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Digital Tools for Heritage Protection and Conservation in Conflict-Prone Areas: A Glympse from Northeastern Africa and the Horn

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Abstract
Northeastern Africa and the Horn are universally recognized as a melting pot of cultures and civilizations with a rich and diverse archaeological heritage paralleled by sumptuous packages of languages, traditions and systems of knowledge. Unfortunately, the area is also prone to recurrent political crises and social tensions that often escalate into long periods of armed conflicts. The impact on tangible heritage is always extremely severe. Sites, museums and cultural centres are intentionally or accidentally targeted by drone attacks, looted or severely damaged by lack of infrastructure and land maintenance. Objects are destroyed, dispersed or entered into the illegal trafficking circuit. Intangible heritage is also heavily compromised. The loss of lives and the migration of people contributes to the disappearance of systems of knowledge impossible to recover and pass on. In such areas, issues related to protection strategies for cultural heritage should become a crucial component in the agenda of archaeological research programs. Based on our experience in Egypt, Ethiopia and Sudan, this paper will discuss a set of digital tools useful to adopt when working in conflict areas. Special attention will be given to the role that virtual museums can play in such regions.

Keywords: Heritage conservation, Digital technologies, Virtual museums, Conflict areas, Horn of Africa, Northeastern Africa
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Introduction

Political crises and military conflicts, together with climatic change, are certainly the factors that have the greatest impact on cultural heritage in our time. Coupled to the old "traditional" ones, such as anthropisation and urban development, they make the issue of cultural heritage management, both tangible and intangible, increasingly challenging. This is certainly true all over the world, but it is obviously more evident in conflict-prone areas, and North East Africa is certainly one of them. Given these challenges, prioritizing conflict protection strategies for cultural heritage in this region is essential.

This paper proposes potential strategies and digital tools of heritage documentation, protection and promotion rooted in our experience in Egypt, Sudan and Ethiopia. Such measures could form the core of a progressively richer robust protocol to safeguard cultural assets and ensure access to information in conflict scenarios.

The macro-region we are dealing with, Northeastern Africa and the Horn, is universally recognized as a melting pot of cultures and civilizations. It includes countries whose tangible and intangible heritage is extremely rich, such as Egypt, Sudan, Eritrea and Ethiopia, that have witnessed profound events in human

[1] Luisa Sernicola authored the part of the article dealing with the mapping and use of GIS, Andrea Manzo the section on the use of remote sensing and on the monitoring of the sale of antiques on the web, Domenico Filosa the section on the virtual museums. Andrea Manzo and Luisa Sernicola are also responsible for the final remarks.

history, from evolutionary processes to migrations, interactions, ecological adaptations, and societal developments. This historical wealth has gifted us with a diverse archaeological heritage, further enriched by a multitude of languages, traditions, and systems of knowledge.

In this region, the University of Naples L'Orientale (henceforth UNIOR) and the International Association for Mediterranean and Oriental Studies (henceforth ISMEO) have a long-established tradition of archaeological research activities.

In this paper we will focus on three UNIOR-ISMEO archaeological projects: the one at Mersa/Wadi Gawasis, on the Egyptian coast of the Red Sea, and its hinterland in the Eastern Desert of Egypt, the one in the Eritrean-Sudanese lowlands, and the one operating in the area of Aksum, in northern Ethiopia (Fig. 1).[2]

Within the framework of joint agreements and programmes with local stakeholders (universities, state agencies at central and regional level, and local communities), all the projects, in addition to research activities, also promote actions geared towards heritage protection and management, community archaeology and capacity building.

Unfortunately, over the past decade, all these areas witnessed the escalation of acute and chronic political and military crises, which are still ongoing in some cases. These tragic circumstances have always also severely endangered the tangible and intangible heritage.

In Egypt, the outbreak of an internal political crisis occurred in 2011 and 2013. As far as tangible cultural heritage is concerned, it led to sporadic direct attacks on cultural sites (e.g. the damage to the

