The Umayyad Period in Jordan: ArcGIS as Story Teller

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Abstract

As GIS technology matures, our understanding of its potential to tell stories continues to grow. This is particularly important in archaeological contexts, where entire histories are built around artifacts that represent a very small percentage of the lives of ancient humans. This paper uses a series of spatial analyses to tell the story of the Umayyad period in the region of Tall al-Umayri, Jordan. Often characterized as a collapsing culture, the Umayyad period in Jordan is undergoing a retrospective renaissance. This study used ArcGIS to analyze settlement patterns, subsistence strategies, and social relationships during this period. Results suggest a dimorphic economy, split between field agriculture and herding, with closer ties to Byzantine subsistence strategies than many have thought. These results provide an important window on this period of transition between the Byzantine and Islamic worlds in Jordan.

Introduction

The purpose of this paper is to tell the story of the Umayyad period in the vicinity of Tall al-Umayri, Jordan. This is not an easy thing to do as there are no large sites in the Umayri hinterland that date to the Umayyad period. The only excavated material is a salvage excavation of an agricultural complex. This means that most of the story will be based on surface collections from small sites in the region. This is further complicated by the fact that although I am well acquainted with the Umayri hinterland, I am not an expert in the Umayyad period, having spent most of my archaeological energy writing (hi)stories about the Iron Age.

So what is the point of this paper? I am hoping to show that even when faced with significant disadvantages it is often possible to tell a good story. For this study spatial technologies, primarily a geographic information system (GIS), were brought to bear on the Umayyad material in the region of Tall al-Umayri. A series of analyses were conducted and the results were combined with non-spatial information to tell the story of two very different groups of Umayyad period sites, and the people who inhabited them.

The following discussion will begin with an introduction to the Madaba Plains Project (MPP), the archaeological data from the Tall al-Umayri hinterland, and the GIS that manages these data. Following this, the discussion will look at what we know about the Umayyads in the Umayri

hinterland before undertaking GIS analyses of settlement, subsistence, and social interaction in the Umayri hinterland as a way to tell the story of the Umayyad period.

Madaba Plains Project

The Madaba Plains Project is a large scale, diverse archaeological and ethnographic project that has been working in Jordan since 1968, concentrating on the area between Amman to the northeast and Madaba to the southwest. Figure 1 shows the location of the MPP's current survey regions in relation to the major cities of Jordan. To the north of the project area is the heaviest population zone of the country, to the south population becomes increasingly sparse. This shift from high to low population mirrors a change in the environment, which becomes increasingly marginal to the south. This zone of transition between Amman and Madaba has proven an excellent location in which to examine the relationship between archaeological sites and changing environmental zones.
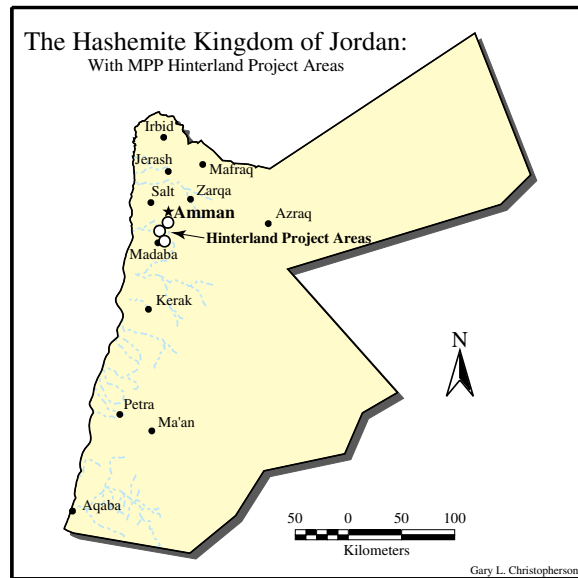
Figure 1: The Hashemite Kingdom of Jordan, showing the location of MPP hinterland project areas.

The Madaba Plains Project has carried out major archaeological excavations and surveys at Tall Hesban, Tall al-Umayri, and Tall Jalul. A five-kilometer radius around each excavation site defined hinterland survey areas. The Umayri territory is the northernmost of the three hinterland surveys. Figure 2 is a shaded relief map of this region, allowing examination of the survey area's topography. This map indicates an area of moderate relief, with wadis cutting valleys and forming steep slopes. With a general orientation running northwest to southeast, these wadis channel runoff toward the Madaba Plain. The lone exception is in the extreme northwest, where the land slopes to the west and north, beginning its steep descent into the Rift Valley. As expected with this drainage pattern, elevations tend to be highest in the northwest and lowest in the southeast. Additionally, relief tends to be greater and slopes steeper in the north and west than in the south and east. Two relatively flat areas are found in the Umayri survey region. In the southeast, the foothills give way to the plain stretching to Madaba and beyond. In the north, a large flat area is the remains of an ancient lake bed dating to the lower Paleolithic period. (Boling 1989)

Archaeology on the Madaba Plain

Within this area, the Umayri regional survey recorded 133 archaeological sites. Lithic and ceramic remains collected from these sites indicate that the region was settled from the lower

Paleolithic until modern times (Boling 1989; Christopherson 1997a, 1997b; Cole 1989). Although most were small collections of agricultural features, there were also two talls, three fortified tower sites, roads, a variety of *industrial* features and a large Paleolithic site. As seen in Figure 2, these sites were found throughout the region.

