THE MEDITERRANEAN ARCHAEOLOGICAL NETWORK – A CYBERINFRASTRUCTURE FOR ARCHAEOLOGICAL HERITAGE MANAGEMENT

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ABSTRACT

The Mediterranean Archaeological Network (*MedArchNet http://medarchnet.org*) is a series of linked archaeological information nodes. Each node contains a regional database of archaeological sites, sharing a common database structure in order to facilitate rapid information retrieval and display within and across nodes in the network. On the world scene, archaeology produces major new sources of cultural heritage data and material remains that require innovative methods for study, interpretation and public presentation. To take advantage of the growing body of such data, the *MedArchNet* cyberinfrastructure provides a workable model for researchers from a wide range of fields dealing with cultural heritage to collaborate, discover and monitor resources. In an era of rapidly expanding population and urban development, a system like *MedArchNet* can provide mechanisms to monitor archaeological site conditions over time and lessen the impact on cultural heritage resources by careful planning, and can significantly enhance site preservation and development potential in the Mediterranean basin. Furthermore, by uniting archaeological site metadata from many disparate datasets and organizations, the *MedArchNet* cyberinfrastructure dramatically improves the ability of researchers to ask large-scale, cross-regional questions of the archaeological data, providing fresh new insights into one of the most culturally meaningful areas on Earth.

1. INTRODUCTION

The Mediterranean Archaeological Network (*MedArchNet*) is envisioned as a series of linked archaeological information nodes, each of which contains a regional database of archaeological sites that share a common database structure in order to facilitate rapid query and information retrieval and display within and across nodes in the network [1]. *MedArchNet* is a signature project of the Center for the Interdisciplinary Study of Art, Architecture and Archaeology (CISA3) at the Qualcomm Institute/California Institute for Telecommunications and Technology (Calit2) at the University of California, San Diego, and the Geo-Archaeological Information Applications (GAIA) Lab, Archaeological Research Institute at Arizona State University. The ultimate vision of *MedArchNet* (Mediterranean Archaeology Network) is to develop a network of archaeological sites (from remote prehistory to the early 20th century). The *MedArchNet* website is found at http://medarchnet.org
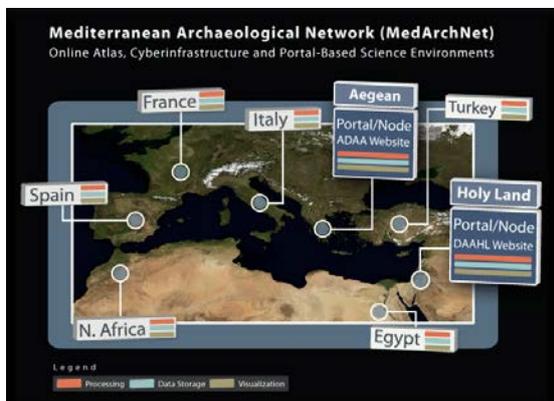
MedArchNet currently contains one active archaeological information node: 1) the *Digital Archaeological Atlas of the Holy Land* (*DAAHL*) at http://daahl.ucsd.edu and one node in development -- the *Aegean Digital Archaeological Atlas* (ADAA), which has yet to be populated and brought online.

The data nodes are developed and maintained by the GAIA Lab, and served from Calit2 at UCSD. A prototype web site, shown above, is currently populated by a small database of archaeological sites drawn from the National Geospatial-

Intelligence Agency's GEOnet Names Server, located at (http://earth-info.nga.mil/gns/html/index.html). This prototype is powered by a Google Maps interface, and illustrates the potential for inter-regional archaeological inquiry that can be realized through the *MedArchNet* concept.
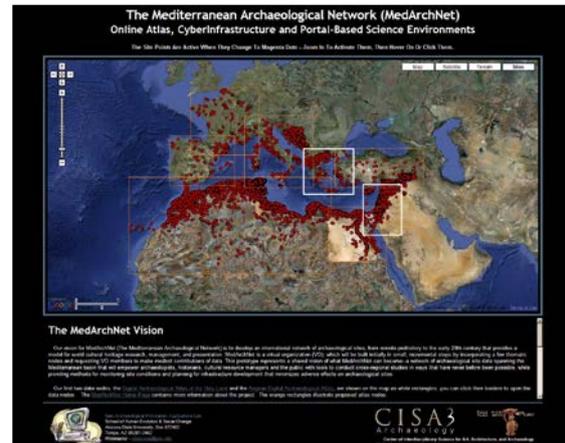
2. A METADATA APPROACH

