19 JADIS (Jordan Antiquities Database and Information System): An example of national archaeological inventory and GIS applications

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19.1 CRM AND NATIONAL ARCHAEOLOGICAL INVENTORY IN JORDAN

In 1987 the American Center of Oriental Research in Amman initiated a Cultural Resources Management (CRM) program in cooperation with the Department of Antiquities of Jordan.

The main purpose of the program was, and still is, to assist the Department of Antiquities in developing an independent system of coordination with governmental agencies responsible for development projects, and to start a process by which cultural resources will be given recognition in the earliest phases of a new construction design. Until very recently in fact, the Department of Antiquities was usually informed of a new construction project only when bulldozers had already damaged a site, often forcing the Department to begin desperate salvage excavations. Thanks to the Cultural Resource Management Project, information flow is now at the feasibility or tender bidding stage, when project design is either almost or totally complete. This leaves only a short period of time to assess the impact of a new construction on the archaeological sites of an area, but at least it is possible now to speak about "rescue" more than "salvage" archaeology being conducted in Jordan.

Of course the ideal situation — towards which we are striving — is that of providing the development agency with information concerning the existence of important archaeological sites in the areas considered for construction at the design phase. To realize this goal, the CRM program is involved in implementing two currently missing elements: a comprehensive legislative framework, and a National Register of archaeological sites.

For the legislative framework, an opportunity is now offered by the new Environmental Law, which takes into consideration a series of recommendations presented only a few months ago in the National Environmental Strategy for Jordan. If approved, this law will provide the framework for formal coordination and information flow between the development agencies and the Department of Antiquities.

As regards the National Register of archaeological sites, the problem was rather more complex. The Department has very large archives, but they are not computerized. There is no recording system, either, except for some index files of sites in alphabetical order. A study to computerize this information (reports, photos, negatives, etc.) was done a few years ago by a French mission, but their recommendation to purchase a mini–computer was not followed because of the cost of the equipment. In addition to the unpublished reports contained in the archives, there are numerous publications on excavations and surveys conducted in Jordan, and a series of volumes (35 so far) published by the Department of Antiquities containing preliminary reports on archaeological projects. Finally, another important project was initiated almost ten years ago, that of a cooperative effort of the Musées Royaux d'Art et d'Histoire in Bruxelles and the University of Sidney. The project has produced three volumes to date, entitled *Archaeology of Jordan*; the first being a list of references (cross–indexed by site), and the second and third containing short reports with similar formats for all the archaeological projects in the field at the time the volumes were published, in 1989 (Homès–Fredericq & Hennessy 1986, 1989).

19.1.1 Genesis of JADIS

Two years ago the Cultural Resources Management Project set as one of its priorities the study and the production of a computerized system to record the archaeological sites of Jordan, mainly known through published reports or unpublished information. The objectives of this database were multiple: to organize the existing information into a flexible system that would allow different types of data search and analysis, to produce site lists based on map grid coordinates for quick reference and to facilitate the exchange of information between Department of Antiquities and development agencies on the location of archaeological sites.

The main concern in preparing the database concept was then to organize the data as to know "where" sites are in Jordan. The problem is that there are four ways in Jordan to say where a place is: using geographical coordinate (latitude–longitude), Palestine grid coordinates, UTM coordinates, and JTM coordinates. We all know what a UTM and a geographical coordinate is. The Palestine grid coordinates were established during the British mandate, and are valid for Palestine and Jordan only. Because of their simplicity of use, and the fact that they are printed on the oldest and the newest map series, they are preferred by the archaeologists. The JTM grid (Jordan Transverse Mercator) is a compromise between zone 36 and 37 of the UTM system, which covers the western and the eastern areas of Jordan, respectively. Fortunately no one uses the JTM system to record its sites, and only very few use geographical coordinates. The UTM grid is printed on the 30–year old 1:50,000 series, which for large sections of Jordan is still the most recent map available. It was unavoidable then, to record each site under two different systems, Palestine grid and UTM.

