LANDSCAPE ARCHAEOLOGY IN THE WĀDĪ AL-ʿARAB REGION

KATJA SOENNECKEN[1], LINDA OLSVIG-WHITTAKER[1], PATRICK LEIVERKUS[2] AND AVI SHMIDA[3]

[1]*German Protestant Institute of Archaeology in the Holy Land (DEIAHL) Research Unit of the German Archaeological Institute, Auguste Victoria Compound, Jerusalem*
[2]*Bergische Universität Wuppertal, Biblical-Archaeological Institute, Wuppertal, Germany*
[3]*Department of Evolution, Systematics and Ecology and Center for Rationality and Interactive Decision Theory, The Hebrew University, Jerusalem, Israel*
[*]*Corresponding author: olsvig2000@yahoo.com*

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ABSTRACT

As an integral part of the Gadara-Region-Project, a survey of the Wādī al-ʿArab region was conducted during the years 2009-2012, by the Biblical-Archaeological Institute Wuppertal and the German Protestant Institute for Archaeology in order to achieve a better understanding of the hinterland of the main study site Tall Zirāʿa and to provide answers concerning settlement pattern, trade relationships and the importance of sites throughout time.

On the basis of this survey we used ecological approaches to see what correlation might exist between archaeological sites and habitat. Since more than half the sites in this survey had Roman occupation, we asked what difference, if any, was there in the distribution of Roman sites compared to previous occupations. A comparison was made of "new" Roman sites (those not previously occupied in the Hellenistic period) with those that had both Roman and Hellenistic occupation.

Open water, riverine habitats, and large archaeological sites all seemed connected. In addition, analysis indicated a correlation of older (more successful or established?) sites with open water and new Roman sites were less related to water. We knew that Roman engineering both of cistern systems and aqueducts opened new areas (such as plateaus) for settlement and exploitation. Hence the weaker correlation of new Roman sites with natural water was reasonable.

Keywords: landscape archaeology, Jordan, Roman era, habitat, survey, multivariate analysis

INTRODUCTION

Archaeological sites are located within a landscape - the surrounding physical, cultural and biological environment which provides the context, driving factors and the system in which an ancient settlement functioned (Leiverkus & Soennecken, 2016). The study of the archaeology of such environments, called landscape archaeology, attempts to describe and understand spatial and functional relationships of features such as settlements, roads, installations, fields, etc. within their physical, ecological and cultural environment. Important questions of this research discipline are, for example: What is the importance of water in

determining site locations? How does political change drive the location of roads and sites? What are the patterns of land use by settlements?

As an integral part of the "Gadara-Region-Project" (see http://tallziraa.de), a survey of the Wādī al-ʿArab region was conducted during the years 2009-2012, by the Biblical-Archaeological Institute Wuppertal and the German Protestant Institute for Archaeology. The aim was to get a thorough understanding of the landscape in which the Tall Zirāʿa is the most prominent archaeological site. Furthermore, the Wādī al-ʿArab is one of the few easily passable ascents from the Jordan valley to the Irbid-Ramtha-basin and so has always been part of trade routes from the Mediterranean coast to Dimašq (Damascus), Baġdad or ʿAmmān. Questions of the actual trade routes through this area and their shifting importance arise.

ARCHAEOLOGICAL SURVEY

Methods

The Wadi al-ʿArab has been surveyed several times before (Schumacher, 1889; Glueck, 1951; Mittmann, 1970; and Hanbury-Tenison, 1984 a;b). While all these surveys are valuable and gave rich sources of information, they cannot give the completeness and level of detail needed for the purpose of the "Gadara Region Project". The former two surveys had a much broader area in view and therefore could only cover the major sites of the area of interest. J.W. Hanbury-Tenison's survey is restricted to two areas and does not cover the full Wādī al-ʿArab. Furthermore, since these surveys are at least a generation old, a fresh look on all the given data seems appropriate considering the improvement in stratigraphy and typology of the region due to the continuing efforts of the "Gadara Region Project".

With the knowledge of the previous surveys and the target of a hinterland survey in mind the approach chosen was two-fold: (a) revisiting the known sites enriching the information about them, and (b) filling the gaps by surveying the areas that had not been surveyed before. During four seasons the hinterland of the Tall Zirāʿa was completely examined. The area of investigation was divided into Zone A (Tall Zirāʿa hinterland) and Zone B (Wādī al-Arab region), together covering about 350 km^2 from Tall Zirāʿa to Irbid in the east, and north to the Yarmūk River watershed.

