PUBLISHING LANDSCAPE ARCHAEOLOGY IN THE DIGITAL WORLD

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ABSTRACT

The challenge of presenting micro- and macro-scale scale data in landscape archaeology studies is facilitated by a diversity of GIS technologies. Specific to scholarly research is the need to selectively share certain types of data with collaborators and academic researchers while also publishing general information in the public domain. This article presents a general model for scholarly online collaboration and teaching while providing examples of the kinds of landscape archaeology that can be published online. Specifically illustrated is WorldMap, an interactive mapping platform based upon open-source software which uses browsers built to open source standards. The various features of this platform allow tight user viewing control, views with URL referencing, commenting and certification of layers, as well as user annotation. Illustration of WorldMap features and its value for scholarly research and teaching is provided in the context of landscape archaeology studies.

Keywords: Mediterranian archaeology, navigation, Phoenician, GIS, landscape archaeology

INTRODUCTION

Few social science research disciplines have embraced the geographic information sciences (GIS) as thoroughly as archaeology. Documentation methods developed over a hundred years for recording historic and prehistoric sites have been revolutionized within less than a decade by 3-D visualizations with accuracies of less than a centimeter.[iii]. Being able to drill down to the micro-scale on excavations has often overshadowed the broader need to represent the macro-scale data, particularly of survey areas and the features they contain. Representations of period-specific sites as dots on a map is the often the manner in which regional social changes indicated by the archaeological record over hundreds or thousands of years are graphically represented to professional audiences. While this graphic method has evolved as a result of print publication, the now wide availability of online mapping and graphic display platforms has shifted the publication paradigm to enable illustrating and sharing data in ways never before possible. This paper explores a few of the types of archaeological and ecological data that can be shared with online mapping, with a specific emphasis on WorldMap, a browser-based mapping platform designed for scholars.
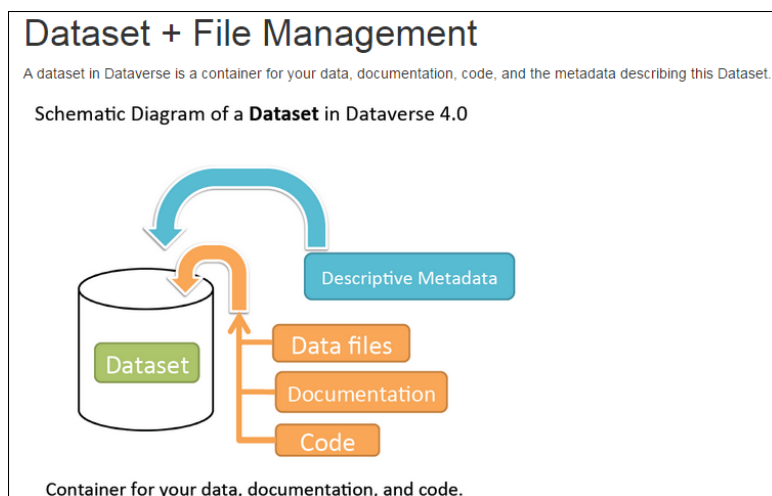
WorldMap and the Dataverse Archive

WorldMap is an open source, web-based mapping platform developed by the Center for Geographic Analysis at Harvard University. WorldMap allows researchers to visualize their

data, principally using GIS techniques and formats, without relying on desktop software to produce two-dimensional maps. Instead, WorldMap permits publishing interactive maps that present their data so that other researchers may view or, at the author's discretion, reuse the published data. A related platform is the Dataverse (www.dataverse.org/about)[iii] an online digital repository developed and maintained by the Institute for Quantitative Social Science at Harvard (www.iq.harvard.edu). This open source platform has been adopted by universities and research institutes worldwide (www.dataverse.org)[iv] as a method of publishing and sharing social science, life sciences, humanities, computer science, law, engineering and astronomy.

"The WorldMap and Dataverse collaboration allows researchers to be able to upload shapefiles to Dataverse for long term storage and receive a persistent identifier (through DOI), as well as be able to easily move into WorldMap to interact with the data and save to WorldMap as well. GeoConnect is the platform integrating Dataverse and WorldMap together and what you will use to visualize your data." [v]

Fig. 1: Managing Data in the Dataverse

Data can be either uploaded *directly* into WorldMap or be stored in the Dataverse archive and viewed in WorldMap. The Dataverse is designed with a feature (Geoconnect) that permits the display GIS files (shapefiles) in WorldMap, thereby enabling a single storage point for one's data.

WorldMap is a scholarly platform because it allows for detailed control of who can view and edit the display of data. The diagram below summarizes the relationships and workflow that WorldMap permits through is user controls. What is particularly valuable is the ability to specific viewing and editing privileges for specific individuals or permit only registered users view a map or layer.

Fig. 2 and Fig. 3: WorldMap User controls

Overview of Map level permissions

When publishing as an individual or as a collaboration of authors, scholars may review drafts of papers or chapters among themselves before sharing them a wider audience who might be reviewers or other individuals who provide critiques. WorldMap allow for adding individuals to form a workgroup while limiting who can view versus who can edit. One feature unique to WorldMap is the ability of both map originators and those with editing privileges to annotate individual layers, as is illustrated later in this paper.

