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# Past Landscapes for the Reconstruction of Roman Land Use: Eco-history Tourism in the Algarve

*“He who’d know what life’s about  
Three millennia must appraise;  
Else he’ll go in fear and doubt,  
Unenlightened all his days”*

Goethe in West-Ostlicher Dewan, 1819

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## Abstract

Over the last 50 years, land use has dramatically changed. Over the past two decades, Remote Sensing imagery and its capacity to observe detailed land use patterns has facilitated a deeper understanding of historical land development patterns. Hence, the goal of this paper is to shed some light on the possibilities of recovering ancient landscapes, by using spatial analysis combined with statistical methodologies applied to archaeological Roman sites in Portugal. The investigation of Roman land use patterns in the Algarve is carried out using density patterns of site propensity based on geographic and topological characteristics. Such a methodology allows a more accurate assessment of what might have been past land use during the Roman period in the Algarve. This experiment is also useful to better comprehend and make a more appropriate interpretation of predictive modelling scenarios. In particular, in our case-study area, to have a share in the Algarve’s archaeological legacy value may be very interesting to the tourist industry because of the possibility to explore more sustainable tourism options rather than the ‘sun and beach’ mass tourism offered traditionally in that region. This may lead to the development of an eco-history tourism product, by recycling existing built environments and creating an opportunity to generate revenues related to historico-cultural assets.

**Keywords:** Ecotourism, Algarve, GIS, Land Use, Survey data, Spatial Analysis, Cultural Heritage, Roman land use

## 1. Introduction

For over two centuries, *“Archaeology has possessed strong conceptual divides between data collection and data analysis, manifested most obviously between excavation and post excavation activities”* (Conolly and Lake, 2006). Material evidence has led to collection of spatial data related to anthropogenic and archaeological subjects (Renfrew and Bahn, 2004). Archaeological material evidence, as is the case for archaeological sites with specific spatial characteristics, has a very unique spatial dimension. The combination of anthropogenic sites at a spatial level helps modern man to understand his origins: *“(…) human behavior consists of people-artifact interactions at various scales, and then research questions in the social and behavioral sciences should be reformulated to include a more symmetrical understanding of people and artifacts. One can no longer be satisfied to analytically separate people (and the “social”) from their material matrix. All human activities simultaneously involve interactions in the life histories of artifacts and participation in cadenas. Separating human behaviour from artifacts always results in neglect of the latter”* (Walker and Shiffer, 2006).

The classical Roman Empire was well-established in the southern region of Portugal, the Algarve, where a rich historical and archaeological legacy remains. Since the 19<sup>th</sup> century, those studying the region have been interested in gaining a better understanding of the Roman socio-economic activity in the area. The region itself has been a cradle for past civilizations, where its favourable geographic location has led to commercial and agricultural benefits since the Neolithic period. By combining a large

amount of (although scattered) site information, Roman land use becomes a source of archaeological insights with ancillary environmental characteristics.

Such environmental characteristics, as well as georeferenced site information, may easily be analysed by means of Geographic Information Systems (GIS). The combination of GIS-related logistic regression properties can reveal patterns of Roman land use. The use of such technologies to 'revive' past land use, may be very valuable both for historians wishing to better understand cultural complexity (Kvamme, 1990) and for the development of new tourism products, such as cultural heritage tourism. This agenda puts archaeology in perspective, not only as a historical domain but also as a sub-area of regional planning and urban growth.

There is a certain social efficiency in recovering the past to value the present. First, the roots of local and regional history often become better remembered, and, secondly, by sensitizing society to the existing heritage, and by offering interesting solutions to meso-economic problems, sustainable and more integrated directions of regional development may be achieved.

The circular flow model proposed by Tribe (1995) in Figure 1 clearly focuses on the consequences of tourism and the use of sinks/sources relating to environmental capacity. The circular flow model shows the consequences of permitting the accumulation of wealth from the production of goods and services and the exploitation of resources. The relationship between the production of goods and services and the utilization of resources necessary for this, combined with the scarcity of

resources, defines the carrying capacity of the environment. Such consequences lead inevitably to land use change, pollution and the vulnerability of ecosystems, and thus sustainability is comprised.