Participants at the recent Workshop on CyberArchaeology, held at the American School of Classical Studies, Athens, on 4 October 2013, discussed the fact that at its most basic level, there is a small set of common variables in all archaeological site databases. These include the site name, the site location (latitude/longitude), time periods when the site is occupied, features that can be found at the site, and links to additional site information, either web-based, or print-based. Participants further expressed the desirability of creating a regional, web-based system of archaeological metadata, encompassing these fields, which would be able to link other, disparate datasets. Essentially, the participants at the workshop were describing *MedArchNet* in a nutshell.

The *MedArchNet* approach to archaeological site data envisions our data nodes as "switchboards" that contain top-level site and project metadata, plus bibliographic references and extensive use of linked resources outside the *MedArchNe*t data structure. It is not our goal to corral every bit of data about every site in the Mediterrane-

an—an enterprise that would clearly be impossible even if it were desirable. Rather, the *MedArchNet* approach is designed to let researchers and the public easily find archaeological sites based on location and other attributes such as site type, features, time periods, etc., provide a mechanism for creating substantive maps linked to the various *MedArchNet* nodes, and then point the user to the locations of substantive research on the site, whether it be on- or off-line. The *MedArchNet* project thus serves to highlight the research of the archaeological community, rather than subsume it under the *MedArchNet* umbrella; it furthermore fulfills the desire of the Athens Cyberinfrastructure Workshop for a inter-regional metadata system that can unite different regional databases under a single query umbrella, without subsuming any of them. Each data node in *MedArchNet* maintains a table of data donors, including contact information and primary web sites, and each site contributed by a donor will be "branded" with the donor's information. Whenever a contributed site is displayed, the donor information is also shown, so the links to the donor's website are clearly shown, along with specific external resources for individual sites.

3. *MEDARCHNET* SPONSORSHIP

Because the MedArchNet approach to archaeological data maintains and highlights the contributions of individual researchers, university departments, and governmental organizations, it has received the active cooperation and sponsorship of such organizations and individual data contributors. The project actively cooperates with research organizations and government agencies to develop new data nodes and applications. Each of our current nodes has received significant sponsorship. The *Digital Archaeological Atlas of the Holy Land* (DAAHL) is a sponsored project of the American Schools of Oriental Research, the flagship organization that coordinates North American archaeological research in the Levant. Likewise, the *Aegean Digital Archaeological Atlas* (ADAA) began as a joint effort of the National Archive of Monuments of the Hellenic Ministry of Culture and the Institute for Aegean Prehistory.

As *MedArchNet* develops additional data nodes, we look forward to expanding our cooperative efforts with additional data donors, research organizations and government agencies. *MedArchNet* has received sponsorship from the World Universities Network, Equinox Publishing, Inc., Google, Inc., NASA, and the Institute for Aegean Prehistory.

4. "PORTAL SCIENCE"

MedArchNet represents the fast growing field of 'portal science' and will serve not only researchers and explorers as a platform for international collaboration, but also the general public to share in the excitement of archaeology. The cyberinfrastructure needed to support data collection and representation, data discovery, information integration, and information display for the rich media collections represented by such a network of archaeological data will be developed such that it is extensible to other locations and other archaeological efforts. Thus, for example, our existing data portals could be applied to archaeological sites in Egypt or Turkey, or any other region in the circum-Mediterranean.

In addition, the basic approach that MedArchNet has taken can be easily adapted to other large regions. For example, three prototype websites have recently been developed at the GAIA Lab to showcase the flexibility of the MedArchNet approach, including "The Arabian Archaeological Network" (shown below), "The Sub-Saharan Archaeological Network," and "The South Asian Archaeological Network."