Fig. 4: Collaboration Model
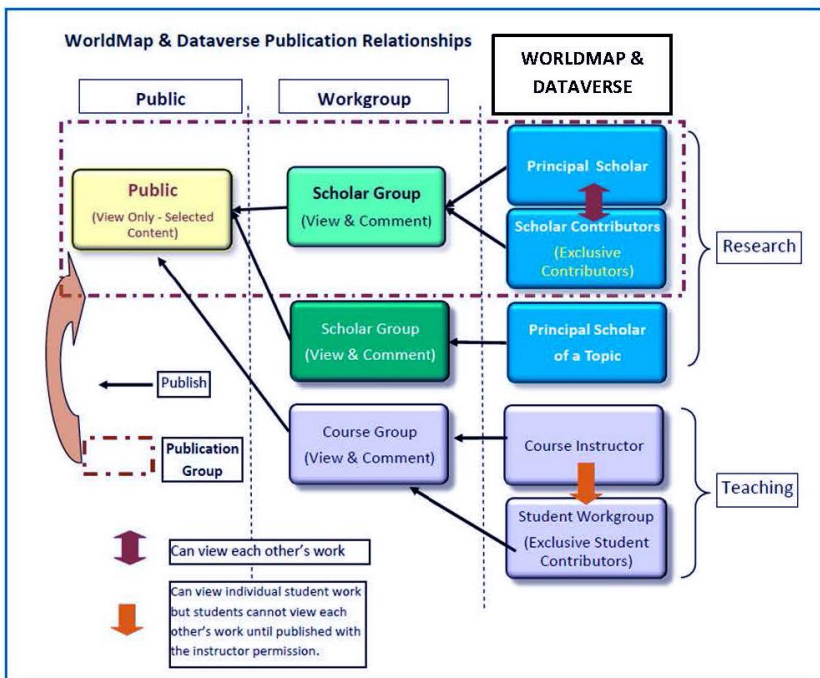
The collaborative model presented in the diagram of Figure 4 should be read from right to left. Either an individual scholar or a group of scholars can develop content and post it to a selected map as separate layers. This same process can be followed for students in a class, with each student contributing individual layers. When completed, the map and its layers can have their permissions changed so that reviewers can view the content. Similarly, an instructor can change a student's permission so that future changes can no longer be made. Once the review process is complete, the individuals with editing privileges can make selected layers public, so that a map can be viewed either without or with registration on WorldMap.

In summary, most online GIS mapping systems typically require a single person to be the 'gate keeper' who posts contributions from many sources within a company. WorldMap is different, as it allows the delegation of responsibility to many individuals who can create and manage their own content. The flexibility of WorldMap distinguishes it as a web-based mapping platform and as one particularly well suited for the lifecycle of scholarly research and publication.

TEACHING AND THE GEOSPATIAL NARRATIVE

At Harvard University there is a popular history course titled "The Making of the Middle Ages" in which every student is required to research and publish their research on at least one saint. As explained in the opening introduction to the map:

> The layers on this map have been created by the students " Each student in the class has chosen one or more saints' lives from medieval Europe and, reading the text, has extracted and plotted the place names mentioned in the text. These place names represent the totality of the compiler's geographer awareness. The goal of this project is twofold: to develop and practice mapping skills, and to explore the boundaries of the geographical imagination in medieval Europe. (http://worldmap.harvard.edu/maps/6211/X3i)

"Mapping the Holy 2015" displayed in Figure 5 presents the locations of saints from their histories or diaries, or possibly the itineraries of their pilgrimages. The locations were extracted from the texts which each student researched; the location was then identified and then, through a relatively simple process, converted in a layer on the single map, with each saint represented by a unique symbol.

For interested users of the map, there is additional information on each saint by clicking on an icon representing a specific location. In the case of Figure 6, the detail of Saint Willibald and his arrival in Joppa is presented in the pop-up box. In the process of publishing their research, each student learns the fundamentals of applying basic GIS techniques to present a spatial representation of their saint's itinerary.