Ceramics were used to assign temporal designations to sites in the hinterland. Common in Near Eastern archaeology, pottery from multiple time periods were recovered from each site; some or all of which may represent settlement at the site. Short of excavation, it is not possible to assign with certainty temporal seriation to sites based on surface collections of pottery, but they do give us a general picture of where people were living and when.
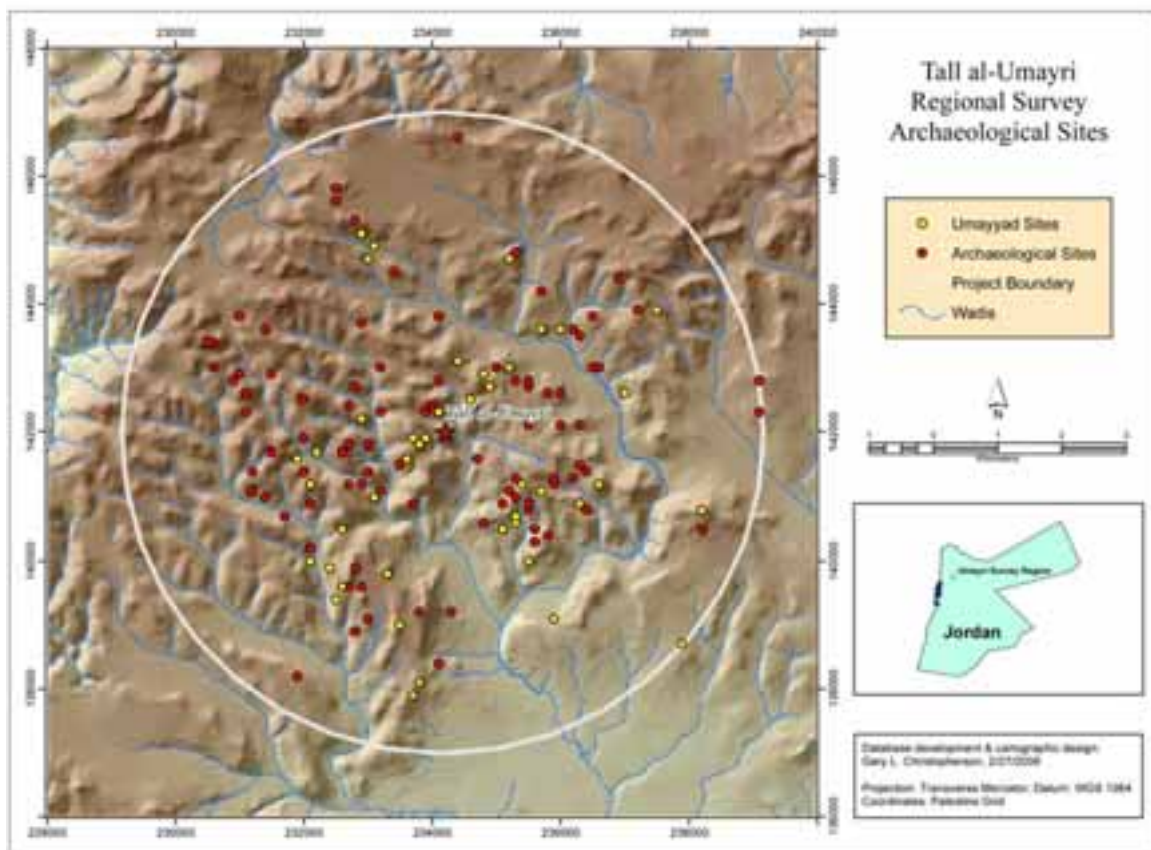

Figure 2: Shaded relief map of the Tall al-Umayri hinterland survey region showing archaeological sites, highlighting those with Umayyad pottery.

The Umayri GIS

The Umayri GIS contained data for both built and natural environments. It included those data collected by the hinterland survey, most importantly the location of the archaeological sites, along with the pottery and archaeological features associated with them. Beyond the built environment, the GIS also contained a number of elements of the natural environment. Soils,

drainages, geology, and topographic contours provided the base data layers. Derived from these were a number of distance measures as well as a DEM and topographic descriptions based on the DEM. Because the people living in the region of Tall al-Umayri were primarily agriculturalists, this mix of archaeological and environmental data provides an excellent opportunity to tell the story of Umayyad agriculture in the Umayri region.

The Umayyad Period in the Umayri Region

Data for the story we want to tell come from different sources. The following paragraphs present both general and specific information that can be used to tell the story. Because we don't have a written record from the Umayyad period for the Umayri region our story relies on archaeological data, on GIS analyses, and on conjecture based on these data and analyses.

A (very) Brief History of the Umayyads

The Umayyad period was sandwiched between the Byzantine and Abbasid periods. One of the pre-Islamic ruling families of Mecca, the Bani Umayya moved to Damascus in 640 when Mu'awiyah was appointed governor of the region. By 661, the Umayyads had consolidated power and their Caliphate became the seat of Islamic political authority until 750 AD. Relying on the remnants of the Byzantine bureaucracy, the Umayyads controlled much of the former Byzantine Empire from Mecca to Spain. During their relatively brief reign, Islamic culture flourished and many of the hallmarks of Islamic art and architecture were created. Following the collapse of the Umayyads in 750 AD, the Abbasids seized control and moved the capital to Baghdad. With this shift in power the Umayyad territories of Syria and Palestine languished in obscurity for centuries. (Hourani 1991; King 1997).

The Umayyad Period in the Tall al-Umayri Hinterland

With no written history of the Umayri region during the Umayyad Caliphate, archaeological material provides the bulk of the information for this story. The following paragraphs discuss archaeological evidence for the Umayyad period based on surface survey and a salvage excavation.