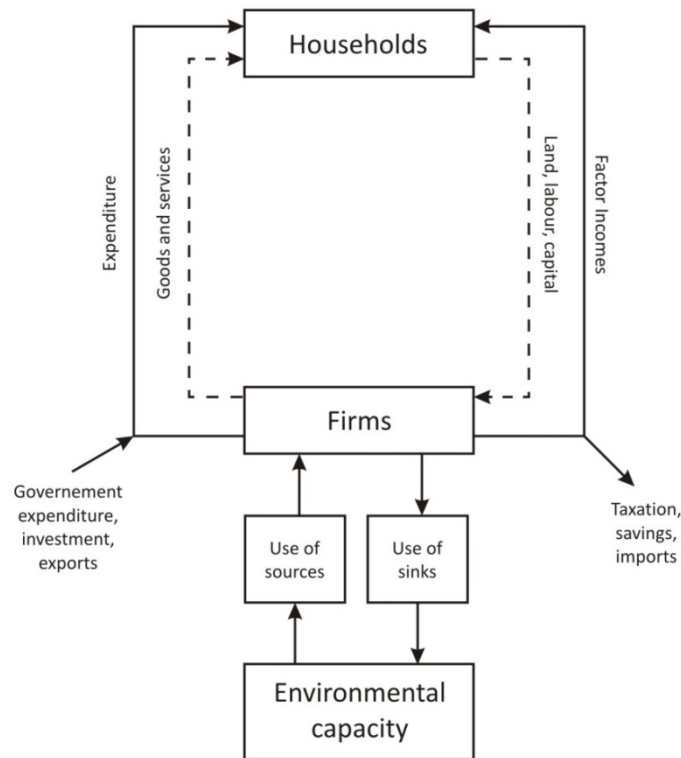


Figure 1 – Environmental capacity and the circular flow model (adapted from Tribe, 1995)

The understanding of cultural legacy at the regional level starts with the application of spatial technologies in the context of detecting patterns of land use, in relation to the regional dimension of land use planning. Although usually left unconsidered for planning purposes, archaeology does have an important role and has long relied on survey data to facilitate the historic understanding of past civilizations. Thus, articulation of survey data brought from archaeology in the context of economic and spatial analysis is both an unprecedented and important task.

Predicting past land use scenarios unavoidably carries a certain degree of spatial uncertainty. However, surveyed archaeological site information not only allows the historical understanding of man's past activities to be questioned but also helps to recover local tradition and culture in a given region for a specific 'place in time'. By recovering historical tradition, it may be possible to revive the past, as well as to set in motion interesting trends for future sustainable development (Holtorf, 2008) in order to avoid excessive exploitation of economic resources.

## **2. The Historical Algarve**

The Algarve region comprises a total area of 4899 km<sup>2</sup> which represents 5.5 per cent of continental Portugal and is the most southerly region in Portugal. It is surrounded by the Atlantic Ocean to the South and West, and to the North a massive mountain range, the *Serra do Caldeirão*, separates it from the Alentejo. This basic morphology of the region has had a profound influence on its more temperate micro-climate compared with the rest of Portugal, contributing to a particular vegetation and wildlife in a unique habitat for many species. From a geomorphological perspective, the Algarve has three distinct layers of indigenous cultural, vegetative and ecological characteristics.

The location of the *Serra do Caldeirão*, is known as the *Barrocal*. As suggested by Malato-Beliz (1986) "(...) because of its climate and soil conditions, the Barrocal area has a very peculiar distinctive coverage, whose floral composition and grouping, if not

*exclusive, are certainly rare outside of this region.”* South of the *Barrocal* is the *Interior*, while the massively populated region along the coast is known as the *Litoral*.

The lack of transportation networks has to a certain extent meant that the degradation of the *Interior* and *Barrocal* has been avoided. However, since the 1960s the coastal region has been affected by the mass tourism industry. This has led to great landscape pressure and urban growth, resulting from population increases due to local economic prosperity and the availability of seasonal jobs. Consequently, a remarkable contrast is found in the Algarve: the southern Algarve is highly populated and has extensive urban areas. Influenced by the economic development in the Algarve, the original scenic landscapes that were once characterized by picturesque whitewashed houses are becoming forever lost as a result of unprecedented city growth (Vaz and Nijkamp, 2008). Nevertheless, some kilometres north of the long stretches of modern buildings, a more remote and ancestral Algarve beckons as an interesting opportunity to reshape the predominant hotel and tourist package offers.

