distribution of known megalithic sites on the familiar 'dots-on-a-map' representation of their location against an outline of the islands' coastline does not seem to bear out the proposition that there is a particular relationship with the sea. A number of sites, such as Skorba on Malta, or Ġgantija, Xewkija, and ta' Marziena on Gozo appear to be located a considerable distance inland. Such a representation may easily mislead, however, as it does not indicate which parts of the coastline allow access to the sea, or how natural features such as the characteristically deep wadis may have conditioned the choice of routes to travel across the landscape. As noted by Pace (Pace 1992; Pace 1996), an understanding of topographic features such as valleys and embarkation points is essential for a reading of the location of megalithic sites.

A relief map is rather more useful for this purpose (Figure 14, page 112). Consideration of a relief map does suggest a preference for locations near bays and creeks that give easy access to the shore. It may be objected, however, that in a small island setting most places are likely to have ready access to the shore, and that this is therefore not an intentional or meaningful pattern. The question whether this is a random pattern or the result of deliberate choices has considerable implications for our understanding of the role and purpose of megalithic buildings. Prior to the development of GIS software, it was computationally unwieldy to subject this problem to quantitative testing. With the benefit of GIS applications, however, such questions may be tested much more efficiently.

Access to the sea appears to be the more interesting variable in this case, rather than simple proximity to the coastline. Accessibility from the sea at different points in the landscape was modelled using the procedure described below.

A key property of the coastline is that the access to the sea that it permits varies widely along its length. A high proportion of the coastline is composed of long stretches of cliffs that drop vertically into the sea. At the other extreme, there are sheltered harbours with convenient beaches that were ideal for the landing of prehistoric seacraft. Between the two extremes, there are rocky shorelines where access to the sea is often dependent on weather conditions. Points on the coastline that permit access to the sea were defined first. Optimal access points such as sheltered beaches, bays and natural harbours were identified. Where the length of a stretch of coastline that provided optimal conditions was less than 200m, it was considered adequate to define a single access point at its mid-point. In cases where the length of coastline providing favourable conditions was greater than 200m, an access point was defined at 200 m intervals along its length. After exhausting optimal access points, attention was turned to rocky shorelines where access was possible though not ideal. In those parts of the coastline that were more than 1 km away from the nearest access point, a new access point was created at the most favourable point that could be identified. This procedure was continued until all those parts of the coastline that could reasonably permit access in moderate weather conditions were represented by access points at intervals of not more than 1 km. A total of 64 access points was identified (Appendix 5). No access points were created along those parts of the coastline where access was considered dangerous or impossible, such as stretches of coastline composed of cliffs.

The reasoning behind this procedure is that optimal access points are preferred whenever available. Further away from these ideal points, however, less suitable access points may be recognized as the most viable option available. A clear example of this is the coastal zone comprising the Ħamrija Bank and Wied iż-Żurrieq, on the south-western coast of Malta. Although rather less sheltered than the deep bays that characterise the north-eastern coast of Malta, these configurations do permit reasonably good access to the sea in moderate weather conditions. The opportunity that they afford to a seafarer may only be understood against the backdrop of the coastline to the north and south of these formations. For several kilometres in both directions, the coastline is composed of precipitous cliffs that plunge vertically beneath the sea from heights of over twenty metres. Ħamrija Bank and Wied iż-Żurrieq represent the only gateway between land and sea along this coast. This is readily confirmed by two observations. Firstly, both Għar Lapsi on the Ħamrija Bank and Wied iż-Żurrieq have been exploited at least since early modern times for the berthing and landing of small fishing vessels by the inhabitants of this region. The second observation concerns early modern coastal defences. By the late 17th century, a network of fortresses and watchtowers was in place to guard vulnerable points on the coastline (Spiteri 1994). The daunting cliffs that characterize the south-western coast of Malta from Ġnejna to Marsaxlokk were considered enough defence for this coastline, and further fortifications were deemed unnecessary. In more than 20 km of coastline, only two watchtowers were built. Their position speaks eloquently of the enduring influence of maritime access on human decisions. One of these two towers overlooks Ħamrija Bank, while the other is at Wied iż-Żurrieq.

Once the access points around the coast had been defined, grid themes to express distance from these points could be built. Once again, this was expressed as simple horizontal distance, and as cost distance.

Hydrology

The definition of hydrological features in GIS-based analyses is notoriously problematic. Various researchers have pointed out difficulties in their data-sets, which are often borrowed from GIS databases created for present-day applications. Such data has to be treated with care, and may easily give misleading results if treated as a straightforward index of prehistoric water availability (Ebert 2000, 132). Such data may include modern artificial channels and ditches (Wescott and Kuiper 2000, 62), and omit springs that have been obliterated by development (Duncan and Beckman 2000, 55).

As noted in Chapter 3, the hydrology of the Maltese archipelago may have changed considerably since the Late Neolithic, as a result of aridization, as well as extraction of water from the water-table, which accelerated during the modern period. Artificial systems of water storage and management have caused further changes. On the other hand, the availability of spring water is closely controlled by geological structure. The availability of a recently published corpus of medieval toponyms (Wettinger 2000), discussed in Chapter 3, allows a detailed glimpse into the hydrology of the archipelago during the later middle ages. While at first glance it may appear to be a rather subjective database, on closer inspection it shows a number of advantages. First, these toponyms were recorded before the more drastic anthropogenic hydrological modifications that took place during the modern period. Second, it includes data about springs fed by minor springlines, which would escape an analysis based on the major springline round the perched water table. A third advantage is that a toponym referring to a spring suggests a water source that was significant and permanent enough for it to become a useful landmark. Furthermore, a toponym referring to a spring is a firm indication that spring water was detectable and accessible at this point, without the aid of complex technology.

In view of the above, toponyms referring to springs were treated as a useful index of natural fresh-water availability. The approximate location of 89 such toponyms was mapped on a 500m grid (Appendix 3). New themes showing horizontal distance and cost distance from these points were then generated, as before.

Results

The results of the bivariate analysis are presented in this section. Different landscape variables, and their relationship with monumental site location, will be considered in turn, beginning with the surface geology of the archipelago.

Geology

The rock that makes up the Maltese archipelago is by far the most abundant resource that it offers. Inevitably, strategies to make the islands habitable have often rested heavily on the skilful manipulation of this material. The Late Neolithic was no exception. There is profuse material evidence for a range of highly developed stone-working skills, requiring a sophisticated understanding of the structure and properties of different types of stone. The excavation of rock-cut tombs in bedrock is clearly attested from the beginning of the fourth millennium BC onwards. In the extensive underground burial complex hewn out of the living rock at Ħal Saflieni, the naturally faulted structure of the rock was exploited to help in the mammoth task, and even to create naturally smooth walls in many of the chambers (Evans 1971, 45). Harder varieties of stone were shaped into tools, often to be used in the working of softer varieties. The carving of exquisite low reliefs and sculpture in the round still astonishes with its sophistication and detail. The most remarkable exploitation of stone that is known to have taken place during the Neolithic, however, was its use in building.

The earliest evidence of building activity on the archipelago has been dated to the Għar Dalam phase, the earliest known phase of human occupation (Trump 1966, 10). By the late fifth millennium BC, clusters of huts that made extensive use of dry-stone walling were being built (Trump 1966, 10-16). Around the second quarter of the fourth millennium, a period of increasingly ambitious megalithic building had begun. The megalithic complexes that were raised during the thousand years that followed are remarkable not only on account of their sheer massiveness, but also because of the innovative and creative design processes that they required (Renfrew 1994, 6-7), as well as their density and complexity (Renfrew 1973).

This range of activities could only be conducted in a society that possessed an acute awareness of the availability and quality of different varieties of stone, and its suitability for different purposes. This knowledge is likely to have been a significant component of the Late Neolithic islanders' cognitive geography. Furthermore, the abundance of material evidence of these activities suggests that these cultural attitudes may be amenable to archaeological investigation. The use of stone in monumental buildings may be a particularly useful index of the perception and ordering of the landscape (Tilley 1996; Bradley 1998b; Bradley 1998c; Tilley & Bennett 2001). The following sections explore these possibilities.

Distribution of megalithic sites

In Chapter 3 it was noted that variations in surface geology have an important bearing on the quality of readily available building materials in different parts of the archipelago. Coralline Limestone and Globigerina Limestone provide the most suitable and abundant materials for building purposes, and both were used extensively during the Neolithic. The distribution of megalithic sites does not suggest that there was a preference for locating sites on one type of rock or another (Figure 11). This absence of a preferential distribution may be confirmed with a simple statistical test (Figure 12).

This test is limited to areas where solid rock occurs at or near the surface, that is excluding clay slopes and alluvial plains, for two reasons. Firstly, clay slopes and alluvial plains are intrinsically unsuitable for massive monumental construction, because they lack the basic requirement of providing a solid foundation. Secondly, these areas are so dynamic that even in the unlikely case that any monumental building activity was ever attempted there, this would be very difficult to detect, and none is known at present.

Of the land area of Malta and Gozo where solid rock is present at or near the surface, circa 8.1 % of the surface geology is composed of Lower Coralline Limestone, 65.5 % is composed of Globigerina Limestone, and 26.4 % is composed of Upper Coralline Limestone.

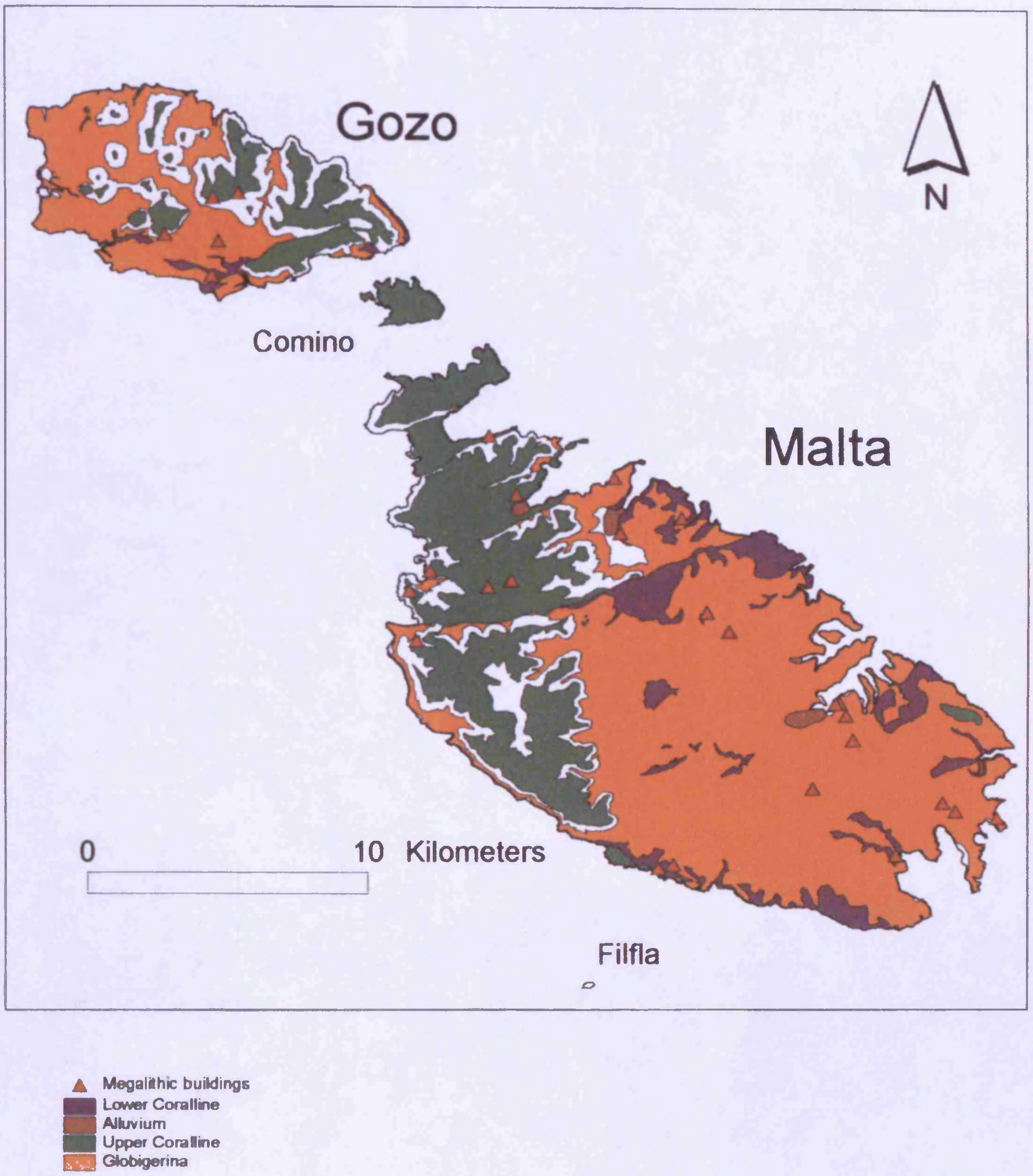


Figure 11. The location of megalithic buildings, shown against surface geology.

	Surface geology	Lower Coralline	Globigerina	Upper Coralline	Totals
	Sites on Gozo				
1	Santa Verna			✓	
2	Ġgantija			✓	
3	Ta' Marżiena			✓	
4	Xewkija		✓		
5	Borġ tal-Imramma		✓		
	Sites on Malta				
6	Għajn Żejtuna			✓	
7	Xemxija			✓	
8	Buġibba		✓		
9	Tal-Qadi		✓		
10	Ta' Ħammut		✓		
11	Ta' Lippija			✓	
12	Ta' Ħaġrat			✓	
13	Skorba			✓	
14	Pellegrin			✓	
15	Kunċizzjoni			✓	
16	Iklin		✓		
17	Tar-Raddiena		✓		
18	Kordin I		✓		
19	Kordin II		✓		
20	Kordin III		✓		
21	Tarxien		✓		
22	Bir Miftuħ		✓		
23	Mnajdra	✓			
24	Ħaġar Qim		✓		
25	Borġ in-Nadur		✓		
26	Ħal Ġinwi		✓		
27	Tas-Silġ		✓		
28	Xrobb l-Għaġin		✓		
	% of solid geology	8.1	65.5	26.4	100
	Observed (O)	1	17	10	28
	Expected (E)	2.27	18.34	7.39	28.00
	(O-E)	-1.27	-1.34	2.61	**X-squared**
	(O-E) squared / E	0.71	0.10	0.92	**1.73**

Chi-squared value at 2 degrees of freedom at the 0.05 level of significance is 5.99.

Therefore null hypothesis is ~~rejec~~ted.
accep

Figure 12. Expected and observed number of sites on the 3 principal classes of solid surface geology.

If it is supposed that there is no preference between locating megalithic sites on these three classes of rock, then it is reasonable to expect approximately the same density of sites on each type. If this is defined as the null hypothesis, it may be tested using a simple chi-squared test (Shennan 1997, 104-126). The surface geology of 28 sites where megalithic complexes have been recognized is given in Figure 12.

The expected number of sites for each type of rock is calculated by dividing the number of sites in the same proportion as the percentages occupied by different types of rock. The expected number of sites may then be compared to the observed number, as shown at the bottom of Figure 12.

The chi-squared test may now be performed. As no correlation could be observed, a low significance level will be set, so that if the result nevertheless proves to be insignificant, the null hypothesis may be accepted with greater confidence.

The level of significance will therefore be set at 0.25. In other words, if there is less than one chance in four that the correlation between site location and surface geology occurred by chance, it will be considered to be significant. If there is more than one chance in four that it did occur by chance, the null hypothesis, that there is no significant preference, will be accepted.

In fact, when calculated the chi-squared value is found to be 1.73, while the tabulated critical value at the chosen level of significance is 2.77. Therefore the null hypothesis is accepted, that is, it appears that there was no preference to locate sites on one class of rock or another.

It should be noted that the chi-squared test is only valid when the following conditions are met. First, no expected category should be less than one. This condition is met in the present case. Second, no more than one-fifth of expected categories should be less than 5. As there are only three categories in this case, the value for Lower Coralline limestone violates this assumption. However the critical difference here is between Coralline Limestone and Globigerina Limestone. If Upper and Lower Coralline Limestone are treated as a single category, this assumption would no longer be violated.

Some qualifications

The apparent lack of preference for building megalithic sites on one type of rock or another must immediately be qualified. The test conducted above has the following three limitations. First, the categories of rock used in the test may not correspond to the classification that would have been meaningful in the Neolithic. Second, the lack of preference for locating sites on one type of rock or another tells us little about the availability of different materials around the site. Third, the possibility of changing preferences over time has not been taken into account. These three issues will be considered in turn.

Neolithic understanding of categories

The first limitation is that the test uses very simplified categories based on our present-day understanding of the geological sequence, which need not quite reflect the categories of stone that the Neolithic builders considered most significant. It does not take into account the considerable internal variability within each formation, which in some cases may have been an important consideration. Further research on the precise geological provenance and properties of the materials used in the megalithic buildings will undoubtedly shed more light on the preferences and attitudes of their builders. Having said that, Globigerina Limestone and Coralline Limestone were exploited in very different ways, and the distinction between them was clearly a very important one in the Neolithic. In spite of this fundamental difference, the test demonstrates that it did not influence the choice of sites for megalithic buildings.

Availability of different materials

The second issue is that the lack of preference for locating sites on one type of rock or another is not to be confused with a lack of preference for locations where different building materials may be available. Due to the densely faulted structure of the islands, together with selective erosion of different geological formations, there are numerous localities where both Coralline and Globigerina limestone are readily available in the immediate vicinity. Mnajdra is a very clear example of how such a situation could be exploited. Although the megalithic complex at Mnajdra is built on Lower Coralline Limestone, Globigerina Limestone also outcrops in the vicinity. Globigerina is available on the surface less than 200 m north of Mnajdra, uphill from the site. An even nearer source of Globigerina lies some 50 m south-west of the building, only in this case the source lies downhill from the site. This optimal situation was fully exploited in the construction of the two principal buildings at Mnajdra. Globigerina Limestone was used to create highly finished interiors in both buildings, while Lower Coralline Limestone was used to build outer walls that were much more resistant to weathering. Although rather less well preserved, Buġibba presents a comparable case. The building stands on a Globigerina outcrop. Barely 40 metres to the West, the selective erosion of the Globigerina along the shoreline has exposed a coastal shelf of Coralline Limestone, at a level only seven or eight metres lower than the building. Enough of this site has survived to show that both materials were used extensively in the structural fabric.

How near was near enough for a material to be used widely in a megalithic structure, as in the case of Mnajdra or Buġibba? The nearby case of Ħaġar Qim is instructive. Located on a Globigerina ridge 500 m east of Mnajdra, Ħaġar Qim is only 40 m uphill from the nearest source of Lower Coralline. Nevertheless, the extensive and multi-phased building activity that takes place at Ħaġar Qim was conducted exclusively in Globigerina Limestone. In one discussion of this characteristic, it has been suggested that the use of Globigerina may have been used for the façade because of aesthetic preference (Evans 1959,103-108). However, the consistent use of Globigerina across a succession of building programmes at Ħaġar Qim suggests that the immediate availability of this material, also noted by Evans (1959, 106), was a more important consideration. This is confirmed by looking a bit further afield around other sites built on Globigerina. The three megalithic buildings at Kordin, the mega-complex at Tarxien, and the smaller structures at Tas-Silġ, Ħal-Ġinwi and Xrobb l-Għagin in south-eastern Malta and tal-Qadi in the North are all located within two kilometres or less of a Lower Coralline outcrop. Nevertheless, none of these sites have yielded any evidence of the use of Coralline Limestone for structural purposes. The boat-shaped threshold at Kordin III, which is made of Coralline Limestone, appears to have had a very particular purpose, which was not structural. Its presence at Kordin does however indicate that, at least in the case of Kordin and Tarxien, the existence of nearby Coralline outcrops was known, making the absence of this material from the fabric of these structures all the more interesting.

Sites built on Upper Coralline Limestone present a rather different scenario. The complex at Ta' Ħaġrat is the only site that is known to be built entirely of Coralline. Considerable care, time and energy were evidently invested in selecting and shaping Coralline boulders for critical parts of the structure such as the monumental double trilithon entrance and the corners where the interior apses met. In the three-apsed building at Skorba and in both the South Temple and the North Temple at Ġgantija, the joints between the three inner apses are likewise formed of carefully selected Coralline boulders that approximate ashlar blocks. The monumental façade at Ġgantija is composed of Coralline boulders that are quite uniform in height, making it possible to build the façade in regular courses. At Skorba and Ġgantija, however, there is also considerable use of Globigerina for key structural components such as doorways as well as elements intended to receive a surface treatment such as relief sculpture. At

Ġgantija, there is evidence that the transportation of Globigerina to the site for the creation of carved screens and other fittings continued during the Tarxien phase (Evans 1971, 180). In the case of Skorba, the nearest source of Globigerina was around 1.5 km to the south-east (Trump 1966, 6), while in the case of Ġgantija, the Globigerina must have been transported uphill from over a kilometre away. Some Lower Coralline megaliths may also be present at Ġgantija (Martyn Pedley, personal communication, February 2004). This is remarkable for two reasons. First, the sources of Lower Coralline on Gozo are located even further away than sources of Globigerina. The Lower Coralline would have had to be brought uphill over difficult ground. Second, the mechanical properties of Lower Coralline do not present any obvious advantages over those of Upper Coralline. The motivation for this exceptional investment in effort may lie in the aesthetic and symbolic values of the material.

A scale of values begins to emerge from these observations of various choices and decisions. Firstly, it is quite clear that local geology was not a key consideration in selecting locations for the building of megalithic complexes. The builders could have had immediate access to both of the principal stone materials if sites had been relocated by less than two kilometres. This did not happen, however. There were evidently other, more important considerations determining the location of these buildings. Secondly, during the construction of these buildings, there was a very marked preference to make the best possible use of the materials that were available in the immediate vicinity. This was through no lack of knowledge of the possibilities that the environment afforded. At Mnajdra, the availability of both Coralline and Globigerina is exploited systematically in both of the main buildings. However, in spite of the evident appreciation of the advantages of Coralline for the exterior of a structure, these benefits appear have to been very rapidly outweighed by the costs of transport from a source that was not in the immediate vicinity. This is most evident in the total absence of Coralline at Ħaġar Qim, in spite of its being available only about 40 m away, and is corroborated by the other sites that were considered above, where the nearest source of Coralline is less than two km away. Coralline appears to have been transported over such distances only for highly specialized components, such as the boat-shaped threshold at Kordin III. The transportation of Globigerina elements to sites on Coralline is more widely attested. This is nevertheless reserved for a very small selection of highly specialized features which required a very high finish, such as relief panels, or which furthermore may have also been critical to the stability of the structure, such as the trilithons framing doorways. The third observation, then, is that megalithic materials may be transported over distances in the order of two or three kilometres, sometimes even uphill, when required for very particular functions, but never for the general structural fabric.

Changing preferences over time

The third issue that was noted earlier is the possibility that changing preferences over time influenced the choice of stone used during different periods. Considerable research has been directed at determining the phasing of these megalithic structures. During the early twentieth century, a number of well-documented excavations, particularly by Temi Zammit and Thomas Ashby, brought this problem into focus. During the 1950's, John Evans conducted a programme of trench excavation across a number of sites, designed primarily to address the question of phasing and chronology of different components of these structures. In the 1960's, the understanding of the ceramic sequence and its implications for the phasing of buildings was developed further by David Trump's excavations, particularly at Skorba. Although a number of phasing questions remain unresolved, this accumulation of research has resulted in reliable indications of the phasing of several building interventions, as well as providing the broad strokes of the duration of activity on these sites.

For the purposes of the present discussion, it will be useful to summarize some of these results schematically (Figure 13). In the light of the preceding discussion, sites are grouped according to the stone materials that are available in the immediate vicinity, defined here as within a 50m radius of the buildings themselves. One unexpected result of Evans' work was that most megalithic interventions took place during the Ġgantija Phase and the Tarxien Phase. A number of other patterns may be readily observed. Firstly, on several of these sites there was clear evidence of human activity predating the surviving traces of megalithic building. Secondly, preferences for building near sources of different materials do not appear to change over time. On all the larger complexes, there is evidence of extensive building activity during both the Ġgantija Phase and the Tarxien Phase, regardless of the surface geology of their location. On some of the smaller complexes, most building activity may have taken place during a single phase. On Globigerina as well as Coralline, there are cases where major building took place during the Ġgantija Phase but not the Tarxien Phase. Likewise, on both geological formations there are cases of sites that may have been founded during or shortly before the Tarxien Phase.

Phase		G	GS	RS	Żebbug	Mġ	Ġgantija	Sa	Tarx	TC
Stone	Site									
Coralline Limestone (Upper or Lower)	Ġgantija				□		■		■	
	Santa Verna	□	□	□?	□		■	□	□	□
	Ta' Ħaġrat				□	□	■			
	Skorba	□	□	□	□	□	■		■	□
	Kuncizzjoni								●	
	Għajn Żejtu.						●			
Globigerina Limestone	Kordin III				□	□	■			
	Tarxien				□		■	■	■	
	Tal-Qadi				□		□		■	□
	Ħal-Ġinwi						●		○	○
	Xrobb l-Għ.				○	○	●		●	
Globigerina & Coralline	Mnajdra				□	□	■		■	
	Ħaġar Qim						■		■	
	Buġibba						□		■	□

□ Stratified ceramic evidence of cultural presence

■ Evidence of megalithic building activity

○ Ceramic evidence without stratified context

● Possible period of megalithic activity, based on unstratified evidence, or typology

Figure 13. Cultural presence and megalithic building activity on different sites, by ceramic phase (Sources: Evans 1971, Trump 1966).

Drawing together these observations, it may be inferred that there was no perceptible shift across time from building on one type of surface geology to building on another. Furthermore, on most sites there is considerable evidence of activity during the Żebbuġ Phase and the transitional Mġarr Phase. On the other hand, the earliest clearly phased evidence of megalithic activity is usually from the Ġgantija Phase. The most detailed record of this comes from Skorba, where a three-apsed building was built immediately next to a succession of huts from the Għar Dalam, Red Skorba, Żebbug, Mġarr and Ġgantija Phases (Trump 1966, 10-17). It cannot be ruled out that earlier megalithic activity may have been effaced by subsequent buildings. If Skorba is at all representative, however, it is more likely that initial activity on these sites was not primarily concerned with megalithic building. If so, there is even less reason to expect concerns with geological constraints and opportunities to influence the choice of site location. Monument building often appears to have taken place on sites that were already important foci of activity. Megalithic building may have been deployed for the monumental elaboration of sites that had been long established as meaningful places in the islanders' cosmology.

Materials, technology and architecture

So far it has been established that a preference for building in Coralline Limestone or in Globigerina Limestone did not significantly influence the choice of location for the building of these complexes. Both formations are widely used in the repertoire of known sites. Closer inspection showed that megalithic complexes are built mainly of the materials available in the immediate vicinity, and only materials for very specific purposes are carried for significant distances. These basic strategies do not change appreciably over time.

So far, this sounds perfectly straightforward. If suitable materials were available locally, materials would only be brought in from further afield if there were important cultural, economic or symbolic reasons for doing so. The use of suitable materials that are available locally does not itself seem to require explanation. What makes this issue a much more interesting one, however, is the sharp contrast between the properties of the two basic classes of stone that are being used. These different properties impose severe constraints on how the stone may be worked, which translate in turn into very different building technologies, different structural solutions and even buildings with a different appearance.

These contrasting properties had very immediate implications for what could, and what could not, be done with these materials using a Neolithic tool-kit. Coralline Limestone could only be broken along pre-existing cracks and bedding planes. The grinding and polishing into shape of Coralline Limestone was an extremely laborious task, generally reserved for the production of tools, and seldom used on building materials. The difference in strength between Coralline Limestone and Globigerina itself presented very attractive opportunities. Several polished Coralline Limestone tools have been found at Tarxien and Hal Saflieni (Evans 1971, 66; 146), and it is very likely that such tools were used in turn to work Globigerina Limestone. Globigerina Limestone could be cut, ground and carved into architectural elements that satisfied the most precise requirements of size, form, finish and decorative detail.

These differences were to have a far-reaching influence on the building techniques that were developed. The use of irregular Coralline Limestone boulders gathered or splintered from the ground, each of which was incorrigibly unique, required building techniques that were very different from those used on the yielding Globigerina Limestone. Coralline boulders had to be selected, matched, fitted and wedged together into an interlocking structure that depended on the irregularity of its components for its stability. Globigerina, on the other hand, allowed the imposition of geometric ideas onto the material. If a form could be dreamt of, it could be realized. Joints between different elements could be perfectly fitted by grinding the faces to be matched together, until not even a hair could be inserted between them. It was also possible to conceive and realize a modularity of design that was impossible with Coralline Limestone.

As a result, the remains of megalithic complexes in different parts of the landscape may present a strikingly different appearance today, in spite of being broadly contemporary. Depending on the surface geology of the chosen site, some megalithic buildings are cunningly crafted masses of irregular boulders shaped more by nature than by workmanship, while others are displays of perfect planes and seamless geometry.

This contrast has been largely taken for granted as the unremarkable consequence of a variable environment. In an isolated effort to explain this process, it has been suggested that changing aesthetic preferences and experimentation with the suitability of different materials for different purposes played a key role in the choice of materials that were used in successive megalithic buildings (Evans 1959, 106-111; 126). In Evans' interpretation, it is suggested that the use of roughly shaped masonry gave way to a 'preoccupation with the production of regular stonework'.

There are two difficulties with this explanation. Firstly, the use of dressed Globigerina is already attested in the three-apsed building at Kordin III, which has been dated to the Ġgantija Phase. This suggests that the use of dressed masonry was determined less by changing preference over time than by the constraints and opportunities presented by locally available materials.

The second difficulty is that there is some evidence that both types of masonry may have been plastered over, concealing the differences that we find so striking today. Traces of a white lime plaster were found on Coralline masonry in the South Temple at Ġgantija, on a part of the wall which had remained buried until 1933, preserving the plaster (Evans 1971, 175). Globigerina orthostats were found plastered over inside the Middle Temple at Tarxien (Zammit 1917), 272). This evidence lends further support to the idea that the choice of different materials was not dictated primarily by aesthetic preference.

Cultural attitudes to stone materials

An idea that is receiving growing attention in the study of prehistoric monuments is that different materials may acquire different symbolic values (Parker Pearson & Ramilisonina 1998). It has also been suggested that the use of naturally formed boulders and the use of worked stone may represent different ways of relating to the environment (Bradley 1998a, 229).

The Maltese evidence discussed above suggests a different attitude to worked and unworked building materials. There is little to suggest that the sharp contrast between dressed Globigerina Limestone masonry and roughly-hewn Coralline Limestone boulders was exploited for symbolic purposes. Instead it appears that people were finding ingenious ways to create the same kind of building out of these different materials. What is most surprising is how the very different constraints and opportunities presented by these materials are overcome and exploited, in order to realise the same architectural form. The use of plaster also made it possible to give these buildings a more similar appearance.

The use of different materials in different parts of the island, according to availability, may easily be dismissed as an instance of environment determining architecture. This is to read the evidence backwards, however. It may be more interesting to turn this on its head, and to think of architecture as the process of reshaping the environment. Very different building technologies were developed in order to overcome environmental variability, and to create the same architectural form across this variability.

Topography

Topography may influence the choice of site location in two fundamental ways. Although they are inseparable in practice, it may be useful to consider these as two distinct steps in the site selection process. The first step is the decision to build a monumental complex in a particular area or region. This decision is likely to be influenced by the affordances and associations of the surrounding area, in the sense described in Site Catchment Analysis (Chisholm 1962). The second step is the choice of the precise building site within that area or region. When choosing a site for the construction of a monumental building, sites with specific properties may be considered more suitable. For instance, a site with level ground may be preferred to a sloping site, or vice-versa. In the previous section, possible preferences for sites having specific geological properties were assessed. This section will continue the analysis with a consideration of three other variables, namely slope, elevation and aspect. The possibility that there is a preference for building monuments on sites with a specific slope or elevation will be tested. The topographic properties of the sites themselves will be tested first. An iterative approach is adopted. The results of these preliminary tests are used to design and test further hypothesis regarding the relationship with the broader landscape.

Elevation

Elevation data were readily available in raster form in the MEPA 50 m DEM. Visual inspection of site distribution did not suggest any obvious preferences for particular ranges of altitude in the choice of site locations (Figure 14). The only possible pattern noted while 'eyeballing' the distribution of monumental sites is their absence from the area of high ground along the western coast of Malta, which is the highest in the archipelago.

In order to test these observations, the entire landscape was categorised into altitude ranges of 25 m each. The area of land and the number of sites in each altitude range may then be compared, and a K-S test performed. The results are shown in Figure 16. To facilitate comparison, the same format will be used in this chapter and the next whenever K-S testing is applied to a continuous variable. This first example will be explained in some detail.

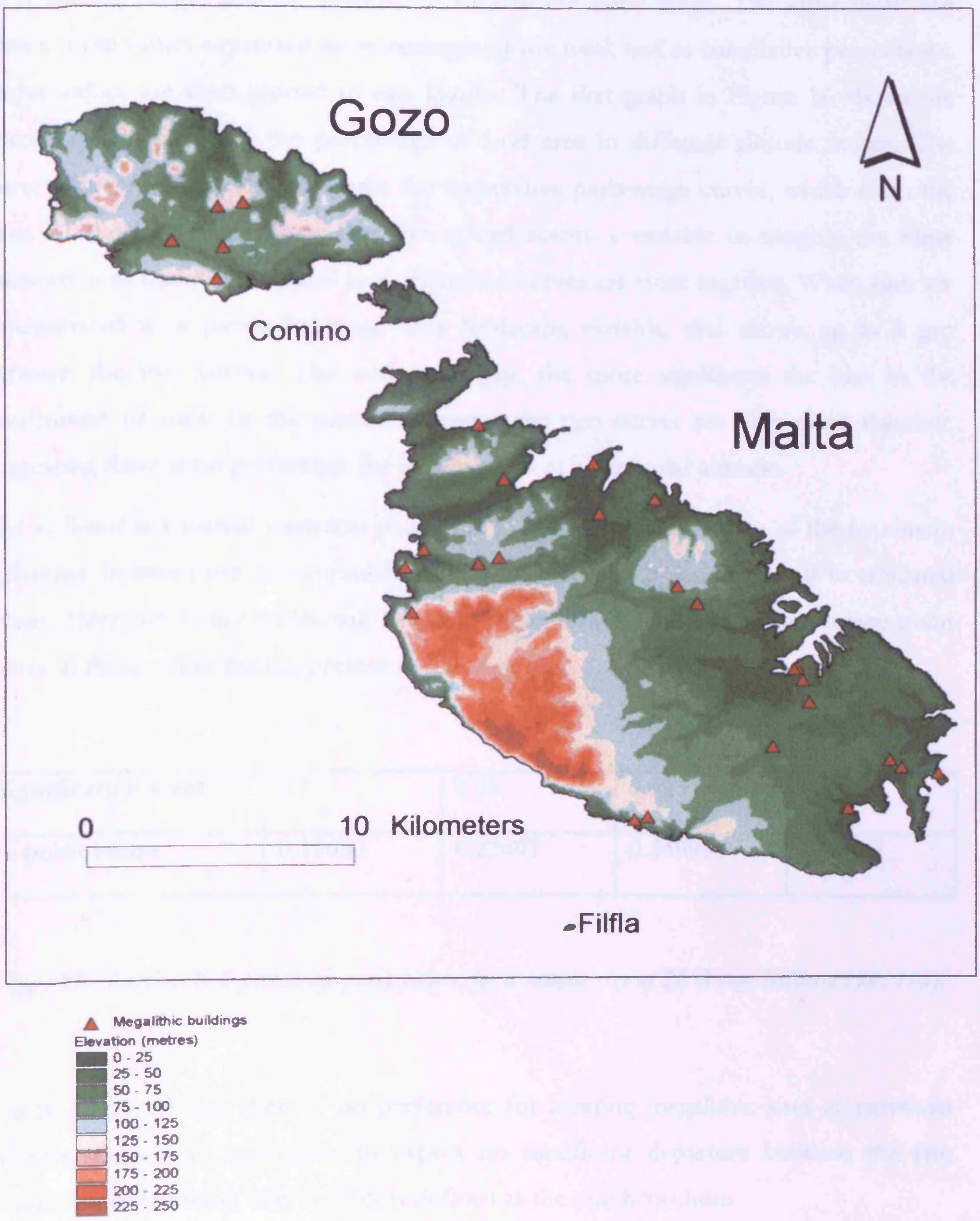


Figure 14. Distribution of megalithic buildings, shown against elevation.

The table at the top of Figure 16 shows the number of 50 x 50m land parcels that fall in each altitude range, and the number of sites in the same range. The same table also shows these values expressed as percentages of the total, and as cumulative percentages. These values are then plotted in two graphs. The first graph in Figure 16 shows the percentage of sites and the percentage of land area in different altitude ranges. The lower graph in Figure 16 compares the cumulative percentage curves, which form the basis of the K-S test. When sites are spread across a variable in roughly the same proportion as the available land area, these two curves are close together. When sites are concentrated in a particular range of a landscape variable, this shows up as a gap between the two curves. The wider the gap, the more significant the bias in the distribution of sites. In the present example, the two curves are very close together, suggesting there is no preference for locating sites at a particular altitude.

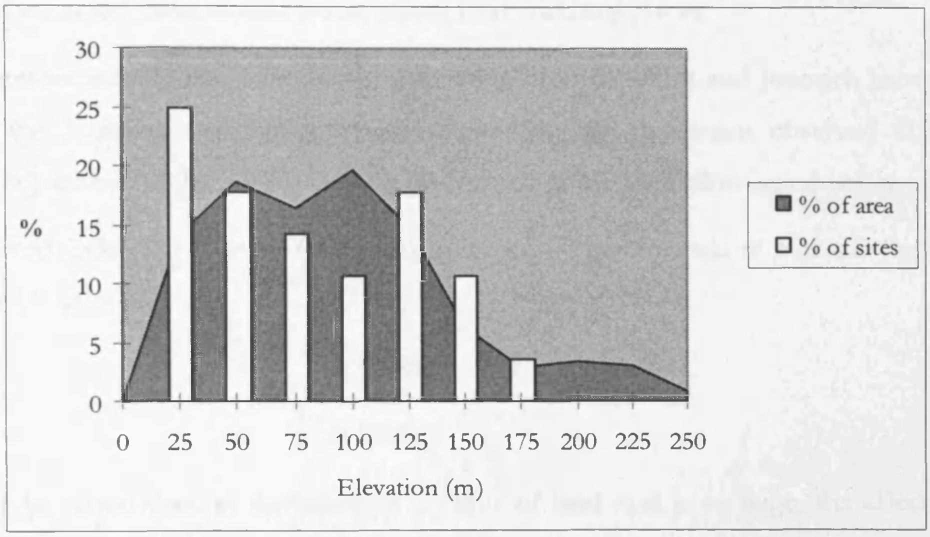
The K-S test is a formal statistical procedure to assess the significance of the maximum difference between the two cumulative percentage curves, by comparing it to tabulated values. Here the Miller tables will be used (Miller 1956). The critical percentage point values in these tables for the present sample size are:

Significance level	0.1	0.05	0.025	0.01
% point value	0.19680	0.22497	0.24993	0.27942

Figure 15. Critical K-S percentage point values, for a sample size of 28 (From Miller 1956, 113).

If it is supposed that there is no preference for locating megalithic sites at particular altitudes, then it is reasonable to expect no significant departure between the two cumulative distribution curves. This is defined as the null hypothesis.

Elev (m)	Area	%	Cumul. %	No. Sts	%	Cumul. %	Difference
0	0	0	0	0	0	0	
25	17587	14.01	14.01	7	25.00	25.00	10.9902
50	23425	18.66	32.67	5	17.86	42.86	10.1871
75	20691	16.48	49.15	4	14.29	57.14	7.9904
100	24664	19.65	68.80	3	10.71	67.86	-0.9425
125	18565	14.79	83.59	5	17.86	85.71	2.1258
150	7773	6.19	89.78	3	10.71	96.43	6.6481
175	3623	2.89	92.67	1	3.57	100	7.3335
200	4341	3.46	96.12	0	0	100	3.8754
225	3862	3.08	99.20	0	0	100	0.7990
250	1003	0.80	100	0	0	100	0



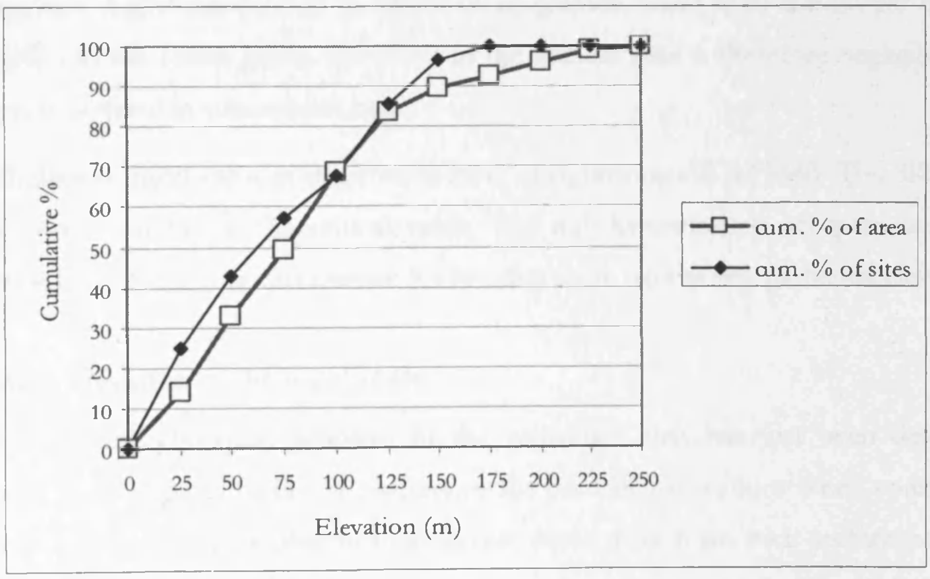


Figure 16. Distribution of megalithic buildings and land area, plotted against elevation.

Visual inspection of the graphs suggests that this null hypothesis is likely to be true. The significance level is set at 0.1. In other words, if there is less than one chance in ten that the relationship between site location and elevation could occur by chance alone, the null hypothesis will be rejected, and the relationship will be considered to be significant. If there is more than one chance in ten that the observed relationship did occur by chance, the null hypothesis will be accepted.

The greatest difference observed between the two curves occurs at 25 metres above sea level (Shown in red in the table in Figure 16). This difference is equivalent to a percentage point of 0.109902. As the Miller tables give values to five decimal places, the difference in the present case is calculated to six decimal places.

The present sample size falls within the range for which Kim and Jennrich recommend using the Kolmogorov Approximation to adjust the maximum observed difference (Kim & Jennrich 1973, 84-86). This is performed, using the following equation:

Corrected difference = Observed difference - 1 / (2n), where n is the number of units of land area.

= 0.109902 - 1 / (2 x 125,534)

= 0.109899

It may be noted that, as the number of units of land area is so large, the effect of the Kolmogorov Approximation is an order of magnitude lower than the lowest decimal place given in the Miller tables. Its effect in the present case is therefore negligible, and this step is omitted in subsequent cases.

The tabulated critical value at the chosen level of significance is 0.19680. The difference in this case is far below the critical value. The null hypothesis is accepted, and it is established that there is no preference for locating these sites at any particular elevation.

Assessing elevation at the local scale

There is a methodological problem in the procedure that has just been described. Although there appears to be no preference for particular elevations when considering the entire archipelago, this does not necessarily mean there is no such preference at the local scale. For example, if one were to run the above test for fortified hill-top settlements in Italy, the results might suggest that there is no preference for locating these in particularly high places, because they are generally at lower altitudes than the Appenines or the Italian Alps. On the other hand, if the elevation of these sites was compared to that of their surroundings at a local scale, it would become very clear that there is a strong preference for the highest possible location. The solution to this difficulty is to repeat the assessment at a local scale. While examining Neolithic sites in Orkney, Fraser dealt with the same difficulty by comparing site elevation to the area within a 1km radius (Fraser 1983). This procedure also appears suitable for the Maltese environment. The elevation values of grid cells within 1 km of each site were selected. In order to make the data from one site comparable to another, the absolute values were transformed into relative values, ranging from 0 to 100 % for each 1 km catchment. The resulting relative elevations are shown in Figure 17 and Figure 18. These relative elevations could now be added, and the distribution of sites subjected to K-S testing, using the same procedure as before. The results are shown in Figure 19. It may be noted that the maximum difference observed in this test is slightly less than that obtained for the entire landscape. This confirms that there is no significant preference for locating monumental sites at particular elevations, even when considered at the local scale.

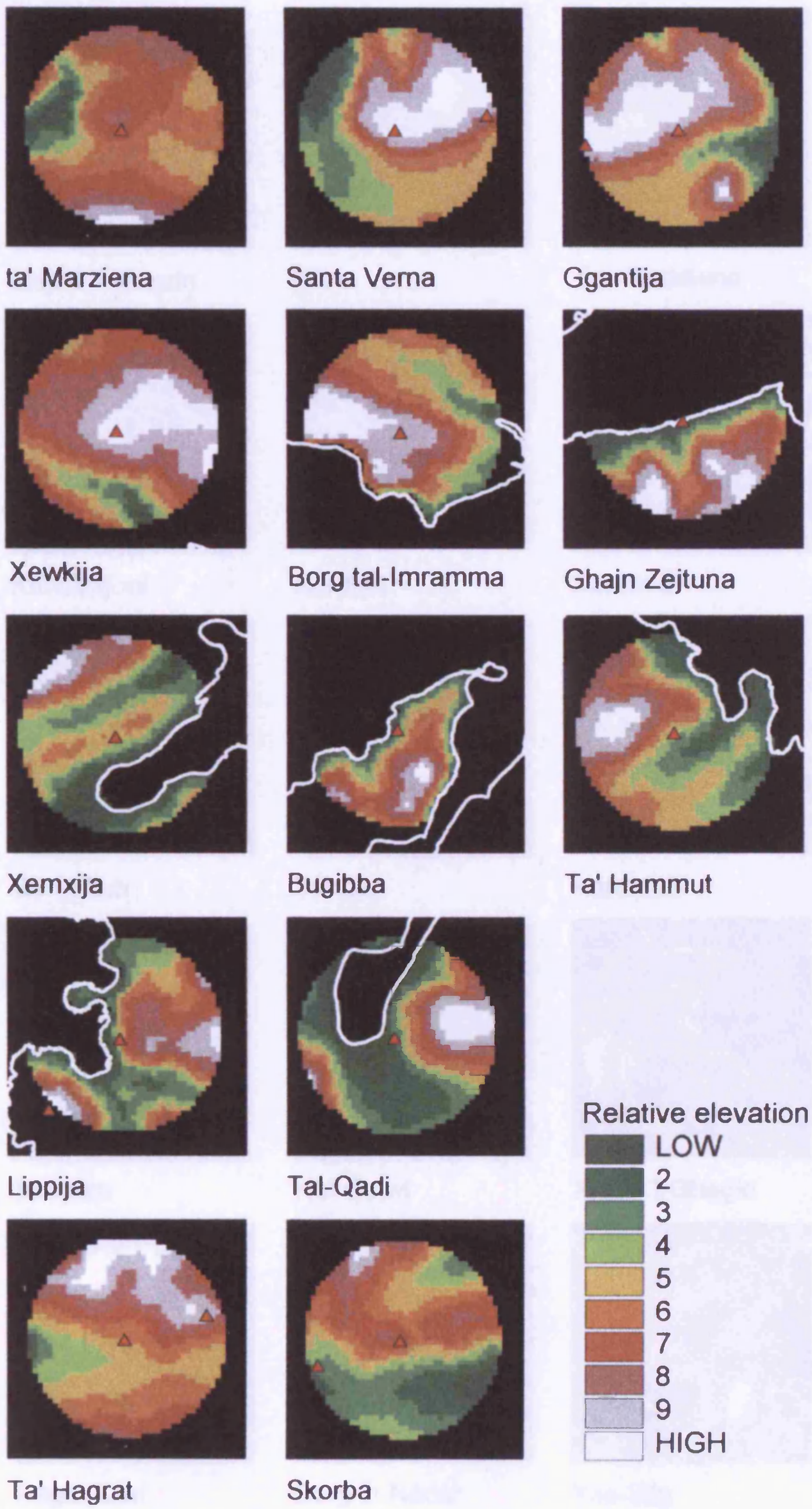


Figure 17. Elevation of megalithic buildings on Gozo and North Malta, compared to land within 1km radius.