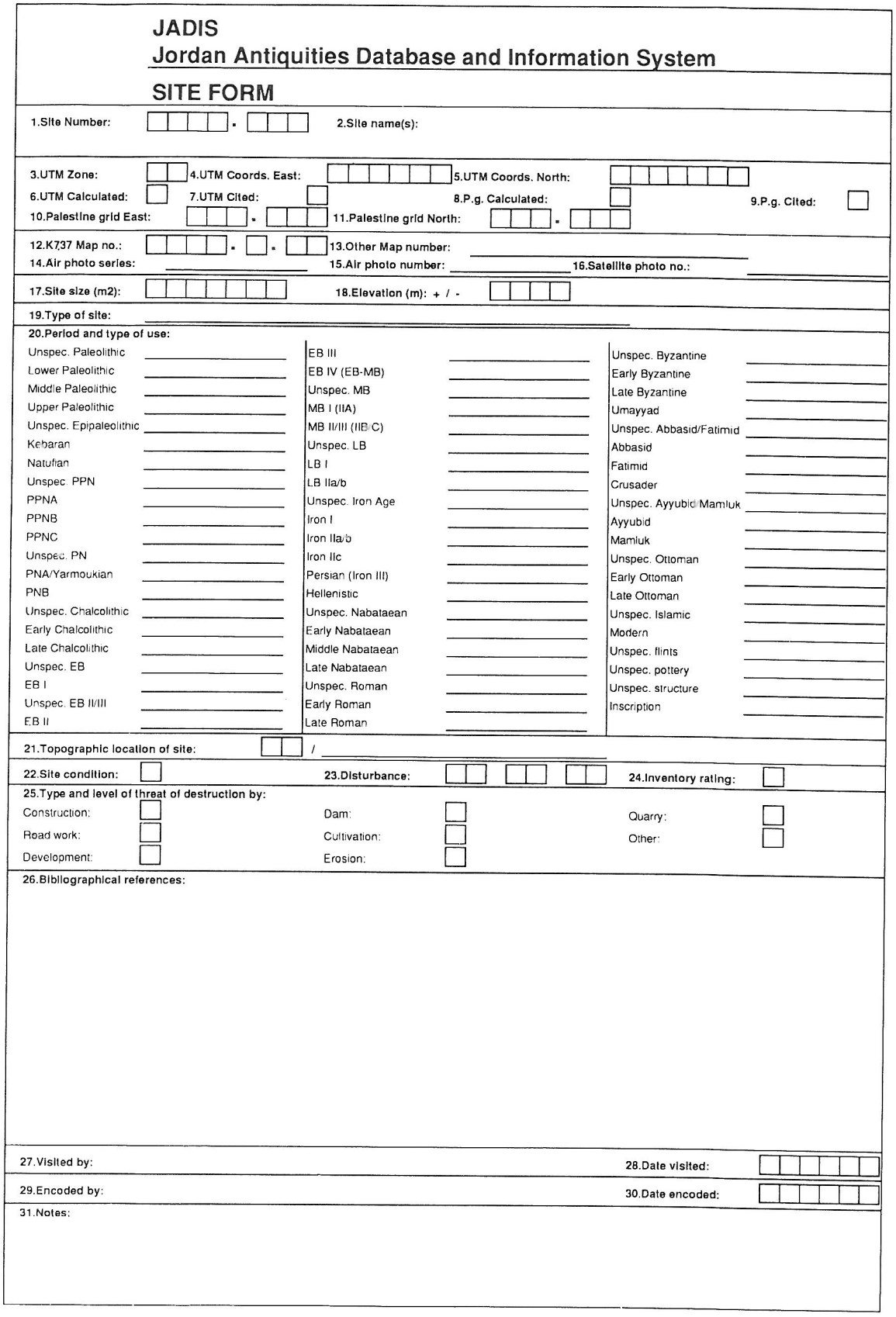
Another problem to solve in the preparation of the database concept was the size of the database and the amount and type of information we wanted. First of all, the choice of a personal computer was a quite natural one: PCs are now relatively cheap and the new 80386 and 80486 machines with high storage capacity and memory can easily handle large and complex sets of data. MS–DOS systems were preferred over Macintosh because of the possibility of integrating the database into ARC/Info.

In any case, a decision was made to keep the databases relatively small, by encoding most of the information and using the least amount of free–text. This obviously limits the possibilities of describing sites; on the other hand a standard set of codes greatly reduces chances of misinterpretation that may arise when free–text descriptions are used. In other words, JADIS has not been designed to answer specific research questions, but to provide a new and rapid tool for CRM purposes. As we will see, however, the data gathered and made available can actually be used also for other purposes than CRM, provided that the user knows the limits of the database.

