

# Visibility and Tholos Tombs in the Messenian Landscape: A Comparative Case Study of the Pylian Hinterlands and the Soulima Valley

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## Abstract

This master thesis aims to investigate the visual characteristics of Late Bronze Age tholos tombs in the region of Messenia, Greece by comparing tholos tombs from two study areas: the Pylian hinterlands and the Soulima Valley. The study utilises cost surfaces and viewsheds created in a GIS-environment as heuristic devices to do so.

With the common assumption that the tholos tombs were erected as visual socio-economic statements, which therefore were placed in visually prominent places, as a starting point the study attempts to analyse the visual attributes of the tholos tombs' spatial locations as they may have been perceived in relation to contemporary settlements and the wider surrounding landscape. Were they all placed in visually prominent places? Is it possible to discern any spatial or temporal patterns? What does the tholos tombs' visual characteristics tell us about how they were perceived by the Messenians?

The results from the study show that the tholos tombs cannot be considered to be a homogenous group of constructions. While there are few real temporal or spatial patterns *within* the two study areas, it is clear that the tholos tombs in the Pylian hinterlands were located in places that could be described as 'hidden' compared to the rest of the landscape, while tholos tombs in the Soulima Valley vary from being hidden to extremely prominent.

It is argued that it is necessary to develop more advanced and theoretically aware methodological frameworks in order to properly place the tholos tombs in relation to other monuments, settlements and human movement/action in the landscape if we want to further our understanding of the tholos tombs.

**Keywords:** Archaeology, GIS, affordance, visibility, prominence, perception, viewshed, Mycenaean, tholos tomb, Messenia, Aegean Bronze Age

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The elevation data used in this study is ASTER L1B data, and was obtained through the online Data Pool at the NASA LP DAAC, USGS' EROS Center, Sioux Falls, South Dakota ([https://lpdaac.usgs.gov/get\\_data](https://lpdaac.usgs.gov/get_data)). All surfaces in the study were created using ASTER data as a base. I am most grateful for their generous distribution policies.

Finally, I would like to thank Linda, Emma, Jarle and all friends and family who have proof-read and/or discussed this thesis and its theoretical and methodological underpinnings with me.

Any errors present in the study are naturally the sole responsibility of the author.

## Glossary and abbreviations

- ASTER: The Advanced Spaceborne Thermal Emission and Reflection Radiometer, a sensor on the Terra satellite which provides high-resolution imagery.
- DEM: A Digital Elevation Model is a digital representation (or model) of a certain area's topographic surface.
- Early Mycenaean period: The early, formative part of the Mycenaean culture, roughly equating the later parts of MHIII to LHII.
- EROS: The Center for Earth Resources Observation and Science; it is a center which functions as USA's national archive of remotely sensed images.
- GDEM: Global Digital Elevation Model, a global DEM based on remotely sensed imagery. The one used in this study was created by imagery from the ASTER sensor, and has a resolution of one arc second (ca. 30 meters).
- Late Mycenaean period: The later part of the Mycenaean culture, roughly equating to LHIIIA-LHIIIB. Many researchers consider this period to be dominated by 'palaces', which are found in e.g. Mycenae and Pylos (i.e. Άno Englianός). These would have been administrative centres with scribes and a ruling elite.
- LBA: Late Bronze Age, also referred to as Late Helladic (LH) when the Greek mainland is discussed. This study involves the following time sub-periods:
  - Middle Helladic III (1700-1600)
  - Late Helladic I (1600-1500)
  - Late Helladic IIA (1500-1430)
  - Late Helladic IIB (1430-1390)
  - Late Helladic IIIA1 (1390-1370/1360)
  - Late Helladic IIIA2 (1370/1360-1300)
  - Late Helladic IIIB (1300-1190)

The dating is taken from figure 1.2. in (Shelmerdine, 2008a, p. 5), all dates are B.C.

The dating is the subject of a continuous discussion in the archaeological community, and is far from set in stone.

- LP DAAC: The Land Processes Distributed Active Archive Center, which handles and distributes data and products derived from NASA's sensors.
- METI: The Ministry of Economy, Trade and Industry of Japan.



- Mycenaean: A prehistoric culture originating from the southern parts of the Greek mainland. Allowing for serious generalisation, one could say that it existed roughly between 1700-1050 B.C.
- NASA: The National Aeronautics and Space Administration, the USA's civilian space program.
- PRAP: The Pylos Regional Archaeological Project, an archaeological expedition carried out in the area around Áno Englianós during the 1990's.
- SRTM3 V3: The Shuttle Radar Topography Mission Version 3, a sensor flown onboard the space shuttle Endeavour and was used to create a DEM with a resolution of three arc seconds (ca. 90 meters).
- Tholos tomb: A relatively large domed tomb found in the Mycenaean sphere. Most examples sport a large dromos (entrance passage) and a stomion (doorway) which leads into the dome itself. Most tholos tombs have been reused over time for multiple burials.
- UMME: The University of Minnesota Messenia Expedition, a program of surveys and excavations running from the 1950's to the 1970's predominantly in western Messenia.
- USGS: The United States Geological Survey, a scientific agency dealing with biology, geography, geology and hydrology.



# 1. Introduction

The Mycenaean tholos tombs have repeatedly, in Messenia and elsewhere, been interpreted as elite burial monuments constructed to signify the socio-economic wealth and heightened status of those interred within<sup>1</sup>. With this interpretation often comes an assumption that the tholos tombs were visible constructions in the landscape and that they therefore, in some way and to some degree, structured the larger landscape as it was perceived by the Messenians. However, this assumption is far from unproblematic as there has been no systematic analysis of how the tholos tombs related to their visual surroundings. If we wish to truly understand the way the Messenian tholos tombs were perceived in the landscape, we need to first establish their visual characteristics in relation to other places in the landscape.

In an effort to elucidate the bases of this assumption this study has first and foremost analysed whether or not the tholos tombs were placed in highly visible locations in the landscapes, and whether or not it was possible to discern any spatial and/or temporal patterns in the tholos tombs' visual characteristics.

Additionally, it has attempted to investigate two other questions. It has examined whether or not the tholos tombs were placed in the landscape in order to create visual connections with settlements, and whether or not the tombs' locations were chosen based on movement patterns in the landscape.

Based on these analyses it has been possible to discuss the roles the tholos tombs played in the Messenian society and how they may have been perceived.

The study was performed in the form of a comparative case study, where the visibility in two study areas and the tholos tombs located within their spatial extents were investigated and compared. The two study areas are located in the western part of Messenia: the Pylian hinterlands and the Soulima Valley. They were selected since they contain the two largest clusters of tholos tombs in Messenia, and are more formally introduced in section 4 ("Material") where their spatial extents are more precisely defined along with the analysed tombs and settlements.

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<sup>1</sup> See section 2 ("Background") for a more in-depth discussion.

The study has investigated the questions postulated above by employing a theoretical framework that puts action (e.g. movement) and perception as the catalysts that dictate cultural structures, which together (to some degree) structure the visual landscape. The framework drew upon the work of e.g. James J. Gibson, Tim Ingold, Marcos Llobera and Mark Gillings.

Methodologically speaking the study employed three different GIS-products: cost-surfaces, cumulative viewsheds and total viewsheds<sup>2</sup>. These products were used as heuristic tools to analyse and investigate potential movement patterns, visibility from settlements in the study areas and perceived topographical prominence in the landscapes.

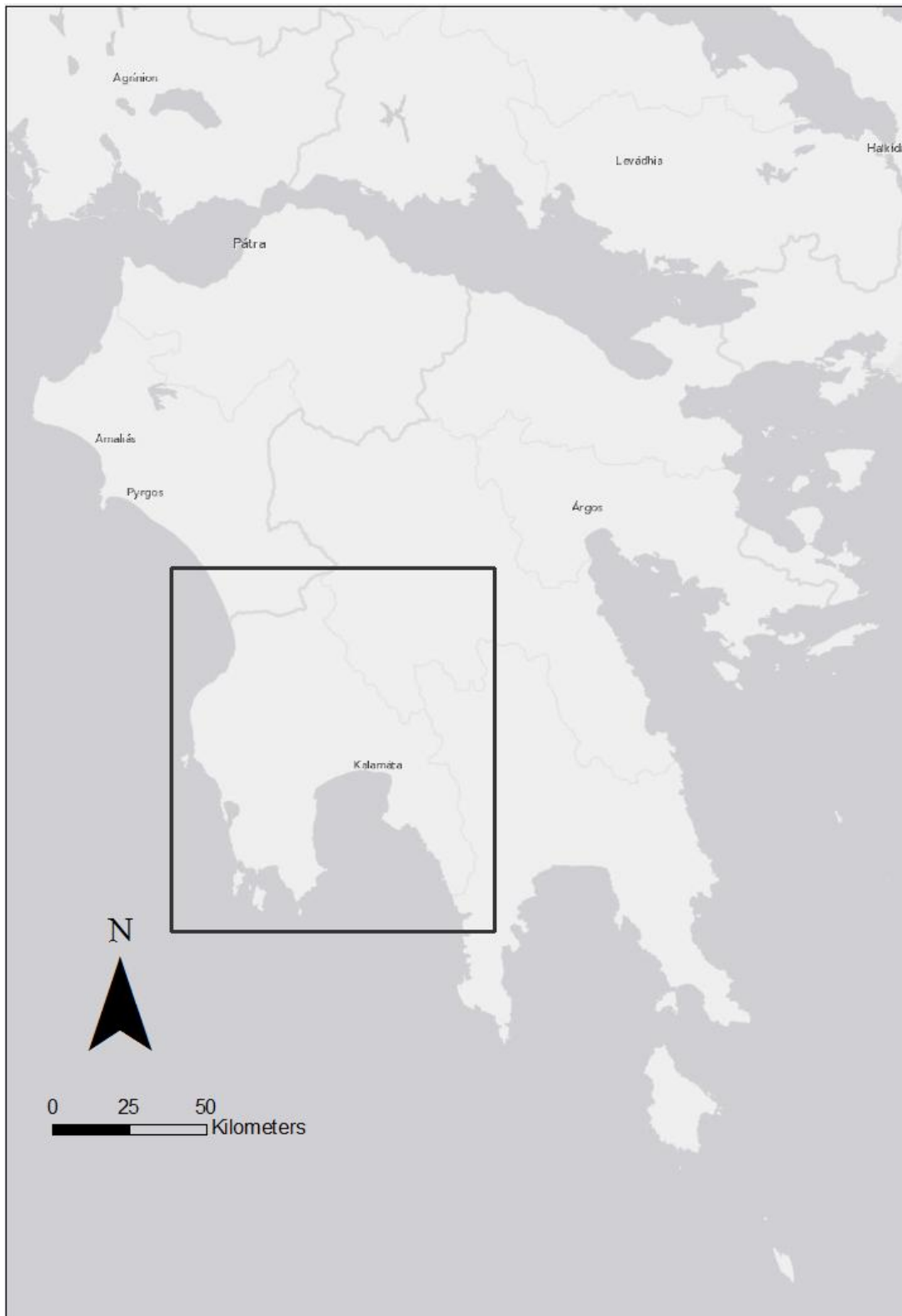
The arguably most important aspect of the type of ‘visual prominence’ investigated in this study is the contextuality inherent in its nature; a location can only be considered visually prominent when compared to its surrounding landscape (i.e. its context). It is argued here that it is not possible to understand the role(s) that the tholos tombs played in Mycenaean Messenia and how they were perceived if they are not incorporated into a larger cultural and spatial-temporal context.

This leads to questions of a much larger nature, questions that pertain such issues as how visual structures were created and maintained within the socio-economic and cultural frameworks that existed in the Mycenaean Messenia, and what role they (i.e. the visual structures) played in the creation of said frameworks. Unfortunately, such questions are far too large for this study, and the questions asked here should be seen as sub-questions of the much larger issues.

The interpretations that were presented in this study should therefore not be seen as an attempt to determine the exact role(s) of the tholos tombs in the Mycenaean culture in Messenia. Rather the study should be seen as an initial investigation into the relevant relationships; an attempt to propose possible forays forward where tholos tombs (and other spatial monuments) are not treated simply as socio-economic statements, but as spatial-temporal locations whose characteristics structured, and in turn was structured by, the perception of individuals in socio-economic and cultural groups.

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<sup>2</sup> The analyses and their methodology are explained in more details in section 5 (“Methodology”).



**Figure 1. Overview of the Peloponnese. The modern region of Messenia is marked. The subregions studied in this thesis are located in the south-western part of the region. Map data © OpenStreetMap contributors, CC-BY-SA.**

## 2. Background

The mortuary practices of the Late Aegean Bronze Age, and the phenomenon of tholos tombs in particular, have received much attention by researchers, and much of the chronological focus has been placed on the Early Mycenaean period. The archaeological record of the period has been interpreted as reflecting societal changes and an intensification of MH funerary traditions. It has been proposed by e.g. Dabney and Wright (1990, p. 49f) that the period shows a more socio-economically stratified culture in general, a culture primarily based on lineage rather than kinship. New funerary practices (e.g. the introduction of the tholos tomb) are in such interpretations taken to be evidence of a shift from the single burials of the MH to being more focused on family and lineage (Cavanagh & Mee, 1998, ch. 5).

The new custom of differentiated burial practices has often, implicitly or explicitly, been seen as being associated with a socio-economic and possibly ruling elite, e.g. due to



**Figure 2.** The entrance to “The Treasury of Atreus”, one of the largest tholos tombs in Greece. While located at Mycenae (i.e. not in Messenia), the image shows the grandeur of many of the tholos tombs. The image was taken by Louise Joly, and is licensed under the GNU Free Documentation License. It was downloaded the 14<sup>th</sup> of April 2013 from Wikimedia Commons.

"...the fact that they [i.e. tholos tombs] form visible markers on the landscape..." (Bennet, 1995, p. 597). Other researchers such as Dickinson (1977, pp. 91-94), Wilkie (1987, p. 127f), Thomas (1995, p. 352), Shelmerdine (1999) and Clinton Wright (2008) cite the tholos tombs' impressive architectural nature when arguing that the tombs were associated with a higher socio-economic class. It has not been uncommon to make statements such as "the tholos tomb always marks elite status" (Shelmerdine, 2008b, p. 144) or "...the tholos tomb can be considered as a territorial marker, as a means of symbolically expressing ownership of the land" (Wells, 1990, p. 128).

If one accepts the interpretation that the early Mycenaean period saw the formation and expansion of rivalling 'chiefdoms', then the erection of a tholos tomb (and the act of burying an individual within) could then be seen not only as a conspicuous display of power and wealth, but also as a way of legitimising claims to status during a transition of power, e.g. when a community leader dies; a demonstration of superior status desired in a period of socio-economic and political turmoil.

There are however problems associated with generalising the cultural nature of the Messenian tholos tombs and simply viewing each tomb as a socio-economic statement, whether that statement was meant for a socially or culturally internal or external group. The tombs are present in most of Messenia and the rest of Greece, and while such a widespread use could at first glance suggest a uniform usage, when viewed in combination with temporal and architectural issues it is apparent that the tombs may in fact not constitute a culturally homogenous group.

It is important to note that they were constructed at least between MHIII and LHIIIB; a period spanning several centuries (Banou, 2008, p. 49f)<sup>3</sup>, and over time the tombs' role in society and landscape may have changed. For instance, it has been suggested that funerary monuments from the early Mycenaean period are interconnected on a local scale and therefore seldom found alone in the landscape, while later tombs are situated in larger spatial-cultural contexts (Boyd, 2002, p. 46f; 93). A chronologically similar distinction is made by others, who view early tholos tombs as displays of socio-economic wealth and later tombs as indications of expanding palatial control (Davis, et al., 1997, p. 421); (Cavanagh & Mee, 1998, p. 64); (Bennet, 1999, p. 16); (Banou, 2008, p. 49f).

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<sup>3</sup> See in particular Banou's table 2.

Architecturally speaking it has been pointed out that the tombs vary greatly in size: ranging from two to thirteen meter in diameter (Mee & Cavanagh, 1984, p. 62); (Voutsaki, 1998, p. 51f). This suggests that the tholos tombs may not have been a completely homogenous group of objects, and may therefore have been perceived quite differently. Additionally, a number of topographical, geological and cultural variables have been suggested to be underlying site selection: e.g. soft bedrock, slope, elevation, proximity to monuments or settlements (Branigan, 1970, p. 152); (Mee & Cavanagh, 1990); (Boyd, 2002, p. 55); (Banou, 2008, p. 48f). Others suggest that conspicuous locations (e.g. near well-traversed roads) were chosen (Wilkie, 1987, p. 128).

Some researchers view the introduction of the tholos tombs not as an innovative phenomenon of architectural exceptionality used to rearrange or affirm socio-economic structures, but as a natural development of traditions within a funerary context. It is argued that the earliest tholos tombs, often set within funerary mounds<sup>4</sup>, are simply other ways of creating a sacred burial space (Boyd, 2002, p. 55). The larger tholos tombs are then the result of a wish/need to build larger tombs, until they eventually formed the only burial space within the funerary monument (Boyd, 2002, p. 56f). This is an interesting form of contextualisation, as it could be argued that it places the tholos tombs in a cultural and spatial framework where the material record not only reflects culture, but may also have changed the way the culture in question was created and perceived.

So, the introduction of the tholos tomb is viewed by many researchers as a step by a ruling elite to further increase social differentiation. Other researchers are more cautious, downplaying the tombs' possible 'elite' status and emphasising the need to view them as contextual nodes within a larger spatial and cultural context. Whether one views the tholos tombs as socio-economic or cultural statements, most researchers are in agreement that the spatial locations of the tombs in the landscape are important and related to their function(s) in society and culture. Underlying almost all of the arguments and interpretations presented above is the assumption that the tombs were consciously placed at chosen locations in the landscape with a purpose, and that they to some degree 'structured' their surrounding socio-spatial landscape.

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<sup>4</sup> See (Protonotariou-Deilaki, 1990, p. 75 fig. 8) for an explanatory image.



This assumption has been criticised by some researchers, who argue that many tombs are not situated at naturally prominent locations, and that (once covered) the tombs were not very visible in the landscape (Dickinson, 1977, p. 60); (Mee & Cavanagh, 1990, p. 229); (Cavanagh & Mee, 1998, p. 43); (Sjöberg, 2001, p. 118).

It is thus important to nuance the concept of prominence within the landscape; equating arbitrary values of elevation, slope, aspect, etc. to different levels of salience or obscurity does not amount to meaningful contextualisation. Rather than discussing the percentage of tholos tombs erected on hill tops contra flat land, it may be more beneficial to attempt to understand how they were perceived in relation to settlements and the rest of the landscape as individuals acted in it. It is only within the larger perceptual context of the landscape that we can hope to understand the tholos tombs' roles as spatial phenomena.

### **3. Theoretical framework**

As this thesis is a multidisciplinary study using methods and theories originating from a number of fields (e.g. archaeology, anthropology, geography and psychology), it is necessary to define the concepts used and the theoretical framework in which the study is performed before any attempt to formulate a methodology can be made. It is also necessary to discuss the nature of the studied entities (e.g. landscape, prominence and movement as an action) before any attempt to unravel the relationships between tholos tombs, landscapes and perceiving individuals is made.

The nature of the questions posed in the introduction entails that it is also necessary to discuss the underlying natural mechanics of human perception of the surrounding environment, as it is the author's view that action as a cognitive process is dependent upon individual and communal perception of the surrounding landscape (which carries with it both geographic and socio-cultural connotations).

As previously mentioned the theoretical framework employed in this study is based upon the works of James J. Gibson. More specifically, it draws upon Gibsonian ideas of perception; it employs not only ideas and theories postulated by Gibson himself but also e.g. via Tilley, Llobera, Gillings and Ingold. The nature of human perception, theoretical underpinnings and used terminology will be fleshed out and discussed in the following sections in order to lay the groundwork for subsequent analyses and interpretations.

#### ***3.1 The nature of perception***

Recent trends in landscape archaeology have emphasised the need to view archaeological material in a wider context by incorporating e.g. human perception and active agency as they relate to social constructs, rather than viewing these different structures as static isolated phenomena. This has been embraced by amongst others researchers employing the phenomenological approach, such as Thomas (1993), Tilley (1994) and (2004) and to some degree Boyd (2002), who employed aspects of it in an Aegean context. The phenomenological approach emphasises the need for experiential interpretation and the active contextual nature of perception.

This study has not employed a strict phenomenological framework. There are however a number of phenomenological concepts that were incorporated into the study's

theoretical framework, such as the aforementioned need to view human action and perception within its proper context. If we are to understand past societies and the archaeological record, we must account for the individuals and social groups whose relationships and associated actions ultimately made up those societies.

The emphasis on movement and action as conditions of perception is also apparent in Gibson's work (1986), who viewed perception as a product of the "...intentional movement of the being (body and mind) in the environment" (Llobera, 2005, p. 179). The focus on (and importance of) movement is stressed in most studies utilising Gibson's ideas (Ingold, 1993); (Llobera, 2001); (Gordon, 2004, p. 164); (Gillings, 2009). Via the interface of actions (e.g. movement<sup>5</sup>), perception essentially becomes an interaction between environment, agent and social structures.

Based on this definition of perception it is assumed that as an individual moves through the landscape the individual's perception of the landscape will change, and as it changes so will the individual's knowledge and understanding of the surrounding environment in relation to him- or herself (Ingold, 1992, p. 45f); (Webster, 1999, p. 916). The nature of this knowledge could be practical: it might tell the individual what actions the perceived object/place allows. While this definition implies that perception is inherently individual, one should realise that cultural and socio-economic structures also shape the way humans perceive the world, meaning that it is possible for a number of individuals to have a shared (or very similar) perception of something (Ingold, 1992, p. 43).

It has been argued here that perception can be viewed as a function of how we act and that the nature of the acquired knowledge is then formed by the nature of our activities (Ingold, 2000, p. 166), which in turn are both created by and create social structures (which of course in turn are perceived differently by different individuals and groups). In other words, the landscape and its characteristics (e.g. topographical prominence) become perceived as it is lived in and integrated into activities, both daily and rare.

Underlying this view of perception are two Gibsonian concepts: the ideas of *affordances* and *direct perception* (as opposed to indirect perception).

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<sup>5</sup> Movement in this context is not limited to physical movement in space, but also includes e.g. the act of individuals 'moving' their eyes as they look at their surroundings.

While the issue of (in)direct perception is relevant for a discussion about the nature of Gibsonian perception, an understanding of it is not crucial for grasping this study's theoretical framework. It is sufficient to say that direct perception deals with the issue of *how* individuals perceive their surroundings; directly via the perceptive organs by 'accessing' an object's potential information without first placing the object in a mental category, or indirectly via culturally determined representations along with mental schemas and only after categorizing the observed objects/locations (Gordon, 2004, p. 148); (Knappett, 2004, p. 44).

Naturally, this is a very complex issue that cannot be given sufficient room in this study. Interested readers are instead encouraged to consult (Gibson, 1986). Discussions and expansions on the issues can also be found in e.g. (Ingold, 1992), (Webster, 1999), (Ingold, 2000), (Sinclair, 2000), (Shaw, 2003), (Gordon, 2004), (Knappett, 2004) and (Llobera, 2007) along with their associated bibliographies.

### **3.1.2 The concept of affordances**

Affordances as a theoretical idea has been used by a number of researchers in archaeology, mostly focusing on location analyses, perception and phenomenological studies (Llobera, 1996); (Wheatley & Gillings, 2000); (Llobera, 2001); (Tilley, 2004); (Gillings, 2009). The concept of affordances is one of the fundamental aspects of Gibsonian perception, the other being the aforementioned direct perception. These two concepts in combination suggest that human perception is, to some degree, aimed at tracking the potential for action in the environment (Ingold, 2000, p. 165).

Some researchers have roughly equated an object's or a place's affordances to its 'use-value', the properties that it could lend to the observer's actions (Ingold, 1992). Others have argued that affordances cannot be equated with an object's or a landscape's physical properties; instead affordances should in essence be seen as relationships between individuals and their environment (Gordon, 2004, p. 162); (Tilley, 2004, p. 24).

For the purpose of this study, I have adhered to an additional definition proposed by Gillings, who has stated that "...affordances should be considered as dispositional properties, where the specific manifestation of the disposition depends upon the specific requirements of the individual animal engaged in a given action" (Gillings, 2007, p. 39). This definition suggests that affordances are always present, constantly inhabiting objects and places in the

landscape. One should however not interpret this definition as a suggestion that there is always a single affordance which is constantly defineable in different binary states, or even that there is a finite number of affordances. Within an object, a place or a landscape any number of affordances can exist. However, their availability to individual agents is dependent upon external factors and the agents' characteristics such as height, vision and socio-economic background/adherence (Webster, 1999). Affordances are therefore not only related to social structures, but also dependent upon the perceiving individual, which implies that researchers need to take into account and model not only the landscape and how it is perceived, but also the perceiver(s).

With that said, it is important to also realise that affordances as employed in this study are not only culturally contextual, but also topographically contextual. The availability of affordances do not depend solely on the characteristics of a place and an individual, since the perceived place itself exists in a nexus of other places and affordances.

For instance: intervisibility (i.e. an affordance) between two individual places is related to the elevation and flora (amongst other things) at those two places. But it is also related to a number of characteristics at other adjacent or interlying places. Features such as tombs or settlements at these places could obscure intervisibility; features which in turn themselves are dependent upon elevation, texture, colour, atmospheric conditions, and so on.

Affordances and perception are thus linked to action and engagement, both daily and extraordinary (Wheatley & Gillings, 2000, p. 4). In the context of this study, action would be both everyday tasks (e.g. movement) in the landscape<sup>6</sup> and more extraordinary events such as the selection of a specific place in the landscape at which to erect a tomb; possibly driven by a will to allow the tomb to be seen and/or allow individuals at that place to see much of the landscape, thereby creating a panoramic view around the tomb. Of course, this may have been only one of numerous considered affordances.

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<sup>6</sup> While boats were utilised in the LBA the majority of movement was most likely done by foot or by animal, such as horses or asses (Crouwel, 1981, p. 149). Traces of extensive road networks have been found, ranging from smaller roads to 'highways' (McDonald, 1964); (Mee & Cavanagh, 1990, p. 228); (Hope Simpon & Hagel, 2006, ch. 2). In addition to this it seems plausible that there existed a vast number of smaller local roads/paths throughout the landscape connecting different places, which were known and used by the individuals inhabiting the landscape.

### 3.1.3 Affordances investigated in the study

As hinted at in the introduction, this study analysed three different (although related) affordances: hypothetical travel time values, visibility between settlements and tombs and perceived topographic prominence. The first two affordances are relatively straight forward; travel time to different locations possibly governed movement (to some degree)<sup>7</sup>, and visibility between settlements and tombs may have affected the placement of tombs and how they were experienced (whether there exists any coherent patterns or not)<sup>8</sup>. The third affordance however, perceived topographical prominence, needs to be properly explained and defined before it can be incorporated into an interpretational framework.

Perceived topographical prominence, i.e. the type of contextual prominence investigated in this study, was defined and formulated using the term 'topographical prominence' as a point of departure. This is a concept discussed in (Llobera, 1996) and expanded upon in (Llobera, 2001) in an attempt to understand the role topography might have played in socialisation processes. Llobera defined topographical prominence as "... a function of height differential between an individual and his/her surroundings as apprehended from the individual's point of view. More precisely, it is defined as the percentage of locations that lie below the individual's location (terrain altitude plus individual's height) within a certain radius" (Llobera, 2001, p. 1007). Topographical prominence as it was defined by Llobera is then a contextualisation of differences in elevation between the modelled individual, his/her observation point and all possible locations in the surrounding landscape within a predefined spatial context. This is a useful concept in that it emphasises the relativity of landscape and scale, however it suffers from some theoretical flaws. It defines the studied landscape as a series of locations compared from an 'all-seeing perspective', rather than attempting to model topographical prominence as a result of human perception (visual and otherwise), experienced as the modelled individuals move through the landscape.

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<sup>7</sup> While the movement pattern analyses deal with hypothetical movement as a result of time it is not the absolute values that are interesting, but how they relate to each other. We do not know how individuals perceived a journey of fifteen minutes, but it is assumed here that it was perceived distinctly differently compared to a journey of two hours. It is this relative difference that should be emphasised.

<sup>8</sup> The modes of investigation and the modelled affordances are also expounded upon in section 5 ("Methodology").

It is this continuous process of perception and interpretation based on human movement that this study refers to as 'perceived topographical prominence'. More specifically it is defined by how much of the studied landscape (within a specified radius) that can see the location(s) in question, compared to the visibility of the other locations within the spatial context. That is, in how much of the landscape can the modelled individual stand in whilst still seeing the location in question in comparison with other locations in the landscape?

These two concepts may seem similar, but they differ in that topographical prominence is a result of elevation while perceived topographical prominence is result of how the studied locations are seen from different places in the landscape. This means that two studies analysing the two affordances in the same region could net vastly different results. A hypothetical example may help elucidate the fundamental differences: imagine a relatively flat landscape, split by a high ridge. A study investigating topographical prominence would net high 'values' of topographical prominence for places on the ridge (assuming that the entire landscape is within the specified radius). Those same locations may be given low values of perceived topographical prominence, as they are too elevated to be seen from much of the surrounding landscape.

Underlying the ideas of topographical prominence and (perceived) topographical prominence is the assumption that the prominence of a location was in some way connected to socio-cultural symbolism and structures, and that these locations were potentially used to affix the surrounding landscape (i.e. to structure it).

### ***3.2 Defining the landscape***

With a definition of the nature and underlying mechanics of perception in place, we can start to define the spatial contexts of perception, i.e. the landscape in which our analysed individuals act. Since without a clear definition and understanding of what the term landscape implies we cannot hope to analyse human perception within its boundaries.

As implied above a central aspect of the theoretical framework employed in this study is the idea that a landscape should not be seen as a static empirical container of space. Instead archaeological research may benefit from viewing the landscape as something that is contextual and at the same time both communal and individual; something that is changing

and being changed by the perception of its inhabitants, thereby reflecting (but also directing) human action. This is important, since it can be argued that any attempt at providing an interpretation of (pre)history must take into account the actions of individuals and their socio-cultural framework by making that the study's focal point (Whitley, 2004, p. 6).

With this in mind, this study has adopted a definition of a landscape proposed by Ingold: "the landscape is the world as it is known to those who dwell therein, who inhabit its places and journey along the paths connecting them" (Ingold, 1993, p. 156). While useful and to the point, the definition may need some explanation before it can be utilized.

Ingold's landscape is connected to those who inhabit it and perform actions within it, actions that to some degree determine and is determined by the landscape in turn. In other words, "...practices leave their spatial-temporal imprint on the landscape, those same practices are 'informed' by the already existing spatial order; the landscape fills up with spaces/places possessing various meanings and connotations" (Llobera, 1996, p. 614). Perception, action and the topographical landscape are intimately intertwined.

This means that the places in the landscape receive their individual character based on the activities they afford to those inhabiting it. A similar concept has been applied to mortuary landscape studies in an Aegean context by Boyd who uses the concept of 'locales', which is quite similar to the Ingoldian view of places and how they relate to the wider landscape (Boyd, 2002). It should be pointed out that these places may not have sharp definable boundaries nor set spatial coordinates, and can be part of larger places (Gibson, 1986, p. 34).

Within the context of this study, this means that when a new tomb was constructed a particular place in the landscape was chosen based on its perceived appropriateness in relation to adjacent locations and the surrounding landscape. This appropriateness is, as argued above, the result of human action within the context of social structures and topographical knowledge. This implies a view of involved individuals as part of larger social and topographical structures, and that the nature of actions (and spatial-temporal changes to them) intimately relate to changes in perception and social structures.

This entails that any interpretation of a landscape is only a spatial-temporal snapshot that does not tell us how a landscape and the perception(s) of it may have changed. As the landscape changed (features were constructed/demolished/forgotten, vegetation and the flow of waterways were changed, etc.), so did human movement and therefore also the way the



landscape was perceived (Llobera, 2005, p. 188). The salience of places would have changed and the inhabiting individuals' attunement to affordances changed as well.

## 4. Material

For this type of GIS-based research three datasets are needed: a Digital Elevation Model (DEM) to calculate visibility and movement and datasets containing the locations of settlements and studied tombs. The datasets used in this study are described below.