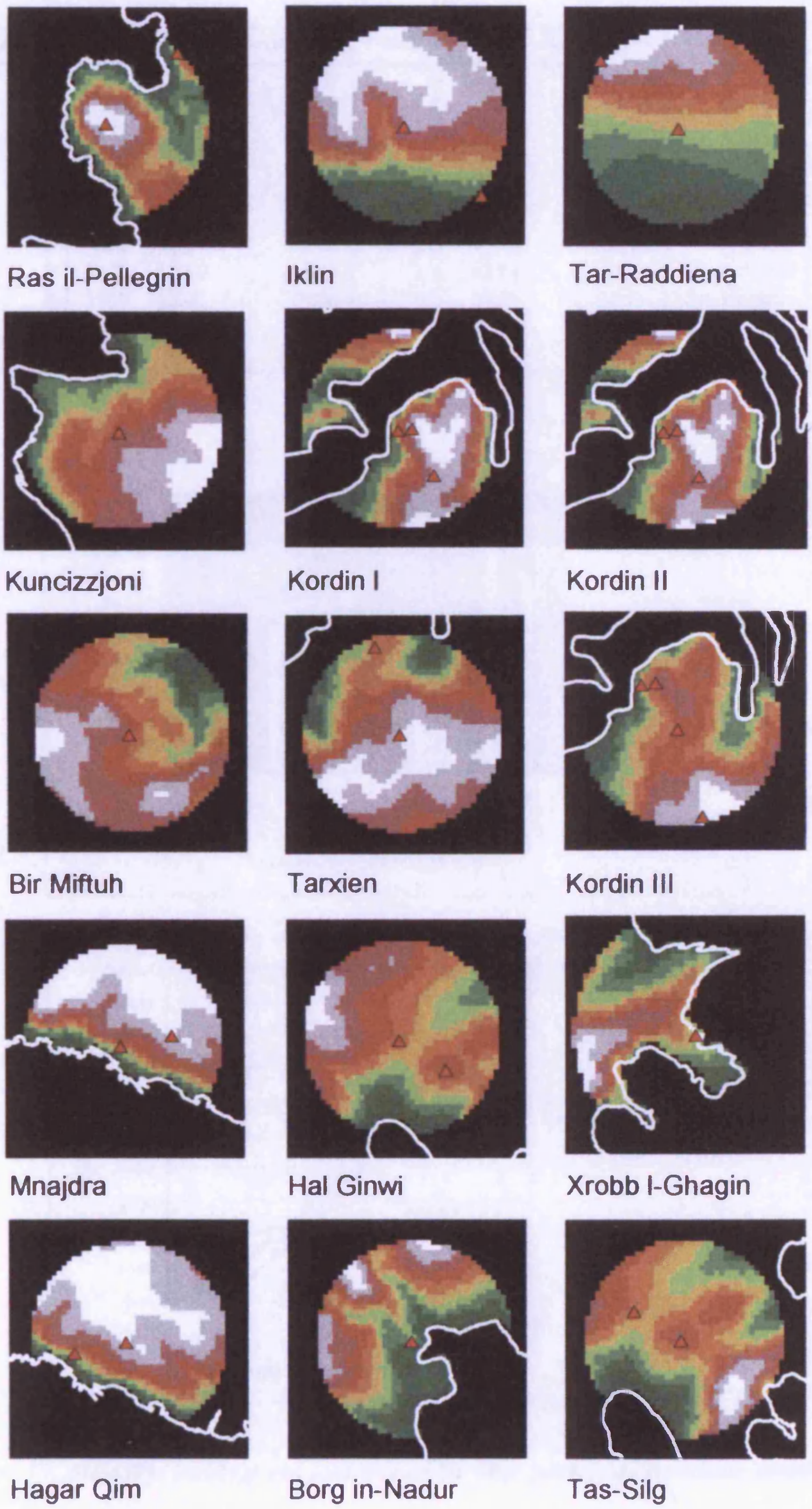
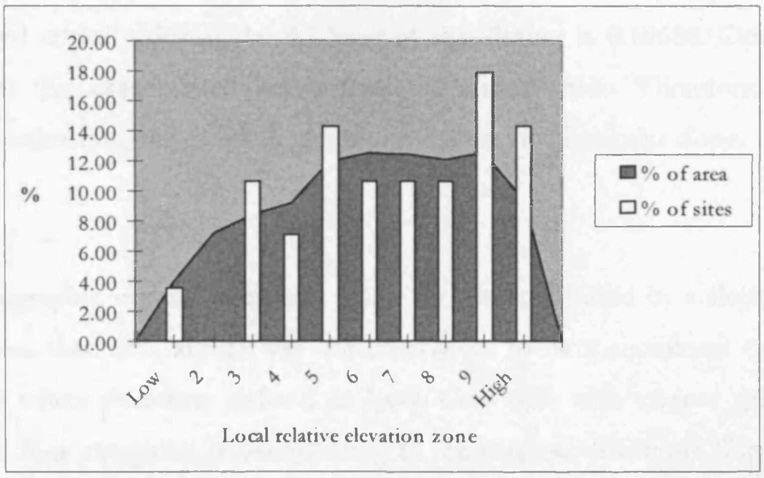


Figure 18. Elevation of megalithic buildings on South Malta, compared to land within 1km radius.

Zone	Area	%	Cumul. %	No. Sts	%	Cumul. %	Difference
	0	0.00	0.00	0	0.00	0.00	-
Low	1159	3.99	3.99	1	3.57	3.57	- 0.41824
2	2105	7.25	11.24	0	0.00	3.57	- 7.66437
3	2455	8.45	19.69	3	10.71	14.29	- 5.40103
4	2664	9.17	28.86	2	7.14	21.43	- 7.42857
5	3501	12.05	40.91	4	14.29	35.71	- 5.19449
6	3642	12.54	53.45	3	10.71	46.43	- 7.01721
7	3628	12.49	65.93	3	10.71	57.14	- 8.79174
8	3505	12.07	78.00	3	10.71	67.86	-10.14286
9	3648	12.56	90.56	5	17.86	85.71	- 4.84337
High	2743	9.44	100.00	4	14.29	100.00	- 0.00000



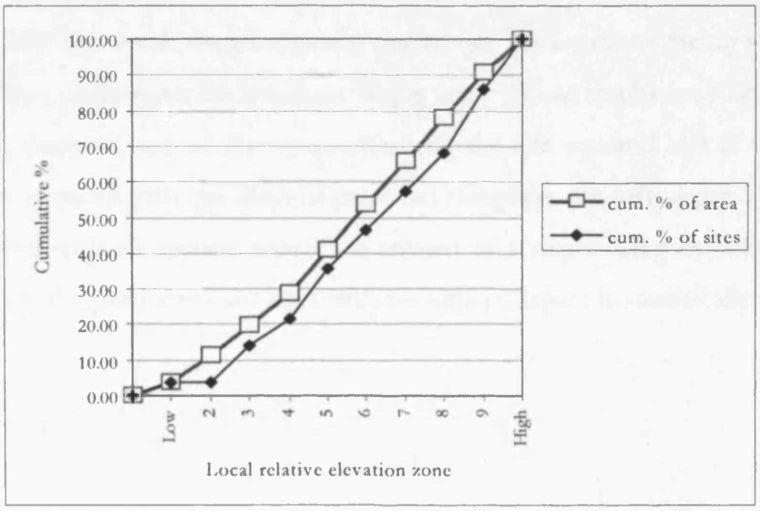


Figure 19. Megalithic buildings and land area within 1km, plotted against relative elevation.

Slope

Slope is another basic variable of most landscapes. Raster slope data were obtained from the MEPA 50 m DEM, using the ArcView slope function. As in the case of elevation, consideration of site distribution did not suggest any obvious preferences for building monumental sites on more level or more sloping terrain (Figure 20).

The same routine as before was applied, and the results are shown in Figure 21.

The K-S test is conducted as before. The greatest difference that is observed between the two curves occurs at a slope of 10 %. This difference is equivalent to a percentage point of 0.096055.

The tabulated critical value at the 0.1 level of significance is 0.19680. Once again, the difference in this case is well below than the critical value. Therefore there is no preference for locating megalithic buildings on sites at any particular slope.

Aspect

A third topographic variable is aspect, that is the direction faced by a slope. Where the slope was less than 3%, aspect was not considered to be a significant consideration. These areas where therefore defined as level. Grid cells with steeper gradients were divided into four categories, corresponding to the cardinal directions (Figure 22). The distribution of sites across these categories could then be submitted to a Chi-squared test (Figure 23). The result shows a strong preference for locations facing south, as well as a less distinct preference for locations facing west. These results may only be treated as indicative, because one of the assumptions of the Chi-squared test is violated by a small margin, as more than one-fifth of expected categories are just under 5. If sites with a northern and with an eastern aspect are treated as a single category, this problem is eliminated, and the preference for sites with a southern aspect is statistically validated.

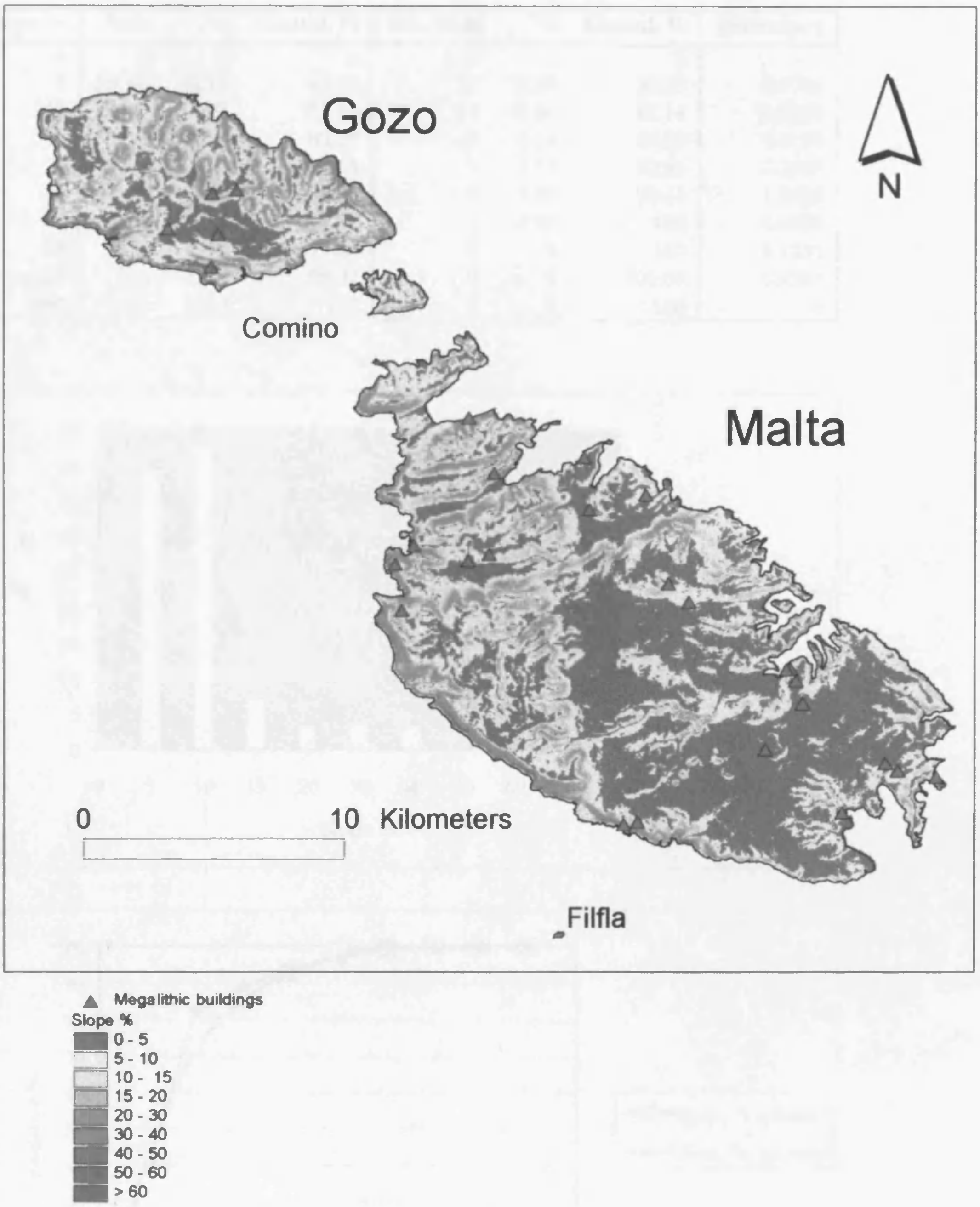
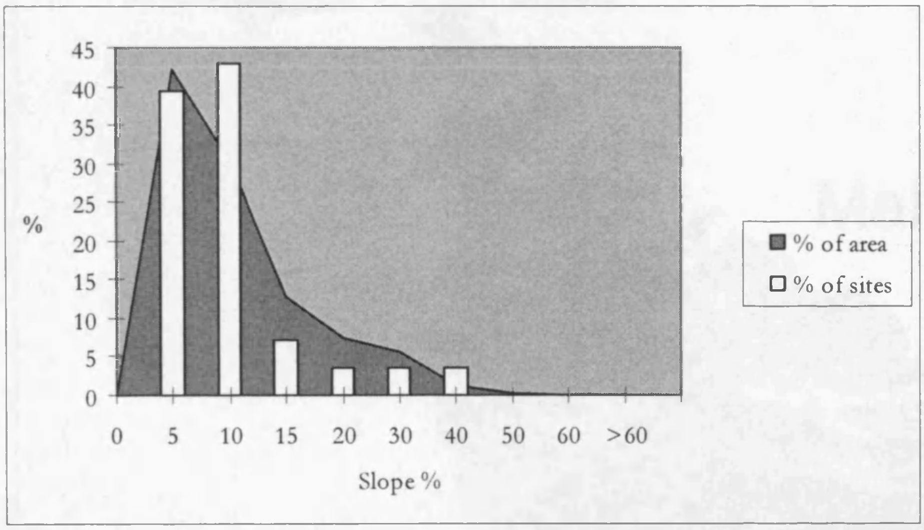


Figure 20. Megalithic buildings, mapped against slope.

Slope %	Area	%	Cumul. %	No. Sites	%	Cumul. %	Difference
0	0	0	0	0	0	0	
5	53046	42.26	42.26	11	39.29	39.29	-2.9706
10	38013	30.28	72.54	12	42.86	82.14	9.6055
15	15980	12.73	85.27	2	7.14	89.29	4.0188
20	9241	7.36	92.63	1	3.57	92.86	0.2289
30	7108	5.66	98.29	1	3.57	96.43	-1.8619
40	1541	1.23	99.52	1	3.57	100	0.4819
50	450	0.36	99.88	0	0	100	0.1235
60	112	0.09	99.97	0	0	100.00	0.0343
>60	43	0.03	100	0	0	100	- 0



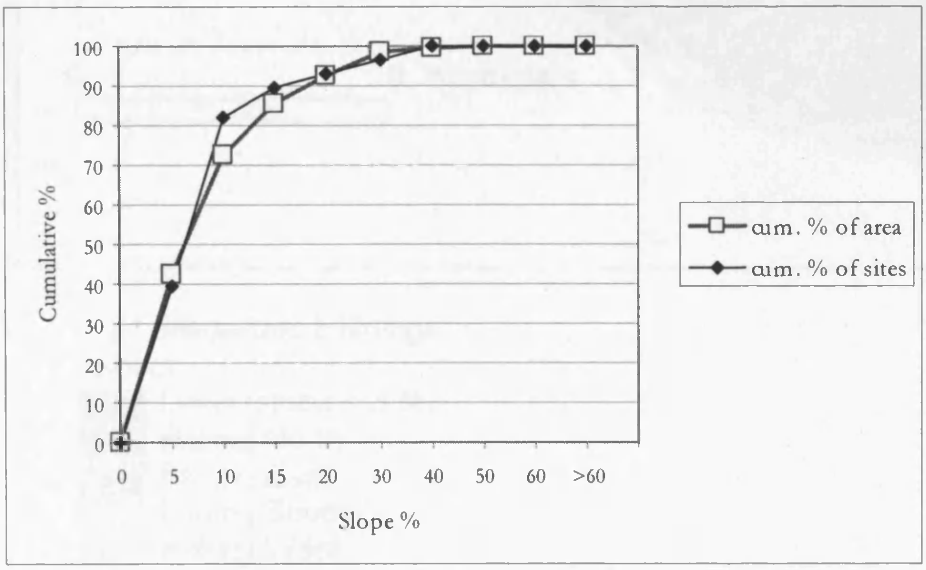


Figure 21. Distribution of megalithic buildings and land area, plotted against slope.

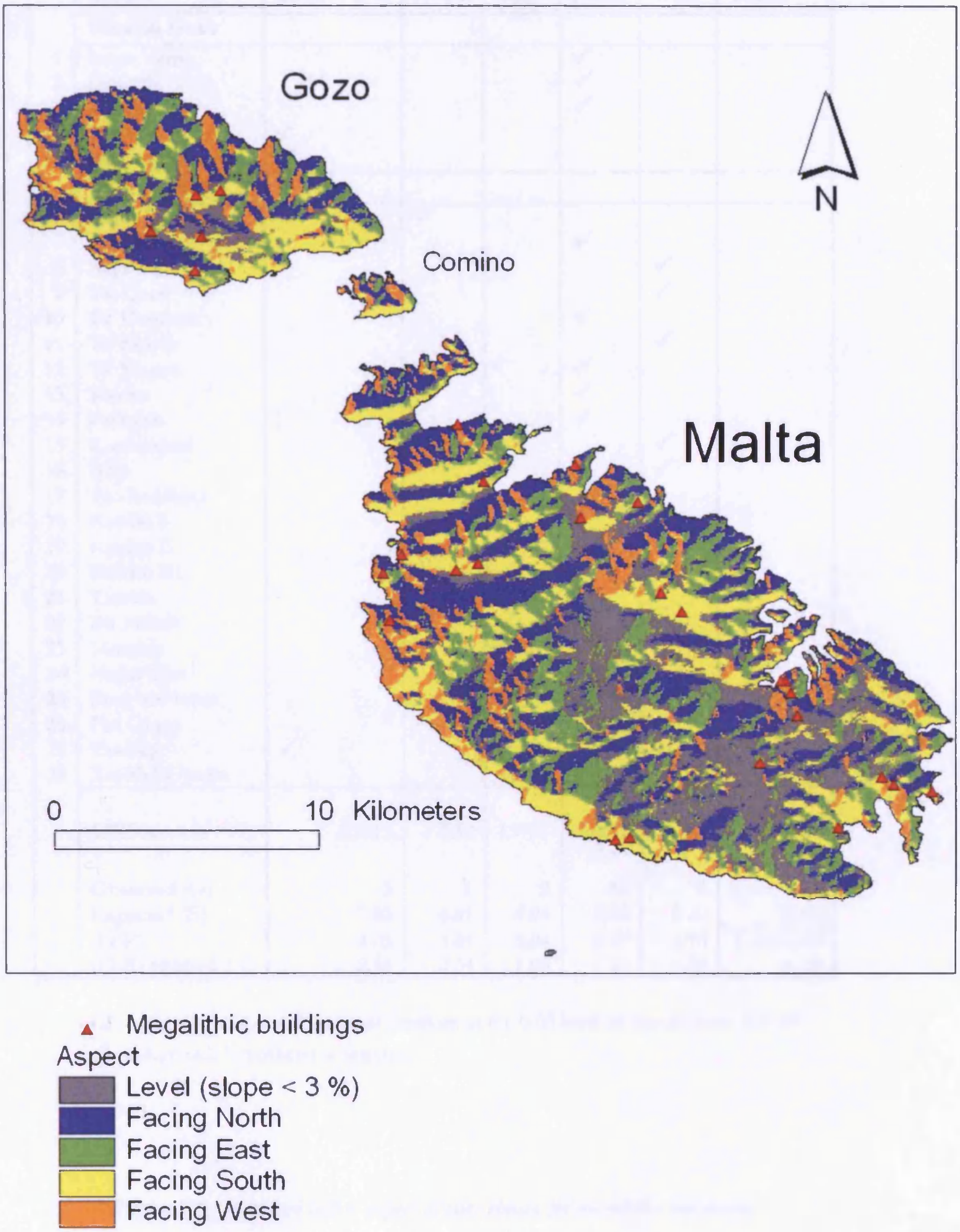


Figure 22. Megalithic buildings, mapped against aspect.

	Aspect	Slope < 3 %	North	East	South	West	Totals
	Sites on Gozo						
1	Santa Verna				✓		
2	Ġgantija				✓		
3	Ta' Marżiena				✓		
4	Xewkija	✓					
5	Borġ tal-Imramma	✓					
	Sites on Malta						
6	Għajn Żejtuna		✓				
7	Xemxija				✓		
8	Buġibba					✓	
9	Tal-Qadi					✓	
10	Ta' Ħammut				✓		
11	Ta' Lippija					✓	
12	Ta' Ħaġrat				✓		
13	Skorba				✓		
14	Pellegrin				✓		
15	Kunċizzjoni					✓	
16	Iklin					✓	
17	Tar-Raddiena				✓		
18	Kordin I					✓	
19	Kordin II					✓	
20	Kordin III					✓	
21	Tarxien					✓	
22	Bir Miftuħ			✓			
23	Mnajdra				✓		
24	Ħaġar Qim				✓		
25	Borġ in-Nadur				✓		
26	Ħal Ġinwi				✓		
27	Tas-Silġ	✓					
28	Xrobb l-Għaġin			✓			
	50X50m cells	27515	17252	15791	24631	24331	109520
	Observed (O)	3	1	2	13	9	28
	Expected (E)	7.03	4.41	4.04	6.30	6.22	28.00
	(O-E)	-4.03	-3.41	-2.04	6.70	2.78	X-squared
	(O-E) squared / E	2.31	2.64	1.03	7.13	1.24	14.36

Chi-squared value at 4 degrees of freedom at the 0.05 level of significance is 9.49.
Therefore null hypothesis is rejected.

Figure 23. χ-squared test of aspect of sites chosen for megalithic buildings.

Distance from plain boundaries

In Chapter 3 it was noted that the layered sedimentary geology of the archipelago together with long-term erosion processes has resulted in a landscape characterized by discrete plains, sharply demarcated by steep slopes, faults and wadis. One of the patterns that may be noted when 'eyeballing' a slope map is that monumental sites appeared to be located close to these discrete plains.

In order to test this relationship, two grid themes were created to show the horizontal distance (Figure 24) and the cost distance (Figure 26) of each cell from plain boundaries, as described earlier in this chapter. For the purposes of K-S testing, cells were 'binned' into zones of increasing distance. As sites appeared to be clustered nearer to plain boundaries, these zones were not set at uniform ranges. Smaller intervals were used nearer to the boundaries, and longer intervals further away. In this way, the distribution of sites could be examined at a higher resolution where it was most dense.

The distribution of these variables is shown against horizontal distance from plain boundaries in Figure 25, and against cost distance in Figure 27. The K-S test was run for both distance surfaces, and the results compared.

Both sets of distribution curves show that there is preference to locate sites nearer to plain boundaries. This is more marked when using horizontal distance than when using cost distance. The maximum difference between the distributions when plotted against horizontal distance is 0.265237. When plotted against cost distance, the maximum difference that is observed is rather lower, at 0.192950.

The tabulated critical value at the 0.1 level of significance is 0.19680. The difference observed for the cost distance surface is just below this value, while that for the horizontal distance surface is rather higher (in fact it is even higher than the critical value at the 0.025 level of significance, which is 0.24993). These results confirm that there is a strong preference for locating these sites near the boundaries of plains. The different results obtained with horizontal distance and with cost distance are considered in the discussion section below.

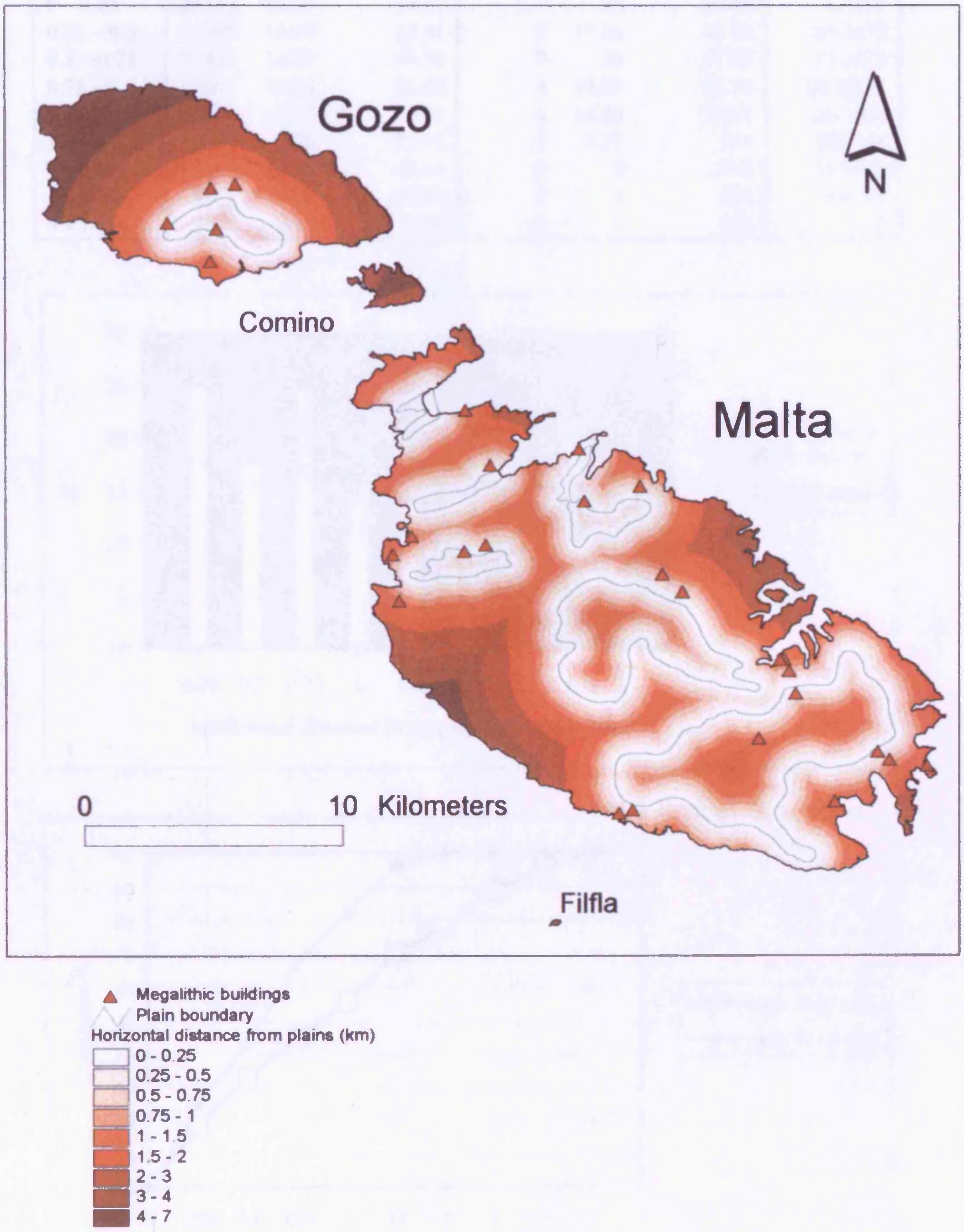
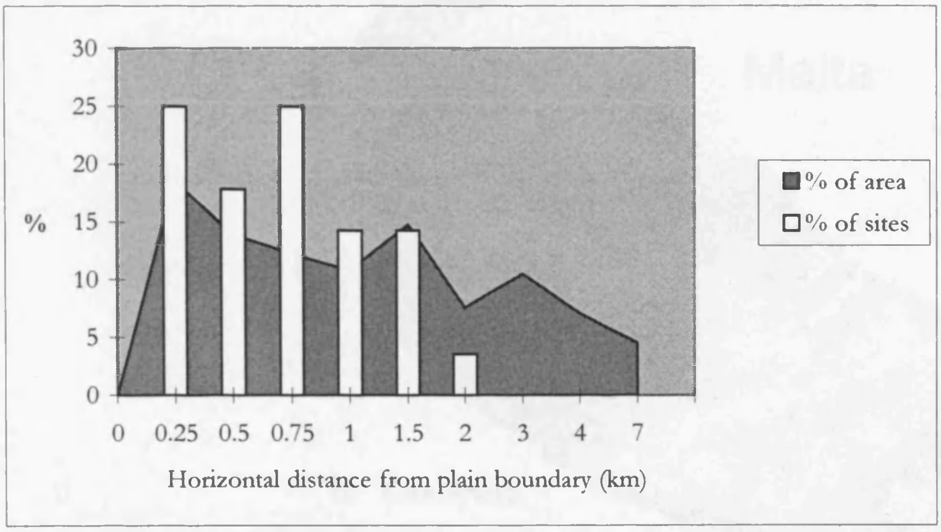


Figure 24. Megalithic buildings, mapped against HORIZONTAL distance from plain boundaries.

Dist. (km)	Area	%	Cumul. %	No. Sts	%	Cumul. %	Difference
0	0	0	0	0	0	0	
0 - 0.25	23312	18.57	18.57	7	25	25.00	6.4297
0.25 - 0.5	17499	13.94	32.51	5	17.86	42.86	10.3472
0.5 - 0.75	15403	12.27	44.78	7	25	67.86	23.0772
0.75 - 1	13607	10.84	55.62	4	14.29	82.14	**26.5237**
1 - 1.5	18541	14.77	70.39	4	14.29	96.43	26.0397
1.5 - 2	9490	7.56	77.95	1	3.57	100	22.0514
2 - 3 km	13185	10.50	88.45	0	0	100	11.5483
3 - 4 km	8875	7.07	95.52	0	0	100	4.4785
4 - 7 km	5622	4.48	100	0	0	100	0



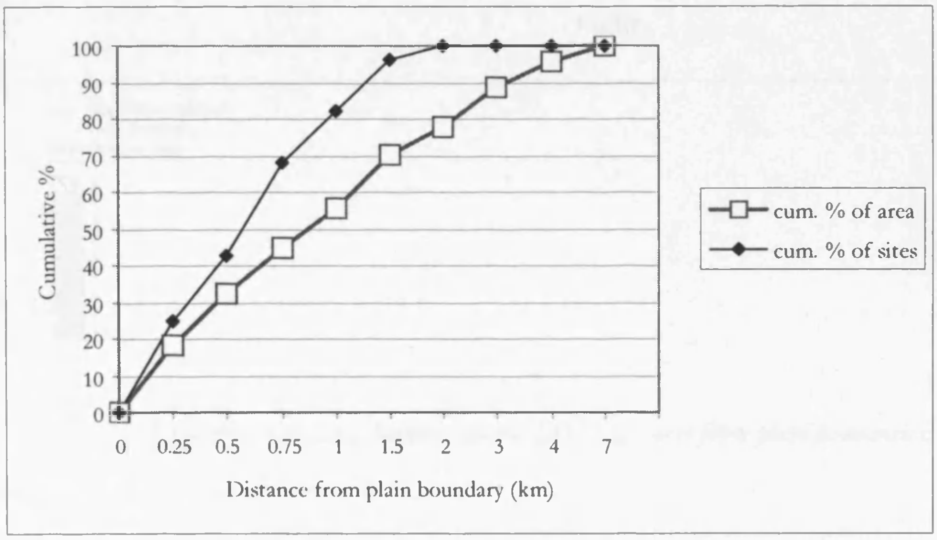


Figure 25. Megalithic buildings & land area, plotted against HORIZONTAL distance from plain boundaries.

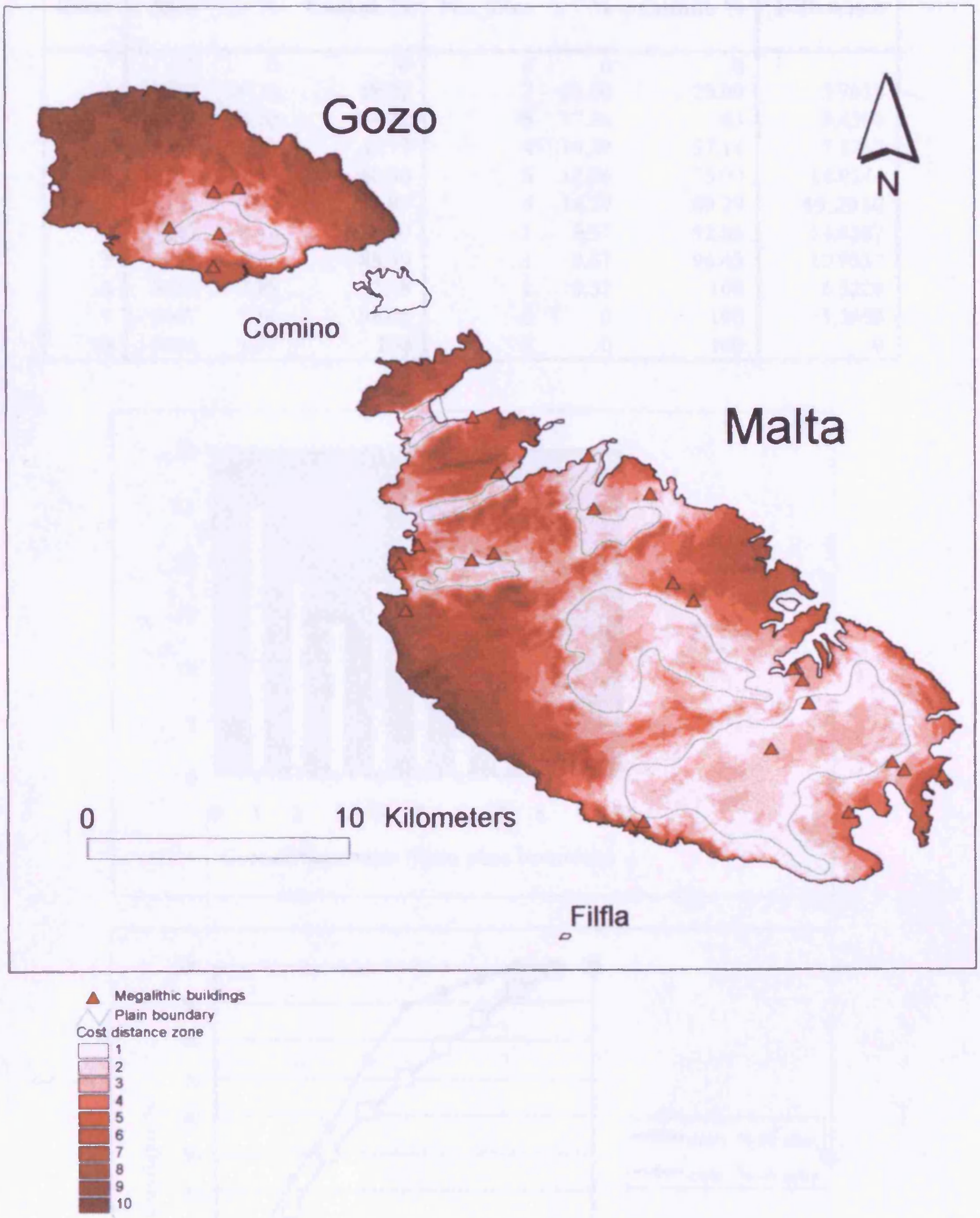


Figure 26. Megalithic buildings, mapped against COST distance from plain boundaries.

Zone	Area	%	Cumul. %	No. Sites	%	Cumul. %	Difference
	0	0	0	0	0	0	
1	23872	19.22	19.22	7	25.00	25.00	5.7833
2	18884	15.20	34.42	5	17.86	43	8.4390
3	19066	15.35	49.77	4	14.29	57.14	7.3767
4	13925	11.21	60.98	5	17.86	75.00	14.0244
5	11199	9.02	69.99	4	14.29	89.29	**19.2950**
6	10447	8.41	78.40	1	3.57	92.86	14.4567
7	8813	7.09	85.49	1	3.57	96.43	10.9337
8	9916	7.98	93.48	1	3.57	100	6.5228
9	6407	5.16	98.63	0	0	100	1.3653
10	1696	1.37	100	0	0	100	- 0

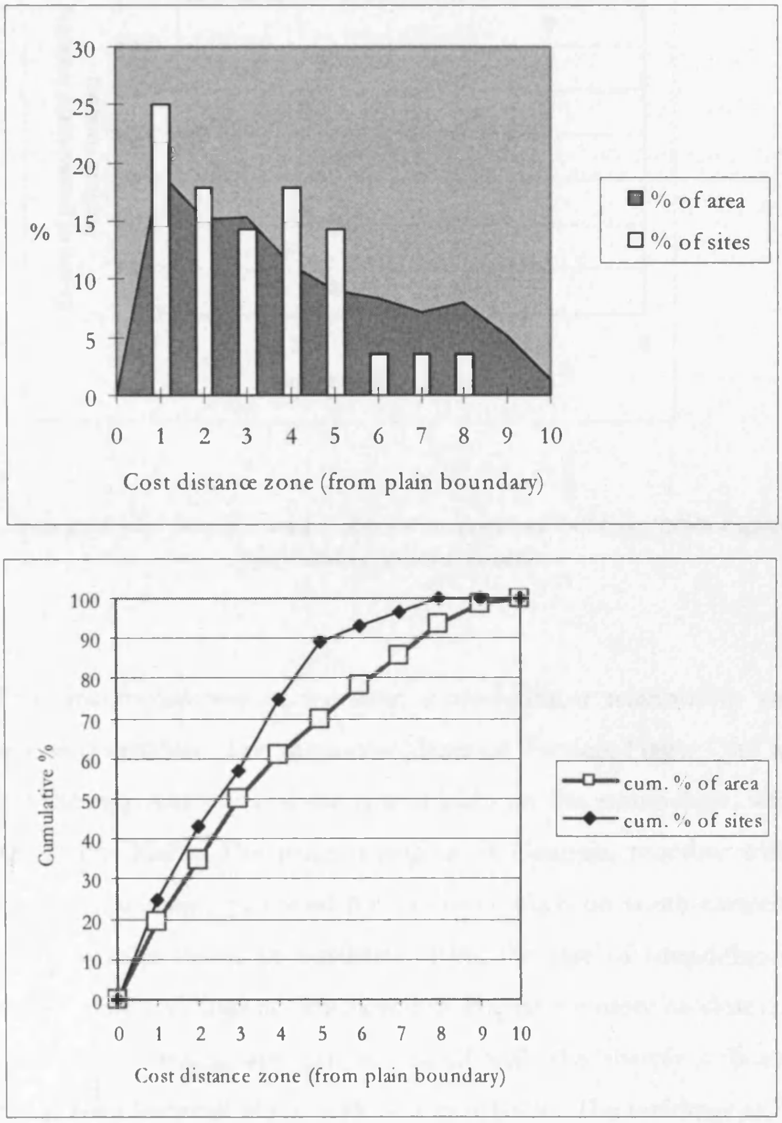


Figure 27. Megalithic buildings and land area, plotted against COST distance from plain boundaries.

Site size and plain extent

The relationship between the plains and monumental activity may be explored by a further test. The size and number of known monumental sites may be compared to the extent of the plain around which they occur. A readily available index of site size is the footprint area they occupy. The total footprint area of the monumental sites associated with each of the seven plains identified earlier was estimated, and plotted against the area of each plain (Figure 28).

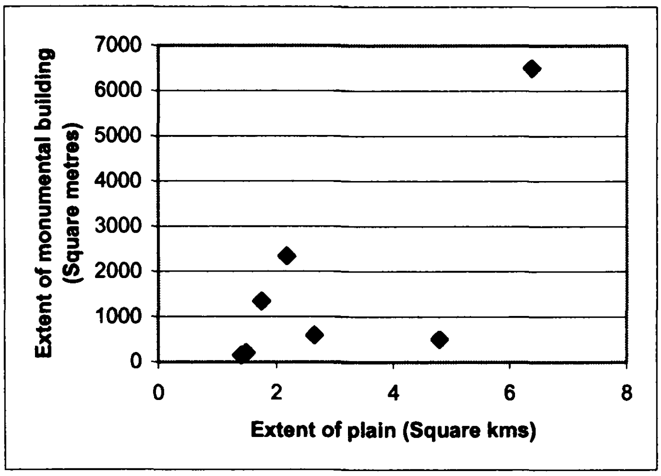


Figure 28. Estimated total footprint area of known monumental buildings, plotted against extent of plain around which they occur.

In spite of the incompleteness of the data, a nearly linear relationship was observed between these two variables. The mega-complexes of Tarxien, Haġar Qim and Mnajdra are located at the opposite ends of the largest plain on the archipelago, which extends across south-eastern Malta. The major complex of Ġgantija, together with a halo of smaller megalithic buildings, surround the extensive plain on south-eastern Gozo. In the case of the smaller plains in northern Malta, the size of megalithic buildings is evidently smaller. The buildings at Skorba and ta' Ħaġrat are more modest constructions than the ones already noted, and are associated with the sharply defined plain that formed in the graben between Mġarr and the Great Fault. The buildings at Buġibba and tal-Qadi are smaller still, and are associated with a relatively small plain. The extreme example is that of Għajn Żejtuna, where a very modest megalithic structure was built in another sharply-defined graben formation, which even when allowance is made for marine transgression since the Neolithic, as discussed in Chapter 3, could only have held a plain very restricted in extent. This result is a further indication of a relationship between the productive capacity of the plains and the monumental activity that was generated around them.

Access to the sea

The K-S test was run for distance from points that allow access to the sea, defined earlier in this chapter. The analysis was run using simple horizontal distance (Figure 29) and again using cost distance (Figure 31). In both cases, the resulting cumulative percentage curves showed a preference to locate sites nearer to places that allowed easy access to the sea. Once again, this relationship was stronger for horizontal distance (Figure 30) than for cost distance (Figure 32). The maximum difference between the distributions when plotted against horizontal distance is 0.299312, and occurs at 1km from the sea. When plotted against cost distance, the maximum difference that is observed is rather lower, at 0.191161. When compared to the critical values in the Miller tables (Figure 15, page 113), these results show a strong preference for locations near access points to the sea. In fact, the maximum difference obtained for horizontal distance is even significant at the 0.01 level, meaning that there is less than one chance in a hundred that the observed relationship could have occurred by chance.

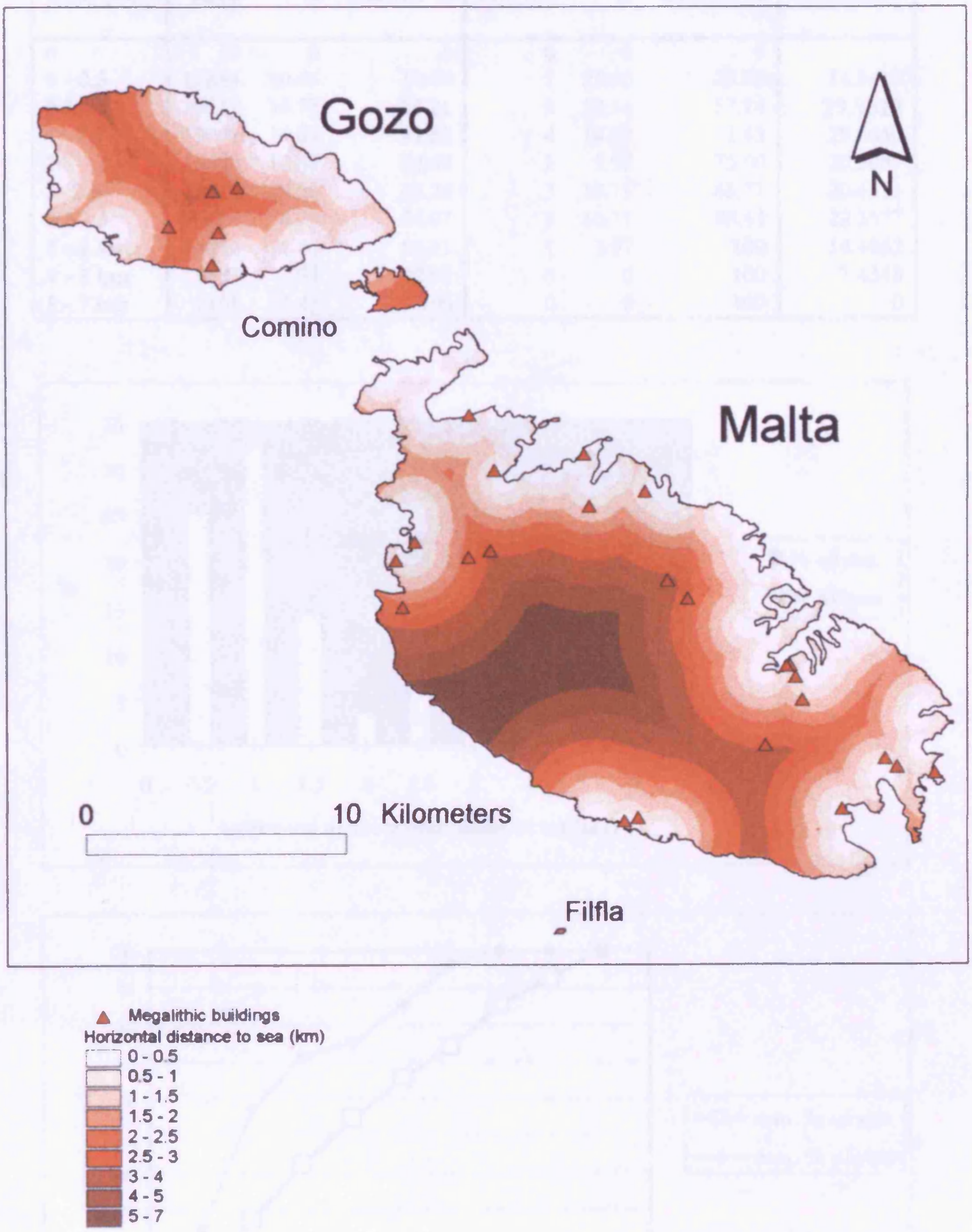
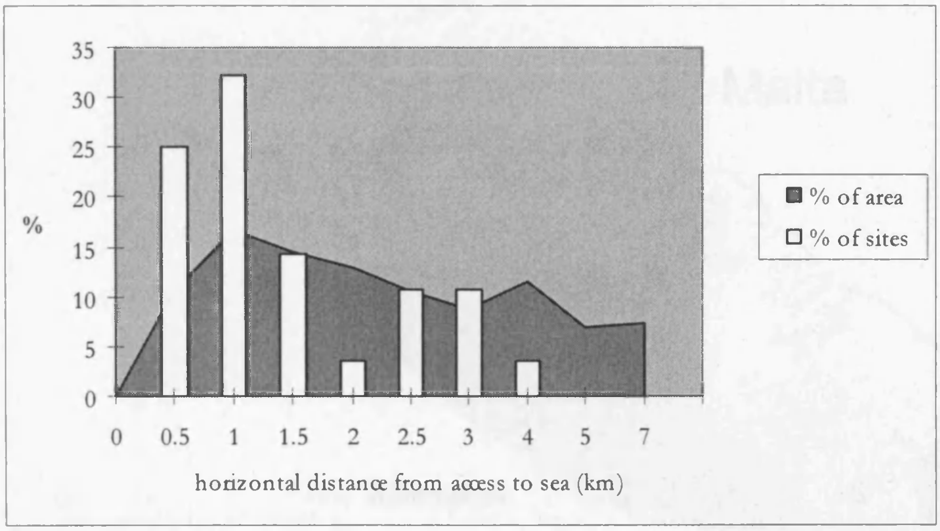


Figure 29. Megalithic buildings, mapped against HORIZONTAL distance from access to sea.

Dist. (km)	Area	%	Cumul. %	No. Sts	%	Cumul. %	Difference
0	0	0	0	0	0	0	
0 - 0.5	12884	10.46	10.46	7	25.00	25.00	14.5410
0.5 - 1	20637	16.75	27.21	9	32.14	57.14	**29.9312**
1 - 1.5	18001	14.61	41.82	4	14.29	71.43	29.6040
1.5 - 2	15850	12.87	54.69	1	3.57	75.00	20.3087
2- 2.5	13045	10.59	65.28	3	10.71	85.71	20.4333
2.5 - 3	10828	8.79	74.07	3	10.71	96.43	22.3577
3 - 4 km	14096	11.44	85.51	1	3.57	100	14.4862
4 - 5 km	8687	7.05	92.57	0	0	100	7.4343
5 - 7 km	9158	7.43	100	0	0	100	0



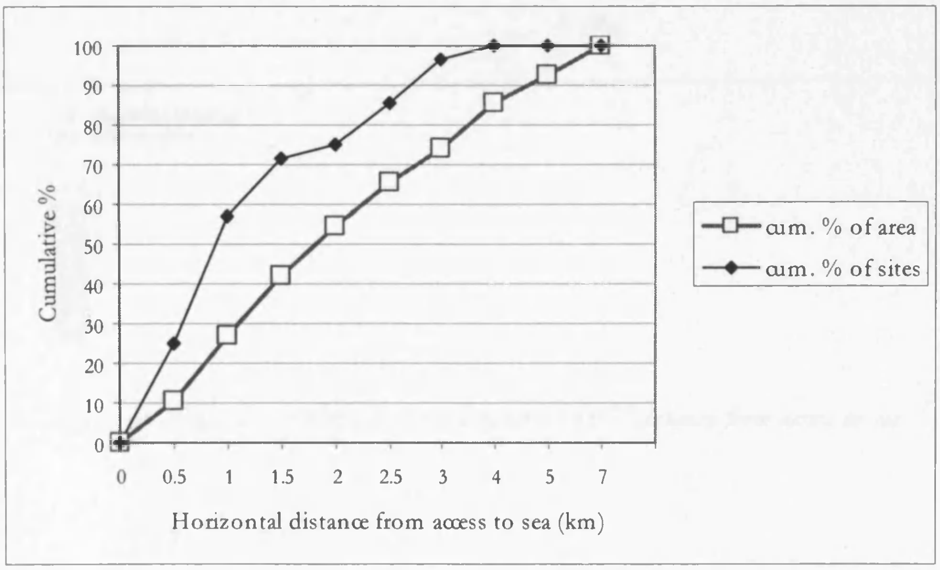


Figure 30. Megalithic buildings and land area, plotted against HORIZONTAL distance from access to sea.

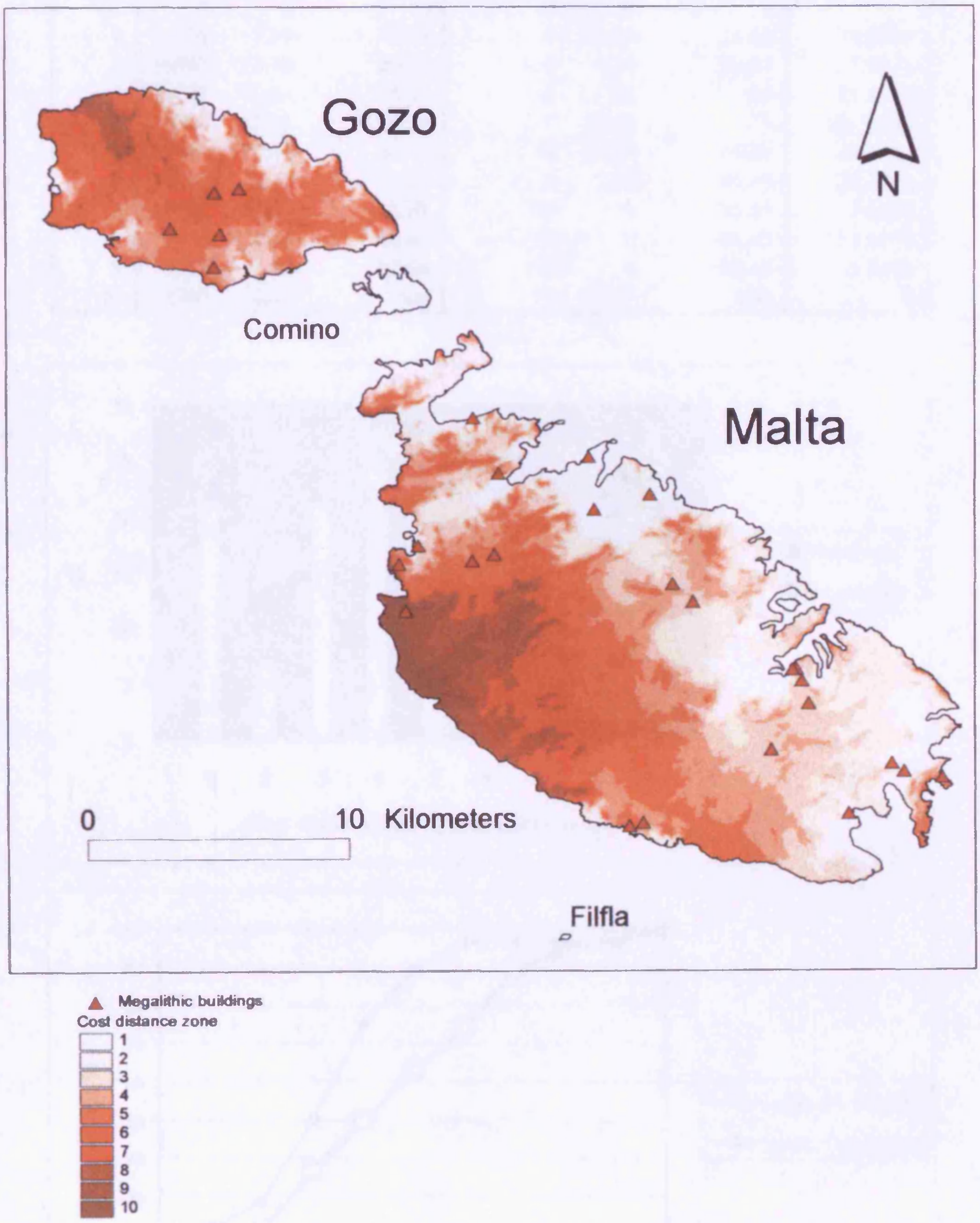
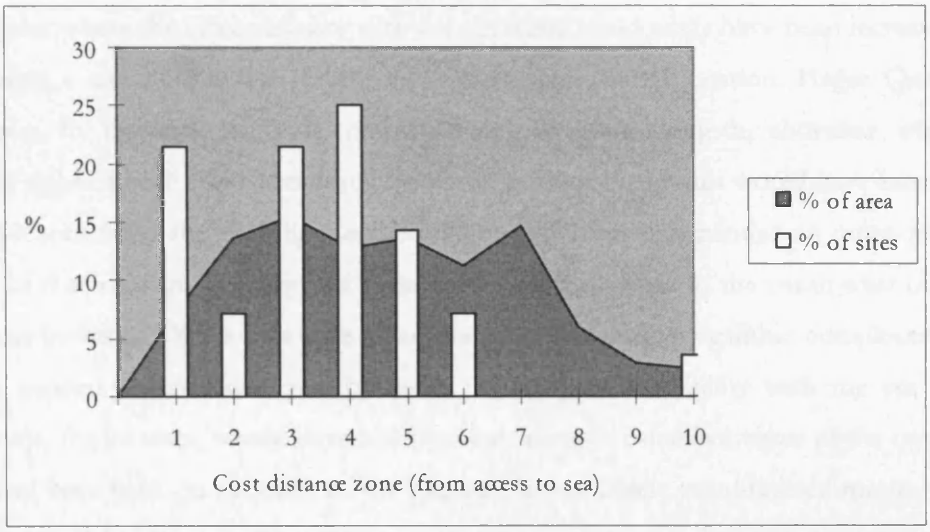


Figure 31. Megalithic buildings, mapped against COST distance from access to sea.