As a first step, the data structure and the type of information to be entered was studied. This led to the outline of the databases needed, but also, after the feasibility of such a structure was confirmed, to the production of a physical card on which the long process of data encoding started almost 10 months ago (Figure 19.1). To ease the process of data encoding, all the available codes were printed on the back of each card, in english and arabic. Six employees were committed by the Department of Antiquities to this project, but it is hoped that more will be able to join the team.

Problems in data encoding are obviously numerous. Information is uneven, site coordinates are often missing or sometimes just wrong, and there is also disagreement between different authors on the terminology to be used to define periods. Period definition, however, has been preferred over absolute dates mainly because most of the authors working on Jordanian material do define their periods rather than specify that a certain layer is to be dated, for example, to the second third of the IX century B.C. It would have been too confusing for the people working on data encoding to figure out the relationships between periods and dates, resulting in slowing down the work, and possibly in introducing an important source of error. A rough correspondence between periods and absolute dates, however, had to be introduced, and for that purpose it was decided to use the chart published on the first pages of volume II of the series *Archaeology of Jordan*, which compromises among the prevailing different views.

A large part of the data collected has CRM significance: site condition, disturbances, inventory rating, type and level of threat of destruction. All these variables have useful applications in organizing lists or maps including sites under threat, in understanding the most common causes of disturbance affecting archaeological sites, and — in general — in providing a database for the creation of what could be defined a "risk map" of the cultural heritage in the country. We will later see how this "risk map" can be integrated in the archaeological policy of the Department of Antiquities.



JADIS
Jordan Antiquities Database and Information System

SITE FORM

1.Site Number: ☐☐☐☐ . ☐☐☐ 2.Site name(s):

3.UTM Zone: ☐☐ 4.UTM Coords. East: ☐☐☐☐☐☐ 5.UTM Coords. North: ☐☐☐☐☐☐☐
6.UTM Calculated: ☐ 7.UTM Cited: ☐ 8.P.g. Calculated: ☐ 9.P.g. Cited: ☐
10.Palestine grid East: ☐☐☐ . ☐☐☐ 11.Palestine grid North: ☐☐☐ . ☐☐☐

12.K737 Map no.: ☐☐☐☐ . ☐ . ☐☐ 13.Other Map number: _____
14.Air photo series: _____ 15.Air photo number: _____ 16.Satellite photo no.: _____

17.Site size (m2): ☐☐☐☐☐☐☐ 18.Elevation (m): + / - ☐☐☐☐

19.Type of site: _____

20.Period and type of use:

Unspec. Paleolithic	EB III	Unspec. Byzantine
Lower Paleolithic	EB IV (EB-MB)	Early Byzantine
Middle Paleolithic	Unspec. MB	Late Byzantine
Upper Paleolithic	MB I (IIA)	Umayyad
Unspec. Epipaleolithic	MB II/III (IIB/C)	Unspec. Abbasid/Fatimid
Kebaran	Unspec. LB	Abbasid
Natufian	LB I	Fatimid
Unspec. PPN	LB IIa/b	Crusader
PPNA	Unspec. Iron Age	Unspec. Ayyubid/Mamluk
PPNB	Iron I	Ayyubid
PPNC	Iron IIa/b	Mamluk
Unspec. PN	Iron IIc	Unspec. Ottoman
PNA/Yarmoukian	Persian (Iron III)	Early Ottoman
PNB	Hellenistic	Late Ottoman
Unspec. Chalcolithic	Unspec. Nabataean	Unspec. Islamic
Early Chalcolithic	Early Nabataean	Modern
Late Chalcolithic	Middle Nabataean	Unspec. flints
Unspec. EB	Late Nabataean	Unspec. pottery
EB I	Unspec. Roman	Unspec. structure
Unspec. EB II/III	Early Roman	Inscription
EB II	Late Roman	

21.Topographic location of site: ☐☐ / _____

22.Site condition: ☐ 23.Disturbance: ☐☐ ☐☐ ☐☐ 24.Inventory rating: ☐

25.Type and level of threat of destruction by:

Construction: ☐	Dam: ☐	Quarry: ☐
Road work: ☐	Cultivation: ☐	Other: ☐
Development: ☐	Erosion: ☐	

26.Bibliographical references:

27.Visited by: 28.Date visited: ☐☐☐☐☐☐

29.Encoded by: 30.Date encoded: ☐☐☐☐☐☐

31.Notes:

Figure 19.1: The JADIS card used to enter codified archaeological information. The codes (in english and arabic) are printed in the verso *of the card.*

Legal/administrative data concerning properties was left out, mainly for two reasons: to keep the database to a minimum size (this data should have included a good deal of free–text information), and because it will be possible, in the future, to link JADIS to other databases of other departments, such as the Lands and Survey Department, where this information is already available.