MedArchNet in general and its data nodes in particular, will serve as the most up-to-date source for 'mining' stories and narratives of archaeological research in the Mediterranean lands. Archaeological data will

be accessed and displayed over the internet through existing tools such as Google Maps/Google Earth. All of the *MedArchNet* databases are UTF-8 encoded, so they support multinational character sets; moreover, the Google Translation tool is included at the bottom of every *MedArchNet* web page, so the output can be translated into any available language at the touch of a button.
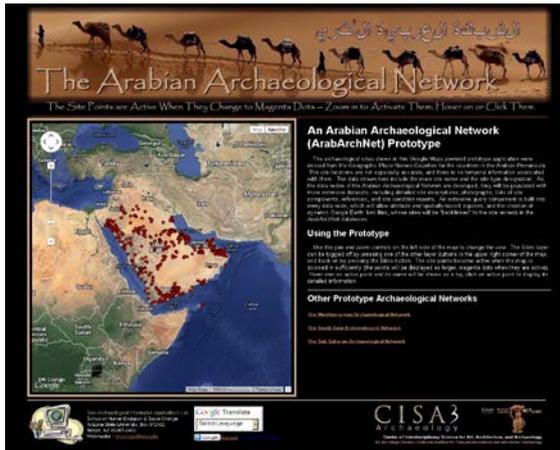
5. DATA NODES IN *MEDARCHNET*

As noted earlier, currently *MedArchNet* consists of one active node, The Digital Archaeological Atlas of the Hoy Land (*DAAHL*), and one node that is under development, The Aegean Digital Archaeological Atlas. Below, we briefly describe these first two nodes.

5.1 The DAAHL Data Node

The first *MedArchNet* data node created was the *Digital Archaeology Atlas of the Holy Land*. The *DAAHL* node brings together many of the developments in information technology that are revolutionizing the fields of archaeology, history, and the social sciences, based on new archaeological discoveries and the latest content concerning one of the most politically complex but meaningful geographic regions in world heritage. The *DAAHL* node was developed at the GAIA Lab and deployed at Calit2, UCSD; it can be reached at http://daahl.ucsd.edu. The *DAAHL* project has recently been judged to be one of a small number of "Exemplary Comparative

or Thematic Collections" by the Digital Collections Group of the American Schools of Oriental Research Committee for Archaeological Policy (Digital Collections Group 2011). It has been directly linked into the recently developed CAP Projects website at http://asosrtest.org. The *DAAHL* data node of the *MedArchNet* system is the only regional, multi-national database of archaeological site and project metadata available for the Levant. It currently contains site metadata for more than 27,000 sites, 60,000 site components, as well as an extensive bibliography, and information related to site conditions.
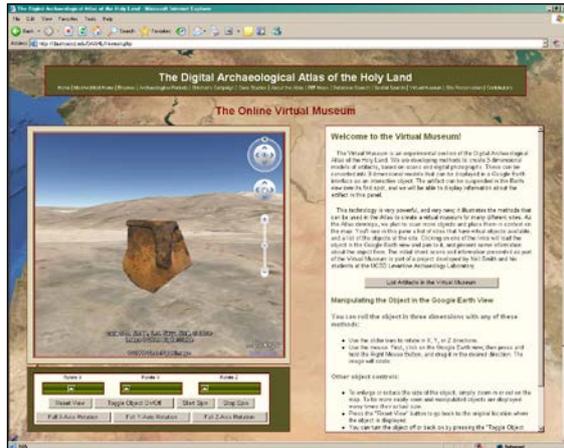
The *DAAHL* database is a highly-customized extension of the basic *MedArchNet* metadata. The web site is organized around two central themes, a series of case studies, the *Palestine Exploration Fund* Maps, the Virtual Museum and the *DAAHL* database search and mapping functions.

Among its rich data display and query tools are the ability to display the latest archaeological survey and excavation information against an interactive Google Maps background that contains the Palestine Exploration Fund maps—classic archaeological and topographic maps created in the 1870s and 1880s. The PEF maps were scanned and converted into an image pyramid of more than 250,000 tiles for Google Maps display. Site points from the DAAHL database are displayed on top of the historic maps, and each site is back-linked to the database, so that its records can be called up simply by clicking on the site point.
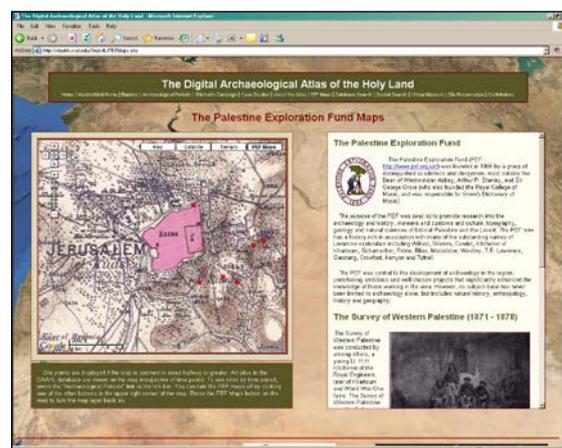
Another highly innovative feature is the DAAHL's Virtual Museum, which displays interactive, 3d objects at their original find locations through a Google Earth API—the user can manipulate the object in all three dimensions as well as the map itself.