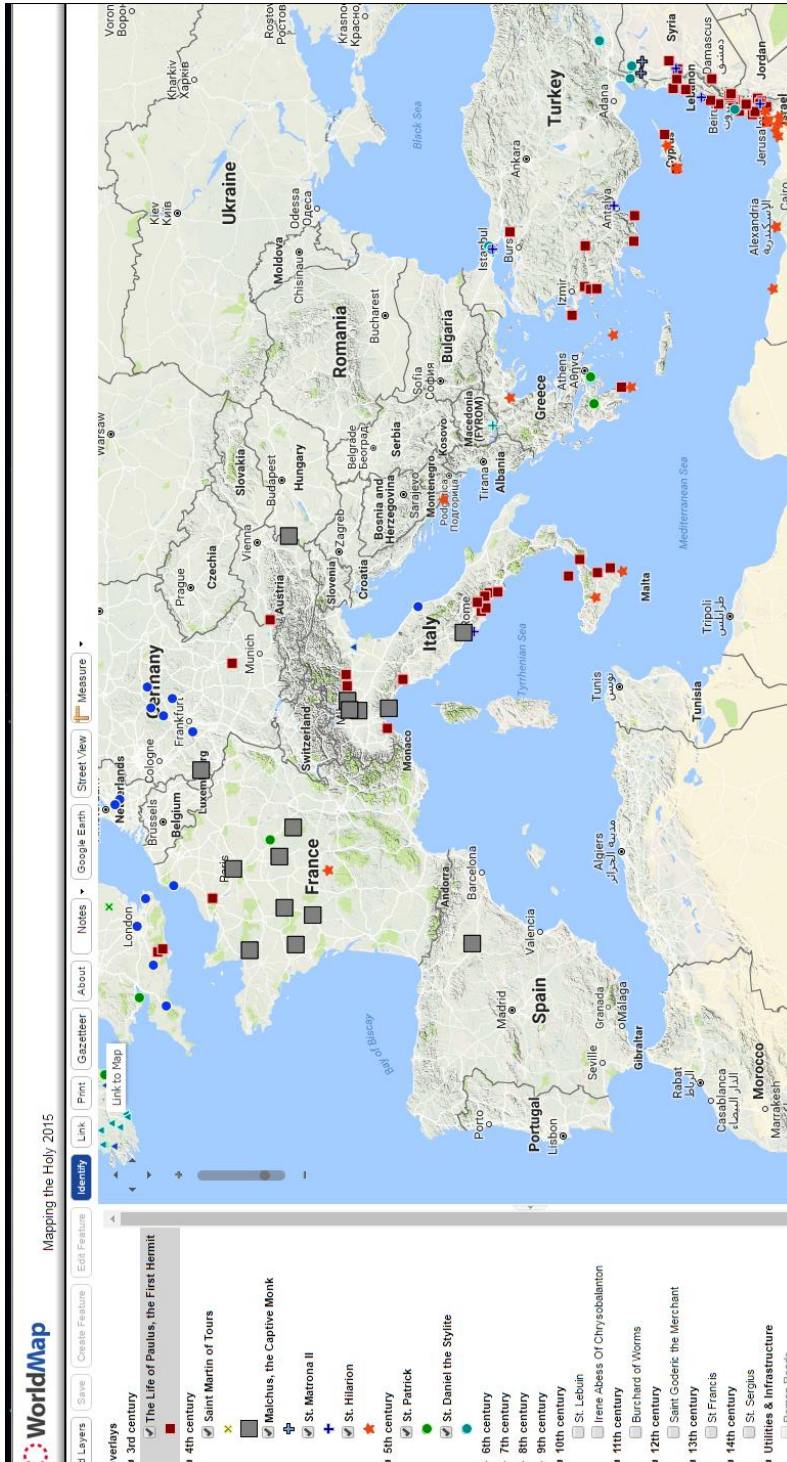**Fig. 5: Mapping the Holy – saints' itineraries as interpreted from their histories**

Fig. 6: Details of 6th century saints in the Holy Land
  (https://worldmap.harvard.edu/maps/6211/X3f)

More pertinenet to landscape archaeology is the ability of interactive maps to display the extent of large area surveys, such as a valley basin or geographic region. An ongoing archaeological survey and ecological survey are presented as examples of large area mapping.

Jezreel Valley Regional Project – 2015-2016 Seasons

The Jezreel Valley Regional Project is an ongoing, multi-year project [vi] The wide-area survey blocks are outlined in Figure 7, and identified features indicated by blue triangles. At this scale, the specific locations of features are not discerable, only their clustering.

**Fig. 7: Overview of a section of the Jezreel Valley Survey (1915 Season)**
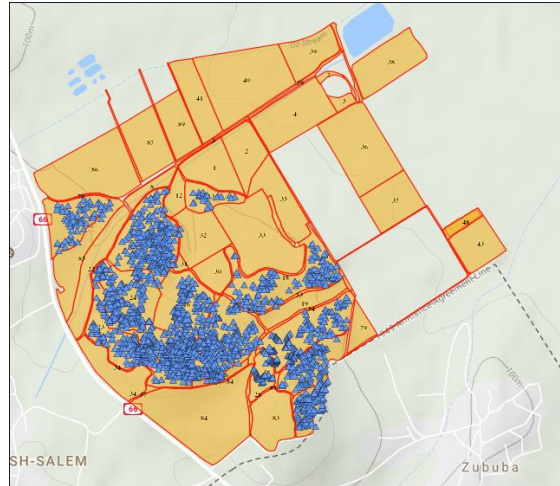
If the user zooms in on a survey block, the locations of specific features are no longer visible. The *Limit by Scale* feature allows the author to control the level of detail that can be viewed, thereby protecting sensitive archaeological feature data from public view.