As a result of its privileged geographical and topographic characteristics, the Algarve has been of great economic importance since pre-Roman times (Gamito, 1997). Its unique location as a port for the Mediterranean areas (including Northern Africa) with its moderate climate and its well-charted waters, which allowed easy access to the lush pastures of the area formerly-known as Lusitania, was already acknowledged centuries ago by Strabo (Strabo, 2007).

With its high Neolithic presence (Nocete et al., 2005; Ramirez et al., 2007) and several Bronze Age settlements, there has been archaeological interest in the region since the 19th century, first shown by archaeologists such as Estácio da Veiga who, among others, catalogued and described a wide range of archaeological findings in the region. The Algarve in the Roman period is well-documented (Santos, 1971; Alarcão, 1974; Teichner, 1994; Bernardes and Oliveira, 2002). The built-up heritage from the classical Roman period is still observable in the vicinity of the coastal cities. In the coastal areas many *cetarias* (rectangular stone vessels) have been found. These vessels once contained a typical Roman fish spice, *garum* (Curtis, 1991; Étienne and Mayet, 2002), widely produced along the Algarve, and exported throughout the entire Roman Empire. The production of *garum* in southern Hispania has been identified as a key element to the Algarve's economic success during the Roman period (Edmondson, 1990; Osland, 2006).

The former area of *Lusitania* prospered from the reign of Augustus until the end of the Antiquity. Major Roman *civitates* (cities) such as *Ossonoba* or *Cilpes* were fortified and reoccupied during the Moorish period. As a consequence of this heterogeneous mixture of styles, the Algarve shows a variety of Moorish, Roman and Christian heritage within its cities' urban limits. Former Roman cities such as *Ossonoba* and *Balsa*, as well as the ruins of *Milreu* in *Estoi* or the ruins found in Vilamoura (*Cerro da Vila*), were economically important during this period.

Also, the abundance of the classical Roman period is visible by the in rich legacy monuments. Many of the mosaics which adorn the monuments have nautical motifs,



accompanied by a profusion of sea creatures and Gods. Such heritage presents a unique ecological vision of the Algarve as a coastal area of the past. Furthermore, it is endowed with an aesthetic dimension composed of the actual landscape together with its cultural archaeological heritage.

### **3. Archaeological Information Systems**

Despite the rich historical legacy, past land use has not been much explored in the Algarve. However, the availability of archaeological catalogue and geo-information data, concerning the environment and supported by geo-statistical inference, enables a better understanding past land use patterns. As the causal relations between georeferenced sites are established, environmental and geographical characteristics can help to recover spatial dimensions of archaeological evidence.

As mentioned earlier, the large quantity of *cetarias* found in the Algarve region show that the region was once a proficient producer of *garum* (Silva, 2007). Overall, the Algarve in Roman times seems to have been an area of economic wealth, based on this production which was distributed to the entire Roman Empire, as well as being a place of leisure and worship of deities. Such socio-economic niches seem to be common throughout the entire southwest region of the Iberian Peninsula.

Understanding Roman land use depends on survey data resulting from almost two hundred years of Roman archaeological investigation in the Algarve. The distribution of material evidence results from the spatial location where the archaeological survey

occurred, based on archaeological excavations. The collection of this spatial information has enabled a database to be compiled with 452 occurrences of archaeological sites excavated from 1910 up to 2006.

The archaeological sites were interpreted in our study by employing a GIS which uses the Universal Transverse Mercator (UTM) as a geographic projection. Georeferenced archaeological sites were classified into socio-economic categories of Ceramics, Mosaics, Coins, Iron, and Epigraphs. The combination of the spatial location of material evidence and environmental characteristics enabled a spatial assessment of Roman land use. Geographic Information Systems (GIS) have an important role in regional development and planning (Douven et al., 1993). Not only do GIS represent systems to access, analyse and represent data (Longley et. al. 2006), but they are also able to cope with different data sets which allows quantitative methodologies to be used within various human sciences (Wheatley and Gillings, 2002).