SURFACE SURVEY

Of the 133 sites recorded during the Tall al-Umayri survey, 43 had pottery from the Umayyad Period. Compared to the Byzantine period (110 sites) and the Abbasid period (3 sites) the Umayyad period has often been characterized as a period of declining settlement in the region. Looking at the graph in Figure 3, it is easy to see why settlement decline during the Umayyad period has been a popular theme in archaeological publications from this area (Christopherson 2000; Ibach 1987).
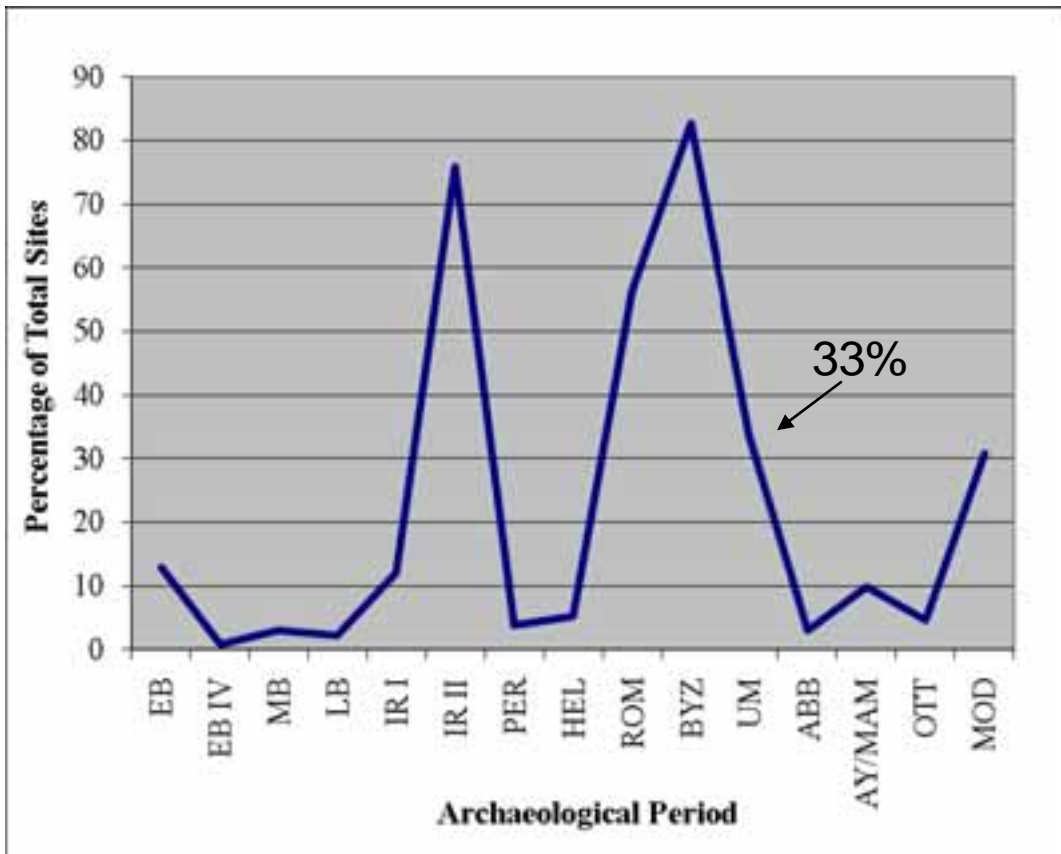
Figure 3: Showing percent of sites with pottery from particular archaeological periods. Note that 33% of sites in the Umayri hinterland had Umayyad pottery.

What makes this graph misleading is that it does not account for the different lengths of time represented by different archaeological periods. For example, given the length of the Byzantine period (ca. 320 years), it should be expected that there would be more sites with pottery from this period than from the Umayyad period (ca. 120 years). In Figure 4, we see the same data, but now normalized to account for differing lengths of time. In this graph, the Umayyad period shows heavier settlement than the Byzantine period. This is one of the trickier parts of telling stories with archaeological data. Depending on the presentation, it is possible to tell multiple stories based on the same data.
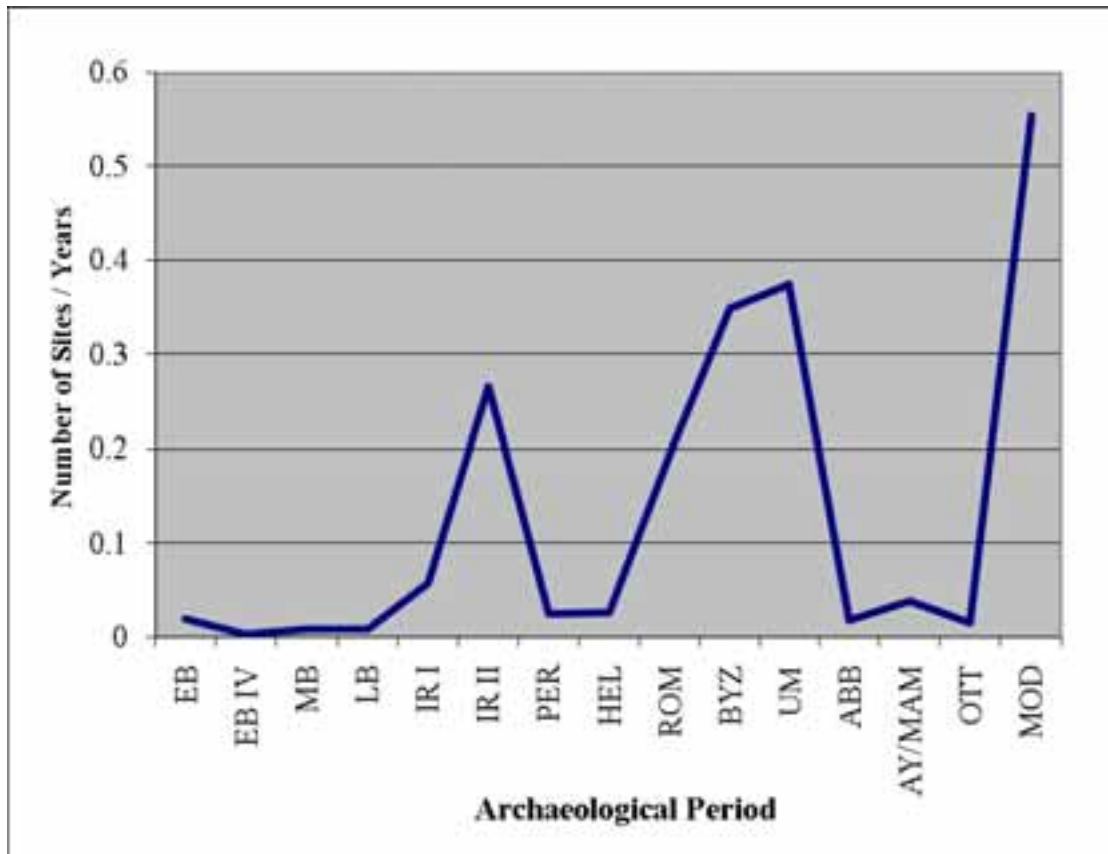
Figure 4: Sites by period, but now normalized by years per period.

The final bit of evidence for this part of the paper, is based not on evidence but on experience. Given the way the hinterland survey was conceived and implemented, there is an important piece of the story that is missing. When this survey began, pottery from particular archaeological periods at hinterland sites was noted as present or absent. There were few quantitative measurements conducted on the collected pottery. Total count, and diagnostic count were kept, but counts by period were not. So at the scale of individual archaeological sites and periods, 1 sherd was equal to 10 sherds was equal to 100 sherds. Lacking pottery counts, experience is an important component in this story. My experience says that the amount of Byzantine pottery is so much greater than Umayyad pottery, greater even than you would expect given the longer period of time represented by the Byzantine period, that the Umayyad period does in some sense represent declining settlement in the Tall al-Umayri hinterland – I just can't prove it. This is one of those places where experienced conjecture is warranted.