Zone	Area	%	Cumul. %	No. Sites	%	Cumul. %	Difference
	0	0	0	0	0	0	
1	9176	7.39	7.39	6	21.43	21.43	14.0416
2	16865	13.58	20.96	2	7.14	28.57	7.6076
3	19182	15.44	36.41	6	21	50	13.5941
4	15960	12.85	49.25	7	25.00	75	**25.7459**
5	16990	13.68	62.93	4	14.29	89.29	26.3541
6	13999	11.27	74.20	2	7.14	96.43	22.2274
7	18147	14.61	88.81	0	0	96.43	7.6185
8	7439	5.99	94.80	0	0	96.43	1.6299
9	3576	2.88	97.68	0	0	96.43	-1.2489
10	2885	2.32	100	1	3.57	100	0



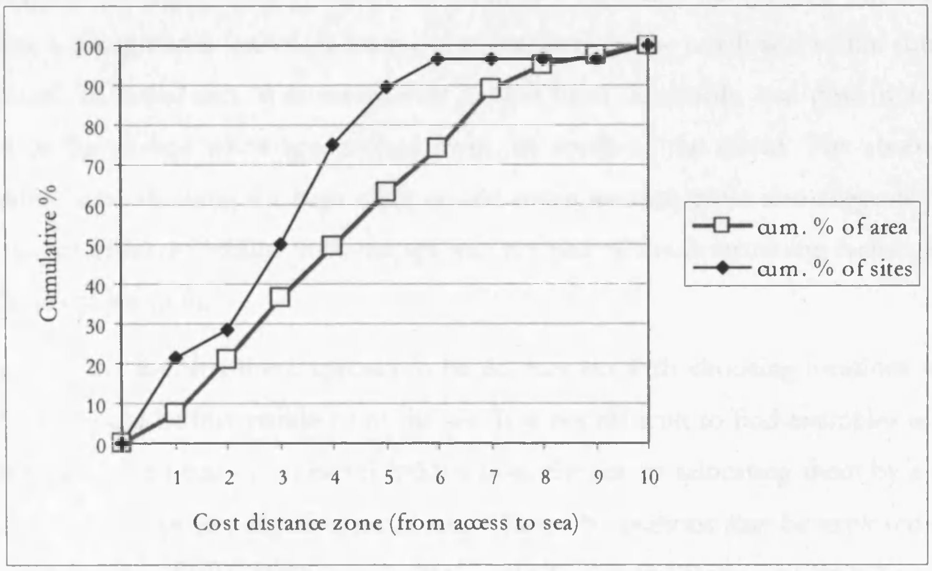


Figure 32. Megalithic buildings and land area, plotted against COST distance from access to sea.

Inter-visibility with the sea

The test described above examined the accessibility of monumental sites from the sea. It is interesting to compare the results obtained with another possible type of relationship with the sea. This is inter-visibility. Different locations in the landscape may command extensive or limited views of the shoreline or the sea, and likewise, a building placed in different locations in the landscape may be more or less visible from the shoreline or the sea. In the present case, it appears that these considerations were not a determining factor in the choice of location. Inter-visibility with the shoreline and inter-visibility with the sea are quite different issues, and should be considered in turn. There are several examples where the inter-visibility with the shoreline could easily have been increased by choosing a site only a few metres away from their actual location. Ħaġar Qim and Mnajdra, for instance, are both completely invisible from along the shoreline, which is out of sight of both these locations. However, both of these sites would have been very conspicuous from the shoreline, and would equally have commanded an uninterrupted view of that shoreline, if they had been built a short distance to the south-west of their present location. This is also true of several other of these megalithic complexes. The same general observations may be made regarding inter-visibility with the sea itself. Ġgantija, for instance, would have commanded far more extensive views of the open sea if it had been built on the crest of the Xagħra plateau, barely two hundred metres north of its actual location. Such a change in location would also have made this massive building a conspicuous landmark from out at sea, both to the north and to the south of the island. In actual fact, it is completely hidden from the north, and does not stand proud of the skyline when approached from the south of the island. The absence of megalithic sites all along the high cliffs on the south-western coast also suggests that a high degree of inter-visibility with the sea was not one of the determining factors in the choice of site location.

It may also be said that there appears to be no concern with choosing locations where these sites would be less visible from the sea. It is not difficult to find examples of sites which could have been much better hidden from the sea by relocating them by a short distance, had this been a significant concern. These observations may be explored using viewshed analysis in GIS. However, as discussed below in the section on limitations, this is sometimes less reliable than first-hand observation in the landscape.

Hydrology

The same procedure was used to test monument location against distance from spring toponyms, defined earlier in this chapter. The procedure was run using a horizontal distance surface (Figure 33) and repeated using a cost distance surface (Figure 35). The results are shown in Figure 34 and Figure 36 respectively. Both sets of curves show a preference for locating sites nearer to springs. In this case, site location shows a stronger relationship with the cost surface than with the horizontal distance surface. The maximum difference between the distributions when plotted against horizontal distance is 0.180513. When plotted against cost distance, the maximum difference that is observed is 0.200751. This may be contrasted to that obtained for distance from plain boundaries, and distance from access points to the sea, where the reverse was true. Some possible implications of this pattern are considered in the discussion section below.

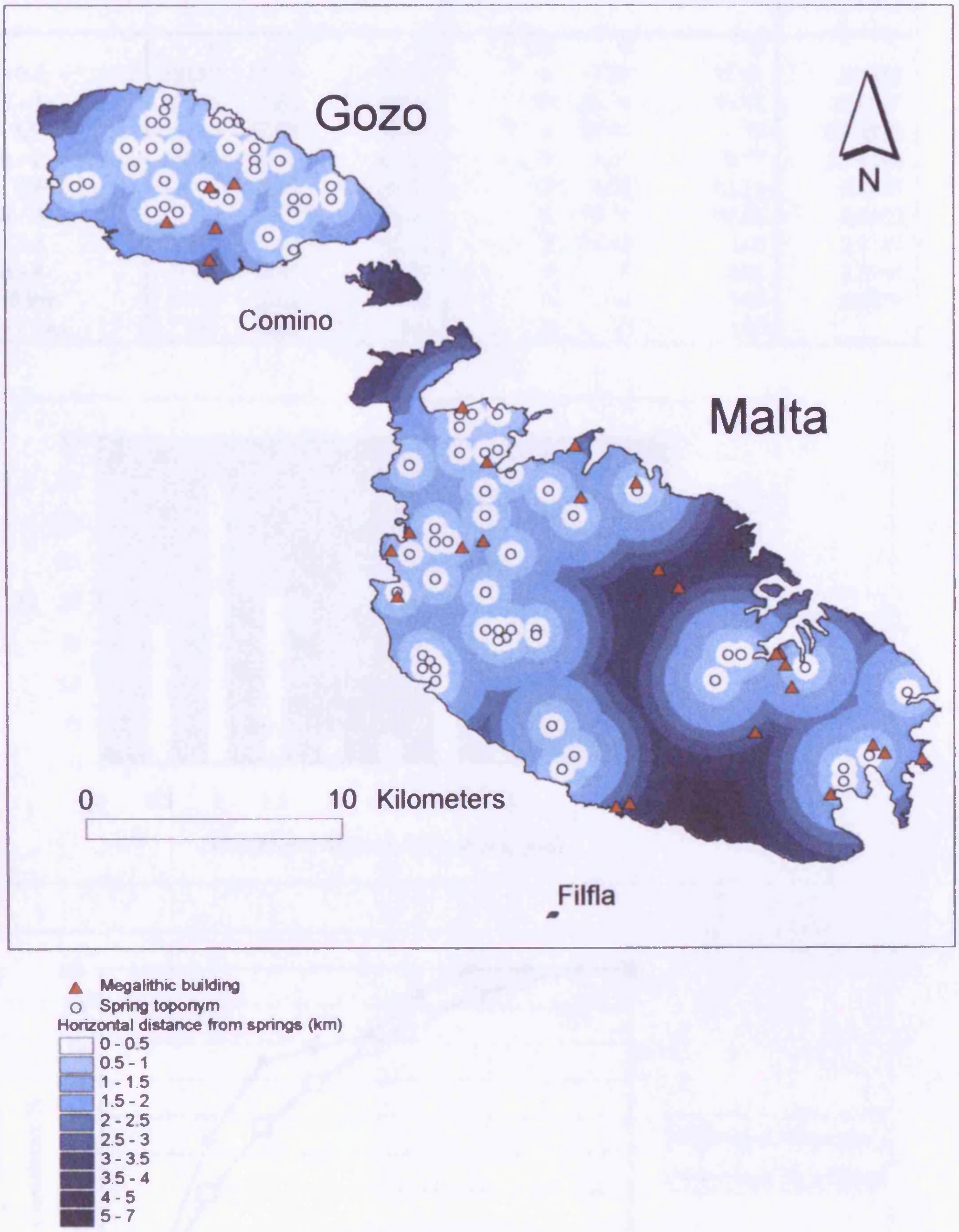
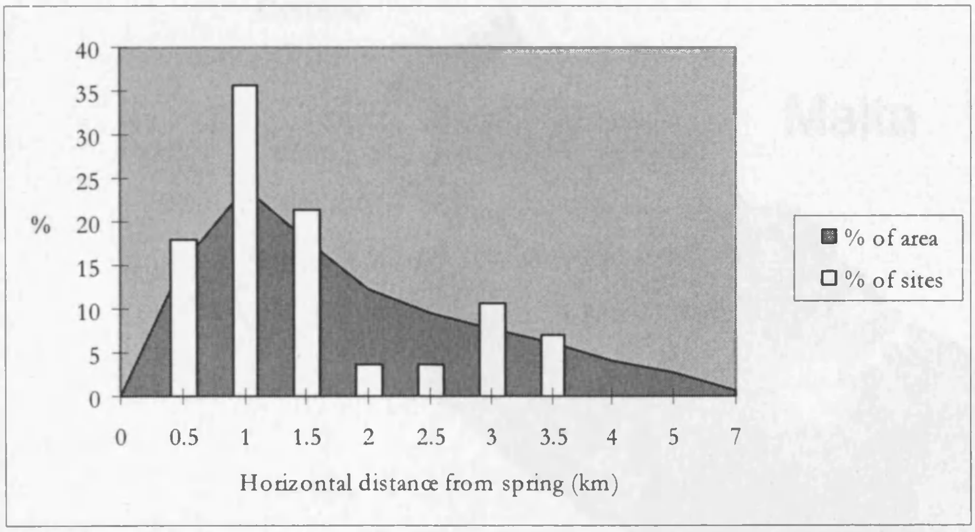


Figure 33. Megalithic buildings, mapped against HORIZONTAL distance from SPRING toponyms.

Distance (km)	Area	%	Cumul. %	No. Sites	%	Cumul. %	Difference
0	0	0	0	0	0	0	
0 - 0.5	19139	15.25	15.25	5	17.86	17.86	2.6111
0.5 - 1	29906	23.82	39.07	10	35.71	53.57	14.5023
1 - 1.5	22445	17.88	56.95	6	21.43	75	**18.0513**
1.5 - 2	15323	12.21	69.15	1	3.57	78.57	9.4165
2 - 2.5	12005	9.56	78.72	1	3.57	82.14	3.4247
2.5 - 3	9755	7.77	86.49	3	10.71	92.86	6.3682
3 - 3.5	7832	6.24	92.73	2	7.143	100	7.2721
3.5 - 4	5105	4.07	96.79	0	0	100	3.2055
4 -5 km	3291	2.62	99.42	0	0	100	0.5839
5 - 7 km	733	0.58	100	0	0	100	- 0



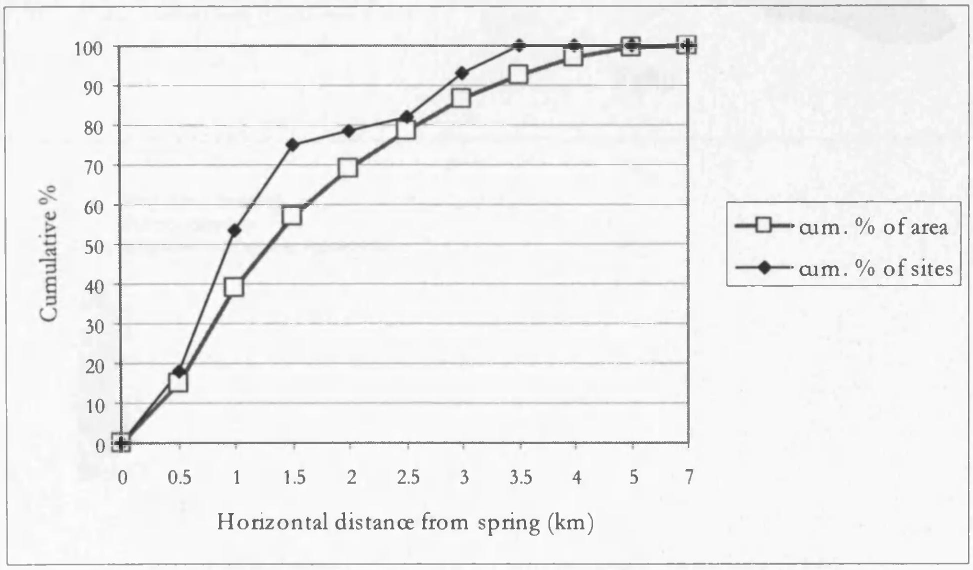


Figure 34. Megalithic buildings and land area, plotted against HORIZONTAL distance from SPRING toponyms.

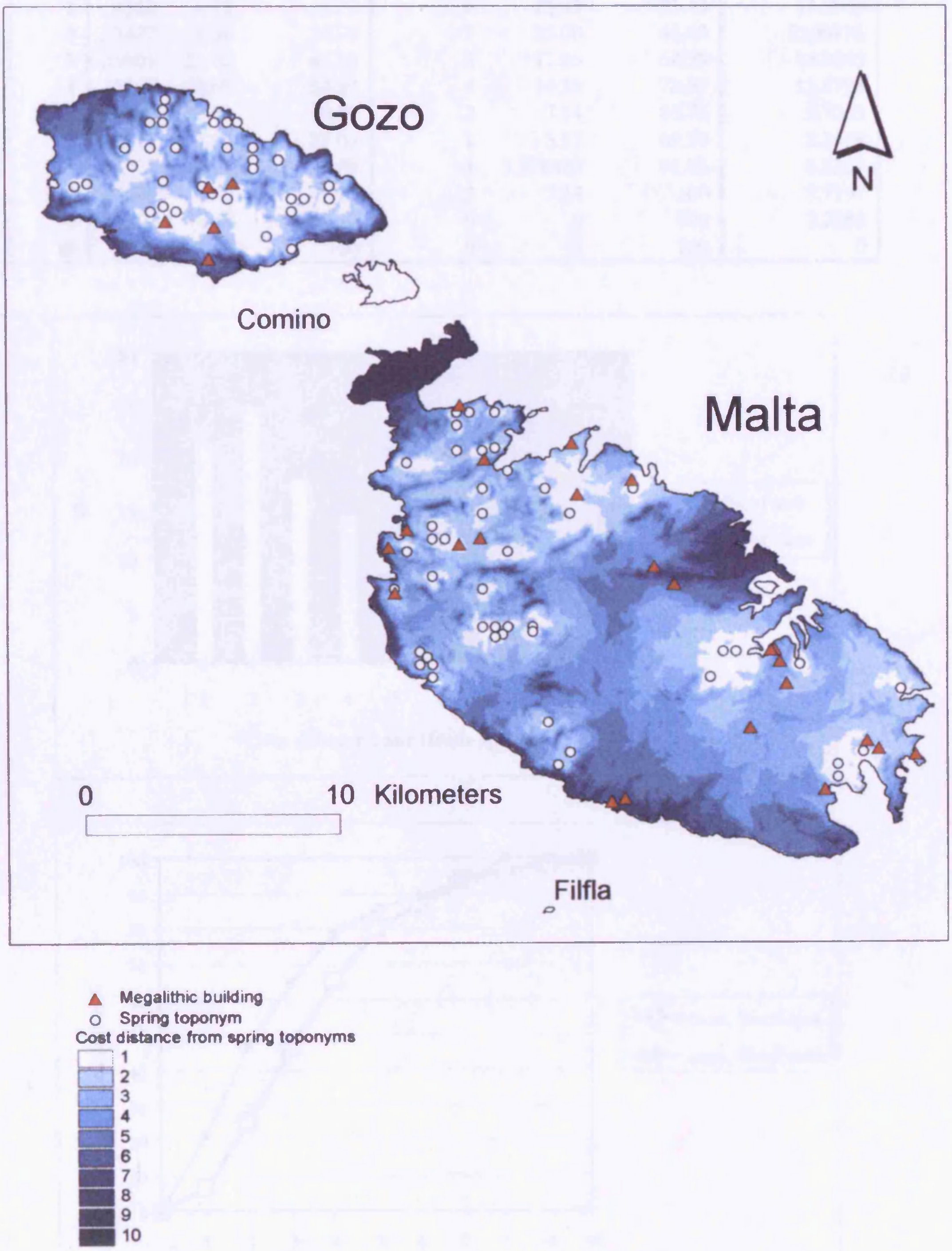
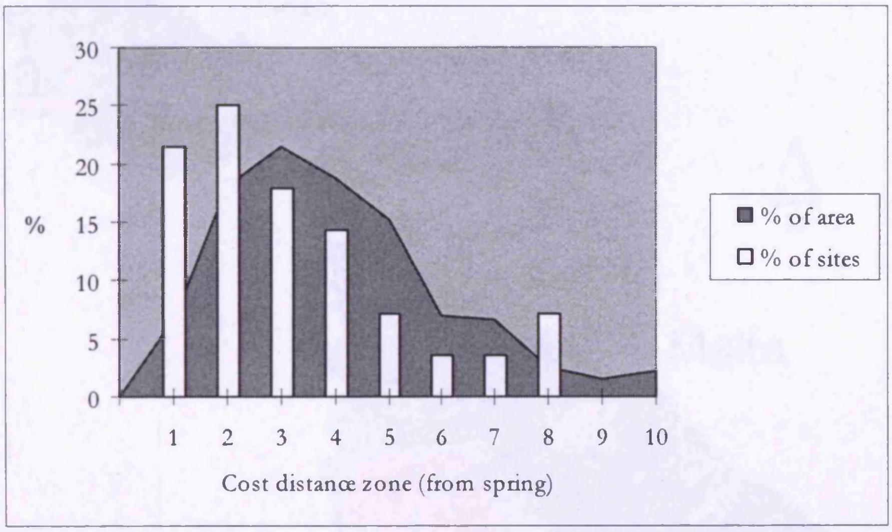


Figure 35. Megalithic buildings, mapped against COST distance from SPRING toponyms.

Zone	Area	%	Cumul. %	No. Sites	%	Cumul. %	Difference
	0	0	0	0	0	0	
1	8352	6.72	6.72	6	21.43	21.43	14.7042
2	22427	18.06	24.78	7	25.00	46.43	**21.6476**
3	26605	21.42	46.20	5	17.86	64.29	18.0843
4	23214	18.69	64.89	4	14.29	78.57	13.6798
5	18750	15.10	79.99	2	7.14	85.71	5.7265
6	8737	7.03	87.02	1	3.57	89.29	2.2636
7	8279	6.67	93.69	1	3.571429	92.86	-0.8307
8	3220	2.59	96.28	2	7.14	100	3.7197
9	1852	1.49	97.77	0	0	100	2.2286
10	2768	2.23	100	0	0	100	- 0



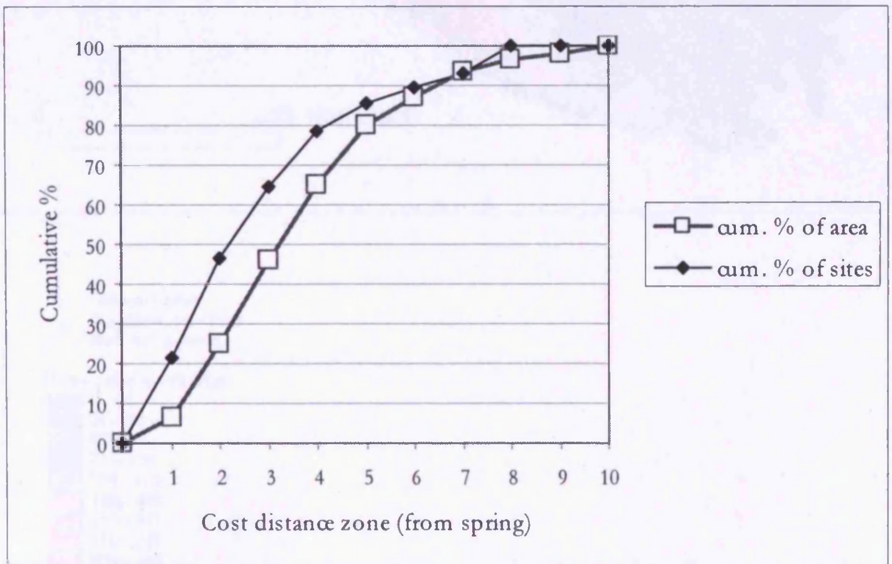


Figure 36. Megalithic buildings and land area, plotted against COST distance from SPRING toponyms.

Funerary monuments

The present chapter has focussed exclusively on megalithic buildings, and has so far not considered funerary monuments. The main reason for this omission is that the known sample of funerary sites is rather too small to permit useful statistical analysis. Nevertheless, it is still very interesting at this point to consider this complementary class of evidence, and to make some general observations in the light of the results obtained for megalithic buildings.

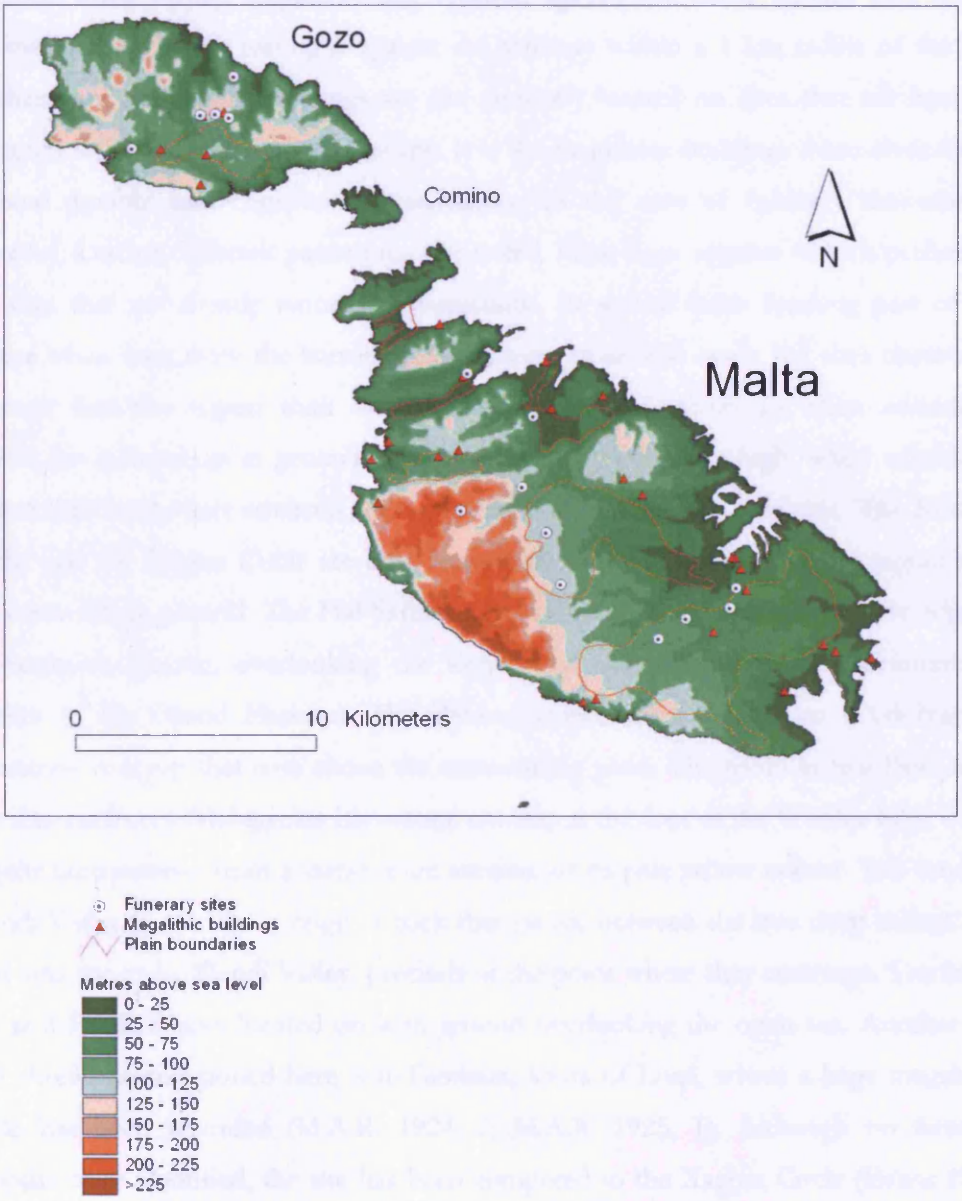


Figure 37. Funerary sites shown in relation to megalithic buildings, elevation, and plain boundaries.

The most up-to-date gazetteer of funerary sites and possible funerary sites is that compiled by Hayden (Hayden 1998, 424-425). The present consideration focuses on a smaller number of sites, where funerary activity is more clearly attested (Appendix 6).

Some contrasts between the location of megalithic buildings and that of funerary monuments are readily apparent. While testing the elevation of the sites chosen for megalithic buildings earlier in the present chapter, it was demonstrated that there is no preference for locations that are at higher or lower elevations. The same result was obtained when testing megalithic site location against the entire surface area of the archipelago, and when testing it against the territory within a 1 km radius of the site. Furthermore, megalithic buildings are not generally located on sites that are naturally conspicuous landmarks in the landscape. It is the megalithic buildings themselves which become durable and conspicuous landmarks. In the case of funerary monuments, however, a rather different pattern may be noted. First, there appears to be a preference for sites that are already naturally conspicuous, in several cases forming part of the skyline when seen from the surrounding territory. In several cases, the sites chosen are hill-tops that rise higher than the surrounding ground. Although when considered against the archipelago in general these sites are not particularly high, when considered against their immediate environs they are often the highest point available. The Xemxija tombs and the Xagħra Circle are both located on local eminences that rise higher than the surrounding ground. The Ħal Saflieni Hypogeum is positioned on the very edge of an extensive plateau, overlooking the slopes that fall away towards the innermost reaches of the Grand Harbour. The Żebbuġ tombs were located on a Globigerina Limestone outcrop that rose above the surrounding plain. The tomb at San Pawl Milqi was also cut into a Globigerina Limestone outcrop at the foot of the Wardija hills, which is quite conspicuous from a distance on account of its pale yellow colour. The tomb in Xlendi Valley is cut into a ridge of rock that stands between the two deep valleys that feed into the main Xlendi Valley, precisely at the point where they converge. The burial site at il-Pergla is also located on high ground overlooking the open sea. Another site that should be mentioned here is it-Tumbata, limits of Luqa, where a large megalithic circle has been recorded (M.A.R. 1924, 2; M.A.R. 1925, 1). Although no funerary deposits were identified, the site has been compared to the Xagħra Circle (Evans 1971, 25). The monumental entrance to the circle at it-Tumbata, described as 'a gateway… made up of two uprights about 2.7 metres high…' (M.A.R. 1924, 2), is particularly reminiscent of early drawings of the Xagħra Circle (see Figure 4, page 43). The topographic position of it-Tumbata is also very comparable to that of the Xagħra Circle. The megalithic circle was located on the highest point in the neighbourhood, and was in fact discovered when the site was chosen as the ideal location to build a reservoir which could supply the region with freshwater, by gravity alone. The very toponym of the field enclosed by the megalithic circle, 'it-Tumbata', is a reference to its topography, signifying a 'bump' or 'hillock'.

The relationship with the sea is worth commenting upon here. In the case of megalithic buildings, it has been noted that there is no particular concern with intervisibility with the sea. On the other hand, considerable importance appears to have been attached to physical access to the sea from the locations chosen. In the case of funerary monuments, a rather different pattern may be noted. In several instances, funerary sites are located on pre-existing landmarks that are clearly visible from the sea. The Xemxija tombs are located on a hill-top that is clearly visible against the horizon down the full length of St Paul's Bay. The tomb at San Pawl Milqi is visible from Salina Bay, which as discussed in Chapter 3 must have extended further inland during the Neolithic. The Hypogeum at Ħal Saflieni as well as it-Tumbata overlook the Marsa basin, the alluvial plain which, as also noted in Chapter 3, very probably formed the innermost part of the Grand Harbour during the Neolithic. A related characteristic is that megalithic buildings are sometimes positioned across the water from a funerary site. The megalithic building at tal-Qadi and the tomb at San Pawl Milqi are placed on opposite sides of the alluvial plain at the inner end of Salina Bay. The hill-top of the Xemxija tombs is visible across St Paul's Bay from the megalithic building at Buġibba (Figure 38).

Figure 38. Buġibba. Megalithic building under excavation in 1928. The hilltop were the Xemxija tombs are located is visible on the horizon across St Paul's Bay (arrowed).

It must be said that there are other funerary sites that do not conform to this pattern, such as the inland sites of Żebbuġ, Buqana or Bur Mgħeż. Nevertheless, some very general observations may be made about the locations that were preferred for funerary sites. First, these are naturally conspicuous places. Second, they tend to be places apart, sometimes separated from megalithic monuments by the medium of water. The way that funerary sites are set apart varies according to the opportunities and constraints presented by the particular local topography. In the case of the tomb in Xlendi Valley, it is visually conspicuous to anyone travelling along the axis of the valley, from the embarkation point at Xlendi Bay to the megalithic site at ta' Marżiena. At the same time, it is located at a very inaccessible point, on the tip of a ridge that is isolated by a deep wadi on either side. Drawing together these observations, it may be suggested that while megalithic buildings are intimately related to the resources and taskscapes of subsistence and daily life, funerary sites have a more remote, yet paradoxically ever-present role. Located in places that were peripheral yet conspicuous, burial sites where carefully placed away from the pathways and trajectories of everyday life, while remaining always visible on the skylines that framed the horizons of the islanders. It is suggested that the paradoxical nature of their location in the islandscape eloquently mediated the paradoxical nature of the relationship of the living with the dead. On the one hand, it suggests respect and curation of the ancestors that legitimised a community's ownership of a territory and protected its boundaries, and on the other hand, a need to segregate the dead from the landscapes of daily life.

Limitations

Resolution

For each variable included in the analysis, a single value is estimated for each 50m square cell. This resolution is more than adequate for some variables, while for others, it may result in some loss of detail. There is a considerable literature on the risks of misrepresentation of a landscape that may be caused by insufficient resolution or inappropriate algorithms (Hageman & Bennett 2000). In the Maltese landscape, topography may change quite dramatically across a distance of less than 50 metres. Such sudden changes are smoothened somewhat in the model used here. The model remains suitable for the analysis of preferences on the macro scale, across the entire landscape. However, it is unsuitable to test relationships for which precise topographic information is required. One example of a procedure that is critically influenced by small changes in topography is viewshed analysis. In the Maltese landscape, the local topographic variability that is often encountered within a 50m cell may dramatically alter the viewshed from a nearby site. Viewshed analysis based on a single value for each 50m cell would therefore be unreliable. In the present work, any discussion of visual properties of sites relies heavily on first-hand observation in the landscape, the reliability of which has been demonstrated elsewhere (Fraser 1988).

Assumptions about environmental change

The definition of the environmental variables described here makes various assumptions about the rate of environmental change since the Late Neolithic. In Chapter 3 it was noted that the environmental evidence that is presently available is still very fragmentary. The definition of these variables is designed to represent and control for the order of magnitude of change that may have occurred since the Late Neolithic. These variables therefore permit robust inferences about macro relationships in the landscape. Caution is required when discussing micro-scale relationships, because environmental change may be much more significant at this scale.

Cost surface quality

The development of cost surfaces has become increasingly sophisticated in recent years. The anisotropic cost surface used here is appropriate for the representation of return-to-base costs, but unreliable for the definition of least-cost paths through the landscape, particularly at a resolution of 50m. The use of cost surfaces in the present analysis is therefore limited to macro patterns of connectivity and accessibility across the archipelago. In the procedure adopted here, comparison between cost surfaces and simple distance surfaces has proved to be a useful control over the results generated by the cost surfaces.

Discussion

A number of relationships have been observed between site location and various landscape variables. Some of their implications are discussed here.

Geology

It was noted that surface geology does not influence the choice of monument location. Variability in building materials does not influence architectural form, and a set of shared design values appears to have been respected across the islands. This is also true of the way these buildings change over time. Developments in the plan of these buildings, such as the reduction in the relative size of the central apse, or the insertion of screens during the Tarxien phase, may be noted across the archipelago. Detailed design information and changing design concepts were evidently circulated throughout the archipelago.

The investment in building technology in order to achieve a shared architectural form in spite of the variability of the materials available is significant. It suggests that considerable importance was attached the sharing common frames of reference across the archipelago. The way this homogeneity is maintained over time also suggests a considerable degree of interaction, information flow, and emulation between people living in different parts of the archipelago.

Topography

A preference for sites with a southern and western aspect has been noted. This is interesting because while there is a considerable literature about the orientation of these monumental buildings, and on its significance, (Ventura & Agius 1980; Fodera` Serio et al. 1992; Vassallo 2000a; Vassallo 2000b; Vassallo 2000c; Ventura 2004), there is little debate on the aspect of the terrain where these sites are built. This begs the question of whether terrain aspect plays a part in determining building orientation. This question will be returned to in Chapter 6, which examines the buildings themselves.

The examination of elevation and slope sheds more light on the properties of the sites chosen for the building of monumental sites. The result for elevation and slope was the same as that for the surface geology of these sites. For each of these three variables, it has been established that there is no significant preference for building monumental complexes on sites with particular values. This absence of discrimination based on local site properties results in considerable costs. Different technological solutions have to be developed to make use of the locally available stone. Stone required for specialized purposes has to be transported over considerable distances. Buildings located on slopes demand a colossal investment in the creation of *terre-plein* platforms in order to create level interiors, as in the case of Mnajdra, or level open courts outside the complexes, as in the case of Ġgantija or ta' Ħaġrat. These observations suggest that the decision where to locate these buildings was largely determined by factors other than the properties of the sites themselves. The relationship of these sites to the surrounding landscape is likely to be a more important factor in the choice of these locations. This possibility was explored next, through an analysis of the relationship between sites and the surrounding landscape.

The plains and agricultural affordances

A strong preference was noted to locate monumental sites near the boundaries of plains. It should be recalled that the examination of site topography established that there is no significant preference to locate these sites on more level ground. The preference to locate sites near plain boundaries is therefore independent of any preference for building on more level sites. The preference for locating sites near plain boundaries is more likely to be an index of the way the landscape is organised. One possible explanation of this correlation is that conditions in the plains were more favourable for agricultural activity (cf Lang 1961). The cultivation of more sloping ground required a tremendous investment in the building of terraces. The earliest known evidence of agricultural terracing in the Mediterranean is usually dated to the Bronze Age (French & Whitelaw 1999). It therefore seems likely that the plains were the core areas of agricultural activity in Neolithic Malta. This is by no means to suggest that agriculture was restricted to these zones. The favourable conditions represented by the plains may have however attracted higher concentrations of agricultural activity.

A prevalent theme in the debate on Late Neolithic Malta is that the limited resource base led to stress and eventually to crisis (Trump 1976; Stoddart et al. 1993; Richards et al. 2001). The suggestion in this literature is that progressive increase in the exploitation of terrestrial resources reached a saturation point, causing a Malthusian crisis. In the light of the present discussion, one possible model for this increase in exploitation may be one of extension from the more favourable conditions on the plains to the more labour-intensive exploitation of the slopes. This possibility should be taken into account in the research design of future field surveys, which would ideally sample both these types of environment.

The close relationship between Late Neolithic monumental architecture and the plains could have other implications. It suggests that topography played an important role in determining the way the landscape was organized. Monument building appears to have followed naturally ordained divisions of the landscape, formalising them into organisational units.

Furthermore, the preference to locate these monumental buildings near the boundaries of the plains suggests that it should not be assumed that these sites are located at the centres of territories, but may rather be located near their boundaries.

Maritime connectivity

The location of these sites has a very specific relationship with the sea. There does not appear to be a great concern with choosing locations that command extensive views of the sea, or locations where a site would be very conspicuous from the sea. On the other hand, proximity to embarkation points is clearly an important consideration.

This suggests that these sites may be related to connectivity between different parts of the archipelago and with the world beyond. These buildings appear to be located along natural corridors of communication between the plains and the sea. Maritime interaction must have been important for a number of reasons. First, it is now widely acknowledged that communication with Sicily and the outside world was much more important than previously supposed. The apparently even distribution of exotic imports across both islands, as well as the consistent positioning of megalithic complexes near the sea suggests that communities in different parts of the archipelago may have maintained direct and autonomous contact with the outside world. Second, communication by sea must also have been important for interaction between different groups within the archipelago. The very high level of homogeneity in material culture, ritual practice, and monumental architecture across the archipelago clearly points to intense inter-group interaction. The two largest plains, around which we find the largest concentrations of monumental activity, are located on different islands, that is on Gozo and on south-eastern Malta. The morphology and orientation of the archipelago provides further incentives for maritime travel. The orientation of Malta on a north-westerly to south-easterly axis effectively meant that the smaller monument groups in Northern Malta were strung along the routes of interaction between the two principal areas of activity. Furthermore, the succession of steep, parallel ridges and valleys that characterise the entire north-west of Malta present a significant obstacle to terrestrial travel along the main axis of the island. The morphology of the islands also encouraged two alternative maritime routes, one along the south-western coast of Malta and the other along the north-eastern coast. In different conditions of wind and swell direction, one or the other of these routes would have been relatively sheltered. These environmental incentives would have helped ensure that boat-building and navigational skills were maintained and developed. Such skills would in turn have encouraged contact with Sicily.

The relationship of monumental sites to topographic features on land is also informative. This relationship tends to vary according to the local topography. In areas of low relief where plains are not far from the coast, megalithic complexes are found near the shoreline. In more rugged parts of the landscape, megalithic sites are located near valley systems that connect the plains of the interior with convenient embarkation points. This relationship may be seen at Ħaġar Qim and ta' Marziena. At Ġgantija, there is also a clear visual relationship with the landscape. Its monumental façade faces the principal axis of approach along a valley leading to the sea, and its colossal composition would have been at its most impressive when approached from this direction.

Island hydrology and survival

A preference for locations nearer to fresh water springs has been noted. This is consistent with the preference for plain boundaries and the proximity to points were the sea is accessible. Considered together, the influence of these three variables suggests that these monumental buildings were an integral part of the landscapes of daily life. These buildings were not placed in remote or marginal locations, but near to the key resources on which island life depended.

The apparent influence of spring location also suggests a considerable dependence on this source of water. The results of the statistical analysis may be complemented with further observations of specific sites. In areas where clay and springs are present, the local position of these buildings does suggest that the availability of fresh water was an important consideration. Megalithic complexes in these areas are usually positioned close to the spring-line. Sometimes, the position of megalithic sites even coincides with an *għajn* toponym. One megalithic site in northern Malta is located at Għajn Żejtuna (The spring of the olive tree). 'Mġarr', the name of the locality where ta' Ħaġrat is located, literally means 'the springs', as borne out by the numerous springs that exisited in this area within living memory (Mario Vassallo, personal communication). On Gozo, the district where the Ġgantija complex is located is known as tal-Għejun ([the place] of the springs). It should be added that the toponomastic evidence on which the present statistical analysis is based represents only a sample of the springs that existed in the past, rather than a complete inventory. A case in point is the area around Ħaġar Qim and Mnajdra. Although the maps showing the distribution of recorded spring toponyms suggest that springs were completely absent in this area (page 138, Figure 33; page 140, Figure 35), a freshwater spring is known to have existed within living memory along the shoreline beneath Mnajdra (Mario Vassallo, personal communication).

In south-eastern Malta, where the clay formation is absent, there are various examples of rain-water management associated with megalithic sites. These features are often difficult to date, partly because they tend to be kept in use and modified over long periods of time. The megalithic complex at Tarxien is the most extensive one to be excavated during the 20th century (Zammit 1916; Zammit 1917; Zammit 1920; Zammit 1930). Three rock-cut features that may be related to rainwater storage were recorded here. A bell-shaped cistern is cut into the rock in the forecourt outside the façade of the South Temple. Although the excavator attributed this to later activity on the site, on the grounds that only late Punic or Roman sherds were found inside it (Zammit 1920, 191-2), these only mark the date of its latest use. Another rock-cut feature found near the entrance of the 'middle temple' was interpreted as a cistern or a granary (Ashby 1924, 25-26). There is another bell-shaped cistern immediately to the southeast of the East Temple, fed from a catchment basin for rainwater connected to it by a rock-cut channel (Zammit 1920, 183).

Being the only Maltese megalithic complex of such size ever to be documented in such detail, Tarxien also allows us very valuable glimpses into the furniture and equipment that was used in these buildings during the Late Neolithic. A considerable number of vessels were found throughout the complex. The repertoire included stone as well as ceramic vessels. Many of these had exceptional dimensions, the largest having capacities in the order of a cubic metre. Various closed forms are represented among the more moderately sized vessels. A concentration of the better preserved of these vessels was found in an area immediately south of the 'east temple', near some of the hydraulic features referred to above (Zammit 1916, 144). The size and number of vessels prompted the excavator to suggest that water '...must have been a necessary element in the ritual of this ancient sanctuary' (Zammit 1917, 271).

The less well-preserved site at Tas-Silġ has also yielded evidence of water management. The Neolithic structures here were extensively modified when the site was re-used as a cult centre throughout the Phoenician, Roman and Byzantine periods. A large stone basin, possibly hewn from a single megalith and measuring over 3m by 5m (Ciasca 1969), has been dated to the Late Neolithic period of use of the site. The present form of a number of large rock-cut cisterns on this site is datable to later periods. Because this site remained in use for so long, it is difficult to establish whether these cisterns were created by modifying and enlarging earlier, prehistoric cisterns. The question of dating is also problematic at the Misqa tanks, a group of rock-cut features near the Late Neolithic complex at Mnajdra. These are still in use today as water cisterns, and are practically impossible to date with any certainty (Evans 1971, 200). In the burial complex at Ħal Saflieni, a deep, well-like shaft was cut into the rock in the upper level of the site, and left open to the sky. While the rock-cut feature evidently dates from the Late Neolithic, the deposits that were found within it were early modern in date (Evans 1971, 47). The use of this feature for the storage of water appears to be the most likely explanation.

These observations suggest that a reliable supply of fresh water at monumental sites was a matter of considerable concern. It has been noted that there was a distinct preference to locate monumental sites in places that had ready access to freshwater from springs. In those parts of the archipelago where this was difficult, the alternative strategy of storing rain-water in cisterns appears to have been used.

Cost distance and horizontal distance

An interesting characteristic of the analysis is the variation between results obtained using horizontal distance and those obtained using cost distance. Most comparable studies tend to publish the results of only one procedure, generally the one showing the strongest relationship, which is therefore the 'best' predictor. There is little debate on the assumptions latent in this procedure, or the implications that these variations may have for our understanding of the way decisions about site location were taken.

In the present case, the results obtained with cost distance and horizontal distance have been presented for three different features of the landscape; plain boundaries, points that allow access to the sea, and freshwater springs. Horizontal distance gave a stronger result for the plains and the sea, though in the case of springs, cost distance appeared to be a better predictor. This underlines the fact that neither horizontal distance nor cost distance are intrinsically superior tools for modelling human decisions. Much of the debate on cost surfaces has been aimed at developing the perfect equation to represent the energy cost of moving across the landscape. The notion that this would permit intrinsically better models for human behaviour rests on the assumption that the people under study based their decisions on a perfectly rational expenditure of energy. Though not often acknowledged in the literature on cost surfaces, this assumption shares some of the difficulties of ***homo economicus***, which do not need to be rehearsed here. It is an assumption that sits rather uncomfortably with the growing recognition that attitudes to space and place may be highly culture-specific. Notions of proximity and distance vary widely according to context.

An interesting approach may be to explicitly explore these different models of distance, in order to learn more about the thinking processes behind decisions on site location. In the present case, different notions of proximity may be in operation in the relationship of monumental sites to the plains and sea on one hand, and to sources of water on the other. The fact that water shows a higher sensitivity to cost suggests an explanation. Water is heavy to carry, the more so with a Neolithic technology. It is also required in abundance, therefore demanding more careful attention to the economics of its transport. On the other hand, a different kind of assessment of distance may be taking place in relation to the sea and the plains. This appears to be less constrained by the cost of movement, and more concerned with linear distance. These different ways of thinking about distance will be returned to in the next chapter.

Conclusions

The bivariate analysis of the landscape context of Maltese monumental activity during the Late Neolithic leads to the following five principal conclusions:

1. The choice of location for these sites is not conditioned by surface geology, elevation or slope, though there is a preference for locations that face South.

2. The suggestion that monumental sites are located at the centres of territories no longer appears tenable.

3. The location and size of monumental buildings was closely tied to the plains that punctuate the landscape. These are likely to have been core areas of agricultural exploitation, because they provided favourable conditions without requiring significant investment in labour-intensive terrace construction. Topography appears to have played an important role in determining the organisational units of the landscape. Monument building appears to have followed naturally ordained divisions of the landscape, formalising them into organisational units.

4. These megalithic complexes were closely bound with maritime connectivity, and were positioned near natural thresholds between land and sea. One of the purposes of these buildings may have been to mediate interaction between communities in different parts of the archipelago, as well as interaction with the outside world.

5. Megalithic buildings appear to be an integral part of the landscape of daily life. They are not located in remote or marginal places, but are closely tied to the resources that sustain island life. In contrast, funerary sites are located in more remote yet paradoxically more conspicuous locations.

5 Modelling taskscapes: a multivariate approach

Introduction

The previous chapter considered site location against different landscape variables. The possibility of a relationship with each variable was considered in turn, using bivariate procedures. In this chapter, the analysis is taken further using multivariate procedures, which consider the effects of different variables simultaneously.

Where bivariate analysis indicated that a variable had no significant influence on site location, this is not considered further. Attention is focussed on those variables that demonstrated a significant bivariate relationship with site location. Issues of interdependence between variables are addressed, in order to assess their relative influence on site location.

Two alternative hypothetical models of the relationship between landscape attributes and site location are set up. The explanatory power of these models is then tested and compared.

Objectives

The multivariate analysis described in this chapter has the following four objectives:

1. to identify suitable multivariate tools for analysing the data.

2. to examine the relationship between the predictor variables, in order to determine whether apparent correlation with the dependent variable was spuriously caused by interdependence between the predictors.

3. to explore different hypothetical models of the relationship between landscape attributes and site location.

4. to identify the optimal model of favourability for monument location.

Theoretical considerations

In the previous chapter, different landscape variables were examined in turn, and the possibility of a relationship with location of monumental buildings was examined. Such an analysis is intrinsically incomplete, and its results may easily mislead. For example, two different landscape variables may be closely related, or interdependent. If one of the two variables influenced site location, bivariate analysis of the other variable may give the mistaken impression that it also had an influence on decisions about site location. In order to address this difficulty, the level of interdependence between different variables must be examined using multivariate techniques.

At a more general level, decisions about site location are likely to have been influenced by several variables at once. Procedures that take different landscape variables into consideration simultaneously are therefore required.

The purpose of the analysis initiated in the previous chapter is to better understand how people took decisions about where to locate their monumental buildings, and which characteristics of the landscape played a part in these decisions. These decisions were shaped by a complex interplay of a multiplicity of factors. To mention but a few factors that are likely to have played a role, we could list shifting demographic and economic needs, systems or ordering and thinking about the landscape, and places tied to important memories. All these factors are still very poorly understood in the context presently under study. Yet all of these factors mediated the relationship between the landscape and the people that inhabited it. Any attempt to fully explain site location by examining the distribution of sites in the landscape is evidently simplistic. A more modest, and more realistic, objective is to make statistically robust observations about relationships between the location of sites and their landscape setting, on the basis of which more plausible propositions may be made about the role of monumental buildings in the landscape.