### 4.1 Study areas

Barring the relatively small coastal plains and the Lower/Upper Messenian Plains<sup>9</sup> the majority of the region consists of mountain ranges and sloping upland. These mountaineous features cut through Messenia, creating numerous subregions and inadvertently guide movement in the landscape (Loy & Wright Jr, 1972, p. 36).

The topography and underlying geology have supported a wide range of vegetation. During the Neolithic and Early Helladic periods much of the landscape was covered in forest (e.g. pine). However, most of the forests were gone by 2000 B.C., and by 1400 B.C. they were completely gone (Wright Jr, 1972, p. 199). Pollen analyses have also shown that during the same period the oak population was halved and the amount of land covered by steppe and phrygana<sup>10</sup> increased dramatically (Zangger, et al., 1997, p. 590), suggesting that Messenia was transformed into a more open landscape. This view of the Messenian landscape is corroborated by Linear B-records which apart from timber also mention items such as grain, flax, vines and olives (Wright Jr, 1972, p. 189).

This plausible dominance of low-growing vegetation suggests that visibility may have been good over larger distances during the Late Bronze Age. That is however countered by the aforementioned mountaineous topography and its associated micro-regions, which may have had a negative impact on visibility over larger distances; although it may have promoted visibility on a smaller scale, emphasising smaller visual structures in the landscape.

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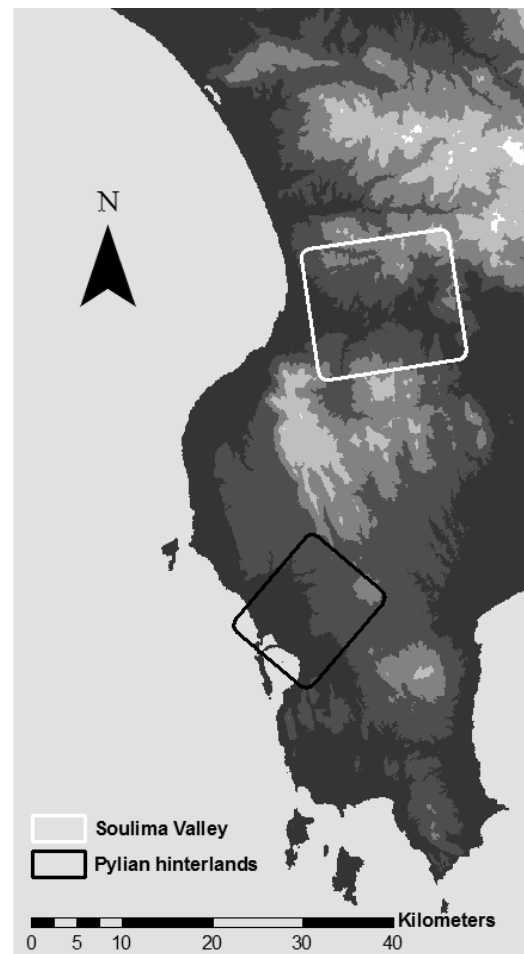
<sup>9</sup> Tholos tombs have been found in the plains, those regions are however beyond the spatial scope of this study.

<sup>10</sup> A form of low shrubs.

As mentioned previously two subregions of western Messenia were chosen as case studies, in which visibility patterns were analysed (see section 5.1 below for a more detailed explanation of how the spatial extents of the study areas were chosen). For their location on the Messenian peninsula, see figure 3.

The Soulima Valley study area covers ca. 239.5 km<sup>2</sup> and is dominated by the central Kyparissia River Valley<sup>11</sup> and the Soulima Valley to the east. The Kyparissia River Valley stretches from the western coast of Messenia eastwards, and is flanked by Tetrazi Mountains to the north and Mount Psychro to the south. Most of the tholos tombs in the study area are situated on the slopes of these ridges. The elevation in the study area ranges from 3 to 1187 m.a.s.l. and the area, especially the river valleys, appear to have been continuously occupied by humans in both the Middle and Late Helladic.

The Pylian study area covers approximately 153.5 km<sup>2</sup> with elevation values ranging from 1 to 835 m.a.s.l. The study area stretches from the Bay of Navarino and the Osmanaga Lagoon in the southwest to the foothills of Mount Aigaleon and Mount Maglava in the northeast. Barring some local variations, there is a uniform increase in elevation as one move from the coast in the southwest towards the mountains in northeast. Notable rivers in the area are the Selas River running along the Ano Englianós Ridge (the location of Nestor's Palace at Pylos) and the Goulavari River whose valley runs eastwards towards Mount Lykodimo. The region makes up what is traditionally viewed as the heartland of Mycenaean palatial administration



**Figure 3.** Map depicting the south-western part of Messenia with the two study areas: the Soulima Valley to the north and the Pylian hinterland to the south.

<sup>11</sup> The northern study area is referred to as "Soulima Valley", although it included large portions of the Kyparissia River Valley as well. The term is used despite possible confusion, since it has been employed in previous studies.

in Messenia, and appears to have been continuously occupied in the Middle and Late Helladic periods, with notable sites such as Korifásio, Ano Englianós and Beylerbey.

Most of the tombs are situated along the eastern or western border of the study area, with the western tombs situated on or near ridges and the eastern tombs situated on more uniformly elevated land.

## ***4.2 Elevation data***

This study utilised a DEM extracted from the ASTER GDEM, which is a product created by METI and NASA. The DEM has a resolution of one arc-second: approximately 30 meters at the Equator (and approximately 28 meters in Greece). Metadata included in the download stated that 2903 out of 25 934 402 cells (or less than 0.012 %) had elevation values derived from SRTM3 V3, which has a resolution of three arc-seconds and 25 719 868 out of 25 934 402 cells are classified as having good accuracy. However, no matter how good the accuracy of the DEM is, it is still a modern-day representation of topography that may not correspond perfectly to the LBA environment. This is a problem that most landscape studies suffer from, and should be kept in mind throughout the analyses.

The DEM was downloaded from the USGS's EarthExplorer<sup>12</sup> on July 18th 2012. As the source data was tiled, two tiles were downloaded covering the western part of Peloponnesus<sup>13</sup>, and merged. The original data, and therefore also the new merged DEM, was in the geographic coordinate system WGS84 which uses decimal degrees as the basic map unit. In order to simplify spatial calculations all data was re-projected to the projected coordinate system UTM 34N.

The DEM did not contain any cells without value (i.e. void pixels). However, in the ASTER GDEM all cells containing ocean water is classified as having an elevation of 0. A manual visual test was performed, which indicated that there were no cells on land with a value of 0. Since the study focused on topographic prominence as an affordance existing between places on land, all cells with an elevation value of 0 (i.e. all cells containing ocean) were reclassified as void pixels.

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<sup>12</sup> The web-tool can be found at <http://earthexplorer.usgs.gov/>

<sup>13</sup> The two tiles were named ASTGTM2\_N36E021 and named ASTGTM2\_N37E021.

While it is possible that there were some artefacts and/or faulty elevation values present in the DEM no smoothing algorithm was applied; since such tools have been shown to often remove local values that site selection and perception may have been based on (Savage, 1990, p. 28).

### ***4.3 Archaeological data***

#### **4.3.1 Tombs**

The dataset containing the tombs' locations were provided by Dimitri Nakassis, who has gathered the data with a GPS-receiver in situ in Messenia. 25 identified tholos tombs were selected for this study, all of which were located in two clusters around the Pylian hinterland and the Soulima Valley (see figures 4-9 for their spatial distribution and tables 1 and 2 for identification). These two study areas are often stated to have the highest concentration of tholos tombs in Messenia<sup>14</sup> (Banou, 2008, p. 48), with 21 of the tombs located in the north-eastern part of the Pylian hinterland and 20 located in the Soulima Valley.

It should be noted that this perceived spatial clustering could be the result of uneven archaeological focus, since these areas have been more thoroughly studied by e.g. PRAP and UMME than other areas of the region.

It is possible to locate additional (possible) tombs not included in the study within the two study areas by analysing satellite photos or distribution maps created by surface surveys, but none of these have been included in the study. A decision was made to only include tombs measured in situ, as the inclusion of unverified tombs could create an artificial landscape populated by ceremonial markers which would skew all subsequent analyses. The decision was made based on the research performed by PRAP, which showed that some of the mounds traditionally categorized as tumulus and tholos mounds may in fact be naturally occurring mounds or knolls (Davis, et al., 1997, p. 486f).

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<sup>14</sup> Banou lists 54 known tombs in the Messenian region, see Banou's table 1 for an overview.



**Figure 4. Settlements and tombs in the Pylian hinterlands with remains possibly dating to MHIII/LHI. Tombs are marked with letters and settlements with the ID-numbers given to them by UMME.**

The tombs in the two sub-regions analysed in this study can be found in table 1 and 2, and are thought to have been constructed between MHIII and LHIIB. Following the two-part chronological separation of Mycenaean civilisation accepted by a number of scholars (see section 2, “Background”) eighteen tombs in the analysed dataset were erected in the formative Early Mycenaean period (MHIII-LHII), four tombs<sup>15</sup> during the palatial Mycenaean period

<sup>15</sup> Note that the Mouriatádfa tomb is included, and the dating of that tomb is uncertain at best.

(LHIIIA-B) and three tombs may have been constructed during either period (i.e. they are dated to LHII-LHIII). While this could be interpreted as an indication that the dataset is biased, it should be pointed out that there were in fact less tholos tombs constructed during the palatial period than the previous Early Mycenaean period (Cavanagh och Mee, 1998: 63)<sup>16</sup>.



**Figure 6. Settlements and tombs in the Pylian hinterlands with remains possibly dating to LHIII. Tombs are marked with letters and settlements with the ID-numbers given to them by UMME.**

<sup>16</sup> Few tholos tombs were constructed in the study areas, there were however new tombs built at e.g. Nichoria, suggesting that any socio-economic analysis of the tholos tombs' nature need to account for spatial heterogeneity.

### 4.3.2 Settlements

The settlements used in the analyses in this thesis were digitised from the publications of the UMME (McDonald & Rapp Jr., 1972). More specifically, they were retrieved from a scanned and georectified image of pocket map 8-14 in the UMME publications (McDonald & Rapp Jr., 1972), which shows the distribution of settlements dating between LHI and LHIIIB. The map was rectified against the ASTER DEM and the dataset containing tombs using approximately 10 control points, placed on the coast line and on tombs inland. See figures 4-9 for their spatial distribution and tables 3 and 4 for attribute information.

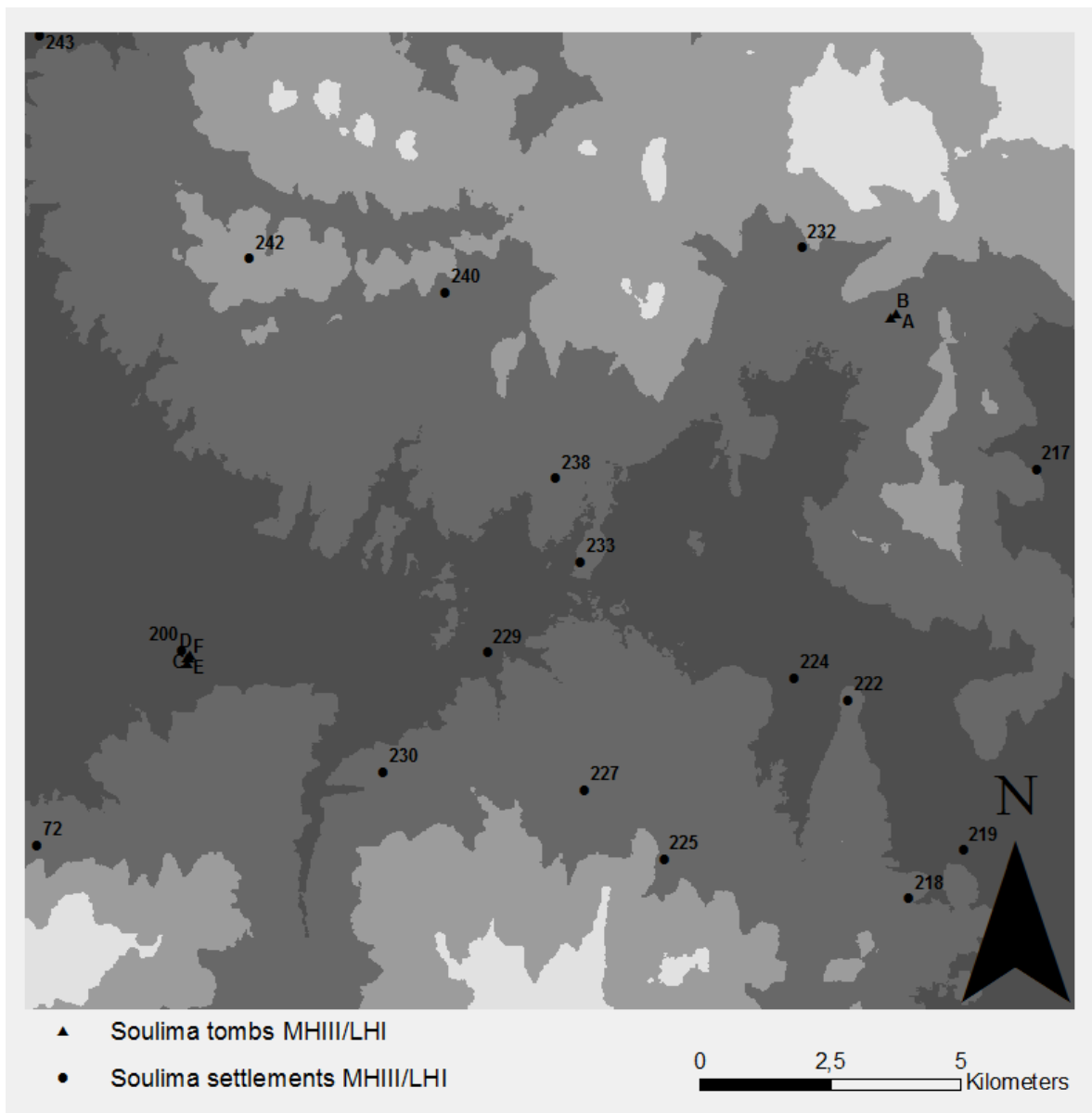


Figure 7. Settlements and tombs in the Soulima Valley with remains possibly dating to MHIII/LHI. Tombs are marked with letters and settlements with the ID-numbers given to them by UMME.



As noted above the results from the UMME were published in 1972, which means that the information retrieved from the expedition’s map and site catalogue is dated. The datum, coordinate system, etc. of the used map are also unknown and the scale of the map is quite small (approximately 1:381 000). It was also impossible to determine the spatial extent of each digitised settlement, meaning that the settlements were represented as generalised points and not full-extent polygons. Despite these limitations it was still possible to use the digitised settlements as bases for some initial analyses involving movement and visibility.

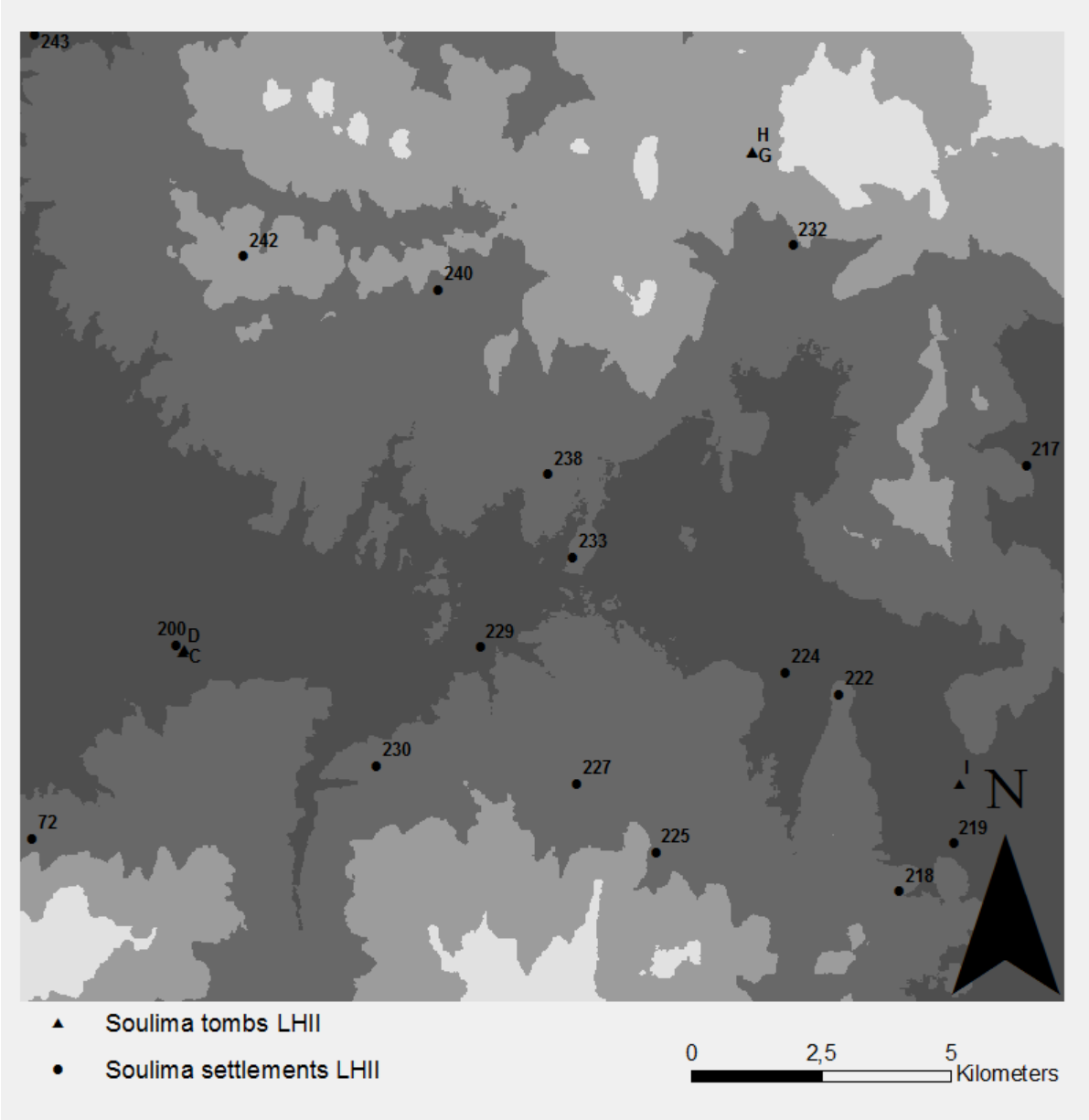


Figure 8. Settlements and tombs in the Soulima Valley with remains possibly dating to LHII. Tombs are marked with letters and settlements with the ID-numbers given to them by UMME.

### **4.3.3 Chronological divisions**

The tombs and settlements were for analytical purposes divided into the three chronological groups MHIII/LHI, LHII and LHIII. The tombs and settlements were divided based on possible construction dates (tombs) and possible periods of habitation (settlements). These settlement groups were not exclusive, meaning that sites that were inhabited during more than one chronological sub-period were included in more than one group. For the settlements' attribute information see tables 3 and 4; for their spatial distribution see figures 4-9.

A similar problematic situation existed in the case of the tholos tombs (as discussed above), and those where it has not been possible to specify one single construction period were included in multiple groups. This could potentially mean that temporal changes in preferred visibility were hidden in the analysis, or that fictitious patterns are emphasised in the results. However, these possible pitfalls were deemed preferable compared to the inherently flawed action of arbitrarily dating a tomb to a chronological period.

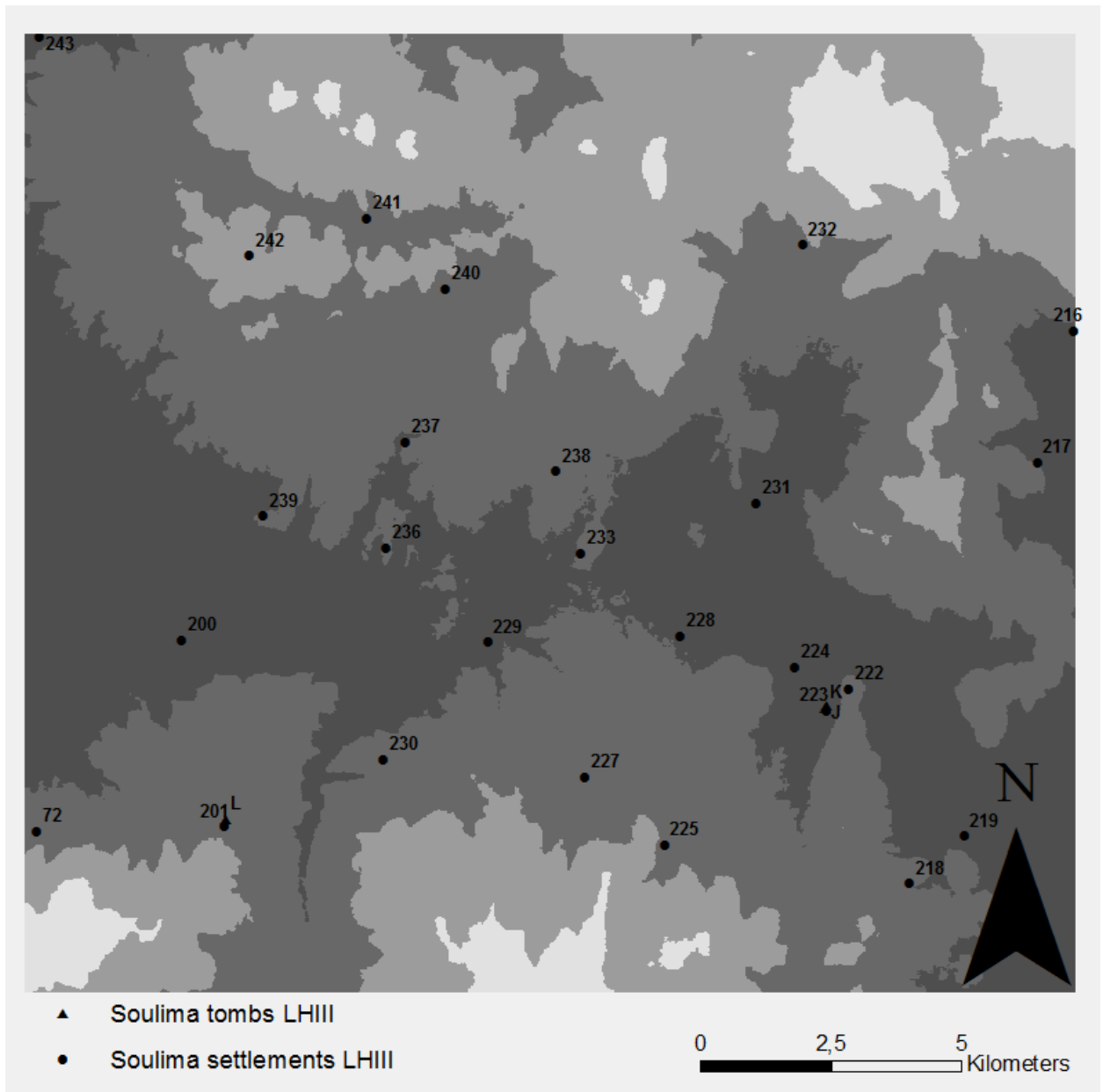


Figure 9. Settlements and tombs in the Soulima Valley with remains possibly dating to LHIII. Tombs are marked with letters and settlements with the ID-numbers given to them by UMME.

Name	Map ID	Date	Reference(s)
Psári 1	B	LHI	Boyd 182; APP 59
Psári 2	A	LHI	Boyd 182; APP 59
Chalkias 1	G	LHIIA-B	Banou 47
Chalkias 2	H	LHIIA-B	Banou 47
Vasilikó: Xeróvrissi	I	LHIIA	Banou 46; Boyd 180; APP 59
Malthí 1	K	LHIII	Banou 46; Boyd 213; APP 82
Malthí 2	J	LHIIIA2-B	Banou 46; Boyd 213; APP 82
Peristeriá 1	C	LHI-LHIIA	Banou 47; Boyd 172; APP 58
Peristeriá 2	D	LHI-LHIIA	Banou 47; Boyd 172; APP 58
Peristeriá 3	E	LHI	Banou 47; Boyd 172; APP 59
Peristeriá S	F	LHI	Banou 48; Boyd 172; APP 59
Mouriatádha <sup>17</sup>	L	LHIIIB/Unknown	Banou 48; Boyd 212; APP 82

Table 1. Tombs in the Pylian hinterlands.

Name <sup>18</sup>	Map ID	Date	Reference(s) <sup>19</sup>
Koukounára Akónes 1	Y	LHIII	Banou 45; Boyd 114; APP 81
Koukounára Akónes 2	S	LHII	Banou 45; Boyd 114; APP 81
Koukounára Fitiés 3	T	LHII-III A1	Banou 45; Boyd 115; APP 58
Koukounára Fitiés 2	U	LHII-III A1	Banou 45; Boyd 115; APP 58
Koukounára Livadhíti 1	P	LHI-II	Banou 44; Boyd 115; APP 58
Koukounára Gouvalári	N	MHIII-LHI	Boyd 112; Banou 45; APP 58
Áno Englianós IV	O	MHIII-LHI	Banou 42; Boyd 151; APP 58
Áno Englianós III	V	LHIIA	Banou 44; Boyd 151; APP 58
Kamínia	M	MHIII-LHI	Boyd 118
Korifásio	Q	MHIII	Banou 44; Boyd 125; APP 58
Tragána Viglitsia 1	W	LHIIA-B	Banou 44; Boyd 132
Tragána Viglitsia 2	X	LHIIA-LHIIIA	Banou 44; Boyd 132
Vöidhokiliá	R	LHI	Banou 45; Boyd 129; APP 58

Table 2. Tombs in the Soulima Valley.

Name <sup>20</sup>	ID (UMME)	Date
Chóra: Áno Englianós	1	MH, LHI-LHIIIB
Korifásion: Pórtes	3	MH, LHIIIA-LHIIIB

<sup>17</sup> The Mouriatádha tomb is listed as dated to LHIIIB in (Cavanagh & Mee, 1998), but unknown in (Banou, 2008) and (Boyd, 2002).

<sup>18</sup> All names follow the transliteration scheme proposed in (Boyd, 2002), with the exception of well-known sites (e.g. Pylos rather than Pílos).

<sup>19</sup> The used references were (Cavanagh & Mee, 1998) which is referred to as APP, (Boyd, 2002) and (Banou, 2008).

<sup>20</sup> All names follow the transliteration scheme proposed in (Boyd, 2002), with the exception of well-known sites (e.g. Pylos rather than Pílos).

<b>Korifásion: Belérbeĩ</b>	4	LHIIIA-LHIIIB
<b>Petrochóri: Osmánaga</b>	7	MH, LHIIIB
<b>Petrochóri: Paliókastro</b>	9	LHIIIA-LHIIIB
<b>Tragána: Vorouília</b>	12	MH, LHI-LHIII
<b>Ambelófito: Lagou</b>	19	MH, LHIIIB
<b>Vlachópoulo: Stamátí Ráchi</b>	24	MH, LH
<b>Vlachópoulo: Agriliá</b>	25	MH, LHIIIA-LHIIIB
<b>Chatzí: Barbéri</b>	26	MH, LHIIIB
<b>Mesopotamos: Chlíia Choriá</b>	28	MH, LHI-LHIIIB
<b>Chandrinoú: Platánia</b>	33	LHIIIB
<b>Káto Kremomídhia: Fourtzóvrissi</b>	34	LH
<b>Koukounára: Kataráchi</b>	35	MH, LHI-LHIIIB
<b>Stenosiá: Londaríti</b>	36	LHI-LHIIIC
<b>Chandhrinoú: Koubé</b>	37	LHIIIB
<b>Kinigoú: Avarinítsa</b>	38	LH
<b>Píla: Elítsa</b>	39	LH
<b>Píla: Kokkinórachi</b>	40	MH, LH
<b>Píla: Vígles</b>	41	MH, LHIIIB
<b>Yiálova: Paliochóri</b>	42	LHIIIB
<b>Schinólakka: Kokkiniá</b>	43	MH, LHIIIA-LHIIIB
<b>Pýlos: Vígla</b>	44	LHIII
<b>Íklaina: Tragánes</b>	46	MH, LHII-LHIII
<b>Plátanos: Lambrópoulou Piyí</b>	49	LH
<b>Íklaina: Panayía</b>	50	MH, LHIII
<b>Plátanos: Merzíní</b>	51	MH, LHIIIB
<b>Papouília</b>	53	LHIII
<b>Mírsinochóri: Váies</b>	55	LH

Table 3. Settlements in the Pylian hinterlands.<sup>21</sup>

<b>Name (UMME)</b>	<b>ID (UMME)</b>	<b>Date</b>
<b>Vríses: Palió-Frigas</b>	72	MH, LH
<b>Mírou: Peristeriá</b>	200	MH, LHI-LHIIIC
<b>Mouriatádha: Ellinikó</b>	201	LHIIIB-LHIIIC
<b>Káto Mélpia: Krebení</b>	216	MH, LHIII
<b>Mándhra: Chazná</b>	217	MH, LH
<b>Míla: Profitis Ilías</b>	218	LH
<b>Kástro: Kástro tou Míla</b>	219	MH, LH
<b>Vasilikó: Málthi</b>	222	MH, LHI-LHIIIC
<b>Málthi: Goúves</b>	223	LHIIIB

<sup>21</sup> All information in the table is derived from the appendix 'Register A' in the UMME publication (McDonald & Rapp Jr., 1972, pp. 264-309).

<b>Kókla: Ráchi Cháni</b>	224	MH, LH
<b>Aëtos: Palió-Kastro</b>	225	MH, LH
<b>Aëtos: Áyios Dhimítrios</b>	227	MH, LH
<b>Aëtos: Mourloú</b>	228	MH, LHIII A-LHIII B
<b>Káto Kopanáki</b>	229	LH
<b>Artíki: Ráchi Gortsíá</b>	230	MH, LH
<b>Dhórion: Kóndra</b>	231	MH, LHIII
<b>Chrisochóri: Panayía</b>	232	LH
<b>Áno Kopanáki: Stilári</b>	233	MH, LHIII-LHIII C
<b>Kamári: Góuva</b>	236	LHIII
<b>Kamári: Mesovouíni</b>	237	MH, LHIII A-LHIII B
<b>Áno Kopanáki: Báfano</b>	238	LH
<b>Glikorízi: Áyios Ilías</b>	239	LHIII B
<b>Kefalóvrissi: Tsoukedhá</b>	240	LH
<b>Sidherókastro: Sfakoúlia</b>	241	MH, LHIII B
<b>Vanádha: Kastrí</b>	242	LH
<b>Fónissa: Áspra Lithária</b>	243	MH, LH

Table 4. Settlements in the Soulima Valley.<sup>22</sup>

<sup>22</sup> All information in the table is derived from the appendix ‘Register A’ in the UMME publication (McDonald & Rapp Jr., 1972, pp. 264-309).

## 5. Methodology

With an established theoretical framework that placed perception in relation to movement and action, a methodology which allowed for active exploration of the role vision and perceived topographic prominence has played in the spatial-visual experience of the landscapes and tholos tombs could be formulated.

It should be pointed out that while movement and vision could be viewed as equally important in the socialisation process and in an interpretation of how people viewed their landscape, they were not given equal emphasis in this study. The analysis of hypothetical generalised travel time should be seen within the context of analysing visual structures. This is not to say that movement patterns are not important; it could be argued locations may have been perceived and visited quite differently based on their involvement in everyday activities, an involvement in which travel time to and from the location(s) may have played a part. The spatial component of a location is important, since frequently visited locations may have played a different role in the society.

An aspect similar to movement patterns is the issue of visibility from settlements (the assumed loci of movement and activities) and the surrounding locations. The output of these analyses were studied in association with the hypothesized movement patterns in order to interpret possible existing visual and spatial relationships between the locations in which individuals resided and acted (i.e. the living) and the locations of funerary constructions (i.e. the dead).

While useful as heuristic devices, these analyses do little to contextualise the tholos tombs in relation to existing visual structures. In order to do this it was necessary to view the studied landscape as a continuous nexus of locations and structures. Due to the previously discussed nature of perception and the diverse topographical characteristics of Messenia it was also important that the methods used to analyse perceived topographical prominence were able to account for the issue of scale, since it seems plausible that the modelled affordance may have increased or decreased in importance depending on the size of the associated perceived landscape. In other words, in order to understand perceived topographical prominence in relation to movement, it was analysed at different scales.