Some kind of geographical information was also left aside: distance from water, presence of springs, soil types, azimuth of site, percentage of slope at the site, average and extreme rainfall patterns, and so on, mainly because this information can be easily obtained by interfacing the database with a GIS module.

The problem of the bibliographic references was solved in the card compilation phase by using the reference system as in *Archaeology of Jordan I. Bibliography* (Homès–Fredericq & Hennessy 1986). This way, only the author name, year of publication, and reference page had to be reported on the card. Later, Professors Homès–Fredericq and Hennessy agreed to make available their databases, which has allowed us to get the complete bibliographical references just by entering author names and years of publication.

Coming up with a number of codes sufficient to describe a site involved the analysis of a series of survey and excavation forms from several projects working in Jordan and nearby countries, as well as the preparation of site cards based on the "translation" into numeric codes of the archaeological information provided. The purpose was to come up with a series of codes flexible enough to be used for different conditions (for example there is only one code for fortifications, regardless of their architectural or structural variety). This approach eliminates problems of "code overgrowth", which happened in the genesis of the IMACS database, created to hold archaeological data for all the sites in several western U.S. states. IMACS quickly became unmanageable because of its size and excessively fine–grained codes (IMACS 1982).

After the database concept was finalized, which involved the comments and criticisms of a number of local and foreign archaeologists, the cards were printed, and training at the Department of Antiquities started on card compilation. In the meantime, the software specifications were prepared. The main problem was to produce an user interface friendly enough to be managed without problems by people quite unfamiliar with computers. Because of ease of pop–up menus handling and screen design, Fox–pro was preferred over DBASE IIIPlus or IV. Two Jordanian designers and programmers helped in the definition of the user interface and executed the programming[1].

19.1.2 The JADIS interface

The JADIS interface was built around a modular structure, in order to allow additions and modifications in the future. It opens with a language selection, which introduces to different screen and codes description. The main menu allows the introduction, editing, or deletion of codes and sites, data search and reporting, reindex, export, and analysis of data files. Different type of codes can be defined, modified, or deleted, provided they are not used in the databases.

The site definition introduces a sub–menu that allow the introduction of a new site, of more site names, of the bibliographical references, or of the modification of records in the database. To avoid the entry of duplicate information, Palestine grid coordinates must be entered before a new blank page is displayed. If the coordinates introduced are within 1 km radius of an existing coordinate, a message is displayed.

To avoid misspellings, mnemonic names can be recalled from a pop–up list. Pop–up lists also allow code entry, with the translation of the code displayed on the screen.

Bibliographical references can be added either at the end of each card or at a later date. Before getting the screen with the list of the references already entered however, the program prompts for a site name or site coordinate.

Data search allows the entry of multiple fields and multiple codes, also in ranges. This is particularly useful to define sites within a certain area, by introducing opposite coordinates. Pop–up lists allow the user to select the codes he wants to search for. After the search is conducted, the user can select among three different report formats: a complete one, reproducing the original JADIS card, a strictly archaeological report, which takes into consideration information such as periods and type of occupation and bibliographic references, and a CRM report, which mainly includes information on disturbances and threats affecting the site. The reports can either be printed, sent to a text file, or to the screen.

The future development of JADIS can be summarized under two headings: field checking and GIS. Field checking will start as soon as feasible, especially for those sites with the least or out-

1 The software is distributed by CDG — Engineering Management and Associates, P.O.Box 925740, Amman.

dated information, or with inaccurate coordinates. A team of archaeologists will re–visit those sites, completing or updating the required information and locating the sites using GPS receivers.

19.2 CRM AND ARCHAEOLOGICAL GIS IN JORDAN

GIS is a relatively new discipline in Jordan. ACOR is the first archaeological institute in this country that, through a generous donation of ESRI Co., has a complete PC–Arc/Info package available.