'predictive' modelling

Site location patterning may be better understood when the properties of the landscape are taken into account. There is a well-established tradition of research into the influence of landscape variables on archaeological site location. This tradition predates the development of GIS technologies (Crawford 1912; Crawford 1922; Fox 1933;

Davidson 1979), and has been reviewed elsewhere (Fraser 1983). The examination of environmental variables has however been dramatically facilitated with the dissemination of GIS software (Kvamme 1990a; Wheatley & Gillings 2002). The application of GIS and quantitative analysis to the characterisation of archaeological site location has itself become the focus of a substantial body of literature. A key focus of this literature is 'predictive modelling' (Kvamme 1988; Kvamme 1990b; Duncan & Beckman 2000; Ebert 2000). This is especially true of the last two decades of research in North America, where predictive modelling is widely used as a cultural resource management tool (Warren 1990; Warren & Asch 2000; Westcott & Kuiper 2000; Dalla Bona 2000). The tools and methods that are gathered under the term 'predictive modelling', however, are not limited to this application. The term 'predictive' is in this sense misleading (Kvamme 1988, 326-7; Ebert 2000, 130-131). The same tools and procedures may be used to develop explanatory models that identify, test and demonstrate patterns and preferences in site location patterning, which may shed light on past decisions and choices, prompting the suggestion that 'site location model' may be a more helpful term than 'predictive model' (Woodman & Woodward 2002, 22). The present work has such an explanatory purpose.

Inductive and deductive frameworks

A further basic distinction that is made between different types of location modelling is that between inductive and deductive procedures (earlier work reviewed in Dalla Bona 1994; Kamermans 2000). Inductive models are generally defined as those that begin with data and build conclusions on the basis of patterns in that data, building general principles on particular facts. Deductive models move from the general to the particular, beginning with a theory of human behaviour, which is then tested against the appropriate evidence.

The present approach is best described as a hybrid of these frameworks. In selecting and defining which variables may have a bearing on decisions about site location, deductive reasoning is used. The decision to select springs to represent sources of fresh water, for instance, is a deductive one, based on our understanding of Neolithic technology. A purely inductive approach would include as many different variables as possible, and to explore these for some form of pattern. This approach has been criticized for its blind reliance on statistical analysis to generate meaning (e.g. Church et al. 2000, 149; Kamermans 2000). In the present analysis, the choice of variables is based on considerations of the mechanisms of human decision-making, which is a basic characteristic of deductive approaches (Kohler and Parker quoted in Dalla Bona 1994).

The actual exploration of the relationship between the different variables also uses inductive reasoning. Where appropriate, variables are explored iteratively. The result of an initial, inductive exploration may prompt a hypothesis, for which a fresh test is set up to confirm or reject the hypothesis deductively. For instance, in the preceding chapter an inductive test of gradient was first conducted to explore whether this has a bearing on site location. The result showed no preference for a particular gradient. However, visual inspection suggested another possible relationship, which was that sites are located near to extensive, level areas. A deductive test was then set up to examine this possibility.

From sites to taskscapes

A high proportion of the existing literature on 'predictive' modelling shares some very fundamental procedural tenets. One of these is the distinction between 'sites' and 'non-sites' (Kvamme 1988, 326). In a typical predictive modelling exercise, a sample area is subjected to intensive survey. Land parcels or grid cells where a pre-determined level of archaeological activity is found are defined as sites, while grid cells where this level is not detected are defined as non-sites. The properties of sites and non-sites are then compared statistically.

The binary division of the landscape into sites and non-sites is problematic, for theoretical as well as methodological reasons. Firstly, the very concept of a site has become a contentious issue in archaeological theory (Ebert 2000, 130-131). There has been a growing awareness of the importance of considering human activity in broader spatial settings, succinctly summarized in Ingold's concept of 'taskscapes' (Ingold 2000b). Paradoxically, while GIS landscape analysis promises to be one of the tools with which to address this broadening agenda, its analytical potential is often constrained from the outset by reliance on weak theoretical models (Church et al. 2000, 149). The binary distinction between 'sites' and 'non-sites' may pose such a difficulty. This binary distinction is manifestly divergent from current models of how human activity is organized in the landscape. Methods and procedures that do not correspond to theoretical models of human activity constrain the results of those procedures, and diminish their value.

This binary distinction poses further difficulties. It has been pointed out that because the properties of land parcels classified as 'non-sites' tend to be heterogenous, their treatment as a single class may produce statistically unreliable results (Rose and Altschul 1988, 207-208). Effectively, the classification of land parcels as non-sites translates their interval-level properties to a nominal level of measurement, discarding or ignoring critical information, and consequently reducing the power of subsequent analysis (Kvamme 1998, 333). These statistical limitations require more critical evaluation (Rose and Altschul 1988, 208).

An interesting alternative to the site/non-site dichotomy is the concept of 'activity space' (Kvamme 1988). This concept was originally defined as '...a subset of the whole environment within which the bulk of human activity (aside from moving from one activity place to another) is performed' (Kvamme 1988, 331). One of the reasons this concept was considered a useful tool when it was proposed was that in certain contexts, it permitted the collective treatment of sites that varied in purpose and date, because they were generally confined to a relatively small part of the landscape. In the Maltese context, this is evidently not the case. However, the concept of 'activity space' still appears useful. Rummaging through the toolkit of concepts used in GIS-based archaeological predictive modelling , 'activity space' appears to be one of the few that try to approximate a representation of Ingold's 'taskscapes'. This interesting possibility is beginning to attract some discussion. Kamermans' work in particular has developed the idea of defining an activity space as part of land use modelling procedures (Kamermans 2000, 133, citing earlier work).

Cognition and site location modelling

In recent years, there has been a growing interest in using GIS environments to explore cognitive questions about past perceptions of landscapes (Wheatley 1993; Llobera 1996; Bell & Lock 2000; Wheatley & Gillings 2000; Llobera 2000). The development of approaches that take the human experience of landscape into consideration has been identified as one of the most needed and most promising areas of GIS-based research in archaeology (Lock 2003, 174-82). Some contributions have aimed to include social considerations in their models (Maschner 1996; Wheatley 1996; Stancic & Kvamme 1999).

More generally however, the literature on site location modelling has been slow to address these concerns. It has been noted (Woodman & Woodward 2002) that much of this literature has taken the relationship between site location and site attributes for granted, without considering the intervening human decision-making processes that are involved in site selection. The use of regression analysis to determine the relative weighting of different landscape attributes rests on a number of implicit assumptions. It assumes that the relative importance of different variables remains constant across the entire population of sites. At the same time, most examples of site location modelling make no attempt to explain how this constancy is supposed to be achieved by human behaviour. These assumptions are problematic. It is safe to presume the human choices behind the patterns under study were made without the help of sophisticated statistical tools. On the other hand, notions of value and distance could have played a very important role in the way different site attributes were assessed when deciding site location. This issue was introduced in the previous chapter, when it was noted that the relative performance of cost distance surfaces and horizontal distance surfaces may offer some insight into culture-specific notions of distance. This line of enquiry is pursued further here. Different ways of combining variables in multivariate models may offer insight into culture-specific ways of weighing different landscape attributes when taking decisions. This promises to be an exciting avenue that may allow GIS-based exploration of particular cognitive issues. The present example is a very simple application of this approach.

Exploring alternative models of site-landscape interaction

The multivariate analysis presented in this chapter explores two alternative models to explain the relationship between site location and site attributes. These two explanations are based on different assumptions about the relationship between site location and site attributes. A statistical test is set up for each model. The model that performs better should be the one that is a better approximation of the observed relationships. The reasoning behind the two alternative models is explained at some length because this exploratory procedure does not appear to be widely used.

Bivariate analysis presented in the previous chapter identified five factors that appear to be correlated with monumental site location. Three of these factors are based on proximity to different resources in the landscape. The three resources are the plains that provided optimal conditions for agricultural activity, maritime connectivity, and fresh-water springs. The nature of these three variables strongly suggests that monumental buildings are located at focal points of the inhabited landscape, rather than areas that were perceived as marginal, remote or uninhabited. The preference for south-facing slopes, likewise, would seem to corroborate a preference to locate monumental buildings in areas that are also more congenial for domestic settlements. These observations are consistent with the meagre domestic evidence that is available at present. The evidence from Skorba (Trump 1966) suggests a very close association between momumental buildings and domestic settlement. The evidence from Għajnsielem (Malone et al. 1988) also suggests that settlement may have been dispersed across the plains that have already been discussed. . The data on Late Neolithic settlement demography is however still far too limited to permit a discussion of settlement densities in different areas, and the location of megalithic monuments remains one of the best proxy indicators available to us for the demography and taskscapes of the Late Neolithic.

This limitation raises an important problem. Much of the existing literature on 'predictive' modelling has hinged on the study of settlement sites, where the basic premise is that access to resources influences site location. The monumental buildings under consideration here are not settlement sites. While the evidence from Skorba suggests they may be closely associated with domestic structures, the evidence from Għajnsielem indicates that domestic structures may also have been dispersed in the surrounding landscape.

The relationship that has been observed between the different landscape variables and the location of megalithic sites may be explained by two alternative models. In the first possible scenario, the landscape variables under discussion influenced settlement location in the first instance. The location of monumental buildings may have been determined by areas of higher concentrations of settlement, rather than the landscape attributes themselves. If this is the case, cells that are nearer to plains, springs and embarkation points are more likely to be densely settled. In this hypothetical scenario, it is also assumed that monumental sites are located to maximise their accessibility from these optimal areas, on the principle of least effort (Zipf 1949). Monumental sites are therefore expected to be centrally located in these areas.

In the second hypothetical scenario, it is proposed that decisions about the location of megalithic buildings may have been directly influenced by the different landscape properties that have been discussed.

Although the two alternatives may at first glance appear similar, this distinction has considerable ramifications for the way the relationship between monumental buildings and their environment is modelled. Here an attempt will be made to construct statistical tests for each of the two alternatives that have been proposed, in order to explore which one fits the data more closely. In principle this procedure follows that advocated by

Kamermans, who generates '...an expected form of land use for every chosen socio-economic model...' then '...repeat[s] this procedure until the outcome fits best with the archaeological record.' (Kamermans 2000, 134).

Model 1: An indirect relationship

Let us assume that the first scenario is correct, and the following two assumptions hold true. Firstly, that environmental variables define areas of more dense human settlement in the landscape, and secondly, that monuments are centrally located in areas that are more densely located.

If the first assumption is correct, the environmental attributes are more suitable to predict which areas have a higher settlement density than to make direct predictions about monument location. If the second assumption is also correct, an overall positive correlation may be expected between distance from monumental buildings and distance from the three resources in question.

Model 1: Method

The use of continuous surfaces instead of a 'site/non-site' dichotomy has interesting methodological implications. It produces values that are measured at an interval scale, rather than the nominal scale of 'site/non-site' values. For the reasons discussed earlier, interval and ratio scale information allows more powerful analysis than information that is merely nominal or ordinal. The three distance variables are ratio-scale variables based on distance. The distance from monument location is therefore eminently comparable to these variables. If it is treated as the dependent variable, the expectation that it is positively correlated with the three predictor variables may be tested.

In order to examine the data and to conduct the multivariate analysis, the values for each variable to be included in the analysis were exported into SPSS Version 10.

Pearson Correlation coefficients

An indication of the relationship between the three predictor variables and the proposed dependent variable 'distance from monument' is provided by the Pearson product moment correlation coefficients (Pearson's *r*) between each predictor and the dependent variable. These were generated in SPSS, and are shown in Figure 39. The r values for all three predictors indicate a significant correlation with 'distance from monuments'. This is consistent with the bivariate relationships that were observed between these three variables and monument location. This is an indication that the replacement of monument location with 'distance from monuments' as the dependent variable in this model may be tenable and potentially useful.

		Monuments	Plains	Sea	Springs
Pearson Correlation	Monuments	1.000	.803	.480	.367
	Plains	.803	1.000	.460	.359
	Sea	.480	.460	1.000	.041
	Springs	.367	.359	.041	1.000
Sig. (1-tailed)	Monuments	.	.000	.000	.000
	Plains	.000	.	.000	.000
	Sea	.000	.000	.	.000
	Springs	.000	.000	.000	.
N	Monuments	123186	123186	123186	123186
	Plains	123186	123186	123186	123186
	Sea	123186	123186	123186	123186
	Springs	123186	123186	123186	123186

Figure 39. Pearson correlations between cost distances, generated in SPSS.

Interdependence between predictor variables

A basic objective of multivariate analysis is to examine whether apparent relationships between particular predictor variables and the dependent variable are the spurious result of interdependence with other predictor variables.

Values for Pearson's *r* between each pair of variables are shown in Figure 39. These show a strong positive correlation between 'distance from sea' and 'distance from plain'. Both these variables also show a strong positive correlation with the dependent variable, 'distance from monuments'. These correlations therefore require closer examination to assess the extent to which they are the spurious effect of interdependence between the two predictors, and the extent to which they represent independent influence on 'distance from monuments'. An indication of the independent influence of each of these predictors will be obtained in the next section, where the partial correlation coefficients are calculated.

'Distance from sea' show a very weak correlation with 'distance from springs'. On the other hand, 'distance from springs' displays a stronger, positive correlation with 'distance from monuments'. In this case, it is clear that the relationship between 'distance from springs' and 'distance from monuments' is independent of the 'distance from sea' variable.

Partial correlation coefficients

In order to obtain an indication of the independent effect of each predictor on the dependent variable, the partial correlation coefficients are calculated in SPSS. These are shown in Figure 40. These make it possible to examine the relationship of a given predictor variable on the dependent variable, while controlling for the effect of another predictor variable. In other words, the partial correlation coefficients provide an indication of whether the correlation in question is caused by interdependence between variables, or whether it truly represents an influence of the predictor variable on the dependent variable.

Controlling for (distance from)	Partial Correlation between (distance from)	p.c.c.
SEA, PLAINS	MONUMENTS and SPRINGS	0.1793
PLAINS, SPRINGS	MONUMENTS and SEA	0.2348
SPRINGS and SEA	MONUMENTS and PLAINS	0.7025

Figure 40. Partial Correlation Coefficients between predictor variables, generated in SPSS.

The partial correlation coefficients show that all three variables have a significant correlation with distance from monument location, independently of each other. All three predictor variables may therefore contribute to an improved model, and should be included in the analysis.

Selecting an appropriate multivariate tool

The use of ratio-scale variables, discussed earlier, has a further methodological implication. Multivariate analysis based on a comparison of sites to a random selection of non-sites is restricted to non-parametric tests such as logistic regression (Maschner & Stein 1995). With ratio-scale variables, however, parametric tests such as multiple linear regression may be performed, if the assumptions of parametric testing are fulfilled. This is a significant advantage, because parametric tests are generally more powerful than non-parametric tests (Rose and Altschul 1988, 199-200).

It should also be noted that the widespread use of logistic regression in site location modelling has tended to ignore some important statistical issues, which have recently been re-examined (Woodman & Woodward 2002, 23).

For these reasons, a parametric test such as multiple linear regression may be the preferable method here. In order to assess whether it is suitable, it is necessary to check whether the data fulfils a number of assumptions. For instance, one of the basic assumptions of linear regression, and parametric tests generally, is that the distribution of the data is normal. Linear regression also assumes that the relationships being tested are linear, and homoscedastic. The next section will confirm whether the data violate any of these assumptions.

Testing the statistical assumptions

Multicollinearity

A general assumption of all regression analysis, regardless whether it is linear or logistic, is that there is no multicollinearity between the different predictor variables (Rose & Altschul 1988, 214; Field 2000, 201). In other words, different predictor variables should not be too highly correlated to each other. The following sections will examine the predictor variables for multicollinearity.

Scatter diagrams

A first impression of the relationship between different predictor variables may be obtained by visually inspecting scatter diagrams of each predictor variable against every other predictor variable. These were generated in SPSS. The usefulness of these diagrams is somewhat impaired by the sheer density of the plot, which makes it difficult to discern patterning within the data area. However, some correlation may be observed between 'distance from plain boundary' and 'distance from sea'. No such pattern is shown by the scatter diagrams for either of these variables against 'distance from springs'.

Pearson's r

A more useful preliminary indication of whether there is multicollinearity may be obtained from the values for Pearson's *r*, shown above. A value of Pearson's *r* between a pair of independent variables that is higher than 0.80 is considered to be an indication that there may be multicollinearity between them (Bryman & Cramer 2001, 244). The values that were obtained between the predictor variables were all well below 0.80, indicating that there is no multicollinearity.

Collinearity statistics

This may be confirmed by examining the collinearity statistics generated in SPSS (Figure 41). This output provides values of the variance inflation factor (VIF) and the tolerence, which is simply the reciprocal of VIF (1/VIF). If any value of the VIF is over 5 (or conversely, if any tolerance value is lower than 0.2), this indicates that there may be collinearity in the data (Field 2000, 131-132, 153-154).

Coefficients

Model	Unstandardized coefficients		Standardized coefficients			95 % confidence interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Lower Bound.	Upper Bound.	Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)	764.226	3.202		238.670	.000	757.950	770.502					
PLAINS	.725	.002	.803	473.125	.000	.722	.728	.803	.803	.803	1.000	1.000
2 (Constant)	576.719	4.011		143.781	.000	568.857	584.580					
PLAINS	.667	.002	.739	395.132	.000	.663	.670	.803	.748	.656	.788	1.268
SEA	.138	.002	.140	74.815	.000	.130	.137	.480	.208	.124	.788	1.268
3 (Constant)	406.536	4.760		85.413	.000	397.207	415.865					
PLAINS	.623	.002	.690	346.460	.000	.619	.626	.803	.703	.566	.673	1.487
SEA	.150	.002	.158	84.774	.000	.147	.153	.480	.235	.138	.771	1.487
SPRINGS	.123	.002	.113	63.948	.000	.119	.126	.367	.179	.104	.852	1.487

Dependent Variable: MONUMENTS

Figure 41. Collinearirity statistics, generated in SPSS.

In the present case, all the VIF values are well below 5 (and conversely, the tolerance values are all well above 0.2), leading to the conclusion that there is no strong collinearity in the data.

Collinearity diagnostics
A final examination of collinearity and the general reliability of a model based on these variables may be obtained from the collinearity diagnostics generated in SPSS (Figure 42). This table shows the proportion of the different variables that varies with different eigenvalues, together with the condition index of the eigenvalues.

Collinearity Diagnostics

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	PLAINS	SEA	SPRINGS
1	1	1.715	1.000	.14	.14		
	2	.285	2.454	.86	.86		
2	1	2.546	1.000	.04	.05	.03	
	2	.293	2.947	.33	.83	.03	
	3	.161	3.981	.63	.12	.93	
3	1	3.263	1.000	.02	.02	.02	.02
	2	.332	3.134	.02	.17	.18	.49
	3	.288	3.365	.18	.58	.15	.07
	4	.116	5.303	.78	.23	.65	.43

a. Dependent Variable: MONUMENTS

Figure 42. Collinearity diagnostics, generated in SPSS.

This data allows two kinds of check to be made. Firstly, if any of the eigenvalues is much larger than the others, the variables are said to be 'ill-conditioned', meaning that a model based on these variables may be unreliable (Field 2000, 202). This may be checked rapidly by looking at the 'condition index' column. All the values are of the same order of magnitude, confirming that there is no difficulty with collinearity.

Figure 42 allows a further check. Different variables should ideally vary with different eigenvalues. In the present case, the variance proportions are well distributed between the three pertinent eigenvalues, showing that although there is some limited collinearity between 'distance from plain' and 'distance from sea', this is not critical, and a model based on these variables would be free from problems with multicollinearity.

Independent errors
Another assumption that is common to parametric as well as non-parametric procedures is that for any two observations of the same variable, the residual terms should be independent of each other (Field 2000, 128). This assumption is clearly violated because of the problem of spatial auto-correlation, introduced earlier (Section 4.5). Geographical variables often exhibit a considerable degree of auto-correlation, particularly those

based on distance (Kvamme 1988, 352). Spatial auto-correlation is a specific case of serial correlation, which may be tested using a Durbin-Watson test for serial correlation. This was performed in SPSS. For populations larger than 200 with 3 predictor variables, the Durbin-Watson statistic must be above 1.643 for there to be no serial correlation (Draper and Smith 1998, 179-185; Savin and White 1977, 1992). The value obtained was 0.016, suggesting strong serial correlation. This is to be expected, because of the strong spatial auto-correlation that is normally found in geographic data.

From a methodological point of view, this is widely recognized as a serious limitation, because it violates the assumptions of independent errors. It should be noted that this issue is equally problematic for parametric and non-parametric procedures (Kvamme 1988, 358), and therefore has no bearing on the choice between logistic and linear regression. It should also be recalled that, as noted in the discussion on sampling in pp 84 -85 ~~Section 0~~, one of the reasons for choosing to include the entire landscape in the present analysis, rather than a random sample, was precisely to avoid the issue of drawing independent samples from the population (Kvamme 1990a, 378). Consequently, the lack of independence caused by spatial auto-correlation should not make the present analysis less robust.

Normality

Visual inspection of histograms

One of the basic assumptions of parametric testing is that the data-sets have normal distributions. The simplest procedure to obtain an indication whether the present data violates this assumption is visual inspection. Histograms of each variable were shown in the previous chapter. It is clear from these histograms that the populations of the different variables are not perfectly normal. The histogram for 'distance from sea' appears to be particularly skewed. Perfectly normal populations are however unusual in real data. In order to determine whether the departures from normality are large enough to make parametric testing unsuitable, it is useful to obtain a more formal measure of skewness and kurtosis.

Skewness and kurtosis statistics

the z-score values for skewness and kurtosis of the different variables were generated in SPSS (Figure 43).

Distance from	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
PLAINS	1.501	.007	2.838	.014
SEA	1.311	.007	2.217	.014
SPRINGS	2.619	.007	11.058	.014
MONUMENTS	1.103	.007	1.023	.014

Figure 43. Skewness and Kurtosis statistics, generated in SPSS.

As a general rule when dealing with fairly large samples, z-scores of skewness and kurtosis above 1.96 are considered to be problematic, while with very large samples such as the present one, higher value may also be tolerated (Field 2000, 41). Of the 4 z-score values obtained for skewness, only that for 'distance from springs' exceeds1.96. The z-score of kurtosis are higher, particularly that for springs. These values suggest that the data-set as a whole is near enough to normality for it to be treated as normal.

Linearity and homoscedasticity

Linear regression is appropriate for relationships that are linear and homoscedastic (Field 2000, 128-130). In order to examine whether the present data fulfill these assumptions, scatter diagrams are generated in SPSS, showing each predictor variable plotted against the dependent variable. A regression line may also be plotted over the scatter diagram. A moderate degree of linearity is apparent in these three scatter diagrams, indicating a positive linear relationship between each of these predictor variables and the dependent variable.

In the light of the above considerations, it was decided that the most suitable procedure to test the first model was parametric testing of continuous data from the entire landscape, using multiple linear regression.

Model 1: Results

Multiple linear regression

The multiple linear regression is performed stepwise in SPSS. Predictor variables are entered stepwise, starting with the one that showed the highest partial correlation with the dependent variable. This is 'distance from plain boundary'. It is followed by 'distance from springs', and then by 'distance from sea'. The correlation coefficients that are produced by this regression appear in Figure 41. The unstandardized B coefficients that appear in this figure allow the dependent variable to be expressed as a function of the predictors, in this form:

y = Constant + (B1 . x1) + (B2 . x2) + (B3 . x3)

Predicted distance from monument = 406.536 + (0.623 . dist. from plains) + (0.150 . dist. from sea) + (0.123 . dist. from springs).

Creating a predicted proximity surface

This equation may be expressed cartographically using map algebra. A new surface is created in ArcView, which performs this equation for each cell. The result is a surface that calculates a value for the expected distance from a monument location, on the basis of the three predictor variables. The continuous surface produced in this way may be read as a favourability surface. Rather than predicting the likelihood of a specific land parcel being a 'site' or 'non-site', however, it predicts the likelihood of being nearer to or further from a site. The result may be displayed as a map (Figure 44).

An indication of the performance of this model may be obtained by conducting K-S testing of this new surface, using the procedure described in the previous chapter. The results are shown in Figure 45. These results show that the new surface based on the weighted addition of the three cost surfaces performs rather poorly. The maximum difference that is observed between the cumulative percentages for the new surface is around 16.16 %. This is actually lower than that observed in the previous chapter for each of the three cost-distance variables on which it is based. These were 19.29 % for cost distance from plain boundaries, 19.12 % for cost-distance from access to the sea, and 20.07 % for cost distance from springs.

The poor performance of Model 1 suggests that it does not represent the relationship between site location and landscape characteristics in a satisfactory way. The initial assumptions of this model are therefore likely to be flawed. The key assumption was that decisions about monument location were not directly influenced by the relationship between site and landscape, but rather that landscape characteristics determined which areas were more suitable for settlement and human activity, which in turn determined monument location. This result may be compared to that obtained for the second alternative model, considered next.

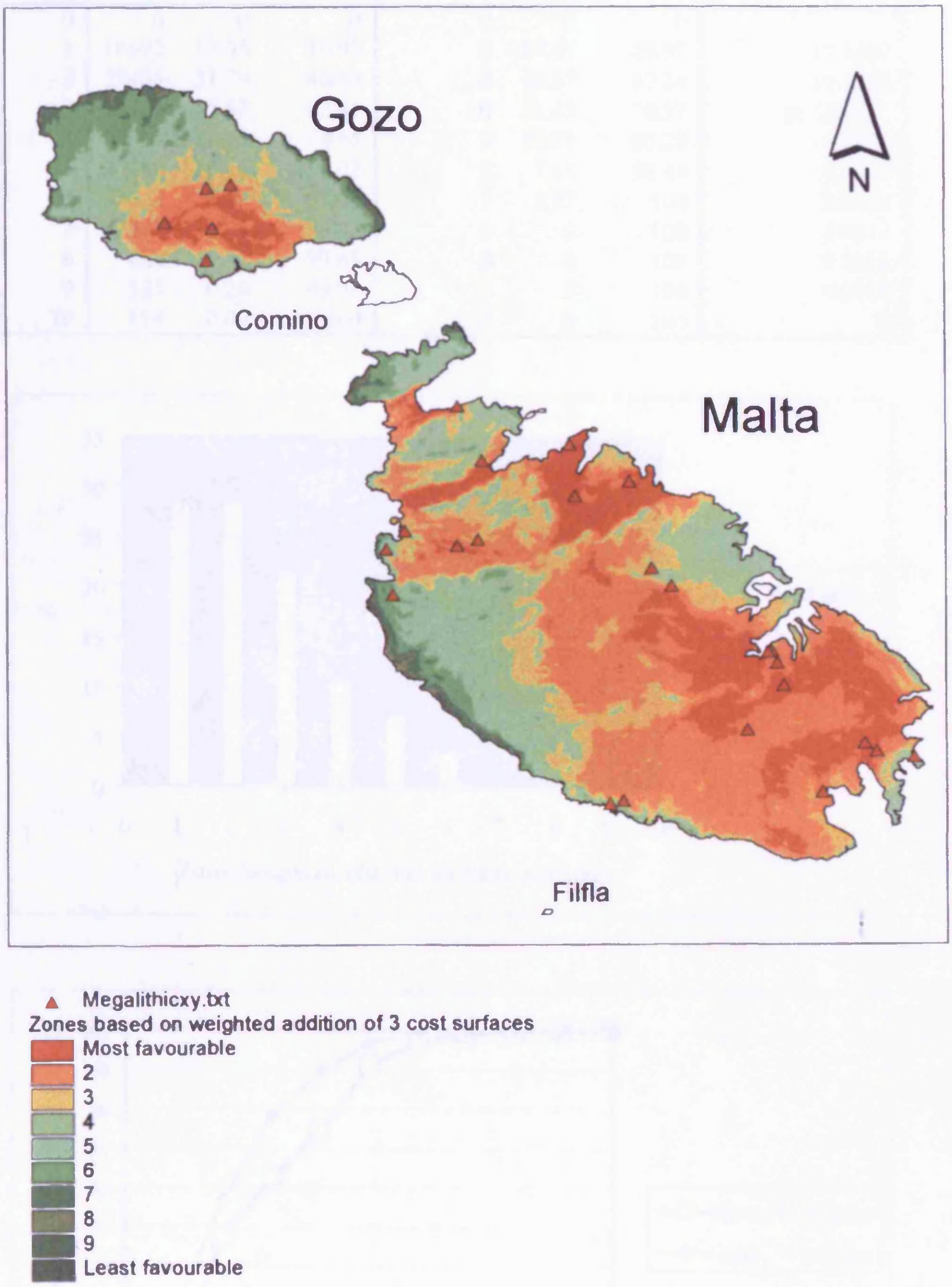
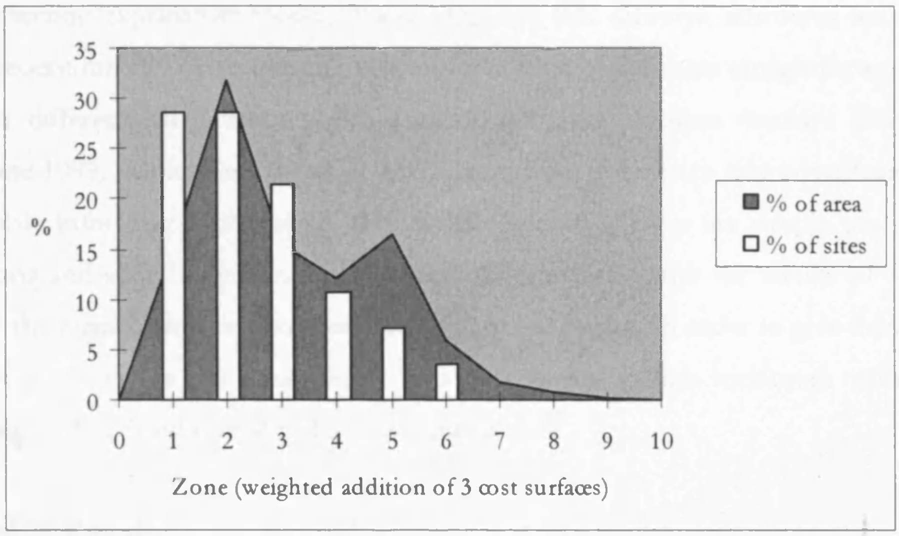


Figure 44. Known megalithic buildings, mapped against predicted proximity to monument location based on weighted addition of three cost surfaces.

Zone	Area	%	Cum %	No. Sites	%	Cum %	Difference
0	0	0	0	0	0	0	
1	18692	15.05	15.05	8	28.57	28.57	13.5230
2	39486	31.79	46.84	8	28.57	57.14	10.3052
3	19345	15.57	62.41	6	21.43	78.57	**16.1596**
4	15093	12.15	74.56	3	10.71	89.29	14.7229
5	20446	16.46	91.02	2	7.14	96.43	5.4052
6	7532	6.06	97.09	1	3.57	100	2.9128
7	2299	1.85	98.94	0	0	100	1.0619
8	882	0.71	99.65	0	0	100	0.3518
9	323	0.26	99.91	0	0	100	0.0918
10	114	0.09	100	0	0	100	- 0



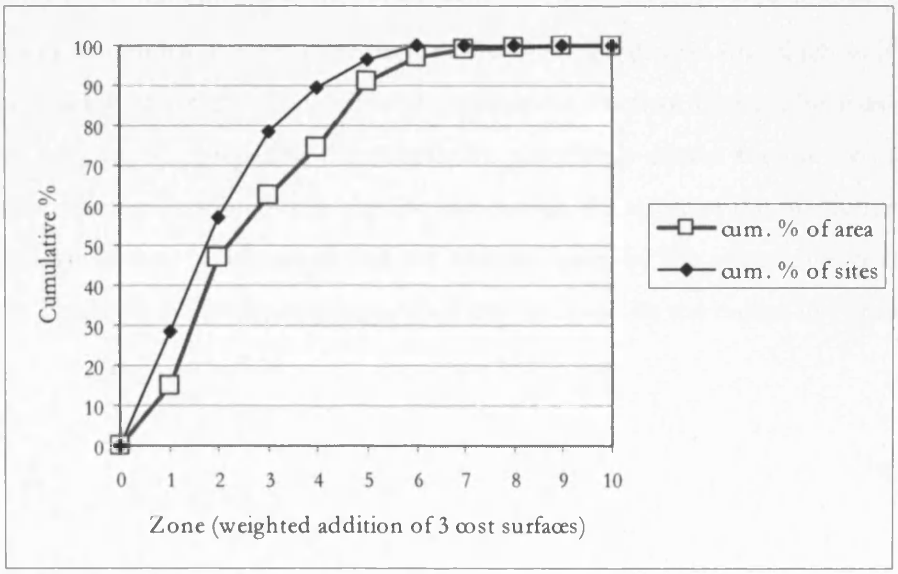


Figure 45. Distribution of megalithic buildings and land area, plotted against predicted proximity (based on the weighted addition of the three cost surface).

Model 2: A direct relationship

A statistical test is also designed to explore the second hypothetical model for the relationship between monument location and site attributes. In this second model, it is assumed that decisions about site location were directly influenced by the landscape attributes in question. In this model, sites would have been chosen on the basis of a conscious and deliberate consideration of their environmental attributes.

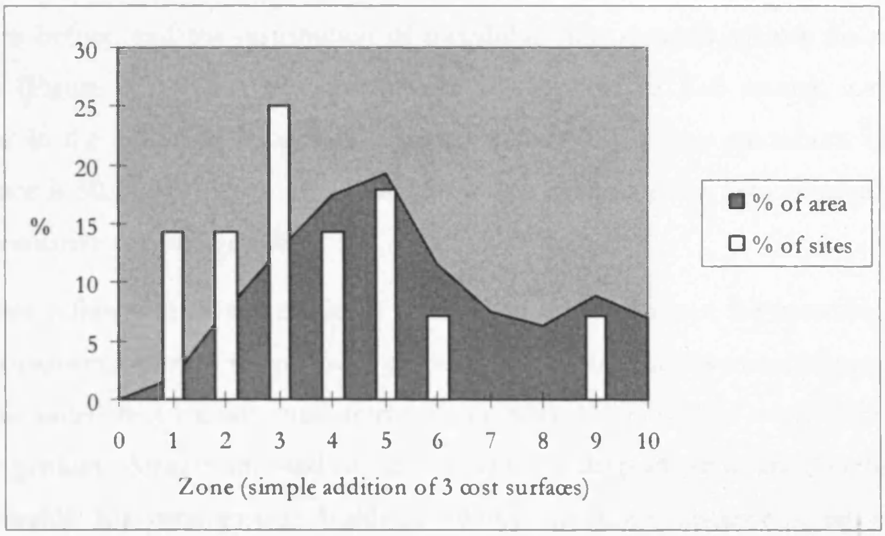
Model 2: Method

In the second explanatory model, it was suggested that different attributes were taken into account directly when deciding site location. One of the most straightforward ways to take different site attributes into account is to use Boolean overlays (Stancic & Kvamme 1999; Kamermans 2000). In the present case, in order to take advantage of the ratio-scale information offered by the distance variables, these are simply given equal weighting and added together. For the sake of comparison with the results of the first model, the same three cost-distance variables are used again. In order to give them equal weighting, all values are transformed into percentages of the maximum value. The resulting surface is submitted to K-S testing as before.

Model 2: Results

The results are shown in Figure 46. The maximum observed difference is now 31.40%. This shows a significant 'gain' over each of the three predictors on which it is based. This is a much better performance than that shown by the first model. This may also be noted at a glance by comparing the cumulative percentage curves for the two models. The greater the area enclosed between the two curves, the stronger the predictive power of the model. It may be observed that the area enclosed by the cumulative percentage curves in Figure 46 is significantly larger than that enclosed by the curves in Figure 45.

Zone	Area	%	Cumul. %	No. Sites	%	Cumul. %	Difference
0	0	0	0	0	0	0	
1	2289	1.84	1.84	4	14.28571	14.29	12.4429
2	9334	7.51	9.36	4	14.28571	28.57	19.2140
3	15913	12.81	22.17	7	25	53.57	**31.4029**
4	21507	17.31	39.48	4	14.28571	67.86	28.3738
5	24014	19.33	58.82	5	17.85714	85.71	26.8979
6	14398	11.59	70.41	2	7.142857	92.86	22.4493
7	9230	7.43	77.84	0	0	92.86	15.0184
8	7770	6.26	84.09	0	0	92.86	8.7630
9	11104	8.94	93.03	2	7.142857	100	6.9663
10	8653	6.97	100	0	0	100	0



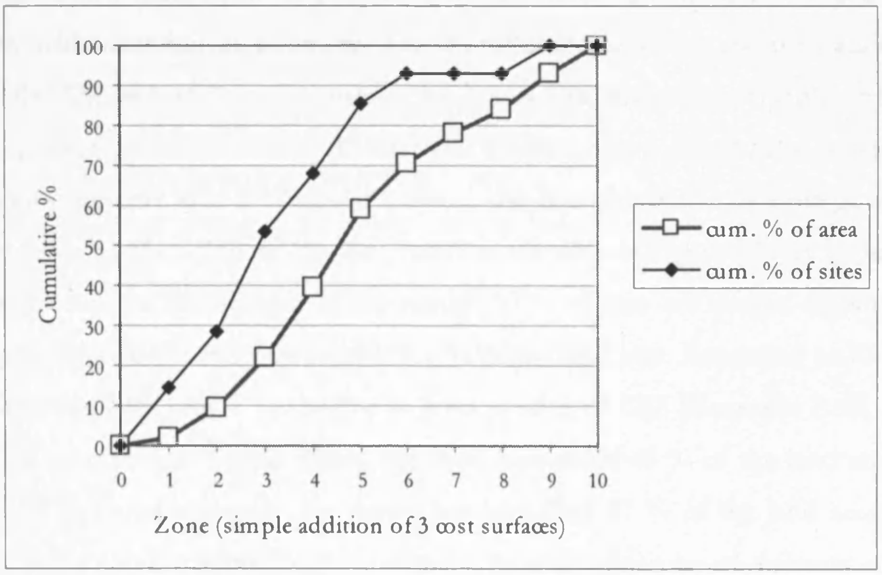


Figure 46. Distribution of megalithic buildings and land area, plotted against total of cost distances.

Having established that the second model is clearly superior to the first, it may now be refined further. In the previous chapter, it was noted that for some distance variables, cost distance proved to be a better predictor than horizontal distance, while in other cases the opposite was true. It was suggested that this may be an indication that different notions of distance are in operation when considering the distance from different types of resources. Following this line of thinking, the next logical step is to add the three best distance predictors. For distance from spring toponyms, cost distance is retained, because it was observed that it was a better predictor than horizontal distance. For distance from plains and distance from access points to the sea, the opposite was the case, and the cost distance is replaced by horizontal distance. These three variables are added as before, and the distribution of megalithic sites mapped against the resulting surface (Figure 47). When the new pattern is subjected to K-S testing, a dramatic increase in the observed maximum distance is noted. The new maximum observed difference is 50.53 % (Figure 48). This gain is also evident in the area enclosed by the new cumulative percentage curves.

A further refinement to the model is to build in the preference for locations with a southern aspect, noted in the previous chapter. During the analysis of surface geology, it was also noted that monumental activity appears to be limited to areas with a solid surface geology. Areas composed of clay outcrops or deep alluvium are therefore very unfavourable for monumental buildings. While the three distance-based ,variables determine which parts of the island are more favourable for monumental activity, the two new additional factors are more likely to influence decisions about location at the local scale. The two additional variables are factored in, using the principle of Boolean overlays, resulting a new surface (Figure 49). When the new distribution is tested, the maximum difference that is observed between the two cumulative percentage curves is an impressive 56.31 % (Figure 50). The values in the table in Figure 50 may be inspected in order to explore the strength of the model. 50 % of sites are located within an area that is identified as the most favourable 7.6 % of the land area. Expressed as Kvamme's Gain Statistic (1-[% area / % sites]) this gives a value of 0.85 (Kvamme 1988, 329). A 100 % of the sites are located within the most favourable 43 % of the land area (Gain Statistic = 1). In other words, the model has identified 57 % of the land area as very unsuitable for megalithic buildings. In view of the dense interplay of different attributes in a restricted and variable landscape, these are very powerful results, suggesting that the model is representing decisions about site location quite reliably.

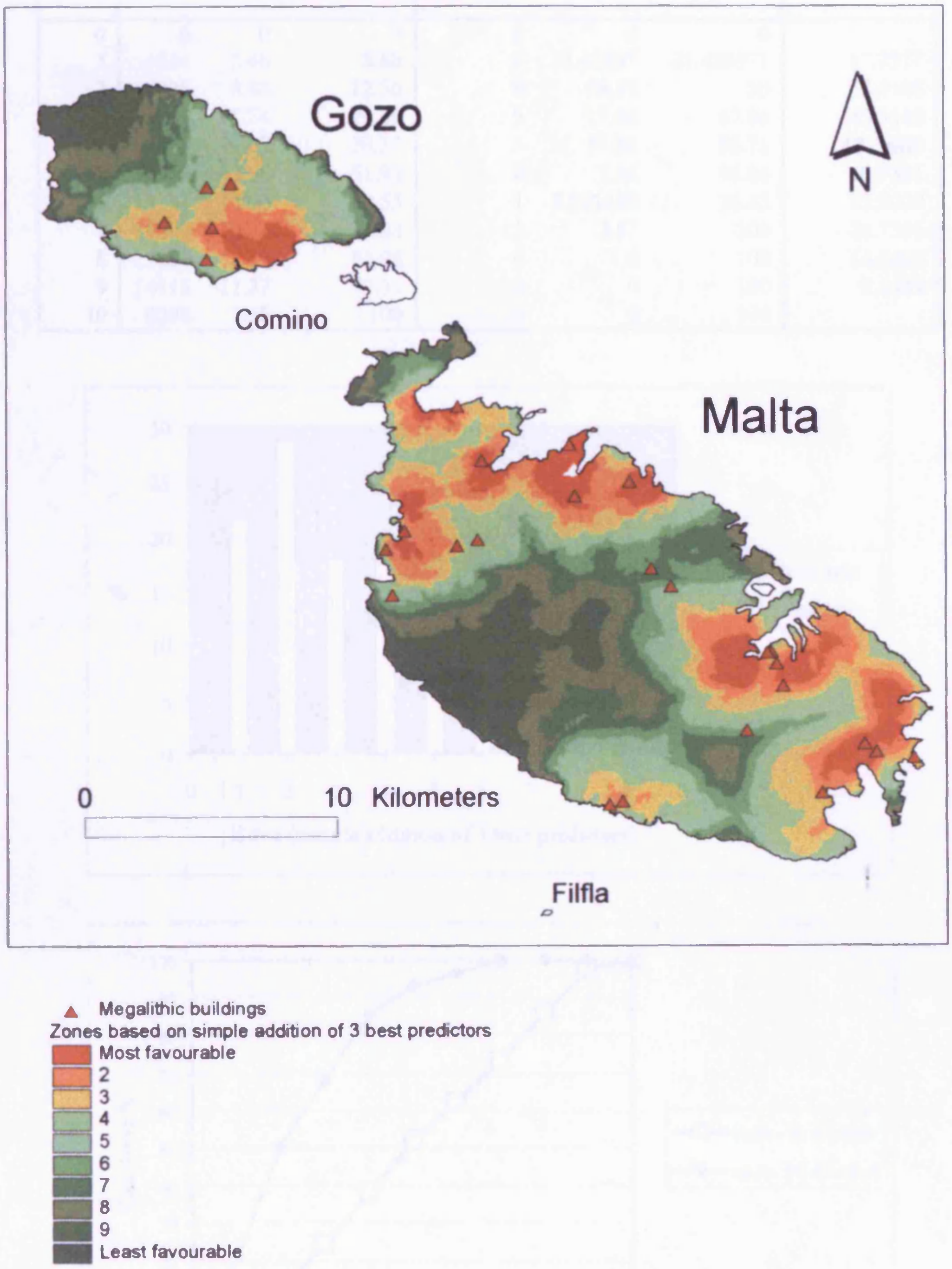
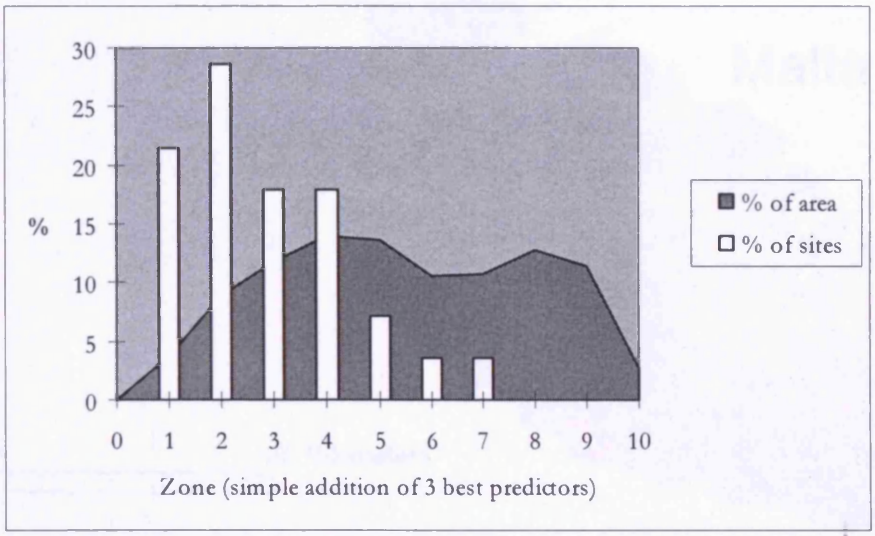


Figure 47. Megalithic buildings, mapped against simple addition of three best distance-based predictors.

Zone	Area	%	Cumul. %	No. Sites	%	Cumul. %	Difference
0	0	0	0	0	0	0	
1	4564	3.68	3.68	6	21.42857	21.428571	17.7517
2	11028	8.88	12.56	8	28.57	50	37.4388
3	14574	11.74	24.30	5	17.86	67.86	43.5548
4	17435	14.05	38.35	5	17.86	85.71	**47.3660**
5	16855	13.58	51.93	2	7.14	92.86	40.9301
6	13157	10.60	62.53	1	3.571429	96.43	33.9020
7	13299	10.71	73.24	1	3.57	100	26.7595
8	15813	12.74	85.98	0	0	100	14.0202
9	14115	11.37	97.35	0	0	100	2.6489
10	3288	2.65	100	0	0	100	-



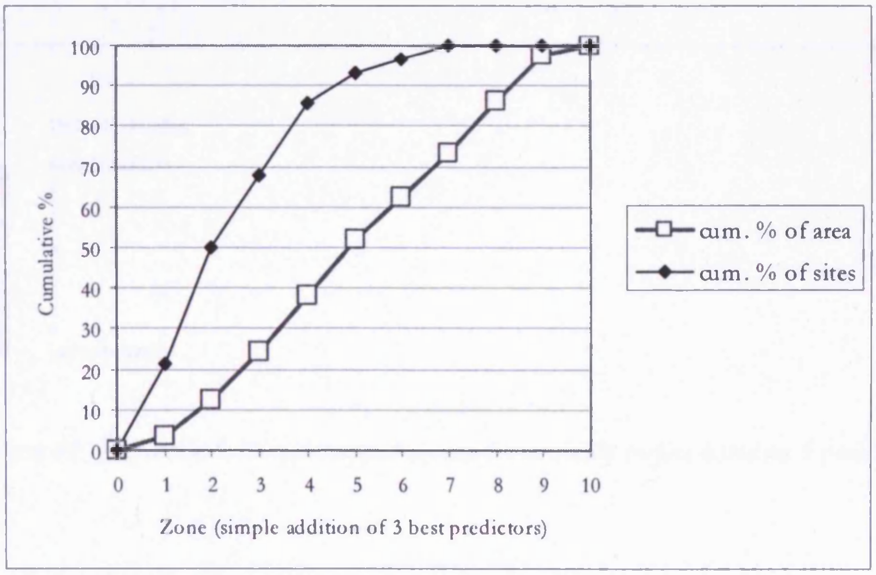


Figure 48. Distribution of megalithic buildings and land area, plotted against simple addition of 3 best predictors.

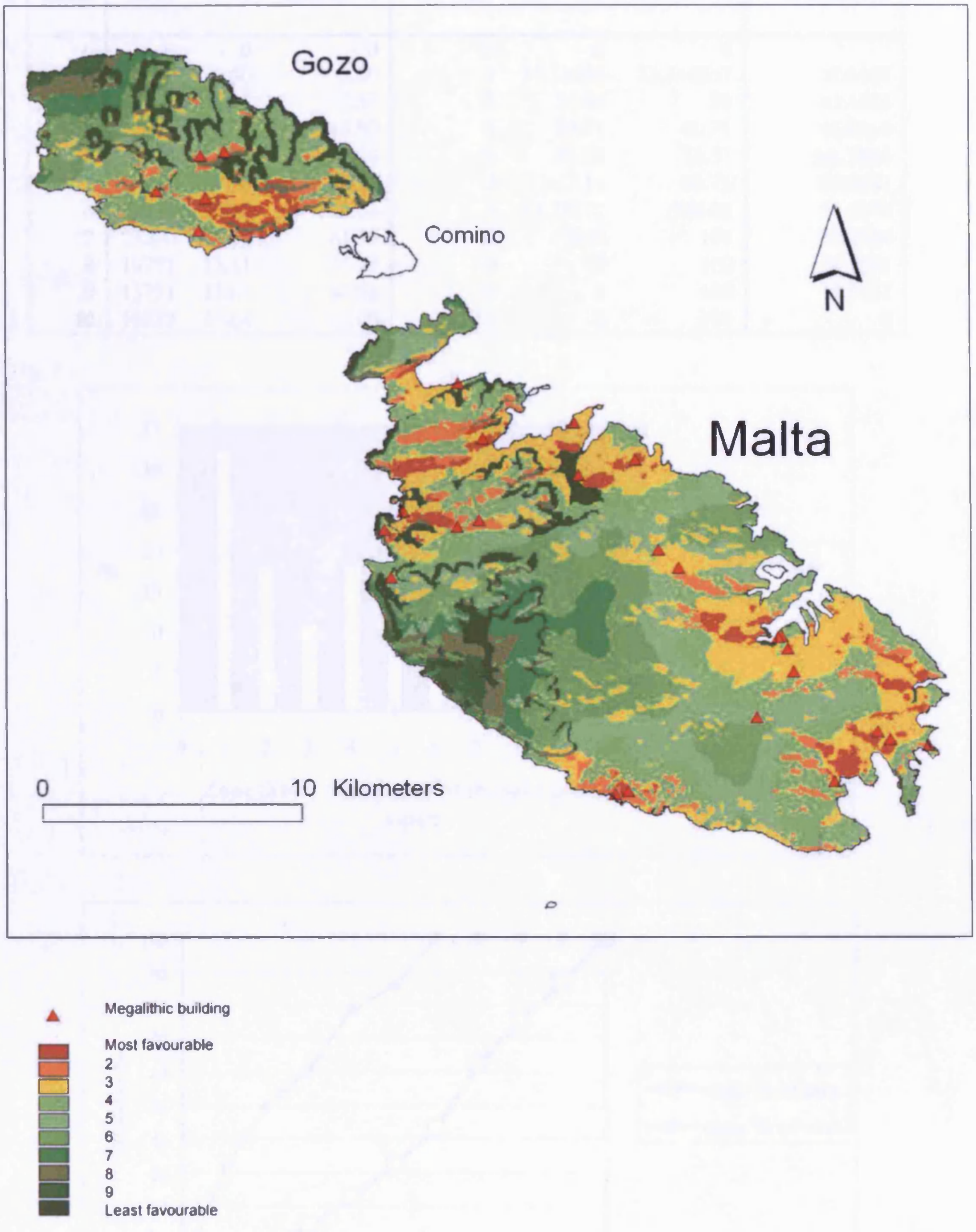
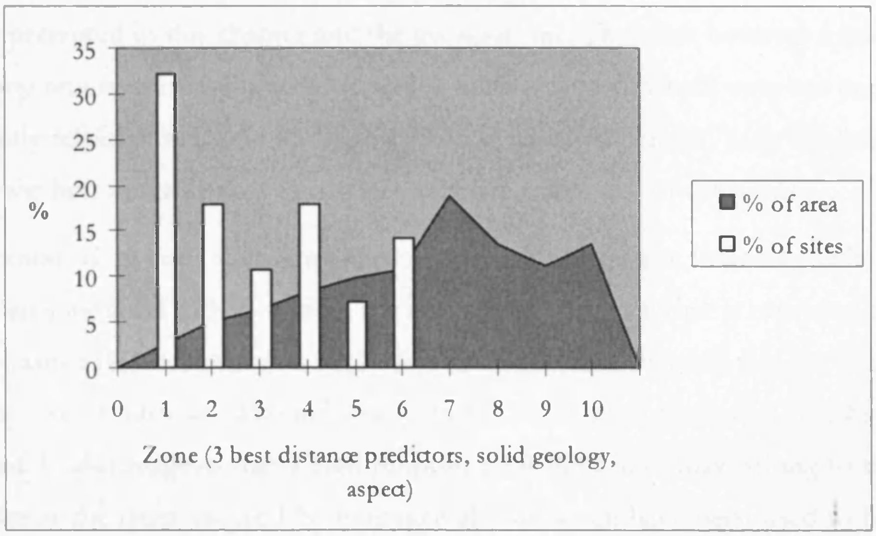


Figure 49. Megalithic buildings, mapped against favourability surface based on 5 variables.