A further topic in which GIS is having great impact and which is considered to be as useful as radiocarbon dating (Westcott and Brandon, 2000) in archaeology. Since the beginning of processual archaeology, material evidence obtained from archaeological excavations has had a key role in the interpretation of material culture (White, 1959). Because of their inherent spatial character (Schiffer, 1972), past activities based on spatial archaeological data become easier to understand (Hodder, 1972). Technological advances, statistical approaches, survey methods, and available information have become more important supporting methodologies for 'quantifying archaeology'.

Although the consequences of environmental determinism are sometimes viewed with a certain scepticism (Burns, 2007), in a regional planning context, environmental determinism in archaeology may be overcome for the following reasons: (1) the possibility to observe past land use has shed light on road networks which lead to monuments of historic interest; (2) the context of historic urban and regional planning differs largely from traditional archaeological subjectivity; and (3) the articulation between tourism and archaeology or cultural heritage leads to a fusion of areas in which spatial environmental determinism already exists because of available infrastructures that complement the provision of the already available tourist industry.

Over the years, archaeology has greatly benefitted from spatial analysis and surveillance by Remote Sensing techniques, as well as Database management and GIS in general (Connolly and Lake, 2006). The ubiquity of areas in which archaeology benefits has such a broad spectrum that the correct manipulation of data and research of collected material is often complex. Such complexity involves many different actors with different needs and demands within the archaeological subject. Information should allow the creation of innovative scientific processes, involving different actors in the archaeological frame. In a combined information flux, anthropologists, conservationists, field archaeologists, GIS experts and cultural heritage managers, among many others, could work together to combine their information in an interdisciplinary way. Such an objective can only be achieved with a robust system that supports many different types of tasks and workflow levels.

The quantification of information in the human sciences is not always an easy process as quantifiable and technological processes are limited. However, some human sciences such as sociology, geography, anthropology and archaeology, have felt the need to dissociate themselves from the strictly qualitative sciences. Given the pragmatic character of real-world phenomena (whether past, present or future), nature retains certain aspects of quantitative relevance. Such aspects of quantification are being explored by a handful of what are known as human sciences, and have brought a convergence between mathematical, social and statistical methodologies.

Attempts to provide quantitative and qualitative integrated future knowledge have led to lively debates such as the Dahlem Workshops<sup>1</sup> where quantitative and qualitative information combined have set the tone for new paradigms of a common sustainable future (Costanza et al., 2006).

For archaeology an interest in quantitative and technological methodologies is justified by the possibility of quantifying material evidence (Doran and Hodson, 1975). With the evolution of archaeological science and GIS, the latter has developed into more user-friendly platforms which allow spatial interpretation. Nowadays GIS represent an important tool for analysis, comparison and the investigation of archaeological phenomena and information (Connolly and Lake, 2006). Thus, archaeological catalogues have developed from simple registries into large data containers with

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<sup>1</sup> Dahlem Workshop Goal: To understand better the dynamics between human societies and their environment by linking various forms of knowledge on human history and environmental change at multiple temporal scales (millennial, centennial, decadal and future scenarios).

information that may be created, retrieved, eliminated and changed, and facilitated by GIS.

The conditions for a database management system were established in the field of archaeology in order to enable the integration of information related to archaeological site phenomena. Nowadays, an archaeological database is not just advantageous for archaeological registry, but is also an important tool for information management and retrieval, thereby permitting the generation of a knowledge flow between the different actors engaged in the archaeological sciences. Technologically, archaeological information demands the physical storage properties of databases. The resulting databases with information centrally stored, keep data consistent and standardized over a multi-user support for data input and output.

The construction of an accurate and complete database is not always an easy task, as linking different actors is often not a standardized process and needs effective assembly. Henceforth, the relation between the abstract concepts of a logical archaeological database and the execution of operational support demands precise technical methods. Next, Section 4 explains the creation of such a framework for Portugal in an operational data experiment designed to identify Roman land use in the Algarve.