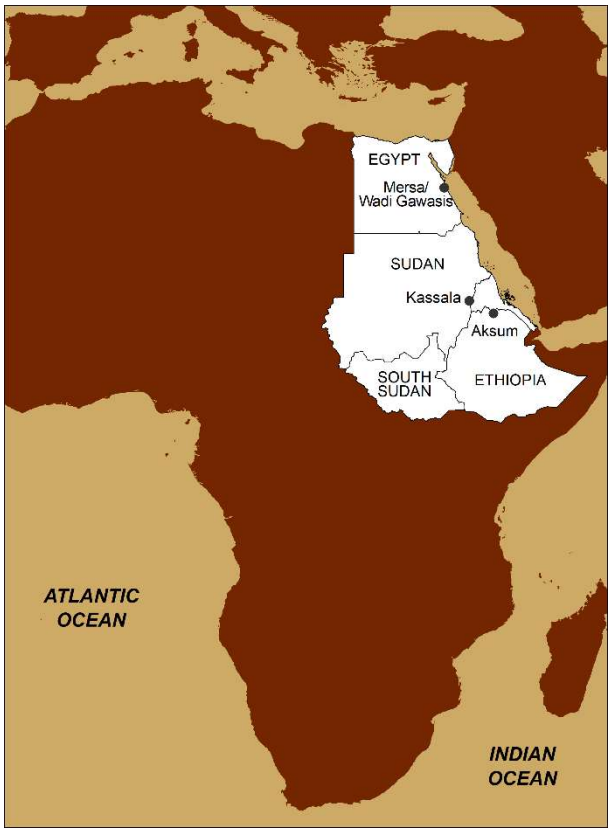


Fig. 1 - Map showing UNIOR-ISMEO research areas discussed in the text

[2] The project in the area of Aksum has been launched in 1993. From 1993 to 2003 it was carried out in collaboration with Boston University (henceforth BU) and co-directed by Rodolfo Fattovich and Kathryn A. Bard. From 2004 to 2013 it was directed by Rodolfo Fattovich and since 2014 it is co-directed by Andrea Manzo and Luisa Sernicola. Overviews of the results of the project are reported in a series of articles authored by the members of the expedition (Bard e Manzo 2025, Fattovich *et al.* 2000, 102 and Sernicola 2021). Comprehensive reports of each field season from 2010 to 2019 are published in *Newsletter di Archeologia*, an online, open access journal edited by the Centro Interdipartimentale di Servizi di Archeologia of the University of Naples L'Orientale. https://www.unior.it/it/centri-di-servizio/cisa-centro-interdipartimentale-di-servizi-di-archeologia/newsletter-archeologia).
The project in the Eritrean-Sudanese lowlands was inaugurated by Rodolfo Fattovich in 1980 in the framework of a collaboration with the Butana Archaeological project by the Southern Methodist University and University of Khartoum directed by Anthony E. Marks and Abbas Mohammed Ali. Fieldwork was suspended in 1995 and resumed in 2010 under the direction of Andrea Manzo. For a detailed discussion of the results of the investigations see Manzo 2017, 100. Like in the case of the expedition to Ethiopia, since the 2010 field season, reports of the activities regularly appeared in the online open access journal *CISA Newsletter di Archeologia*. The project at Mersa/Wadi Gawasis, in collaboration with BU and the ISMEO, was inaugurated by Rodolfo Fattovich and Kathryn A. Bard in 2001. Fieldwork was suspended in 2011 and resumed in 2022 with the name of SAWW project, under the direction of Andrea Manzo, Mahmoud Emam and Chiara Zazzaro. For a discussion of the results of the first ten years of investigations see Bard, Fattovich 2007, 368 and Bard *et al.* 2022, 752.

Egyptian Museum in Tahrir Square) but, more importantly, they resulted in decreased control over monuments and archaeological sites with a consequent increase in illicit excavation activities.

In Sudan, in spite of the endemic political crisis and instability that has characterised the country since 2019 and the long-lasting armed conflicts in the western and southern regions, tangible heritage was not significantly affected until the outbreak of armed conflicts in April 2023 in the capital Khartoum. The National Museum is located in the centre of the city, which has since been turned into a battlefield, and the museum was immediately seized by armed groups. Moreover, as also happened during military crises in the western and southern regions of the country for many years, the consequences of the ongoing widespread conflict on the intangible heritage are incalculable, due to the forced displacement of entire communities and human loss.

In the case of Ethiopia, after the end of the civil war in 1991, a war broke out in 1998 with Eritrea which only lasted in 2019, with a direct impact on the tangible heritage mainly on the Eritrean territory, and an internal conflict affected the northern part of the country, and in particular areas of the Tigray, Amhara and Afar regions, from November 2020 to November 2022. In this last occasion, there have been extensive damages. Archaeological sites, museums, and cultural centres have been targeted, looted, or left to deteriorate. The illegal trade of artifacts, including ancient manuscripts and liturgical items, has been rampant. The intangible heritage, embodied in traditions, knowledge, and societal bonds, is also at risk.

In the following sections, we will explore how the use of digital tools can help mitigate and monitor the effects of conflicts on heritage. Special attention will be given to virtual museums, whose contribution to heritage preservation and promotion is such regions is highly significant.