EXCAVATION DATA

A salvage excavation of Umayri hinterland site 7 was carried out in 1980 by the Department of Antiquities. This excavation revealed a substantial building with walls of dressed stones, some plastered, with intact arches to support a roof and likely a second story. The large number of tesserae discovered in the debris indicated a second floor and spoke to the *wealth* of the

inhabitants. In addition to this structure, there was a large plastered winepress to the north of this building (Zayadine 1981). Although not mentioned in Zayadine's report, there were also a number of caves and cisterns, and a limekiln ([Christopherson, et al. 1998](#)). Finally, two bodies crushed in unnatural positions in the main structure indicate that Site 7 was likely destroyed suddenly and without warning. Coins in the debris suggest that this is most probably a result of the earthquake of 746 (Zayadine 1981), just four years before the collapse of the Umayyad Caliphate.

Summary

Before turning our attention to the GIS analyses, it is helpful to summarize what we know about the Umayyad period in the Umayri hinterland. We know that there were 43 sites with Umayyad pottery. One of these sites was excavated, revealing a fairly large structure with a winepress and a variety of other features suggestive of an agricultural complex. This site was destroyed, apparently without warning, most likely in 746. These sparse data do not provide enough to tell the story of the Umayyad period in the Umayri hinterland.

GIS and the Umayyad Stories

Attention can now be directed to a series of GIS analyses that will lead to a greater understanding of the people living in the Umayri hinterland during the Umayyad period. Issues that will be examined in the following paragraphs include settlement patterns, subsistence strategies, and social interaction.

Umayyad Settlement Patterns

Discerning settlement patterns in this study were based on connecting site locations to a set of specific environmental conditions, based on the following assumptions:

- The processes ancient humans used to select site locations were not random

- Part of the site selection process involved selection for favored environmental zones

- Consequently, it should be possible to identify specific *environmental signatures* for specific groups of archaeological sites

Discovering these signatures was accomplished through a three step process: 1) logistic regression was used to discover relationships between the archaeological sites and a series of environmental variables; 2) a spatially explicit model was created by weighting the variables by their corresponding regression coefficients; and 3) the model was tested to see how focused it was by examining how well it predicted the sites used to create it.

The result of step 2 was a probability model for sites with Umayyad pottery (Figure 5). Here darker colors indicate model values closer to one – higher probability – and lighter colors indicate values closer to zero – lower probability.
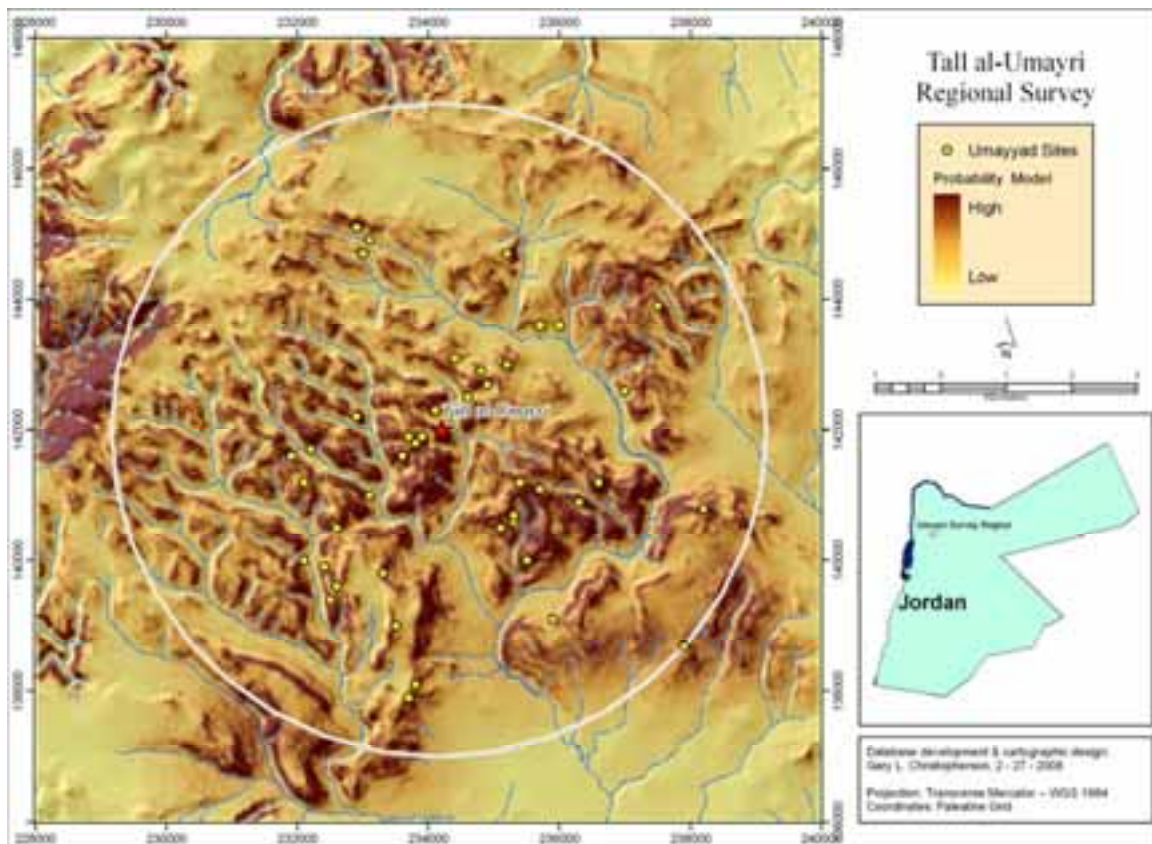

Figure 5: Logistic regression model for Umayyad sites in the Tall al-Umayri hinterland.