This was done by comparing the material record (i.e. the locations of tholos tombs and the surrounding landscape in the study areas) with the hypothesised affordance (i.e. topographic prominence as it was perceived by the modelled observer). The results were then used as a heuristic devices, which allowed the author to explore how the tombs and the landscape may have been experienced by the modelled individuals. It was important that the places associated with tholos tombs were evaluated as well as the rest of the landscape, since a place should only be considered 'prominent' in relation to its context; it would make little sense to claim that a place was perceived as topographically prominent because it can be seen from most of the surrounding landscape if the same can be said for all other adjacent places.

### ***5.1 Determining the spatial extent of the study areas***

The aforementioned two clusters of tholos tombs were used to select the areas to be used in the study. Two convex hulls were calculated using the two clusters as input, similar to the method employed in (Llobera, et al., 2010). The convex hulls were buffered with 1000 meters radii (the largest viewshed radius used in the study, see below). These buffered zones made up the areas in which visual structures were investigated (i.e. the study areas).

In order to avoid edge-effects in the viewshed analyses the buffered study areas were also buffered with 1000 meters radii, since cells close to the edge of an input DEM may suffer from edge effects such as lower values of visibility. The large ASTER GDEM was cut by the two buffered study areas in order to minimize the number of cells included in the viewshed analyses. Viewsheds were calculated for all cells within the buffered study areas, however as mentioned the outer 1000 meters were not included in subsequent analyses.

### ***5.2 Modelling a perceiving individual***

While there can be little doubt that the approaches and tools dealing with visual perception currently available in most GIS-programs suffer from some theoretical and methodological issues, some of the more glaring issues were avoided by controlling and specifying the nature of the modelled viewer (i.e. the perceiving individual).

The individual created for this study was modelled as being 1.75 meters tall when standing upright at each observation point, and was modelled as looking at the ground of the 'viewed' target locations. (S)he was given the ability to 'look' everywhere from straight up to



straight down on a vertical axis, in addition to being able to turn while standing at the observation points, i.e. viewing 360° of the surrounding landscape. This means that the modelled observer had the ability to view the entire panoramic landscape, in an attempt to understand how individuals with good eyesight may have experienced the surrounding landscape from the different viewpoints.

In addition to this the perceiving individual was modelled as ‘perceiving’ on a clear day with no cloud coverage and normal atmospheric conditions, a not uncommon occurrence in Southern Greece.

### ***5.3 Modelling travel time in the landscape***

While there are a number of problems associated with modelling movement patterns, both on the basis of travel time and other factors, it is argued that hypothetical movement patterns could potentially elucidate spatial relationships between tombs and settlements.

#### **5.3.1 Function used to calculate movement speed**

The generalised and hypothetical travel time patterns modelled in this study was based on a movement speed-formula first postulated by Tobler in what is referred to as ‘Tobler’s Hiking Function’, which is based on empirical data gathered during the 1950’s (Tobler, 1993, pp. 2-4). This function calculates movement speed as a function of surface slope in degrees:

$$W = 6e^{-3.5 | s + 0.05 |} \quad \textbf{Formula 1.}$$

where  $W$  is the walking speed in km/h,  $s$  is the slope of the terrain in degrees and  $e$  is the base of the natural logarithm (approximately 2.718). The formula postulates a top speed of just under 6 km/h, which is achieved when the modelled agent is walking slightly downhill. This formula, and methodologies based on it, have been analysed and discussed in a number of archaeological movement analyses such as (van Leusen, 2002, ch. 6) and (Kondo & Seino, 2010).

### **5.3.2 Creating the travel time cost surfaces**

Travel time to each location in the landscapes were calculated as cumulative cost surfaces using the settlements as points of departure. The created cost surfaces were anisotropic surfaces, i.e. the analyses took into account the directionality of the modelled individual's movement (downhill, uphill or parallel to the slope). This is particularly important when discussing movement and travel time as results of walking speed, since walking speed should not be considered to be the same for mirrored slope values (it is e.g. assumed that movement speed is not the same when walking uphill a 30° slope as when one is walking downhill a 30° slope). It should be noted that the values in the downloaded array assume that individuals are moving *away* from the starting points towards the rest of the landscape.

In order to use Tobler's walking speed formula an array of values that contain slope values and their associated movement speed values (depending on the direction of the movement) were downloaded from <http://www.mapaspects.org><sup>23</sup>, as it was a required input for the analyses to run.

The array was used in the tool together with the inputted settlements digitised from the UMME-publications as starting points and the DEMs of the two study areas as surface rasters. As discussed in section 4 ("Material") settlements and tombs were divided into three separate chronological sub-periods: MHIII/LHI, LHII and LHIII. This means that it was necessary to create three different travel time cost surfaces per study area.

### ***5.4 Analysing settlement-to-tomb visibility***

The analyses dealing with the visibility from settlements were not quite as advanced as the total viewsheds discussed in section 5.5. They were performed and included in order to investigate existing relationships between settlements and tombs, but do little to contextualise the archaeological material in relation to the surrounding landscape (for this, see the analyses involving total viewsheds). This does not mean that the output from this type of analysis are meaningless; the outputted surfaces are valuable heuristic devices and can be useful when e.g. discussing tholos tombs as spatial 'reminders' of socio-economic structures in the landscape. Noticeable changes in visibility between settlements and tombs over time and space could potentially indicate changes in the role of the tholos tombs and how they were viewed.

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<sup>23</sup> The array was downloaded from

<http://mapaspects.org/sites/default/files/webfm/website/tutorial/ToblerAway.txt> the 30th of October 2012.

### **5.4.1 Calculating visibility**

The analyses calculated which locations (i.e. cells) in each study area that were visible from the settlements. Since the settlements were divided into three chronological groups, this means that the tool outputted six individual surfaces with visibility values. As there are numerous points (i.e. settlements) in each inputted source file the produced viewsheds were technically what in archaeological GIS-research are referred to as 'cumulative viewsheds'. These were first introduced in the 1990's by e.g. Wheatley (1995). Methodologically they are quite similar to simple viewsheds, but instead of just having two binary values (1 = visible, 0 = non-visible) the cumulative viewsheds could potentially have values ranging from 0 (non-visible) to the number of observation points (the observed location is visible from all inputted observation points).

It should be pointed out that some tombs have viewshed values from more than one chronological period, since some settlements were used in more than one period and the construction of some tombs are not specified to one single period.

### **5.5 Visibility in the landscape**

As argued previously, perceived topographic prominence should be seen as a contextual affordance that relates the visual characteristics of each location to every other possible location in the surrounding landscape. In this study this was done by analysing how many of these surrounding locations which could see the analysed location using what is known as 'total viewsheds'. The total viewshed is similar to the standard viewshed that is available as push-button analysis in most GIS-programs, and is a logical extension of the 'cumulative viewshed' discussed in section 5.4.

Simply put: the total viewsheds were created by analysing viewsheds for each cell in the DEM, and then adding the values of the outputted viewshed-surfaces together<sup>24</sup>. This

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<sup>24</sup> The used viewshed tool created a raster that recorded the number of times each area could be seen from the inputted spatial points. This means that each cell contained the number of points (i.e. locations) in the surrounding landscape that could see it. For more information about the tool see <http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/009z000000v8000000.htm>.

created a raster surface which, when processed and interpreted, contained information about how visibility changed in the modelled landscape as a result of topography (Llobera, et al., 2010, p. 146). By using the centre of each cell in the DEM as an observation point (i.e. generalised models of all locations in the landscape), the perceived visual prominence of each location in the landscape as it was perceived by the modelled individual was analysed.

In order to investigate the issue of scale mentioned above a limitation on the distance of the total viewshed calculation was implemented. This allowed the author to see the study areas' places in relation to the surrounding landscape, and allowed for an investigation of how those relationships changed as the modelled observer included larger or smaller visual contexts in his perception of the landscape.

### **5.5.1 Preparing for the total viewshed analyses**

Since viewshed tools require an input of vector-objects (i.e. observation points) from which viewsheds are calculated, points were created at the centre of each cell that contained an elevation value. This resulted in two separate files containing 487 872 and 384 498 points for the Soulima Valley and the Pylian hinterland respectively.

The large number of viewpoints in combination with the resource-heavy nature of the viewshed tool meant that it was necessary to split the observation points into numerous smaller files with less objects in order to not overload the GIS-environment; the files were therefore split into smaller files containing approximately 2000 objects each.

The majority of the data manipulation and information extraction done during the total viewshed analyses were performed using four separate Python-scripts (see appendix 1), the foundational tool used in those scripts being the aforementioned viewshed tool.

### **5.5.2 Modelling spatially different topographical contexts**

In order to investigate how topographical prominence may have been experienced it is not enough to create an observer with certain attributes, it is also necessary to account for the issue of scale. As mentioned numerous times previously perceived topographical prominence should be seen as a contextual affordance, one that changes in importance and value as the spatial and topographical characteristics of the context changes.

In an attempt to incorporate these spatial changes three differently sized total viewsheds were created for each study area. The different radii of the total viewsheds would then correspond to changes in the context of the perceived visual landscape, and correspond to changes in perceived topographical prominence as the modelled individual viewed the different places in differently sized spatial contexts. This methodological approach is similar to the ones employed in (Llobera, 2001) and (Gillings, 2009).

This was done by limiting the calculating range of the viewshed tool to 100, 500 and 1000 meters, meaning that only cells within those distances to the active observation point were included in the visibility analyses. These distances were chosen in an arbitrary fashion, and should not be interpreted to represent any type of defined borders at which the visual structures in the landscape changes. These input variables, along with the variables controlling the characteristics of the modelled observer, were created and controlled using script #1.

### **5.5.3 Creating the total viewsheds**

Using the methods discussed above the viewshed analyses were executed using script #2. The output was six groups of raster images depicting the viewshed of the inputted observation points. All raster images belonging to the same group were added together using script #3 in order to create three different total viewsheds of the two regions, which depicted quite different visual structures.

As mentioned above the viewshed tool recorded the number of times each observed cell was seen from the inputted observation points within the three radii. The created total viewsheds could therefore be seen as an estimation of how often the different cells were seen. In other words, the total viewsheds indicated how the visual structures of the landscape may have been perceived depending on where in the landscape the modelled individual was standing.

The values in the six total viewsheds were then normalised to values ranging between 0 and 1, with the value 1 representing the cell(s) which were viewed the highest number of times in the viewshed analysis and the value 0 representing the cell(s) which were viewed the least number of times:

$$x_{normalised} = \frac{x - x_{min}}{x_{max} - x_{min}}$$

**Formula 2.**

The method of normalising viewshed-values has been employed by other researchers, see e.g. (Llobera, 2006, p. 136f). The normalisation was done not only to simplify subsequent analyses, but also to contextually relate the values to each other. Rather than comparing the calculated viewsheds to a hypothetical 'maximum value'-viewshed it made more sense, in the context of this study, to discuss how perceived visibility differed in the area based on the actual topographic differences in the landscape.

Script #4 was then used to create points at the centre of each cell in the total viewsheds, stored in six different shape-files. The script extracted the normalised cell-values of the underlying raster image and saved it as attribute information associated with each object. As mentioned above these values represent the number of times the cell is seen from all viewpoints within the specified radius.

The attribute information in the files produced by script #4 were transferred to the objects representing tholos tombs using ArcGIS's 'Spatial Join'-tool, meaning that the tombs were given the viewshed-values of the points closest to them.

## **6. Results**

The result of the analyses are merely described here and only briefly put into context. For an interpretation of the results and how they relate to individual agents' possible perception of the landscape, see section 7 ("Discussion").

Travel time analyses, settlement-to-tomb visibility and visual prominence in the landscapes are presented separately for the two study areas. While overarching information about visibility in and of the landscape at large is discussed, focus lies on the role of the tombs.

Each section starts with descriptions of the travel time and settlement-to-tomb visibility. While these two types of analyses were performed separately, their results are presented together. This may seem counter-intuitive, but it is argued here that the descriptions benefit from this juxtaposition since the analyses not only deal with the same chronological periods, but also involve similar types of activities that perceptually are related to and dependent upon each other.

It should be noted that the travel time-analyses are not the explicit focus of this study, but are included to serve as a 'backdrop' to the visibility-analyses and to illustrate hypothetical movement patterns between settlements and in the landscape. After this the results from the total viewshed analyses are presented.

### ***6.1 Pylian hinterlands***

This section presents the result of the analyses performed in the Pylian hinterlands. For information about the study area and the data used, see section 4 ("Material").

#### **6.1.1 Travel time and settlement visibility**

There are sixteen settlements (and six tombs) that can possibly be dated to MHIII or LHI. The analysis of hypothetical movement patterns between settlements within the study area shows that healthy adult individuals could walk between almost any settlement and that settlement's neighbour in less than twenty minutes (see figure 10 for a visualisation of values). The same analysis also shows that any location within the study area could be reached from the nearest settlement within 65 minutes.

None of the six tombs from MHIII/LHI are located that far away from their nearest settlement, and most of them are situated near settlements. The tomb that is the furthest away is Voïdhokiliá, which is located approximately fourteen minutes away (see table 5 for travel time and settlement visibility values). The other two tombs on the western side are Korifásio and Áno Englianós IV, which are located ten and five minutes away from the nearest settlement respectively. The three remaining tombs are located on the eastern side of the study area and are all located between four and nine minutes from the nearest settlement(s).

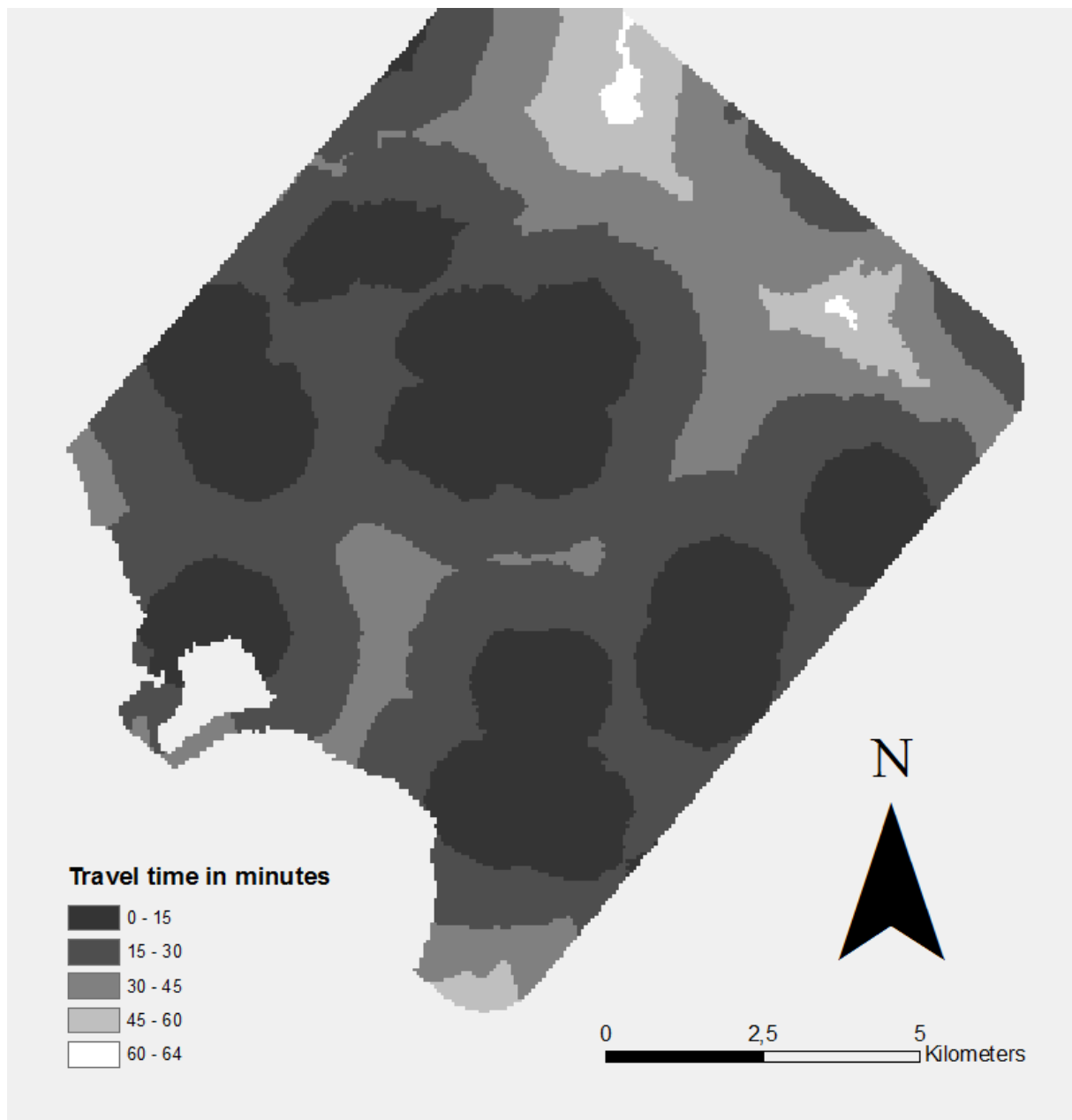
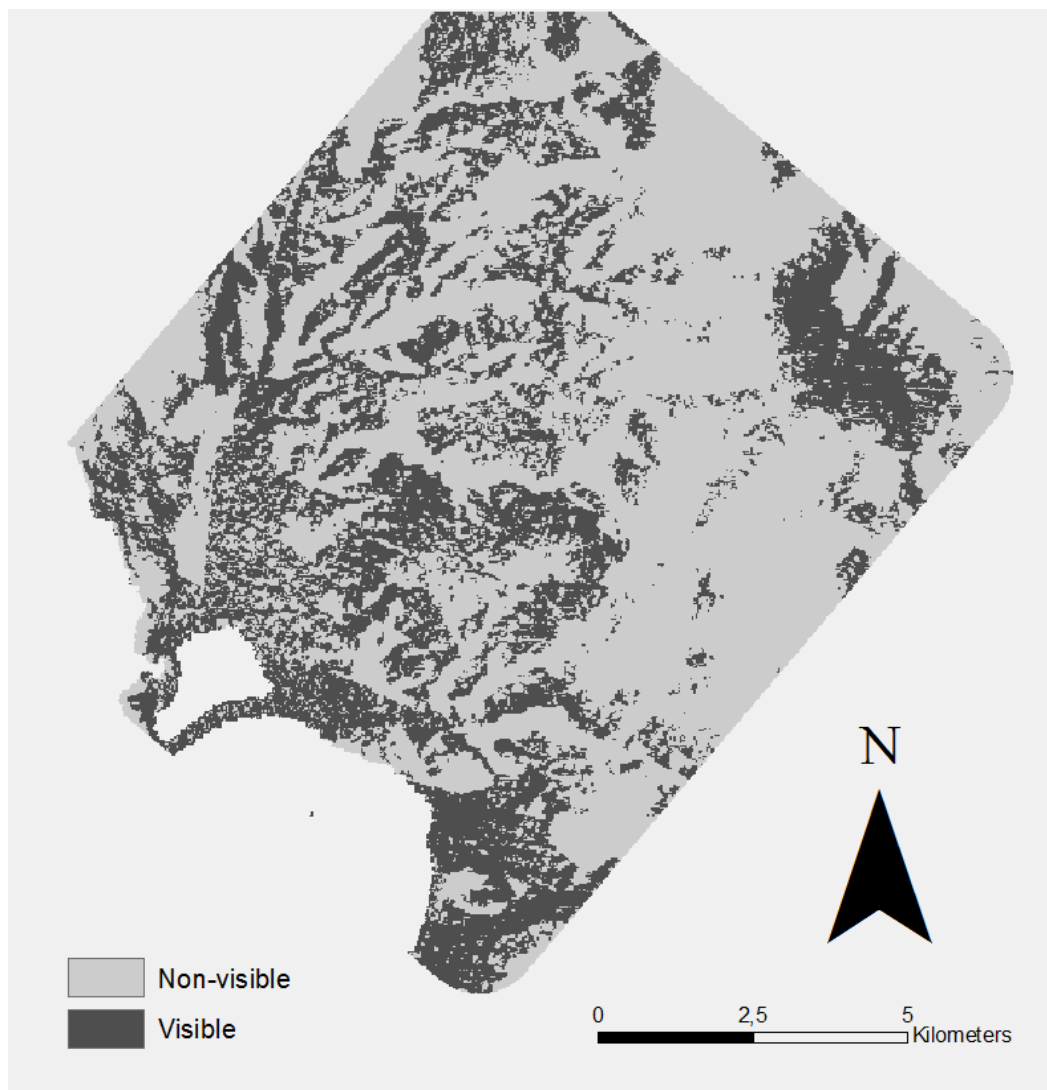


Figure 10. Travel time in minutes to all locations in the Pylian hinterlands from the nearest settlement dating to MHIII/LHI.



Although all tombs display a relative spatial proximity to settlements, none of the three tombs in the eastern section of the study area are visible from any of the nearby settlements, and neither is Áno Englianós IV in the north-western section of the study area (see figure 11). The two remaining tombs, Korifásio and Voïdhokiliá, are both visible from one nearby settlement each. It should however be pointed out that they are situated quite far away from the nearest settlement, and that it is not certain that they are distinguishable from the surrounding landscape at that distance. For comparison, one could note that approximately 72% of the study area is not visible from settlements, and that the eastern sections of the study area is dominated by non-visible locations (excluding the highly visible mountainous locations at the edge of the study area).

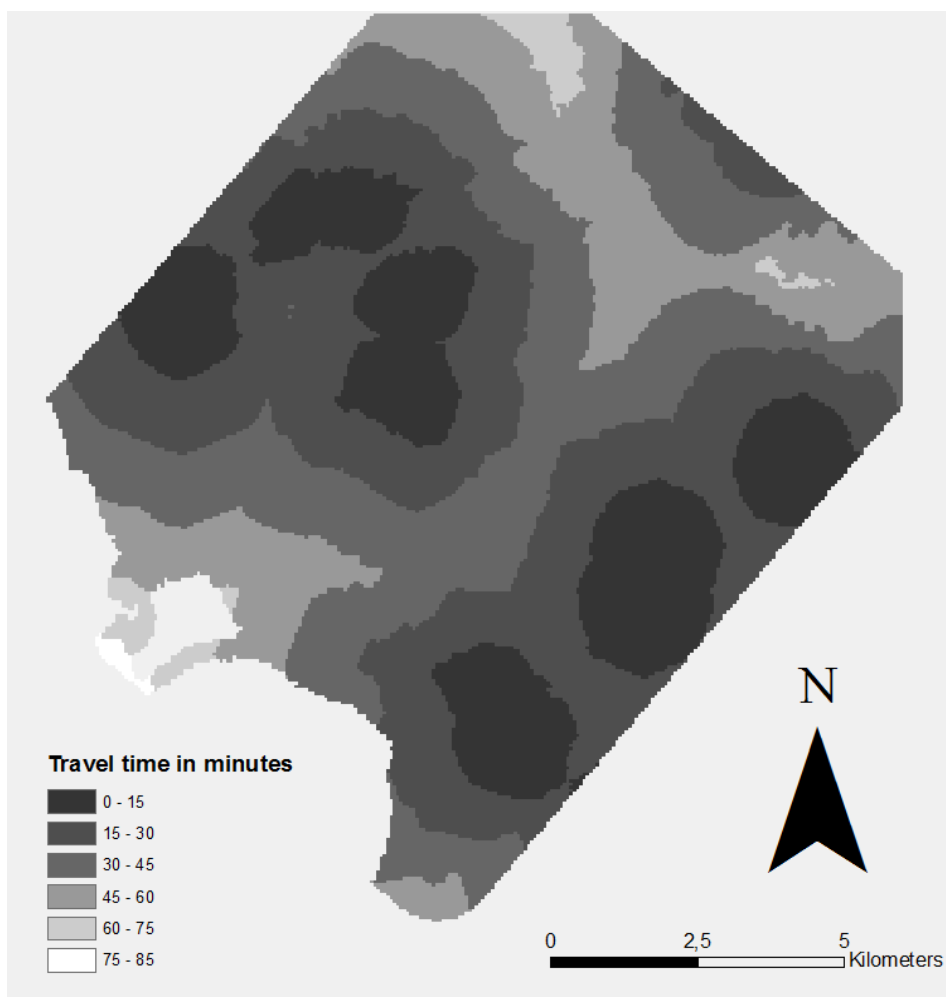


**Figure 11. Locations that might have been visible from settlements dating to MHIII/LHI.**

Moving on to the LHII, it is apparent that there is a significant decrease in the number of potential settlements when compared to the MHIII/LHI: ten compared to sixteen.

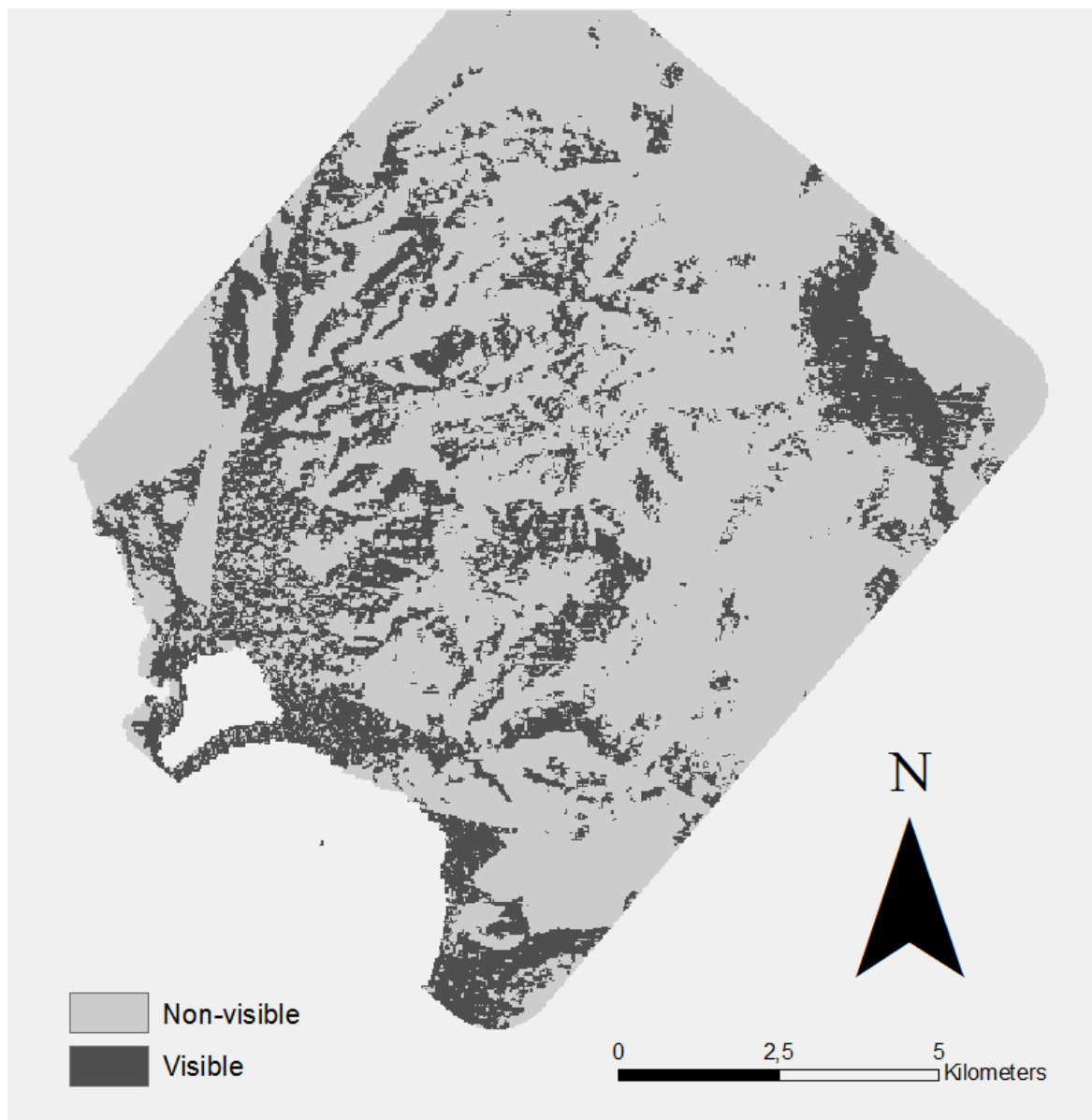
Paradoxically the number of tombs potentially erected during the period increases: from six to seven.

The decreased number of settlements naturally affects movement in the landscape. During LHII movement between a settlement and its nearest neighbour could take up to 35 minutes, and it could have taken up to 85 minutes to reach some locations from their nearest settlement (see figure 12). While the mountainous sections still display high values, the locations that are the furthest away (from a travel time perspective) are near the Voïdhokiliá tomb. The Koukounára tombs are all situated within five minutes of the nearest settlements and Áno Englianós III is located approximately ten minutes away from Chóra: Áno Englianós. The Tragána Viglítsia tombs break the established pattern by being almost twenty minutes away from the nearest settlement.



**Figure 12. Travel time in minutes to all locations in the Pylian hinterlands from the nearest settlement dating to LHII.**

Despite the proximity to the nearby settlements discussed above, none of the four Koukounára tombs are visible from the nearby settlements. Neither are the two tombs at Tragána Viglítsia; they are located in a section of the study area that is by and large non-visible. This means that the only tomb from the period that is visible is Áno Englianós III, which is visible from one settlement. The theme of non-visibility is noticeable in the entire study area, as ca. 80% of the study area cannot be seen from the settlements (see figure 13). The visibility between landscape and settlements in the eastern sections of the study area is similar to the visibility during MHIII/LHI, with the mountainous locations being the only continuously visible locations. The coastal plains are also still visible, and so are slopes and especially ridges.



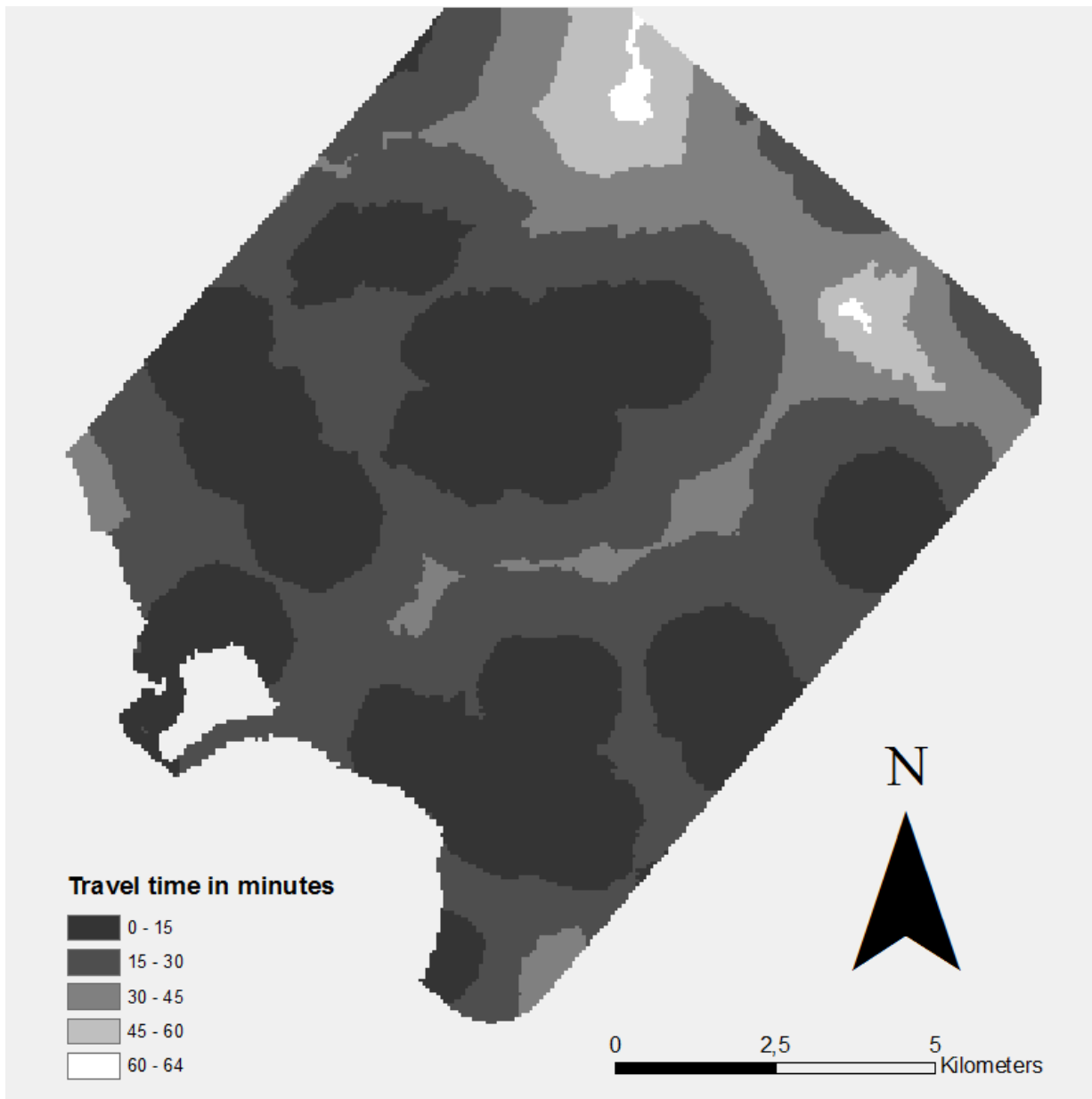
**Figure 13. Locations that might have been visible from settlements dating to LHIII.**

When compared to the LHII the LHIII is densely populated; 21 settlements were registered by the UMME, although only four tombs possibly date to the period. Naturally, this leads to a more densely populated landscape and movement between every settlement and its nearest neighbour would have taken less than 25 minutes (with two exceptions, see figure 14). Each location could have been reached within 65 minutes of walking from the nearest settlement. The time-distance surface presented in figure 14 is very similar to the surface produced for MHIII/LHI.

