



The Archaeological Map: An Inventory Tool for Heritage Preservation

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Abstract :

New technologies offer great possibilities for scientific exploration. For over the past decade, Algerian researchers have demonstrated remarkable persistence in keeping up with this rapid progress. However, the effectiveness of their research results is still limited by difficulties in handling these tools and, mainly, by a lack of training. The introduction of computer tools in archaeology is a real revolution. The use of Geographic Information Systems (GIS), and specifically archaeological maps, allows researchers not only to inventory historical sites and monuments but also to document and analyze them from a spatial perspective. As a result, the archaeological map becomes a key means of preservation and a management tool for Algerian archaeological sites.

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1. Introduction

Archaeology is essentially a human science. Through data acquisition techniques in the field namely surveys, soundings, excavations, quantification operations, and the description and analysis of material remains, the archaeologist attempts to reconstruct and interpret ancient material cultures. The goal is to make inferences regarding human behavior on one hand, and settlement patterns at macro and micro-regional scales on the other.

For a long time, archaeological research considered the archaeological inventory as a constantly evolving state of knowledge and an incomplete catalog in perpetual need of updating (Ournac, 2012). Consequently, the resulting archaeological map was a myth that archaeologists strongly aspired to realize.

In modern archaeological research, the archaeological map has gained new momentum. Thanks to spatial archaeology methods and the use of new technologies (GPS, GIS, remote sensing, thematic mapping, predictive mapping), it is now possible to place and visualize sites within their spatial, environmental, and chronological contexts. This is achieved through a system that serves as a documentary, relational, and informational tool, combining databases with thematic maps. The archaeological map has become not only a tool for cataloging but also for interpretation and decision-making. It is, in fact, primarily a tool for heritage preservation.

2. Key Milestones in Algerian Archaeological Heritage Legislation

In the immediate post-independence period, Algerian legislators paid close attention to cultural heritage. Despite the critical challenges the country was facing at the time, a bill was proposed for the management of archaeological sites and monuments. Given the circumstances, this text provisionally adopted parts of the colonial legislation:

Law No. 62-157 of December 31, 1962, extending the legislation in force as of December 31, 1962, except for provisions contrary to national sovereignty.

This legal text relied on a range of laws and ordinances, such as:

- The Law of May 2, 1930, regarding natural monuments and sites of artistic, historical, scientific, legendary, and picturesque character, along with all supplementary and modifying texts.
- The Decree of September 14, 1925, concerning historical monuments in Algeria, modified by the decrees of March 3, 1938, and June 14, 1947, and the Law of November 21, 1954.
- The Decree of February 9, 1942, extending to Algeria the Law of September 27, 1941, confirmed by the Ordinance of September 18, 1945, on excavations regarding prehistory, history, art, and archaeology.
- The Decree of September 10, 1947, regulating advertising, signage, and signs in Algeria; and the Order of

April 26, 1949 (modified and supplemented), creating territorial districts in Algeria for the surveillance of archaeological and prehistoric deposits.

In 1967, Algerian legislation established its own legal texts through **Ordinance No. 67-281 of December 20, 1967**, regarding excavations and the protection of Historic and Natural Sites and Monuments. This text was more refined and made reference, for the first time, to the inventory and classification of historical sites and monuments.

The year 1998 marked a crucial step in legislation favoring archaeological heritage by introducing new concepts and procedures in heritage management. Adopted in 1998, this law is well known among Algerian professionals as "**Law 98-04**". Geared toward the protection of cultural heritage, its objective was to define the Nation's cultural heritage, enact general rules for its protection, preservation, and enhancement, and establish the conditions for their implementation. The concepts of the General Inventory of Classified Cultural Property and the establishment of "Safeguarded Sectors" were definitively adopted via this law.

Subsequent texts were enacted to better organize the cultural heritage sector and to decentralize the management of certain regions with high archaeological potential. The aim was to provide these regions with an adequate legal framework to carry out missions of inventory, preservation, and cultural property enhancement.

Notable among these are **Executive Decrees No. 03-323 and 03-324 of October 5, 2003**. These outline the procedures for establishing the Plan for the Protection and Enhancement of Archaeological Sites and their Protection Zones (PPMVSA) and the Permanent Plan for the Safeguarding and Enhancement of Safeguarded Sectors. Furthermore, **Executive Decrees No. 08-157/158 and 159 of 2008** created the Cultural Parks of the Saharan Atlas, Touat-Gourara-Tidikelt, and Tindouf.

3. The Status of the Inventory in Practice

This review of the legislative framework summarizes the actions taken for archaeological heritage. However, within this context, the concept of archaeological site inventory remains unclear.

Practically, in Algeria and the Maghreb region, *"interest in heritage is often occasional and situational. Operations are conducted in close dependence on foreign countries or international organizations... these actions seem to result more from mutual opportunism than from prior and sustained national planning"* (Mrabet 2018:7).