Fig. 8: Detail of a section of the Jezreel Valley Regional Survey
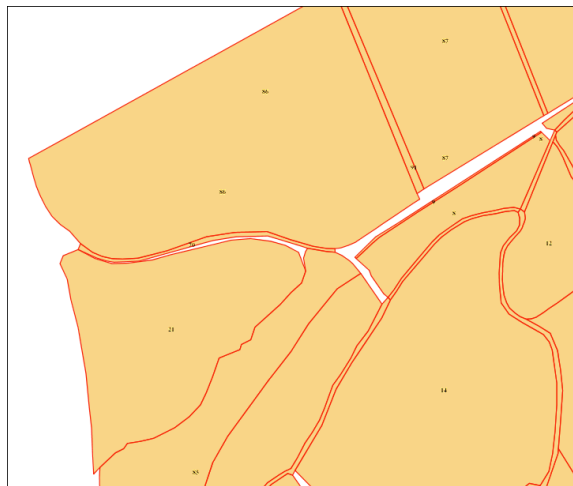
However, selected users can *annotate* a layer, as is illustrated in the figure below. In this case, a member of the survey team has annotated the layer indicating three of the features (not publically viewable at this scale) are all wine presses.

Fig. 9: Annotation of a Map Layer
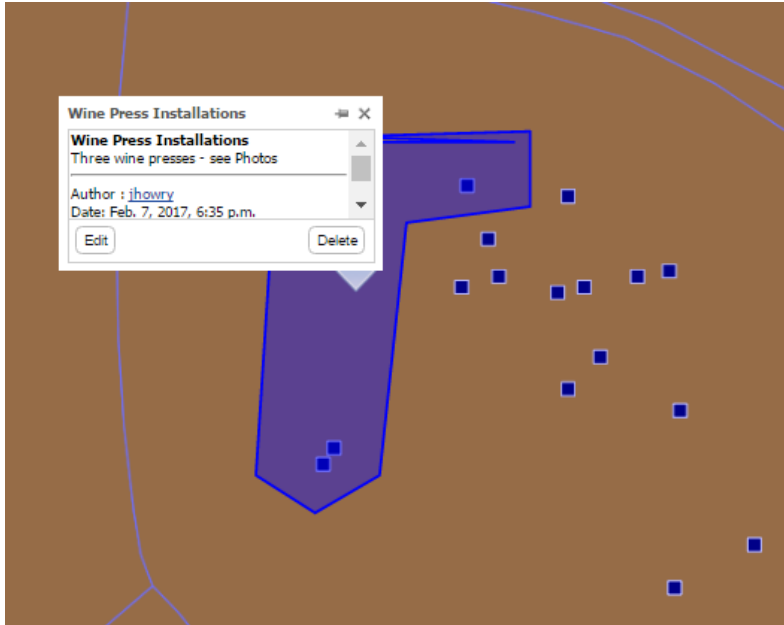
Gadara Ecological Survey

A nine-year ecological[vii] survey in northwest Jordan is another example of how spatial data can be published on WorldMap. The figure below illustrates the overall extent of the survey in northwest Jordan.