To test the strength of the model, probability scores were collected from the location of the Umayyad sites and from a random sample of non-sites. Stronger models will be indicated by a distribution of high values for archaeological sites and low values for the random sample locations – that is, a split in the distribution values between site and random samples. A weak model will be indicated by a normal distribution – that is, values that approximate a normal distribution for both sites and random locations. The graph in Figure 6 shows the distribution for Umayyad sites in the Umayri hinterland. This distribution indicates something other than a strong or a weak model. The bi-modal distribution suggests that during this period there were two separate settlement patterns and likely two subsistence strategies as well.
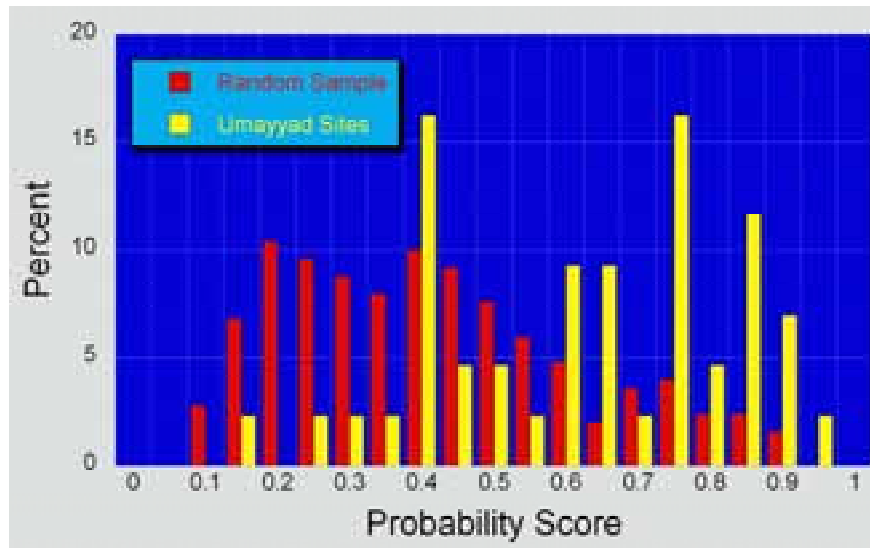
Figure 6: Distribution of site and non-site samples within the Umayyad probability model. The bi-modal distribution suggests two settlement/subsistence strategies during this period.

To test this idea, the Umayyad sites were split into two groups:

- Group 1 were those sites in areas with low probability scores

- Group 2 were those sites in areas with high probability scores.

These groups were subjected to a second logistic regression and models were made and tested for each group. Even a quick visual analysis of the maps in Figure 7 shows that the Group 2 model is focused and the Group 1 model is unfocused. This indicates that Group 2 Umayyad sites favored a specific environment while Group 2 Umayyad sites were not concentrated on any specific environment.

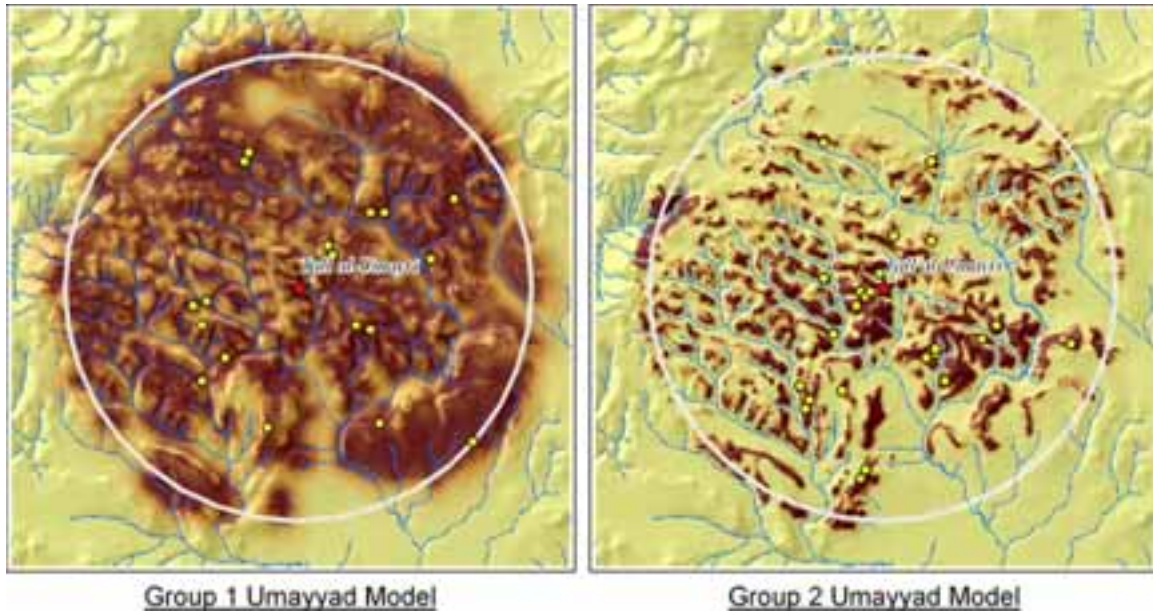Group 1 Umayyad Model   Group 2 Umayyad Model

Figure 7: Regression models for Group 1 and Group 2 Umayyad sites in the Umayri hinterland.

Figure 8 shows the distribution for each group of Umayyad sites. As expected the distribution of the Group 2 sites shows the separation of sites and non-sites – a focused model. The distribution of Group 1 sites shows both sites and non-sites are normally distributed – indicating a model that is no more focused than a random distribution.
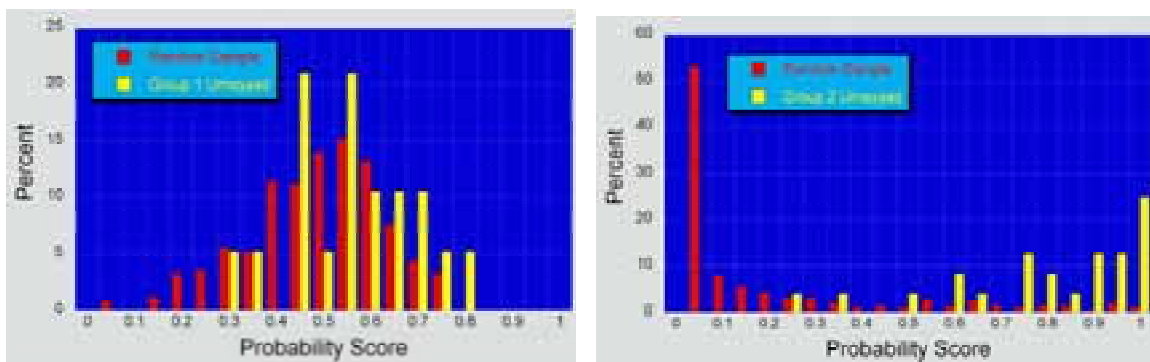

Figure 8: Distribution of sites and non-sites within Umayyad models. These distributions indicate that the Group 1 model is weak and unfocused. On the other hand, the group 2 model is strong and focused.