The exact location of all sites was measured by GPS, pottery was collected for comparison, descriptions of the current site status were refreshed, and detail and overview pictures taken. All gathered information was entered into a database. At the end we were able to map more than 200 sites and installations, some of them known, but 30 % previously unknown (or at least unpublished). Over 80 percent of the sites relate to the classical era. The other sites were inhabited in the Bronze Age, Iron Age or different Islamic periods. Only very few lithic sites could be discovered.

Results

One smaller site directly across the wadi from the Tall Zirāʿa deserves special mention in the context of landscape archaeology. This site was published first by Kerestes (1977-1978; site 2 in the Wādī al-ʿArab; site 211/225-8 in our database) and identified as of Middle Bronze Age date. Its position relates this site directly to Tall Zirāʿa. Together they control a narrow passage in the wadi and of course a direct line of sight is given between this site and the tall. Just 50 meters up the slope of the spur another previously unknown/unpublished site could be recorded with architectural remains of the Roman period (site 211/225-7 in our database). This site not only overlooks the lower wadi, as the closest older site, it has also

a direct line of sight to Gadara, which is missing in the lower position at Site 2. This gives us a hint on the shifting of centrality from the Tall Zirāʿa to Gadara during the classical era.

One important result of revisiting the previously published sites during the survey in the Wādī al-ʿArab is the observation of heavy destruction of many sites in the last decades. The drastic increase of deterioration is alarming. In the last years a large tall with Roman, Byzantine and Islamic occupation (no. 26 in the Hanbury-Tenison survey; site 211/224-2 in our database) south of Tall Zirāʿa has been completely destroyed by bulldozing. Covering an area of approximately 130 x 90 m (maybe more before the destruction in modern times) we could see ancient remains – some of the stones still in situ, but most of them shoved away. The section produced by a bulldozer showed at least two layers of Roman-Byzantine settlement, divided by layers of ash. Only recently an unknown site, probably a Roman villa (214/227-3) suffered the same fate and last year even the south side of Tall Zirāʿa was damaged.

Almost all of the modern villages dated back at least to the Roman and/or Byzantine periods, and some to the Iron Age or the Bronze Age. Only very few of the ancient settlements are not covered and destroyed by modern settlements. That includes also most of the Islamic places of the Wādī al-ʿArab. It is especially very sad to note that none of the old mosques in the area of the Wadi - some of them dating back to the medieval period - are any longer in existence. To our knowledge, the last old mosque in the area can be found in the village Harga. Even this one is in a very bad condition (site 233/229-1 in our database).

Several smaller sites are [have been] destroyed by agricultural activities. Especially olive tree cultivation leaves sites in an unrecognizable state. These observations lead the members of the "Gadara Region Project" to the firm commitment to this survey not only as a necessary complement to an excavation but also as a preservation of information on the history of the Wādī al-ʿArab, most of which will be lost in the near future.

Despite the continuing demolition of the ancient sites, we could discover a representative amount of pottery from all sites, from which we can form a concise overview of the history of the Wādī al-ʿArab (see Table 1.). Apart from these heavy destructions, another problem emerged clearly: most of the unknown or at least unpublished sites showed traces of recent unauthorised excavations/digging, mainly concentrating on tombs (using metal detectors) and removing most of the finds. Two examples: One site was first described by Mittmann and called Khirbet Sris (M 059; 228/221-1 in our database). When we visited the 1½ ha site, the vegetation was burnt down. We found pottery, tesserae, a cistern and a robber trench (3 layers of ashlar masonry visible). The pottery could be dated to Roman-Byzantine-Islamic (Omayyad) periods. Another site was not published before and is located north of Fuʿara, southwest of Wādī al-ʿArab (220/224-1). An area of approximately 2 ha (250 x 80 m) was covered with pottery, tesserae and some pieces of glass. Additionally cisterns, a quarry, some natural caves and graves were found. Most of the graves were only visible because of recent robber trenches and nearly all of them were shaft tombs. In one robber trench ashlar blocks could be seen. The pottery dates to Roman-Byzantine-Islamic periods and suggests at least two phases of occupation.