Zone	Area	%	Cumul. %	No. Sites	%	Cumul. %	Difference
0	0	0	0	0	0	0	
1	3231	2.60	2.60	9	32.14286	32.142857	29.5410
2	6165	4.96	7.57	5	17.86	50	42.4336
3	7863	6.33	13.90	3	10.71	60.71	46.8160
4	10385	8.36	22.26	5	17.86	78.57	**56.3104**
5	12353	9.95	32.21	2	7.14	85.71	53.5057
6	13439	10.82	43.03	4	14.28571	100.00	56.9693
7	23290	18.75	61.79	0	0.00	100	38.2144
8	16771	13.51	75.29	0	0	100	24.7091
9	13751	11.07	86.36	0	0	100	13.6357
10	16933	13.64	100	0	0	100	- 0



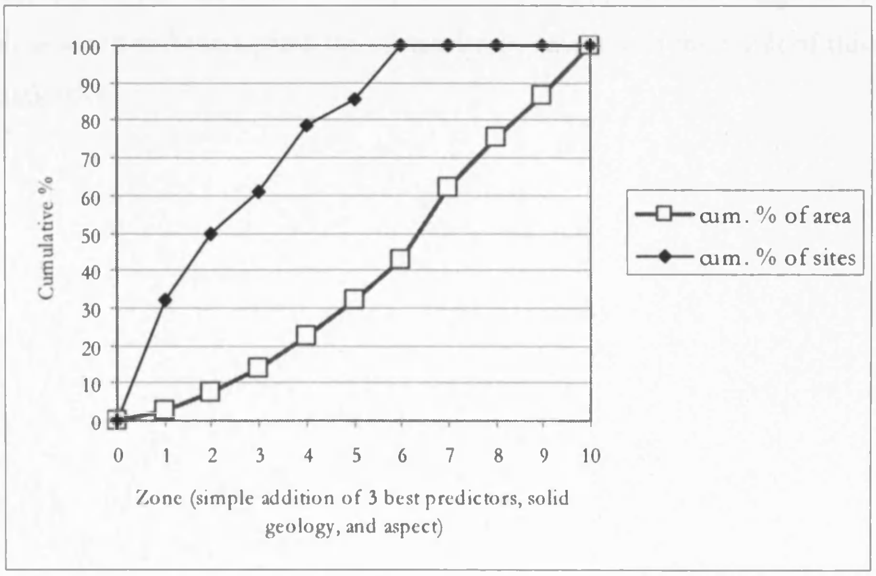


Figure 50. Distribution against addition of 3 best distance-based predictors, aspect and solid geology.

Good statistical practice requires that the efficacy of a site location model be tested against a sample of sites that has not been used while building the model. Early on in the modelling process, it was considered whether to divide the sample into a 'training sample' and a 'test sample', possibly using the sites on one island to develop the model, and then to test it against the sites on the other island. This was avoided for three reasons. Such 'jack-knife' sampling techniques have however been heavily criticized as very inefficient use of data (Ebert 2000). Furthermore, this procedure was also considered problematic because there is some degree of inhomogeneity in the landscape characteristics of the two islands. Thirdly, the sample size was very limited, and it was decided to use all the clearly attested LN megalithic sites in the bivariate and multivariate analysis presented in this chapter and the previous one. There are however a number of less secure reports of megalithic structures at other locations, which were not considered sufficiently reliable to include in the foregoing analysis (Appendix 7). At this stage, they present the best available data to conduct an independent test of the model.

The location of 12 such sites is mapped against the second site location model (Figure 51). When submitted to K-S testing, the maximum difference that is observed between the cumulative distance curves is 38.21 % (Figure 52). This suggests that the location of these less secure sites was also influenced by the environmental factors that have been discussed. It also suggests that a high proportion of these sites may belong to the same repertoire as the more secure LN monumental sites which have been used to build the model. In view of the uncertain nature of the data, neither of these suggestions may be positively asserted without lapsing into a circular argument, and the result of this last test is only indicative.

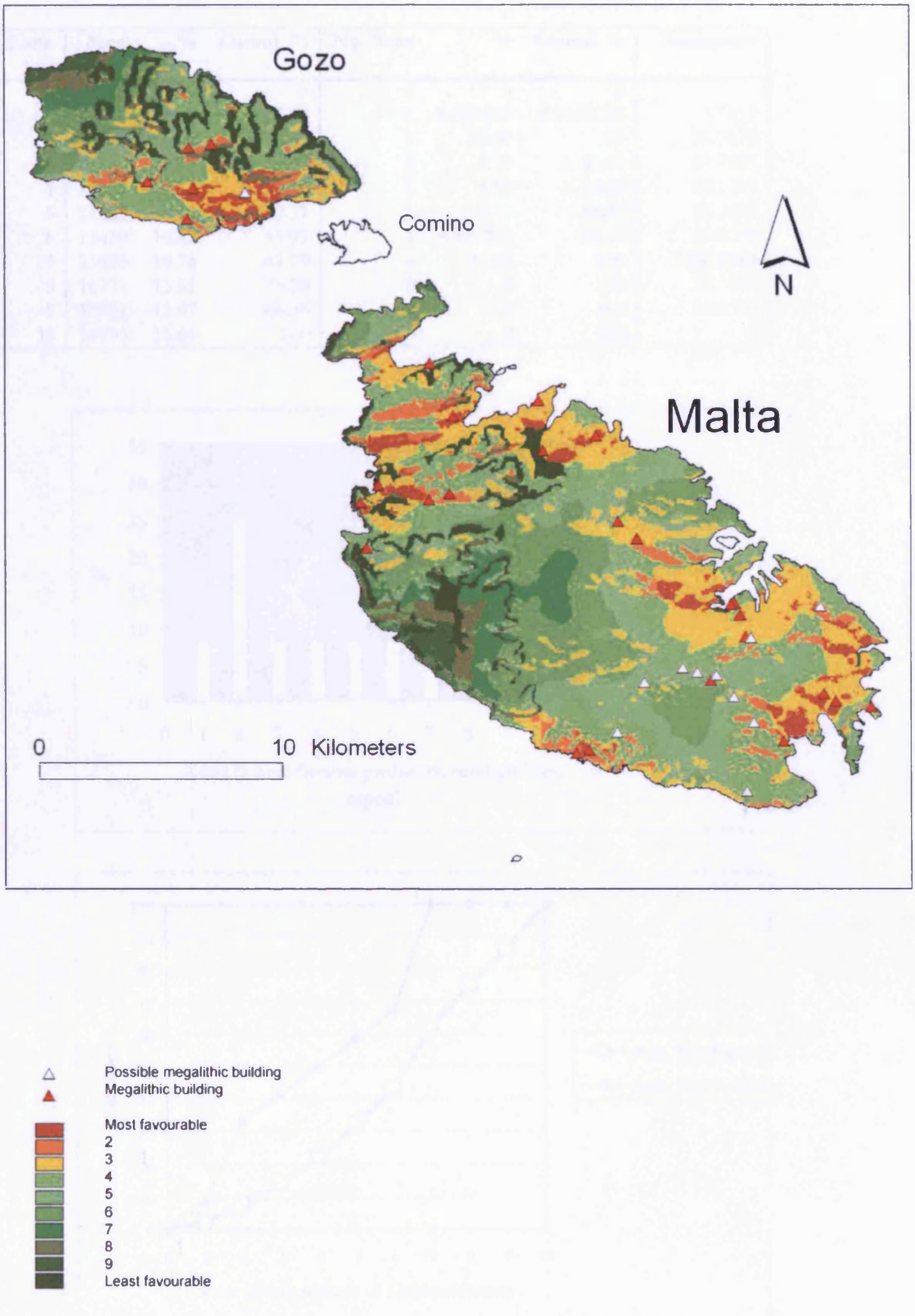
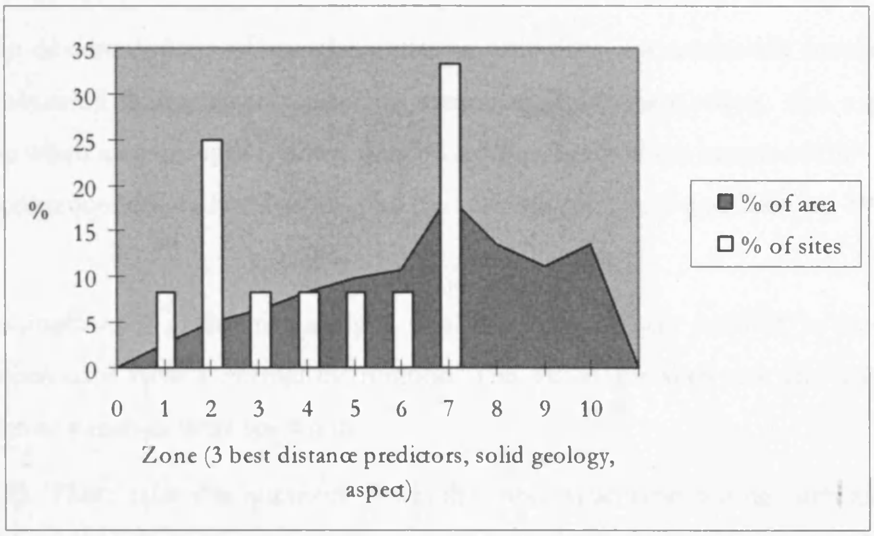


Figure 51. Secure and insecure locations of megalithic buildings, mapped against favourability surface based on 5 variables.

Zone	Area	%	Cumul. %	No. Sites	%	Cumul. %	Difference
0	0	0	0	0	0	0	
1	3231	2.60	2.60	1	8.333333	8.3333333	5.7315
2	6165	4.96	7.57	3	25.00	33	25.7670
3	7863	6.33	13.90	1	8.33	41.67	27.7684
4	10385	8.36	22.26	1	8.33	50.00	27.7389
5	12353	9.95	32.21	1	8.33	58.33	26.1247
6	13439	10.82	43.03	1	8.333333	66.67	23.6359
7	23290	18.75	61.79	4	33.33	100	**38.2144**
8	16771	13.51	75.29	0	0	100	24.7091
9	13751	11.07	86.36	0	0	100	13.6357
10	16933	13.64	100	0	0	100	-



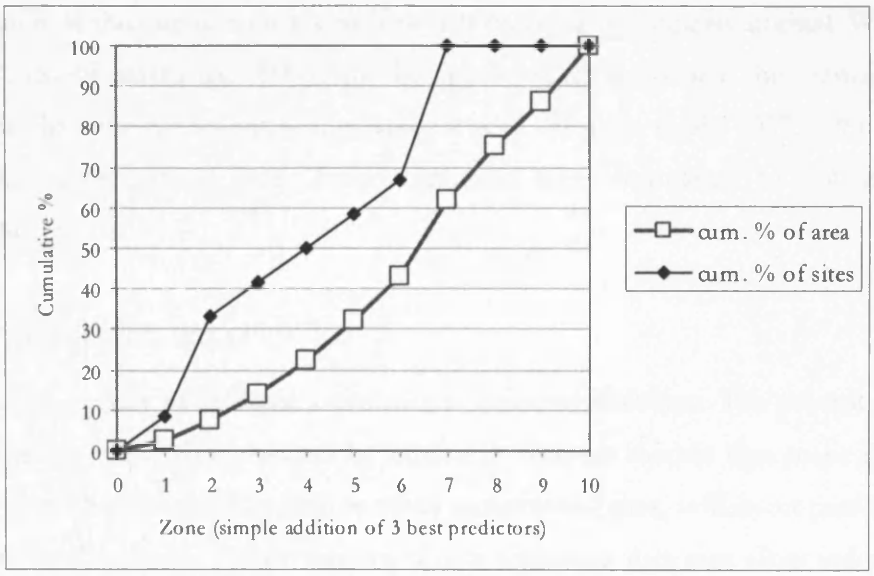


Figure 52. Distribution of locations not used in building the model, plotted against favourability surface.

Limitations

Normality of data

The regression analysis performed for the first model is limited by some of the characteristics of the variables, which violate some of the assumptions of linear regression. This is a common problem in statistical analysis of spatial phenomena. It is '...extremely difficult to fully meet the assumptions of many statistical classification models in archaeological spatial contexts...' (Kvamme 1990b, 286). The present analysis is no exception.

Violation of assumptions of specific statistical tests does not necessarily invalidate the results obtained. Some assumptions are more important than others, and a practical response when an assumption is not fulfilled is to understand the extent of the violation and its consequences, rather than dismiss the test outright (Rose and Altschul 1988, 199; 214).

One assumption of parametric analysis that is not completely satisfied is that all the populations used have a normal distribution. The values for skewness and kurtosis of the different variables were shown in

Figure 43. These raise the question of whether non-parametric testing such as logistic regression would be more appropriate, because it does not require normality. The distribution of the populations tested here is however approximately normal. When the assumptions of parametric testing can be approximately sustained, they remain more powerful than the equivalent non-parametric tests (Haggett et al., 1977, 348). In this case, the advantages of using linear regression were considered to outweigh the difficulties.

Paucity of settlement evidence

The present paucity of settlement evidence is a serious limitation. The present analysis has navigated round this problem by exploring different models that make different assumptions about the relationship between monumental sites, settlement patterns, and environmental variables. Future capture of new settlement data may allow independent testing of the patterns that have been observed.

Discussion

This chapter has explored two alternative models for the relationship between site location and site attributes. In this manner, some of the cognitive factors that may be involved in decisions about site location have been introduced into the analysis, albeit in very crude form. The procedure that was proposed was based on the principle that the way different attributes were perceived and evaluated may sometimes be detected in the resulting relationship between site location and site attributes. This methodological point is not usually made in the literature on site location modelling. Most examples present only a single model, that which is considered to have the greatest 'predictive' power, without examining why it may be fitting the data better than alternative models. Such a normative approach may represent something of a lost opportunity, and may warrant further research. It may also be noted that even some contributions that have advocated the generation and testing of alternative deductive models have suggested that this procedure is still limited by the assumption of the principle of least effort (Kamermans 2000, 142). The present analysis has suggested that the question whether such normative principles are respected may itself be investigated by constructing and testing appropriate alternative models.

Of the two alternative models examined here, the first one was found to perform very poorly when compared to the second. One of the basic assumptions of the first model was that monumental sites were centrally placed in areas that provided optimal access to plains, freshwater springs, and the sea. The poor performance of the first model suggests that this assumption may be unfounded. One of the conclusions of the previous chapter was that these monumental sites were not necessarily 'central places', as has sometimes been assumed. The present result lends further support to this observation.

Conclusions

The multivariate analysis conducted in this chapter has confirmed and built upon the results of the previous chapter. The inclusion of each of the five landscape attributes that were shown to have a bivariate relationship with site location resulted in a significant 'gain' in the predictive power of the second model. Access to the sea, proximity to plain boundaries, proximity to springs, aspect and solid-surface geology were all factors that influenced decisions about monumental site location. On further consideration of these factors, it is evident that practically every one of them played a central role in human strategies for survival on the archipelago. This suggests that these monumental buildings formed an integral part of the landscape of daily life. This is a useful result, because the present paucity of settlement evidence does not allow a discussion of Neolithic demography. The sensitivity of monument location to these landscape variables suggests that the areas that afforded access to these different resources were recognized and exploited. These optimal zones are likely to have been foci of settlement and exploitation of the landscape. The building of monuments in these places furthermore suggests that the variability of the environment exercised a strong influence on the social organization of the landscape. Pockets in the landscape that afforded optimal conditions appear to have shaped organizational units. The building of monuments may have played an important role in this socialization of the landscape. Monumental buildings do not however appear to have been 'central places' located in the middle of these pockets. Instead, their relationship to site attributes suggests they may have been located near the boundaries of these zones. The relationship to maritime connectivity suggests that one of their purposes may have been that of ceremonial gateways mediating interaction between communities in different parts of the archipelago, and with the outside world.

The overall picture that emerges, therefore, is one of different communities exploiting the more favourable areas of the archipelago. As observed in the previous chapter, the size of different megalithic complexes appears to be directly proportional to the land area providing favourable conditions. If the size of monumental complexes is taken to be indicative of the size of the respective communities responsible for their construction, an assumption which appears reasonable, then it appears that communities in different areas may have varied considerably in size, largely as a factor of the productive resources afforded by the part of the landscape within their control. In spite of variations in size, the widely distributed nature of megalithic activity, as well as the access to the sea enjoyed equally by different communities, do not suggest a hierarchic relationship between different communities. It is suggested that a heterarchic model may be more appropriate. Larger megalithic monuments and the communities they represent may have had the status of first among equals, rather than dominating smaller communities in a hierarchic manner.

6 Architecture and the shaping of space

Introduction

The preceding chapters have identified patterns and preferences in the location of megalithic buildings, allowing some fresh insights into their relationship with the landscape. The present chapter will focus on a smaller scale of analysis, namely the layout of the buildings themselves. The issue of different scales of spatial analysis was introduced at the end of Chapter 1 (p. 18 ff.). It has become a well-established tenet of archaeological theory that examination at different scales of analysis may provide a more complete understanding of the evidence (eg. Flannery 1976; Clarke 1977). In the preceding chapters, the primary focus has been the location of Maltese megalithic monuments in the surrounding landscape. The insights that have been gleaned into the purpose and function of the monuments may in turn shed light on the internal organisation of the buildings themselves.

The building of monuments in the landscape invites analysis at different scales for a further reason. Monumental buildings change the very landscape that surrounds them (Bradley 1993). The shaping of space within a monument is inseparable from the way that monument re-shapes the surrounding landscape. Architecture and environment were experienced as reciprocal and complementary components of a single continuum. An examination of the relationship between monument and landscape is therefore incomplete without a consideration of the spatial organisation of the monument itself.

The present chapter will therefore consider some key characteristics of these buildings, and identify patterns in the way that they organise space. The next chapter continues the analysis through a consideration of the use of iconography within megalithic buildings. A fresh model will be proposed for interpreting the use of space and iconography within these buildings.

Objectives

The objectives of the present chapter are to:

1. outline current approaches to spatial organisation in Maltese megalithic buildings;

2. identify devices that are used to define and order space inside these buildings;

3. identify topological patterns in the spatial organisation of these buildings;

4. propose a spatio-temporal approach to the study of these spaces.

Some characteristics of Maltese megalithic buildings

The megalithic buildings of the Maltese archipelago share a number of common characteristics that identify them as a distinct architectural form. In plan, the fundamental components are an external forecourt, leading to an internal central space or court, which in turn leads onto sub-circular chambers. Although the sub-circular chambers are the largest spaces inside the buildings, they are generally referred to as 'apses' in the literature, and the same term will be used here to avoid confusion.

The surviving walls of the apses are often corbelled inwards, and the apses were almost certainly roofed over with a corbelled vault. The interiors that were created in this way are astoundingly ambitious, employing novel technological solutions in order to create some of the largest artificially enclosed volumes that are known from the Neolithic. The vaulted apses are linked together by central courts. It remains an open question whether the courts were roofed over or left open to the sky.

Within this basic formula there is considerable variability and development in the number of apses, in their proportions, as well as in their disposition in relation to each other and to the central court. This variability has been discussed in detail and modelled as evolution of the basic plan across time, from the earlier three-apsed structures to the more intricate plans of the Tarxien Phase (Evans 1959, 84-125; Evans 1971, 218; Trump 1972, 25-27; Trump 1983, 65).

As noted in the previous chapter, more variability is encountered in the way the megalithic buildings are grouped together. In some instances, a single megalithic structure may occur in apparent isolation, as in the case of Kunċizzjoni or Għajn Żejtuna, or it may be grouped with other buildings in a variety of combinations (Bonanno et al. 1990, 193). This may take the shape of a complex of interconnected structures, as in the case of Tarxien, contiguous structures with independent access, as in the case of Ġgantija or Mnajdra, or separate buildings that may be a few metres apart, as in the case of Ħaġar Qim, or rather further apart, as in the case of Kordin.

Approaches to space in megalithic buildings

The literature on Maltese megalithic buildings has put forward a number of models to explain their layout, and the way that it varies from one example to another. Some of the more salient ideas that have been put forward will be recalled below. The literature on the experience of architectural space in general, and prehistoric monuments in particular, also contains a panoply of theoretical approaches that may be usefully applied to the analysis of space in Maltese megalithic buildings. Work conducted in a variety of kindred disciplines, including anthropology, cognitive psychology, and the sociology of scientific knowledge, has generated several concepts that, notwithstanding their potential usefulness in the analysis of the Maltese monuments, have not been brought to bear on the subject. Some of the more pertinent of these ideas are also outlined below.

The present analysis of the organization of space in Maltese megalithic buildings will draw upon, first, the strengths and weaknesses of prevailing models for the organization of these buildings, and second, the alternative theoretical tools that may be borrowed from work on archaeological sites elsewhere, and from other disciplines.

Development over time

As noted above, there is a broad consensus that the variability between the plans of different examples of Maltese megalithic buildings is partly the result of the evolution of the basic plan over time. Another important factor that has been recognized is that the more complex buildings are not planned and built as a single project, but are the result of a succession of interventions, often spanning many centuries (Bonanno et al. 1990, 195-200). This process of accretion, modification and extension has contributed to the idiosyncrasy of individual buildings (Bradley 1912, 46). Any attempt to model the use of space within these buildings must of course take this diachronic variability into account.

Specialized function

The megalithic buildings that are usually gathered under the label of 'temple' have generally been treated as a single type. Their treatment as a single architectural form appears reasonable in view of the characteristics shared by their architecture and layout. On the other hand, the same basic architectural form may be used for, or adapted to, different specialized functions. This remains a distinct possibility in the case of Maltese megalithic buildings. Largely due to the dearth of evidence, there has been little debate on the question in the literature. A notable exception is a study that has suggested that two main types of megalithic building may be recognized (Hayden 1998, 267-271). Hayden notes that, in those instances where a pair of 'temple' buildings may be observed side by side, as in the case of Ġgantija, Skorba, Ta' Ħaġrat or Mnajdra, the western building generally makes more use of elaborate sculpture, furniture and boundary markers, while the interior of the eastern building is usually rather simpler in execution. In the case of Tarxien, the same contrast may be noted between the western and central building on one hand, and the eastern building on the other (Hayden 1998, 268). The evidence that is presently available is too fragmentary to allow conclusive statements on this question. However, the possibility of variations in purpose and function should be taken into account when considering variability between one building and another.

Anthropomorphic plan

A persistent interpretation in the popular literature is that the plan of Maltese megalithic buildings is anthropomorphic in inspiration, echoing the form of the figurines and statues often found on the same sites (eg. Zuntz 1971, 8). This explanation appears unlikely, for two reasons. First, it does not account for the development from the early three-apsed plan to the six-apsed example at Tarxien. Only one stage in this development, namely the five-apsed plan, happens to have a superficial resemblance to the outline of the human form. The second reason that this explanation appears unlikely is that it presumes a bird's eye view of the plan, which is very different from the actual experience of moving through these buildings. Archaeologists are accustomed to visualising and thinking about megalithic buildings through the medium of plan drawings. The idea that these buildings may be anthropomorphic is to a large extent an artifact of such thinking. It is a useful reminder that, when trying to model the organisation of space within these buildings, it is vital to think in terms of the three-dimensional physical experience of a person moving through these spaces, and not to restrict our vision to two-dimensional plan drawings.

In recent years, anthropologists have increasingly underlined the importance of considering the way senses other than sight also contribute to experience (Seremetakis 1994). Archaeologists have also begun to investigate the effects that prehistoric monuments may have had on different senses (Watson & Keating 1999; Watson 2001a; Watson 2001b). In Malta, the acoustic effects of the Ħal Saflieni Hypogeum have received some attention (Devereux & Jahn 1996), while the need has also been recognized for further research into how the Maltese megalithic structures built above ground effected senses other than sight (Stoddart 2002, 182).

Orientation

The orientation of Maltese megalithic buildings has attracted considerable discussion. Their façades and entrances predominantly face a southerly direction. Two alternative hypotheses have been put forward as explanations (debate summarized and reviewed in Ventura 2004). Most contributions have explored the possibility that it may be related to astronomical alignments, particularly with critical rising and setting positions of the sun (e.g. Fodera` Serio et al. 1992; Vassallo 2000a; Vassallo 2000b; Vassallo 2000c). The most persuasive alignments are those in the South Temple at Mnajdra, where a case has been made for intentional alignments with sunrise during the summer and the winter solstices, as well as the spring and autumn equinox. The fact that this sophisticated alignment is only in evidence at Mnajdra may be used to question its statistical significance (Ventura & Agius 1980). On the other hand, this unusual alignment may be an instance where the familiar architectural form was being adapted to a specialized function.

An alternative explanation has suggested that the axes of megalithic buildings may be oriented towards ancestral homelands in Sicily to the north, or minor islands such as Pantelleria to the northwest (Stoddart et al. 1993). The argument continues that such an orientation was deliberately intended to connect ritual activity within the buildings to these ancestral homelands. Developing the idea that access to the interior may have been restricted to certain members of the community, it has also been suggested that the arrangement was designed so that people gathered before the building would have been conscious of facing their ancestral homelands as they faced the entrance (Stoddart et al. 1993, 15-17).

It has been noted that the explanations for building orientation that have been considered overlook the influence of the terrain (Turnbull 2002, 132). In order to take this factor into account, it is useful to recall one of the results of Chapter 4 (page 120 above). A distinct pattern was observed when examining aspect, that is the direction faced by the slope of the ground. When the terrain of Malta and Gozo was classified according to the four cardinal directions, a much higher concentration of megalithic buildings was noted on south-facing slopes. This pattern suggests another possible explanation for the buildings' orientation. This is that the generally southerly orientation of the buildings is closely tied to the direction of slope of the terrain itself. The façades and entrances of the buildings generally face downslope. Such an orientation offered considerable practical advantages. It heightened the monumental effect of the façade as it was approached from below, and furthermore permitted the creation of an open-air terrace outside the main entrance.

Another conclusion presented in Chapter 4 (page 136 above) was that there is no particular preference to locate megalithic buildings on sites that command a visual relationship with the sea. For a viewer standing before these buildings, the sea to the north or northwest is in most cases completely hidden from view by the lie of the land. The argument that the buildings were designed so that their axes pointed towards Sicily or Pantelleria would have been more persuasive had the choice of site permitted a view of the sea in their direction. It may be added that although Etna is visible from vantage points on Malta and Gozo on very clear days, there is no preference for such vantage points in the choice of location for megalithic buildings.

In Chapter 4 it was also observed that megalithic buildings appear to have been built on sites that were already foci of human activity. In some cases, there is evidence that the sites were in use for more than a thousand years before the megalithic structures were built. Their location may therefore be quite independent of the physical requirements of a megalithic monument. The most plausible explanation for the preference for southern slopes is a preference for the conditions that these slopes afforded, such as better exposure to sunlight, or shelter from northerly winds. The orientation of the megalithic buildings themselves is, very probably, conditioned by the aspect of the terrain as well as by considerations of light and shelter.

As already noted (Chapter 1 and Chapter 2 above), the existing literature has largely examined Maltese megalithic buildings in isolation from their landscape setting. The discussion on their orientation is a good example of how some of their characteristics may be better understood when considered in their topographic context.

Metrology

In contrast to the orientation of Maltese megalithic buildings, the subject of their metrology has received very little attention (Turnbull 2002, 133). A very interesting, albeit isolated contribution in this regard is that by Mario Vassallo (Vassallo 2003a; Vassallo 2003b; Vassallo 2003c). Rather than searching for a standard unit of measurement or 'megalithic yard', Vassallo examines the proportions between different architectural elements within each building. On the basis of direct measurement and statistical testing, the study proposes that the dimensions of the entrance doorway were used as the basis for determining the overall length of a building, as well as the size of the apses. One of the strengths of the study is that it engages with the practical processes required in the making of a megalithic building, beginning with the laying out of its plan on the ground.

Architecture and technology

A growing body of research has addressed the question of how the megalithic buildings were constructed (See Torpiano 2004 for a recent summary). This work has focussed on the question of the sequence in which they were built (Tampone et al. 1987; Tampone et al. 1991), whether and how the buildings were roofed over (Ceschi 1939; Xuereb 1999), and the amount of man-hours that was needed for their construction (Clark 2004).

The technological constraints under which the megalithic buildings were created had direct implications for their spatial layout. For example, the maximum span that could be enclosed beneath a roof was definitely an important design constraint. Xuereb (1999) has demonstrated that it is quite possible that apses were roofed with stone elements alone. If this were the case, the properties of local stone materials and the technological knowledge that was available to the builders would have heavily conditioned the size and layout of the buildings. Maltese vernacular architecture of the early modern period is instructive here. One of the most recognizable architectural forms in vernacular buildings is a long, narrow room roofed with *xorok tal-qasba* (stone slabs 1 cane [c.2m] long). The width of these rooms hardly varies across the archipelago, as it is closely determined by the technology that was used for the roof, and by the properties of the Globigerina Limestone from which the roofing slabs were made. These constraints were partially overcome by using corbelling to gain a few more centimetres of width at floor level. In order to create larger spaces, however, the more viable solution was to extend the length of the room. As a result, rooms roofed in this technique are often several times longer than they are wide. Returning to the megalithic buildings of the Neolithic, the same basic principle may also be observed. While different examples of Maltese megalithic buildings vary considerably in their footprint area, the size of individual apses is rather less variable. Furthermore, while the footprint area of several megalithic complexes increased over time, the size of individual apses did not, and the impressive dimensions of the earliest apses at Ġgantija are never surpassed (For a drawing of the different plans at the same scale, see Torpiano 2004, 349). The reasonable conclusion is that when the builders extended existing buildings or planned a larger building, the option permitted by the available materials and technology was to concatenate more units together, rather than to create units of a larger size. This fundamental constraint was clearly an important factor in the development of the plan of the buildings, which should be borne in mind when trying to understand their spatial organisation.

Space Syntax and Access Analysis

A promising approach to the internal organization of space in Maltese megalithic monuments is the use of Space Syntax and Access Analysis (Hillier & Hanson 1984; Bonanno et al. 1990). These tools are very useful to demonstrate the increasing complexity of the buildings over time. The buildings are characterised by internal partitioning and sub-division of space, which becomes increasingly elaborate, culminating in the Tarxien Phase (Bonanno et al. 1990, 195-198). Zammit was the first to suggest that boundary markers such as the raised threshold in the Central Temple at Tarxien were '...intended to keep out the *profanum vulgus* from the holy precincts destined for the priests or those initiated into the mysterious rites of the temple' (Zammit 1917, 269-70). Access Analysis has been used to develop this idea, and to suggest that as the access diagrams of the buildings became 'deeper', some form of exclusion was practised (Bonanno et al. 1990, 200-202).

This explanation has its limitations. First, it comes close to reading architectural space as a fossil-record of social relations. Such a reading is problematic when considering an accretionary type of building, such as the one before us, which repeatedly has new spaces added to it across time. In such a building, the addition of more architectural spaces need not necessarily represent a change in social relationships. In a context where monument building is an important focus of activity, monuments may become more elaborate over time, as a cumulative result of successive episodes of building activity.

A second consideration is that the accessibility of the Maltese buildings should be compared to that of other buildings with the same number of rooms. This exercise has been conducted by Hayden (Hayden 1998, 261-267). When the layout of the buildings was considered against all the different configurations that are possible with the same number of spaces, it was found that their configuration '...facilitates access from outside and movement inside to the highest possible degree' (Hayden 1998, 263). The same analysis revealed another important characteristic of the layout of the Maltese buildings. 'More than any other configuration, they produce a contrast between highly integrated and highly segregated spaces, the courts and apses respectively. The smallest number of spaces thus controls access to all other spaces' (Hayden 1998, 265). These different characteristics suggest that a shift in emphasis may be required in the interpretation of the access diagrams of the buildings, from 'exclusion' to 'regulated access'. Ethnographic comparison suggests various possible forms of regulation, which include access only at appropriate times or on appropriate occasions, or the need for specific performances and appropriate behaviour.

A final consideration is that Access Analysis makes no distinction between the different types of boundaries that divide spaces from one another. In one critique of Access Analysis, Leach observed that because the method focuses on the succession of spaces that are its units of analysis, it draws attention away from the boundaries that separate them. In terms of the social practices that are embedded in architectural forms, boundaries are at least as significant as the spaces themselves (Van Gennep 1909; Leach 1978, 400-401).

Repositories of knowledge

In a recent article, David Turnbull, a specialist in the Sociology of Scientific Knowledge (Turnbull 2000), has made a case for a broadened perspective on Maltese megalithic buildings (Turnbull 2002). Turnbull chooses the Maltese example to illustrate his argument that knowledge, place and architecture are closely intertwined (Turnbull 2002, 127-8). In the process, he proposes a fresh and challenging research agenda for the understanding of the Maltese buildings. The core of Turnbull's argument is concerned with the way knowledge is assembled, perpetuated and transmitted in a prehistoric society. For Turnbull, Maltese megalithic buildings are early examples of a sophisticated assemblage of knowledge that is maintained through the shaping of architectural space.

The idea of buildings as repositories of knowledge is closely related to the idea of external symbolic storage (ESS). The concept of ESS has been put forward by Merlin Donald, a cognitive psychologist who has studied the systems used by human societies to model and express knowledge. Donald suggests that four stages may be distinguished in the development of these systems, namely episodic, mimetic, mythic and theoretic. In his model, the 'mimetic' stage is associated with communication through bodily practices, and the 'mythic' stage is associated with language and oral communication.

For Donald, 'theoretic' communication is the most powerful, because it makes use of 'external symbolic storage', defined as devices outside the body that store or communicate information (Donald 1998, 14-15). The use of a monument or image to organise and represent knowledge is a form of external symbolic storage (Renfrew 1998, 4). One of the principal forms of knowledge that have been recognized in prehistoric monuments is knowledge of a cosmological nature, which will be considered next.

Spatial systems and cosmological order

The role of architecture in the creation of models for the understanding of the world is widely attested in the ethnographic literature (Barth 1987; Bourdieu 1990; Parker Pearson & Richards 1994b; Strathern 1998). The arrangement of space in the microcosm of an architectural form may be based on ideas about how the wider world is ordered. Such considerations are attracting more and more debate in the interpretation of prehistoric monuments. Monumental architecture has often had a central role in defining and expressing attitudes to the environment. Architectural spaces were important for the creation of order in the surrounding landscape (Bradley 1993; Tilley 1994; Tilley 1996; Richards 1996; Thomas 1996; Bradley 1997; Bradley 1998b; Tilley & Bennett 2001; Watson 2001a). The possibility that Maltese megalithic monuments may have had a cosmographic role has started receiving more attention in recent years (Robb 2001; Grima 2001; Grima 2003; Tilley 2004).

Architecture and temporality

Much of the work that has just been cited is focussed on the relationship between architectural spaces and the ordering of space in the surrounding environment. A further important dimension that should be introduced here is that of time. The experience of space is quite inseparable from that of time. The work of Chris Gosden and Tim Ingold has underlined the temporality of the experience of landscape (Gosden 1994; Ingold 2000b). In recent years, the debate on prehistoric monuments has also begun to address the question of temporality (Barrett 1994; Thomas 1996; Bradley 1998c; Bradley 2002b). The primary concern of this work has been to chart the changing life-histories of monuments as they unfold over time. Study of the relationship between time and ritual in archaeological contexts has focussed on how the ritual engagement of monuments with the surrounding landscape may have varied at different stages in these life histories. There is however a further issue to be dealt with when considering the relationship between monumental architecture, ritual and time, which is discussed less often (Watson 2001a). This is the temporality of ritual itself, the implications of which deserve some attention.

Ritual and ceremonial activity takes place in time. Moreover, many rituals go through a number of temporal stages, which are recognized and understood as representing distinct events, processes and transformations, as is widely attested in the historic and ethnographic record (Gell 1992). When working with the archaeological traces of such activity from the remote past, however, the prospect of reconstructing the temporal patterns that may have taken place over minutes, hours or days appears unlikely. In consequence, the question has tended to be prudently avoided by most archaeologists. While the temporal dimension of such practices is largely invisible in the material record, there may be some avenues of investigation that are worth exploring, which are pursued further below.

Performing knowledge in spatial systems

Ethnographic evidence of cosmological systems embedded in architectural space has often shown how such frames of reference acquire and maintain their meaning through their enactment by people. Strathern has emphasised the point with reference to her work in the Mekeo villages of Papa New Guinea. The spatial ordering of a Mekeo village embodies a series of cosmological ideas and values about their place in the world. These values maintain their meaning and potency because they are constantly being enacted in the daily activities of the inhabitants, as they cross boundaries between different domains within and around the village (Strathern 1998). The importance of enactment has also been recognized in the study of prehistoric monuments. Cultural knowledge is perpetuated through its performance (Thomas 1996, 137). The forms of monuments are closely related to the bodily practices that take place inside and around them. For example, it has been argued that at the Neolithic henge monument of Mount Pleasant (Dorset), the architectural form was closely related to prescribed ways of moving through it (Barrett 1994, 104; Thomas 1996, 199).

In his discussion of the Maltese buildings, Turnbull underlined the importance of performance and action in the perpetuation and transmission of knowledge (Turnbull 2002). However, these issues remain largely unexplored in the case of the Maltese megalithic buildings. A notable exception is a study of the way knowledge and vision was controlled inside the buildings, which proposed that activities performed within the buildings could be brought in and out of sight of participants standing outside the main entrance (Stoddart 2002, 181). Another contribution has underlined the significance of the megalithic buildings' effects on the body and the way they constrain movement (Tilley 2004, 131-133). The organisation of space, access and movement in the funerary context of the Hypogeum has also received attention (Pace 2000).

The question of performance is closely tied to the temporality of the human encounter with architecture. Performances may only take place in time, and are inseparable from the way buildings shape the movement of people through time as well as through space. In order to understand the performative engagement of people with monumental architecture, therefore, it is useful to develop models that include the temporal dimension.

Setting an agenda

The overview given above outlines prevailing models for the layout of Maltese megalithic buildings, as well as ideas that may help broaden the current explanations. This overview will form the foundation of the present analysis. A number of lessons may be drawn from the different models that have been considered.

First, our models should recognize the complex variability that exists within this group of buildings. Their variability is only partly explained by developments over time. A specialized function for different megalithic buildings cannot be ruled out, and may account for further variations in spatial organisation. Another possibility is that specific zones within different complexes may have shared the same function, even though the overall plan of the same complexes may differ considerably. One example is a very similar arrangement that may be observed in the South Temple at Ġgantija (Figure 53) and in the South Temple at Tarxien. In both cases, a screen treated with low-relief sculpture separates an apse from a court. In both examples, the screen is perforated by a threshold, following a very similar design. Although the two complexes are very different in their overall layout, we may recognize the same arrangement of court, screen, threshold and apse on both sites. The topological relationship between these elements follows the same formula, and in all probability would have had the same function in both complexes. Our explanatory model must therefore recognize such formulaic replications, in spite of the overall heterogeneity against which they occur.

Figure 53. Ġgantija, South Temple. Detail from 19th century watercolour by C. F. de Brocktorff showing screen separating court from apse.

Another fundamental point is the importance of thinking in terms of the physical experience of these spaces. Today we are accustomed to comparing these sites as plans on paper. The actual experience of encountering these buildings is very different however. A shift from an 'etic' to a more 'emic' approach is required. Our models should not be conceived in terms of plan views alone, but must engage with the question of how these spaces were experienced through the senses. A closely related issue that also deserves more attention is the way the buildings condition the movement of people within them. Movement here is intended in a broad sense, to include not only the way people may reach different parts of the structure, but also the bodily actions that may be required to move across and between spaces, as well as the temporality of this movement.

A final observation is that the buildings should be considered in their landscape setting. A corollary is that, even when examining the organisation of space within the buildings, the possibility of a relationship between architectural space and the surrounding environment should be borne in mind.

The remainder of the present chapter re-examines architectural space in Maltese megalithic buildings, paying particular attention to the issues that have been raised. The material evidence of the treatment of space will be considered, before turning to the question of how architectural spaces are experienced. The analysis will then be continued in the next chapter, which examines the use of images within the same spaces.

The elements of spatial organisation

A useful point to begin a re-examination of spatial organisation within Maltese megalithic buildings is to look at the way space is defined. The articulation of different spaces immediately raises the question of how boundaries are created in order to demarcate different spaces. Taking the lead from Leach's comments, noted earlier in this chapter, the present discussion pays particular attention to the treatment of boundaries. Leach's observations about the significance of boundaries may be especially pertinent here, because the division of space within these buildings is heavily emphasised. Boundaries are strongly demarcated, particularly in the buildings that Hayden terms 'western temples' (Hayden 1998, 268).

The most fundamental boundary is that between the outside and the interior of the buildings. Access points into the building are usually few in number, typically a single entrance into each three-apsed or five-apsed building. The entrance doorways are typically some two metres deep, effectively forming a megalithic corridor framed by a succession of trilithons. The doorways are monumental compositions, often with raised thresholds and holes for the fitting of removable apertures and barriers. From a structural point of view, the deep box-structures forming the doorways performed the function of permitting a safe perforation through the thickness of the massive outer walls of the building. From the point of view of spatial organisation and ,use, the entrance arrangement sharply divided the interior from the exterior, permitted the closing off of the interior, and also restricted the visibility of the interior from the outside. As will be considered more closely in the next chapter, the symbolic transition between the exterior and the interior of the building was often heightened further with the use of foundation deposits beneath thresholds, such as was found at the South Temple at Ġgantija, as well as the choice of distinctive materials for the thresholds, as in the case of the South Temple at Mnajdra. Trilithon doorways within the buildings may also be emphasised with the use of various devices, such as the relief panels in the Central Temple at Tarxien, which will be considered more closely in the next chapter.

Once within the main entrances into the building, another important type of boundary is encountered, this time the one between the internal courts and the apses that lead off them. Although the number of internal courts and apses changes with time, this boundary is distinctly recognizable in the simpler as well as the more elaborate of these buildings. This suggests an enduring topological relationship between court and apse, in spite of the considerable development and variability that may be noted in the layout, form and detail of different buildings.

The boundary between internal courts and the apses around them is marked in a variety of ways (Evans 1996, 41). Three principal devices are used repeatedly to mark these boundaries: elevation, screening, and sculpture. In addition, the division between court and apse is sometimes reinforced further by the different treatment of the flooring, and possibly of the roofing as well. The positioning of fixtures such as hearths may have played a part in articulating boundaries and spaces within the buildings. These devices and treatments will be considered in turn.

Elevation

In the simpler, three-apsed plans, a raised threshold marks the transition from the central court to the surrounding apses, with the floor level in the apses at a higher level than in the court. One of the best-preserved examples of this arrangement is Ta' Ħaġrat (Page 206, Figure 56). Here the threshold of the main entrance into the court is also at a higher level than the court itself, resulting in a sunken, rectangular court surrounded by a raised kerb on all sides (Evans 1971, 30-31). At Ġgantija, the three inner apses of the South Temple may originally have formed a three-apsed structure (Evans 1971, 180). A raised threshold has been preserved across the central apse, the floor level of which is at a higher level than the court. Early watercolours of the northern apse show that a raised kerb also separated the northern apse from the court (Figure 54).

Figure 54. Ġgantija, South Temple. 19th century watercolour by C. F. de Brocktorff showing change in level between court and inner apses.

The most extreme example of elevation being used as a device to demarcate the boundary between court and apse is the central apse of the South Temple at Tarxien, which is raised about sixty centimetres above the floor of the court leading to it (Evans 1971, 123).

Screening

During the Tarxien Phase, further developments in the treatment and elaboration of the boundaries between court and apse may be observed. One process that has been observed repeatedly on a number of sites is the insertion of screens or partitions, usually marking off apses from the central courts (Evans 1996, 41). One example is the three-apsed structure built at Skorba during the Ġgantija Phase. During the Tarxien Phase, a cross-wall with a central doorway was built across the central apse of this building, and a kerb installed across the two lateral apses (Trump 1966, fig.3). In the South Temple at Ġgantija, the first northern apse is separated from the court by an elaborate screen. This screen incorporated altar-like platforms and a central opening with a raised, semicircular threshold (see Figure 53 on page 198). It has been noted that this arrangement is very similar to that across the south-western apse of the South Temple at Tarxien (Evans 1971, 174). The latter forms part of the most elaborate and well-preserved example of a 'temple' interior yet discovered. The two southern apses of the South Temple at Tarxien are both separated from the court by elaborate examples of such screens. The screen across the south-western apse shows some similarities to the model of a 'temple' façade that was also found at Tarxien (Evans 1971, 120). Another instance of liminal screening is encountered in the Central Temple at Tarxien, where a raised slab about sixty centimetres high lies across the threshold leading from the outer to the inner court (Figure 59).

Sculpture

The screens separating courts from apse are almost invariably carved with low-relief sculpture and drilled decoration. In fact the screens represent one of the highest deployments of iconography in Maltese megalithic buildings. The use of sculpture underlines the importance of the screens for the meaning of these spaces, and for the practices that were conducted within them. The distribution, composition and content of the sculptured panels will be examined in detail in the next chapter.

Treatment of floors

A further distinction between court and apses is sometimes made by the use of different flooring materials. In a number of instances, flagstone floors survive in the courts, while the floors in the adjacent apses are made of *torba*, that is compacted limestone dust. The contrast is most evident at ta' Ħaġrat, in the main trefoil at Kordin III, at Xrobb l-Għaġin, in the inner trefoil of the South Temple at Ġgantija (Figure 54), and in the southern court on the main axis of Ħaġar Qim. Elsewhere the contrast is less clear, sometimes because the original floors have not been preserved, or, less often, because the use of flagstones is extended into the apses as well.

Hearths

Stone hearths with traces of burning have been recorded in some of the megalithic buildings. The two clearest and most comparable examples are in the South Temple at Ġgantija, and the Central Temple at Tarxien. The examples from Tarxien are the most clearly documented. Two hearths are located on the central axis of the six-apsed Central

Temple. The first hearth is located between the outermost pair of apses, while the second is located between the middle pair. The hearths have the form of shallow basins carved in globigerina limestone. The excavator reported signs of burning on both basins, which also contained traces of burnt limestone and ashes (Zammit 1917, 267-8; 271). The doorway between the spaces where the two hearths are found is blocked with a high threshold slab bearing a pair of spiral motifs in low relief. The famous pair of panels bearing spiral low-reliefs also form part of the same doorway arrangement.

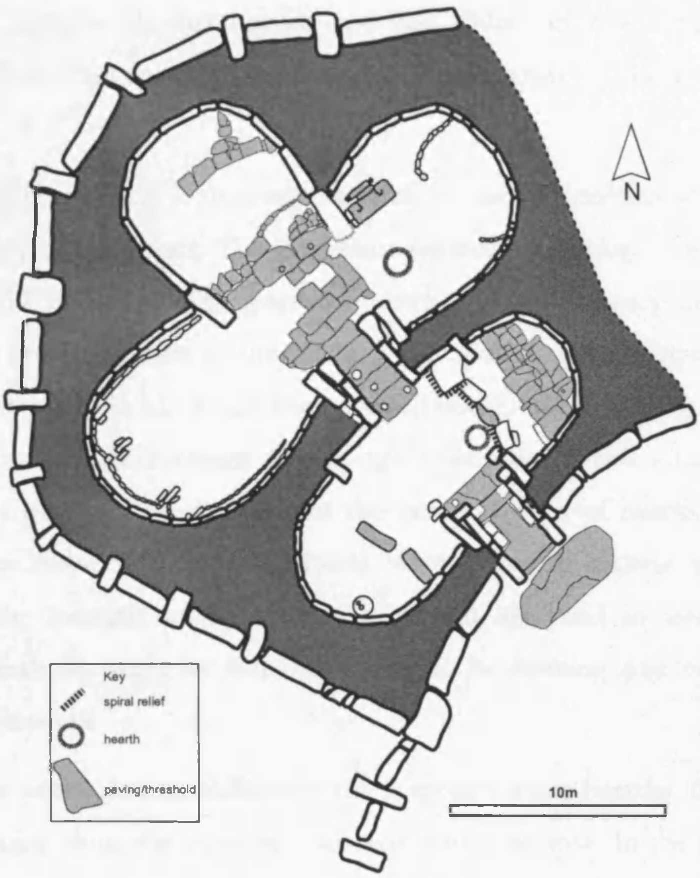


Figure 55. Ġgantija, South Temple (after Evans 1971).

At Ġgantija, two comparable circular stone features have been recorded in the South Temple (Figure 55). The first of these lies just outside the screen that separates the outer court from the outer northern apse (Evans 1971, 174). Another shallow circular stone feature is located immediately within the inner northern apse of the same building. As noted by Evans, although this feature has sometimes been interpreted as a container for water, the fact that it is cracked and reddened by fire, as well as its similarity to the features at Tarxien, suggest that a more likely interpretation is that it was used as a hearth (Evans 1971, 175). The stone circular feature in the outer court is likewise reddened and cracked, and a similar function appears very plausible.

The hearths at Tarxien and Ġgantija are all closely associated with boundaries between different parts of the building. The two hearths on the central axis of the Central Temple at Tarxien are positioned within and without one of the most dramatically designed barriers in any of the Maltese megalithic buildings. The position of the features in the South Temple at Ġgantija is somewhat different, as they are not on the central axis and not inter-visible. However, their position in relation to the boundaries between court and apse, respectively just outside and just within an apse, suggests that, at Ġgantija as well as Tarxien, the relationship of the hearths to these boundaries is significant.