The four tombs possibly dating to LHIII are displaying a relatively wide array of values (in regards to travel time). The two Koukounára Fitiés tombs are located within five minutes of the nearest settlement, while the Koukounára Akónes tomb is located approximately seventeen minutes away from the same settlement. The tomb Tragána Viglítsia 2 is also located ca. seventeen minutes away from the settlement, a travel time that is comparable to the travel time between most neighbouring settlements. Like during previous periods, none of the Koukounára tombs are visible from the nearby settlements, even though many of the surrounding locations are visible. Tragána Viglítsia 2 is visible from a nearby settlement, although it is placed almost 1.5 kilometres away. For comparison, approximately 65 % of the study area is not visible from the settlements (see figure 15).

Name	Travel time from settlements			Seen from settlements		
	MHIII/LHI	LHII	LHIII	MHIII/LHI	LHII	LHIII
Koukounára Akónes 1	-	-	17	-	-	No
Koukounára Akónes 2	-	6	-	-	No	-
Koukounára Fitiés 3	-	6	6	-	No	No
Koukounára Fitiés 2	-	6	6	-	No	No
Koukounára Livadhíti 1	5	5	-	No	No	-
Koukounára Gouvalári	4	-	-	No	-	-
Áno Englianós IV	5	-	-	No	-	-
Áno Englianós III	-	10	-	-	Yes	-
Kamínia	-	-	-	No	-	-
Korifásio	10	-	-	Yes	-	-
Tragána Viglítsia 1	-	18	-	-	No	-
Tragána Viglítsia 2	-	19	17	-	No	Yes
Voïdhokiliá	14	-	-	No	-	-

**Table 5. Plausible travel time from the nearest settlement to the tomb in question. The values are in minutes and hypothetical. Several tombs have values from more than one chronological period; this is due to the fact that it has not been possible to date their construction more precisely. Tombs that do not date to a certain period are marked with “-“.**



**Figure 14.** Travel time in minutes to all locations in the Pylia hinterlands from the nearest settlement dating to LHIII.

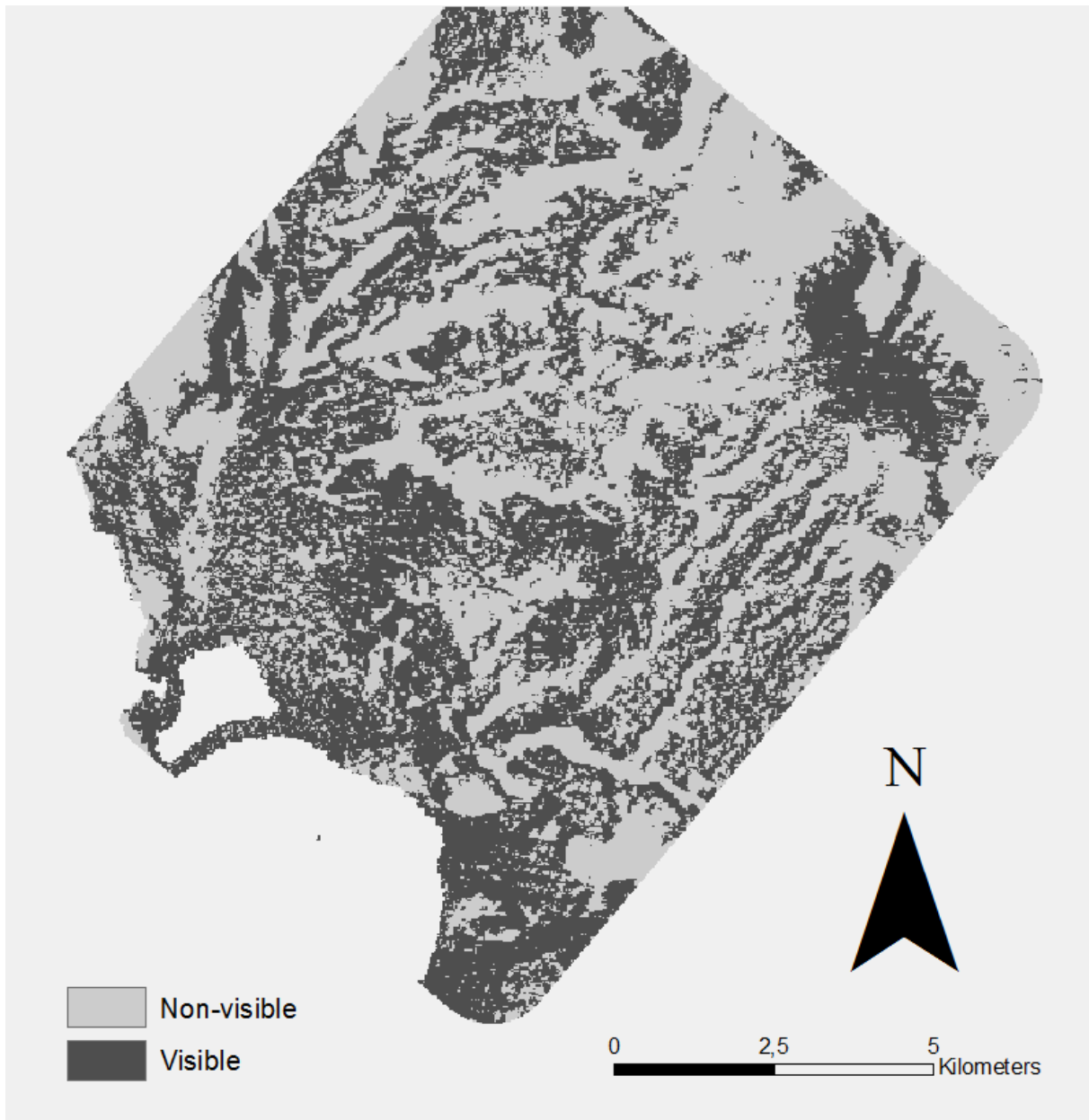


Figure 15. Locations that might have been visible from settlements dating to LHIII.

### 6.1.2 Visual structures in the landscape

At 100 meters it is possible to see that a large majority of cells (over 80 %) have values ranging between 0.4 to 0.8 (see figure 28 in appendix 2). This wide cluster around the upper bins suggests that the study area's visual structures are heterogeneous, with a large number of locations having different visibility.

If we turn to figure 16, which is a visual representation of the total viewshed, it is easy to see that there is a clear cluster of higher viewshed values at lower elevation in the southern region near the coast. This is not surprising, since the homogenous elevation of the area would

allow for high visibility at lower scales, when compared to the more abruptly changing topography of e.g. the western and north-eastern parts of the study area.

There are few sections of the study area that display visual structures with continuously low values. However, some of these areas are clustered around the slopes of the valleys in the northern and southern parts of the area; conversely the flat areas in the valleys themselves often have high values. The same patterns cannot be found in the smaller valleys in the central and eastern parts of the study area where it is not possible to discern any dominant visual structures.

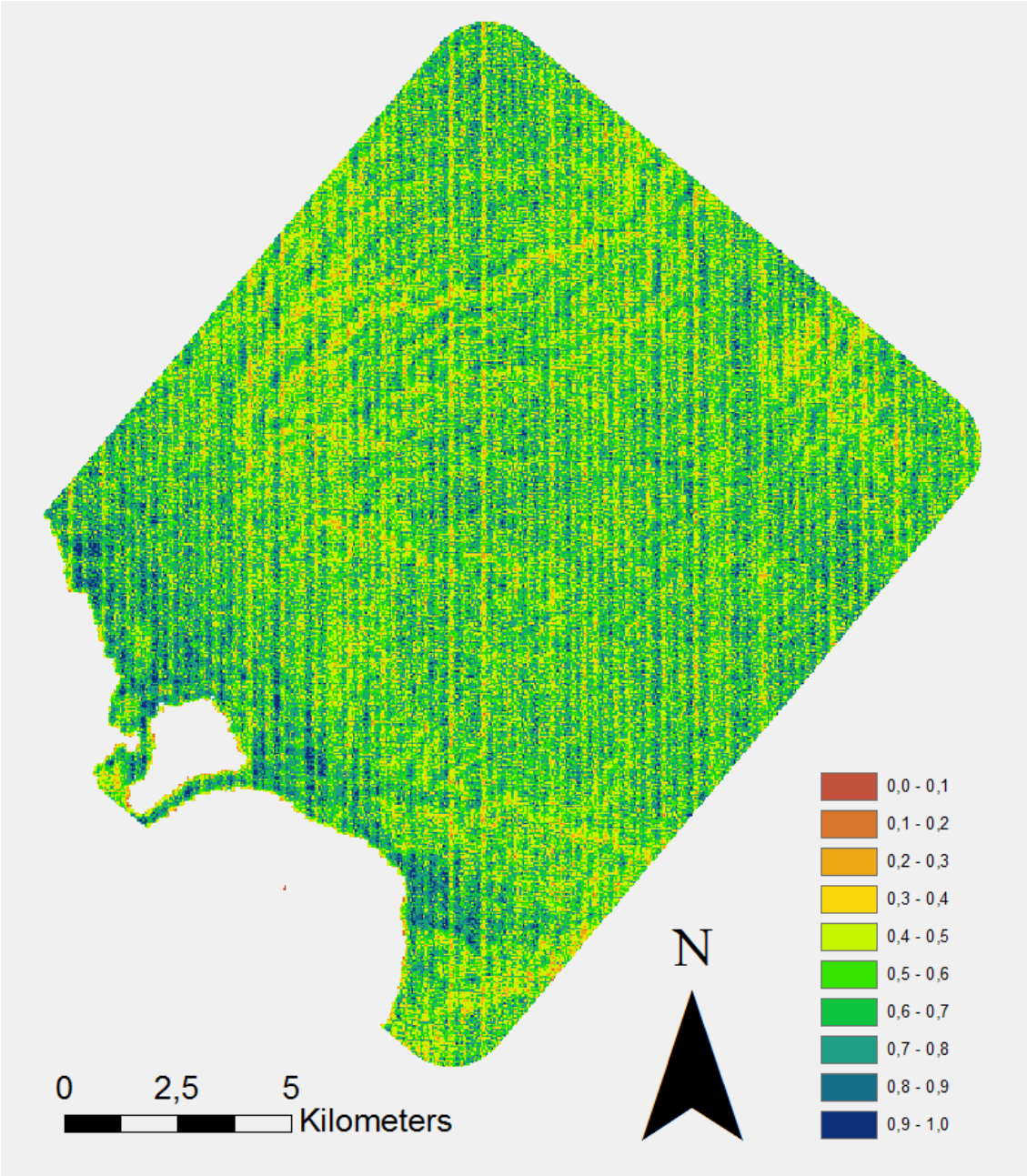


Figure 16. Normalised viewshed values with a radius of 100 meter in the Pylia hinterlands.

With the micro-local visual structures of the larger Pylian hinterlands presented, it is time to turn our attention to the tholos tombs situated throughout the landscape and see how their values compare to the landscape. At a radius of 100 meters it is possible to see that they diverge from the value-distribution of the landscape (see figure 28 in appendix 2). The majority of the tombs (approximately 69%) are situated at locations with values between 0.5 and 0.8, while only about 60% of the landscape values have values within that range. However, tholos tombs are also overrepresented in the 0.2-0.3 range, with ca. 15% as compared to the landscape's 3%.

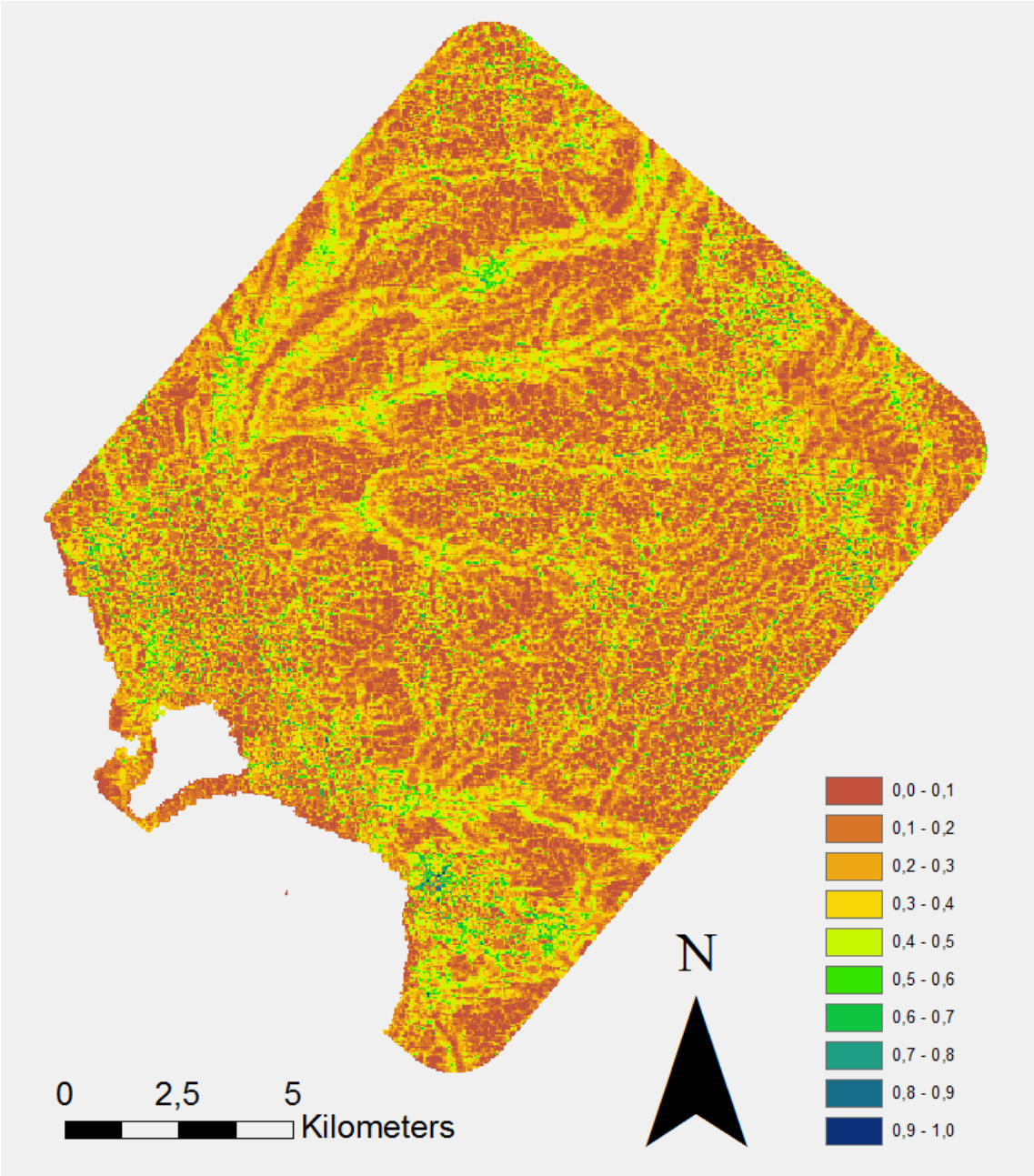


Figure 17. Normalised viewshed values with a radius of 500 meter in the Pylian hinterlands.



If we turn our attention to figure 24 in appendix 2 which depict the tombs and their associated values in relative chronological order, the view of the tombs as a heterogeneous group is reinforced. There are nine out of thirteen tombs with values above 0.5, however their potential construction dates range from MHIII to LHIII. The formative early Mycenaean period (i.e. MHIII-LHII) display both high and low values, and the later tombs display similar differences in value.

There does not appear to have existed any obvious differences in visibility based on the spatial locations of the tombs, as tombs in different parts of the study area display similar values.

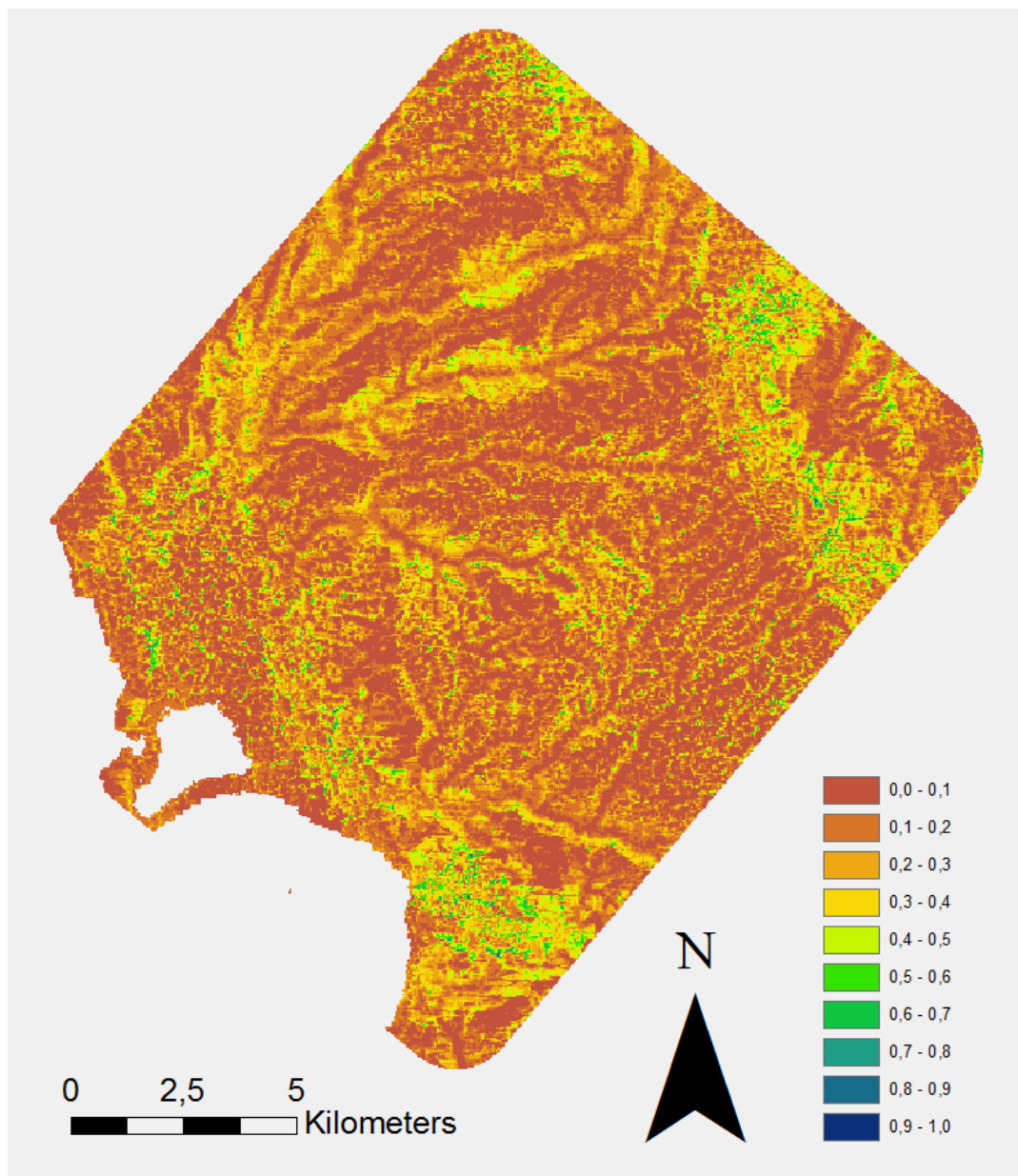


Figure 18. Normalised viewshed values with a radius of 1000 meter in the Pylian hinterlands.

By extending the radius to 500 meters a larger section of the landscape is incorporated, thereby placing the observed locations in a presumably more diverse topographical context. The distribution of values resemble the distribution at 100 meters, although clearly skewed to the left (figure 30). The increase in radius is paralleled by a sharp decrease in average viewshed values; approximately 50 % of the values range between 0.1 and 0.3 and over 87 % can be found between 0.0 and 0.4. The decrease in visibility values suggests that an increase in radius may have a noticeable impact on the perception of topographical prominence.

Figure 17 paints a similar picture with relatively drastic changes to the visual structures. The flat lowland in the south-western area is no longer as dominated by high values as it was at lower radius, while the southernmost flatland has increased in prominence. It is interesting to note that some of the locations in the south-western lowland which displayed the highest values at 100 meters now display very low values, and some of the locations that previously had low values now display above average visibility.

As previously, the valleys that are sprawling through the study area are all associated with high values of visibility. However, a small but important spatial shift has occurred; while the river valleys are still associated with relatively high visibility values, the highest values are now associated with the slopes of the valleys. A similar change can be detected around the mountainous section in the far eastern part of the study area, where high values are associated with the ridges' slopes.

The results also suggest that the small valleys characterising the central and eastern sections of the study area were too narrow and too deep to allow for high visibility, and their bottoms are all associated with the lowest values. It seems that the valleys in combination with the increasing elevation and local variations in topography together created small subregions that were visually limited.

Just as the landscape's visibility values decreased in general, so did the tombs' values, although more drastically. Six out of thirteen tombs have values that are lower than 0.1, and ten out of thirteen tombs have values lower than 0.3. Looking at figure 28 in appendix 2, it is clear that the tombs are markedly overrepresented in the 0.0-0.1 bin, and underrepresented in almost all other bins. With the exception of this overall decrease in visibility value it is not possible to detect any preferred value at any time period, and the decrease does not appear to have had any form of chronological component with the value decrease being either random or dependent on other issues.

The eastern tombs, with the exception of the Kaminia tomb, decrease in visibility value with between 0.25 and 0.55. The decrease is mirrored by a majority of locations in the area; however, as evident in figure 17 there are pockets of locations that were highly visible.

Unlike the eastern tombs, the four tombs in the south-western flatlands do not display any kind of uniformity in their value drops. Three of the tombs experience value drops between 0.25 and 0.45, with the tomb at Voïdhokiliá standing out with a small decrease of 0.05. Most locations in the area go from being highly visible to having low values. The high value of Tragána Viglitsia 2 could potentially be attributed to the fact that it is placed on a slope surrounded by uniformly low locations.

The two tombs on the Pylian ridge display values that are quite average in the analysis. They are both located atop of the ridge which is dominated by visual structures with continuously low visibility.

When the radius is increased to 1000 meters, approximately 65 % of all locations display a value lower than 0.2, and ca. 84 % have a value lower than 0.3 (see figure 32 in appendix 2). It seems that the decrease in average value that was visible at 500 meters continues when the analysis radius is increased to 1000 meters, hinting at a region with relatively low long-range prominence (i.e. few visually prominent places).

The visual structures of the southern coastal part of the study area could be described as a mosaic of low values (see figure 18). Locations that are slightly elevated above the homogenous plains have high values and could be viewed as perceptibly prominent.

Similarly, the few locations in the central part of the study area that are visually prominent are small and slightly elevated, or located on the slopes between the few large valleys and surrounding ridges. Much like at 500 meters it appears as if the deep and narrow valleys, in combination with the surrounding homogenous landscape, create visual structures that limit the possibilities for long-range visibility.

Compared to the central part, the north-eastern section of the study area display rather different visual structures. The most elevated locations (i.e. located atop the mountain near the border of the study area) have low values, since they are part of a relatively flat area much higher than the surrounding landscape, and are therefore not as visible as one would first assume. The most visually prominent locations are instead located in a band at the foot of said elevated area and in isolated pockets of relatively flat land that are slightly elevated above the

surrounding head's of the small valleys, which make up the central part of the study area (see above).

The visual structures in the western and north-western areas can be characterised as compact and heterogeneous, with values changing from high to low following the nature of the areas' major topographical characteristics: the deep relatively wide valleys and the high ridges. It seems as if these two feature types together create small subregions of quite diverse visibility. It should be pointed out that while the two topographical opposites create the regions' visual structures, both the bottom of the valleys and the most elevated locations are associated with low values.

Turning to the tombs, it is clear from figure 32 that the majority of the tombs (seven out of thirteen) have values below 0.1, in fact only two of them have values above 0.05. Much like at 500 meters, the tombs are overrepresented in the lowest bin and underrepresented in almost all other bins. In fact, the distribution of tomb values are very similar between 500 and 1000 meters with only a few changes; there are no longer any tomb with a value between 0.4 and 0.5, and one additional tomb has a value below 0.1 at 1000 meters.

The lack of major change is interesting, especially when compared to the distribution of the rest of the locations in the landscape, which are clearly lower on average (see the discussion above). This suggests that while the visual structures present in the landscape change as the radius is increased to 1000 meters the locations of the tombs remain stable.

Looking at figure 26 it is apparent that while the decrease in visibility value continues in most cases, it is not the same plummet as between 100 and 500 meters, suggesting that the tombs' locations are more stable in the visual structures. In fact, five out of thirteen tombs show increases in values, albeit some of the increases are exceedingly small. There does not appear to be any preference for a specific visual type of location in any chronological period, with high and low values found from MHIII to LHIII. Neither does there appear to be any kind of chronological aspect to the observed increases and decreases in value.

With no distinct chronological pattern detectable, we turn to the three spatial clusters. At 1000 meters the six Koukounára tombs in the eastern cluster could potentially be seen as part of the same visual structure, as each of these tombs are located less than 1000 meters away from their closest neighbouring tombs. None of the tombs display any increase in value,

and five out of six display decreases in value. In fact, at 1000 meters the Koukounára tombs have six out of the seven lowest values of all the tombs.

Moving to the tombs in the south-western flatlands a rather different picture emerges. The two Tragána tombs have both increased in value, while Korifásio and Voïdhokiliá have decreased. While the two tombs at Tragána Viglítsia only show incremental increases in value, they are two out of only four tombs that do so. As they are located on a slope between the low flatlands and the surrounding ridges it is hard to imagine that their naturally prominent locations' were chosen at random. Looking at figure 18 it is clear that their locations are some of the few locations in the area with high values, indicating that high visibility was one of the reasons that the locations in question were chosen.

The two last tholos tombs, on the Pylian ridge, both display comparatively high values and increases in values between 500 and 1000 meters. Much like the visual structures present at 500 meters the ridge is still dominated by locations with low visibility, with the change that the surrounding slopes are no longer displaying high values.

## ***6.2 Soulima Valley***

This section presents the result of the analyses performed in the Soulima Valley. For information about the study area and the data used, see section 4 ("Material").

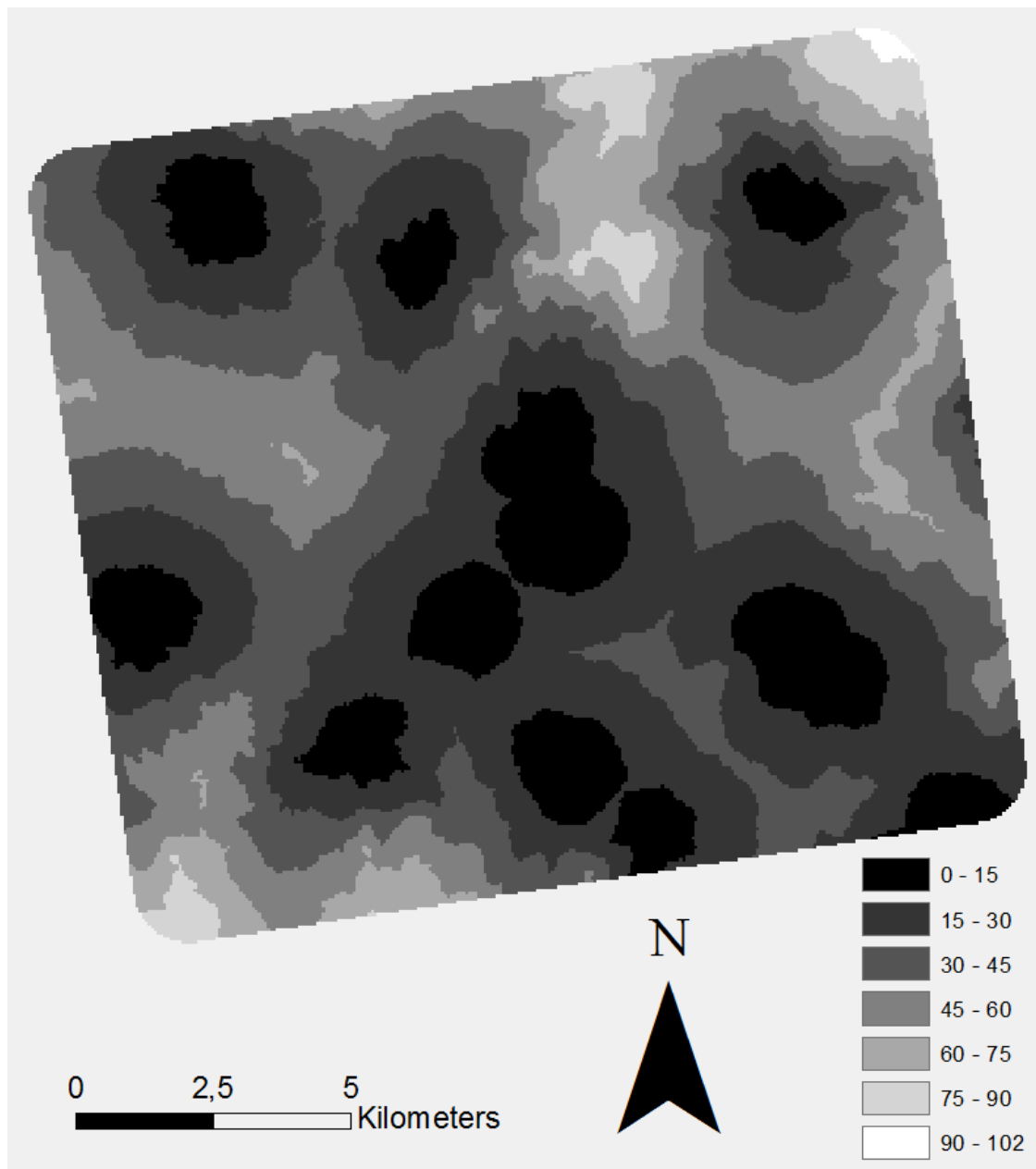
### **6.2.1 Travel time and settlement visibility**

There are twelve settlements and six tombs possibly dating to MHIII/LHI. While this is similar to the same period in the Pylian hinterlands, the travel time-surface produced in the analysis is more diverse, with travel time between neighbouring settlements differing between fifteen and 90 minutes. Each location in the study area could be reached within ca. 102 minutes of walking from the nearest settlement, and almost all of these locations found in the mountainous sections on the outskirts of the study area (see figure 19).