#### **4. *Endovélico*, a Portuguese database management system for archaeology**

In 1989, the first attempt was made to create a map of archaeological findings. Nevertheless, it was only in 1995 that this map (*Carta Arqueológica de Portugal*) was actually compiled. This initiative became the responsibility of the Portuguese Archaeological Institute in 1997. Thus, as of this date, this map has been recognized as an important landmark in the present information to support archaeological preservation in Portugal (Divisão de Inventário do Instituto Português de Arqueologia, 2002). A contextual framework, driven by the main objective of the Portuguese Archaeological Institute to “*detect, protect and manage archaeological vestiges*” (Decree no. 117/97, May 14th, Paragraph 1A, Article 2), reinforced this achievement. As an important event in the national archaeological framework, the Archaeological map (*Carta Arqueológica Portuguesa*) became a recognized asset for the validation and confirmation of research and excavations.

The archaeological information available in the *Carta Arqueológica Portuguesa* is organized into a database named *Endovélico*. This database allows the addition of current research, as well as spatial validation of past site information. The context of information systems from an archaeological perspective generates synergy among institutions and stakeholders. Thus, *Endovélico* may prove to have a central role in archaeological preservation and archaeological excavation in Portugal. Moreover, it is important to provide a common ground for the ubiquity of archaeological information.

Figure 2 is a graphical representation of the conceptual workflow of all the attributes stored in the *Endovélico* database. The structural relations are separate from the occurrence of archaeological sites, and have a central role in the evolution of scientific as well as other important research. As sites are supported by bibliographic research, as well as fieldwork, people as well as institutions become an inherent part of the workflow process. Institutions, on the other hand, play an important role in proactively defining new projects to enrich the scientific work field and create new documents, reports or ancillary scientific processes, and, as a result, inherent spatial dimensions might be framed in a Geographic Information System. The location of institutions and people as well as the location of sites, share important spatial dynamics which are stored in the *Endovélico* and supply a coherent validation of Archaeological data, as facilitating intra-institutional cooperation.

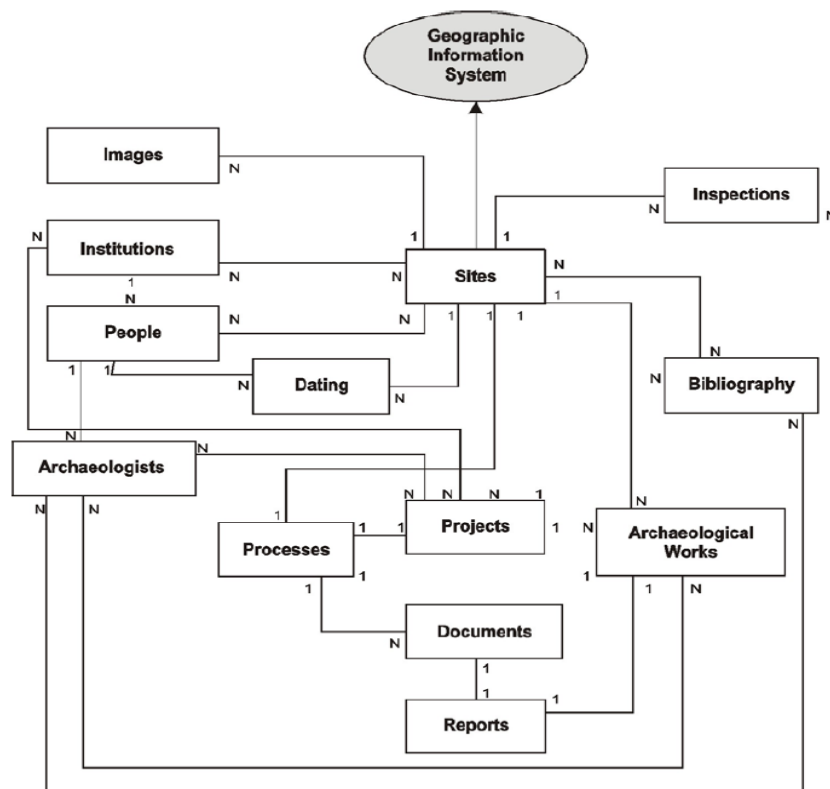


Figure 2 - Simplified ER Diagram of Endovélico (adapted from Divisão do Inventário do Instituto Português de Arqueologia, 2002)

## 5. Roman land use in the Algarve a predictive modelling approach

The Roman land-use prediction model for the Algarve was calculated by combining environmental variables with available archaeological material evidence. Furthermore, statistical inference on site location allowed a generalized land use propensity to be established (Kvamme, 1988).