The northern slopes of the wadi directly upstream from Tall Zirāʿa are characterized by a dense occurrence of water sources. Many of the sites found there relate to them. This can shed further light on the Roman water management in the region.

Table 1: Distribution of sites in the study area through time
(Note that the same site may appear in more than one era.)

Period	sites
Bronze	31
Iron	26
Hellenistic	39
Roman	94
Byzantine	76
Islamic	51

LANDSCAPE ECOLOGICAL ANALYSIS

Methods

On the basis of this archaeological survey we used ecological approaches to see what correlation might exist between archaeological sites and habitat. Since more than half the sites in this survey had Roman occupation, we asked what difference, if any, was there in the distribution of Roman sites compared to previous occupations. A comparison was made of "new" Roman sites (those not previously occupied in the Hellenistic period) with those that had both Roman and Hellenistic occupation. Clearly there could have been other definitions such as "never previously occupied". Hence this analysis is preliminary.

As groundwork for further investigations, the sites within the boundaries of the survey area were mapped by their centroid coordinates on QGIS, superimposed on a Google satellite image (Fig. 1). Polygons were drawn by hand at the 1:10,000 level (at times reduced to 1:5,000 when clarity was needed). The landscape observed by satellite (Google Earth from 2017 TeraMetix images) was relatively simple and could be defined into crude categories. Originally the entire area was to be mapped to define habitat boundaries, but this proved very time consuming. Instead, a 0.5 km buffer area around each site was mapped by eye as orchard, maquis, steppe, urban, riverine, field, bare, water, archaeological site, or development (not urban, can include military bases, water installations, etc.). Ground verification of habitat type still needs to be done for the habitats mapped from satellite images. Hence these categories are preliminary.

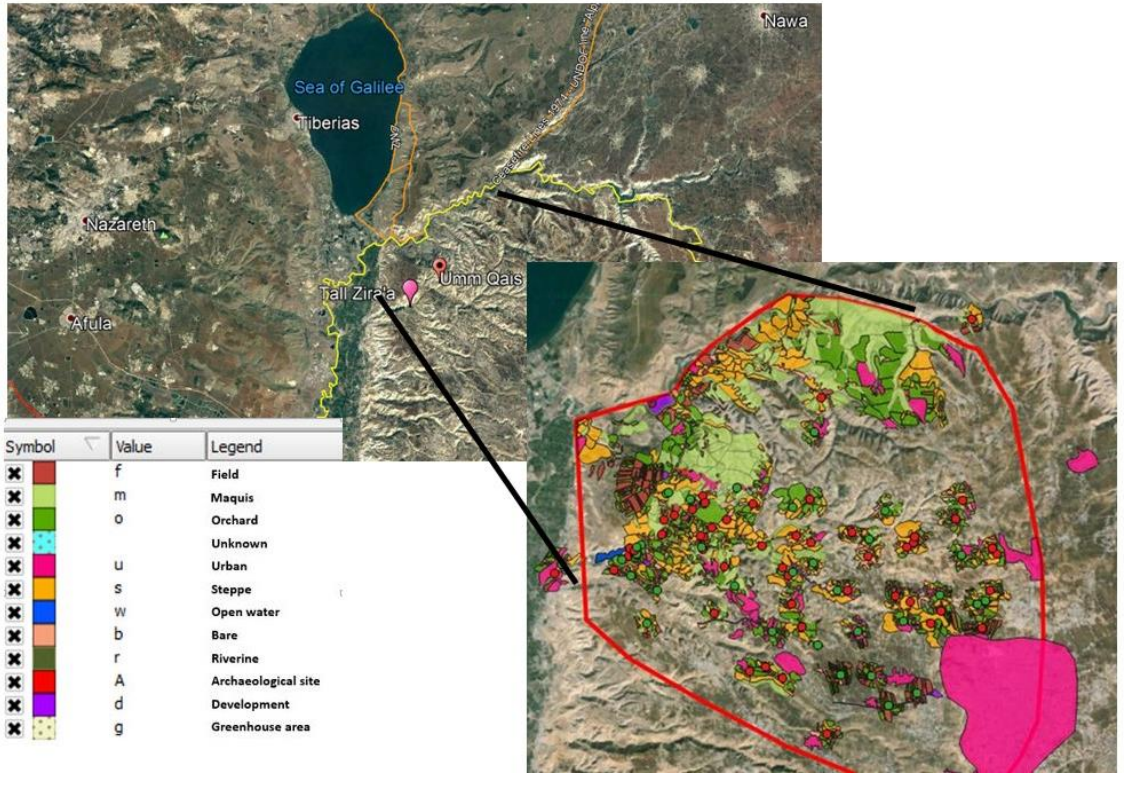
For the ecological analysis, categorical habitat data were used as response variables. The habitat mapping provided the response matrix data as percentage of the 0.5 km buffer zone around each site in each habitat category. The driver variables were of two types: (A) new or old Roman sites and (B) site size categories.