These two models are clearly different. Group 2 sites are focused on a particular environmental signature, while the Group 1 sites are not. This suggests that during this period, one group of Umayyad setters took an intensive approach and the other an extensive approach to their collective economies. These differences are summarized in Table 1.

Table 1: Summary of regression models for Group 1 and Group 2 sites in the Umayri hinterland.

Group 1 Umayyad Sites	Group 2 Umayyad Sites
Model strength is low	Model strength is high
Settlement pattern is <u>not</u> focused on a particular environment	Settlement pattern is focused on a particular environment
This suggests an extensive settlement/subsistence strategy	This suggests an intensive settlement/subsistence strategy

Umayyad Subsistence

The second GIS analysis was designed to test whether the Umayyads practiced intensive, or an extensive agriculture. The hallmark of intensive agriculture in the Umayri region has been the use of agricultural terraces. Agricultural terraces are one of the most ubiquitous features of the Levantine hill country where they were used both to prevent erosion and to retain moisture in the soil. The principal problem for the archaeologist is that terraces defy traditional methods for dating. Terraces built recently are identical in form to those built thousands of years ago. They exhibit little or no stratigraphy, and artifacts associated with them are generally of uncertain context. A piece of pottery within a terrace wall may have as much to do with gravity induced percolation down the slopes as it does with construction dates.

This study took a different approach to the question of whether terrace agriculture was being used. Based on the assumption that if archaeological sites were located in areas with high erosion potential terracing would have been necessary. Determining erosion potential was accomplished by a commonly used equation for determining soil loss, the Universal Soil Loss Equation (USLE), developed by the United States Department of Agriculture. Using the USLE a spatially explicit model for erosion potential was created for the Umayri hinterland.

This model was split into acceptable and unacceptable erosion levels and combined with the different soil types in the region to create a model for erosion and soil type (Figure 9). Areas whose erosion potential was below 30 Mg/ha/year were labeled acceptable, and those above 30 Mg/ha/year were labeled unacceptable.[1] In the Umayri region, there are three types of soil – ridge, slope, and wadi (drainage) soils. Ridge soils are the best for agriculture, but also the most erodible. Wadi soils are also good for agriculture but susceptible to flooding. Slope soils are poor for agriculture and susceptible to erosion. During times of known agricultural intensity, the majority of sites were located in areas of ridge soils with unacceptable levels of erosion. This

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[1] Although erosion between 10 and 30 Mg/ha/year would eventually prove problematic for farmers, this danger would likely not be apparent to the farmer for several years, or perhaps decades, and thus have little impact on the initial site selection process.

indicates that they were using agricultural terraces to support an intensive approach to agriculture.
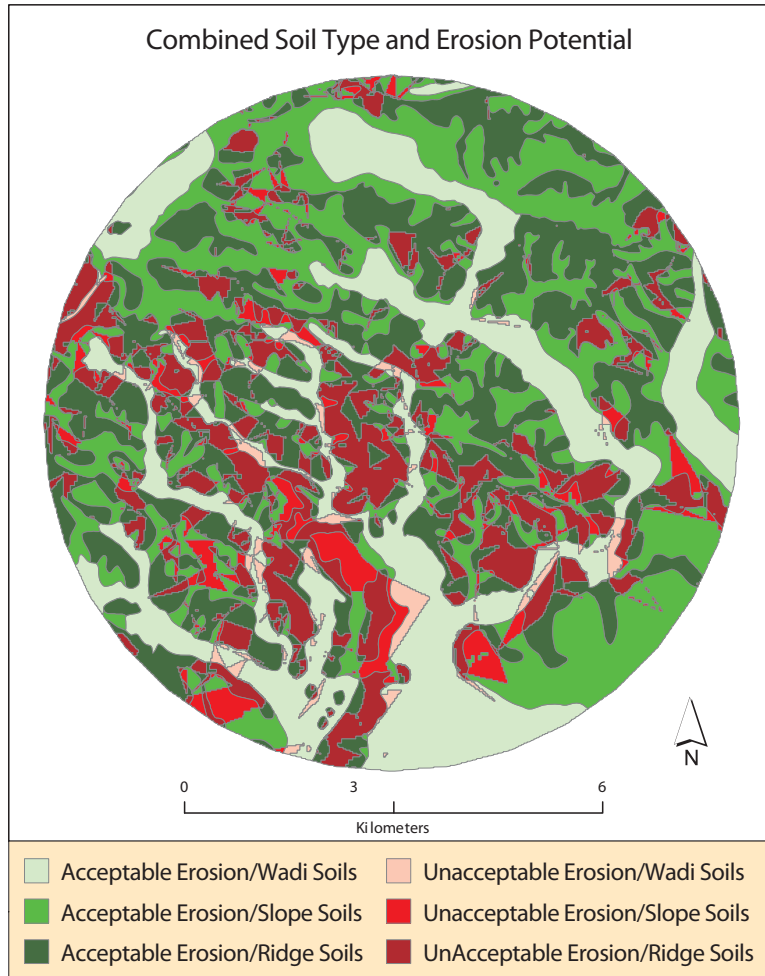

Figure 9: Map of Umayri region showing combinations of erosion potential and soil type.

Table 2 shows cross-tabulation for soil type and erosion potential. This table contains values for the different categories from the Umayri hinterland as a whole, and from 3 hectare buffers around sites from each Umayyad group. A short discussion of some of the numbers and what they mean will illustrate that the Group 1 and Group 2 Umayyad sites were following different subsistence strategies. The first important number to notice is that only 21.97% of the survey region has unacceptable levels of erosion, yet 43.8% of the Group 1 Umayyad sites and 54.9% of the Group 2 Umayyad Sites were located in areas of unacceptable erosion. The second set of numbers to look at is the totals for ridge soils. Here we see that the survey area consists of 44% ridge soils, but 85% of the Group 2 and 54.5 percent of the Group 1 Umayyad sites were located in ridge soils. Finally, 56.8% of Group 1 Umayyad sites were located in the agriculturally poor slope soils, compared to only 13.2% for the Group 2 sites and 31.23% for the region as a whole.