After choosing a region of a total area of 5x5km, a digital elevation model was generated to allow the calculation of slope and direction. The cost surface corresponding to the prediction of higher Roman activity propensity was based on the combination of those variables within a quantification standard of site densities (Figure 3), brought from the *Endovélico*-confirmed regional data set.

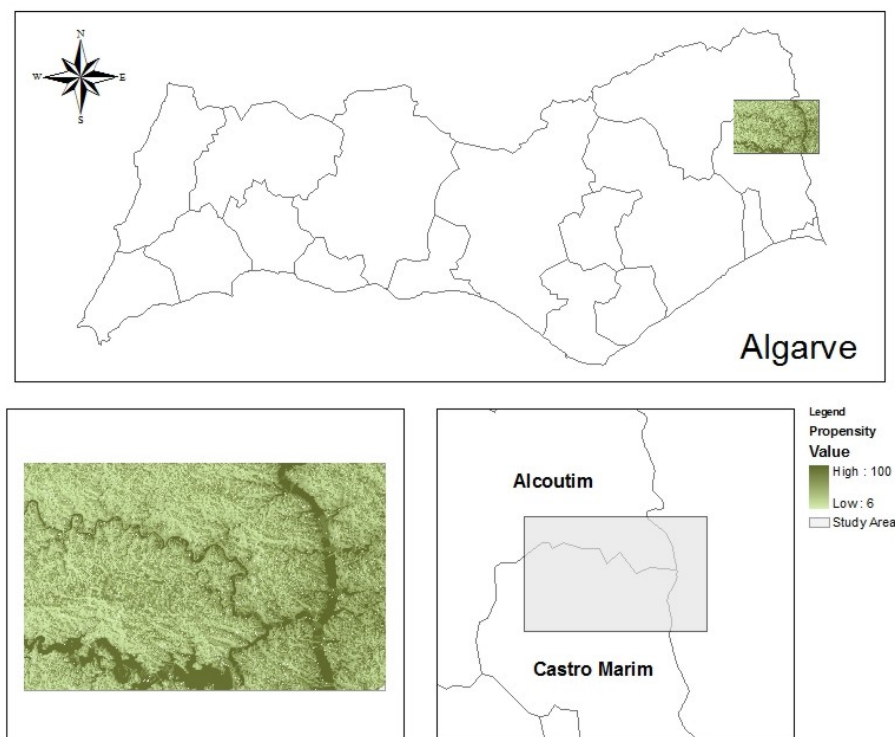


Figure 3 – Overview of study area with propensity for Roman heritage



As archaeological activity is supposed to reveal Roman behaviour, information regarding elevation from the digital elevation model (DEM) provided a solid methodology to calculate other environmental surfaces (Miller and Barton, 2008; Hayakawa and Tsumura, 2009). The variation of weights related to the presence or non-presence of Roman remains depending on spatial location permitted us to generate specific weights based on a logistic regression of weight behaviour throughout distances. The combination of those aggregated classes generated the propensity for the potential to find future archaeological sites and Roman land use.

As may be observed in Figure 3, a greater potential for finding Roman remains exists in the area with low slope and lower elevation. Such conclusions are interesting, as this resembles contemporary settling preferences in contemporary urban growth, i.e. the vicinities of river basins or coastal shores, which establishes an interesting correlation between past and present human behaviour as well as the central role of past land use traditions.

The accuracy of the land use model was investigated in a more regional context, making the following assumptions: (1) Roman settlement preferences are linked to higher elevations and shade; (2) south or north facing locations are preferred for human activity; (3) and so is proximity to river basins and coastal bodies of water. A generalized propensity model was next established via the comparison of the generated 5x5 km model, within a lower resolution spatial area. NASA's Shuttle Radar Topography Mission (SRTM) digital elevation model (DEM) with 90m spatial resolution

was used to calculate weights for comparable environmental characteristics. Table 1 shows a comparison of the accuracy and similarity of the observed sites in both scenarios.