A closer examination discloses the detailed pattern of landuse and land types, ranging from possible archaeological landscapes to water resources. On the left side of the display, a list of the color-coded landuse types is diplayed that allow the user to interpret the map.
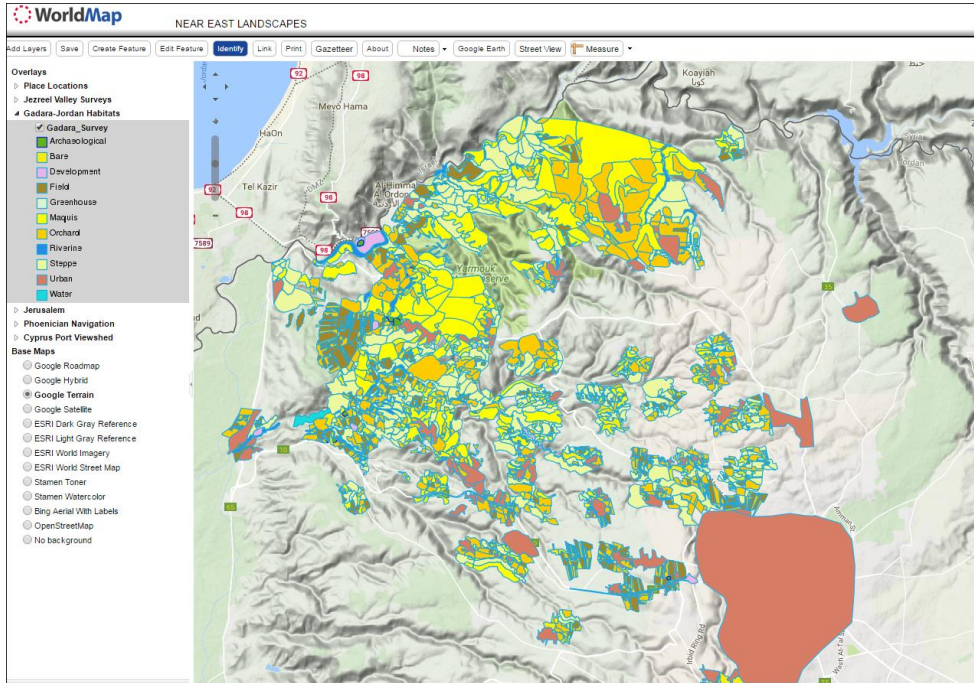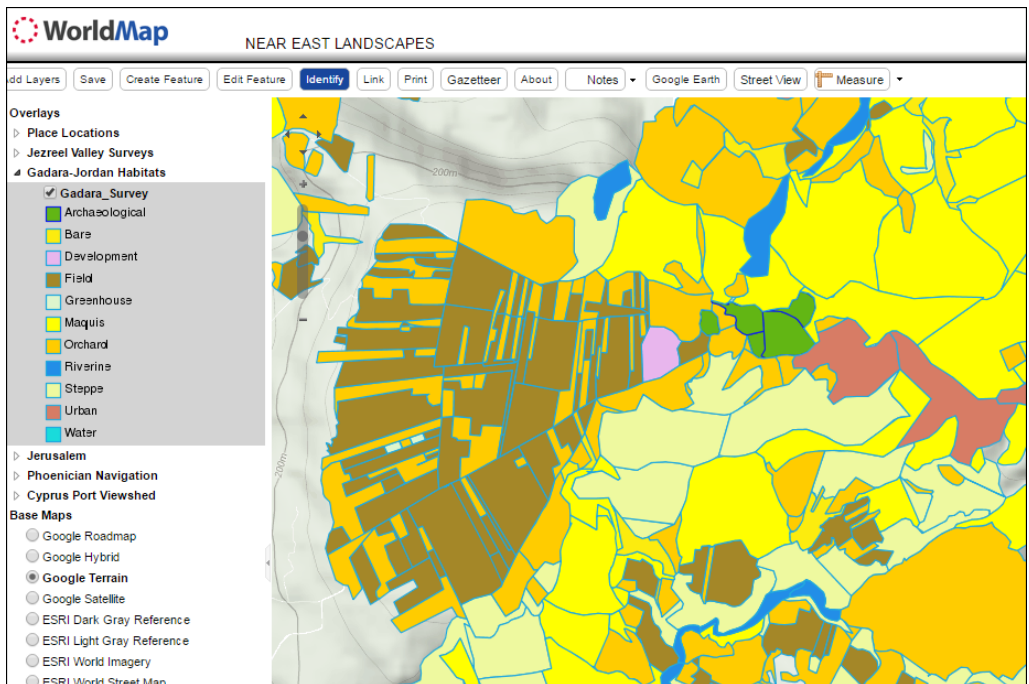
Fig. 10: Gadara, Jordan Ecological Survey

Fig. 11: Detail view of survey area

Mediterranean Navigation – Sailing to Kition

Web-based GIS platforms can dynamically display the results of analyses that are exclusively the domain of geospatial analysis. One such example is the calculation of a viewshed, the surface area that can be viewed from a specific location[viii]. The diagram below illustrates the area of a viewshed which is calculated from a specific height of an individual or geographic location. Typically, viewsheds are calculated to determine the areas that might be viewed from a vantage point or stratigic location. However, this same technique can be applied to 'seascapes', the area on a body of water which can be viewed from a point on land, such as a mountain top or artifical high point such as a light house. Conversely, the extent of the sea or land area that a mountain peak can be viewed is the mountain's viewshed on the surrounding water and land. In this way, it is possible to estimate in what directions and from what distance a mountain peak could be used for line-of-sight reckoning for navigation.

Fig. 12: Viewshed Area Calculation
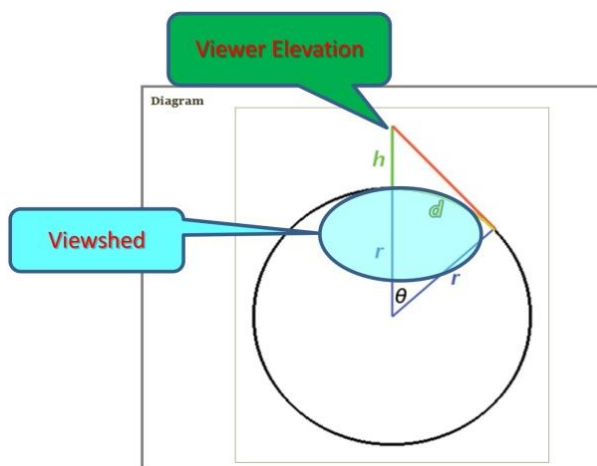
SAILING TO KITION

In order to expand their trading network, the Phoenicians established a major settlement and trading port at Kition, located in the present day Larnaca, Cyprus during the 9th Century CE. [ix x xi xii] A major Phoenician port-city on the island of Arwad, along the present-day coast of Syria, was situated between the major coastal cities of Tardus to the north and Amrit to the south, each a short 5 km sailing distance.

Fig. 13: Arwad Island, Tardus and Amrit (coastal Syria)

Figure 14 below illustrates the relative positions of Arwad to the east and Kition to the west on the Cypriot coast.