After training is completed, it will be possible to integrate the JADIS data into digitized or scanned maps. The objective is to obtain a database which would allow the monitoring of areas with sites under threat of destruction, following "step–by–step" the development of construction projects and the expansion of agricultural areas across the country. The output will be a "risk map", to be updated periodically when more information on archaeological sites and on the expansion of development projects is available. This map could be provided to the main agencies responsible for development in Jordan, reducing the risk of inadvertent construction projects over archaeological sites — still a common occurrence today — thus reducing the need for either rescue or salvage projects concurrent with construction. It is even possible that ACOR's and the Department of Antiquities GIS could be shared with other agencies which already have their own GIS systems running: the Royal Geographic Center, the Lands and Survey Department, the Soil Mapping Project of the Ministry of Agriculture, and the Natural Resources Authority.

19.2.1 An experimental application of GIS for CRM purposes

A preliminary experiment was conducted at ACOR by Glen Peterman on the location of a new dam in the area of an important Iron Age site in Central Jordan: Tell er–Rumeil[2]. The site itself is not directly threatened by the dam, but a series of smaller sites, located by interfacing the GIS module with the site database, are under threat of destruction.

Using a digital model of elevations, we produced a quick map of the total inundation area. Since we already knew how high the dam will be, it was a simple process to map the entire reservoir area using elevation data. Using a modelling technique, we produced a model to identify areas which are going to be given a first priority in a survey of the impact area.

For this purpose we constructed a model on four landscape variables associated with the Neolithic village of 'Ain Ghazal, North of Amman. We asked GIS to map out areas fitting the following parameters: Areas less than 10 degree slope; less than 200 meters to water, which are not wadi beds, and which are greater than 2 hectares in size. From this model it is also a simple matter to extract some basic statistics for feasibility studies. For example: the modelled area is 349 hectares, which is 51 percent of the total impact zone. From that information the costs and time involved for survey work could be calculated. It is also a very simple matter to calculate the capacity of the reservoir itself, and then gauge the efficiency of the dam in terms of potential archaeological impact.

As part of the project, the road linking Madaba to Umm er–Rasas will have to be relocated to the west of its present position, since it will most probably be flooded.

The entire alignment of the new road was entered in the GIS module, including road cuts through hills, and filling operations across minor wadis. Also included in this impact zone is a quarry area just west of the dam. All these areas could have — (or could have not) contained sites of archaeological interest.

The capacity of this model to show also predicted site location makes it extremely useful for CRM needs: through the integration of map data, archaeological data and statistical modelling, GIS has then taken us to the point where Cultural Resource Management and Preservation decisions can be wisely made (Kincaid 1988).

In the case that the site in the predictive area is deemed important enough for preservation, an alternative road can be planned and designed well in advance of final design phases, when it is usually too late to include important modifications of the original design. In the case of other threatened sites, a CRM decision could dictate the excavation of these sites prior to road construction, and place Department of Antiquities Inspectors in areas potentially endangered.

In summary, JADIS is already a powerful tool in the hands of the Department of Antiquities for the purpose of site management and preservation. The refinement of the database using GPS technology, as well as the possibility of integrating it into a GIS program, will allow the output of

2 The author is grateful to Mr. Peterman for allowing the publication of his Tell er–Rumeil experiment in this paper.

detailed maps and the production of a "risk map" containing all the information for future construction work and for forecasting the expansion of urban and agricultural areas in the country. This "risk map" may be the best tool available to the Department of Antiquities for the management of the archaeological heritage, and may constitute the basis for its policy of site protection and preservation in the coming years. The integration of the JADIS database system into the network of already existing GIS applications in Jordan (Royal Geographic Center, Department of Lands and Survey, Natural Resources Authority) will also contribute to the ability of those departments to positively impact cultural environment preservation.

Finally, the system might be used, with a few *caveats* by scholars interested in the study of site distribution and patterning through ages, but also by the Department of Antiquities to check on the expansion of the archaeological activities in the country, and to implement a policy of emergency archaeological surveys to be conducted in areas where updated information is missing. In those cases, predictive models — if proved correct — might be used to plan surveys more effectively and to reduce the costs of a project involving the total coverage of the country.

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