Epochs were available as provided from the survey database, but broader groupings were made as follows: Neolithic and Chalcolithic; Bronze Age; Iron Age; Hellenistic; Roman; Byzantine; Islamic; 'undetermined' and 'modern' not into a group. For the analysis presented here, only two categories of site age were used, "New Roman" = 1 and "Old Roman" = 0.

Three very coarse size categories were used in the analysis: (1) a few meters in area, (2) a dunam (0.1 ha) in area or less, or (3) several dunams in area.

Fig. 1: Roman epoch sites in the Wadi al 'Arab

Upper left: general reference image. Lower Right: study area: Green dots had pre-existing settlements; red dots are new Roman sites. Below left: habitat codes used in the map. Image source 2017 TerraMetrix via Google Earth.



The analytical approach was ordination, a form of multivariate analysis (Jongman *et al*., 1995). Multivariate analysis can be used for the statistical correlation of archaeological sites and habitat (Baxter, 1994; Olsvig-Whittaker *et al*., 2015). We used both indirect ordination (DCA) and direct ordination (CCA) in the Canoco 5 software (Ter Braak & Smilauer, 2002) as the algorithms for assessing patterns and correlations in site attribute and habitat attribute data. While ordination has long been in use in community ecology, its application to archaeological data is somewhat more recent. There is a vast literature on the subject of ordination and many algorithms to do it (cf. Jongman *et al*., 1995; Gauch, 1982).

In general, ordination methods help to find structure in complex matrix data sets, i.e. site by attribute or habitat by attribute tables. In the case of direct ordination, this is a regression of the site data versus the habitat data, conceptually similar to multiple regressions. CCA direct ordination can be used either heuristically or as a statistical test of correlation with measured driving factors, using Monte Carlo simulations. When a heuristic search for pattern is desired, indirect ordination such as DCA is the proper tool.

Most algorithms for indirect ordination calculate similarity/dissimilarity between habitats (or sites) and their attributes, from a single table. Results are projected onto two dimensions in such a way that similar habitats (or sites) and most closely correlated attributes are plotted close together, and dissimilar habitats (or sites) and their attributes are placed far apart. Most importantly, in both direct and indirect ordinations, the scatter plots for habitat and site values can be superimposed. In this way the habitats driving the pattern in sites can be studied graphically.

Detrended Correspondence Analysis (DCA, Fig. 2) was used on the habitat matrix, with site data carried passively, to determine major trends in variation of habitat distribution and the response of site factors to them. DCA is an indirect ordination method using only one matrix. It is an analytical approach in its own right, and is also is a necessary first step in every CANOCO analysis, regardless of algorithm. The first information obtained in DCA is the habitat turnover along the first gradient (Axis 1, horizontal), which is either short (less than 4 standard deviation units in habitat composition), in which case a linear model such as PCA or RDA can be used in in subsequent steps. If the gradient is longer than four standard deviation units, a unimodal model such as DCA, or Canonical Correspondence Analysis (CCA) is used in subsequent steps. In our data, the gradient was longer than 4 s.d. units, so CCA was the direct ordination method used.

Canonical Correspondence Analysis (CCA, Fig. 3) is a direct ordination method which correlates two matrices using eigenvector methods. In this study we used habitat as the ‘species’ matrix and the two factors of sites (size and age) as the environmental matrix factors. Monte Carlo tests were run to determine the significance of the correlation of habitat with site factors, but the results were not statistically significant.