The most recent development to the *DAAHL* data node is a mapping function that allows the user to query the database by time period and/or site/feature type. Results are displayed as a series of interac-


tive site clusters on the terrain layer of the Google Maps interface. The site clusters are clickable, where doing so zooms to the next level and displays smaller clusters, and individual sites. Site points are also clickable. These maps are suitable for presentation or publication.
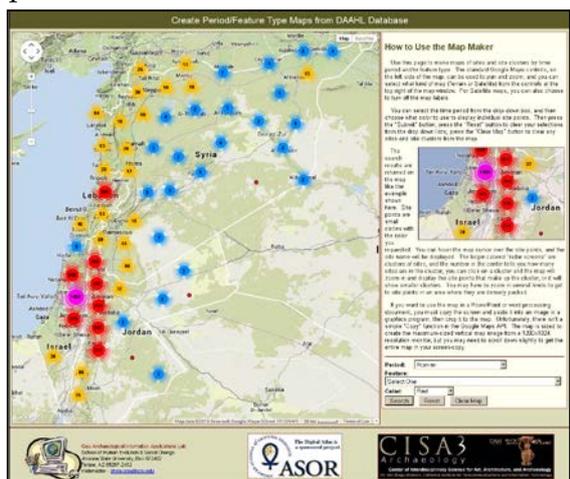
5.2 The ADAA Data Node

The second node in the *MedArchNet* cyberinfrastructure is the *Aegean Digital Archaeological Atlas*, begun through the cooperative effort of the National Archive of

Monuments, Hellenic Ministry of Culture and Tourism, the Institute for Aegean Prehistory, and the *MedArchNet* project. The *ADAA* project is in its initial stages, with initial data gathering conducted at the Temple University Archaeology Laboratory and at INSTAP Study Center for Eastern Crete at Pachia Ammos, Crete.
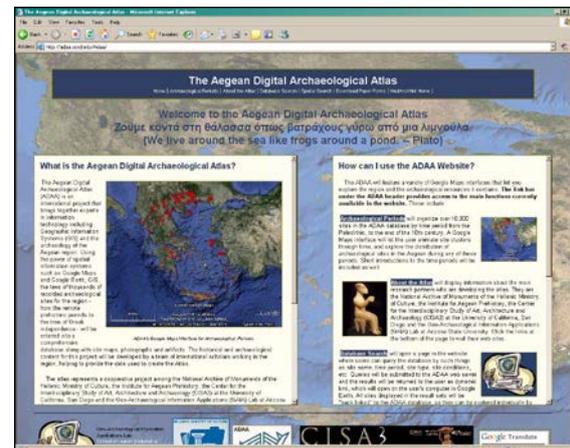
The Aegean Digital Archaeological Atlas illustrates the "basic" *MedArchNet* data node. The basic node supports a dedicated database in the *MedArchNet* format, plus the same kinds of tabular and spatial searches described earlier for the *DAAHL* website. Like the *DAAHL*, the *ADAA* portal supports site Contributor's listings and "branding" of archaeological sites.

The *ADAA* node also includes online data entry and editing tools. Users with password access to the database have data entry screens available, where site and project records can be created, site pictures uploaded, and other important data entry and maintenance tasks.

The site record contains the basic *MedArchNet* metadata for the site, and is linked to other tables in the database that capture information related to site periods and site/feature types. The combination of period and site/feature type is termed a "Site Component," and is the preferred method of assigning temporal and archaeological attributes to the site record. Our experience in developing the *DAAHL* database, MedArchNet, and predecessor archaeological database applications has shown that the most typical query that users make involves a time period and a

site/feature type. For example, a typical query might be "Show me all the Early Bronze Age Dolmen sites," or 'Let me see all the Iron II period fortresses." We encode sites with these combinations so that these kinds of queries can be performed. Simply recording a list of occupation periods and another list of site features does not allow for the kind of query that most users want to conduct.