The use of hearths in such a monumental and ceremonial context must have had powerful symbolic connotations. The important symbolic role played by the hearth is widely attested in historic and ethnographic contexts, and is often assigned the role of a central focus or even the centre of the world (Various examples summarized in Parker Pearson & Richards 1994b, 12). It has been pointed out that the Latin term for hearth is 'focus' (Parker Pearson & Richards 1994b, 12). Comparison with ethnographic and historic evidence has been used to inform the interpretations of hearths in Neolithic contexts (Parker Pearson & Richards 1994a, 41-42) In the Maltese context under consideration, the location of hearths on a central axis and in association with monumental thresholds suggests that they may also be forming part of a system of cosmological references.

It should also be noted that, in addition to the purposely-made hearths, there is further evidence of burning along the boundary between court and apse. In the South Temple at Tarxien, the altar-like partition that separates the southwestern apse from the court has several burn marks on its upper surface, further confirming that this boundary was an important focus of ritual activity.

Roofing

The extent to which Maltese megalithic buildings were roofed over is a matter of long-standing debate. The corbelling that survives in the upper courses of apse walls is generally accepted as evidence that apses were roofed over. Zammit recorded what he considered to be conclusive proof that this was the case when excavating the Central Temple at Tarxien (Zammit 1915a, 30). The question whether the courts were also roofed is still a more open one, however. No evidence of corbelling is known from around the courts themselves. The presence of hearths within the buildings also suggests that they had some degree of ventilation. Another possible indicator of the extent to which the buildings were roofed over may be the degree of erosion of megaliths in different parts of the interior. It is worth noting that when the 'niche and altar' arrangement in the first court of the South Temple at Tarxien was first exposed, the excavator noted that the low-relief sculpture on the altar-like feature was 'weatherworn' (Zammit 1915a, 59). If courts that were hypaethral (open to the sky) are admitted as a possibility, it immediately raises the question of how rainwater runoff was managed.

Rainwater management

The use of different floor levels for different areas in the temple complex may have interesting implications for the management of rainwater. The clearest example of the problem is probably the sunken court at ta' Ħaġrat (Figure 56). The court is separated from the main entrance by a raised threshold. The threshold would effectively have prevented water from escaping from the court and flowing out of the site.

The raised threshold is at a lower level than the three raised apses around the court, meaning that even if the court were flooded, the apses would remain dry. It should also be noted that the floor of the court is paved with massive megaliths that are so well fitted that it has even been suggested that they may have originally been a single huge slab (Evans 1971, 31). On closer inspection it appears ~~that~~ more likely that the paved floor was assembled from separate megaliths, as believed by the original excavator (Zammit 1929). Nevertheless, the paving represents a tremendous investment in effort and planning, and it would also have slowed down the draining away of any ponded water, unlike the floors of crushed limestone dust which are usually found in the apses. Considered together, these different characteristics suggest a rather surprising possibility. If the court at ta' Ħaġrat was not roofed over, it could be argued that it was designed to allow the ponding of rainwater.

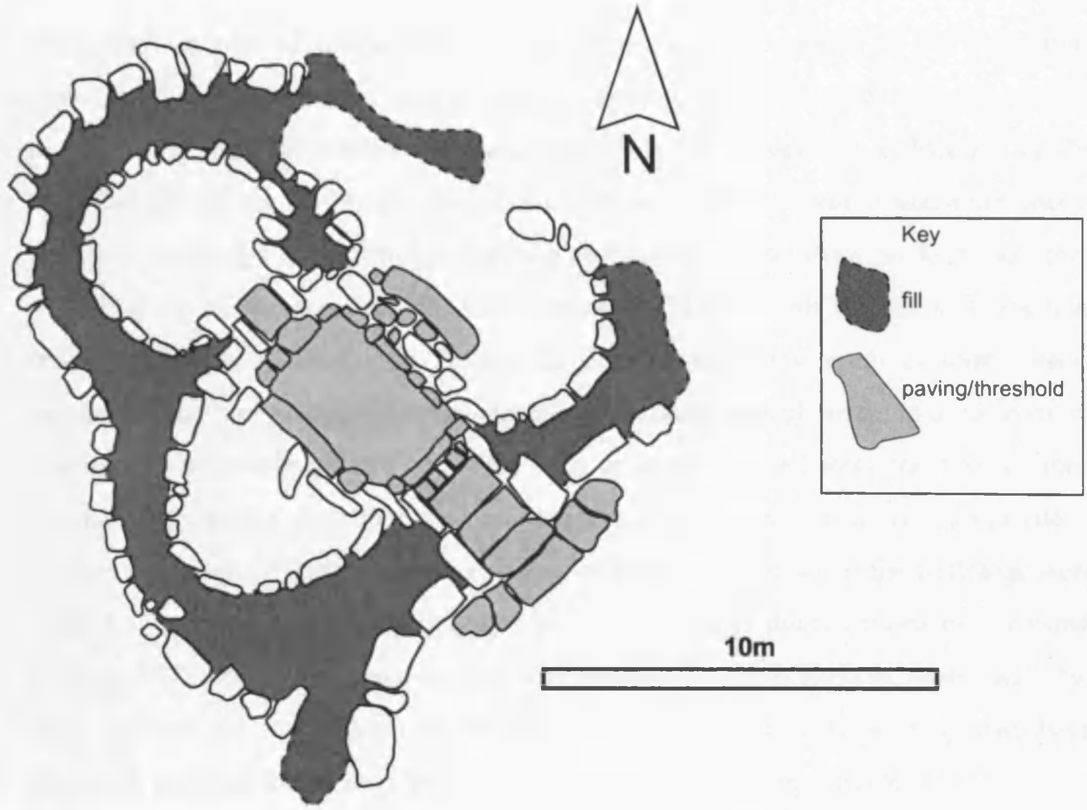


Figure 56. Ta' Ħaġrat, three-apsed building.

A similar arrangement may be observed in at least four other sites. In the main entrance to the South Temple at Tarxien, a similar raised edge may be observed across the threshold (Evans 1971, 118). The eastern end of this raised edge has been chiselled away, probably in a modern intervention intended to facilitate water runoff from the interior. In the nearby temple known as Kordin III, a comparable arrangement may be observed (Evans 1971, 72). The site recorded at Xrobb l-Għaġin also had a raised threshold across its entrance, formed by a narrow slab set on edge (Evans 1971, 27). A fifth example is the southern entrance into the main complex at Ħaġar Qim (Evans 1971, 82). In the five examples just referred to, the height of the raised threshold above the floor level is very evident, because the original paving of the court is still present in four cases, while at Xrobb l-Għaġin it was recorded during the excavation. Two further possible examples of this characteristic are less certain, because the original floor of the court has not been preserved or recorded. These are the South Temple at Mnajdra, and Kordin II, where it has been suggested that the raised thresholds are a result of the removal of the original flooring (Evans 1971, 69).

In several of the surviving examples, ponding of rainwater may presently be observed as a seasonal occurrence. From a conservation point of view, this phenomenon has been recognized as one of processes contributing to the deterioration of the megalithic structures. From the point of view of the photographer in search of the picturesque, the ponded water provides endless opportunities to capture suggestive reflections of the ruins and the sky above. The ponding that occurs in the paved corridor and court within the main entrance to the principal building at Ħaġar Qim has even made its way into popular guide-books. Ponding may also be observed in the South Temple at Mnajdra as well as in the South Temple at Tarxien. In all these examples, pools of water collect within the building practically every winter, often taking several weeks to soak away or evaporate. The buildings have of course been drastically altered since the time of their original use, and the areas that tend to be flooded in the present are not necessarily a reliable indication of which areas may have retained rainwater when the buildings were created. However, the ponding that may be observed today demonstrates that seasonal ponding within these buildings was not only possible but even likely in those areas that were open to the sky. It also allows us a glimpse of how such ponding may have appeared, and how it may have behaved as an excellent reflecting surface.

The examples of raised thresholds and sunken courts listed earlier deserve further investigation. Their repeated occurrence over so many different sites strongly suggests that they played an important role in the articulation of space inside the buildings, which may have included the deliberate control of water. It should be recalled that in Chapter 4 it was demonstrated that the location of megalithic buildings is closely related to the location of sources of freshwater (p. 137 ff.). Furthermore, as noted in the discussion on hydrology (Chapter 4, p. 150 ff.), receptacles that may be intended for the portage and storage of water are frequently encountered on Maltese megalithic sites, prompting the excavator of the Tarxien Temples to suggest that water '...must have been a necessary element in the ritual of this ancient sanctuary' (Zammit 1917, 271).

If courts were unroofed, therefore, a further distinction between court and apse would have to be added, namely that while apses are 'dry' spaces, courts may be 'wet'. This possibility will be examined in the next chapter.

The ordering of architectural space

The topological order of space

Maltese megalithic buildings are characterized by the features and devices that have just been considered. Collectively, they define and organize space within the buildings. Some of the principal characteristics of this spatial organization may be recapitulated here. Several devices are used to mark the boundaries between different areas of the building, or to heighten the contrast between them. Monumental doorways with raised thresholds, as well as porthole doorways carved from a single stone, require specific bodily actions in order to be crossed. The principal types of space within megalithic complexes are external fore-court, internal court and apse. Boundaries between these spaces are in most cases emphasized by a series of devices. Megalithic screens are used to create a physical boundary to separate an apse from the court that gives access to it. Different floor levels and different flooring materials are employed in court and apse, heightening the contrast between them. Elaborate sculpture tends to be concentrated on screens, boundaries and doorways, focussing more attention on them and heightening their visual impact. The positioning of hearths immediately within or beyond a boundary may also have been intended to heighten the scenographic power of that boundary.

Boundary markers and other devices to demarcate space not only emphasise the separation of one space from another. They also work together to define and distinguish the character of different spaces, in ways that are consistent and recognizable across the known repertoire of megalithic buildings. One of the most readily recognizable distinctions is that between courts and apses. Generally, courts are paved, sub-rectangular spaces with a sunken floor, while apses have a floor made of beaten limestone dust, are sub-circular in plan, and have a floor level higher than that within courts. Apses may be roofed and dry, while courts may be open to sky and rain. This structured series of distinctions reinforces the different position of court and apse in the topology of the building. Furthermore, in terms of access, court and apse have a reciprocal relationship. Courts provide access to apses, whilst apses may only be reached through courts.

A further distinction is the use of different images and motifs in different topological positions. Low-reliefs that show running spiral motifs are generally found around the courts, particularly on screens separating courts from apses. The deployment of images will be examined more closely in the next chapter. The contextual analysis of portable implements and furniture should also shed considerable light on the topology and use of these different spaces. However the presently available sample of secure and well-documented deposits is so limited that it allows rather less generalisation than the analysis of fixtures and architectural elements. The defining features that characterize and distinguish courts from apses are shown in the following table.

Court	**Apse**
Sunken	Raised
Paved floor	*torba* floor
Open to the sky (?)	Roofed
'wet'	'dry'
Boundary	
Screen and threshold arrangements	
Low-reliefs of spiral motifs	
Hearths immediately within / outside boundary	

Figure 57. Summary of features and devices that distinguish different spaces within the megalithic buildings.

The series of devices and features that have been noted function together to define the topology of different spaces within the building. The fundamental topological opposition between court and apse displays variations and idiosyncrasies between one site and another, and between earlier and later examples of megalithic buildings. In spite of these variations, the fundamental topological relationship remains recognizable across the sites where enough evidence has been preserved. There is however one building that appears to break all the generalised rules that have been listed here, which shall be considered next.

The case of the Central Temple at Tarxien

The general statements that have been made about the systematic opposition of court and apse have their exceptions. The clearest exception is the Central Temple at Tarxien. Its unique, six-apsed plan is generally recognized as the latest stage in the evolution of Maltese megalithic buildings. The building is also unique in the way some of the devices discussed above are deployed within it. The outermost pair of apses is paved with massive and well-fitted megaliths from end to end, with no sign of the usual distinction between the lateral apses and the central court or corridor. The arrangement of the monumental doorway separating the outer pair of apses from the next pair is also unique. A raised threshold slab bearing a pair of reflected spirals lies across the entrance, and must be stepped over in order to gain access to the inner apses (Figure 58, Figure 59). Upon crossing the threshold, a person entering through the doorway must pass between a pair of spiral relief panels that face each other just beyond the doorway. This sophisticated arrangement of relief sculpture is without parallel in any other of the Maltese megalithic buildings. The transition from the outer pair of apses to the inner part of the building is also marked by the unique arrangement of two hearths on the central axis, one just outside and one just within the elaborate doorway just described. It may be added that the floor beyond this elaborate doorway is not paved in stone, regardless of whether it is within any of the four lateral apses or on the central axis.

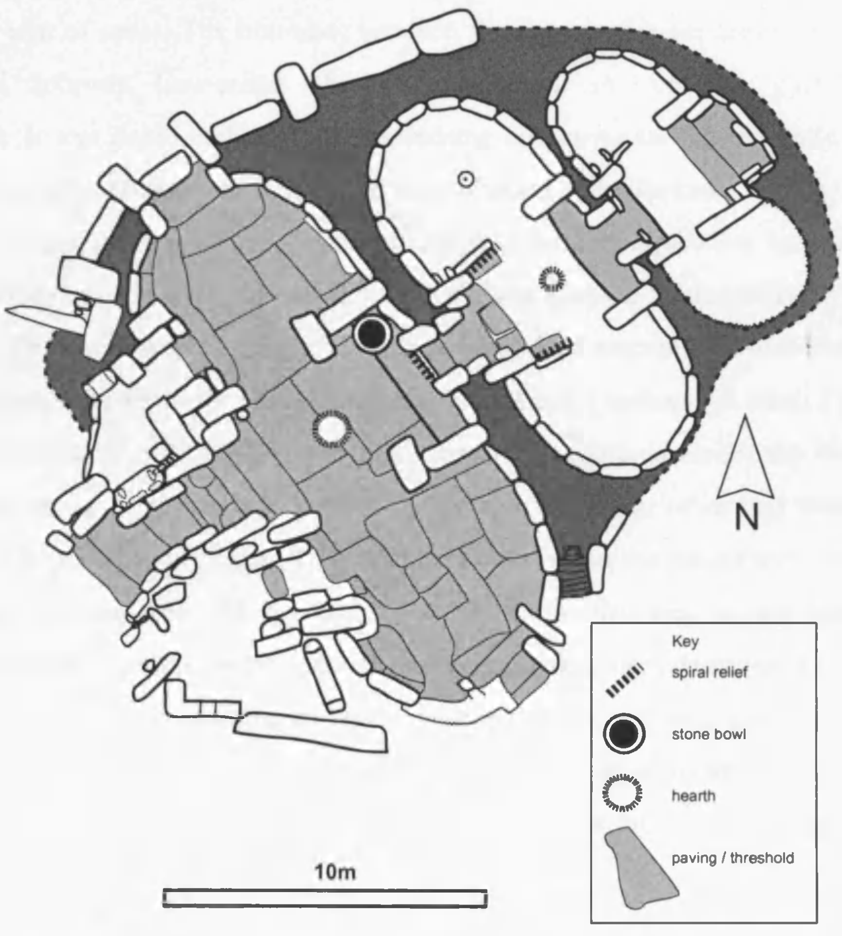


Figure 58. Tarxien, Central Temple. Position of devices along central axis (After Evans 1971).

The series of exceptions that have just been listed may suggest that the Central Temple at Tarxien does not conform to any of the generalisations that were made earlier to characterize the systematic opposition of court and apse. Here it will be argued that the contrary may be the case, and that this building is the exception that confirms the rule. All the different rules that appear to be broken here, when considered together, have the net result of preserving some underlying principles. Different devices are deployed in an internally consistent manner, but instead of setting up the usual set of oppositions between court and apse, here the same series of oppositions are created between the outer pair of apses and the remainder of the building. It is worth recalling Evans' observation that '...the outer pair [of apses] are in many respects more like a court than a set of chambers...' (Evans 1971, 137). The checklist of distinctions between court and apse compiled earlier appears to bear out this observation, because it is basically valid for the opposition between the outer and inner parts of the Central Temple. The outer pair of apses has a floor made of megalithic paving, while the four inner apses have a *torba* floor. The floor of the inner part of the building is also raised relative to the paving of the outer pair of apses. The boundary between the outer and inner area consists in a monumental doorway. Low-reliefs of spirals also form an important part of the arrangement. It was noted earlier that the screening arrangements that separate courts from apses are often characterized by spirals motifs facing onto the court. In the Central Temple at Tarxien, spiral motifs are used once again to mark an equivalent boundary. In the present instance, the arrangement of low reliefs was adapted to the different spatial constraints. The architectural context does not permit or require the insertion of a megalithic screen to create a boundary. Instead, two different devices are used. The first is the raised threshold with a pair of reflected spirals that is placed across the doorway. The second consists in the unique pair of panels that face each other just within the doorway. An important difference in this novel solution is that the panels are not visible from outside the doorway. At the same time, however, the idea of the spirals as boundary markers between the two topological domains has been retained by rotating the panels through 90^0. A crossing of this boundary requires a crossing between these spiral motifs, the same way that crossing the screen with spiral motifs in the South Temple at Tarxien or the South Temple at Ġgantija requires a crossing of the spirals on the screen.

In the case of the Central Temple at Tarxien, the choreographic effect of passing through the monumental entrance arrangement is heightened further because a person entering through the doorway is suddenly confronted with the low-relief panels which cannot be seen form outside the doorway. On reaching the point between the two panels, the person entering is simultaneously faced by a low-relief panel to the left and one to the right. At this point, it is the relief panels themselves that occlude much of the field of view of the person passing through them, until they are surpassed and the inner part of the Central Temple is reached. In other words, the crossing of this boundary does not simply involve the crossing of a screen that is making symbolic references, as in the case of the screens in the South Temple at Ġgantija or the South Temple at Tarxien. In the Central Temple, crossing the boundary into the inner part of the building requires an almost complete visual immersion in an environment that is not normally visible, before passing on to the interior.

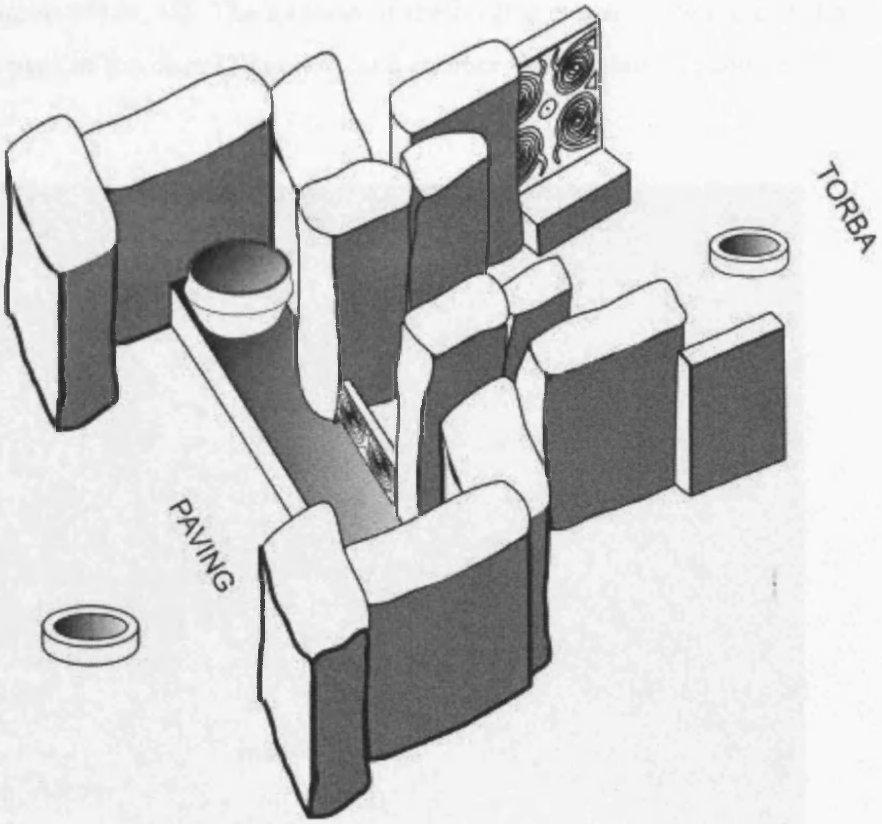


Figure 59. Tarxien, Central Temple. Isometric view of doorway from the outer pair of apses into the inner part of the building. Note position of the stone bowl, hearths, and spiral reliefs.

A further device that is used in the Central Temple at Tarxien to heighten the importance of the boundary under discussion is the placing of hearths immediately within and outside it, on the central axis of the building. While in the South Temple at Ġgantija hearths are positioned just outside one apse, and just within another, here the hearths are placed on either side of a topologically equivalent boundary. Meanwhile, the position of the colossal stone bowl in the Central Temple at Tarxien is also worth noting. The excavation report refers to the discovery of fragments of the bowl in two different locations. 'On the western end of this step [the threshold of the doorway under discussion] fragments of a large stone vessel broken *in situ* were found. The vessel when reconstructed was set up in the apse D (pl. XXXIII, figs. 2,3)' (Zammit 1917, 269). Elsewhere in the same report it is stated that 'the vessel was found crushed in the north-west corner of the oval space CD…', where it was set up again when reconstructed (Zammit 1917, 274), and where it may still be seen today.

Zammit's diary of the excavations gives a more detailed and clear account of where the stone vessel was found. In his entry for the 26th of August 1915, Zammit recorded that the large stone bowl was found broken in situ, in the left corner of the entrance arrangement (Zammit 1915a, 42). The location of the bowl is clearly shown in a sketch-plan on the same page of the diary (Figure 60), and another sketch-plan on page 44.

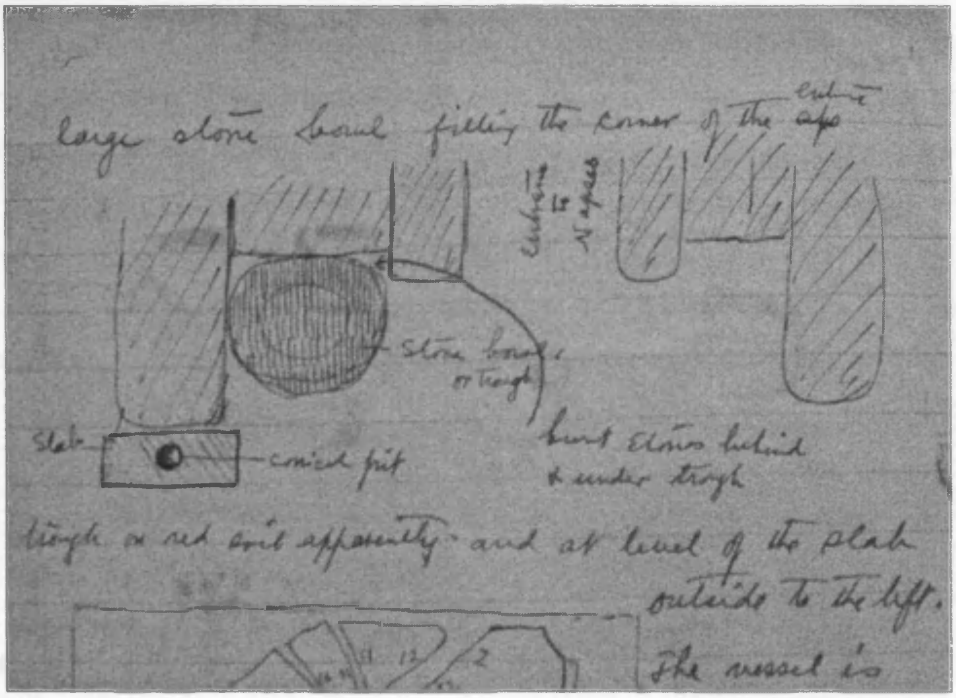


Figure 60. Tarxien, Central Temple. Plan from excavation notebook for 1915, showing position where the large stone bowl was discovered.

The stone bowl is one of the largest vessels ever found on any of the Maltese megalithic sites. The sheer size of the vessel suggests that it was used to hold water. If this inference is correct, its position in the building would be consistent with the wet / dry opposition noted earlier. Its location in relation to the elaborate threshold and the two hearths on the main axis suggests that it functioned as part of the same arrangement. The juxtaposition of fire, water, and carved symbols in the context of a doorway reinforces the idea that they may form part of a system of cosmological references.

When all these devices functioned simultaneously, the multi-sensory effect of navigating through the doorway must have had tremendous synaesthetic power. In light of the wide repertoire of evidence from later archaeological, historic and ethnographic contexts, it is tempting to suggest that odours from plant products burnt on the hearths may have been a further element in this multi-sensory experience.

Finally, the way space is accessed in the six-apsed Central Temple should also be noted. The outer pair of apses is unusual in that each apse appears to have a doorway at the far end. The western apse has a feature which the excavator described as '…originally a doorway… subsequently walled up by lowering a huge slab across it' (Zammit 1930, 23). Zammit's interpretation is corroborated by the existence of V-shaped double holes on the doorjamb on either side of this feature (Zammit 1930, 24). Elsewhere in Maltese megalithic buildings, such holes are normally found in association with doorways. The symmetrically opposite opening at the far end of the eastern apse is still extant. The four inner apses, on the other hand, have no such additional doorways, and may only be accessed through the highly elaborate doorway arrangement on the main axis, which was described above. The lateral doorways in the outer pair of apses at Tarxien are not discussed in previous work on the Access Analysis of the building (Bonanno et al. 1990, 198, fig. 5). If the access diagrams for the building are redrawn to represent the building with the two lateral doorways open, a different pattern emerges (Figure 61).

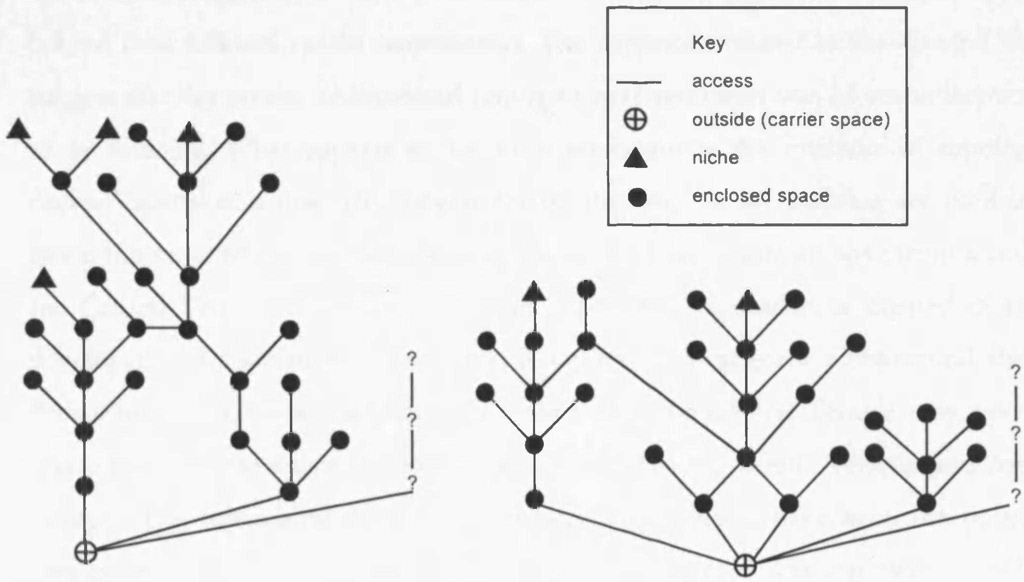


Figure 61. Left: Access diagram of the final phase of the Tarxien complex (After Bonanno et al. 1990, 198, fig. 5). Right: the same diagram, modified to show direct access to the outer apses of the Central Temple from outside 'carrier space'.

The way access is organized in the Central Temple at Tarxien may be compared to the access patterns in the more typical court and apse arrangements. Generally, access to apses is only possible through a court, as apses do not usually have independent access. Once again, the apparent inversion of rules in the Central Temple at Tarxien is consistent with all the other inversions that have been noted. The treatment of the outer pair of apses as a space that is directly accessible from outside the building suggests that it has a topological status equivalent to the internal court in the more conventional plan. The basic topological relationships that have just been described may be represented in a simplified access diagram (Figure 62).

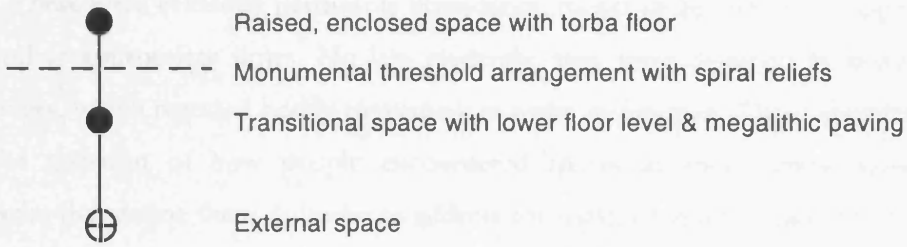


Figure 62. Simplified access diagram showing the basic topological characteristics that the Central Temple at Tarxien shares with buildings having a more conventional plan.

The case of the Central Temple at Tarxien is instructive in its idiosyncrasy. The way different devices are deployed in this building complements the general pattern observed in other buildings, and allows a more rounded understanding of the values and priorities behind their internal spatial organisation. The departures noted in the Central Temple suggest that the precise architectural setting of apse and court was of secondary concern to its creators. What appears to be more important is the creation of topologically ordered spatial domains. The various devices deployed in the building are used in very much the same way as they are in other buildings to demarcate an apse from a court. In the Central Temple at Tarxien, the same topological separation is created in a more developed and sophisticated form, and is housed in a different architectural shell. As Evans suggested, the idiosyncratic plan followed in the Central Temple may have been constrained by the space that was available between the South Temple and the East Temple. The topological division of the interior appears to have been the paramount concern in the conception and layout of the Central Temple. The traditional topological order was preserved in the new and original plan of the six-apsed building.

Movement

The dense use of spatial markers and devices produced an architectural experience that heavily emphasised the transition from one space to another. An important characteristic of the boundaries separating different spaces is that they are never solid and permanent barriers. The closing arrangements in doorways could be opened and closed. Whenever a megalithic screen is used to mark the boundary between court and apse, it is also interrupted with an elaborate threshold. Sometimes specific bodily actions were required in order to cross a boundary. Raised threshold slabs could be stepped over, while low porthole doorways required a person to bend down from his or her full height. These were evidently permeable boundaries, meant to be crossed in appropriate ways and at appropriate times. No less evidently, they were designed as kinaesthetic experiences, which required bodily movement in order to function. These characteristics raise the question of how people encountered spaces as they moved across the boundaries that define them. In order to address the issue, a temporal model is required. To develop such a model, it is useful to begin with a detour into the question of how people represent space and time.

Space and time in systems of representation

The way people experience space is inextricably intertwined with the way they experience time. Our present-day perception of space and time is deeply influenced by the culture of measurement. Centuries of accumulation of data allow us to adopt a bird's-eye view of the landscape, and even of the globe itself (Ingold 2000a). Such a Cartesian approach to space is primarily visualist in focus. Although most people will never see the earth from space at first hand, globes and photographs have assured that we think of the world from this privileged viewpoint. When we want to represent movement across the landscape, one of the simpler ways to do so is as a route across a map. This statement appears so obvious to us that it hardly seems worth repeating. Generations of schoolchildren have been brought up on maps that trace the great voyages of discovery in red lines across outline maps of the world. In such representations, a sequence of events over time is plotted against space. Space is a more visual medium than time, and is more readily apprehended. Because of our preponderantly visualist models of the world, we generally prefer to use space as the matrix against which time is plotted. There are, of course, many exceptions. The timetable is one, very familiar, example. A timetable represents a succession of places, be they classrooms, bus-stops or train-stations, plotted against the axis of time. Verbal communication also tends to be sequential. When we give directions, we usually describe a succession of landmarks, in the same order that they are encountered on the way to a destination. Narrative descriptions of journeys deal with a succession of places and events, usually in chronological order.

The examples above should suffice to remind us that the experience of space and time may be represented in very different ways. Time may be plotted against space, and space may be plotted against time. In one particular type of representation, both time and space are used as axes. This is the Hägerstrand diagram, also known as the 'Space-Time-Cube', developed by the distinguished Swedish geographer Torsten Hägerstrand during his pioneering work on time-geography (reviewed in Kraak 2003). This tool has also been applied to archaeological modelling (e.g. Laurence 1994). A Hägerstrand diagram represents a three-dimensional space or box, in which the two horizontal dimensions correspond to geographical dimensions, while the third, vertical axis represents the dimension of time. In this manner, movement may be plotted against both time and space (e.g. page 219, Figure 63). The 'Space-Time-Cube', however, remains the exception rather than the rule, and most representations are either organized around time or around space.

Different types of representation rely on conventions in order to be understood. The world maps showing the voyages of discovery illustrate this well. They are projections of the earth's spherical surface onto a flat plane. Usually, the left and right edges of these maps show the same place. A line tracing a voyage round the world usually runs from one of these edges to the other. Yet although it appears to begin and end at opposite ends of the map, this poses no difficulty to anyone familiar with the conventions it uses. They know that the points where the line appears to begin and end represent one and the same place.

What do these examples tell us about people's models and representations of time and space in the past? First of all, they should alert us to the fact that ways of representing time and space may vary widely. In order to understand the models used in different cultures, an 'emic' rather than 'etic' approach is required. In particular, the relationship between space and time may be structured in different ways, which may be organized around one or the other. As Gell is at pains to explain, while the metaphysical nature of time and space is universal, the way it is modelled and represented by different cultures may vary immensely (Gell 1992, 233-241). Furthermore, the direct, first-hand experience of space and time is sequential rather than Euclidean or Cartesian (Golledge 1999), and among non-literate, non-industrialised societies, sequential representations of space are widely used. It has also been emphasised that the criteria of Euclidean geometry are inappropriate to assess prehistoric systems of cartographic representation, which may be more concerned with topological than scalar accuracy (Delano Smith 1987).

The temporal experience of Maltese megalithic buildings

It is useful to bear these observations in mind when considering the Maltese evidence. These observations suggest that a Cartesian model may be inappropriate to think about the spatial organisation of the Maltese megalithic complexes. A model that takes into account the temporal, sequential experience of space may be more appropriate. The shift in thinking that is required may be illustrated with a simple example. Earlier it was noted that Space Syntax and Access Analysis (Bonanno et al. 1990) have been used to suggest that as the access diagrams of these buildings became 'deeper', some form of exclusion was practised (Bonanno et al. 1990, 200-202). The same access diagrams may be read in a different way. If we shift the focus from exclusion to movement across these spaces, the access diagrams may help us model possible pathways through the buildings. The human trajectories that were actually practised in the buildings are of course lost forever, and we can never hope to achieve the level of detail and understanding that is possible from ethnographic observation. The material constraints of the buildings, however, do allow us to make some inferences about the topological order in which different spaces were entered and crossed. In this sense, access diagrams may be used to draw Hägerstrand diagrams of possible pathways that may be followed through space and time in order to enter different parts of the building. This presents us with a rather exciting possibility. Read in this way, access diagrams may allow us to sketch out some of the basic characteristics of people's temporal experience of spaces within the megalithic buildings (Figure 63).

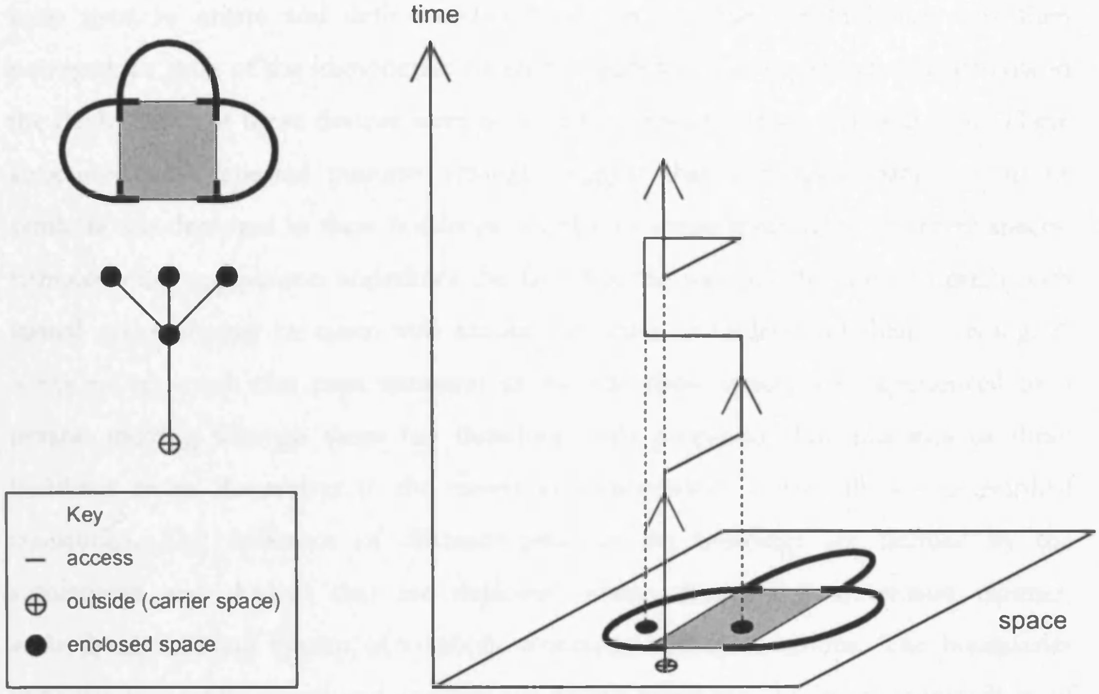


Figure 63. Comparison between schematic access diagram and equivalent Hägerstrand diagram.

One of the most basic characteristics of the Maltese megalithic buildings is the way that movement is shaped through them. As noted earlier, most examples of these buildings have a single entrance in their façade, which may only be accessed after crossing the forecourt. The entrance into the building usually gives access to a central internal, court. In their turn, apse environments may only be accessed through the courts. In temporal terms, an apse could only be entered after crossing a court. When leaving an apse, a court would have to be crossed again. Likewise, movement from one apse to another usually entails crossing a court. These observations may seem rather self-evident. Nevertheless, they may provide an important key to understanding how people experienced these buildings and the spaces and images within them, as will be explored further in the next chapter.

Conclusions

This chapter began with a consideration of prevailing interpretations of the spatial organisation of Maltese megalithic buildings, and explored some possible alternative approaches. It was noted that the design of these buildings pushed the technological constraints in order to enclose the largest possible volumes. The range of devices that were used to create and define architectural space inside the buildings was then surveyed. In spite of the idiosyncrasy of each megalithic building, structured patterns in the deployment of these devices were observed to reoccur across different sites. These structured and repeated patterns strongly suggest that a programmatic system of symbols was deployed in these buildings in order to assign meaning to different spaces. Ethnographic comparison underlines the fact that the way people move through such spatial systems must be taken into account in order to understand their meaning. A temporal approach that pays attention to the way these spaces are experienced by a person moving through them has therefore been proposed. The interiors of these buildings reveal themselves to the viewer in a succession of carefully choreographed transitions. The attributes of different areas in the buildings are defined by the furnishings and devices that are deployed within them in a systematic manner, embodying a potent system of symbolic meanings and connotations. The boundaries between one environment and another are heavily emphasised with concentrations of choreographic devices, which constrain a person moving across them to perform specific bodily actions. Ethnographic comparison strongly suggests that the very process of moving across such symbolically loaded spaces was a performance and an enactment of the symbolic system embodied in these architectural forms.

Ethnographic comparison also suggests that the choice of devices used, such as the use of hearths or the manipulation of water, had a cosmographic purpose. In order to explore this possibility further, it is now useful to take a closer look at the use of images within the same buildings. This will be the subject of the next chapter.

7 Images and representations

Introduction

The interpretation of prehistoric images is a difficult and uncertain enterprise. The narratives, myths, names, and emotions that were once conjured by such images are, to a large extent, irretrievably lost. Faced with an image in isolation, it is difficult or impossible to decipher the representational codes that were used in its creation. When a group of images survives, the prospect of understanding them is somewhat improved by the patterns and relationships between these images. If the spatial context in which images were used is also known, it may permit further inferences about the concerns they expressed, and the practices they were associated with. The present chapter reconsiders the evidence for one such group, namely the images used in association with Maltese megalithic buildings. Results obtained in earlier chapters will be used as a basis for a more informed approach to the spatial context in which the images are used.

The art-forms associated with Maltese megalithic monuments have been surveyed and discussed with great thoroughness (Zammit & Singer 1924; Ugolini 1934; Evans 1971; Ridley 1971; Ridley 1976; Pace 1996; Bonanno 1996; Townsend 1997; Malone & Stoddart 1998; Townsend 1999). It is not the purpose of the present chapter to conduct a comprehensive review of this literature. Instead, some problematic issues in the interpretation of these representations shall be identified, before proposing a fresh approach.

Objectives

The objectives of this chapter are to:

1. outline some problematic issues in current approaches to the use of images in Maltese megalithic buildings;

2. develop a framework for a more contextual approach to the deployment of images in these buildings;

3. propose a new interpretation for some of the representational systems used on these sites.

Theoretical considerations

The need for a contextual analysis

The sculpture associated with Maltese megalithic monuments has attracted considerable attention, at least since the 19th century. The high quality of workmanship, the wide range of themes and the variety of representational systems displayed in these works have made them the focus of long-standing debate. Partly as a result of their exceptional nature, these works have often been discussed as outstanding works of art in their own right. The emphasis on artistic achievement and on artistic masterpieces is problematic. Contemporary Western notions of 'art' and 'capacity for art' have been criticized as inappropriate and inapplicable to prehistoric societies (Ingold 2000d, 130-1; Bradley 2002a, 231). The use of such concepts tends to carry a considerable baggage of assumptions about the role of the 'artist' and the function of images in society. Following Ingold, the present discussion will attempt to steer clear of such connotations by avoiding the term 'art', and using more neutral terms such as 'image' or 'depiction' (Ingold 2000d, 111).

A further consequence of the emphasis on artistic achievement is that individual sculptures have often been discussed in isolation, with little reference to the inter-relationships between different carvings. The removal of most known examples of sculpture to a museum environment for their safekeeping has tended to reinforce their decontextualisation. As a result of spatial constraints, museums have generally presented sculptured elements from megalithic buildings as collections of individual works. For example, in the present display of the low-relief sculpture from Tarxien, now housed in the National Museum of Archaeology, it is not possible to present all the different elements in their original position relative to each other. As a result, the panels are presented and experienced as a collection of separate works, rather than a system that is spatially ordered, in which spatial relationships may be intrinsic to their meaning. The same observation may also be made of the way the sculpture is illustrated in the published literature. While there is a profusion of reproductions of individual panels, composite pictures or reconstruction drawings that document the relationships between different panels are extremely rare.

The need to pay more attention to the context of the images used in Maltese megalithic buildings has been noted repeatedly in the recent literature. Several contributors have underlined the importance of a more contextual approach, which considers sculptured works in relation to each other (Cutajar 1986) and to their spatial setting (Stoddart et al. 1993, 13; Malone & Stoddart 1996, 45). One of the main aims of the present approach is to examine the spatial context of the use of images in megalithic buildings, and to explore the implications of the inter-relationships between these images.

Different media and different planes of representation

The repertoire of images and representations that are known from Maltese megalithic buildings includes a wide range of representational media and conventions. Representations may be small, portable objects or large and heavy ones that are fixed in space (Malone et al. 1995b, 7). Representations forming part of the structural fabric fall clearly into the second category. The primary focus of the present analysis is on representational media that are fixed and stationary, which generally allow a higher degree of certainty about their spatial context. At least six different media of this kind may be noted. They are:

1. Sculpture in the round. This medium is widely used in Maltese megalithic buildings, usually to depict the human form. Anthropomorphic representations in the round may vary from large stone sculptures to small, portable terracotta figurines (Malone et al. 1995b; Townsend 1997; Malone 1998, 155-156).

2. High-relief sculpture. High-relief is also used for anthropomorphic representations, and will be treated as a variation of sculpture in the round.

3. Low-relief panels carved from the face of a Globigerina Limestone megalith. Subjects are shown raised in low-relief, usually in outline, while the field is often treated with circular drilled holes. Low-relief panels are used almost exclusively to show zoomorphic subjects and curvilinear motifs. Anthropomorphic subjects are absent from the known sample of low-relief panels.

4. Wall painting. The extensive use of wall painting in the Saflieni hypogeum strongly suggests that the same medium was also used in megalithic buildings, where it may have been applied to plastered surfaces. As the evidence from megalithic buildings is extremely limited, however, this medium is not discussed further here.

5. Graffiti incised into the surface of megaliths. The known examples include a group of graffiti at Tarxien showing seafaring vessels, and an isolated example at Mnajdra that is usually interpreted as the façade of a megalithic building.

6. The deployment of different materials in the structural fabric. Examples include architectural elements with peculiar geological properties, as well as the embedding

of pebbles and shells into megalithic surfaces. The deployment of materials is included here because it may be used to make metonymic references that are also a form of representation.

Much of the published literature has focussed primarily on the anthropomorphic statues and figurines (Zammit & Singer 1924; Townsend 1997). On the other hand, the low-relief sculpture has attracted less discussion. The use of graffiti, meanwhile, has tended to be considered as casual, even intrusive, activity, unrelated to the original use of the architectural spaces where they are found. The deployment of different materials in the fabric and surface treatment of megalithic buildings has only received scant attention.

Fundamental questions about which media are used to represent different subjects, and why, also appear to have been neglected. The use of different media for different subjects has been largely taken for granted in the literature. This may represent a missed opportunity to shed some light on the systems of representation used. The systematic use of different media or different conventions for different subjects may have important implications for the way these subjects are represented (Ingold 2000d, 116). Different subjects may be located in different planes of representation in relation to the viewer. The use of different representational devices for this purpose in the context of Maltese Neolithic monuments merits closer examination.

The present discussion will pay particular attention to the use of low-relief panels. It will also attempt to relate the use of media such as graffiti and of different materials to their spatial setting. The use of different media for different subjects will also receive attention, and an explanatory model for the significance of these different planes of representation will be proposed.

Witkin's theory of representation

A fundamental issue in the interpretation of images created by a past culture is that they may employ representational codes very different from the ones we are accustomed to. The representational codes used in different societies and in different periods may vary widely. Art historians have devoted considerable attention to this complex issue. In a relatively recent synthesis, Robert Witkin has built upon the work of others, to provide a wide-ranging model of different systems of perception and representation (Witkin 1995). As the present analysis draws heavily on Witkin's model, some of the salient points of his argument are summarized here.

Witkin's ambitious agenda is to provide a framework encompassing the whole range of traditions of visual representation developed by different cultures across time. A key objective of the model is to identify fundamental categories of representation that are applicable to all artistic traditions. Witkin distinguishes between three principal types of perception, which he terms 'perceptual systems'. The three systems are labelled 'haptic', 'optic', and 'somatic' (Witkin 1995, 67-82). Each of these perceptual systems is associated with a 'presentational code', which is used in the artistic representations produced in that perceptual system.

perceptual system	**presentational code**	**relations among subjects**	**Examples**
Haptic (tactile)	Invocation	Coaction	Ancient Egyptian, medieval European iconography
Optic	Evocation	Interaction	European perspective painting from Renaissance to 19th century
Somatic	Provocation	Intra-action	Impressionism, cubism

Figure 64. Schematic summary of Witkin's model of different perceptual systems.

The first system that Witkin discusses is the one he refers to as 'haptic' or 'tactile'. This perceptual system is characterized by the knowledge that comes through handling objects. Consequently, the representational codes used in this system generally represent individual objects as bounded and self-contained. In this kind of representation, there is usually little concern to show how the appearance of things changes at different distances or in changing light conditions. In Witkin's words, 'the [haptic] perceptual process is *embedded* in material things [original emphasis]'. Such representations do not have a point of view, and are not equipped to define spatial relationships between the viewer and the object, or between the different objects that are represented. Different subjects are simply represented next to one another. Hierarchic relationships between different subjects may be shown by depicting more important figures as larger than less important figures, or through the ordering of their position relative to each other. Such a system of representation is not well suited to show spatial interaction between different subjects. Instead, the relationship between them is one of coexistence or co-action (Witkin 1995, 67).

Optic perceptual systems, on the other hand, produce perceptual-realist art, that represents groups of objects as they appear from a single point of view, using devices such as perspective. This mode of representation became dominant in the West during the Renaissance. Such a system makes it possible to represent spatial relationships and interaction between different objects in the same image. A further distinction that Witkin makes between haptic and optic systems is that haptic systems use 'invocation' to represent a subject, while optic systems use 'evocation'. In a haptic system, the subject is invoked, or made present, through the literal description of its characteristics as they are known, paying less regard to how it appears from any particular viewpoint. In optically based representation, the subject is evoked or suggested through the reproduction of the visual sense-impressions produced by the subject from the desired viewpoint.

The term somatic is applied to work that followed the departure from perspectivally correct representation that took place in the late 19th and early 20th century. During this period, a range of movements from impressionism to pointillism and cubism sought to go beyond representing things as they appear to the eye, to explore the way visual experience may be assembled, ordered, and recalled in the mind. Such perceptual systems are of less direct concern here, and will not be discussed in detail.

For the purposes of the present discussion, the most important distinction made by Witkin is that between haptic and optic systems. To the present-day viewer immersed in representational systems that virtually reproduce visual experience, Witkin's categories are a salutary reminder that earlier representational systems may have functioned in a fundamentally different way, creating a different relationship between subject and viewer. In the following analysis of Maltese Neolithic representations, it will be argued that these display many of the characteristics of haptic systems. Witkin's observations on how such a system depicts relationships between different subjects will then be used to further the contextual analysis of these representations.

'Abstract art' and 'representational art'

The sculpture found in megalithic buildings, particularly the low-relief panels, represents a variety of themes. These include quadrupeds, fish, and other, less explicit motifs, such as rows of spirals or branching, tree-like designs. Images which show a clearly recognizable subject have tended to be classified as representational or naturalistic, while the less explicit motifs have tended to be classified as abstract (e.g. Ridley 1976, 20; Pace 1996, 11; Trump

2002, 93-94). This division may be useful when describing and categorizing the range of motifs presented by the evidence. On the other hand, the use of the term 'abstract' may become a stumbling block if it is allowed to condition the interpretation of that evidence. If motifs are consigned to the realm of the abstract when it is not clear what they represent, there is a risk of imposing an ethnocentric divide between 'representational' and 'abstract' art, which may not be very meaningful or helpful in this context (Arnheim 1974, 164-5). Such a division takes today's visualist traditions and categories for granted as timeless and absolute, and transfers them into the past.