Table 2 – Weight Matrix of variable criteria for site propensity

	High Spatial Resolution		Accuracy	Weight
	Classified	Non Classified		
Elevation (48-120m)	11	8	0.578947	79
Slope (0 - 33%)	14	5	0.736842	100
Aspect (North and South)	9	10	0.473684	64

A propensity map for regional comparison was generated by structuring a propensity equation with relative weights of elevation, slope, and aspect. The resulting formula may be expressed as follows:

$$P = (w_1X_1+w_2X_2+w_3X_3)/N,$$

where w1, w2 and w3 represent the relative accuracy for each of the variables, and where x1, x2 and x3 show the respective landscape variables used. It appears that most archaeological sites may be found in the 80-100% interval of the archaeological site potential (Figure 4), which supports the accuracy of generalizing local scale sites to a more regional scope of analysis.

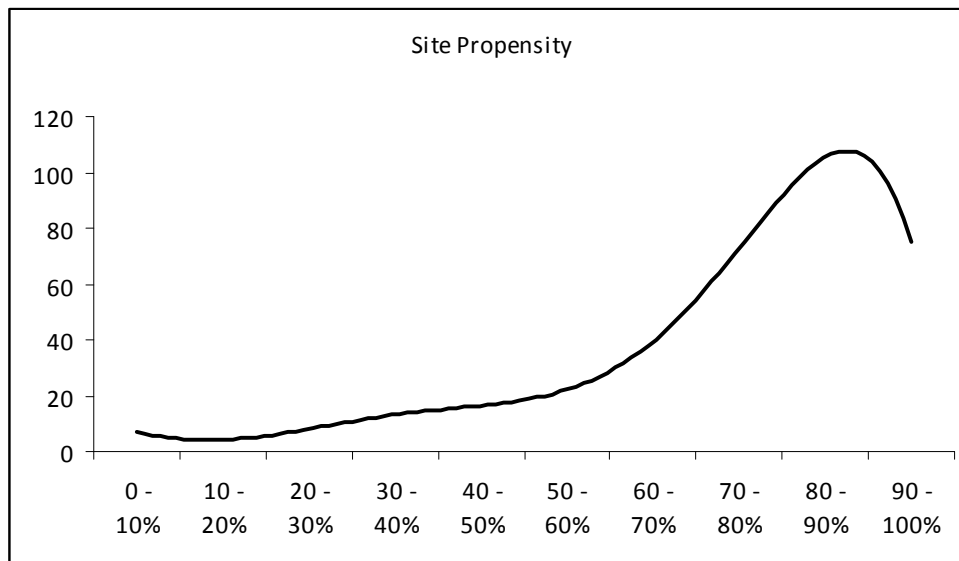


Figure 3 – Overall site propensity for Roman sites in the Algarve

## 6. Conclusions on Archaeological Predictive Models

By comparing the propensities generated by local and regional models in our study, it was possible to determine the influence of scale in the archaeological predictive context. Comparing the model accuracy, we have witnessed the possibilities of combining local spatial strata into a more aggregated macro-analysis level. Our information combined stochastic methodologies leading ultimately to a generalized framework of Roman land use propensity. Some interesting questions were raised by this analysis: (i) possibilities of combining smaller and higher scales of study, as spatial patterns seem to be constant over regional territory for anthropologic behaviour. The use of smaller scales may further allow the breakdown of the areas into simpler and more homogeneous units which would lead to higher data consistency, although this issue is often neglected by the archaeological community (Bevan and Conolly, 2009);

(ii) calculated cost surfaces of Roman land use have confirmed that Roman land use and settlement occur in proximity to river basins; (iii) the spatial orientation that human settlements might have had obviously plays an important role in geo-archaeological circumstances.

## **7. Conclusions on policy choices for eco-history tourism**

The Algarve has experienced a rapid increase in its tourist industry since the beginning of the 1960s. Exploration of the tourist product related to 'sol e praia' ('sun and beach'), strongly focused on the exploitation of coastal landscapes (Cunha, 1993), has inevitably led to an increasing fragility of littoral ecosystems. The increasing vulnerability of marine ecosystems has been brought to light in particular as a result of the rising number of hotels and resorts. However, the depletion of scarce ecosystems in order to create leisure products should be analysed critically from the perspective of the dynamics of the carrying capacity of the ecosystem itself (Tribe, 1995).