Fig. 2: Multivariate analysis:
DCA showed a close relationship of larger archaeological sites and open water. The analysis used DCA with supplementary variables. Total variation was 0.84771, supplementary variables accounted for 2.6 % (adjusted explained variation is 0.4 %). The x axis denotes the strongest variation in the data; the y axis presents the residual variation.

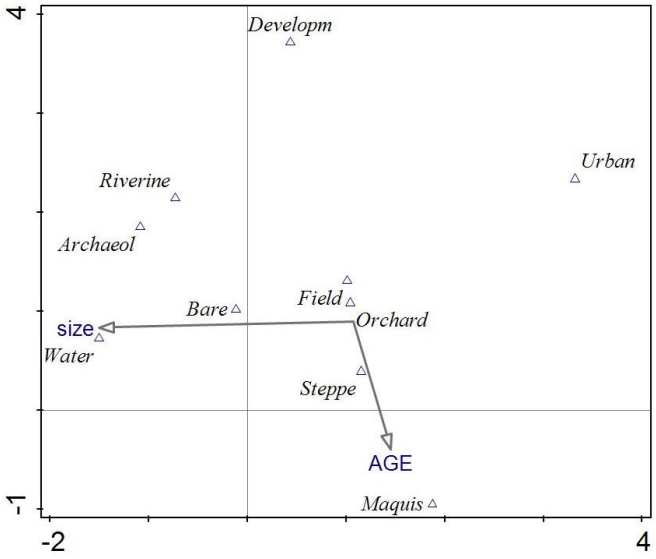
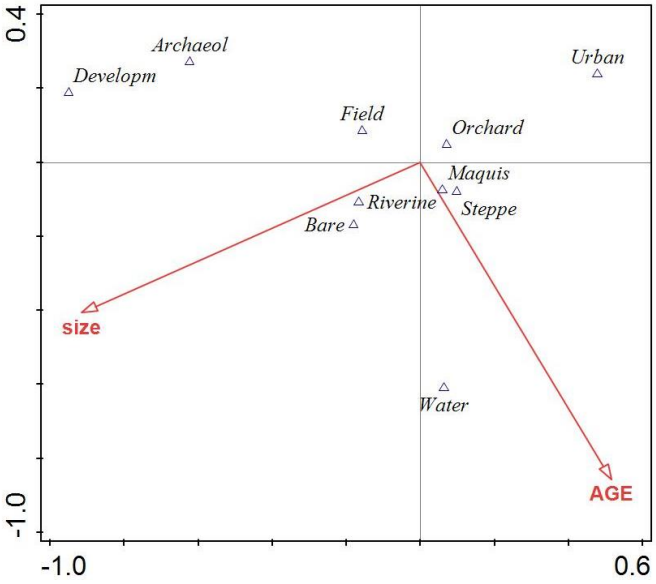


Fig. 3: CCA analysis was run on habitat with site size and age as environmental variables. Total variation was 0.84771, explanatory variables accounted for 2.6 %; (adjusted explained variation is 0.4 %). Permutation tests on all axes provided a probability of correlation of p = 0.304, hence the Monte Carlo testing of the correlations of site and habitat factors was not significant. Even so, sites had a relationship with open water, in this case older sites (those with Hellenistic as well as Roman artifacts). The x axis denotes the strongest variation in the data; the y axis presents the residual variation.



Results

The ordinations, despite the lack of statistical significance of correlations, suggested interesting relationships. Open water, riverine habitats, and large archaeological sites all seemed related according to their graphic distribution. In addition, analysis indicated a correlation of older (more successful or established?) sites with open water. Analysis also suggested that new Roman sites were less related to water. (In ordination biplots of this type when factors are close to each other, they are more correlated; when they are distant, they lack correlation; when they are directly opposite, they may be negatively correlated

We knew that Roman engineering both of cistern systems and aqueducts opened new areas (such as plateaus) for settlement and exploitation. Hence the weaker correlation of new Roman sites with water also made sense. More detailed analyses will be conducted during the coming year.

In addition to the archaeological survey and habitat mapping, another facet of landscape archaeology has just began: a small geobotanical survey was conducted in the Wādī al-ʿArab region by A. Shmida and will be expanded during the following years. During this preliminary campaign 14 relevees (standardized vegetation samples) and additional, more casual surveys were conducted. Results will be presented in a later publication, and should improve our analysis of land use in the area.

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