This situation applies to the National Archaeological Map project, led by the Algerian Ministry of Culture in cooperation with the European Union. In our opinion, this initiative is administrative in nature rather than focused on scientific issues.

3.1. The Archaeological Map

The archaeological map enables the spatial interpretation of sites at various scales. Its principles are derived from spatial archaeology, a discipline developed between the 1970s and 1980s by researchers such as Binford & Binford (1968), Vita-Finzi & Higgs (1970), Hodder & Orton (1976), and Harris (1986). This discipline allowed researchers to identify spatial dynamics over time and human-environment interactions.

The archaeological map is populated by data from bibliographic sources, excavations, as well as pedestrian, aerial, and geophysical surveys. Consequently, it functions as a tool for documentary research prior to interventions and for gathering information for enhancement initiatives. It serves as a working basis for archaeologists during field operations, acting as a decision-support tool.

3.2. Inventory as a Data Source for the Archaeological Map and Decision-Making Support

Site inventory through archaeological survey encompasses all operations aimed at obtaining information on the occupation of a given geographical area by ancient populations, based on the study of remains found within that zone. It constitutes a fundamental step in establishing the archaeological map.

Surveying facilitates the collection of information and its structuring into archaeological and geographical databases. The use of Geographic Information Systems (GIS) offers the advantage of

synthesizing, visualizing, and assembling large datasets quickly and dynamically. Furthermore, it allows for their representation on various digital cartographic mediums (thematic maps, predictive maps, Digital Elevation Models) (Rabhi & Bellahreche, 2017).

Consequently, cartography becomes an indispensable analytical element. Unlike traditional approaches that viewed inventories as static and necessarily fragmentary records, current spatial technologies transform the archaeological map into a dynamic system. By visualizing sites within their environmental and chronological contexts, the map transcends simple cataloging to become a robust instrument for interpretation and strategic decision-making (Chaillou & Thomas, 2007).

3.3. Objectives and Issues

Effective management of archaeological remains requires the application of new methodologies aimed at both interpretation and preservation. The utilization of emerging technologies specifically digital mapping, remote sensing, GPS positioning, and GIS applied to spatial archaeology offers significant contributions. These tools facilitate, on the one hand, a re-examination of cultural phenomena within their landscape context and, on the other, an innovative approach to heritage management.

4. Materials and Proposed Methodology for Implementing an Archaeological Map

Largely inspired by New Geography (Hodder & Orton, 1976; Clark, 1977) and New Archaeology (Binford & Binford, 1968; Vita-Finzi & Higgs, 1970), this work focuses on spatial analysis and the use of Geographic Information Systems (GIS), particularly regarding the collection and management of archaeological field data.

The redefined concept of the spatial dimension in archaeology has transformed classical methods and introduced the spatial paradigm. Consequently, spatial modeling in archaeology has flourished, finding in GIS a specialized tool tailored to its needs, as evidenced by numerous recent studies and research projects. Space has become a crucial element in any analysis of past and present human behavior. GIS provides the conceptual tools and practical solutions to conceptualize space across time.

By applying this methodology, the research seeks to bridge these two concepts. Through field archaeology which generates primary data and the utilization of GIS tools, the objective is to establish an Archaeological Information System (AIS). This system facilitates archaeological interpretations and allows for the proposal of various model types: settlement models, protection and enhancement models, and site management models. This entire methodology is specifically applied to the phenomenon of Atlasic rock art.

The study is structured around several methodological aspects, including:

- **The application of classical methods** for interpretation.
- **Fieldwork methodology:**
 - Division of the study region into survey zones.
 - Archaeological surveys.
 - Documentation (technical sheets, photography, and recording).
 - GPS recording.
- **Implementation of a Geographic Information System (GIS) aimed at:**
 - Collection and management of archaeological data.
 - Development of databases.
 - Design of thematic cartography.

4.1. Spatial Archaeology

Driven by pioneering researchers in spatial analysis, a new perspective on the study of ancient settlements and territories has emerged. Archaeological research has advanced significantly through the introduction of modern methods and the integration of disciplines previously untapped in this field.

Numerous publications demonstrate the complementarity between classical archaeological methods and disciplines such as spatial archaeology (Clarke, 1977; Harris, 1986), intra-site and inter-site spatial analysis (Clark, 1954; Hietala, 1984), Site Catchment Analysis (Vita-Finzi & Higgs, 1970), and archaeogeography (Higgs, 1975).

The evolution of computing, combined with the advent of Geographic Information Systems (GIS) and Global Positioning

Systems (GPS), has provided archaeologists with tools to manage and analyze spatial data collected in the field. The application of these tools results in specific Archaeological Information Systems (AIS), which possess their own spatial information production processes, data structures, themes, scales, and analysis methods (Barge, 2004).