Witkin's work may alert us to another limitation with the common usage of the term 'abstract'. He argues that haptic, optic and somatic modes represent successively higher levels of abstraction (Witkin 1995, 64-67). In the sense used by Witkin, 'art that is low in abstraction is non-naturalistic, while art that is much higher in abstraction makes use of naturalistic modes of depiction' (Witkin 1995, 65). In haptic representations, the values that are represented are embedded in their material referrent. For Witkin, an optic or perceptual-realist representation, such as perspective painting, allows a higher level of abstraction, because it conveys complex information such as the spatial relationships and interactions between the persons and objects represented. With the third, or 'somatic' type of perceptual system that he identifies, representations reached new heights of abstraction, because they could, for instance, convey something of how optical experience is ordered in the mind. In this sense, the popular usage of the term 'abstract' for somatic representations converges with Witkin's model. The use of 'abstract' for haptic representations, however, may be misleading because it fails to make the distinctions that Witkin argues for.

Caution is of course required when applying a generalising model of the breadth of Witkin's to a specific case. His observation that a simple dichotomy between 'abstract' and 'representational' or 'naturalistic' is unsatisfactory, if not downright misleading, does however appear very pertinent to the present discussion. The abstract / representational dichotomy is therefore avoided in the present analysis. An alternative possibility that is entertained is that images or patterns that we find difficult to decipher may nevertheless have had a very clear representational significance to their creators. It should be borne in mind that the representation of certain subjects may be more reliant on culture-specific artistic conventions, and are consequently more difficult for us to recognize than, for example, the outline of an animal. This is true of representations of an organic form, such as a tree or plant, or an amorphous subject, such as water.

Towards a contextual analysis of low-relief panels

As already noted (p. 224), the use of low-relief panels has received rather less attention than the use of sculpture in the round. The spatial context of low-relief panels is so secure that it promises to reward closer examination. The present analysis will therefore begin by focussing on this class of evidence.

Low-relief panels are attested on several of the better-preserved megalithic sites. Their state of preservation ranges from the almost intact assemblage that was found in situ at Tarxien, to isolated fragments on some of the smaller, more poorly preserved sites. To date, around 60 examples of carved panels are known, nearly all of which were recorded in situ. Of these, two-thirds were found on a single site, that is the Tarxien Temples. The remainder are distributed between Ġgantija, Mnajdra, Ħaġar Qim, Buġibba and Xrobb l-Għaġin.

Due to the fragmentary nature of this record, the known sample of carved panels from these buildings is too small and uneven to allow useful statistical analysis. On the other hand, the very precise context of the panels makes them a qualitatively rich resource, which invites analysis on a number of nested scales (cf. Flannery 1976; Clarke 1977; Townsend 1999). To begin with, the basic fact that these images were created in an island environment should not be forgotten when trying to understand the systems of representation that they use. The location of megalithic buildings in the landscape, considered in chapters 4 and 5, may shed further light on the context in which the images are being deployed. The organization of space inside the megalithic buildings themselves, discussed in chapter 6, has direct implications for the way images are positioned and ordered within these spaces, as will be discussed in the present chapter. Further scales of analysis that are also examined here are the internal composition and structural grammar of low-relief panels, and the subject matter that they represent.

Spatial context

The low-relief panels are usually carved out of the faces of megalithic blocks. The sheer size of many of these megaliths has three very practical implications.

First, it is clear that the relief sculptures were created as stationary rather than portable features of the interior, with a fixed location. In several cases, the megaliths bearing the reliefs are literally fixed into the ground, wedged into place between other megaliths or threshold slabs.

Second, the position of the relief sculpture had to be carefully planned and engineered. The position of different reliefs, and the way different reliefs are grouped together, is therefore likely to be the result of intentional planning, and very probably, the relationship between different subjects is meaningfully ordered.

The third implication concerns the way the reliefs have been preserved in the archaeological record. Due to the sheer mass of the reliefs, and the way they are often built into the structure itself, their context is usually very secure, and in most cases we may be reasonably certain that they are still in their original position. This allows us to study them as a group, and to study their relationship with the architectural setting as it was originally conceived and experienced. Because the low-relief panels have generally been treated as individual art objects in their own right, their very precise spatial context is often overlooked in the debate on their aesthetic value. The use of low-reliefs, however, may be closely bound to the architectural spaces where they are found. Low-relief panels are found around courts as well as within apses. The content of the panels appears to vary according to where they are located. This pattern is considered more closely below.

Composition and structure

The low-relief panels share a number of characteristics, lending further support to the idea that they are planned as group compositions, and intended to be read as such. Practically all the panels have a raised border around 5 cms wide, usually left reserved along the top and sides. Such a reserved border may be observed framing reliefs showing different themes, from different sites and in different spatial contexts. This bordering device effectively frames the content of different panels, locating them in the same plane of representation. It also lends support to the idea that the reliefs form a group of meaningfully constituted compositions, sharing a common grammar of representation and juxtaposition. This possibility is pursued here.

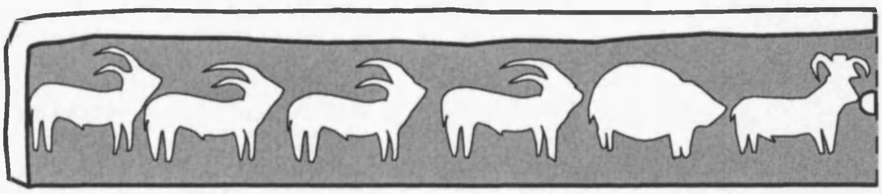


Figure 65. Tarxien, South Temple. Low-relief showing a series of quadrupeds. Height 20 cms.

Another characteristic is that different subjects are never mixed within the same panel. For instance, some panels at Tarxien are dedicated entirely to the representation of quadrupeds (Figure 65), while others are treated exclusively with spiral motifs. In many instances, more than one face of the same megalithic block bears a low-relief panel, depending on the position of the block and which faces are exposed. Furthermore, when more than one face of the same block bears a relief panel, the same subject is shown in all the panels on the block. In other words, different subjects are never mixed on the same block. One example of this characteristic is the cube-shaped element from the South Temple at Tarxien, which carries the same tree-like motif on the three visible vertical faces (Figure 66).

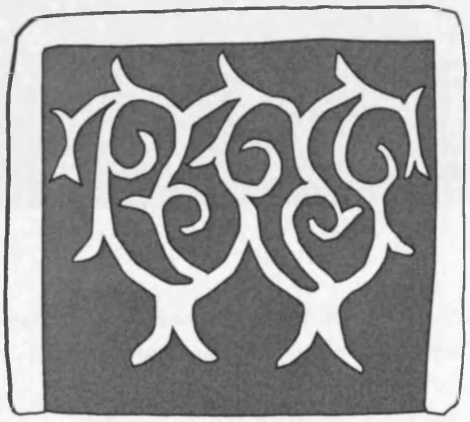


Figure 66. Tarxien, South Temple. Front elevation of block with tree-like motifs. Height 28 cms.

On the other hand, blocks that are adjacent often show quite different subjects. The two adjacent blocks from the court of the Buġibba Temple are a good example. One block carries two relief panels, both showing representations of fish (Figure 69). The adjacent block also carries two relief panels, both of which show spiral motifs (Figure 67). The 'altar' block from an insecure context in Ħaġar Qim, likewise, has the same representation of a tree-like pattern on all four sides (Evans 1971, Plate 41).

Figure 67. Bugibba, internal court. Excavation photograph dated June 1928, showing in situ *position of the two elements with low relief decoration.*

Witkin's theory of different models of representation, referred to earlier, is helpful when analysing these characteristics. The first of the three perceptual systems identified by Witkin, that is the haptic system, is the most pertinent to the present analysis. Various characteristics of the Maltese low-relief panels identify them as a clear example of haptic representation. Citing earlier researchers, Witkin compiles a list of defining characteristics of haptic imagery (1995, 71-72), which closely correspond to the characteristics of the Maltese reliefs.

The first characteristic concerns the way an individual object is represented. Haptic images emphasize the boundaries of objects, which are shown as isolated and self-contained. In the Maltese reliefs, figures and elements are usually rendered in outline. Furthermore, only a single subject is treated on an individual megalithic block.

A second characteristic of haptic systems is that images invoke the subject that they represent. The subject is embedded in the representation (Witkin 1995, 72). In the Maltese reliefs, the insistent treatment of a single subject on any given megalith suggests that in this system of representation, the megaliths themselves are intended to re-*present*, or make present, the subject depicted in the reliefs that they bear (cf. Arnheim 1974, 216). The relief blocks themselves may be said to stand in for, or in Witkin's terms to invoke, the elements they represent.

A third characteristic concerns the depiction of relationships between the different objects represented. Haptic images show the relationship between objects '...as part of an arrangement of complete and separate things' (1995, 71). In other words, these images do not show interaction between different objects. Instead, relationships between objects are expressed through the juxtaposition of their representations. In the Maltese reliefs, there is no attempt to show engagement or interaction between different subjects in the same panel. Instead, different subjects are often represented in panels on adjacent megaliths. Relationships between elements are articulated through the meaningful arrangement of megaliths showing different subjects.

In the same way, the distribution of these images in the ordered space of the architectural interior may also have defined the relationship between the viewer and the subjects represented. The way these low-reliefs function may be compared to the way theatrical 'props' work. It is worth noting that the term 'props' is an abbreviation of 'properties', because their function is to define the properties of theatrical space through recognizable metonymic references. An interesting possibility is that the low-reliefs in the Maltese megalithic complexes may also have been used to define the properties of different spaces, through recognizable references to the environment. Such a system of ordered references may have created meaningful spaces for appropriate actions and performances. In order to explore these ideas further, it is now necessary to turn to the content of the reliefs.

Content

The low-relief panels represent a variety of zoomorphic subjects, as well as other, less explicit motifs, such as rows of spirals or tree-like designs. Earlier in the present chapter, it was noted that reliefs have tended to be classified as 'representational' when they show a clearly recognizable subject, and 'abstract' when their meaning is less explicit. It was also noted that such a division is problematic. A different approach is adopted here. In view of the characteristics that the low-relief panels share, they are considered as components of a continuous representational system.

Although the narratives and myths associated with the animals and designs in the panels have probably been lost forever, their spatial context and the relationships of juxtaposition and separation between different motifs may allow us a glimpse of their meaning. More specifically, the more recognizable motifs may provide the key to some of the more 'abstract' motifs that are associated with them. The most clearly recognizable subjects on the panels that are known are the zoomorphic representations. The evidence from different sites may be considered in turn, focussing first on the more recognizable motifs, then moving on to the less explicit motifs that are associated with them.

The iconographic evidence is most elaborate and abundant at Tarxien, which has been better preserved and better recorded than most of the other major temple complexes. A particularly interesting area is the first apse on the left as one enters the South Temple. As noted in Chapter 6, the apse is separated from the court by an elaborate screen carved with spiral motifs. Within the apse itself, there are various other relief carvings. Immediately beyond the doorway through the first screen, an elaborate threshold arrangement incorporates more elements treated with variations on the spiral motif. Beyond, there are the remains of a highly finished structure which once stood across the innermost end of the apse, and which has sometimes been described as an altar (Figure 68; Evans 1971, 119).

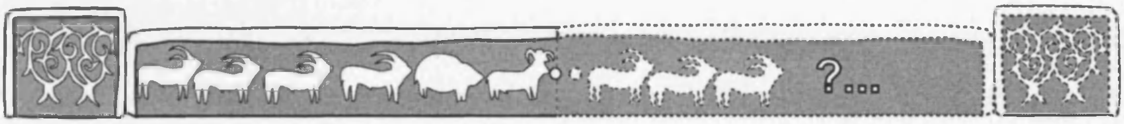


Figure 68. Tarxien, South Temple. Hypothetical reconstruction of low-relief arrangement in southwestern apse.

This structure incorporates a partially preserved panel showing a number of animals in low relief. The surviving part of the panel shows a row of six animals facing towards the right, where the panel is interrupted near the mid-point of its original length. Moving from left to right, the animals appear to be four sheep or goats, a pig, and a ram. A roughly cube-shaped block was placed at the left end of this panel. A similar block probably stood at the right end of the panel (Figure 68), where the platform on which it would have rested has been recorded (Evans 1971, 120). The three visible sides of the surviving block each show a similar low-relief carving (Figure 66) of what has been variously described as a spiral ornament (Zammit 1930, Plate III) and as a tree-like motif (Evans 1971, 120). To the left of this composition and facing towards it, another elongated slab, preserved in its entirety, shows a low-relief of more sheep or goats, this time in two registers, with eleven animals in each register.

A more isolated, but nevertheless important piece of evidence comes from the partially preserved temple at Buġibba. Along one edge of the first court of this building, a block showing low-reliefs of fish was found in situ, adjacent to the block showing spiral motifs noted earlier (Figure 67). The low-reliefs occur on the two visible vertical faces of the block. Three fish appear on the longer side (Figure 69), while a fourth is represented on the shorter side.

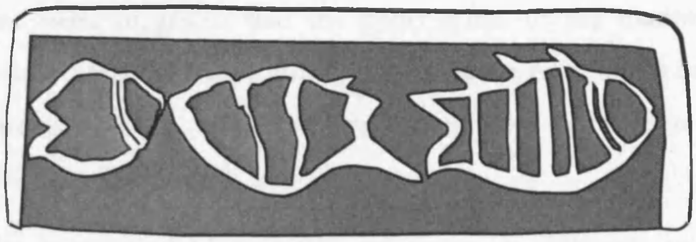


Figure 69. Buġibba. Front elevation of block with fish motifs. Height 28 cms.

Another zoomorphic representation is recorded from South Temple at Ġgantija. It is a relief panel showing what has been variously described as a fish (La Marmora 1836), snake (Evans 1971, 175) or eel (Ridley 1976, 48). This panel is first recorded on the boundary between the inner court and the inner right-hand apse of the South Temple (La Marmora 1836). However, its original context is less secure than the other examples from Tarxien and Buġibba.

The known repertoire of zoomorphic low relief panels is discouragingly small in numerical terms. Nevertheless, the spatial context of the different reliefs raises an interesting possibility. This is that different subjects may be associated with different spaces within the building, in a manner that is topologically consistent across different megalithic complexes. The fish from Buġibba and the quadrupeds from Tarxien are located at different points in the spatial topology of the megalithic buildings. The quadruped reliefs are grouped at the inner end of an apse, well behind the boundary defined by the screen across the front of the apse. The representations of fish, on the other hand, are placed along the edge of a court, closely associated with spiral reliefs, and in a position equivalent to that where spiral motifs are more usually encountered.

The location of terrestrial animals in an apse, and of fish in a court, raises an interesting possibility, which may be put forward as a working hypothesis. The zoomorphic evidence suggests different parts of the interior of the buildings may be associated with the terrestrial and with the maritime domain. This hypothesis may be explored further by examining the deployment of less explicit, curvilinear motifs in the same spaces.

The juxtapositions between recognizable motifs and less explicit motifs may provide a key to reading the latter. One example of a comparable approach is a recent re-evaluation of the rock-painting at Tumlehed, on the south-west coast of Sweden (Nash 2001). This rock-painting shows deer, fish, boats, horizontal wavy lines associated with the image of a fish, a human figure, and a net-like design (Nash 2001, 178). It has been pointed out that subjects related to the maritime environment appear in one part of the panel, while subjects related to the terrestrial environment appear in a different part of the panel. On the basis of this observation, it has been suggested that the panel refers to the maritime and terrestrial elements of the surrounding landscape. Furthermore, on the basis of the recognizable figures that they are associated with, the horizontal wavy lines have been interpreted as a representation of the sea (Nash 2001, 181-191).

Depictions of the sea may take a variety of forms in different cultures and artistic conventions, ranging from zigzag lines to patterns of repeated curves (Crowley 1991). Spiral motifs are among the more widely attested patterns that have been adopted to represent water and the sea. In the prehistoric Aegean, for example, some Early Bronze Age Cycladic 'frying pans' that are roughly contemporary with the Tarxien reliefs bear depictions of fish and boats surrounded by a sea of spirals (Broodbank 2000, 252, fig.81; Sherratt 2000, plate 247). In such representations, the clear association with evidently maritime motifs leaves little doubt that the intention was to use spirals to represent the sea.

On the basis of the contextual associations that have been noted so far in the case of the Maltese temple reliefs, a case may likewise be made for interpreting spirals as a representation of the sea. Running spirals are generally found around courts, particularly on the screens that separate courts from apses (Pace 1996, 11; Evans 1996, 41). In the case of Buġibba, relief panels showing spirals were found adjacent to the two reliefs showing fish. The emphasis on repetition and rhythm in these spirals is consonant with the behaviour of waves as they may be apprehended, organized and represented by an observer (See Arnheim 1974 for a discussion of some of the cognitive processes that may be involved).

Curvilinear motifs also appear in apses. One example is the block noted earlier in the south-western apse of the South Temple at Tarxien, adjacent to a relief showing quadrupeds (Figure 66, Figure 68). In spite of its stylistic similarity to spiral motifs, however, the curvilinear motif that is repeated on the three visible vertical faces of this block is different in structure. As noted earlier, its branched structure, stemming from a pair of thickened vertical elements, has prompted its description as a tree-like motif (Evans 1971, 120). Comparison with the structure of the spiral motifs encountered around the court reveals a number of differences. The branching, tree-like structure uses a dendritic hierarchy of different thickness to show the place of different elements within the hierarchy. On the other hand, the structure of spiral motifs around the court is rhythmic and repetitive, with no distinguishable variation in the thickness of the elements in the composition. On many of the panels on the screens between court and apse, spirals follow each other in a horizontal series, facing the same direction. In the more elaborate examples at Tarxien, two horizontal running registers are typically shown on each panel, one facing left, the other facing right. Other variations may also be noted, as in the case of the threshold slab in the Central Temple at Tarxien, where a symmetrical composition of two reflected spirals is preferred. In spite of these variations, however, there is a consistent emphasis on horizontal repetition and regularity, with individual spirals retaining the same form, size, and topological relationship with other spiral elements, across the whole interlocking composition.

In the same way that fish are represented in the domain of the court, and animals in the domain of the apse, the reliefs around the court may be read as representations of the sea, while those at the far end of the apse may represent plants, shrubs or trees. The seemingly more 'abstract' treatment of these subjects may be explained simply by the nature of the subjects themselves. While animals and fish may be recognizably portrayed with an outline alone, the representation of more amorphous bodies such as the sea, or organic bodies such as a tree, is somewhat more challenging, and the use of more stylised conventions to fulfil the task is all the more necessary and likely.

Symbol and connotation

The meaning and connotations of symbols and images may vary according to the context, occasion or audience (Layton 1991; Bradley 2002a, 231). A system of images such as the one under consideration here may have multiple layers of meaning, which are difficult or impossible to unravel on the basis of the material evidence. Some of the curvilinear motifs shown in the low-relief panels cannot be resolved into the tidy categories of 'running spirals' or 'tree-like structures'. Certain examples, such as the small blocks just inside the entrance of the apse with the quadruped reliefs at Tarxien, display a mixture of the characteristics that have just been noted to distinguish between different motifs. The repertoire of reliefs may be making further, more complex symbolic references that are even more elusive to the modern viewer. As noted in a recent contribution (Tilley 2004, 137), the symbolic references embedded in this representational system may be polysemous and multivalent. Deliberate ambiguity in reliefs located in transitional spaces is also a possibility. Such questions must remain. Nevertheless, the predominant motif used around courts is the repetitive running spiral, which is absent within apses. On the other hand, the most clearly tree-like motifs appear within an apse. This general pattern is consistent with the distribution of zoomorphic motifs noted above.

The use of water may be another example of a medium that carries multiple connotations. The interpretation that is being put forward proposes an association between areas that are 'wet' and open rather than roofed and 'dry', noted in the previous chapter, and references to the maritime environment. The association between freshwater and the sea appears somewhat paradoxical. Freshwater and seawater played a very different role in the life of the islanders, and their elision may seem rather curious. A possible solution to this question may lie in Barth's ethnographic work in New Guinea, which has paid particular attention to the way cosmologies are constructed, transmitted, and developed (Barth 1987). One of the important observations that he makes is that when material objects from daily life that are given a symbolic value, they may become 'associated with a fan of connotations, and split into a multiplicity of levels of ambiguity…' (Barth 1987, 21). These connotations may vary according to context (Barth 1987, chapter 5). Furthermore, it was observed that a symbolic schema, once established, could be linked to a growing number of facts, interpretations, and dichotomies (Barth 1987, 50). Water could even acquire very different connotations among neighbouring groups. While for the Bimin-Kuskusmin, water is associated with cold as opposed to hot, for the Baktaman it is associated with ideas about increase and removal (Barth 1987, 32-34). A pervasive element such as water has the potential for considerable latitude of interpretation and symbolic connotation.

It is useful to bear in mind this potential for different symbolic associations when considering the Maltese evidence. Although fresh water and the sea play such different roles, their apparent association suggests that the symbolic scheme in operation here may hinge on the common factor of water. Within the very specific context of these buildings, fresh water may have acquired a symbolic association with the watery medium of the sea. The manipulation of water in specific architectural spaces could have heightened the scenographic effect of crossing these spaces, as a performative representation of travel across the sea.

Sculpture in the round & high-relief sculpture

Sculpture in the round is widely used in association with Maltese megalithic buildings. The predominant subject depicted in this medium is the human form. Anthropomorphic representations have been found in several megalithic buildings. As noted earlier, anthropomorphic representations have received more attention in the literature than any other associated with these buildings. The present purpose, therefore, is not to rehearse the descriptions and discussions of representations of the human form, but to make some general observations on the relationship between different media and the subjects represented. Numerous examples are known of anthropomorphic statues carved in the round. There are also some examples carved in high-relief, such as the pair of figures at

Ħaġar Qim or the example from tas-Silġ. The main difference between the high-relief sculptures and sculptures in the round is that the high-reliefs form part of a larger megalith, and are consequently even more fixed and stationary than a statue in the round of the same size. The subject matter depicted in high-relief sculpture suggests that this medium was used in the same way as sculpture in the round. For the purposes of the present discussion, the former will be treated as a variation of the latter.

The statues may vary considerably in size. In one study, they were grouped into small (less than 10 cms high), medium (between 10 and 20 cms) and large (from 20cms to 2m high) categories (Malone 1998, 156). The same contribution also noted that 'large' statues are invariably carved in stone. It may be added that representations of the human form are invariably carved in the round or in high relief. Furthermore, if only sculptures larger than 10 cms are considered, it is found that the media of sculpture in the round and sculpture in high relief are used only to represent the human form.

Evidence for the precise spatial contexts where anthropomorphic statues in the round were used is somewhat more fragmentary than that for low-relief sculpture. A careful study of the high-relief figure discovered at tas-Silġ has proposed that that it was found in a secondary context, and that it may have been deliberately defaced (Vella 1999). At Tarxien, a series of fragments of anthropomorphic statuettes were found concentrated in the outermost, western apse of the Central Temple (Zammit 1915a, 8-12, 17, 20, 28). The context and condition of these statues suggests that, as in the case of tas-Silġ, their find-spot need not be a reliable indication of where they were used, and may further corroborate the evidence that has been put forward for deliberate destruction and iconoclastic behaviour at Tarxien around 2,500 B.C. (Vella 1999, 228-229), which is also being corroborated in contemporary funerary contexts (Stoddart 2002, 183-184). Practically all the statues found by Zammit at Tarxien were found in a fragmentary state. The discovery of the first statuette is recorded in the diary entry for the 29 July 1915. The statuette was found 'under about 3 ft. of soil', suggesting that it very probably was re-deposited after the end of the Neolithic. The front of the figure was 'broken time ago', and 'the upper part of the figure was hacked about' (Zammit 1915a, 12). Similar observations were made for the fragments of at least four other statuettes that were found in the following days (Figure 70). The colossal figure in the South Temple at Tarxien also sustained considerable damage. Nevertheless, its sheer size has assured that it has the most secure context for any of the anthropomorphic figures found in Maltese megalithic buildings. The statue was permanently positioned immediately within the main entrance into the South Temple, along the boundary marking off the first apse on the right.

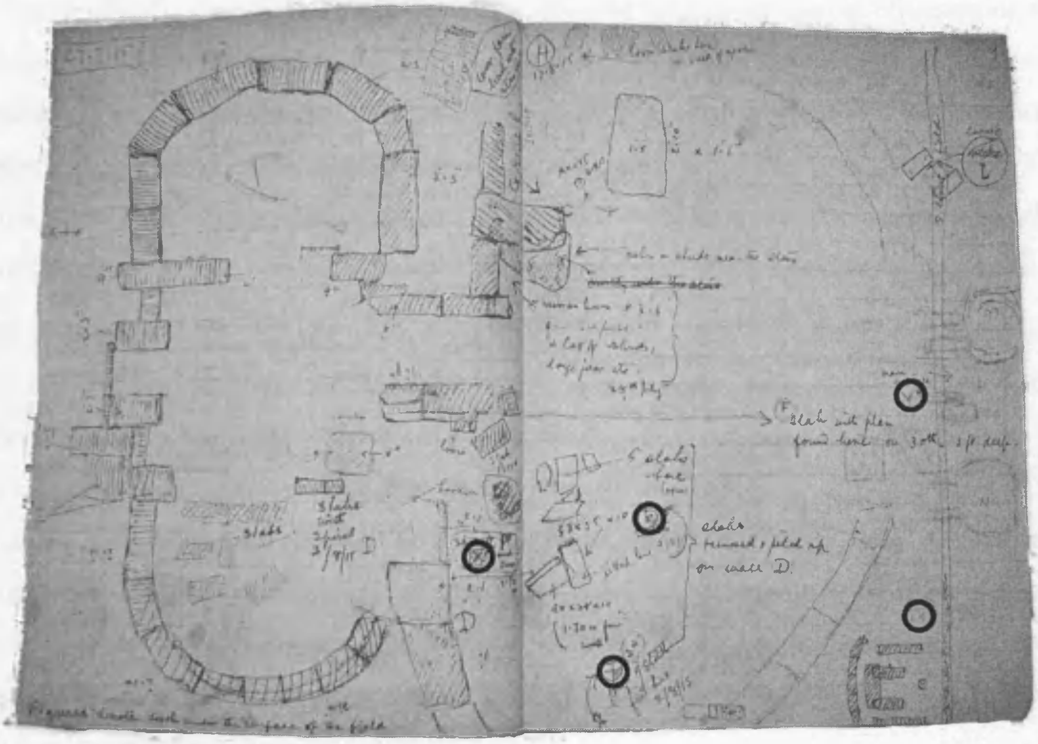


Figure 70. Tarxien, Central Temple. Plan from excavation notebook for 1915. Circles added to highlight position of fragments of five different statuettes.

The rather better-preserved anthropomorphic statues from Ħagar Qim were found in two main groups. The first group, which includes seven stone figures as well as two ceramic statuettes, was found in 1839, reportedly in the area just within the south entrance into the main building, or in an adjacent apse (Vance 1842; Evans 1971, 91-92). The second group, consisting of three more stone statues and the fragment of a fourth, were discovered in 1949 beneath a threshold (M.A.R. 1950, 1-11; Evans 1971, 85, 91-92).

From these various observations, it is difficult to make useful generalisations on the precise spatial context where the anthropomorphic figures were used. The general pattern is that the statues are located in the more readily accessible areas of the buildings, close to entrances and on principal axes, rather than in niches or apses deep within the building. The location of the statues also appears to coincide with areas that are characterized by concentrations of low-relief sculpture. The limited evidence available suggests that anthropomorphic statues were conspicuously deployed within the buildings as prominent 'attention-seeking devices' (cf. Renfrew 1994, 51-52), rather than being carefully hidden sacra intended for a very restricted audience.

When the subject-matter of sculpture in the round is compared to that of low-relief sculpture, the contrast is striking. Notwithstanding the intense interest in representing the human form in other media, it is completely absent from the low-relief panels. What is omitted from a representation is sometimes as telling as what is shown, and this glaring omission may shed some light on the way different media are being deployed. The appropriate medium to make references to the environment appears to be the low-relief panel. By contrast, the human form may only be represented in the round or in high relief.

The systematic use of different media for different subject matter has interesting implications for the way such subjects are represented. Different media create different relationships between subject and viewer. It was suggested earlier that low-relief panels appear to be making references to the environment. Their systematic deployment in different parts of the building was compared to the way stage props define the properties of a space. Anthropomorphic representations, on the other hand, are located in a different plane of representation through the use of a different medium and of different conventions. Their representation in the round, or almost in the round in the case of high-relief sculpture, allows them to occupy three-dimensional space.

The omission of the human form from the low-relief panels suggests that they are not concerned with representing historical or mythical events. Their content suggests that they are more concerned with references to place. Their purpose is to create a meaningful spatial context within which symbolic performances may be acted out. The representations of the human figure, on the other hand, are executed in the round and actually inhabit the same space as the individuals who enter these buildings. In this sense, these anthropomorphic images are co-present in these interiors together with the viewer. In these places, it was not only possible for people to articulate and mediate their relationship with their world, but also to encounter anthropomorphic figures, re-presented and made present by the statues.

The boat graffiti

So far, it has been suggested that low-relief panels were used to make systematic references to the maritime and to the terrestrial domain in different architectural spaces. Against this background, other features that are encountered in these buildings appear in a new light. The first of these is a group of graffiti of boats at Tarxien, which have been studied and recorded by Woolner (1957). Although the graffiti do not appear to have attracted much attention during the excavation of the site between 1915 and 1919, the more deeply incised are clearly visible in the original excavation photographs, removing any doubts about their authenticity. The graffiti are found at the entrance to the southwestern apse of the South Temple, which was discussed earlier on account of the high concentration of relief carvings. The graffiti are located on a pair of upright megaliths forming the north jamb of the entrance into the apse. Nearly forty graffiti were identified, varying in technique and detail of execution. Many of these are densely superimposed, suggesting that they probably accumulated over a span of time. The details of the boats represented vary considerably. Many are very simply executed, and represent small canoes or similar vessels, such as those attested in the Neolithic (See Johnstone 1980, 56-61; Marangou 1991, 31 for sources on Neolithic evidence in Europe ; Broodbank 2000, 96-101 for a recent summary and discussion of the Aegean evidence). A few of the graffiti have been compared to the longboats that are depicted on Early Cycladic pottery (Woolner 1957, 63) from around the mid-third millennium BC, although they may well have developed earlier (Broodbank 2000, 99). Although doubts have been expressed about whether these graffiti could be contemporary with the original use of the building (Evans 1959, 116; Ridley 1976, 90), the stratigraphic evidence and the height at which the Tarxien graffiti occur suggest that they were created before the end of the Tarxien Phase, when the building complex was still serving its original purpose (Woolner 1957, 65).

The spatial context of the graffiti, together with the reading of the associated iconography that is being proposed here, lends more plausibility to such an interpretation. Earlier it was suggested that the images associated with courts were related to the maritime domain, while images found within certain apses were related to the terrestrial domain. The boat graffiti at Tarxien are located precisely at the juncture between these two domains, at the entrance that crosses the screen into the apse. The apparent engagement of the graffiti with this spatial discourse strongly suggests that they were incised by individuals who knew and understood the meaning of the spatial setting.

Another enigmatic piece of evidence should also be reconsidered in this light. In the nearby three-apsed temple known as Kordin III, an intriguing slab made of Coralline Limestone forms one of the thresholds into the side apses (Figure 71).

Figure 71. Kordin. The boat-shaped threshold shortly after excavation (from Ashby et al. 1913, pl. VII, fig.2).

The three-apsed structure at Kordin III has been dated to the Ġgantija Phase (Evans 1971, 77). The Coralline Limestone threshold forms part of a later modification that divided an apse into two spaces. The sherd counts for the site suggest that the modification took place before the end of the Tarxien Phase (Evans 1971, 77). The original excavators described the Coralline Limestone threshold as '...a remarkable trough cut out of a single boat-shaped block... divided by cross-divisions into seven compartments' (Ashby et al. 1913, 42). Citing the smoothened surfaces of the trough's interior, and the presence of a smoothened stone in one of its compartments, the excavators suggested that the feature had been used for grinding grain (Ashby et al. 1913, 42-43). More recently it has been suggested that the hollowing out of this rather idiosyncratic trough is the result of secondary use after the building had fallen into ruin (Evans 1971, 73). In view of these interpretations, the possibility that this feature represents a boat has only been suggested very tentatively (Basch 1987, 395).

The context of the boat-shaped feature puts the question in a different perspective. Positioned across a threshold between court and apse, it lies along the structural boundary discussed earlier. The court outside it is paved with flagstones, while an earth floor lay in the apse beyond it. The two floors also display the change in level noted earlier. While the paving in the court lay below the boat-shaped threshold, the earth floor within it was found flush with its upper surface (Ashby et al. 1913, 42-43). It was argued above that the boundary created by this series of oppositions is also frequently marked by imagery related to the sea. More specifically, the boat graffiti found in a topologically equivalent doorway at Tarxien support the idea that this mysterious boat-shaped object is in fact deliberately mimicking a boat. In some respects it may be compared to the Neolithic dugout canoes that are widely attested in Europe (Marangou 1991, 21-29). The distinctive separation of the threshold feature into seven compartments is strongly reminiscent of the compartments attested on some dugouts. Such compartments have been observed on a model from Tsangli in Thessaly, which is believed to be a Neolithic representation of a developed dugout (Marangou 1991, 27-29), while several other examples of dugouts internally divided into compartments by partitions or bulkheads have been recorded in a range of archaeological and ethnographic contexts in northwest Europe (McGrail 1987, 76-77, fig. 6.16). The Marmotta dugout from Lake Bracciano has four such bulkheads, dividing the vessel into five compartments (Fugazzola Delpino & Mineo 1995, 227-228). These compartments are usually created by leaving reserved bulkheads during the hollowing out of the craft, which served to divide the boat into spaces with different functions, as well as providing seating and strengthening the hull. In the model from Tsangli, the thickening of the partition towards its base was read as an attempt to reproduce the effect created when leaving a reserved partition, rather than inserting a plank into a completely hollowed hull (Marangou 1991, 28). This characteristic also tallies well with the partitions on the threshold feature at Kordin. The smoothened surfaces on this feature indicate that abrasion was chosen as the most practical method to hollow it out. The basic concept of hollowing out the desired form from a solid mass was essentially the same as that of creating a real dugout; only the tool-kit would have been changed to suit the different material.

The significance of the boat graffiti at Tarxien and the boat-shaped threshold at Kordin may be re-evaluated in the context of the present reading of the low-relief sculpture. Sea-craft in the prehistoric Mediterranean represented a valuable resource, and under certain circumstances their control and use could be closely linked to prestige and status (Broodbank 2000, 99-101). In an island context, sea-craft could easily gather associations of exotic knowledge and contact with other islands and beyond (Helms 1988). It has been suggested that pressure on limited resources in Malta during the Late Neolithic could have accentuated the value of such associations (Stoddart et al. 1993, 17).

The representation of sea-craft in a monumental context is perhaps less surprising when considered against this background. If the reading proposed here is correct, the references to sea-craft could be a further indication of a concern with the island environment, cosmology and geography. The location of the representations of sea-craft in a liminal context, straddling boundaries that appear to be invoking the sea, suggests a preoccupation with the significance of maritime crossings. The accumulation of superimposed graffiti at Tarxien speaks eloquently of a succession of individual actions and events, perhaps making references to actual journeys. The polyvalent boat, receptacle, and threshold at Kordin, could have invoked the movement of people and exchanges across the sea when used in ritual activity. Developing Robb's (2001, 192) suggestion that 'the distinction between Maltese and other would have been constructed through the experiences of both temple ritual and overseas travel', it is suggested that the ritual engagement with the architectural space within the megalithic complexes was itself a metaphoric journey.

The use of different materials

One final medium of representation that must be considered is the selection and insertion of different materials in the structural fabric. It should be recalled that in Chapter 4, the choice of materials for the structural fabric of megalithic buildings was considered. It was established that generally, the stone materials that were most readily available in the immediate vicinity were used, Research on Neolithic monuments elsewhere has suggested that different materials may have been selected and used in megalithic structures in a way that was significant and meaningful to the builders (Parker Pearson & Ramilisonina 1998; e.g. Bradley 1998a, 229). In the case of the Maltese megalithic structures, however, it appears that the bulk of the structural fabric was not intended to make any such symbolic references, and that it was simply selected according to the principle of least effort (Zipf 1949). There are however some instances where it appears that different materials were carefully selected because of their particular properties, and deployed in the megalithic structures in deliberate and meaningful ways.

Figure 72. Mnajdra, South Temple. Calcite formation in threshold across main entrance.

One example is the Coralline Limestone slab forming the threshold of the main entrance to the South Temple at Mnajdra (Figure 72). The block that was chosen for this purpose has a calcite formation that had formed in a crack in the rock, with the accumulation of mineral deposits left behind by evaporating water. The block was positioned so that the calcite forms a dark line across the width of the threshold. Another example is the boat-shaped threshold at Kordin III, discussed in the previous section. The threshold is made of Coralline Limestone, while the prevailing material in the building is almost exclusively the Globigerina Limestone that is found on the surface around the site. Yet another example is a cylindrical pillar at Ħaġar Qim that is also made of Coralline Limestone, while the material used for the structural fabric is once again the Globigerina Limestone that outcrops on the site.

Another instance of the insertion of unusual materials in these buildings was recorded during the excavation of Tarxien. Five polished stones were fitted into five recesses, cut in two horizontal rows near the base of a megalith that stands between the court and the middle right-hand apse of the Central Temple (Zammit 1917, 271; plate XXXVI, Fig. 2). The set stones were described by the excavator as fossil shells and dark round pebbles.

Although the calcite formation in the threshold at Mnajdra is exceptional in the Maltese context, its very precise positioning suggests that it is deliberately worked and placed. The use of stone deposited by water is well attested in other prehistoric ritual contexts elsewhere (Whitehouse 1992). Such formations have been read as a form of stillicide water, which may be used in ritual contexts because of its association with the element of water (Whitehouse 1992). In the Maltese context, the position of this threshold into the court may be another of a series of structured references that identify the court as 'wet' and the apse as 'dry'. The position of the calcite formation across the threshold is consistent with the preoccupation with boundaries and liminality that has been observed in the present chapter and the previous one.

The inlaid pebbles and fossil shells at Tarxien are equally unusual in a Maltese context (Zammit 1917, 271). The '...dark round pebbles...' were most probably gathered from a coastal environment. The use of marine pebbles and fossil shells on a megalith flanking the entrance to an apse may once again be making metonymic references to the marine environment. The use of fossil shells in a liminal context at Tarxien also recalls the inverted bowl that was found beneath the colossal threshold slab to the South Temple at Ġgantija, containing 158 seashells (Evans 1971, 173).

Both the example from Mnajdra and that from Tarxien may therefore be using materials from the environment to represent that environment within architectural spaces. The way these materials are selected and deployed appears to be consistent with the present reading of other media, which together suggest that the courts in megalithic buildings, and particularly the boundaries that define them, may have had some association with water and the sea.

Cosmology, architecture and representation

The contextual relationships and characteristics that have been noted suggest that the use of images in Maltese megalithic buildings made extensive references to the environment and to the way people engaged with that environment. Beginning with the use of low-relief panels, it has been argued that the designs that are usually considered to be 'abstract' also represent elements from the environment. Low-reliefs as a group appear to be making structured references to the surrounding environment. Motifs related to the land occur in one part of the interior, while subjects related to the sea occur in a different topological position.

In order to further examine the relationship between these images and the islanders' perception and representation of the environment, three closely-related and fundamental issues will be addressed in turn. The first issue is the way people perceive their physical environment. The second issue is the way this experience is recollected and represented. The third issue is the way these representations are used and understood. Some general points will be recalled about each of these issues, followed by more particular observations on how these processes may be shaped by island environments, and more specifically by the Maltese Neolithic environment.

How is landscape perceived?

The question of how people perceive their environment is a long-standing focus of research in cognitive psychology. The work of James Gibson in particular has emphasised that our perception of the environment is largely based on what we observe as we move through it, and on the way we assemble this information. As we travel along a path, vistas open up ahead, as others are left behind (Gibson 1979, 198). The sense-impressions gathered along a journey usually consist of a succession of such vistas. Knowledge of an environment is often collected in linear strips along familiar routes. In experiments on how people structure their experience of an environment, it has been observed that they tend to use frequently travelled paths as linear anchors around which to organise their spatial experiences (Golledge 1999, 11).

The above observations underline an important fact, which has also been noted in ethnographic and historic research. This is that Euclidean models of a space are quite unlike the lived experience of that space, and they are unlikely to be typical of most pre-industrial societies (Ingold 2000a; Ingold 2000c). 'Knowing, like the perception of the environment in general, proceeds along paths of observation' (Ingold 2000c, 229). In an almost Binfordian sense, the opportunities and limitations dictated by the human body predisposed us towards a more linear experience of landscapes. A Cartesian understanding of space is in this sense somewhat counter-intuitive, and is only possibly after mastering abstract concepts such as Euclidean geometry.

In the specific context of an island environment, the ever-present elements of daily experience are land, sea, and sky. Travel in an archipelagic environment involves a constant interplay of land and sea (Gosden & Pavlides 1994; Broodbank 2000). Mediterranean seafaring and island-hopping is a linear succession of terrestrial preparation, embarkation from one shore, the maritime crossing, and disembarkation on another shore (cf. Broodbank 2000, 23; Horden & Purcell 2000, 11). When the distances to be crossed takes the voyagers out of sight of land, the maritime crossing itself is experienced as a succession of three critical stages (Gladwin 1970, 147). In the first stage, while departing from a landmass this may be used to maintain a bearing. A critical threshold is reached when this landmass is left behind and lost from sight. The next stage of the journey is the most difficult and dangerous, as it must be made by dead reckoning. Another critical threshold is reached when a landfall is sighted. The final part of the journey consists in using distinctive features of the coastline to navigate towards the desired destination. In optimal conditions, it is theoretically possible to cross from Malta to Sicily without losing sight of land (Chapman 1990, fig. 59). During a crossing on a small vessel in August 2002, for instance, the present writer had the experience of sighting Gozo before losing sight of the Hyblaean hills of southeast Sicily. Experienced sailors who make this crossing frequently have however described this as rather unusual, and in practice, crossings are more likely to involve the succession of stages described by Gladwin, which must have loomed large in the recollection, narration, and representation of these crossings in prehistory. Maritime crossings between the archipelago and Sicily were a matter of considerable concern for the islanders, as they were their only link with the outside world. Maritime crossings within the archipelago were also essential for interaction between communities in different parts of the archipelago. The positioning of megalithic complexes near embarkation points, discussed in chapters 4 and 5, suggests that monumentality was related to these concerns.

How is landscape remembered and represented?

Results in cognitive psychology as well as ethnography have indicated that the linear experience of landscapes is often recollected and organised in linear models and narratives. The Australian song-lines are perhaps the best-known example. Among the Inuit, travellers returning from a journey are able to describe the landforms and features seen along the route in great detail (Rundstrom quoted in Ingold 2000c, 232-3). Linear models of space and landscape have been recorded in a wide range of contexts. In ethnographic work on landscape perception and representation in Nepal, Chris Evans has observed what he terms 'serial geographies'. This usefully ambiguous term refers to the systematic and repetitive ordering of landscape features into linear sequences of cosmological significance. Successions of features such as 'valley, river, mountain' in different parts of the landscape are codified into equivalent cosmological schemes, often following linear routes through the landscape. Man-made temples, monuments, and settlements are meaningfully positioned within these serial geographies (Evans 1999). Positioning ritual centres in a particular relationship to elements of the local topography locates them in a cosmological scheme of universal significance. This conflation of local topography with universal cosmological systems is part of a wider phenomenon, well attested in the Jaina and Hindu traditions of temple building. In these traditions, there is a non-cartographic understanding of the landscape, which is perceived as an embodiment of the cosmos. Furthermore, these cosmological conceptions of space provide the basis for the architectural layout of ritual centres (Hegewald 2002; Nanda 2002).

Returning once again to the ethnographic record from island contexts, we may note several interesting parallels. For many island societies, elements from the daily experience of the islandscape often acquire cosmological significance (Helms 1988, 24-25). The directional systems of many island societies do not use the cardinal directions, but are based on the notion of 'inland' and 'seaward' (Zubrow & Daly 1998, 161). The use of islandscapes as a model of understanding the world may also be embodied in architectural forms. (Louwe Kooijmans 2000, 325-8).

As demonstrated in Chapter 4, the Late Neolithic monuments of the Maltese archipelago are very precisely positioned in relation to the landscape, between the plains of the interior and embarkation points on the shore. Their repetitive and consistent relationship with the islandscape suggests that they were also engaged in the construction of 'serial geographies'. The use of imagery within the buildings is inseparable from the project. References to the environment that have been noted in images within the buildings also suggest an engagement with the creation of cosmological order out of the islandscape. The subject matter prompts the suggestion that the cosmological domains that are being represented here are land and sea, perhaps the two most inevitable components of an islander's cosmology (cf. Broodbank 2000, 21-23; Helms 1988, 24-28).

Furthermore, images related to the maritime environment are located around the courts, while images related to the terrestrial environment are located within certain apses. This suggests that the ordered architectural space of these buildings may itself perform the role of a cosmological representation of the islanders' world.

The possibility that rainwater may have been allowed to collect in some of the temple courts, noted in the previous chapter, is worth recalling. If this were the case, the deliberate flooding would have played a powerful part in the cosmological programme, transforming the domain representing the sea into a pool of water, which would have had to be crossed to reach the apses representing dry land. Reflections on the surface of the water may also have played a part, replicating the temple interior and the sky.

How are these representations experienced and understood?

Performance and knowledge are the subjects of a recent paper by Turnbull (2002), noted in the previous chapter. Turnbull chooses the Maltese megalithic buildings to develop his argument about the inseparability of bodily action and performance from the systems of knowledge and perception of a given society. Turnbull suggests that the meaning and purpose of the Maltese megalithic buildings should be sought '...in the performance of space and knowledge through the movement of people and their reading of the monument as encoded memories...' (Turnbull 2002, 130). Turnbull's paper focuses primarily on questions of theory and method, without pursuing all the ramifications for the interpretation of Maltese monumental buildings. Some of the questions raised by Turnbull are common to those addressed in the present discussion. In order pursue these questions further, we must continue to examine the relationship between landscape, space, knowledge and performance.

The ethnographic evidence suggests that systems of cosmological representation are not passive reflections of a perceived reality, but active tools in the creation of order and meaning in experiences and perceptions. This issue deserves to be explored further in the context of the present discussion. In order to do so, it is useful to recall the comparison made earlier in this chapter with a recent reading of the painted panel at Tumlehed in Sweden. There is a very important structural difference from the Swedish example. A painted panel is ordered by the grammar of its internal composition, across which people may travel in their mind, and which Nash compares to a map. On the other hand, the systematic deployment of images in architectural space is itself a spatial system that people enter and move through. This combination of iconography with architectural space is an important point, and its implications deserve attention.

Firstly, such a combination of evidence is rather particular. Monument building and rock-art are both widely attested in the Neolithic, however they are often encountered separately. When monumental architecture and images are deployed together as a single project, as in the case before us, the combination may allow us to read patterns at more than one scale of analysis (cf. Bradley 2002a). On the one hand, the positioning of monumental buildings in the landscape may offer some insight into the role and purpose of the buildings in ordering that landscape. On the other hand, the use of images within the buildings is also spatially ordered, and may furthermore be making systematic references to features of the island environment. Comparison may also be made between observations made at different scales of analysis. In the case in hand, monumental buildings are placed at liminal points in the landscape, in natural gateways that allow movement between the sea and the interior. Within the buildings themselves, the representations invoking the maritime and the terrestrial environment are separated by the various devices noted in the previous chapter. The most conspicuous of these devices are the monumental screens that separate some apses from the adjacent courts. The screens are perforated by elaborate central thresholds that allow movement between the two environments separated by the screens. The symbolic spatial order inside such an architectural composition echoes the positioning of the buildings in the islandscape.

Secondly, the deployment of these images in an architectural space means that they are not encountered simply by being viewed, but need to be performed. These assemblages of spatially ordered representations create meaningful spaces, and they may only be encountered by entering these spaces. The bodily practices of engagement with such spaces and images are essential to their meaning. The dynamic relationship between the viewer, or rather actor or actress, and the representations of different elements of the landscape could be an enactment of a relationship with the landscape itself. The act of crossing these spatial representations of the islandscape could itself be a representation of travel and interaction across that landscape.

In this sense, megalithic monuments appear to be repositories of knowledge about the world that the islanders inhabited. Furthermore, it is a form of knowledge that must be performed in order to be maintained, understood, and transmitted. This is where the present analysis converges with Turnbull's concerns. The present examination of the relationship between landscape, space, knowledge, and performance fulfils part of the agenda that he proposes, through a fresh reading of architectural space as a locus for the performance of cosmological knowledge.

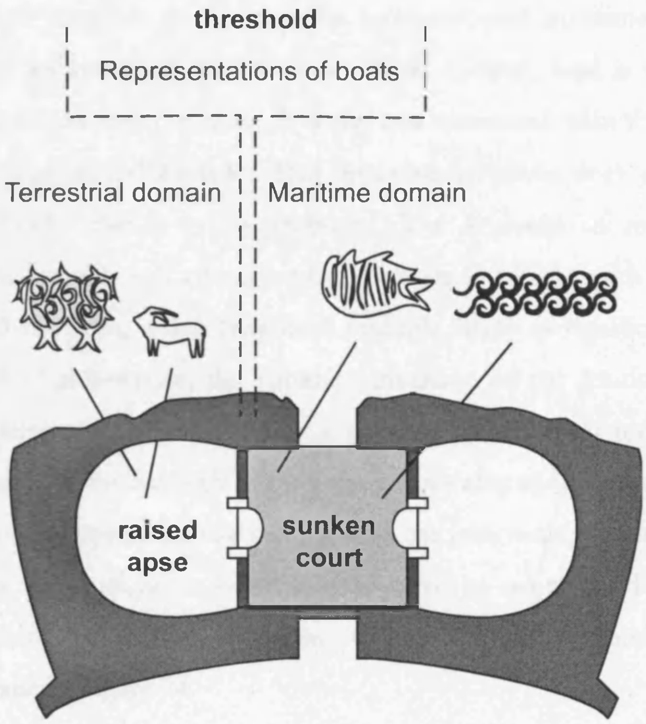


Figure 73. Schematic representation of spatially ordered cosmological references.

In the present reading of the evidence, certain apse environments may be associated with the terrestrial domain, while certain court environments may be associated with the maritime domain (Figure 73). If this reading is correct, it means that the temporal experience of movement through these buildings entails the crossing of a maritime domain to reach a terrestrial domain, then crossing the maritime domain once again in order to leave the terrestrial domain. This is only the simplest possible sequence, which could of course have been repeated or elaborated into longer sequences, particularly in the more complex examples of these buildings.

The monumental doorway arrangement in the Central Temple at Tarxien, considered in detail in the previous chapter, is worth recalling here. It was noted that one of the characteristics of this doorway is that in order to enter through it, it is necessary to pass through an environment where one's field of view is almost completely occluded by the two opposing spiral low-relief panels, which are not visible from outside the doorway. It is tempting to argue, but difficult to demonstrate, that the elaborately choreographed kinaesthetic experience of going through this doorway may have referred to the experience of a maritime crossing out of sight of land, which requires a stage of complete visual immersion in the maritime environment, before sighting a landfall again.