Among the factors in choosing a distant port city would have been the ease of navigation to locate the coastal settlement. An analysis of the route between the port island Arwad (or Aradus) and Kition shows a possible rationale for locating Kition at its particular point on the Cyprus coast: the sailing distance was the shortest – a straight line. Perhaps equally important, navigators could use line-of-sight navigation by using Mount Stavrovouni, a 689 meter (2,260 feet) high volcanic peak 12 km (7 mi) from the coast as a navigation aide.

The blue areas east of the Cyrus coast represent the viewshed of Mount Stavrouvouni, the projected areas from which the peak would be visible over the western horizon if sailing in from the west or in the surrounding waters of eastern Cyprus.

The possible sailing route between Arwad and Kition is shown as a red line between the two ports. The route was a straight line, and the shortest distance. Navigating the route by a line-of-sight meant orienting the sailing vessel so that the top of Mt. Stavrovouni was visible once the vessel nears the coast. If the mountain was out of view, the vessel was sailing too far to the south (or, possibly *very* far south if the coast of Cyprus could not be seen). The 'pie-slice' in the viewshed indicates the area of coastal Cyprus where Mount Stavrovouni cannot be viewed as a result of a small mountain plateau of more than 200 meters high (Mount Alexigros at 209 meters)[xiii] which stands between Mount Stavrovouni and the coast. The presence of a 'blank window' is itself a navigation aid, as it provides an indication to the navigator if he is off-course.

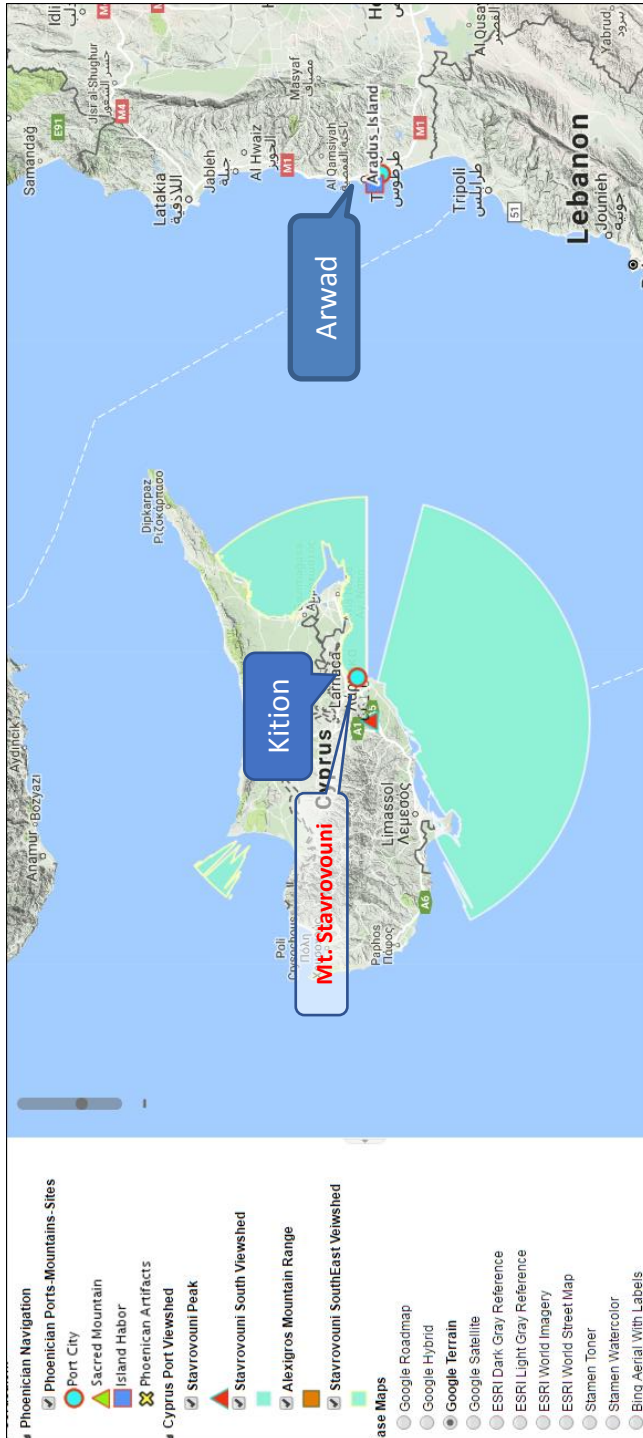**Fig. 14: Arwad, Kition and Mt. Stavrovouni**