During the MHIII/LHI there are two groups of tombs: the four Peristeriá tombs and the two Psári tombs. The former are located less than five minutes away from the nearby settlement, while the latter are located almost 50 minutes away from nearest settlement (see table 6 for values).

The four Peristeriá tombs in the south-western corner of the study area are not visible from the nearby settlement, even though they are only located 150-270 meters away from it. Conversely the two Psári tombs are both visible from one ‘nearby’ settlement, although nearby is a relative term considering the settlement is located over two kilometres away.

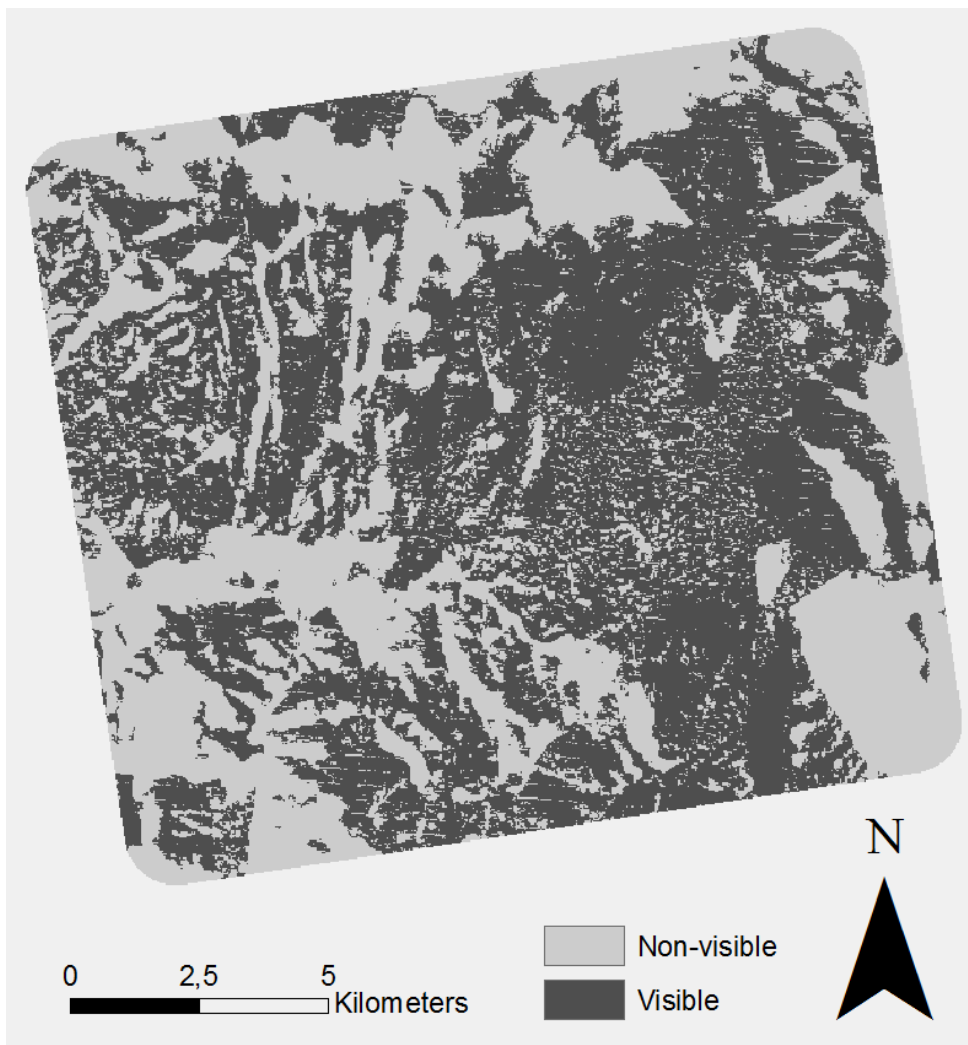
For comparative purposes it could be noted that approximately 45% of the locations in the study area are visible from at least one settlement (see figure 20). Overall there are no overwhelming differences in visibility between locations with different topographical characteristics; slopes, ridges, valleys and the vast plains are all both visible and non-visible.



**Figure 19. Travel time in minutes to all locations in the Soulima Valley from the nearest settlement dating to MHIII/LHI and LHI.**

Turning to the LHII, it is obvious that the period is identical to the preceding period in regards to habitation, with the same twelve settlements being inhabited. There are however some changes in the funerary record, with five tombs possibly dating to the period. Since the same settlements and the same underlying elevation surface were used for the MHIII/LHI and LHII the produced travel time-surfaces are identical; see above for a short description (see figure 19 for a visual representation of the values).

Out of the five tombs mentioned above two were part of the Peristeriá group (Peristeriá 1 and Peristeriá 2), and they naturally retain the same travel time (under five minutes). The tomb at Vasilikó Xeróvrissi in the south-eastern corner of the study area is located approximately fifteen minutes away from the nearest settlement, and the two tombs at Chalkias in the north-east are located approximately 50 minutes away from the nearest settlement.



**Figure 20.** The image shows which locations that might have been visible from settlements dating to MHIII/LHI and LHII.

Since no changes are observable in the settlement record, the two Peristeriá tombs are not visible. Vasilikó Xeróvrisi is not visible from any settlement, and it is located in a larger area that is not visible from any settlement, despite the area's flatness and settlements located nearby. The two tombs at Chalkias are not visible, and are located just north of a continuously visible area.

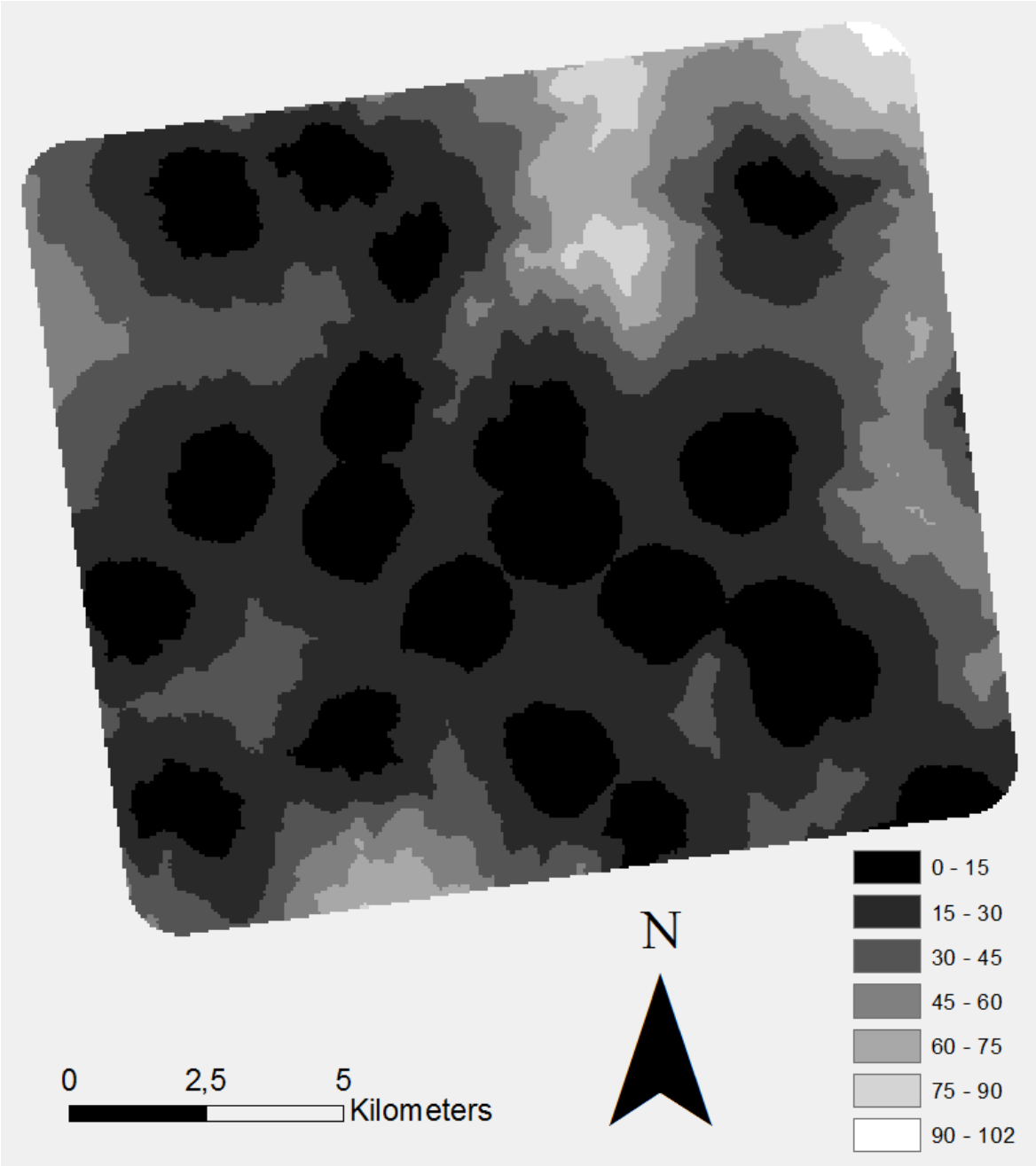


Figure 21. Travel time in minutes to all locations in the Soulima Valley from the nearest settlement dating to LHIII.



There is a significant increase in the number of tombs during LHIII; over twenty settlements could possibly be dated to the period, most of them situated in the central low-lying plains. In addition three tombs date to the period: the Malthí tombs and the tomb at Mouriatádha.

Travel time-wise the three tombs display a homogeneity that did not exist during the previous periods. The Mouriatádha tomb is located less than two minutes away from the nearest settlement and the two Psári tombs are both located less than one and a half minute away from the nearest settlement.

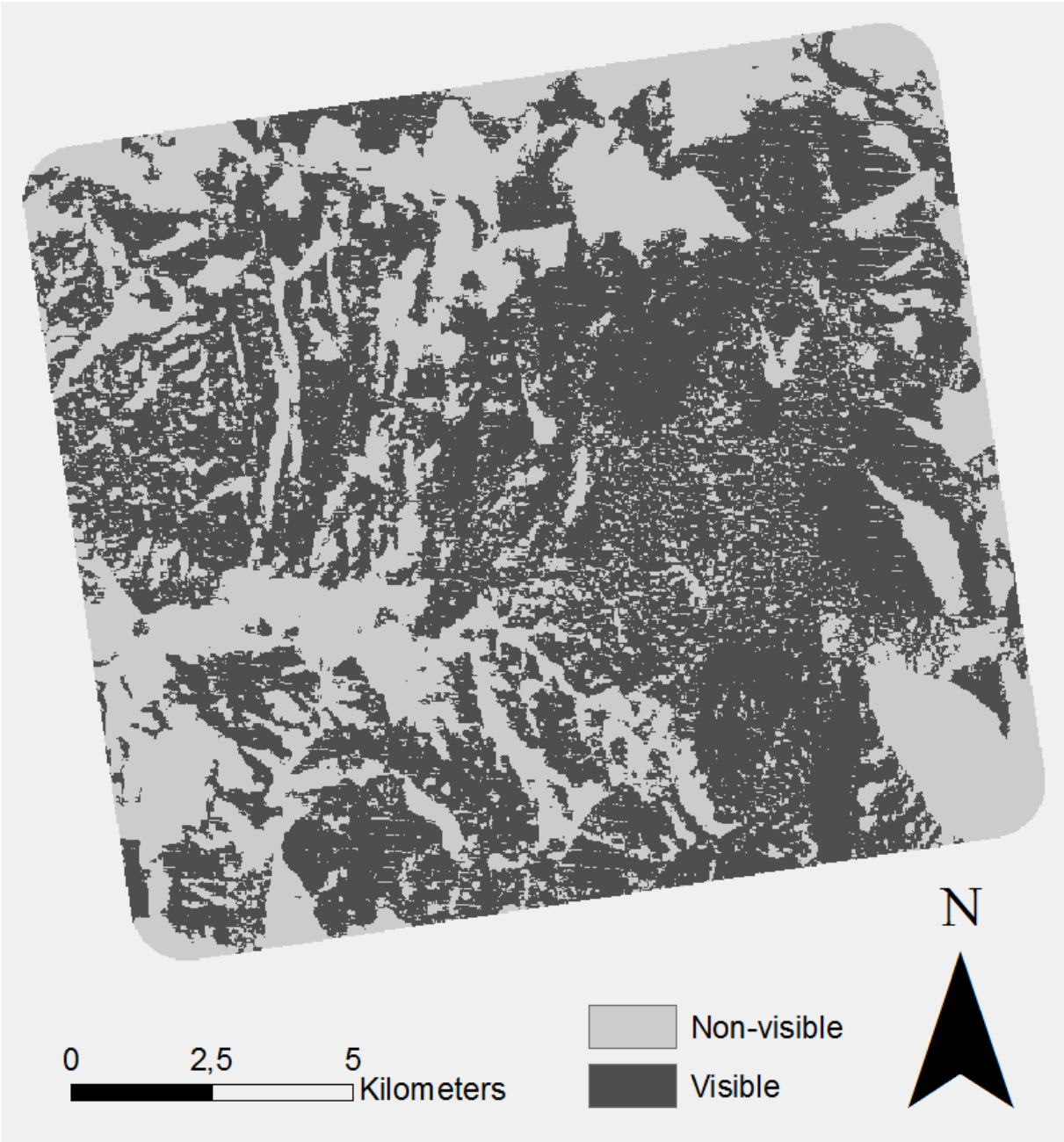


Figure 22. The image shows which locations that might have been visible from settlements (possibly) dating to LHIII.

The increased number of settlements mean that most settlements could reach their nearest neighbour within 30-40 minutes (see figure 21). Of course, there are a few exceptions in the mountainous northern and southern areas. Despite the increased number of settlements, it would still take approximately 102 minutes to walk between the most isolated locations in the area and the nearest settlements.

The increase in number of settlements does not however affect the number of locations in the landscape that can be seen from at least one settlement. During MHIII-LHII ca. 45% could be seen and during LHIII approximately 48% of all locations are visible (see figure 22). The tomb at Mouriatádha is located north of the nearby settlement and is visible from it. The two tombs at Malthí are also placed in visible locations; Malthí 2 can be seen from two settlements and Malthí 1 can be seen from all three nearby settlements.

Name	Travel time from settlements			Seen from settlements		
	MHIII/LHI	LHII	LHIII	MHIII/LHI	LHII	LHIII
Psári 1	50	-	-	Yes	-	-
Psári 2	48	-	-	Yes	-	-
Chalkias 1	-	48	-	-	No	-
Chalkias 2	-	49	-	-	No	-
Vasilikó: Xeróvrisi	-	16	-	-	No	-
Malthí 1	-	-	1	-	-	Yes
Malthí 2	-	-	1	-	-	Yes
Peristeriá 1	4	4	-	No	No	-
Peristeriá 2	3	3	-	No	No	-
Peristeriá 3	3	-	-	No	-	-
Peristeriá S	4	-	-	No	-	-
Mouriatádha	-	-	2	-	-	Yes

**Table 6. Plausible travel time from the nearest settlement to the tomb in question. The values are in minutes and hypothetical. Several tombs have values from more than one chronological period; this is due to the fact that it has not been possible to date their construction more precisely. Tombs that do not date to a certain period are marked with “-“.**

## 6.2.2 Visual structures in the landscape

Figure 29 in appendix 2 shows that the study region is very heterogeneous at 100 meters, with values widely distributed between all bins; approximately 80 % of the locations have values

between 0.4 to 0.8. The relatively high average value suggest that at 100 meters most places could be seen from the surrounding locations.

The study area is dominated by relatively flat plains situated at the centre, and it is here that we find the largest concentration of high values (see figure 23). The few concentrations of low values found can be linked to the slopes of small isolated areas of land elevated above the surrounding plains.

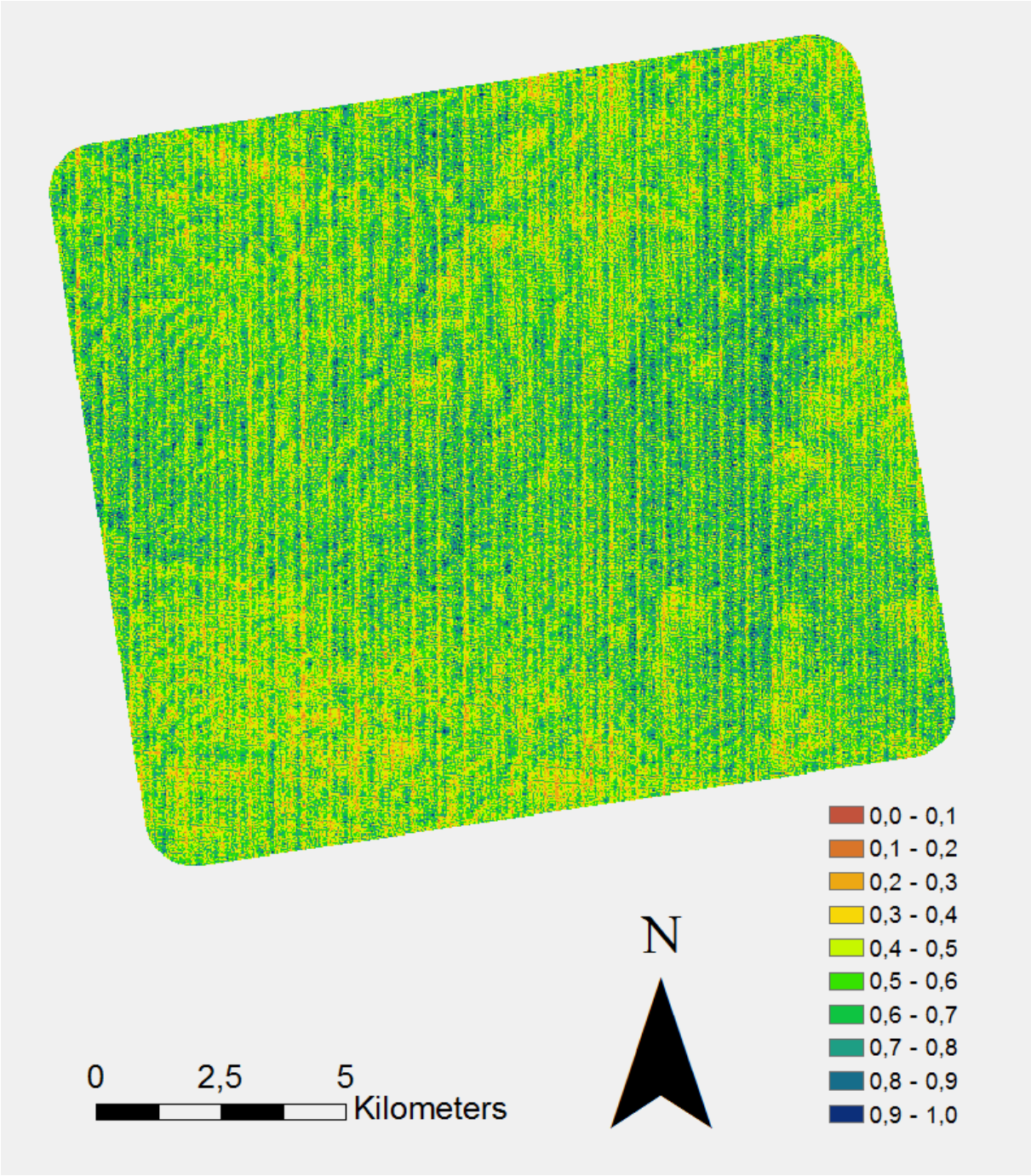


Figure 23. Normalised viewshed values with a radius of 100 meter in the Soulima Valley.

A general overview tells us that the south-western, northern and eastern areas of the study area are all dominated by mid to low ranges of values. The topography of these areas is dominated by increasing elevation as one moves towards the edges of the study area, and almost all of the low values are situated atop of the highest ridges and mountains (or on slopes close the tops). The thin bands of higher values that cross these regions are all associated with valleys or local pockets of low-lying land.

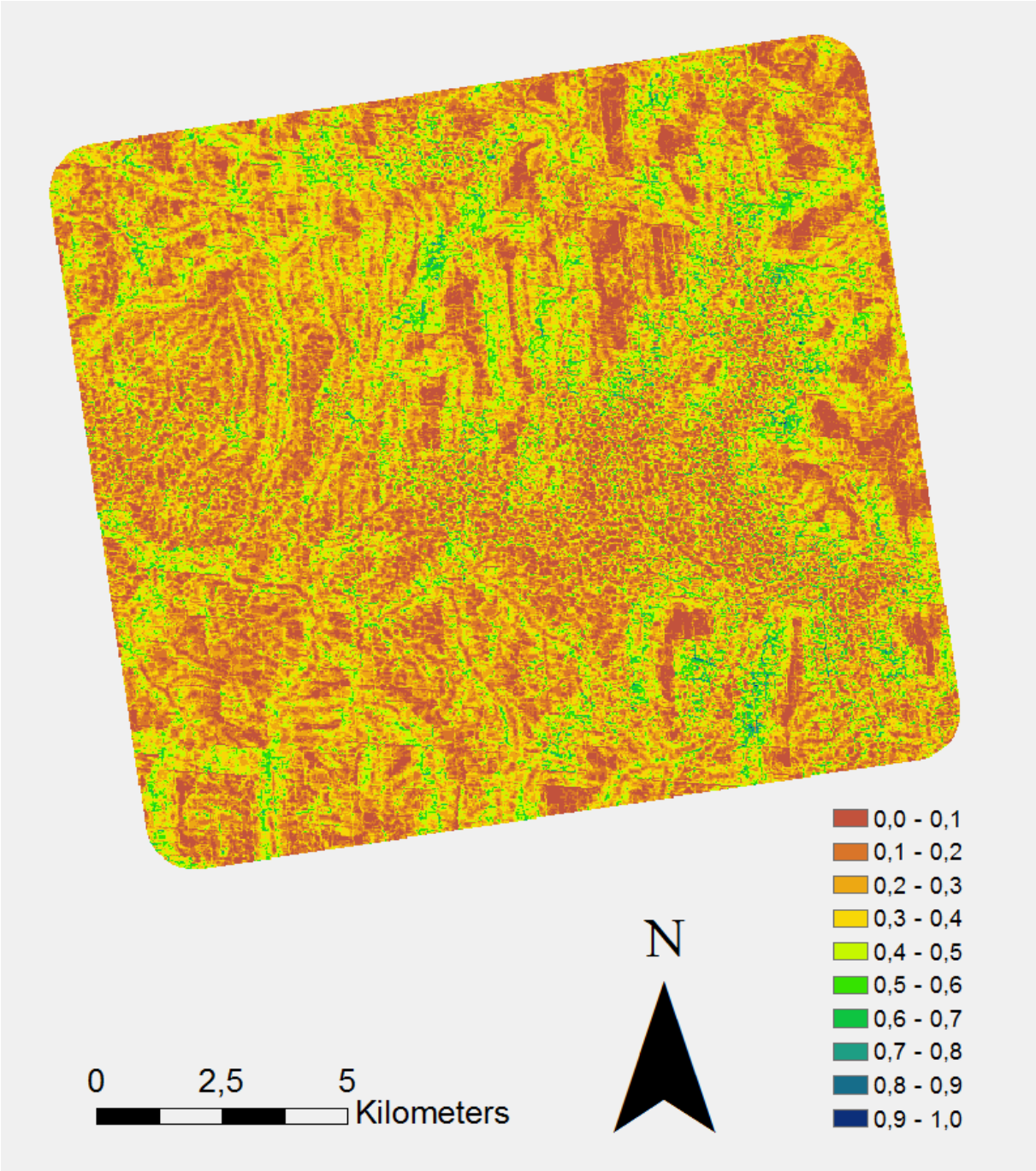


Figure 24. Normalised viewshed values with a radius of 500 meter in the Soulima Valley.

As mentioned previously there are twelve tombs in this study area, all of which are situated on the outskirts of the region near elevated land. Looking at figure 29 it is apparent that the tombs have a diverse range of values which are spread out over seven of the ten bins. While the high percentage (33% to be exact) of tombs in the 0.4-0.5 bin may seem indicative of clustering, one should realise that the cluster is only made up of four tombs and should therefore not be used to make any rash conclusions. It is interesting to note that the tombs' value distribution does not conform to the distribution curve of the larger landscape, which potentially could indicate that locations were chosen based on some kind of visual preference(s).

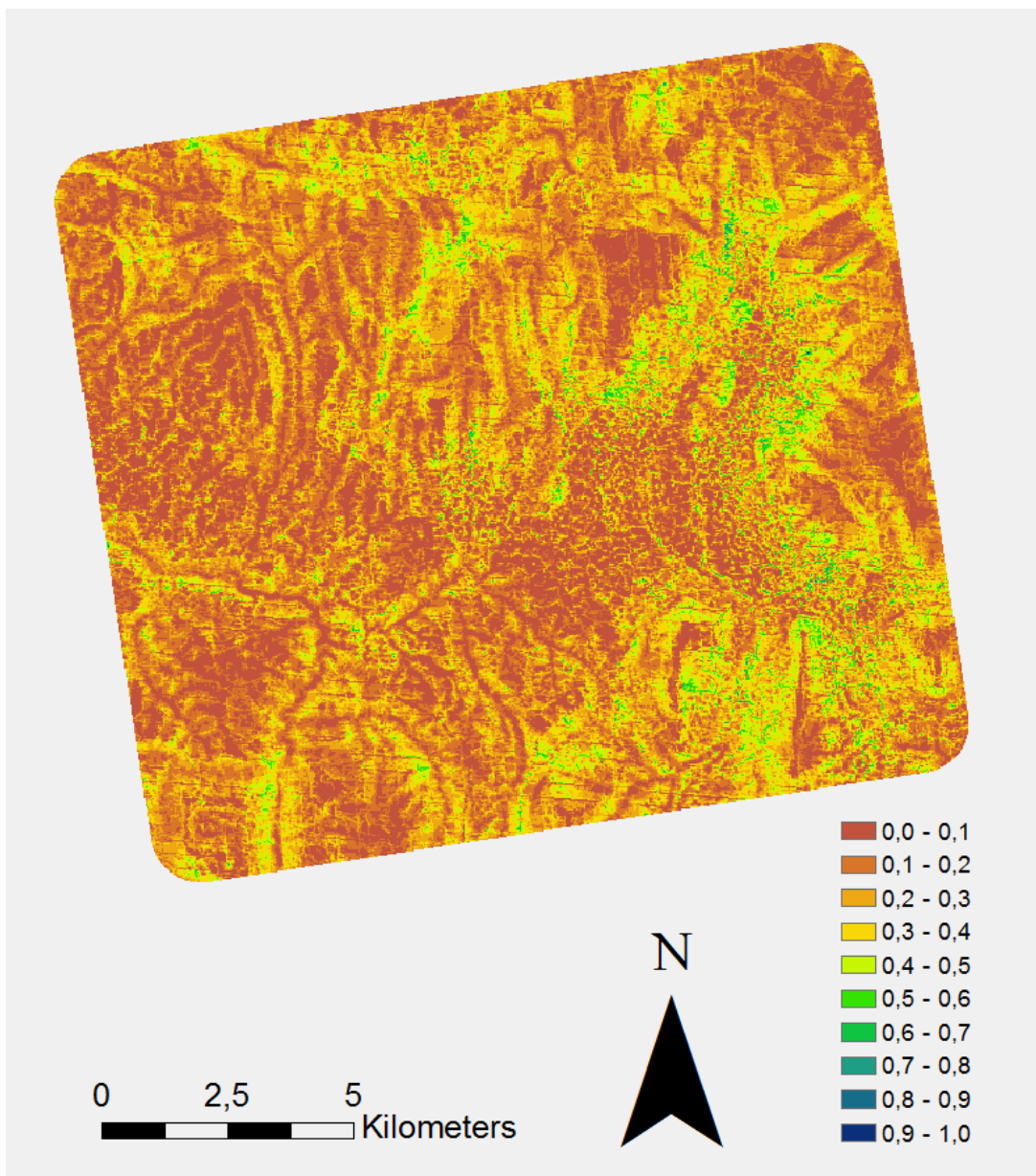


Figure 25. Normalised viewshed values with a radius of 1000 meter in the Soulima Valley.

Furthermore, the data presented in figure 27 suggests that there were no obvious value trends or clustering of values within the early Mycenaean Period, with values ranging from 0.29 to 0.74. There may be evidence for small increase in value in LHIII, however the small number of tombs (only three, of which the dating of Mouriatádha is uncertain) makes it hard to draw any real conclusions.

Turning to the spatial component of the tombs, it is possible to make a few statements. The Malthí tombs have high values, and so does most of the surrounding valley. The tomb at Vasilikó Xeróvrissi is located to the south-east of the Malthí tombs in an area with very similar visual structures.

In the south-western part of the study area there are five tombs: the Mouriatádha tomb and the Peristeriá tombs. The Mouriatádha tomb is located rather high up on a slope in a part of the area that is dominated by low visibility. While the tomb has a relatively high value, there are both higher and lower areas with better visibility adjacent to the location. The Peristeriá tombs on the other hand are located on the lower slopes near flat land. Their low values are intriguing, since the majority of the surrounding locations are highly visible with values at or above 0.7.

The last spatial cluster in the study area is made up of the tombs at Chalkias and Psári, although it should be noted that they are located approximately four kilometres away from each other. The Chalkias tombs are located in an area that displays unstable visual structures, with visibility changing rapidly from location to location. It is noteworthy that the two tombs have low values, despite the apparent mix of highly visible and hidden locations. The two tombs at Psári are located on top of a ridge overlooking the flatter central area. Despite this apparent topographical prominence, only one of them has a high value.

When the radius is increased to 500 meters the average visibility value, much like in the Pylian hinterlands (see figure 31 in appendix 2). The three largest bins are between 0.1 and 0.4, although it should be noted that these three classes only hold about 50% of all locations. This suggests that although there is a decrease in average value when compared to the values at 100 metres, it is still a visually diverse landscape.

Turning to the spatial distribution of these structures, we can indeed see that the study area is now dominated by locations with low values (see figure 24). The central plains are dominated by locations with low values. The few places with higher values are located on the

slopes of small places that are marginally more elevated than their surrounding contexts. It should however be noted that the elevated locations themselves are primarily associated with the same low range of values as the lower surrounding context.

In comparison to the rather homogenous plains the surrounding areas are more topographically and visually diverse. The most elevated locations are still associated with generally low values, with the most visible places located on slopes and at the floor of relatively deep valleys that cut into the more mountainous locations.

Going back to figure 31 we can see that the value distribution of the tombs are similar to the distribution curve of the landscape, with some important differences. The tombs are underrepresented in the three lowest bins and overrepresented in the following four.

Chronologically speaking there does not appear to exist any preferences limited to a specific time period (see figure 27). It is interesting to note that the average decrease in value is lower than those seen in the Pylian hinterlands.

Moving on to the spatial clusters one can see an interesting change in values, starting in the south-eastern corner. The locations of the two Malthí tombs are still associated with high values; what has changed is that most of the surrounding locations are not. The nearby tomb at Vasilikó Xeróvrissi has dropped much in value, along with the surrounding landscape. The area is now dominated by locations with low visibility, with high values only being associated with smaller isolated locations.

The visual structures around the Mouriatádha tomb are a mix of high and low values, with values changing rapidly. This indicates that the area contains a number of locations that provide the ability to either hide or present the tomb to individuals in the landscape. The tomb itself is associated with a low value, there are however locations with high values bordering the tomb; it is possible that a different picture would emerge if the analysis was done using a DEM with a higher resolution. The visual structures around the tombs at Peristeriá are quite similar to those present at the Malthí tombs. Their values have remained relatively stable (or in the case of Peristeriá 1 even increased), while most of the surrounding locations have lower values.

The visual structures surrounding the Chalkias tombs are similar to the visual structures present at the Mouriatádha tomb, with values changing rapidly over relatively short distances. With that said, it is apparent that the Chalkias tombs are located in places that display relatively average values, with nearby locations that are both highly visible and

hidden. The Psári tombs display a rather different pattern. The visual structures on the ridge and flatter areas are now more homogeneous, and dominated by lower values; the tombs on the other hand display values slightly above average.