There is an apparent paradox in the way the terrestrial and maritime environments are represented in these architectural spaces. In an island context, land is surrounded by sea, while in these architectural compositions, it is the area associated with the maritime domain that appears to be surrounded by land. This apparent inversion does not in itself pose a difficulty for the model that is being proposed. The evidence of ritual behaviour and representation from historic and ethnographic contexts is replete with examples of ritual inversion of normal relations, which may have multiple layers of significance (Turner 1967; Babcock (ed.) 1978). Furthermore, the apparent inversion of the relationship between the maritime and the terrestrial domain is only a paradox in Cartesian terms. In the present reading, these representations are built around the temporality of human experience. In these terms, they are a faithful representation of the sea as the intervening medium, which must be crossed to move from one island to another, or to travel by sea to another part of the same island. A schematic comparison between Cartesian and performative systems of representation is made in Figure 74.

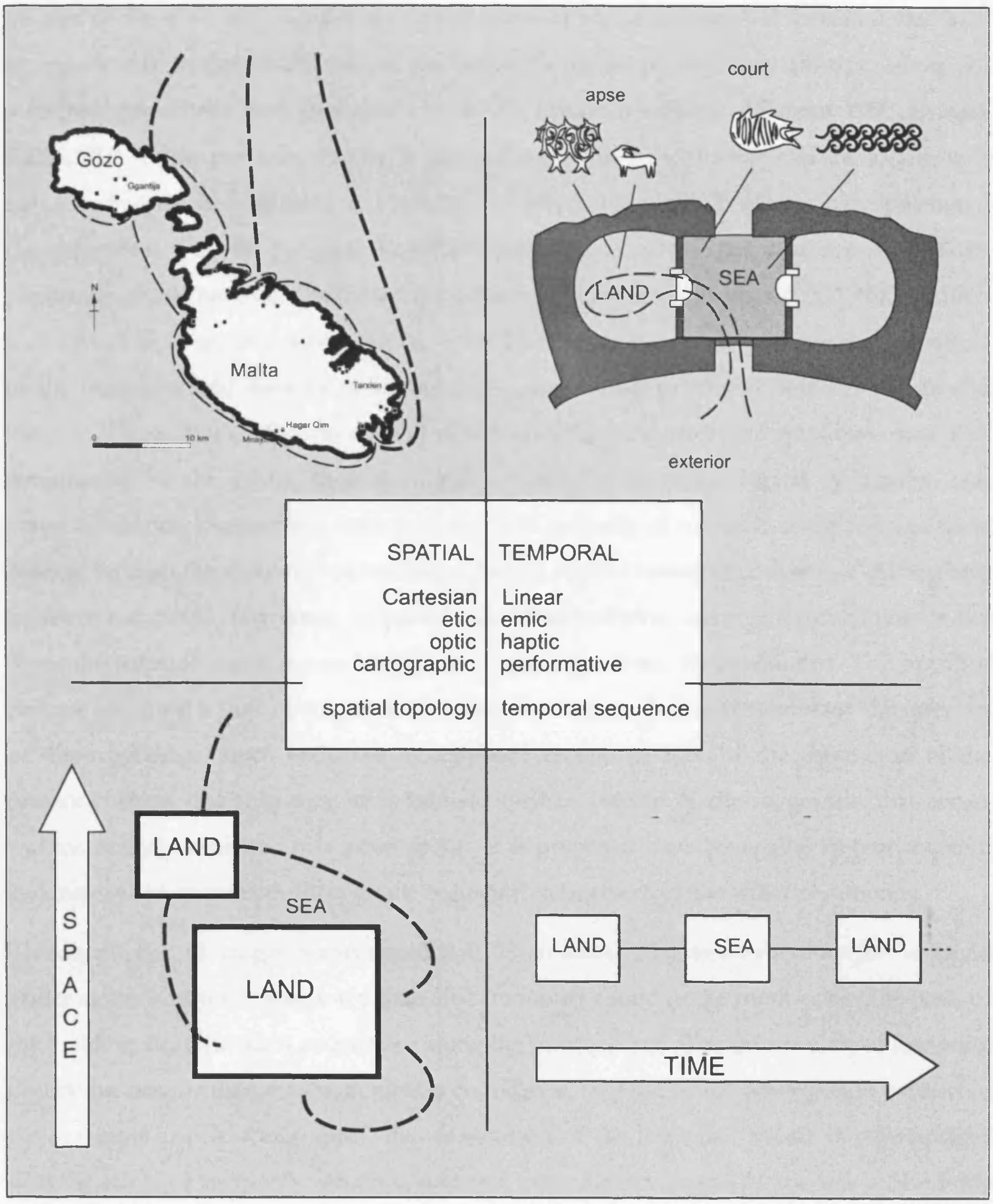


Figure 74. Schematic comparison between Cartesian and performative representations.

From exclusion to regulated access

A related question is that of who would have gained admittance to the interior of the Maltese megalithic buildings, and access to the systems of knowledge, representation, and performance embedded within them. As emphasised by Bradley, the accessibility or otherwise of a system of representation, and the audience it is accessible to, is fundamental to its significance (Bradley 2002a). When images are found within an architectural space, the size of the space may suggest the size of audience that the image was intended for. Such an argument is familiar in the case of the megalithic tombs of northwest Europe, where the restricted spaces have been used as evidence of a restricted audience (Thomas 1992; Bradley 2002a, 237). In the previous chapter, it was noted that the limited space and the increasingly elaborate internal boundaries that characterize Maltese megalithic buildings have prompted the suggestion that, by the final Tarxien Phase of this culture, the vast majority of the population would have been excluded from these monuments (Bonanno *et al.* 1990; Stoddart *et al.* 1993, 13). In an alternative opinion, it has been pointed out that it is unlikely that access to the interior would have been limited to '...just a small privileged body of priests and initiates' (Evans 1996, 44). The reading of the evidence proposed here would envisage that membership of the group, individual understanding of its cosmological geography, and practices surrounding journeys across the sea were probably all rooted in some form of ritual passage through the monumental buildings. Access to the cosmological space of the interior, however controlled, infrequent or partial, would nevertheless have given members of the community shared memories and understandings of the world they inhabited. The previous chapter proposed a shift of emphasis in the interpretation of the accessibility of the interiors of these buildings, from exclusion to regulated access. In light of the discussion in the present chapter, this shift may be developed further. Instead of the suggestion that access was increasingly restricted to a small group, it is proposed that this spatial system acquired and maintained its potency through the regulated engagement of the wider community.

The distribution of images is also significant. When considering representations in the round earlier in this chapter, it was noted that they are mostly found in the more accessible parts of the building, near the main entrance or along the principal axis. The distribution of low-relief decoration may be discussed with greater confidence, because of the more secure context of the low-relief panels. Once again, the distribution of the low-relief panels is concentrated near the principal entrances and along principal axes. Almost invariably, the low-relief panels are positioned facing outward. Deeper inside the less accessible parts of the megalithic buildings, the number of relief sculptures drops dramatically. As in the case of the anthropomorphic images, the overall distribution of the low-reliefs suggests that they are designed to be impressively conspicuous to a person entering the building, rather than being concealed for the eyes of a very select audience.

The boundaries between spaces within the Maltese megalithic buildings were evidently an important focus of ritual activity, as witnessed by the series of devices that mark boundaries, discussed in the previous chapter and the present one.

The screen that separates the southwestern apse of the South Temple at Tarxien from the adjacent court is worth recalling once more. The possible replication of elements of a temple façade in some of the details of this screen may be a reference to the location of the building itself, along the boundary between land and sea. Monumental buildings may have been used to reify and mediate the passage across different cosmological domains, in a way that bears comparison to the 'earth-navels' of the Tewa Indians. In Tewa cosmology, these are places of encounter between different natural domains, which become foci of architectural elaboration and ritual activity (Ortiz 1969, 21-25). In the Maltese context, the crossing of spaces and boundaries within the architectural spaces may not only have recalled the islanders' experiences of land and sea, but could also have given meaning and order to those experiences. Certain journeys and encounters across the boundary between land and sea might have required a ritual passage through the monument, culminating in the enactment of the journey in the symbolic cosmology of the interior. The references being made to the environment are likely to have had multiple layers of significance, which may have varied according to the occasion and the audience. Ethnographic and archaeological comparison also suggests that concerns with individual affiliation (Van Gennep 1909; Turner 1967; Whitehouse 1992), exotic knowledge (Helms 1988), pollution and danger (Douglas 1966) all played a part in shaping these rituals.

Limitations

The interpretative model that has been proposed here is by no means intended as an exhaustive reading of the evidence. On the contrary, the readings presented here are put forward as possible strands in what is certainly a more complex tapestry of meanings. The repertoire of portable objects that is presently known from secure archaeological contexts within these megalithic buildings is somewhat scant, and does not facilitate further generalisations. Comparison with the use of iconography in other media, such as ceramics, and in other contexts, such as funerary monuments, although beyond the present scope, will certainly enrich future interpretations and raise new questions.

Conclusions

The deployment of imagery within Maltese megalithic buildings may be restated in the light of the foregoing discussion. A contextual approach has been used to argue that patterns of spatial organisation and structured representations found within the temples articulate cosmological preoccupations, through a metonymic representation of the insular landscape. The low-relief images of different elements of the island environment were spatially ordered in different parts of the building. The order and juxtaposition between these images was essential to their meaning. The content and structure of low-relief panels suggests that they were making ordered references to the environment. The systematic references to the maritime and terrestrial environment invoked these environments in different parts of the building. The setting of temples along the boundary between land and sea was echoed in the internal spatial order, locating ritual activity in a cosmological frame of reference.

The relationship of these images to the viewer was also fundamental. These were not simply pictures to be looked at, but kinaesthetic and synaesthetic spatial systems to be moved through. The bodily movement of an individual through these spaces was required to enact, and therefore complete, this system of representation. These practices are likely to have played an important cosmological role, which was central in the articulation of the islanders' place in the world. They are also likely to have had other layers of significance, depending on the context, occasion or audience. This was not a cartographic or Cartesian representation of the landscape. The temporality of the encounter with these spaces was essential to their meaning. The crossing of the maritime domain that was required to reach the terrestrial domain echoed the temporal experience of travel across the archipelago and beyond. This system of representation is primarily performative. It is built sequentially around the time-line of human experience, closer to a verbal narrative of a journey than to a Cartesian map. If this reading is correct, we are dealing here with a representational system that is ordered primarily around time, not space, which may be better understood in the medium it was conceived in, the temporality of human experience.

8 General conclusions

Knowledge, narrative and landscape

The first two chapters posed a problem in the current state of research on Malta during the Late Neolithic. In Chapter 1, it was noted that the narratives, models and paradigms that we as archaeologists use in our accounts of prehistoric Malta may often be quite remote from the material and geographical realities of an island context.

In Chapter 2, the problem was explored further by considering the history of prehistoric archaeology in Malta. It was argued that a parting of ways took place between popular and scientific discourse during the nineteenth century. The scientific discourse that was developed during the 20th century to organize and explain the prehistory of the Maltese archipelago was largely concerned with fundamental questions of chronology, typology, ritual and culture sequence. While such important questions were being addressed, questions about the geographic context, and about the way this context influenced the perception and experience of the inhabitants, received less attention. As a result of the processes that were traced in detail in Chapter 2, the scientific narratives that we have inherited from the 20th century often fall short of addressing some of the questions that are most relevant to the islanders who inhabit the same archipelago in the present day.

Drawing on recent work in the Sociology of Scientific Knowledge (SSK), it has been argued that popular knowledge and scientific knowledge need not be mutually exclusive, but may on the contrary be complementary and mutually enriching. Furthermore, the creators of scientific knowledge have a responsibility to include and address questions and concerns that are relevant to the communities that they serve. Applying these principles to the study of Maltese prehistory, it has been argued that scientific research agendas must pay more attention to the landscape context of the archipelago, and to the way people in the past responded to the constraints and opportunities presented by its morphology, topography, geology, hydrology and ecology. Such an approach has several potential gains. First, closer examination of the islandscape promises to give a better understanding of the Neolithic inhabitants of the archipelago. Second, the reservoir of popular knowledge about the islandscape that is maintained by present-day inhabitants through language, toponyms, and first-hand experience of the material environment may enrich our understanding of the way people responded to the same islandscape in prehistory. A third gain is reciprocal to the second; a better understanding of the way past inhabitants exploited the island environment, and their successes and failures in this regard, may have important lessons for the inhabitants of the same archipelago today. At a time when sustainability has become a global concern of the first order, strategies that were tested by time in the past may acquire fresh relevance. The fourth gain follows as a corollary to the third. Archaeological narratives that are rooted in a landscape setting are more relevant and meaningful to the people familiar with the same landscape today. Such narratives are also more accessible, as their dissemination offers endless opportunities to use the familiar environment to communicate understanding about the past.

The inhabited landscape

The general principles outlined above set the agenda for the chapters that followed, which explored the significance of the islandscape to the Late Neolithic inhabitants of the archipelago. Chapter 3 to Chapter 5 focussed on the relationship between landscape and social organisation, at the scale of the entire archipelago. In Chapter 3, the dynamics of the island environment were considered, setting the stage for the quantitative analysis in Chapter 4 and Chapter 5. Chapter 4 examined the relationship between the known sample of megalithic monuments, and different variables in the landscape. Megalithic monuments were considered useful for such analysis because at present, they represent the best available proxy indicator for social organisation and demography. The GIS-based bivariate statistical analysis of the location of megalithic buildings against different landscape variables revealed a number of significant relationships.

Chapter 5 undertook the multivariate analysis of all the landscape variables that demonstrated a bivariate influence on the location of megalithic buildings. Routine statistical procedures were used to establish that these variables were independent of each other. The different variables were then combined using Boolean, simple and weighted addition, in order to develop a more powerful 'predictive model' for the location of these buildings. The resulting model produced a map showing which areas were more favourable or less favourable for the location of megalithic buildings. The 'predictive model' was not intended to predict the location of undiscovered sites, but rather to explain the location of known ones.

The key conclusions drawn from the GIS-based statistical analysis may be recapitulated. It provided a number of negative results that are also significant, which may be considered first. The first negative result was the lack of concern with surface geology in the location of megalithic buildings. It was statistically demonstrated that the choice of site for the buildings disregarded the very different properties of the different geological formations that make up the solid surface geology of the archipelago, and the different constraints and opportunities that they present as building materials.

Another negative result concerned the influence of topography. It was established that there was no preference to locate megalithic buildings on sites at any particular altitude. The same result was obtained when testing site locations against the landscape of the whole archipelago, as well as when testing it against the local environment, within a one-kilometre radius of the building itself. Likewise, it was established that there was no preference for steeper or shallower slopes.

The disregard for surface geology, elevation and slope together suggest that there were other, more important considerations that determined site location. In many cases, megalithic buildings were built on sites that were already frequented and used for centuries before their megalithic monumentalization. Statistical analysis of other variables also gave a number of positive results, which shed more light on the factors that influenced the choice of location for these buildings. These positive results shall be recapitulated next.

Landscapes of subsistence

The location of megalithic buildings was strongly influenced by several characteristics of the landscape that are related to subsistence. Megalithic buildings were repeatedly found to be in locations near the boundaries of plains that provide optimal conditions for the practice of agriculture without the need for the labour-intensive creation of agricultural terraces. They are also located in areas near to perennial sources of fresh water. Furthermore, south-facing slopes were generally preferred for the location of megalithic buildings. A correlation was also observed between the size of monumental buildings and the extent of the particular plain that they were associated with. Taken together, these factors shed considerable light on the question of the social organisation of the landscape, allowing a better-informed model to be put forward for the relationship between landscape, demography, and monumentality in Malta during the Late Neolithic. What emerged from the relationships that have been noted is that the highly varied geomorphology of the archipelago created windows of opportunity in specific areas that were more favourable for agricultural exploitation. The constraints and opportunities presented by the landscape appear to have heavily conditioned the organisation of the landscape into cultural units. The core areas of agricultural exploitation and settlement appear to have been defined by the affordances of the landscape. The zones that afforded the more favourable conditions appear to have been transformed into units of social organization. Megalithic buildings played a central role in this transformation. Their location closely reflects the distribution of the areas more favourable to agricultural subsistence. This evidence strongly suggests that their location reflects the demographic distribution of the inhabited landscape, and that their purpose was closely tied to the fabric of daily life. These buildings were not remote places to be approached only on rare occasions, but on the contrary were focal points in the everyday life of the community.

Site size and site hierarchy

In those parts of the island where the extent of readily available agricultural land was more limited, such as in the plains in northwest Malta, this limitation appears to have sharply defined a ceiling for the size of the communities that could be supported there. The smaller size of the communities in these areas is reflected in the extent and number of the megalithic complexes to be found there.

A wide range of different sizes of megalithic complexes may be observed, from the modest structures of Għajn Żejtuna or tal-Qadi to the mega-complexes of Tarxien or Ġgantija. In spite of this wide spectrum of different sizes, it is difficult to make a compelling case for a hierarchic relationship between larger and smaller sites. The geographical relationship between larger and smaller sites does not suggest that the larger sites are central places that dominate the smaller sites. A more plausible model for the present evidence may be a heterarchy of different communities across the archipelago, some of which were permitted to grow organically by environmental affordances, while others were constrained by the limiting factors imposed by the landscape. The relationship between monument location and the sea is also illuminating in this respect.

Connectivity

Megalithic monuments were found to have a very specific relationship to the sea. Their location displayed little concern with any specific kind of intervisibility with the sea or coastline. On the other hand, their location showed a marked preference for places that were readily accessible from embarkation points along the shoreline, which in a Maltese context may be few and far between. Such a relationship was noted in practically every known example of megalithic building, allowing for some variation to adapt to the local topography. A paramount concern in the siting of these buildings was therefore access to the sea. The most plausible reasons for this concern are access to the sea as a source of subsistence, and access to the sea as a medium of travel, facilitating connectivity with other parts of the archipelago and with the outside world. In no case could it be argued that a community represented by a megalithic structure was dependent on another community for access to the sea. Once again, the equal access to maritime resources enjoyed by these communities lends more support to a heterarchic model than to a hierarchic one.

Death

The observations summarized so far were based on the distribution of megalithic monuments built above the ground. Another type of monument, that is funerary sites hewn into the rock, is represented by a smaller number of known sites. Although the smaller sample did not allow rigorous statistical analysis, some general observations could still be made. Funerary sites are generally located at points in the landscape that were already naturally conspicuous landmarks. Contrary to megalithic buildings, which are rarely located on the summit of hill-tops, funerary sites are often located on such summits, as in the case of Xemxija or the Xagħra Circle. To the extent that it was possible to make useful generalisations, it was found that funerary sites tended to be in locations that were more visually conspicuous than those of megalithic buildings, yet were at the same time more remote from daily activities related to subsistence. This pattern suggested that, although more physically distant and remote from the taskscapes of everyday life than the megalithic buildings, the sites of the dead nevertheless remained visible from those taskscapes.

Representation and cosmology

The empirical observations and deductions conducted up to this point on the basis of quantitative analysis have shed considerable light on the relationship between the islandscape, its cultural organisation, and the deployment of megalithic monuments. These buildings were repeatedly found to be in natural gateways in the landscape, between the core areas of agricultural production and embarkation points on the shore.

As already noted, the presence of monumental architecture indicates that these windows of opportunity in the islandscape were exploited and developed into units of social organisation. Furthermore, it has been argued that the liminal position of the megalithic buildings may shed light on the role and significance of the buildings themselves. It was suggested that the empirical analysis of site distribution and landscape setting may inform the debate of cognitive issues, such as the perceptions, representational systems, and cosmological models of the islanders during the Late Neolithic.

Chapter 6 and Chapter 7 explored these issues, taking the debate onto different scales of analysis, requiring different methodological and theoretical tools than the preceding chapters. Chapter 6 examined the spatial organisation of monumental buildings, while Chapter 7 focussed on the deployment of images within the same buildings. Although traditional archaeological approaches have treated landscape, architecture and iconography as separate research domains, more recent work has demonstrated how a more holistic approach may often enrich archaeological interpretations. In the present case, it has been argued that the deployment of iconography within megalithic buildings, as well as their spatial order, may be related to the same concerns that determined the choice of location for these buildings. It has been argued that we are dealing here with a spatially ordered system of representation that made multiple references to the island environment, which effectively constituted the world of the islanders. It has been proposed that this system of symbolic storage and communication was intended to reify and mediate the cosmological concerns of the islanders. The spatial and iconographic order of these buildings is therefore inseparable from the very creation of these buildings, and the way they transformed the islandscape. Furthermore, it has been argued that the systems of knowledge embedded in the buildings required performances within their symbolically loaded spaces in order to maintain their potency and significance. These conclusions may have considerable significance, for at least three reasons. First, they shed fresh light on the interpretation of the symbolic systems developed in Malta during the Late Neolithic. Second, the present examination has suggested that the Maltese case is a very early and interesting example of such a sophisticated system of cosmological reference in a monumental setting. The third reason brings us back to the opening argument. The interpretative narratives that have been put forward here explore aspects of the Neolithic evidence that are tangible, accessible and relevant to diverse audiences in the present day.

Future research potential

The conclusions and answers that have been put forward here leave at least as many questions unanswered. Firstly, the limitations in the presently available data, pointed out in the preceding chapters, still constrain the exploration of many possible ramifications, and the levels of confidence with which they may be analysed. Future discoveries of new evidence will certainly allow some of the conclusions put forward here to be elaborated, and others to be dismissed. In particular, the capture of new data on settlement distribution through extensive field survey should fill out our understanding of Neolithic demography and social organisation. In this respect, the present thesis can contribute to the formulation of research agendas for the capture of such data. For example, if a landscape survey fails to include the plains within its sample area, the value of its results would be considerably diminished. The arguments put forward here can help inform such decisions. In turn, it should then become possible to test the present observations about site distribution against more complete datasets.

A second area that invites further work is the examination of how monumental megalithic buildings were experienced by a person navigating through the spaces inside and around them. Developments in digital technology have reached the point where three-dimensional reconstructions and walk-throughs are powerful and viable research tools. One of the main challenges here will be overcoming the limitation of such tools to the visual, in order to allow a multi-sensory exploration that is more faithful to the way these buildings were conceived and experienced.

A third area that requires further research is the role of archaeological narratives in shaping present-day perceptions of the past. Here it has been argued that archaeological narratives should seek to include aspects of the past that are relevant to our audiences. Such considerations have shaped the research questions addressed above. However, a number of possible ramifications have not been explored. The degree to which different kinds of archaeological narrative are appropriated in popular discourse warrants more systematic attention. The present examination of a small island context has shown how archaeological narratives may be enriched and made more relevant by paying greater attention to the landscape context. However debate must continue about the relationship between archaeology and the public, the social role of archaeology, and how knowledge about the past may contribute to a sustainable future.

Appendices

The 7 appendices in this section summarize some of the classes of data used in the analysis that has been presented, such as the geographical co-ordinates of sites referred to. Exhaustive gazetteers of the prehistoric sites under discussion have been provided elsewhere (Evans 1971; Hayden 1998), and it is not the present purpose the duplicate such gazetteers. The main purpose of the data provided here is to allow verification, replication and refinement of the quantitative results that have been presented.

Appendix 1. Date of earliest known written reference to megalithic buildings.

Date	Site	Island	Total no. of recorded sites
1536	Borġ in-Nadur	Malta	1
1647	Ħaġar Qim	Malta	3
1647	Xewkija	Gozo	3
1647	Ġgantija	Gozo	4
1840	Mnajdra	Malta	5
1870	Kordin I	Malta	7
1870	Kordin II	Malta	7
1897	Borġ tal-Imramma	Gozo	8
1906	Santa Verna	Gozo	9
1909	Kordin III	Malta	10
1916	Tarxien	Malta	11
1915	Skorba	Malta	13
1915	Xrobb l-Għaġin	Malta	13
1917	Ta' Ħaġrat	Malta	15
1917	Tal-Qadi	Malta	15
1919	Ħal-Ġinwi	Malta	16
1923	Buġibba	Malta	17
1923	Ta' Marżiena	Gozo	18
1928	Ta' Ħammut	Malta	19
1935	Għajn Żejtuna	Malta	20
1939	Kunċizzjoni	Malta	21
1944	Ta' Lippija	Malta	22
1944	Bir Miftuħ	Malta	23
1955	Xemxija	Malta	24
1964	Tas-Silġ	Malta	25
1966	Ras il-Pellegrin	Malta	26
1987	Tar-Raddiena	Malta	27
1998	Iklin	Malta	28

Appendix 2. Secure locations of megalithic buildings used in the analyses in Chapter 4 and Chapter 5.

	Megalithic building	UTM grid co-ordinates		Island
		E	N	
1	Ġgantija	34200	89620	Gozo
2	Santa Verna	33270	89470	Gozo
3	Ta' Marżiena	31580	88110	Gozo
4	Xewkija	33480	87880	Gozo
5	Borġ tal-Imramma	33230	86610	Gozo
6	Għajn Żejtuna	43120	80790	Malta
7	Buġibba	47580	79280	Malta
8	Xemxija	44090	78660	Malta
9	Ta' Hammut	49940	77840	Malta
10	Tal-Qadi	47790	77270	Malta
11	Ta' Lippija	40990	75900	Malta
12	Skorba	43910	75540	Malta
13	Ta' Ħaġrat	43080	75290	Malta
14	Ras il-Pellegrin	40270	75160	Malta
15	Iklin	50820	74390	Malta
16	Tar-Raddiena	51600	73700	Malta
17	Qortin l-Imdawwar / Kunċizzjoni	40520	73350	Malta
18	Kordin II	55510	71090	Malta
19	Kordin I	55370	71070	Malta
20	Kordin III	55730	70620	Malta
21	Tarxien	55980	69740	Malta
22	Bir Miftuħ	54550	67970	Malta
23	Ħal-Ġinwi	59150	67440	Malta
24	Tas-Silġ	59620	67140	Malta
25	Xrobb l-Għaġin	61090	66900	Malta
26	Borġ in-Nadur	57500	65520	Malta
27	Ħaġar Qim	49650	65170	Malta
28	Mnajdra	49130	65060	Malta

Appendix 3. Għajn *toponyms. Where known, the approximate location is indicated. Only toponyms for which the approximate location was known were used in the analyses in Chapter 4 and Chapter 5 (Key source: Wettinger 2000).*

	Għajn toponym	Location		UTM grid co-ordinates	
		Area	Island	E	N
1	Għajn, tal-	Marsa	Malta	53000	70000
2	Għajn Ballut	Unlocated			
3	Għajn Barrani	Near Għajn Riħana	Gozo	34400	92000
4	Għajn Bierda	Ras il-Knejjes	Malta	40500	73500
5	Għajn ta' Bir il-Baħar	Għallis / Baħar ic-Cagħaq	Malta	50000	77500
6	Għajn Btejtes	Wied ir-Rum	Malta	42000	70500
7	Għajn Ċirani	Ġnien is-Sultan	Malta	45000	72000
8	Għajn Ċorr	Mtaħleb	Malta	41500	71000
9	Għajn Damma	SE of Marsalforn	Gozo	34000	92000
10	Għajn Dwieli	Korradino	Malta	56500	70500
11	Għajn Fekruna		Gozo		
12	Għajn Filep/Qortin/Għajn Formaġ	Marsa	Malta	54000	71000
13	Għajn tal-Fkieren	Mellieħa	Malta	44000	79000
14	Għajn Futni		Gozo		
15	Għajn Ġifra	Għajn Sfurija / Rdum il-Pellegrin	Malta	41000	75000
16	Għajn Galea		Gozo		
17	Għajn Għabdun	Għar Ilma	Gozo	28500	89600
18	Għajn Għajxa		Gozo		
19	Għajn Għorab	Mtaħleb	Malta	42000	70000
20	Għajn Għulem Alla	Ġebel Ciantar	Malta	47000	66500
21	Għajn Ħadid	Selmun	Malta	44500	80500
22	Għajn Ħamiem	Mdina / Mtarfa	Malta	46000	72000
23	Għajn tal-Ħanaq	ta' Kuljat	Gozo	32000	91000
24	Għajn Ħommed	Miżieb ir-Riħ, south of Mellieħa	Malta	43000	79000
25	Għajn Ħosna	Għajn Xibla - South of Ramla	Gozo	35000	90200
26	Għajn tal-Kalkara	Tas-Santi	Malta	42000	74000
27	Għajn tal-Kalkara	Kalkara, near Mistra Village	Malta	44500	79100
28	Għajn tal-Kastell	Citadel	Gozo	31500	89700
29	Għajn il-Kbir, tal-				
30	Għajn il-Kbira	Mtaħleb	Malta	41500	70500
31	Għajn il-Kbira	Girgenti	Malta	46600	68200
32	Għajn il-Kbira	South of Rabat	Gozo	31500	88700
33	Għajn Kittien	San Ġorġ tal-Għadir, B'buġa	Malta	58000	66000
34	Għajn il-Klieb	West of Rabat	Malta	44500	71600
35	Għajn Kullija (Qollija)	West of Mdina	Malta	46000	71800
36	Għajn Kuċċat	Żebbuġ	Gozo	31000	92000
37	Għajn Kulin		Gozo		
38	Għajn il-Liebru	Wied ir-Rajjes, Nadur	Gozo	37000	89000
39	Għajn Lukin	Xagħra - SW flank	Gozo	33400	89200
40	Għajn ta' Marsaxlokk, tal-	Marsaxlokk	Malta	59000	67000
41	Għajn Meddew		Gozo		
42	Għajn Melel	North end of Żebbuġ	Gozo	31600	92900
43	Għajn Mhalhal	Dwejra	Gozo	28000	89500
44	Għajn il-Mielaħ	Marsalforn	Gozo	33500	92000

45	Għajn Mixa, ta'	Ta' ghemmuna / el himeri			
46	Għajn Morr, ta'	Għammar	Gozo	30000	91000
47	Għajn Nadur	Ta' Qabbieza	Gozo	36000	90500
48	Għajn Naħrija, ta'	Qala	Gozo	38000	89000
49	Għajn Naħrin	Daħlet Qorrot	Gozo	38000	89500
50	Għajn Qadi	Ġebel Ciantar	Malta	47500	67000
51	Għajn Qajjied	West of Rabat	Malta	44800	71700
52	Għajn Qanċun	Żebbuġ	Gozo	31500	92000
53	Għajn il-Qasab	Żebbiegħ / Torri Falka	Malta	45000	75000
54	Għajn il-Qasab	Ramla	Gozo	35000	91000
55	Għajn Qassis		Gozo		
56	Għajn Qatet	South east of Rabat	Gozo	32000	88500
57	Għajn Qattus, ta'	Binġemma	Malta	44000	73500
58	Għajn Rabib	Marsa	Malta	53500	71000
59	Għajn Rażun (Rasul)	Tal-Veċċa, St. Paul's Bay	Malta	45000	78200
60	Għajn ta' Rdum Mdawru	Nadur	Gozo	36500	88500
61	Għajn Riħana	Near Burmarrad	Malta	47500	76500
62	Għajn Riħana		Gozo		
63	Għajn ta' Sagħtrija	Żebbuġ	Gozo	31000	91000
64	Għajn Saldin, ta'	Wied il-Għabid			
65	Għajn Saliba, ta'	Wardija (?)	Malta	44000	76500
66	Għajn ta' San Pawl	Fiddien	Malta	44000	72000
67	Għajn Selmet	Burmarrad	Malta	46500	77500
68	Għajn Sellum	Xagħra - W flank	Gozo	33000	89500
69	Għajn Sender	Dellimara / Marnisi	Malta	58000	66500
70	Għajn Sfurija	Mġarr	Malta	42500	75500
71	Għajn Sielem	Għajnsielem	Gozo	35500	87500
72	Għajn Stas	West of Pwales	Malta	44000	77500
73	Għajn Taqsis	Nadur	Gozo	36500	89000
74	Għajn Tarġa	Mġarr	Malta	42000	75500
75	Għajn Tejtes	Mtaħleb / Wied ir-Rum	Malta	41800	70800
76	Għajn Tewżien	Ġnien is-Sultan, Rabat	Malta	44500	72000
77	Għajn Tili	Overlooking tal-Mikħal	Gozo		
78	Għajn Tuffieħa	Għajn Tuffieħa	Malta	42000	76000
79	Għajn Tulin	San Tawdar tal-Imġarr	Gozo	36500	87000
80	Għajn Tuta	Mellieħa (Tal-Fkieren)	Malta	44000	79000
81	Għajn Tuta	Xlendi / Għajn il-Kbira	Gozo	31000	88500
82	Għajn Tutiet	Żebbuġ	Gozo	31500	92500
83	Għajn ta' Wied Sara	NW Gozo	Gozo	30300	90300
84	Għajn Xajxa	Cliff end of Għajn Żejtuna	Malta	43500	80500
85	Għajn Xejba	Ġnien Imrik	Gozo	34000	91000
86	Għajn Xibla	South of Ramla	Gozo	35000	90500
87	Għajn Xorok, ta'	Għajn Żejtuna	Malta	43000	80000
88	Għajn Żagħrun	Unlocated			
89	Għajn Żejtun		Gozo		
90	Għajn Żejtuna	East of Mellieħa	Malta	43000	80500
91	Għajn Żnuber, ta'	West of Mellieħa	Malta	41000	78500
92	Tal-Għajn	Mġarr	Malta	43250	75150
93	Tal-Għejun	Xagħra	Gozo	34000	89000
94	Wied il-Għajn	Marsaskala	Malta	60500	69500

Appendix 4. Bir *toponyms referred to in Chapter 3. Where known, the approximate location is indicated. (Key source: Wettinger 2000).*

	Bir toponym	Location		UTM grid co-ordinates	
		Area	Island	E	N
1	Bir, tal-	Xagħra – Unlocated			
2	Bir, tal-	Ħaz-Żebbuġ	Malta	50000	70000
3	Bir Agħweġ	Żebbiegħ	Malta	44500	75500
4	Bir Antun	Unlocated			
5	Bir Baġar	Ħax-Xluq	Malta	50000	67500
6	Bir il-Baħar	Għallis / Baħar ic-Cagħaq	Malta	50000	78500
7	Bir il-Barrani	Ħal Kirkop	Malta	54000	67000
8	Bir il-Barrani	Ħal Tarxien	Malta	57000	69000
9	Bir ta' Barro, il-	Unlocated			
10	Bir Bitut	Ras il-Qortin, Swieqi	Malta	53000	75500
11	Bir Bixkilla	Ħal Tarxien	Malta	56000	69000
12	Bir Bixrilla	Unlocated			
13	Bir il-Blat	Magħtab	Malta	50000	77000
14	Bir Bonan	Unlocated			
15	Bir Bonel	Near Ħal Millieri	Malta	52000	66500
16	Birbuba	NW of Għarb	Gozo	28000	91500
17	Bir Buhagiar	Xwieki – Unlocated			
18	Bir iċ-Ċagħak	Unlocated			
19	Bir Ċikku	Żurrieq	Malta	52500	66000
20	Bir Cuschieri	Żurrieq	Malta	53000	66000
21	Bir id-Deheb	Għaxaq / Żejtun	Malta	57000	67500
22	Bir Dundulaj	Żurrieq	Malta	53000	64500
23	Bir id-Dwieb	Birkirkara, Għargħar side	Malta	52500	73500
24	Bir Fellusa, ta'	Unlocated			
25	Bir il-Felu	Siggiewi (?)	Malta	49000	68000
26	Bir tal-Ferħa	Near Ħal Għargħur	Malta	51000	75000
27	Bir il-Fies, ta'	Unlocated			
28	Bir ta' Fillieri, tal-	Wied is-Sewda (central Malta)	Malta	51000	71500
29	Bir il-Fuqani	Ħaz-Żebbuġ	Malta	49000	70000
30	Bir Furmejja	Unlocated			
31	Bir Ġrajġa	Unlocated			
32	Bir Ġabrun, ta'	Near Ħax-Xluq	Malta	50000	67000
33	Bir Ġlat	Near Gudja (?)	Malta	55000	68000
34	Bir Gerżuma	Unlocated			
35	Bir il-Gżira	Unlocated			
36	Bir Għabdilla	Unlocated			
37	Bir tal-Għadira	Ħal Dejf, Naxxar	Malta	50000	75000
38	Bir il-Għajn	Qrendi	Malta	51000	65500
39	Bir Għali, ta'	Qrendi (?)	Malta	51500	66000
40	Bir il-Għalqa	Birkirkara	Malta	52000	73000
41	Bir il-Għar	Qrendi	Malta	50500	65500
42	Bir il-Għar iż-Żgħira, ta'	Qrendi	Malta	51000	66500
43	Bir Għarb	Qrendi	Malta	50500	66500
44	Bir Għarwien, ta'	Unlocated			

45	Bir il-Għasafar	Ħal Safi	Malta	53500	66000
46	Bir Għattar	Binwerrad (Burmarrad)	Malta	48000	77000
47	Bir Għawejna, ta'	Ħandaq	Malta	52000	70000
48	Bir Għawweġ (?)	Żebbiegħ	Malta	44000	75000
49	Bir il-Għebejjer	Ħal Qormi or Marsa	Malta	53000	71000
50	Bir Għisa	Near Ħal Millieri	Malta	52500	66500
51	Bir Għoġla	Birkirkara, Għargħar side	Malta	53000	73500
52	Bir Għomor	Tal-Qalgħa (Qala)	Gozo	38000	88500
53	Bir Għonoq	Near Mqabba	Malta	52000	67000
54	Bir Għulem, ta'	Ħal Tarxien (Barrani / S. Ġwann t'Għuxa)	Malta	57000	70000
55	Bir Ħabes / Qabes	Unlocated			
56	Bir il-Ħamiem, ta'	Ħal Ġwann, Żejtun	Malta	58000	68000
57	Bir Ħamis, ta'	Xgħajra – unlocated			
58	Bir Ħammut	Ta' Ħammut (?)	Malta	50000	78000
59	Bir Ħandul	Mrieħel	Malta	52000	72000
60	Bir il-Ħanżir	Xwieki – Unlocated			
61	Bir il-Ħaruf	Unlocated			
62	Bir Ħerba	Unlocated			
63	Bir il-Ħerża	Menqa, Naxxar / Għargħur	Malta	50500	75500
64	Bir il-Ħruq	Santi Basili – unlocated			
65	Bir il-Ħut, ta'	Wied l-Iklil/Wied Ħal Man (Ab. 85)	Malta	50500	73500
66	Bir l-Imrejħla, ta'	Wied Busewdien, Bir Imrieħel	Malta	51500	72000
67	Bir Imrieħel		Malta	51000	72000
68	Bir l-Imriekeb	Binwerrad (Burmarrad)	Malta	47500	77000
69	Bir l-Imwieġel	Qrendi / Żurrieq	Malta	52000	66000
70	Bir Inġim, ta'	Ħandaq	Malta	52500	70000
71	Bir Izu	Unlocated			
72	Bir Jaħlef	Qormi	Malta	52000	71000
73	Bir Kbir	Siġġiewi - Blat il-Qamar / Tabrija	Malta	48500	. 68500
74	Birkirkara	Birkirkara	Malta	51500	73000
75	Bir Kuċi / Bir Kuki	Binwerrad (Burmarrad)	Malta	47000	77500
76	Bir Lanġasa	Unlocated			
77	Bir il-Lifgħa, ta'	Ta' Għarram, ta' Ħasruna/Qasruna			
78	Bir Magħtub, ta'	Ħal Għaxaq / Ħas-Saptan	Malta	56000	67000
79	Bir Maħnuq, ta'	Rabat	Malta	45500	71000
80	Bir Markiż, ta'	Żurrieq	Malta	53000	65500
81	Bir il-Meġil, ta'	Ġebel Jagħqub, near Lija	Malta	50000	73000
82	Bir Menqa, ta'	Unlocated			
83	Bir Meru, ta'	Qormi / Marsa	Malta	53000	70500
84	Bir Merżuq, ta'	Unlocated			
85	Bir il-Mielaħ, ta'	Marsaskala	Malta	60000	69000
86	Bir il-Mielaħ, ta'	Siġġiewi	Malta	50000	68500
87	Bir Mifsud, ta'	Mosta	Malta	48000	74000
88	Bir Miftuħ, ta'	Near Gudja	Malta	54700	67800
89	Bir il-Miġlis, ta'	Ħlantun	Malta	54000	65000
90	Bir Miksur	Ħal Tarxien	Malta	56000	69500
91	Bir il-Mogħoż, ta'	Near Luqa	Malta	53500	69000
92	Bir Muni	Ta' Żebbuġa			

93	Bir Nieġa	Unlocated			
94	Bir in-Nigret, ta'	Unlocated			
95	Bir Nuħħala	Unlocated			
96	Bir il-Qannata, ta'	Unlocated			
97	Bir il-Qasab	Laqxija, Għargħur	Malta	51000	75500
98	Bir Qatet, ta'	Near Qrendi	Malta	51000	66000
99	Bir Qatran, ta'	Bingħisa	Malta	58000	63500
100	Bir Qtates	Near Żejtun (?)	Malta	58500	68500
101	Bir Ramond, ta'	Near Għargħur	Malta	50500	76500
102	Bir Ranka, ta'	Ħal Kbir (?)	Malta		
103	Bir Raqat	Near Għargħar, Birkirkara	Malta	53000	74000
104	Bir ta' Ras Torbiet, il-	Unlocated			
105	Bir ir-Riebu, ta'	Rabat	Malta	45500	71500
106	Bir ir-Riħ	Naxxar	Malta	50000	74500
107	Bir ir-Rikna, ta'	Birkirkara	Malta	51500	73500
108	Bir Riqqa	Tas-Silġ	Malta	59500	67000
109	Bir ir-Rum	Hal Miselmiet, Naxxar	Malta	49500	74500
110	Bir ir-Ruwa	West of Rabat	Malta	45000	71000
111	Bir Sajd	Meġin, near Zurrieq (?)	Malta	53000	66000
112	Bir Sallur	Swieqi	Malta	53500	75500
113	Bir Sammut, ta'	Ta' Bixir, Qrendi (?)	Malta	50000	66000
114	Bir San Pawl	Birgu	Malta	57000	71700
115	Bir is-Sagħtar	Unlocated			
116	Bir Sewda	Unlocated			
117	Bir is-Sieqja	Santa Sophia			
118	Bir is-Sies, ta'	Safi / Żurrieq	Malta	53100	65600
119	Bir Sigra	Bubaqra	Malta	53000	65000
120	Bir Sqaq, ta'	Hal Bisqallin, Żejtun	Malta	58000	68500
121	Bir is-Swieqi, ta'	Swieqi	Malta	53000	76000
122	Bir it-Taħtieni	Vnezja	Malta	47000	72500
123	Bir it-Tarġa	Ħal Pisse	Malta		
124	Bir it-Telliera, ta'	Binwerrad (Burmarrad)	Malta	47000	76500
125	Bir Tlieli, ta'	Unlocated			
126	Bir it-Twil	Mqabba / Qrendi	Malta	51500	66500
127	Bir Werrad	Binwerrad (Burmarrad)	Malta		
128	Bir il-Wied	Probably near Ħ'Attard	Malta	50000	72000
129	Bir il-Wiesa'	Luqa / Marsa	Malta	54000	69500
130	Bir il-Wilġa	Mrieħel	Malta	52000	71500
131	Bir il-Wilġa	Żurrieq, Ħal-Lew	Malta	52000	65500
132	Bir Xara	Birkirkara	Malta	51500	74000
133	Bir ta' Xaqqa, il-	Ħandaq	Malta	52000	69500
134	Bir Xewk, ta'	Wied Xkora, SE of Siġġiewi	Malta	50000	68000
135	Bir Xewka	Unlocated			
136	Bir ix-Xiħ, ta'	Bir il-Ħut (Wied l-Iklil/Wied Ħal Man)	Malta	50000	75500
137	Birżebbuġa	Birżebbuġa	Malta	57000	65000
138	Bir Żengur, ta'	Mrieħel	Malta	51500	71500
139	Bir Żerda	Unlocated			
140	Bir Żgħir	Unlocated			
141	Bir Żigrilla	Near Mtarfa	Malta	46000	72500

142	Bir Żiju, ta'	Għassiewi, near Siġġiewi	Malta	50000	69000
143	Bjar Baġar	Qrendi	Malta	50500	66000
144	Bjar il-Bassar	Qortin – unlocated			
145	Bjar Beġuġ	Ħal Tigan	Malta		
146	Bjar Bixkilla	Unlocated			
147	Bjar Blat	Raħal Kbir	Malta		
148	Bjar Ġabar	Ħax-Xluq	Malta	50500	67000
149	Bjar Ġamar	Unlocated			
150	Bjar tal-Gzira	Unlocated			
151	Bjar il-Għaġuż, ta'	Żebbiegħ (?)	Malta	44000	75500
152	Bjar Għattar	Unlocated			
153	Bjar Ħabes / Qabes	Unlocated			
154	Bjar Ħamed	Unlocated			
155	Bjar il-Ħaruf	Near Ħ'Attard	Malta	49500	72000
156	Bjar (tal-)Lhudi	Unlocated			
157	Bjar il-Lifgħa, ta'	Ta' Ħasruna / Qasruna			
158	Bjar il-Magħtab, ta' l-l	Ta' Żdiedem - unlocated			
159	Bjar Maħluf	Mentna	Malta	51500	67000
160	Bjar ta' Mlit	Near Mosta	Malta	48500	73500
161	Bjar il-Qannata, ta'	Ħ'Attard	Malta	49500	72500
162	Bjar Qatetu	Ħabel Għassies- Ħas-Sejjiegħ	Malta		
163	Bjar Qatran	Bingħisa	Malta	57500	63500
164	Bjar Rqajja, ta'	Ħlantun	Malta	54500	65000
165	Bjar Sammut	Madliena	Malta	52000	76500
166	Bjar il-Wilġa	Unlocated			
167	Bjar ix-Xewk, ta'	Sant'Anton, near Bjar Sammut	Malta	52000	77000
168	Bjar Ximbir	Tal-Barrani, Gudja	Malta	56000	68000

Appendix 5. Embarkation points along coastline used in the analyses in Chapter 4 and Chapter 5.

	Location		UTM grid co-ordinates	
	Area	**Island**	**E**	**N**
1	Dwejra	Gozo	27150	90000
2	Xlendi	Gozo	29530	87870
3	Mġarr ix-Xini	Gozo	34375	86670
4	Xatt l-Aħmar	Gozo	36120	86640
5	Mġarr	Gozo	36750	87309
6	Ħondoq ir-Rummien	Gozo	38970	87480
7	Daħlet Qorrot	Gozo	38570	89780
8	San Blas	Gozo	37040	90620
9	Ramla 1	Gozo	35430	91160
10	Ramla 2	Gozo	35640	91160
11	Marsalforn	Gozo	33250	92210
12	Qbajjar	Gozo	32680	92880
13	Xwejni	Gozo	32360	93060
14	Paradise Bay	Malta	39870	82330
15	Ċirkewwa	Malta	40380	82750
16	Ramla tal-Bir	Malta	41120	82750
17	Little Armier	Malta	41590	82850
18	Ramla tat-Torri	Malta	42820	83440
19	Għadira North	Malta	42090	81920
20	Għadira 1	Malta	41400	81140
21	Għadira 2	Malta	41700	80600
22	Għajn Żejtuna	Malta	42870	80640
23	Imġiebaħ 1	Malta	44350	80700
24	Imġiebaħ 2	Malta	44850	80650
25	Mistra	Malta	45000	79850
26	Xemxija	Malta	44470	78320
27	Tal-Għażżellin 1	Malta	45700	78650
28	Tal-Għażżellin 2	Malta	46300	78600
29	Buġibba	Malta	47200	78990
30	Qawra	Malta	48270	79780
31	Burmarrad	Malta	47850	78180
32	Salina	Malta	48490	78570
33	Qalet Marku	Malta	50450	77950
34	Baħar iċ-Ċagħaq	Malta	51000	77600
35	Pembroke	Malta	53210	76930
36	St. George's Bay	Malta	53840	76020
37	Spinola	Malta	54000	75290
38	Balluta	Malta	54390	74700
39	Għar id-Dud	Malta	55420	74870
40	Strand	Malta	55690	73950
41	Gżira	Malta	54430	73640
42	Msida	Malta	53940	72640
43	Pieta`	Malta	54660	72330
44	Marsamxett	Malta	55830	73170

45	Marsa 1	Malta	54620	71420
46	Marsa 2	Malta	54480	70810
47	Docks	Malta	56360	70740
48	Dock 1	Malta	56730	71060
49	Kalkara	Malta	57360	71810
50	Ricasoli	Malta	57450	72400
51	Għammieq	Malta	58150	72460
52	Marsaskala 1	Malta	60590	69330
53	Marsaskala 2	Malta	60470	69000
54	San Tumas	Malta	60560	67830
55	Xrobb l-Għagin	Malta	61230	66430
56	Marsaxlokk	Malta	59040	66700
57	Birżebbuga	Malta	57540	65360
58	Kalafrana	Malta	57630	64230
59	Wied iż-Żurrieq	Malta	50590	64490
60	Tal-Ħamrija	Malta	49190	64800
61	Għar Lapsi	Malta	48000	65150
62	Ġnejna	Malta	40800	75520
63	Għajn Tuffieħa	Malta	40960	76470
64	Golden Bay	Malta	40940	76900

Appendix 6. Location of funerary sites discussed in Chapter 4.

	Funerary site	UTM grid co-ordinates		Island
		X	Y	
1	Pergla	34600	91100	Gozo
2	Xagħra Circle	33830	89530	Gozo
3	North Cave, Xagħra	34400	89400	Gozo
4	Xlendi	30400	88080	Gozo
5	Xemxija	44290	78750	Malta
6	San Pawl Milqi	47030	76930	Malta
7	Busbisija	46600	74000	Malta
8	Nadur	44000	73000	Malta
9	Buqana	47600	72100	Malta
10	Żebbug	48200	69960	Malta
11	Ħal Saflieni	55530	69800	Malta
12	It-Tumbata, Luqa	53420	68500	Malta
13	Santa Luċija	55290	68960	Malta
14	Bur Mgħez	52300	67700	Malta

Appendix 7. Location of possible megalithic buildings used in the analysis in Chapter 5.

	Possible megalithic building	UTM grid co-ordinates		Island
		X	Y	
1	Borġ Għarib	35580	87720	Gozo
2	Imrejżbiet	35580	87670	Gozo
3	Sqaq ta' Sardinja, Tarxien	56200	69700	Malta
4	Il-Ħofra 'menhir', megaliths	55500	67330	Malta
5	It-Tumbata, Luqa	53420	68500	Malta
6	id-Debdieba, Luqa	51900	67900	Malta
7	tat-Tamla, Luqa	54000	68300	Malta
8	Tal-Għoljiet, Gudja	54800	68200	Malta
9	tal-Ġiebja, Għaxaq	56310	66285	Malta
10	tal-Ħurrieq, Żabbar	59000	71000	Malta
11	Sqaq il-Bagħal, Qrendi	50800	65900	Malta
12	Santa Sfija, Ħal Far	56000	63500	Malta

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