Fig. 15: The straightest route using Mount Stavrouvouni for line-of-sight navigation
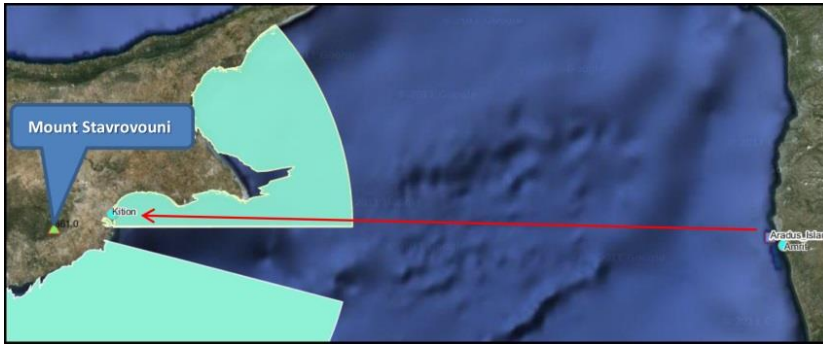

Fig. 16: Measuring with WorldMap

WorldMap provides a measuring tool that provides the user with useful data about Phoenician navigation. Figure 18 below shows a dashed line, which is the direct route between Arwad and Kition and which WorldMap measures as a distance of 204 km (127 miles). The distance from the peak of Mount Stavrovouni to the farthest possible edge of its viewshed is approximately 93 km (57 miles). However, the distance from the edge of the viewshed to Kition is only 74 km (46 km). Therefore, the navigator heading west would know if he is on course for a landfall near Kition while still a considerable distance from the port. The nearby Cypriot coast to the north would provide an additional aid to navigation.

Fig. 17: Arwad to Kition (above)
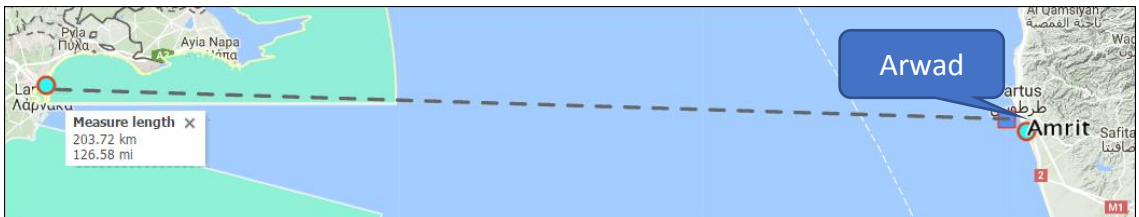
WorldMap measurements indicate that it would require at least 130 km (80.6 miles) of straight sailing from Arwad Island before top of Mt. Stavrovouni would be visible in the best of weather conditions.

Fig. 18: Distance to Edge of Mount Stavrovouni viewshed (above)
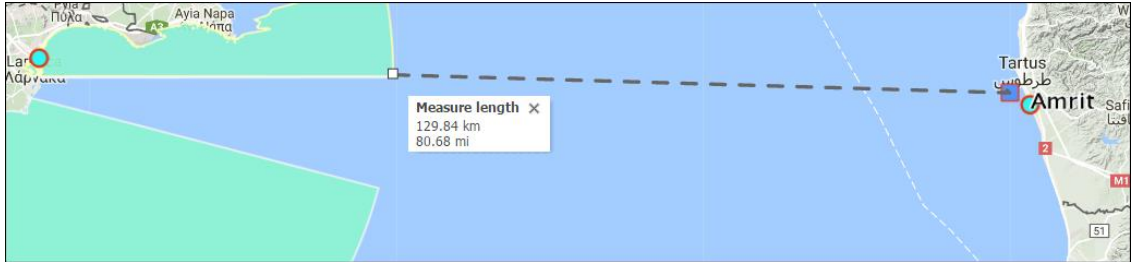
Upon sighting the top of Mount Stavrovouni, the navigator would need to sail 70-74 km to reach Kition.

Fig. 19: Sighting of Mount Stavrovouni
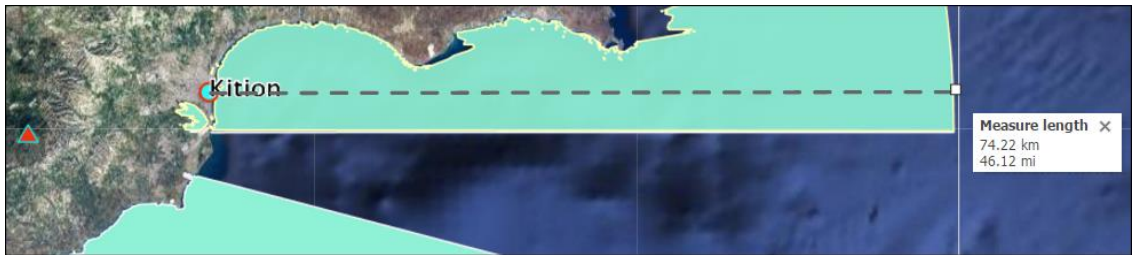
For Phoenicians, one of the most revered gods was Ba'al, "Lord of the Wind and High Places." Mountain peaks and near-shoreline topographic features were often the sites of Ba'al shrines. For seamen, Ba'al was an revered deity to whom offerings were made, as were prayers for safe passage. Peaks like Mount Stavrovouni likely had shrines to Ba'al. But, as is often the case, a more recent religious structures have been constructed on the site. Today, the oldest monastery in Cyprus occupies the peak of Mount Stavrouvouni. What is relevant, is that the "high places" of Ba'al were navigation aids. The areas of the seacoast from which the high places could be viewed had their corresponding viewsheds which defined the specific realm of Ba'al. In this sense, the viewsheds of the god's high places define the sacred seascapes of the deity.[xiv]

Publishing to WorldMap and Dataverse

The viewshed analyses displayed in the figures above are published as shapefiles (red circle) in a Dataverse titled *Sailing to Kition* which the author created to share information about navigation in the Mediterranean. The particular Dataverse also includes shapefiles on Phoenician Ports and a brief presentation on navigating from the much older city of Salamis located on the Cypriot northeast coast, around Cape Greco and to Kition.