4.2. Proposed Research Framework

This study aligns with modern archaeological research frameworks. Its primary objective is to propose an inventory methodology for rock art sites in the Central and Western Saharan Atlas. Furthermore, it aims to establish this inventory and its associated data as a foundation for interpreting Prehistoric and Protohistoric **settlement patterns**. It also seeks to propose behavioral hypotheses based on material remains, their spatial distribution, and the influence of the environmental framework on these spatial structures.

To achieve this, the study employs spatial and geographical analysis, combining classical archaeology with Geographic Information Systems (GIS) and GPS positioning techniques.

In this specific case study, GIS facilitates the creation of **spatial data** and provides access to geographical analysis tools. It allows for the cross-referencing of large quantitative datasets with qualitatively diverse information, integrating data from various sources to produce analytical and inventory maps. The selected theme focuses on Holocene archaeological

remains, emphasizing rock art in interaction with other chronologically connected cultural aspects.

Although numerous studies have been conducted on Algeria's recent prehistory and protohistory, few approaches have accounted for the environmental and spatial context. Consequently, the results of these works remain relatively limited, as they focused primarily on the chrono-cultural aspects of human traces without integrating them into their surrounding environment. Therefore, the implementation of new research methodologies is required.

Drawing heavily from New Geography (Hodder & Orton, 1976; Clarke, 1977) and New Archaeology (Binford & Binford, 1968; Vita-Finzi & Higgs, 1970), this study focuses on spatial analysis and the use of GIS, particularly regarding the collection and management of archaeological data.

4.3. Fieldwork and Data Acquisition

Fieldwork based on archaeological survey facilitated the geolocation of stations as well as their detailed description. Surveying is therefore essential for collecting information and structuring it into archaeological and geographical databases.

The use of Geographic Information Systems (GIS) offers the specific advantage of synthesizing, visualizing, and assembling large quantities of data in a rapid and dynamic manner. Furthermore, it allows for their representation on cartographic media of various formats and types. Among these, the topographic map

is the most significant; it contains valuable information that serves as a foundational layer for the produced thematic cartography.

4.4. Satellite Imagery and Digital Models

Satellite imagery has become an essential component in GIS. The imagery utilized in this work originates from Google Earth software. Offering high resolution, this solution enables numerous manipulations, such as the integration of GPS data, the visualization of specific geographical phenomena, and the addition of data in raster or vector modes.

Another type of map has become indispensable in GIS: the Digital Elevation Model (DEM). This is a 3D representation of a terrestrial zone's topography in the form of a raster grid where values indicate terrain elevation. Data generated from DEMs are crucial in modern archaeology, allowing for the extraction of significant information regarding human interaction with the environment, such as contour lines, slopes, aspect, visibility, and the drainage network. When combined with archaeological information, these data can lead to archaeological modeling (Lieff, 2006).

Access to data transmitted by the TERRA satellite (specifically ASTER GDEM) provided DEMs with a one arc-second grid (30m ground precision). These DEMs allowed for the 3D visualization of the study terrain, the extraction of contour lines, and the refinement of the drainage network initially generated through the digitization of topographic maps.

4.5. Processing and Analysis Criteria

Several layers of archaeological and geographical information were generated thanks to the contribution of specialized software for spatial data management and analysis, such as ESRI ArcGIS, QGIS (Quantum GIS), and Global Mapper.

To address the research questions, four geographical criteria were considered in this analysis trial:

- **Slope**
- **Mobility**
- **Visibility**
- **Links to Natural Resources (Water) or Site Catchment Analysis**

These variables represent criteria for both spatial analysis and the modeling of the rock art phenomenon. Consequently, future inventory projects will be able to exploit these settlement models to target survey zones with high probable potential for rock art.

5. Conclusion

The transition from traditional inventory methods to digital spatial analysis marks a significant evolution in the management of Algerian archaeological heritage. This study has demonstrated that the archaeological map is no longer a static repository of site locations but a dynamic instrument for both scientific research and heritage preservation.

The methodology applied to the rock art of the Saharan Atlas confirms the relevance of integrating Geographic Information

Systems (GIS) and remote sensing data (DEMs, satellite imagery) into the inventory process. By analyzing environmental variables such as slope, visibility, and proximity to water resources, it becomes possible to move beyond simple description to understand the logic of ancient settlement patterns.

This approach addresses the gap between the legislative framework—which establishes the legal necessity of protection—and the reality of fieldwork. The "Archaeological Information System" proposed here serves as a crucial decision-support tool. It allows heritage managers to predict high-potential zones, optimize survey strategies, and implement protection measures that are proactive rather than reactive.

The generalization of these digital tools constitutes a prerequisite for the modernization of archaeological research in Algeria. It ensures that the inventory becomes an effective lever for the safeguarding of heritage in the face of growing planning and development challenges.

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