6. SITE CONDITION ASSESSMENT

One of the most significant attributes of the *MedArchNet* approach is the inclusion of a Site Condition Assessment module in each of our data nodes. We recognize that archaeological sites are under tremendous pressure from development, agricultural expansion, warfare, and other factors. These are facets of modern life that have created extremely adverse effects on a finite cultural resource base (see Savage and Rempel, 2013). Too often, though, the tools that are required to help manage and monitor ongoing impacts or threatening developments on sites are lacking.

MedArchNet addresses this pressing need by including an assessment module that lets authorized users create what we term a "Visit" record, for any site in the database, and attach to it records related to Site Disturbances 9things already happening on a site that are damaging it), Site Threats (things that have not yet come to pass, but are easily foreseen, such as a road development that will cut through a site in five years' time), and Site Hazards (conditions

on a site that are dangerous for people or animals, such as the presence of unexploded ordnance, oil or chemical spills, or other factors of this type).

Furthermore, the query capabilities that come with each node in the *MedArchNet* system include a spatial-based query—the user can draw an area on a Google Map window, which might represent an area of potential effect for a planned project. The *MedArchNet* node can take that drawn area and query its data node for sites that fall in or near it, and the results are returned to the user as a KML file, which can be opened in Google Earth. Each site in the file is back-linked into the database so it can be examined in detail. This allows planners to use the system to interactively design development projects in such a way that they minimize the impact on known sites.
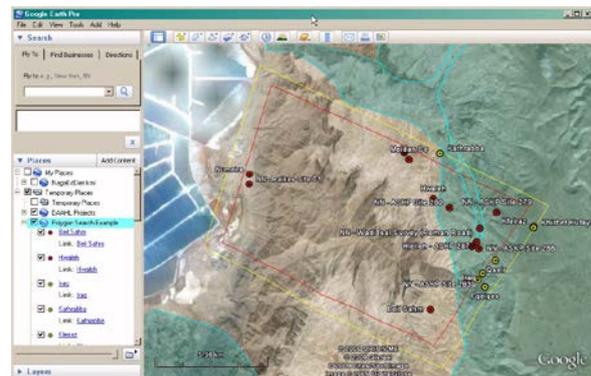
7. FUTURE PLANS FOR *MEDARCHNET*

With the establishment of *DAAHL*, the basic digital atlas infrastructure for the entire Mediterreanean region is now in place. *MedArchNet/DAAHL* has been recognized by the American Schools of Oriental Research (ASOR) as an essential tool for addressing «big picture» issues of archaeological dissemination (Levy 2013) and site conservation. Currently, *MedArchNet* provides a platform for 68 ASOR Committee on Archaeological Policy (CAP) recognized projects to present 'snap shot' overviews of their research in Cyprus, Egypt, Israel, Jordan, the Palestinian territories, Turkey. Our goal reach out to these ASOR projects to contribute settlement pattern data from

their research to strengthen *DAAHL* and initiate new Atlas nodes for the MedArch-Net. We would also like to collaborate with other research organizations such as the American School of Classical Studies in Athens, and other non-government organizations that can contribute data to *MedArchNet*.

8. SUMMARY

MedArchNet will have a significant research and education impact by providing easy online access to archaeological data and information. We will deploy the *MedArchNet* hub and its data nodes, which will provide access to information contributed by each member of the *MedArchNet* "Virtual Organization". Via the hub, users will be able to navigate back to the original member sites and databases to access the full information and related data from the

respective site. Each data donor receives full recognition and credit for their contribution. Individual portals have been developed initially for ASOR (*DAAHL*), IN-STAP (*ADAA*), and other partnering groups. The network of linked portals will support collaborations among users and provide a platform for initiating and sustaining discussions related to cross-site thematic areas of study.

On the world scene, archaeology produces the major new sources of cultural heritage data and material remains that require innovative methods for study, interpretation and public presentation. To take advantage of the growing body of such data, the *MedArchNet* cyberinfrastructure will provide a workable model for researchers from a wide range of fields

FOOTNOTE

[1] This paper provides a general description of the project; a more technical description is currently in preparation for submission to *Mediterranean Archaeology & Archaeometry* near the end of the year.

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