Part of the Dataverse functionality includes the ability to display shapefile data (in .shp or .zip format) in WorldMap. Clicking the *Map Data* button (blue circle) for a specific file will initiate Geoconnect and display the specific file in WorldMap. In this way, a user can

preview a file's content, thereby obviating the need of downloading the file to desktop GIS software to view its content.

Fig. 20: Sailing to Kition Dataverse
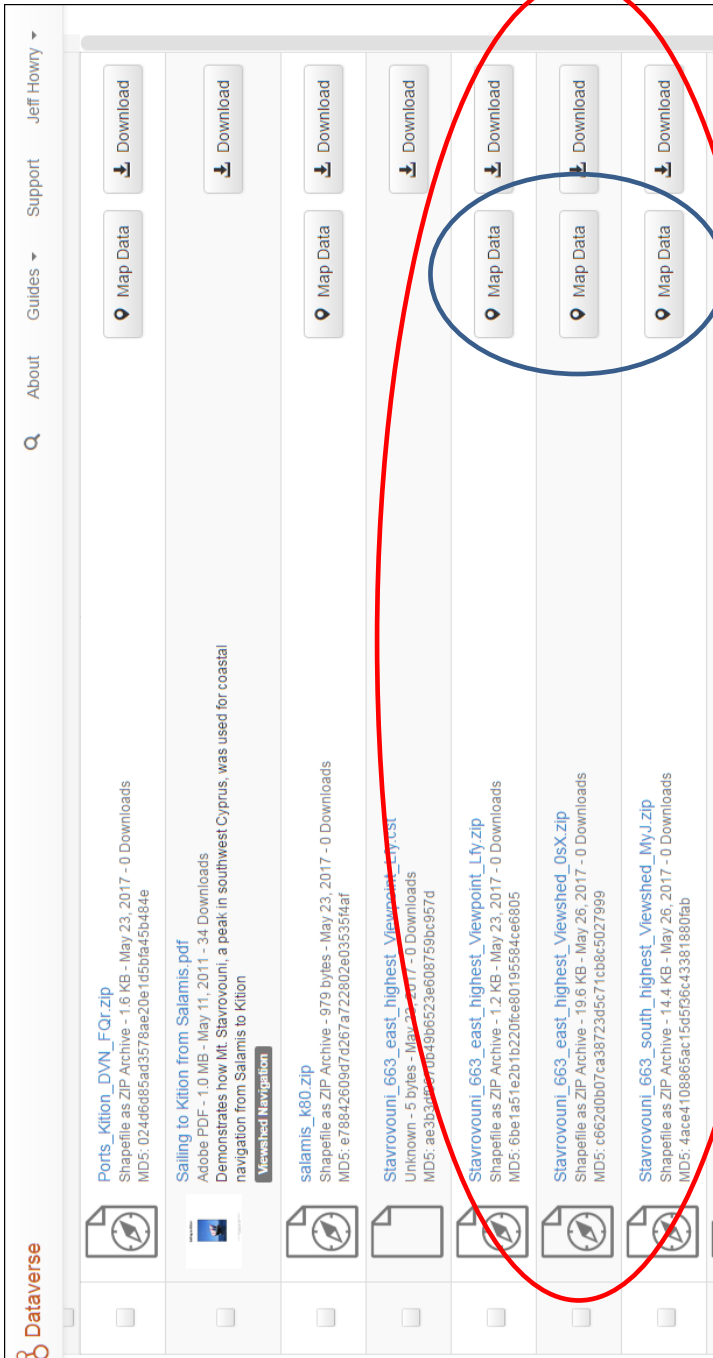
CONCLUSIONS

The widely adopted use of GIS techniques in archaeology has particular relevance for landscape archaeology. Accompanying the trend toward structure in motion recording techniques of archaeological excavations, the need for publishing large area surveys and analyses in more than a two-dimensional printed format is unquestionably evident. The emergence of web-based mapping platforms has now provided the opportunity to publish maps and data in ways not previously possible. This paper has considered WorldMap, an open source mapping platform specifically designed for scholarly publication. The granular control of viewing and editing privileges allows for collaboration during the full life-cycle of research and publication. WorldMap's integration with a digital archive (the Dataverse) is not found elsewhere among current web-based mapping platforms. Together, WorldMap and Dataverse, provide a unique opportunity for publishing geospatial data with any form of text or quantitative data.

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