Table 2: Cross-tabulation of soil type and erosion in the Tall al-Umayri survey area, and distribution of Umayyad sites within the different categories of soil and erosion.

Erosion – Soil	Ridge Soil	Slope Soil	Wadi Soil	Total
Acceptable Erosion				
Survey Area	28.34%	26.59%	23.10%	78.03%
Group 1 Umayyad Sites	26.80%	25.40%	4.01%	56.20%
Group 2 Umayyad Sites	31.40%	12.20%	1.45%	45.10%
Unacceptable Erosion				
Survey Area	15.66%	4.64%	1.67%	21.97%
Group 1 Umayyad Sites	27.70%	11.40%	4.67%	43.80%
Group 2 Umayyad Sites	53.60%	1.02%	0.32%	54.90%
Total				
Survey Area	44.00%	31.23%	24.77%	100%
Group 1 Umayyad Sites	54.50%	56.80%	8.68%	100%
Group 2 Umayyad Sites	85.00%	13.20%	1.78%	100%

These numbers indicate significant differences in subsistence strategies for the two groups of Umayyad sites. Of particular importance is the preference by Group 2 Umayyad sites for ridge soils and unacceptable erosions level. This combination of best agricultural soils and the necessity for agricultural terraces are strong indicators of intensive agriculture. On the other hand, Group 1 Umayyad sites showed a preference for slope soils and acceptable erosion levels indicating a more extensive approach to agriculture. Table 3 summarizes the differences in subsistence strategies suggested by this analysis for Group 1 and Group 2 Umayyad sites.

Table 3: Highlighted difference in subsistence strategies between Group 1 and Group 2 Umayyad Sites in the Tall al-Umayri hinterland.

Group 1 Umayyad Sites	Group 2 Umayyad Sites
Distribution within soil/erosion map is unique for this region	Distribution within soil/erosion map is typical of agricultural sites in this region
Relatively low total in best agricultural zone (ridge soils and unacceptable erosion)	Very high total in best agricultural zone
Higher total in acceptable erosion zones	Lower total in acceptable erosion zones
The above suggests very little, or no intensive/terrace agriculture	The above suggests high level of intensive/terrace agriculture

Umayyad Social Interaction

The third GIS analysis looks at social networking in the region during the Umayyad period. Difficult to quantify, a common approach to questions of social interaction is to use environmental data as a proxy for social connections amongst archaeological sites. These approaches utilize such things as logistic trend surfaces, cost surfaces and viewshed analysis to explain cultural factors in settlement patterns (Boaz and Uleberg 1995; Gaffney and Leusen 1995; Gaffney and Stancic 1991; Gaffney, et al. 1995; Stead 1995; Wheatley 1992, 1995). In this study visibility analysis was carried out to answer questions of social interaction amongst sites with Umayyad pottery. Not surprisingly, Group 1 and Group 2 Umayyad sites took starkly different approaches to social interaction.

The analysis for this part of the study was based on the creation of cumulative viewsheds. Viewsheds are all the locations visible from one or more points in an area. Cumulative viewsheds counts the number of points visible at each location. In this case, how many archaeological sites are visible. The idea being that if sites could see each other, it would represent some level of social interaction. The higher the number of sites visible, the more interaction there was. This analysis began by calculating cumulative viewsheds for the Group 1 and Group 2 Umayyad sites. Figure 10 contains maps of these viewsheds for each group of Umayyad sites in the region of Tall al-Umayri. Darker colors represent more sites visible and lighter colors represent fewer sites visible.

Group 1 Umayyad Cumulative Viewshed   Group 2 Umayyad Cumulative Viewshed
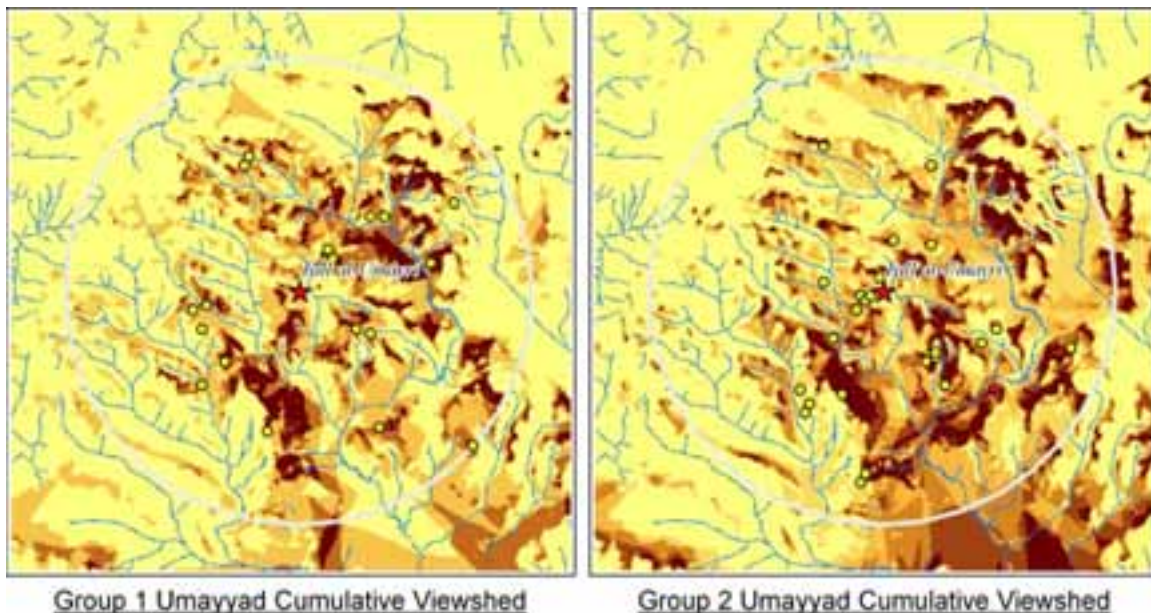
Figure 10: cumulative viewshed maps for Group 1 and Group 2 Umayyad sites in Tall al-Umayri hinterland.