Much like in the Pylian hinterlands, we can at 1000 meters see a continued shift towards a concentration of values in the lower bins (see figure 33 in appendix 2): almost 80% of all locations have values ranging between 0.0 and 0.3. The graph paints a picture of a more homogenous landscape with few exceptionally prominent locations, albeit more diverse than the Pylian hinterlands.

As seen in figure 25 the visual structures are quite similar to the ones visible at 500 meters, albeit with lower average visibility and some changes in as to what is regarded as prominent. Generally speaking the most prominent locations are on the slopes between valleys and nearby ridges, and the lowest values can be found at the bottom of small valleys and at places that are both highly elevated and vast (the central parts of these locations can then not be seen from surrounding lower locations).

It is evident that the visual structures on the central plains consist mostly of low values, with the few highly visible locations mostly situated on the slopes of the few hills. It appears as if the flatness and the slow changes in the topography of the region does not favour visual prominence, and it is in the more topographically diverse outskirts of the study region that most higher values can be found.

The exception to this is the north-western area, which topographically consists of a continuously increasing elevation along with small ridges and valleys. This changing topography creates dynamic visual structures that do not support long-range visibility in the same way as the combination of mountainous slopes and flat plains do. Granted, there are locations with high visibility-values in this section of the study area, but not to the same degree or concentration as we do in other similarly elevated areas.

With the visual structures in the landscape briefly discussed we turn to the role of the tombs. Looking at figure 33 one can see that the tombs' values are no longer conforming to the distribution curve of the landscape; with nine out of twelve tombs found between 0.1 and 0.3, it is clear that there is a clustering of values. The possibly homogeneous nature of the tombs is present also in figure 27. The only tombs outside of the 0.1-0.4 range are Psári 1 and 2, and if



those are viewed as anomalies the graph paints a picture of a relatively uniform class of tombs with no real temporal changes.

Turning to the spatial clusters, it is possible to detect a rather abrupt change in the spatial distribution of values in the south-eastern corner. The two Malthí tombs are no longer displaying higher values than their surrounding landscape, and the high values are no longer found on the small slopes at the foot of the hills. Instead they are now found much higher up on the slopes, at the very edge of the hill or mountain. Due to this the two tombs and the surrounding flat land have low values. A similar situation is found to the east at Vasilikó Xeróvrissi where the flat land is dominated by visual structures with low visibility.

The area in the south-western corner of the region is also dominated by locations with low visibility values. While the Mouriatádha tomb has not decreased in value to any significant degree, the surrounding landscape has gone from being visually diverse to being dominated by visual structures with very low visibility. The Peristeriá tombs to the north display similar values. While visibility in the area was diverse at 500 meters, it is rather uniform at 1000 meters and dominated by low values. It is interesting to note that the few isolated high values in the area are associated with locations at the feet of elevated locations, while the Peristeriá tombs are located slightly higher up on the slopes.

In the north-eastern corner the area around the Chalkias tombs is dominated by low values. Almost the entire area is dominated by locations with values lower than 0.2, in most cases lower than 0.1.

With that, we turn to the value-abnormalities that are the Psári tombs. It is interesting to note that at 100 and 500 meters they had rather average values; it is only at 1000 meters that their locations could be described as visually prominent. This can most likely be attributed to the location of their small ridge with its steep slopes in association with surrounding flat area. The visual structures in the area, while still diverse, now contain mostly locations with low values. It is interesting to note that the tombs' ridge is one of very few areas in the sub-region associated with high values, indicating that it is possible that the locations were chosen based on long-range visual characteristics.

## **7. Discussion**

The previous sections have shown that there are numerous issues, both theoretical and practical, associated with the modelling and analysis of perception as a result of visibility. Despite this it is argued here that the results presented in the previous section showed that there are possibilities to gain real insight into the role and perceived nature of tholos tombs in the Messenian Bronze Age landscape.

The discussion below is divided into two main categories that discuss and interpret the results from the performed analyses and then discuss the possibilities of expanding the theoretical and methodological frameworks employed in the study.

### ***7.1 Landscapes and tholos tombs***

There can be no uncertainty when it comes to the longevity of the tholos tombs. Their continued reuse show that they were built to last; they were not used once and forgotten, which indicates that they were known spatial entities in Messenia. But what of the assumptions and questions stated in the introduction and background section? Were the tholos tombs constructed to be visible markers in the Messenian landscape? Can all tombs be considered part of the same homogenous group, or are there spatial and temporal differences? How do they relate visually to the rest of the landscape? To answer these questions this section will first discuss the landscapes surrounding the tholos tombs, in order to place the tholos tombs within their proper context. The tombs themselves are discussed thereafter.

#### **7.1.1 'Natural' visual structures and the 'lived-in' landscapes**

The results from the analysed total viewsheds suggest that both the Pylian hinterlands and the Soulima Valley were landscapes with rather varying visibility at smaller visual contexts, and places located quite close to each other may have been perceived rather differently. However, this should not be interpreted as signs of landscapes that were perceived as having binary 'open' (i.e. often seen) and 'hidden' (i.e. not seen) places. As individuals moved in the landscapes the surrounding places may have phased in and out of their field of vision, but within a local context there would have been few locations that were continuously obscured from the surrounding places.

The few places that would not have been continuously visible were often located on the slopes of valleys. This is interesting, since one might initially have assumed that slopes by their definition were quite visible and prominent. While this assumption may have been true in larger contexts, it was not in a micro-local context. Overall at a lower radius the study areas appear to not have been predominantly hidden landscapes, but landscapes where locations were continuously seen and experienced (although some may have been seen more frequently than others).

The landscapes' relative openness in smaller contexts is most likely a result of the study areas' topographies. Although continuously changing, visibility did not change so radically that it created isolated pockets of micro-local landscapes; this is particularly apparent in the flatter southern areas in the Pylian hinterlands and in the central flat plains of the Soulima Valley.

It should be noted that other areas of the regions may have been experienced slightly differently, as they display more varying visibility values (e.g. the outlying mountainous areas of the Soulima Valley and some areas of the Pylian hinterlands). Within these differing visual structures there would have been places that were continuously seen (i.e. 'dominating' the visual landscape) and places that would have been perceived as more obscure, as they would only have been seen intermittently. This should however not be interpreted as them being 'hidden', only that they were less visible than other types of locations. Many of these dominant places were located on the floor of valleys (especially in the Soulima Valley), which goes against some researchers' assumption that elevated locations are inherently the most visible places in a landscape.

The landscapes with varying visibility appear to have changed into more homogenous and less exposed landscapes as individuals increased the size of their visual contexts. The low viewshed values produced at 500 and 1000 meters does not however suggest that the landscapes were *perceived* as completely hidden. The low values should instead be interpreted as an indication that most locations were not continuously visible from *all* locations within the radii to the modelled individuals moving in the landscape. With an increasingly larger context and varying topographies, it is to be expected that locations cannot be seen from everywhere in the landscapes.

These interpretations apply to both study areas, albeit perhaps to a larger degree to the Pylian hinterlands; much like in the smaller contexts, the Soulima Valley displays more

varied visual structures. There are places and areas sprawling through the valley which may very well have been continuously visible to moving individuals; places and areas that to some degree structured the perceived visual landscapes. With that said, visibility *is* comparatively low in larger contexts in both study areas when compared to smaller contexts.

The comparatively overall homogenous low visibility values suggest that most places did not stand out in comparison to the surrounding places, which most likely could be attributed to the topography of the Pylian hinterlands and the Soulima Valley. Considering the relatively lower visibility over larger distances it is possible that the landscape was perceived as continuously ‘opening’ and ‘closing’, with most places constantly going in and out of view as individuals moved over larger distances in the landscape.

Despite this opening and closing and the emphasis in the previous discussion on the overall low visibility at larger radii, it appears as if there were locations which potentially framed the perceived environment due to their continual visibility to individuals acting in the landscape. However, these were not the same locations that were continuously visible on a micro-local level. While the flat coastal plains in the Pylian hinterlands and the flat central plains of the Soulima Valley were very open within smaller contexts, this does not appear to have been the case at larger contexts (with the exception of the south-eastern semi-isolated lowland in the Pylian hinterlands). It is curious that these areas display the same opening and closing as the rest of the landscape, despite its relative flatness.

The few places that were slightly elevated above the plains must have been comparably prominent, as is evident from their higher total viewshed-values. Similar situations can be found in the rest of the Pylian hinterlands, with isolated pockets of flat and slightly elevated land found e.g. at the heads of valleys and locations at the feet of mountainous sections.

As noted previously, the results from the total viewshed analyses show that one cannot equate high elevation with hypothesized high visual prominence. It is e.g. likely that the highly elevated places in the north-eastern section of the Pylian hinterlands were not very visible to individuals moving in the rest of the landscape. It appears as if the natural topography of the landscape (i.e. deep valleys in combination with ridges) may have created what can be referred to as isolated ‘perceptual pockets’, that were not seen or perceived before they were entered. This does not mean that they were not conceptualised by the people inhabiting the

landscape, but rather that the landscape in itself, to some degree, emphasised locally focused visual contexts.

One of the more interesting transformations of the visual structures in the Pylian hinterlands, and to a lesser extent in the Soulima Valley, is the change of visual prominence that occurs in and around the valleys. While the slopes may have phased in and out of individuals' field of vision at smaller contexts, they are among the most prominent types of places at 500 meters, only to lose some of this prominence in larger contexts. The valley floors continuously lose visual prominence as the size of the contexts increase, to the point that they, along with highly elevated and isolated areas, are among the least visible types of places at 1000 meters.

The clustering of highly visible locations at the intersections of valleys and ridges should be considered symptomatic for the study areas, since as previously mentioned, the topographies of the regions limit the possibility of finding places that were visible from locations far away. These intersections, or edges, could be seen as overlooking the nearby valleys. At the same time they were also being overlooked from both the valleys and places on the adjacent relatively flat ridges, creating a sense of natural prominence, since no other type of location has this type of dualistic visual emphasis on the landscape.

So, the visual landscapes that emerge from the interpretations above are landscapes that continuously change as the spatial size and location of the visual contexts of the perceiving individuals change. From being relatively open at 100 meters with few hidden places, to a landscape that constantly opens up and closes with few highly visible locations in larger contexts.

But these 'natural' visual structures, which are derived from topography, are only one facet of the lived-in landscapes and do not give us a complete picture without other aspects of human perception. How do they relate to the settlements, tombs and actions of the inhabiting individuals?

There are a few conclusions we can draw regarding these relations based on the results from the performed analyses. For one, there is a noticeable difference in landscape visibility between the two study areas. In the Pylian hinterlands only between one fifth and one third of the landscape could be seen from settlements during the studied time periods, while approximately half of the Soulima Valley could be seen from settlements.

Based on the spatial distribution of visible locations, we can see that there were few settlements in the Pylian hinterlands that could see the majority of their surrounding landscape, while a comparison with the Soulima Valley suggests that the settlements there could see their nearby landscape to a much larger degree.

The low visibility in the Pylian hinterlands, in combination with the lack of local environment visibility, could suggest that settlements were not placed in the landscape to ‘overlook’ it and that the ability to view the surrounding landscape from the places of habitation were not crucial; the implication being that visibility was more important in the Soulima Valley. This could suggest that the societies and communities in the Soulima Valley lived in a context where the ability to see when and where individuals moved in the landscape was of importance.

At this point in the discussion it might be prudent to address the issue of the analysed places’ spatial distribution. Implied in the discussion and interpretations presented so far is that all locations in the study area were, more or less, equally interesting to the investigated individuals (from an analysing perspective). But is this assumption theoretically and analytically acceptable?

One could e.g. make the argument that areas in the landscapes that did not contain any actively used human-made constructions did not play as big a part in the life of the individuals inhabiting landscape. However, it is argued here that to do so would be to miss the point of the definitions of perception and landscapes put forward by Ingold and others. The world of the studied individuals and their lived-in landscape were not simply the small areas around e.g. settlements and tombs, but all locations as they were perceived and related to by these individuals. Due to the small sizes of the study areas and the relatively short travel times calculated in the study it is doubtful that any place in the two study areas would have been considered to be so far away that they were ‘impractical’ for use, or so far away that we as researchers could deem them to be outside the realm of the structure-creating everyday activities.

While the hard numbers in themselves do not tell us how the ancient Messenians perceived their landscapes, they do suggest that individuals acting in the landscape were constantly aware of other individuals from both their own and neighbouring settlements. As noted above this does not mean that these other individuals were continuously *visible* to the observing

individuals; the visual structures of the landscapes would have prevented most long-range visibility. It is however possible that they were perceived via other senses or via places, constructions or paths associated with them. This means that the acting individuals and the socio-economic structures they lived in did not exist in a spatial-cultural vacuum during any of the studied time-periods; it is most probable that their decisions, actions and perceptions were made and existed in relation to the people living in and outside of their community.

### **7.1.2 The tholos tombs in the landscape**

How, then, can we interpret the findings presented in the results section? What do they tell us about the relationships between tombs and settlements? Based on travel time values it is argued here that the placement of a large majority of tombs was not done to ‘isolate’ the tombs from the rest of the landscape, as they were not located in the remotest locations in the landscape; if a healthy individual wanted to visit the tombs, (s)he could do so with little effort. However, the nature of the relationships between tombs and settlements appear to be quite complex, and considering the width of the travel time range they could hardly be seen as belonging to a single homogenous group of relationships. While a majority of the tholos tombs lie very near settlements from a travel time-perspective, one should not forget that some tombs were located as far away as the travel time between many neighbouring settlements.

It is also important to point out that perceived low travel time between settlements and tombs does not necessarily mean that the tholos tombs were erected in some form of relative micro-local landscape and therefore only related to the nearest settlement; the travel time between most neighbouring settlements in the Pylian hinterlands were less than 25 minutes and 40 minutes in the Soulima Valley. This suggests that some of the tombs were not strictly spatially bound to the nearest settlement, but were rather part of larger networks consisting of numerous places and locations in the landscape.

It is interesting to note, perhaps a bit disappointing for some, that there does not appear to exist any specific temporal patterns. Tombs were not intrinsically associated with settlements early in MHIII/LHI only to have slowly moved towards having more independent roles in wider landscape contexts in LHII and LHIII; tombs were placed near and far away from settlements seemingly at random in all periods. This suggests that the hypothesis that early

tombs were interconnected on a local scale while later tombs were located in larger spatial contexts, postulated by e.g. Boyd (2002, p. 46f; 93), may be troublesome.

With that said, it is important to point out that it is potentially hazardous from an analytical point of view to focus too much on the spatial-temporal relationships between tholos tombs and settlements, as we do not know how the Messenians viewed the highly subjective relationship between action and time.

What we can state however is that it does not appear as if there existed any obvious relationship between travel time and settlements to tombs visibility, as there are tombs both near and far that are visible while others, naturally, are not. It is also argued here that the lack of visibility between tombs and settlements, primarily in the Pylian hinterlands, in combination with the travel discussion above, indicate that there may not have existed any special visual relationships between tholos tombs and settlements during any of the time periods. The perceived visual characteristics of the Soulima Valley tombs may have been slightly different, since five out of twelve tombs were visible from settlements. This may have been a sought-after affordance to *some* of the tholos tombs' creators, however it is far from certain that this should be considered to be one of the defining characteristics of the tholos tombs.

So, based on this study one cannot state that there existed any form of 'eye-contact' between tombs and settlements or that the tombs existed as some form of visual markers aimed at people moving within the boundaries of the settlements in the study areas. The lack of settlement visibility in combination with the travel times indicate that the primary focal points for the tombs were not settlements, but the surrounding landscape in which individuals perceived and acted. It also appears as if the tholos tombs were placed in the landscape in relatively the same way all throughout the Mycenaean period from a settlement perspective. If the tholos tombs' roles in the Messenian societies changed between MHIII and LHIII, as suggested by e.g. Cavanagh and Mee (1998, p. 64), Bennet (1999, p. 16) and Banou (2008, p. 49f), it is not reflected in the tombs' spatial-visual relationships to the nearby settlements.

One could also interpret the fact that the majority of tholos tombs were not seen as an indication that the tombs were 'hidden' from the settlements on purpose, and that this in turn indicates an urge to hide the deads' presence to the people living in the settlements. However, the fact that one third of the tombs may have been visible from settlements suggests that this was at least not a pan-Helladic custom. Also, from a logical (albeit highly subjective) point of



view, it seems counterproductive to build large tombs in the first place if the Messenians felt a cultural need to hide their dead.

If we leave the relationships between tombs and settlements for a while, how do the tombs relate to the larger surrounding landscape? A large majority of the tombs in the Pylian hinterlands plausibly dating to MHIII/LHI were located in places that displayed an average amount, or slightly below an average amount, of visibility (i.e. prominence) at 100 meters. Roughly the same can be said about the Soulima Valley, although some of the tombs are slightly *above* average.

Like places in the rest of the landscapes, the values of most tombs decrease drastically as the size of the context increases. Other tombs, such as Áno Englianós IV, Kamína and the Peristeriá tombs either retain their perceived prominence in relation to the decreased visibility values in the rest of the landscape or increase it slightly as the size of the context increases. It seems probable that the locations of these tombs were perceived as quite average in regards to visual prominence. Some tombs, such as the Koukounára tombs, Korifásio and the Chalkias tombs decrease in value quite drastically as the size of the context grows; their locations in the landscape go from being average to much lower than average, perhaps even hidden.

Although there are several tombs in the Soulima Valley that remain averagely visible (or somewhat above), the Psári group are the only tombs that display a true and pronounced *increase* in perceived topographical prominence as the size of the visual context is increased. Their locations appear to have rather different characteristics than the average location in the Soulima Valley's visual structures; from being visually average at a micro-level, to slightly above average at 500 meter to being two of the most prominent locations in the entire study area. There are very few locations that would have been perceived in this way, and it is not improbable that the tombs were placed there as a result (considering their unusual distance to the nearest settlement).

The places of tombs dated to LHII have similar visual characteristics as the places of the older tombs, albeit with some oddities. The Koukounára tombs in the eastern section of the Pylian hinterlands display average visibility at 100 meters, but appear to have been as close to hidden as places can be in a landscape. Their perceived obscurity is peculiar, as there are very few tombs that were hidden to such a large degree. The other tombs in the study area (Englianos III, Tragána Viglítsia 1 and 2) appear to have been located in locations with average visibility,

or in the case of Tragána Viglítsia 2 quite prominent (especially in larger contexts). It should be pointed out that the low visibility of the Koukounára tombs must have been a *chosen* characteristic, since even though the area is dominated by low visibility there are places of high prominence available.

The tombs in the Soulima Valley possibly dating to the LHII appear to have displayed rather erratic changes in visibility, which makes them harder to interpret. For instance: the Peristeriá tombs appear to have been slightly below average in a micro-local context, above average at 500 meters and then average at 1000 meters. Vasilikó: Xeróvrissi display a similar change, although it appears to have been slightly above average in a micro-local scale. The two Chalkias tombs are perhaps the most enigmatic of all, with Chalkias 1 appearing to have been below average, to above average and at 1000 meters it appears to have been almost hidden while Chalkias 2 appear to have followed a pattern of average, below average and then average again as the size of the context increases. In other words, the two tombs appear to follow opposite trends.

In the Pylian hinterlands during LHIII the same types of locations seem to have been preferred for tombs as during the previous periods. In the eastern section tombs appear to have been placed in places of average visibility in a micro-local context, which were hidden in larger contexts. In the western part of the study area Tragána Viglítsia 2 must have been perceived, as mentioned previously, as quite prominent. Note that the only tomb dated to the LHIII with certainty is Koukounára Akónes 1.

In the Soulima Valley there are three tholos tombs dated to LHIII with certainty. The Malthí tombs, located on the flat plains, appear to have been highly visible within contexts of all sizes (although more so in smaller contexts). The tomb at Mouriatádha appears to have possessed average visual characteristics.

The discussion above should have made it clear that the tholos tombs of Messenia could not be considered to be a homogenous group from a visibility perspective. It appears as if throughout the investigated time periods open/prominent, average and hidden locations were utilised. Even the decrease (or in a few cases, the increase) of perceived topographical prominence of places as their visual context increases does not appear to hold any distinguishable kind of temporal patterns.

What we have is then a mishmash of places with different visual characteristics, albeit with a few points of contact. At a micro-local level it seems as if most tombs were located in places of average visibility. It does therefore not seem likely that the tholos tombs as a group in any way *dominated* the visual structures of either the Pylian hinterlands or the Soulima Valley. For instance: while the tholos tombs in the Pylian hinterlands were most likely visible as individuals moved in a micro-local context, so were most of the surrounding places, as the landscapes were relatively open.

Of course, this interpretation is based on the aforementioned definition of topographical prominence as a relational affordance. By this definition, the places of the tombs should not be considered to have been perceived as topographically prominent, since the surrounding locations (as mentioned) also were continuously visible in the landscape. However, if a prominent place would have simply been defined as a place that was highly visible, most tombs would indeed have been prominent (although, so would most of the landscapes). It is therefore possible that the tholos tombs did indeed structure and/or divide the micro-local visual landscapes solely based on the tombs' cultural connotations and the openness of the landscape. The decipherment of such connotations is however beyond our reach.

As mentioned above, when larger visual contexts were taken into account the landscapes 'closed', and fewer places were visible to perceiving individuals. It is here in these larger contexts that we can detect one of the few important differences between tholos tombs in the Pylian hinterlands and the Soulima Valley. Most tombs in the Pylian hinterlands have visibility values of 0.3 or lower at 500 meters, while the majority of tombs in the Soulima Valley have values above 0.3 which when taken in comparison with the low values of the landscape could indicate that the locations of the tombs were visually prominent.

As the size of the visual contexts increase in the Pylian hinterlands, the visibility of tholos tombs in relation to the rest of the landscape decrease while the relative visibility of the tholos tombs in the Soulima Valley remains *comparatively* stable. In fact, as previously noted one could make the argument that some of the tholos tombs in the Soulima Valley may have increased in prominence as the visual contexts of the observing individuals increased from 100 to 500 meters.

Almost all of the Pylian tholos tombs went from being visible fixtures in an open landscape to being almost hidden in a landscape that were continuously opening up and

closing. While the topography of the region may have influenced individuals to focus on more micro-local visual contexts and structures, it is rather telling that the tholos tombs in the Pylian hinterlands were not placed in the few places that could be described as prominent, but rather the opposite.

The opening and closing of the landscape in the Pylian hinterlands in relation to this low visibility suggest that they did not dominate large-scale visual networks nor structured anything but micro-local visual structures. Put simply, it does not seem as if the Pylian tholos tombs were supposed to be perceived as visibly prominent over larger distances.

This, in combination with the fact that only two out of thirteen tombs were visible from the settlements in the region could be interpreted as a desire on the part of the builders to construct the tholos tombs at places that were concealed or hidden from other places in the landscape. This could in turn suggest that the tombs were meant to be present but not seen; that they, in a way, were meant to be visited and experienced rather than seen and perceived from a distance. Another possibility is that the tombs, as physical representations or reminders of deceased ancestors, were hidden both from the settlements and in the landscape. It is possible that visibility was simply just not taken into account when places were selected in the Pylian hinterlands for the construction of tholos tombs, however their homogeneity suggests that this was not the case.

This stands in stark contrast to the development seen in the Soulima Valley, where the visibility of the tholos tombs appear to have approximately followed the more varied distribution of visibility in the landscape; as mentioned previously the places of the Soulima Valley as a group most likely displayed more varied levels of visibility than the places of the Pylian hinterlands. So while the Soulima Valley was most likely opening and closing in a visual sense similarly to the way the Pylian hinterlands did, it seems likely that there also were places that were continuously visible as individuals moved from one location to another.

It is plausible that this varied distribution of visibility (of both tombs and landscape) entailed that some of the locations of the tholos tombs in the Soulima Valley were not as visually inconspicuous or hidden as the tombs in the Pylian hinterlands. In fact, at 500 meters it seems likely that many of the tombs' locations were visually prominent in the landscape. This prominence, which arguably becomes less observable as the size of the visual contexts increase to 1000 meters, suggests that some of the tholos tombs in the Soulima Valley may

very well have been perceived as visually dominating , thereby structuring the perceived landscape surrounding them.

However, it should be once again be emphasised that not all tholos tombs in the Soulima Valley were located in prominent places; some were located in places that could be deemed as being of average visibility, while others were so infrequently seen that they ought to have been quite hidden in the landscape.

It is possible to interpret the heterogeneous visual affordances of the tholos tombs in the Soulima Valley to indicate that visibility was simply not an affordance that was generally taken into account when the tombs were placed in the landscape. This could explain the varied distribution of visibility values, as the places of the tholos tombs would have been selected more randomly<sup>25</sup>. Note that this explanation does not sufficiently explain the overall low values of the tholos tombs in the Pylian hinterlands, which means that either the Soulima Valley tombs represent a group of tombs where visibility was disregarded, or different builders desired different visual characteristics of their tomb locations (or ranked visibility different in relation to other sought-after affordances).

However, based on the nature of the tholos tombs and the interpretations presented above, it is proposed here visibility *was* taken into account when the tholos tombs were constructed in the Soulima Valley, although the tombs do constitute a much more heterogeneous group of structures than the tholos tombs in the Pylian hinterlands. Some, much like the tholos tombs in the Pylian hinterlands, were hidden and only part of micro-local visual structures. The majority of the tholos tombs (which were visible over larger distances) were however most likely part of more extensive visual structures; some of the more prominent tombs, such as the Psári tombs, may even have been the focal points of these visual networks.

Their visual characteristics, in relation with the fact that five out of twelve tombs can be seen from the nearby settlements, make it quite unlikely that the selection of their locations were based on the same cultural and socio-economic preferences that were prevalent in the Pylian hinterlands. While it is possible that the less visible tomb locations in the Soulima Valley were chosen in an attempt to hide the tombs' presence from nearby places and

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<sup>25</sup> Note that the use of the term 'randomly' refers only to the perceived insignificance of *visibility* as an affordance. It is quite likely that other topographical or cultural preferences were in play.

settlements, the fact that these less visible tombs are a minority and the fact that there are no real temporal or spatial patterns make such interpretations doubtful – at best.

Instead, it may be more beneficial for the study to focus on the prevalence of tombs of average or high visibility. There would have been no need to visit the spatial locations of these tholos tombs in order to experience or to be reminded of their existence; the dead would not have been very hidden but rather visually present in a landscape in which individuals moved and performed their everyday activities.

If we entertain the previously mentioned assumption that the tholos tombs were perceived, at least by some, as physical representations or reminders of dead ancestors (which is not an unreasonable hypothesis), then the results indicate that the way the dead were viewed and represented may have differed greatly in the Soulima Valley when compared to the Pylian hinterlands. The wish to actively choose places that made them part of larger visual structures and networks (whether they were just present in them or dominated them) potentially indicate that the deceased ancestors were continuously displayed. This could potentially indicate that the deceased ancestors in the Soulima Valley were perceived as being more ‘included’ in the landscape than in the Pylian hinterlands; the tholos tombs were spatial reminders of deceased ancestors and those still living who may have been associated with them (e.g. via kinship or socio-economic standing).

This leads us to another potential aspect of the tholos tombs which so many researchers have emphasised: their significance as hypothesised socio-economic statements. As noted earlier, many of the assumptions and hypotheses cited in the beginning of this thesis revolve around the tholos tombs role in the landscapes’ visual structures; that they to some degree were visually imposing and were placed in prominent locations (Wilkie, 1987, p. 127f); (Wells, 1990, p. 128); (Bennet, 1995, p. 597); (Shelmerdine, 2008b, p. 144) . However, the results of this study and the discussion up to this point ought to have indicated that any hypothesis which assumes that the tholos tombs in Messenia were a homogenous and visually prominent group of structures is wrong. If the interpretations of the tholos tombs in the Pylian hinterlands as socio-economic statements of power and wealth rest on their perceived topographical prominence, then it follows that they were not.

Their lack of perceived topographical prominence does however seem paradoxical when viewed in relation to the time, energy and resources the tombs’ constructions ought to have consumed. However, their lower-than-average visibility (and in some cases their hidden

locations) could indicate that they may have been socio-economic statements meant for an *internal* audience rather than an external one. That is, it is possible that the majority of the tholos tombs were constructed for people within the constructors' own socio-economic and/or cultural group rather than as statements of power people outside their own settlement or (or other social groups in their own community).

There would have been no need for the tholos tombs to be located in highly prominent places if we view the majority of the tholos tombs in the Pylian hinterlands as internal veneration of deceased ancestors and internal statements of socio-economic and cultural adherence to a set of funerary or eschatological codes. What these may have entailed more specifically is however uncertain. This suggests that obscured locations were deliberately chosen as it is possible that the tholos tombs, as internal statements, were something that their constructors may not have wanted to display in a wider context.

If the tholos tombs of the Pylian hinterlands were 'hidden' constructions meant for an internal audience, what then of the more visible tombs of the Soulima Valley? Due to their presence in larger visual structures it seems possible that one of their functions were to act as visible markers in the landscape; although whether or not these markers also symbolically expressed ownership of the surrounding land is perhaps best left unsaid. This follows the logic established in the previous paragraph, which also suggests that the majority of the tholos tombs in the Soulima Valley were not only constructed to be cultural and socio-economic statements to an internal group, but to a wider audience as well.

Based on this it would appear as if the tholos tombs in the Soulima Valley to a much larger degree than the tholos tombs in the Pylian hinterlands adhered to the traditional scholarly view of tholos tombs as visually prominent statements of socio-economic power as suggested by e.g. Dickinson (1977, pp. 91-94), Wilkie (1987, p. 128) Thomas (1995, p. 352) and Shelmerdine (2008b, p. 144).

It should be pointed out that this study does not conclude that it is beyond any doubt that the tholos tombs in the Soulima Valley were visible socio-economic statements intended to showcase the power and wealth of those interred within; the results simply do not exclude the possibility.

On the issue of a possible chronological distinction between early and late tholos tombs, as discussed by e.g. Davis et al. (1997, p. 421), Cavanagh and Mee (1998, p. 64), Bennet (1999,

p. 16) and Banou (2008, p. 49f), little can be said with certainty. The study has not provided any form of certain proof that there exists a clear distinction between early socio-economic displays of wealth and later indications of palatial presence. It should however be reiterated that there does not appear to have existed any chronological distinctions based on perceived topographical prominence.

## ***7.2 Theoretical and methodological issues***

Throughout the course of this study it has become apparent that there are a number of problems associated with modelling visibility and experiential action in a (pre)historic landscape, both methodological and theoretical. Some of these are summarised here, and possible forays forward are discussed.

### **7.2.1 Limitations of the archaeological record**

Before we can discuss the methodological and theoretical limitations of the study there is another problematic subject that needs to be addressed: the ambiguous nature of the archaeological record. For example: archaeological contexts from MHIII and LHI are notoriously hard to date, and it is not always possible to date the construction of a tholos tomb with any real certainty (it is for instance not unheard of for LHI/II pottery to be crafted in a MH-style). This coupled with the unfortunate fact that many Messenian cemeteries and settlements are unpublished or unexcavated<sup>26</sup> makes it hard to properly interpret changes in site selection and perception from a temporal perspective.

It is naturally tempting to attempt to distinguish differences in tomb visibility based on dating. However, the nature of the tholos tombs internal chronology makes such interpretation analytically problematic. For instance, the Peristeriá tombs are dated to LHI-LHIIA, and if one chooses to group them with the other LHII tombs rather than the tombs dated to LHI, one can interpret the results differently. This is obviously quite problematic from a research perspective, and it is an issue that most archaeological studies suffer from. The lack of a proper internal chronology in the different sub-periods discussed in the study makes it hard to

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<sup>26</sup> In the cases where the tombs have been excavated and published it is also often hard to distinguish between subphases, such as LHIIIA1 and LHIIIA2.



discuss how preferences in visibility and other affordances may have changed within each sub-period. However, despite this it is argued that it is still possible to see changes (or lack thereof) in larger temporal perspectives, such as between the beginning and the twilight of the Mycenaean period.

Another possibly limiting factor related to the archaeological record should also be explicated; this study does not separate the studied tholos tombs into different groups based on size. It is difficult to make any form of division (other than completely arbitrary), since the tombs cover a continuous spectrum of sizes ranging from monumental to almost inconspicuous. With that said, it is possible that there are undocumented relationships between the tholos tomb's size and its role in the landscape.