Tourism in the Algarve currently faces several competitors regarding tourist products, as low airfares encourage tourists to visit more tropical destinations, with unrivalled 'sun and beach' attractions. Choosing other tourist products such as historical tourism/cultural tourism relating to the rich fauna and flora of the region, would enable the Algarve to explore a new concept of eco-history tourism, which would provide a more competitive and less environmentally-exhaustive alternative. Clearly, the availability of a rich cultural heritage that is not located in the areas of current fragile coastal ecosystems brings an interesting opportunity to relieve tourist pressure

on the littoral areas. The creation of new tourist attractions inherent to the richness of the region and based on existing and renewable resources seems to be an immediate answer to sustain tourism in the Algarve.

Thus, evidence of Roman land use in the Algarve and the existence of an abundant Roman historic legacy suggest that this regions should be promoted as a route of Roman past portrait in a typical Mediterranean landscape, and thus an opportunity for a new kind of tourist product<sup>2</sup>. Furthermore, recent studies (Campos Carrasco et al., 2008) describe the rich collection of Roman mosaics found in the southern part of the former region of Hispania (Algarve and South-Andalusia) which emphasizes the relevance of this area as one of the Roman Empire's poles of cultural heritage. If archaeology and the tourist industry were to collaborate in joint initiatives, then the role of scientific information would be to underpin the concept of eco-history tourism. This might represent a more ecological alternative by avoiding the consequences of the mass tourist industry and supporting an environmentally-benign, historical landscape.

This paper has suggested a new approach to define an innovative area for the tourist sector: eco-history tourism. On the one hand, this tourist product relies on scientific information (such as archaeological predictive models), and, on the other, factual information on archaeological sites (by use of databases) to confirm relevant patterns

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<sup>2</sup> A good example to illustrate the first steps in such a direction is the project MOSUDHIS ("Roman Mosaics in the southeast of Hispania: Andalusia and Algarve", European Community INTERREG III-A, Measure 2.4, Axis II, URL: <http://www.cepha.ualg.pt/mosudhis/>). By combining spatial information and touristic information within a framework of scientific archaeological research is developing a new type of touristic product.

of past land use in regions. This information supported by scientific findings may help to market regions on the basis of their archaeological legacy, offering a cultural tourism alternative which is an interesting solution for developing conservation and cultural sustainability alternatives. In the Algarve, such a product would adapt quite well, given the already-existing tourism infrastructures. In regions such as the Algarve, with a diverse and attractive fauna and flora, ecotourism is likely to do well, while simultaneously offering a past identity to the region focused on the existing historic monuments and archaeological heritage.

The re-equilibrium of the asymmetric spatial properties of tourism in the Algarve demands new solutions to provide an attractive alternative to the mass tourism industry in the region. More attention to carrying capacity of existing infrastructures, whether natural or artificial (monuments and archaeological heritage), should be given (see also Coccossis, 2004). Lessons to be heeded are thus:

- Mass tourism exerts pressure on land use and affects natural and land resources. Therefore, the trade-off of providing a new tourist product in the Algarve related to ecotourism and cultural heritage may rebalance an already overexploited resource;
- A profound awareness of impacts is necessary to comprehend more fully the actual state of local and micro-scale degradation due to tourism in the Algarve. As the coastal area seems clearly affected, Pressure-State-Response<sup>3</sup> will lead necessarily to solutions which would spatially protect the resource.

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<sup>3</sup> The Pressure-State-Response is an Environmental deterministic framework which measures existing environmental pressures (pollution, urban degradation, etc.), current state (How much pollution? What areas are degraded?), and policy responses (What can be done and how?) in a given location.

The resources available in the Algarve are many, and policy options regarding sustainability must have consideration for the environment. This paper has demonstrated the possibility of bringing alternatives of sustainable tourism to the Algarve. As highlighted in the proceedings of *Património e Turismo* ('Heritage and Tourism', 1999) by the coordinator of the national increment programme of cultural tourism: "*Heritage tourism is a growing demand at national and European level that should be cherished and protected, while vitalized as an interesting alternative for tourism and development*".

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