To test the significance of the visibility models, Kolmogorov-Smirnov tests were performed. These tests measure the greatest difference between the cumulative proportions of the visibility values at the archaeological sites and these same values at a random sample of non-site

locations. Results of this test for each group of Umayyad sites proved significant at the 5% level, but for different reasons. Cumulative proportion plots for the Umayyad sites can be seen in Figure 11. These graphs indicate that almost all sites from Umayyad Group 1 could see only a single site, but that most Group 2 sites could see more than one site. A summary of the results is found in Table 4.
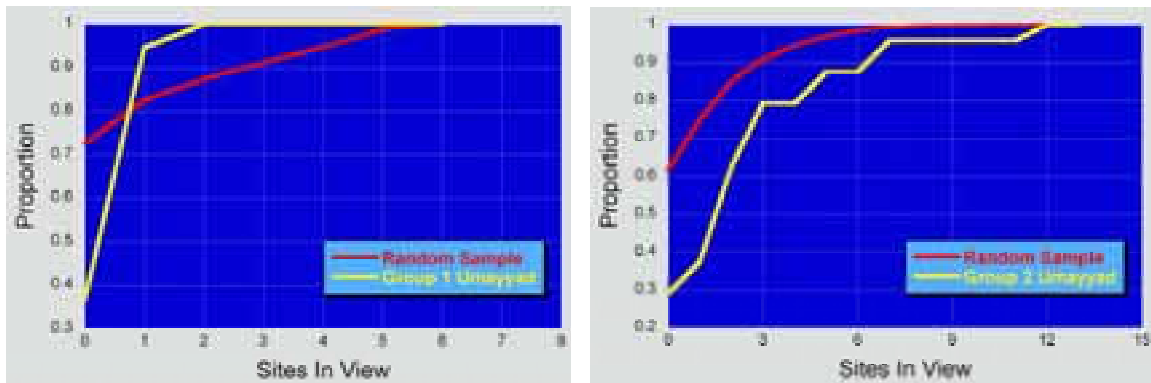

Figure 11: Cumulative proportion graphs representing cumulative visibility for Umayyad sites in the Umayri hinterland.

Table 4: Summary of the visibility analysis

Group 1 Umayyad Sites	Group 2 Umayyad Sites
The maximum number of sites visible in the area was 6	The maximum number of sites visible in the area was 14.
Six percent of the Group 1 sites could see more than one other site – (a maximum of 2).	63% of the Group 2 sites could see more than one other site – (a maximum of 12)
They were locating sites in areas of limited intervisibility	They were locating sites in areas of higher intervisibility
We can conclude that these people wanted to remain hidden to their neighbors.	We can conclude that these people wanted to be visible to their neighbors.
The above suggests low levels of social interaction.	The above suggests higher levels of social interaction

The Story of the Umayyad Period in the Umayri Hinterland.

We have reached the point when we can begin to tell the story of the Umayyad period in the region of Tall al-Umayri. This is a story of two groups, characterized by their differences rather than their similarities – differences in settlement patterns, subsistence strategies, and social interaction.

In the first part of our story settlement patterns indicate that Umayyad sites in the Umayri hinterland should be divided into two groups. Regression models were created to identify settlement patterns based on measured relationships between Umayyad sites and a variety of environmental variables. These models show that Group 1 sites had little connection to the environment, suggesting that they were not dependent on a specific landscape. In contrast, Group 2 sites were focused on a well defined environment, suggesting that they were closely tied to a particular set of environmental variables.

The differences seen in settlement patterns between Group 1 and Group 2 extended into subsistence strategies based on soils and erosion potential. Their strong connection to areas of the ridge soils with unacceptable erosion potential makes it clear that Group 2 sites were practicing intensive agriculture. At the same time Group 1 sites were scattered throughout the different categories of soil and erosion potential. Their main connection was to the poorest soils. This indicates that field agriculture was not the source of their livelihood.

Group 1 and Group 2 sites were also sharply divided when it came to social interaction. At a very basic level, Group 2 sites wanted to see each other and Group 1 sites did not. This indicates that Group 2 sites were more interested in social interaction, perhaps cooperative labor, while Group 1 sites wanted to be left alone.

These three analyses are indicative of distinctly different approaches to life and I would characterize these approaches as extensive and intensive. Group 2 was focused on field agriculture within a cooperative social structure. I believe that they were the remnants of Byzantine agricultural society; that they were continuing to practice intensive agriculture within a very specific environment. Group 1 followed an extensive subsistence strategy, they were nomads not focused on a specific environment. They followed the herds to wherever there happened to be forage for their animals. They likely planted crops as well, but they were not dependent on them and probably were not interested in building agricultural terraces.

One might argue that these two groups represent the movement from the sophisticated, agricultural economy of the Byzantines toward a simpler, herding economy. But it seems clear to me that part of this story is that these two groups represent contemporary rather than consecutive strategies. Evidence for this is found in the lone excavation of an Umayyad site. The fact that this site was still inhabited until the earthquake of 746 suggests that Group 1 and Group 2 sites coexisted in a symbiotic relationship in the Umayri hinterland.

The last part of this story concerns the end of Umayyad settlement in this region. The destruction of Umayri Site 7 suggests a sudden, and nearly complete end to intensive strategies in the area – in 746 A.D. Maintaining terraces, and other intensive infrastructure is not an easy

thing. A disaster like an epidemic, a war or an earthquake can push an already weakened society past the breaking point. It may be that the Umayyad period in the Umayri region was the last gasp of Classical culture – a tired system that was winding down and perhaps unable to survive the earthquake of 746.

Thus ends this story of the Umayyad period in the vicinity of Tall al-Umayri. It is important to remember that this story has been told with few direct voices. With the exception of the two bodies found in the earthquake destruction at Umayri Site 7, this is a story based entirely on conjecture about cultural remains and spatial analyses. These conjectures are drawn from patterns within arrays of numbers found in a GIS that represent environment and culture. I suspect that the people about whom this story has been told would resent having their lives and their world reduced to numbers. But I think that stories like this are important and it is our job as archaeologists to tell these stories. Even though I am sure that I have gotten some of it wrong, this story allows the Umayyad people of the Umayri hinterland to live again, to tell us what their lives were like.

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