The lack of two- and three-dimensional spatial information for both tombs and settlements should also be mentioned, as it is possible that it may have impacted the analyses of visual relationships between settlements and tombs. It is possible, indeed likely, that some of the tombs and places that were classified as non-visible from settlements may have been re-classified if the analyses had included the entire spatial extents of the studied entities.

Similarly, the results may have been different if the data used in the analyses had a higher resolution. It is possible that the ASTER DEM hid or created artificial patterns of visibility that would not have existed in reality, while the analysed tombs and settlements may have displayed different levels of visibility if their locations had been recorded using GPS with a different margin of error.

These are issues of generalisation, and they are relatively common in archaeological research. With that said, they should not be blindly accepted, and future studies that attempt to deal with the visual relationships between settlements and their surrounding landscapes should attempt to incorporate both the spatial extent and the three-dimensional characteristics of settlements and tombs, which could include things such as elevated places that would boost the visual possibilities of the settlements (e.g. guard towers) and objects that would limit visibility (e.g. tall city walls).

### **7.2.2 Problems associated with modelling movement and vision**

There are a number of issues associated with modelling hypothetical movement patterns within a GIS-environment, most of them associated with methodological limitations or analytical assumptions. For instance, the analyses performed in this study assumes that people preferred to move over flat areas rather than sloping ones, and that it is possible that people may have moved in patterns that ‘saved’ time when they were performing some types of everyday activities in the landscape. This means that there is an assumption of a certain form of rationality involved in the movement patterns. Assumptions involving hypothesised rationality are naturally problematic, although it could be argued that it is possible that one could assume that individuals acted ‘rationally’, but within the frameworks of their socio-cultural environment. Analysing movement patterns as a result of travel time also assumes that people visited nearby locations more often, which is problematic.

The methods, results and interpretations presented in this study also assume that people moved all over the landscape without any form of cultural biases. If we were able to include areas that acted as attractors or repellents in the landscape, such as religious sites or taboo areas, the outcome may have been very different.

There is also the issue of global knowledge; i.e. that movement in a landscape is dependent upon the spatial knowledge of the moving agent about the landscape as a whole, rather than just being locally based which most GIS-based cost surfaces are. By this it is meant that humans arguably decide how to move in the landscape from place A to place B with the entire journey in mind, rather than just moving to the next ‘least costly’ adjacent location in the landscape.

With some of the issues related to movement discussed, we can move on to dealing with the issues associated with perception. When discussing human perception, vision has dominated most studies as it is far easier to both model and interpret than e.g. hearing or smell. This means that analysing visibility, e.g. via the creation of viewsheds, is far from a revolutionary approach in archaeological research, and it has been done for decades.

However, it is important to point out that using viewsheds to study visibility is not unproblematic. Many available GIS-programs do not account for e.g. atmospheric distortion, the curvature of the earth, vegetation, etc. It could be argued that these are problems that are

amendable by using better and more advanced modelling software, nevertheless they are problems that most studies suffer from.

Another important issue to discuss has to do with the individual nature of human perception. A large majority of studies, including this one, model visibility as it is perceived by an adult with good to perfect vision, and does not take into account the possibility of e.g. impaired vision and other perceptual nuances that might play a role in the individual's perception of the landscape. In other words, we are not modelling individuals with differing perceptual characteristics.

There is also the unavoidable issue of vegetation, and its impact on visibility in the landscape. While Messenia may have been a relatively open landscape during the LBA, there can be little doubt that trees and shrubs affected the visibility of locations. At its current level, most viewshed analyses are modelling barren surfaces akin to a moon landscape. This is one of the most serious problems in perception-based analyses, and unfortunately it does not seem as if we will be able to solve it anytime soon. It is possible to model hypothetical populations of prehistoric flora based on preserved seeds at different locations in the landscape, however from such analyses we can only hope to understand *how* visibility is affected by vegetation in general, not how the landscape was actually perceived.

Nevertheless, as long as we are aware of, and account for, these methodological limitations and properly define the analysed affordances then viewshed analysis should be seen as a viable tool when it comes to analysing human action within a landscape. While created models are in no way completely accurate recreations of a prehistoric landscape, it is argued here that we should not confuse these limitations with complete analytical deficiency.

### **7.2.3 The problems of models and analytical determinism**

It is obvious that it is not been possible to carry out a study such as this without the use of models, a practice which some schools of archaeological theory oppose; for examples, see e.g. Tilley (1994) and (2004). One of the main reasons to this aversion is their rejection of scientific methods, as it is argued that scientific methods automatically de-humanises the study and ultimately lead to positivism. Any attempt to incorporate modelling into a methodological framework is then bound to transform the researcher into a static misunderstanding observer of the landscape rather than becoming an engaged participant,

thereby missing core parts of landscape perception and possibly mistaking the model-output for objective truth.

I would argue that this is an overly polemic stance, and that modelling does have a place in archaeological research. Few archaeological researchers today argue that a GIS-model represents an objective (pre)historic reality, and as pointed out by other researchers GIS-users (just like everyone else) are 'embodied inhabitants' in the world. Simply stating that GIS as a methodological tool is a bad thing for archaeology is simplistic, and the discussion concerning GIS and its theoretical limitations would benefit from a distinction between individual application areas and their relationships to GIS. One could also argue that the use of models in humanistic research brings positive aspects, such as the need to be explicit about biases and assumptions, an issue which is sometimes ignored in other strands of archaeological research.

For instance, this study has dealt with the affordance visual prominence in the meaning of *being seen*, rather than *seeing*. A study that attempted to analyse how much of the landscape is seen from each location, rather than how much of the landscape that can see the location, may show the tholos tombs in a very different light.

With that said, if we see GIS-models as heuristic tools (as done in this study) with which we can explore postulated processes and hypotheses rather than as objective truths, we can use the models to explore aspects of landscapes and society that we are not able to do via fieldwork. Naturally there are limitations as to which degree they can be used and to which type of information can be extracted; GIS-models are not replacements of fieldwork but tools which can be used to further our understanding of prehistory.

By using the models as heuristic tools rather than seeing them as objective models of past behaviour we can hope to avoid the environmental determinism that many early archaeological studies that incorporated GIS fell victim to.

If one allows for some generalisation and wishful thinking, a possible methodological and theoretical way forward for future studies attempting to investigate similar issues is presented. Based on the discussion above and experiences gained throughout this study, it is argued here that in order to further our understanding of vision and perception in general, it will be necessary to evolve and integrate viewshed studies into larger methodological and theoretical

frameworks, that accommodate the uncertainty and individuality of vision as one of several components in human perception.

This would require a shift in how excavation and surveys are viewed and recorded, moving away from viewing settlements and tombs as isolated nodes and instead focusing on their roles in activities performed in the landscape. It may also be necessary to expand upon the concept of visibility, and differentiate between different types of it. For instance, it may be that different cultures and, even different types of constructions within a specific culture, view and relate very differently to visibility. While some may prefer visibility as perceived topographical prominence, it is possible that others may have defined prominence as having a particular visual context or a specific form of visual backdrop as individuals move towards/away from the construction. As our algorithms and models advance, it may also prove possible to analyse how objects and places ‘come into view’ when individuals move in the landscape, rather than simply being in the binary state of visible or hidden depending on the perceiving location.

As hinted at above, it would also need to incorporate other aspects of perception in the study. While arguably a dominant sense, vision should be investigated alongside other senses, and an all-encompassing study would also need to take into account e.g. smell, sound and touch. It may also prove beneficial to experiment with differently modelled individuals, with differing physical and cultural characteristics. However, this would require more advanced algorithms than those found in most GIS-suites available today.

## 8. Conclusion

This thesis has attempted to elucidate the role tholos tombs may have played in the Messenian landscape by analysing travel time in the landscape and the tombs' visibility in relation with contemporary settlements and the wider landscape. This was done via cost surfaces and viewshed analyses.

Throughout the course of the study it has become apparent that there are a number of problematic issues associated with the modelling of the visual aspect of human perception, both theoretical and methodological (in which issues pertaining uncertain data are included). Some of these can be avoided by changing the way we view the archaeological entities we study, while others require serious commitment by archaeologists and computer specialists alike. Others again may not be solvable, as they relate to the very nature of humanistic research and its relation to scientific methods.

Despite these issues it has been possible to draw a few conclusions. It has become apparent that we can no longer accept some of the older, and to some degree still prevailing, assumptions that the tholos tombs in Messenia were a homogenous class of highly visible socio-economic statements no matter their spatial or temporal contexts. The results from this study, in which two relatively close study areas were investigated, have shown that tholos tombs may have filled very different cultural and socio-economic roles in different areas (and perhaps even within a single area).

Almost all tholos tombs in the Pylian hinterlands were located in places with below-average visibility or in places that were hidden in comparison with the rest of the landscape; the tholos tombs in the Soulima Valley display an array of visual characteristics, ranging from semi-hidden to highly prominent.

This all means that we need to nuance the way we view the tholos tomb. We can no longer assume that a tholos tomb was a visual socio-economic statement. Further studies are necessary to evaluate their roles in landscape and society; not only in relation to settlements but in relation to other forms of monuments and in relation to more advanced patterns of movement.

## Bibliography

- Banou, E., 2008. *The Tholos Tombs of Messenia: An Overview*. In: Dioskouroi. Studies Presented to W. G. Cavanagh and C. B. Mee on the Anniversary of Their 30-year Joint Contribution to Aegean Archaeology. Oxford, pp. 42-58.
- Bennet, J., 1995. *Space Through Time: Diachronic Perspectives on the Spatial Organization of the Pylian State*. In: Politeia. Society and State in the Aegean Bronze Age. Proceedings of the 5th International Aegean Conference / 5e Rencontre Égéenne Internationale, University of Heidelberg, Archäologisches Institut, 10-13 April 1994. Liege, pp. 587-602.
- Bennet, J., 1999. Pylos: The Expansion of a Mycenaean Palatial Center. In: *Rethinking Mycenaean Palaces: New Interpretations of an Old Idea*. Los Angeles, pp. 9-18.
- Boyd, M. J., 2002. Middle Helladic and Early Mycenaean Mortuary Practices in the Southern and Western Peloponnese. Oxford.
- Branigan, K., 1970. The Tombs of Mesara: A Study of Funerary Architecture and Ritual in Southern Crete, 2800-1700 B.C.. London.
- Cavanagh, W. G. & Mee, C., 1998. A Private Place: Death in Prehistoric Greece. Jonsered
- Clinton Wright, J., 2008. *Early Mycenaean Trade*. In: The Cambridge Companion to the Aegean Bronze Age. New York, pp. 230-257.
- Dabney, M. K. & Wright, J. C., 1990. *Mortuary Customs, Palatial Society and State Formation in the Aegean Area: A Comparative Study*. In: Celebrations of Death and Divinity in the Bronze Age Argolid. Proceedings of the Sixth International Symposium at the Swedish Institute at Athens, 11-13 June, 1988. Göteborg, pp. 45-53.
- Davis, J. L. et al., 1997. *The Pylos Regional Archaeological Project Part I: Overview and the Archaeological Survey*. Hesperia: The Journal of the American School of Classical Studies at Athens, 66(3), pp. 391-494.
- Dickinson, O. T. P. K., 1977. The Origins of Mycenaean Civilisation. Göteborg.
- Gibson, J. J., 1986. The Ecological Approach to Visual Perception. New York.
- Gillings, M., 2007. *The Ecsefalva Landscape: Affordance and Inhabitation*. In: The Early Neolithic on the Great Hungarian Plain. Investigations of the Körös Culture Site of Ecsefalva 23, County Békés. Volume I. Budapest, pp. 31-46.
- Gillings, M., 2009. *Visual Affordance, Landscape, and the Megaliths of Alderney*. Oxford Journal of Archaeology, 28(4), pp. 335-356.
- Gordon, I. E., 2004. Theories of Visual Perception (Third Edition). New York.

- Ingold, T., 1992. *Culture and the Perception of the Environment*. In: Bush Base: Forest Farm. Culture, Environment and Development. London, pp. 39-56.
- Ingold, T., 1993. *The Temporality of the Landscape*. World Archaeology, October, 25(2), pp. 152-174.
- Ingold, T., 2000. *The Perception of the Environment: Essays in Livelihood, Dwelling and Skill*. Abingdon.
- Knappett, C., 2004. *The affordances of things: a post-Gibsonian perspective on the relationality of mind and matter*. In: Rethinking materiality: the engagement of mind with the material world. Oxford, pp. 43-51.
- Kondo, Y. & Seino, Y., 2010. *GPS-aided Walking Experiments and Data-driven Travel Cost Modeling on the Historical Road of Nakasendō-Kisoji (Central Highland Japan)*. In: Making History Interactive: Computer Applications and Quantitative Methods in Archaeology (CAA). Proceedings of the 37th International Conference, Williamsburg, Virginia, United States of America, March 22-26, 2009. Oxford, pp. 158-165.
- Llobera, M., 1996. *Exploring the Topography of Mind: GIS, Social Space and Archaeology*. Antiquity, Volume 70, pp. 612-22.
- Llobera, M., 2001. *Building Past Landscape Perception With GIS: Understanding Topographic Prominence*. Journal of Archaeological Science, Volume 28, pp. 1005-1014.
- Llobera, M., 2005. *The Nature of Everyday Experience: Examples from the Study of Visual Space*. In: Re-presenting GIS. London, pp. 171-192.
- Llobera, M., 2006. *What You See is What You Get? Visualspaces, Visual Genesis and Hierarchy*. In: Digital Archaeology: Bridging Method and Theory. Abingdon, pp. 132-151.
- Llobera, M., 2007. *Reconstructing Visual Landscapes*. World Archaeology, 39(1), pp. 51-69.
- Llobera, M. et al., 2010. *Calculating the Inherent Visual Structure of a Landscape ('Total Tiewshed') Using High-Throughput Computing*. In: Beyond the artefact: Digital Interpretation of the Past: Proceedings of CAA2004, Prato, 13-17 April 2004. Budapest, s.n., pp. 146-151.
- Loy, W. G. & Wright Jr, H. E., 1972. *The Physical Setting*. In: The Minnesota Messenia Expedition: Reconstructing a Bronze Age Regional Environment. Minneapolis, pp. 36-46.
- McDonald, W. A. & Rapp Jr., G. R., 1972. *The Minnesota Messenia Expedition: Reconstructing a Bronze Age Regional Environment*. Minneapolis.
- Mee, C. B. & Cavanagh, W. G., 1984. *Mycenaean Tombs as Evidence for Social and Political Organisation*. Oxford Journal of Archaeology, 3(3), pp. 45-64.



- Mee, C. B. & Cavanagh, W. G., 1990. *The Spatial Distribution of Mycenaean Tombs*. The Annual of the British School at Athens, Volume 85, pp. 225-243.
- Savage, S. H., 1990. *GIS in Archaeological Research*. In: *Interpreting Space: GIS and Archaeology*. London, pp. 22-32.
- Shaw, R., 2003. *The Agent–Environment Interface: Simon’s Indirect or Gibson’s Direct Coupling?*. *Ecological Psychology*, 15(1), pp. 37-106.
- Shelmerdine, C. W., 1999. *A Comparative Look at Mycenaean Administration(s)*. In: *Florent Studia Mycenaea. Akten Des X. Internationalen Mykenologischen Colloquiums in Salzburg vom 1.-5. Mai 1995*. Wien, pp. 555-576.
- Shelmerdine, C. W., 2008a. *Background, Sources and Methods*. In: *The Cambridge Companion to the Aegean Bronze Age*. Cambridge, pp. 1-18.
- Shelmerdine, C. W., 2008b. *Mycenaean Society*. In: *A Companion to Linear B: Mycenaean Greek Texts and their World. Volume I*. Leuven, pp. 115-158.
- Sinclair, A., 2000. *Constellations of Knowledge: Human agency and Material Affordance in Lithic Technology*. In: *Agency in Archaeology*. London, pp. 196-212.
- Sjöberg, B. L., 2001. *Asine and the Argolid in the Late Helladic III Period: A Socio-economic Study*. Uppsala.
- Thomas, C. G., 1995. *The Components of Political Identity in Mycenaean Greece*. In: *Politeia. Society and State in the Aegean Bronze Age. Proceedings of the 5th International Aegean Conference / 5e Rencontre Égéenne Internationale, University of Heidelberg, Archäologisches Institut, 10-13 April 1994*. Liege, pp. 349-354.
- Thomas, J., 1993. *The Hermeneutics of Megalithic Space*. In: *Interpretative Archaeology* Oxford, pp. 73-97.
- Tilley, C., 1994. *A Phenomenology of Landscape: Places, Paths and Monuments*. Oxford.
- Tilley, C., 2004. *The Materiality of Stone: Explorations in Landscape Phenomenology*. Oxford.
- Tobler, W., 1993. *Three Presentations on Geographical Analysis and Modeling*. In: *Technical Report 93-1. National Center for Geographic Information and Analysis*.
- van Leusen, M., 2002. *Pattern to Process: Methodological Investigations into the Formation and Interpretation of Spatial Patterns in Archaeological Landscapes*. Groningen.
- Webster, D. S., 1999. *The Concept of Affordance and GIS: A Note on Llobera (1996)*. *Antiquity*, Volume 73, pp. 915-917.

- Wells, B., 1990. *Death at Dendra: On Mortuary Practices in a Mycenaean Community*. In: Celebrations of Death and Divinity in the Bronze Age Argolid: Proceedings of the Sixth International Symposium at the Swedish Institute at Athens, 11-13 June, 1988. Stockholm, pp. 125-140.
- Wheatley, D., 1995. *Cumulative Viewshed Analysis: A GIS-based Method for Investigating Intervisibility, and its Archaeological Application*. In: Archaeology and Geographical Information Systems: A European Perspective. London, pp. 171-185.
- Wheatley, D. & Gillings, M., 2000. *Vision, Perception and GIS: Developing Enriched Approaches to the Study of Archaeological Visibility*. In: Beyond the Map: Archaeological and Spatial Technologies. Amsterdam, pp. 1-27.
- Whitley, T. G., 2004. *Spatial Variables as Proxies for Modelling Cognition and Decision-Making in Archaeological Settings: A Theoretical Perspective*. Internet Archaeology, Volume 16.
- Wilkie, N. C., 1987. *Burial Customs at Nichoria*. In: Thanatos. Les coutumes funéraires en Egée à l'âge du Bronze. Actes du colloque de Liège, 21-23 avril 1986. Liège, pp. 127-136.
- Voutsaki, S., 1998. *Mortuary Evidence, Symbolic Meanings and Social Change: A Comparison between Messenia and the Argolid in the Mycenaean Period*. In: Cemetery and Society in the Aegean Bronze Age. Sheffield, pp. 41-58.
- Wright Jr, H. E., 1972. *Vegetation History*. In: The Minnesota Messenia Expedition: Reconstructing a Bronze Age Regional Environment. Minneapolis, pp. 188-199.
- Zangger, E. et al., 1997. *The Pylos Regional Archaeological Project: Part II: Landscape Evolution and Site Preservation*. Hesperia: The Journal of the American School of Classical Studies at Athens, 66(2), pp. 549-641.

## Appendix 1 - Scripts

These are the scripts used for the various analyses or in preparation of them.

### *1.1 Script used for adding attribute-fields*

```
# Import system modules
import os
import arcpy
from arcpy import env

# Enable file overwrite
arcpy.env.overwriteOutput = True

# Set environment settings
workspace = arcpy.env.workspace = "D:/ThesisData/AsterGDEM2/viewpoints/Pylian1000/"
arcpy.AddMessage("Workspace is: " + workspace)

# Set variables, remember to check radius!
offaValue = "1.650"
offbValue = 0.0
azi1Value = 0.0
azi2Value = 360.0
vert1Value = 90.0
vert2Value = -90.0
rad1Value = 0.0
rad2Value = 1000.0

# Errorchecking
arcpy.AddMessage("Parameters set.")

# This loops through every file in the workspace, and if the file ends with .shp it executes the
loop.
```

# I would have preferred to use `arcpy.ListFeatureClasses()`, but it doesn't work with shape-files which is what I'm currently working with. Please realize that this script was created as an ad hoc-solution since my observer points were already split. It is MUCH better to add attributes BEFORE splitting the observer points into smaller files. It might not even be necessary to use multiple files for the observer points.

# Runnable without starting ArcGIS (simply doubleclick the .py file), which is a faster and more stable way of running it.

```
for file in os.listdir(workspace):
```

```
    if file.endswith(".shp"):
```

```
        vshedField = ['OFFSETA', 'OFFSETB', 'RADIUS1', 'RADIUS2', 'AZIMUTH1',  
                    'AZIMUTH2', 'VERT1', 'VERT2']
```

```
        inField = arcpy.ListFields(file)
```

```
        for field in inField:
```

```
            if field.name in vshedField:
```

```
                vshedField.remove(field.name)
```

```
        for x in vshedField:
```

```
            arcpy.AddField_management(file, x, "FLOAT", "", "", "", "", "", "", "")
```

```
        # Populate the fields with input values (else defaults)
```

```
            arcpy.CalculateField_management(file, "OFFSETA", offaValue, "PYTHON", "")
```

```
            arcpy.CalculateField_management(file, "OFFSETB", offbValue, "PYTHON", "")
```

```
            arcpy.CalculateField_management(file, "RADIUS1", rad1Value, "PYTHON", "")
```

```
            arcpy.CalculateField_management(file, "RADIUS2", rad2Value, "PYTHON", "")
```

```
            arcpy.CalculateField_management(file, "AZIMUTH1", azi1Value, "PYTHON", "")
```

```
            arcpy.CalculateField_management(file, "AZIMUTH2", azi2Value, "PYTHON", "")
```

```
            arcpy.CalculateField_management(file, "VERT1", vert1Value, "PYTHON", "")
```

```
            arcpy.CalculateField_management(file, "VERT2", vert2Value, "PYTHON", "")
```

```
            arcpy.AddMessage("Done with file: " + file + ".")
```

```
# Stop the command window from closing until the user presses enter, that way (s)he can see
output etc.
# Forcing input to close the command prompt is a personal preference, and if the user doesn't
want it, feel free to comment it away. If you are running Python 3 rather than 2.6, you need to
change this from raw_input() to input().
print "All done. Press enter to close the window."
raw_input()
```

## ***1.2 Script used to calculate viewsheds***

```
# Import system modules
import os
import arcpy
from arcpy import env
from arcpy.sa import *
import datetime

# Print the starting time, simply used to check how long the script takes to complete.
print datetime.datetime.now()

# Enable file overwrite
arcpy.env.overwriteOutput = True

# Set environment settings
workspace = arcpy.env.workspace = "D:/ThesisData/AsterGDEM2/viewpoints/Pylian500"

# Set local variables
inRaster = "pyliandem"
outPath = "D:/ThesisData/AsterGDEM2/viewpoints/Pylian500/viewsheds/"
outName = "500Pyl"
fileNumber = 0
zFactor = 1
useEarthCurvature = "CURVED_EARTH"
```

```

refractivityCoefficient = 0.13
vsFieldName = "VsDone"
vsDoneMessage = ""Viewshed calculated""

print "This script calculates viewshed based on input raster, observation points and associated
variables."
print "Local variables etc. has been loaded."
print "The workspace is " + workspace + "."

# Check the ArcGIS 3D Analyst extension license
arcpy.CheckOutExtension("3D")
print "3D license checked for and found."

# This loops through every file in the workspace, and if the file ends with .shp it executes the
loop. I would have preferred to use arcpy.ListFeatureClasses(), but it doesn't work with shape-
files which is what I'm currently working with.
for file in os.listdir(workspace):
    if file.endswith(".shp"):

# Create a list with all the attribute fields for the file.
# If the file already has a field called "VsDone", it has already been used in
# a viewshed analysis and should be ignored.
inField = arcpy.ListFields(file,vsFieldName)

if len(inField) > 0:

fileIsUsed = True

else:

fileIsUsed = False

if fileIsUsed == True:

```

```
print "The inputed shape-file (" + file + ") has already been used for a viewshed analysis, the script will therefore ignore it."
```

```
fileNumber += 1
```

```
else:
```

```
# Execute Viewshed
```

```
outViewshed = Viewshed(inRaster, file, zFactor, useEarthCurvature, refractivityCoefficient)
```

```
# Errorchecking
```

```
arcpy.AddMessage("Viewshed for file " + file + " has been done.")
```

```
# Save the output
```

```
strFileNumber = str(fileNumber)
```

```
outFull = outPath + outName + strFileNumber
```

```
outViewshed.save(outFull)
```

```
# Add a field that lets the user know that this file's viewshed has been calculated.
```

```
arcpy.AddField_management(file,vsFieldName,"STRING","","",25,"","","","")
```

```
# Populate the newly created field with values.
```

```
arcpy.CalculateField_management(file, vsFieldName, vsDoneMessage,"","")
```

```
# Increment fileNumber with 1 so that it can be used to properly name all output
```

```
fileNumber += 1
```

```
print "File " + file + " has been analysed."
```

```
print "All done! I think... probably at least. Might want to double-check so that the correct numbers of rasters have been created, just in case you know."
```

```
#Print time and date, simply to check how long the script takes to run.
```

```
print datetime.datetime.now()
```

```

# Stop the command window from closing until the user presses enter, that way (s)he can see
output etc.
# Forcing input to close the command prompt is a personal preference, and if the user doesn't
want it, feel free to comment it away. If you are running Python 3 rather than 2.6, you need to
change this from raw_input() to input().
print "Press enter to close the window."
raw_input()

```

### ***1.3 Script used to add viewsheds together to create a total viewshed***

```

# Import system modules
import arcpy
import os
from arcpy.sa import *

print "This script adds all rasters in the specified workspace and outputs a combined raster."

# Enable file overwrite
arcpy.env.overwriteOutput = True

# Set environment settings
workspace = arcpy.env.workspace =
"D:/ThesisData/AsterGDEM2/viewpoints/Pylian500/viewsheds"
print "The workspace is: " + workspace

# Set output path. However, this does not CREATE a new folder, so make sure that the output
folder/gdb exists beforehand.
outputPath = "D:/ThesisData/AsterGDEM2/viewpoints/Pylian500/viewsheds/totalViewshed/"
print "The output workspace is: " + str(outputPath)

# Just declare save variables etc.'
outputName = "ToVsPyl500"

```



```

totalOutput = outputPath + outputName

# Create a list of rasters in the workspace
rasters = arcpy.ListRasters("*", "GRID")

i = 0
# Loop through rasters in list
for raster in rasters:
    print ("processing raster: %s" %os.path.join(workspace,raster))
    #sum rasters together
    if i == 0:
        outSUM = arcpy.Raster(raster)
        i += 1
    else:
        outSUM = outSUM + raster
        i += 1

# Save final output to the current workspace
outSUM.save(totalOutput)
print "The output has been saved as: " + outputName + ". It is located in folder: " +
outputPath

# Stop the command window from closing until the user presses enter, that way (s)he can see
output etc.
# Forcing input to close the command prompt is a personal preference, and if the user doesn't
want it, feel free to comment it away. If you are running Python 3 rather than 2.6, you need to
change this from raw_input() to input().
print "All done. Press enter to close the window."
raw_input()

```

#### ***1.4 Script used to calculates important attributes for each observation point***

```

# Import system modules

```

```

import arcpy
from arcpy import env
from arcpy.sa import *

# Enable file overwrite
arcpy.env.overwriteOutput = True

print "This tool will extract the VALUE from the input cumulative/total viewshed and create a
shape file with points. The points will have attributes specifying the value from the input
raster and the area of the landscape (within the viewsheds' radius) that can see it, NOT the
area seen FROM the point."

# Set environment settings
workspace = arcpy.env.workspace =
"D:/ThesisData/AsterGDEM2/viewpoints/Pylian500/viewsheds/totalViewshed"
print "The workspace is: " + workspace

# Set local variables
inRaster =
"D:/ThesisData/AsterGDEM2/viewpoints/Pylian500/viewsheds/totalViewshed/tovspyl500"
tempShape =
"D:/ThesisData/AsterGDEM2/viewpoints/Pylian500/viewsheds/totalViewshed/tempShape.sh
p"
outPoint =
"D:/ThesisData/AsterGDEM2/viewpoints/Pylian500/viewsheds/totalViewshed/500PylTotalVi
ewshedAreaPoints.shp"
field = "VALUE"

print "The output will be saved: " + outPoint

# Check out the ArcGIS Spatial Analyst extension license
arcpy.CheckOutExtension("Spatial")

```

```

# Calculate cell equivalent area from input raster
vsDesc = arcpy.Describe(inRaster)
vsCellsize = float(vsDesc.meanCellHeight)
vsCellarea = vsCellsize * vsCellsize
print "Cellarea is: " + str(vsCellarea)

# Execute RasterToPoint
arcpy.RasterToPoint_conversion(inRaster, tempShape, field)
print "The tool RasterToPoint has successfully completed."

# I was unable to get the RasterToPoint-tool to transfer the 'VALUE'-attribute to the file
tempShape, therefore this work-around is used. It is time-consuming and FAR from optimal,
so feel free to make it better!
ExtractValuesToPoints(tempShape, inRaster, outPoint, "NONE", "VALUE_ONLY")
print "The tool ExtractValuesToPoints have successfully been completed, and its output will
be saved."

#Delete the file tempShape since it is not necessary for the calculations
arcpy.Delete_management(tempShape, "")
print "The file tempShape has been deleted."

# Add a field to the file in which to calculate area that can SEE the point, _not_ the area
SEEN from the point
arcpy.AddField_management(outPoint, "SeeingArea", "FLOAT")
print "The field 'SeeingArea' has successfully been added."

# Create update cursor for shape file
rows = arcpy.UpdateCursor(outPoint)

for row in rows:
# Update the field used in based on the value in the field 'VALUE' and the cell size
row.SeeingArea = row.RASTERVALU * vsCellarea
rows.updateRow(row)

```

```
print "SeeingArea has been updated."
```

```
# Information.
```

```
arcpy.AddMessage("All done. Press enter to close the window.")
```

```
# Stop the command window from closing until the user presses enter, that way (s)he can see  
output etc.
```

```
# Forcing input to close the command prompt is a personal preference, and if the user doesn't  
want it, feel free to comment it away. If you are running Python 3 rather than 2.6, you need to  
change this from raw_input() to input().
```

```
raw_input()
```

## Appendix 2 – Graphs

### Pylian tholos tombs in chronological order

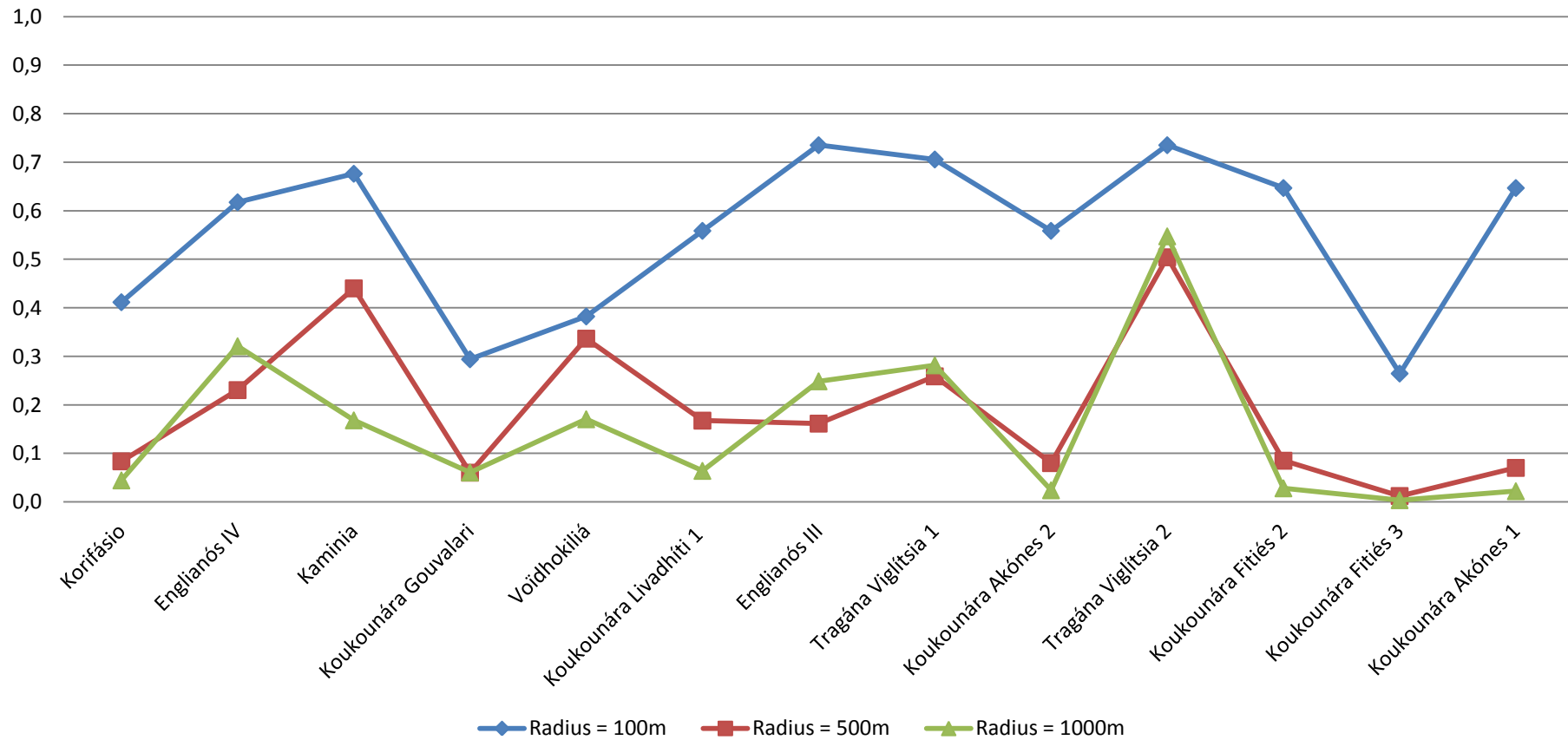


Figure 26. Graph displaying normalised viewshed values of tholos tombs in the Pylian hinterlands in approximately chronological order.

## Soulima Valley tholos tombs in chronological order

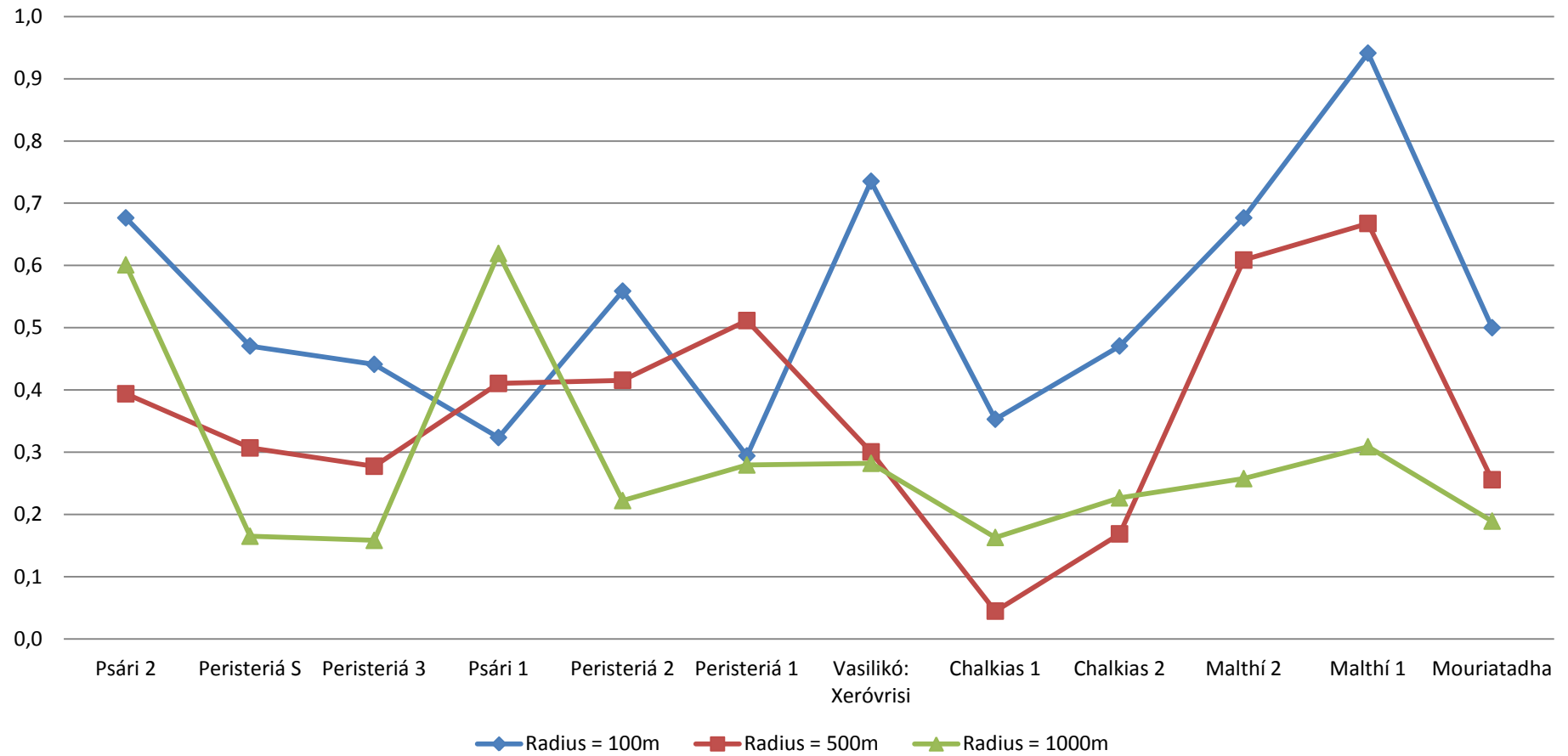


Figure 27. Graph displaying normalised viewshed values of tholos tombs in the Soulima Valley in approximately chronological order.

### Radius = 100 m

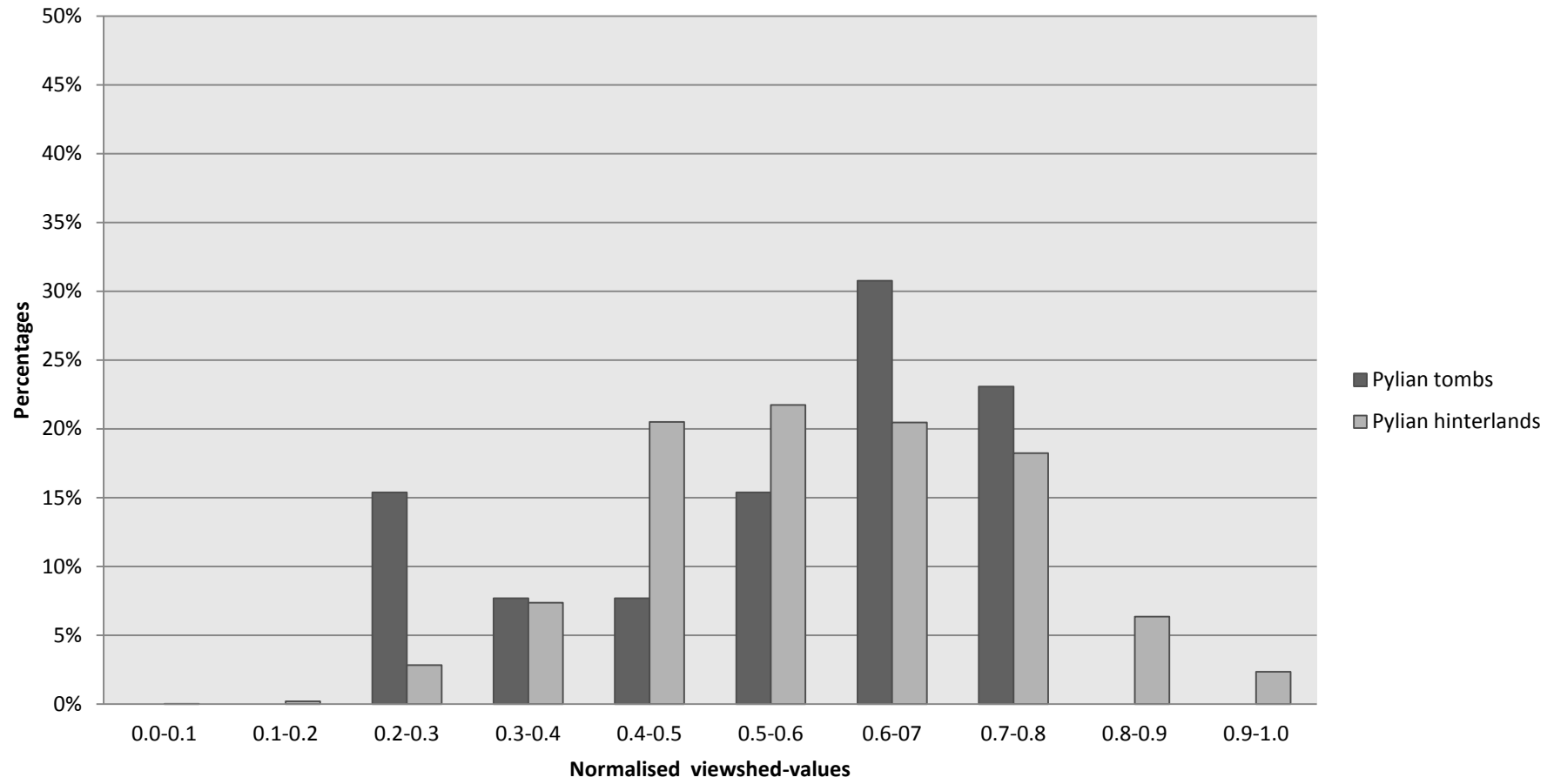


Figure 28. The distribution of normalised viewshed values in the Pylian hinterlands when analysed with a 100 m radius.

### Radius = 100 m

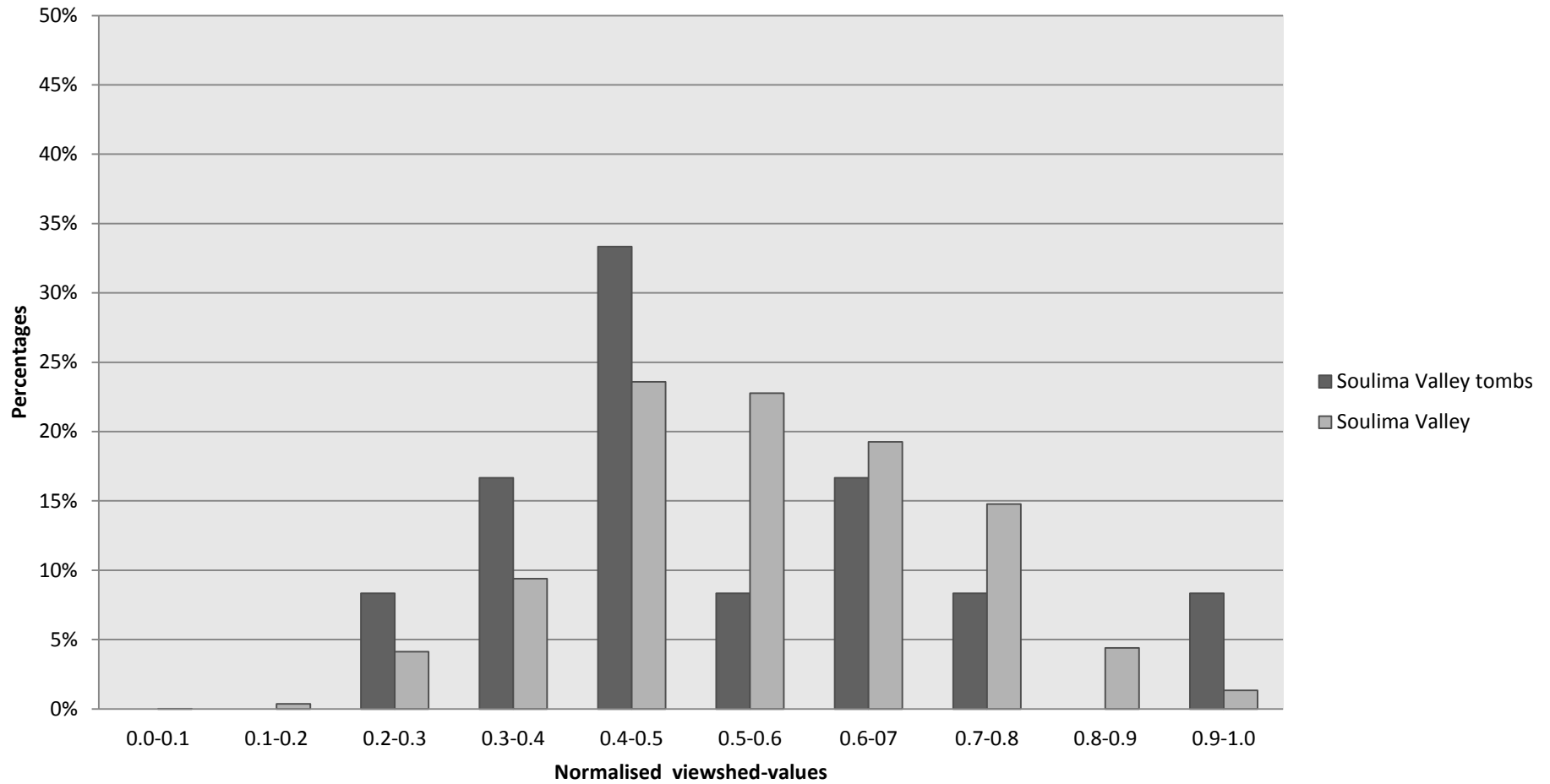


Figure 29. The distribution of normalised viewshed values in the Soulima Valley when analysed with a 100 m radius.



### Radius = 500 m

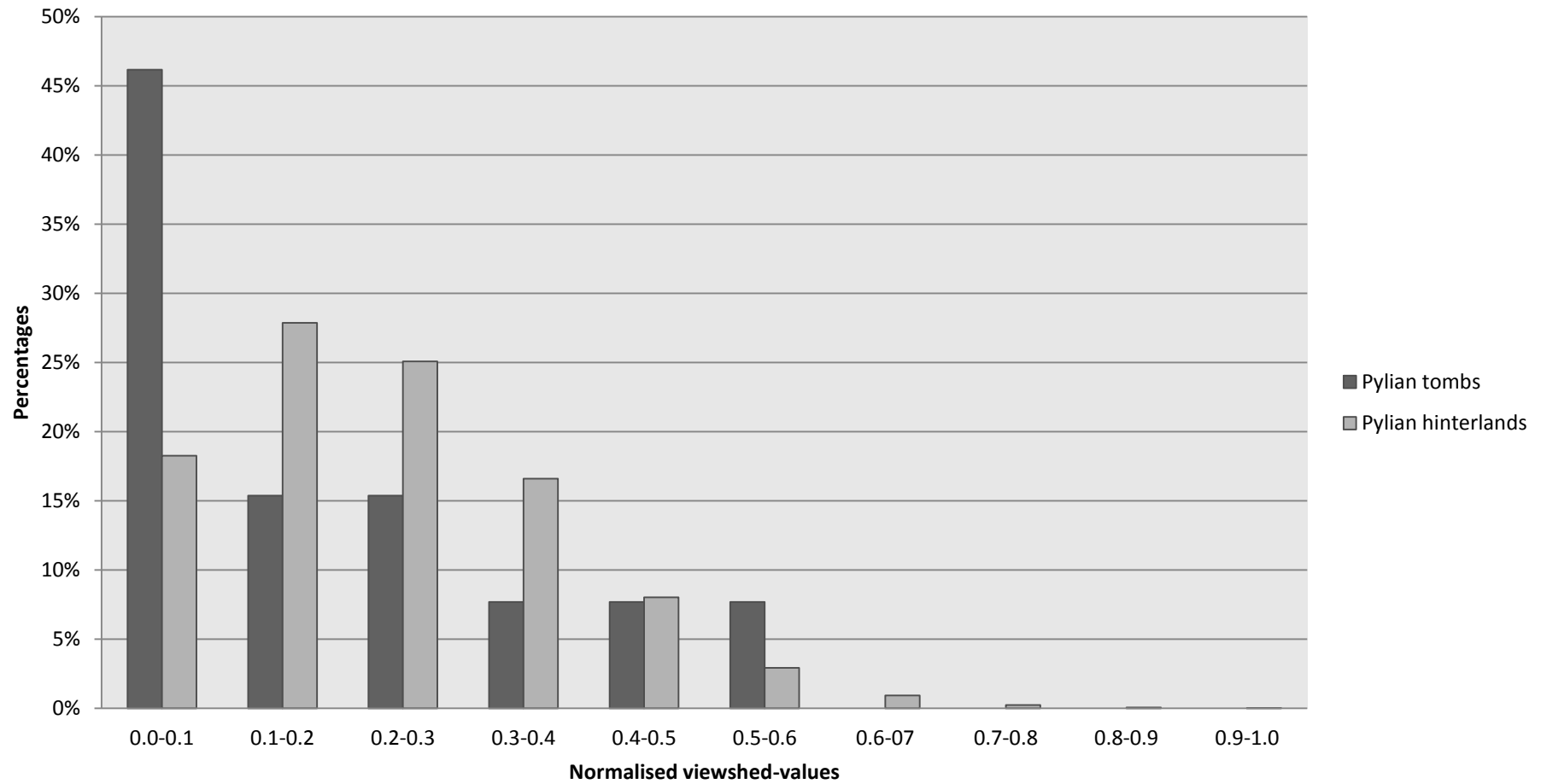


Figure 30. The distribution of normalised viewshed values in the Pylian hinterlands when analysed with a 500 m radius.

### Radius = 500 m

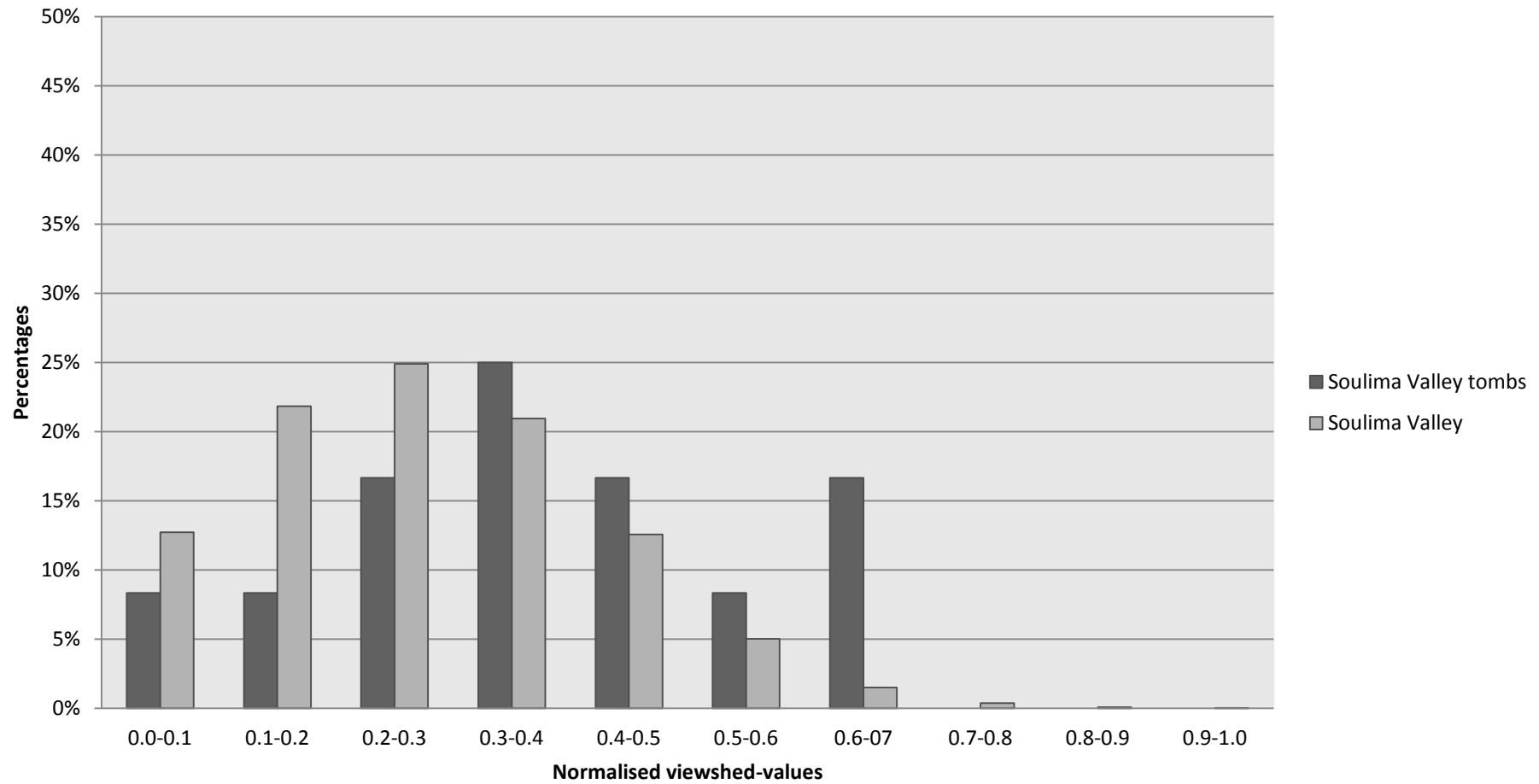


Figure 31. The distribution of normalised viewshed values in the Soulima Valley when analysed with a 500 m radius.

### Radius = 1000 m

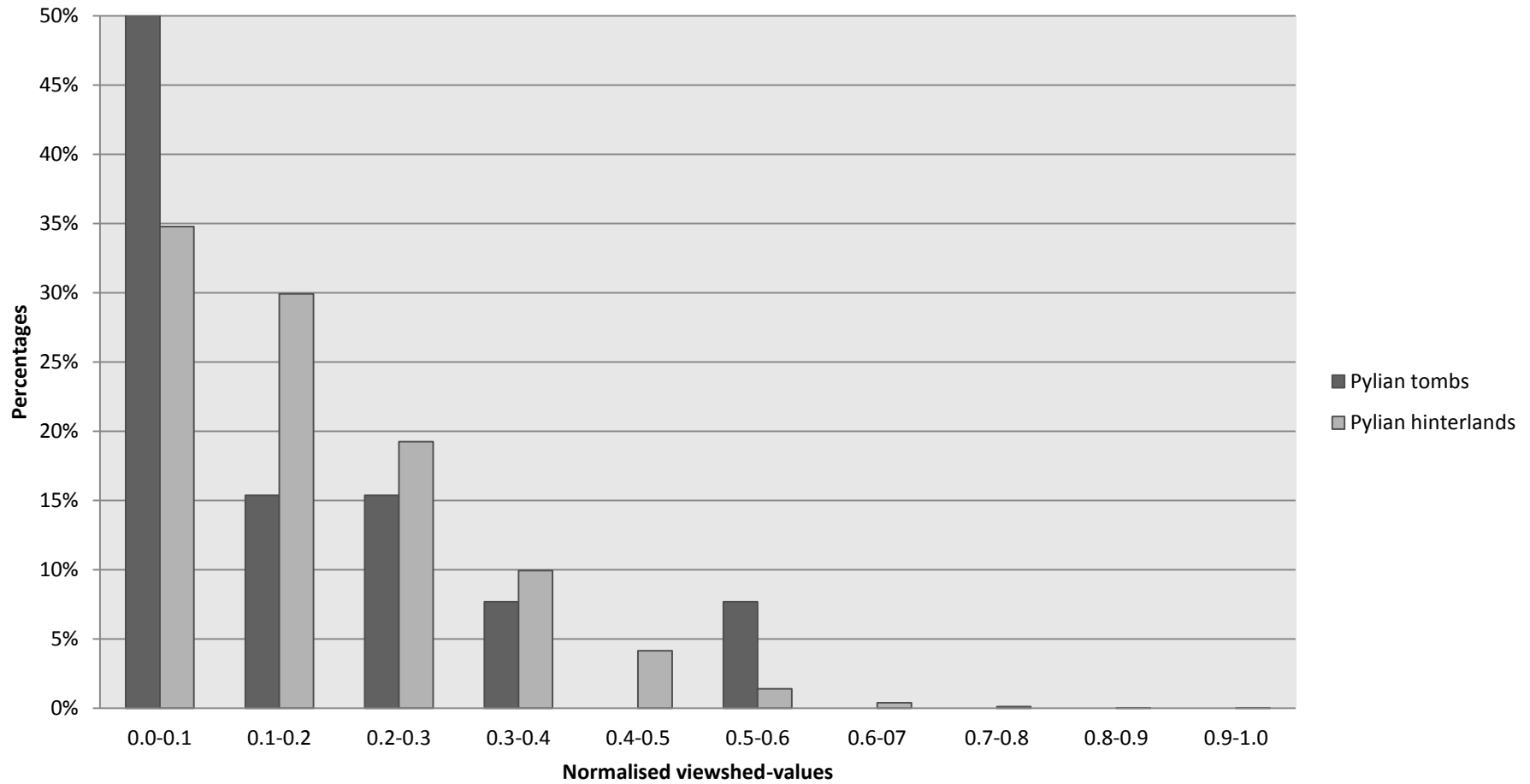


Figure 32. The distribution of normalised viewshed values in the Pylian hinterlands when analysed with a 1000 m radius.

### Radius = 1000 m

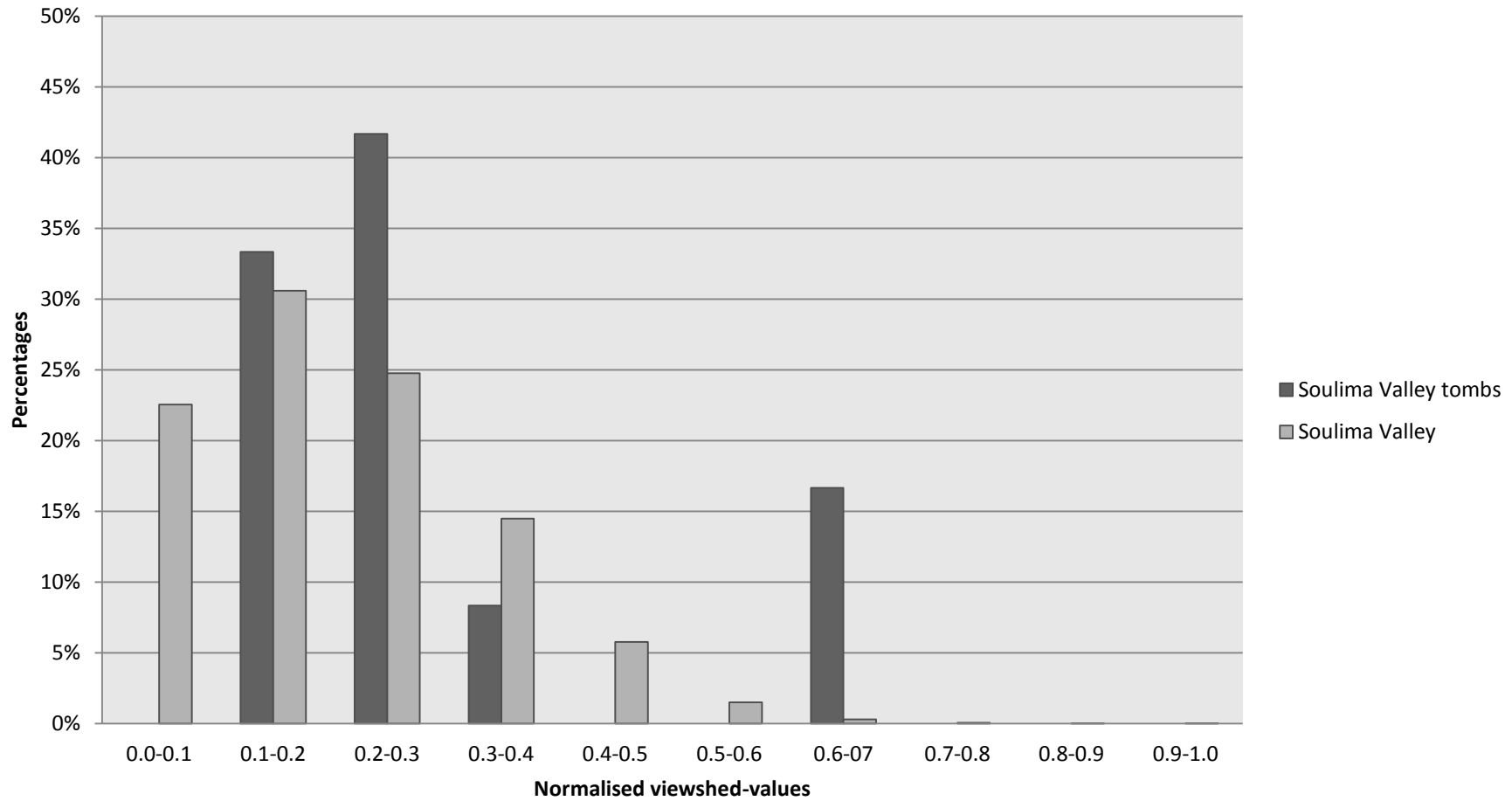


Figure 33. The distribution of normalised viewshed values in the Soulima Valley when analysed with a 1000 m radius.

## Appendix 3 – Previous LUMA-GIS Publications

Series from Lund University

Department of Physical Geography and Ecosystem Science

### Master Thesis in Geographical Information Science (LUMA-GIS)

1. *Anthony Lawther*: The application of GIS-based binary logistic regression for slope failure susceptibility mapping in the Western Grampian Mountains, Scotland. (2008).
2. *Rickard Hansen*: Daily mobility in Grenoble Metropolitan Region, France. Applied GIS methods in time geographical research. (2008).
3. *Emil Bayramov*: Environmental monitoring of bio-restoration activities using GIS and Remote Sensing. (2009).
4. *Rafael Villarreal Pacheco*: Applications of Geographic Information Systems as an analytical and visualization tool for mass real estate valuation: a case study of Fontibon District, Bogota, Columbia. (2009).
5. *Siri Oestreich Waage*: a case study of route solving for oversized transport: The use of GIS functionalities in transport of transformers, as part of maintaining a reliable power infrastructure (2010).
6. *Edgar Pimiento*: Shallow landslide susceptibility – Modelling and validation (2010).
7. *Martina Schäfer*: Near real-time mapping of floodwater mosquito breeding sites using aerial photographs (2010)
8. *August Pieter van Waarden-Nagel*: Land use evaluation to assess the outcome of the programme of rehabilitation measures for the river Rhine in the Netherlands (2010)
9. *Samira Muhammad*: Development and implementation of air quality data mart for Ontario, Canada: A case study of air quality in Ontario using OLAP tool. (2010)
10. *Fredros Oketch Okumu*: Using remotely sensed data to explore spatial and

- temporal relationships between photosynthetic productivity of vegetation and malaria transmission intensities in selected parts of Africa (2011)
11. *Svajunas Plunge*: Advanced decision support methods for solving diffuse water pollution problems (2011)
  12. *Jonathan Higgins*: Monitoring urban growth in greater Lagos: A case study using GIS to monitor the urban growth of Lagos 1990 - 2008 and produce future growth prospects for the city (2011).
  13. *Mårten Karlberg*: Mobile Map Client API: Design and Implementation for Android (2011).
  14. *Jeanette McBride*: Mapping Chicago area urban tree canopy using color infrared imagery (2011)
  15. *Andrew Farina*: Exploring the relationship between land surface temperature and vegetation abundance for urban heat island mitigation in Seville, Spain (2011)
  16. *David Kanyari*: Nairobi City Journey Planner An online and a Mobile Application (2011)
  17. *Laura V. Drews*: Multi-criteria GIS analysis for siting of small wind power plants - A case study from Berlin (2012)
  18. *Qaisar Nadeem*: Best living neighborhood in the city - A GIS based multi criteria evaluation of ArRiyadh City (2012)
  19. *Ahmed Mohamed El Saeid Mustafa*: Development of a photo voltaic building rooftop integration analysis tool for GIS for Dokki District, Cairo, Egypt (2012)
  20. *Daniel Patrick Taylor*: Eastern Oyster Aquaculture: Estuarine Remediation via Site Suitability and Spatially Explicit Carrying Capacity Modeling in Virginia's Chesapeake Bay (2013)
  21. *Angeleta Oveta Wilson*: A Participatory GIS approach to *unearthing* Manchester's Cultural Heritage 'gold mine' (2013)