Mapping

Digital archaeological maps are nowadays a fundamental and widespread tool in historical and archaeological heritage study and management projects as they, on one side, facilitate the study of relevant historical phenomena, on the other hand, enable the assessment of archaeological areas and of the state of preservation of the evidence, the creation of high-resolution maps to support urban planning strategies that protect the heritage, the elaboration of predictive models to produce maps of potential location of new archaeological sites, and the identification of areas suitable for scientific research and tourism development. Equally important, a further significant application of digital archaeological maps would be its use in post-war reassessments of the archaeological heritage, as it proved to be for the area of Aksum, in northern Ethiopia.

Located in the core region of the Tigrean plateau, the city of Aksum is universally recognized as a prominent religious and historical centre, a significant symbol of Ethiopian cultural identity and one of the most important archaeological sites of the country, included since 1980 in the UNESCO World Heritage List.

Due to its historical relevance, Aksum has been undoubtedly one of the most thoroughly archaeologically investigated sites of the northern Horn of Africa. Intensive research in the area not only has increased knowledge on the dynamics that underwent ancient Aksum's emergence and subsequent development, but also has allowed the assessment of its archaeological heritage with the creation of a progressively richer literary corpus of data from occasional descriptions of monuments by 15th-to 19th century European travellers and explorers to scientific reports of 20th and 21st century excavation and survey projects.

The combination of these resources within a GIS-based geodatabase led to the creation of the Archaeological Map of Aksum which undisputably resulted to be a key tool for the study, management and protection of the archaeological heritage of the area also in the aftermath of the recent conflict.

Generated by the systematic scrutiny of bibliographic resources and by the comprehensive survey of the whole territory of Aksum,[3] the map includes an overall amount of 698 sites. It covers a total area of ca. 105 sq km that includes flat lands, steep slopes and terraced hillsides as well as intensively settled spots including the present urban area (Figs. 2, 3). Topographic maps[4] and satellite images[5] were used to navigate the area both remotely and near ground.

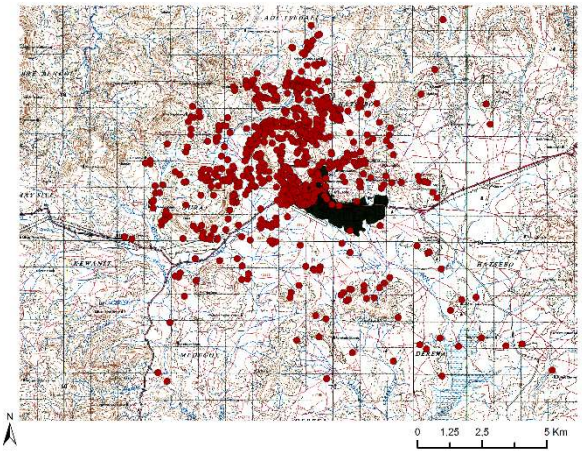


Fig. 2 - The archaeological map of Aksum (1:50.000)

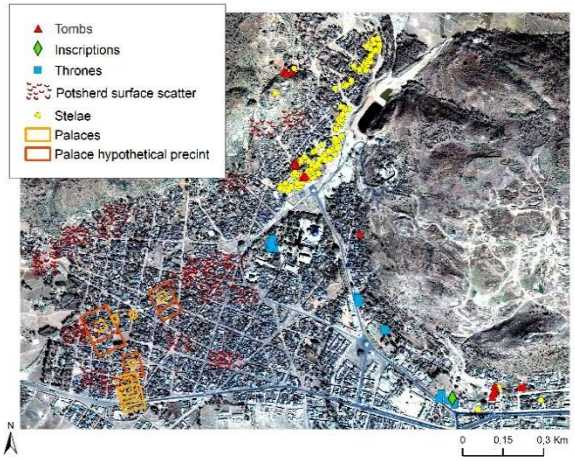


Fig. 3 - The archaeological map of Aksum-City Centre (base: Ikonos satellite image)

All the sites in the database are accompanied by information about their location, environmental characteristics, type and extension of evidence, present land-use, state of preservation and the natural and/or anthropic disturbance factors, and are classified on the basis of their chronology and function.

Quantitative and spatial analysis performed using a GIS software allowed to classify the archaeological area of Aksum into three major zones based on the density of the archaeological evidence as well as to analyse distribution of the sites with respect to the topography of the area and present land-use (Sernicola 2017, 150). This led to the creation of a map of the archaeological risk where the susceptibility to the main causes of alteration, degradation and obliteration of the archaeological heritage is displayed (Fig. 4). Post-depositional taphonomic processes due to agriculture, grazing, and reforestation were considered in this phase (Schofield 1991, 151). A map of slopes degree has been also generated to evaluate the areas where the preservation of archaeological deposits may be most disturbed by erosion (Fig. 5).

One of the main consequences of the three years of conflict in Tigray on Aksum's archaeological heritage has certainly been the lack of maintenance of the slopes. This has initiated

[3] The survey was carried out between 2000 and 2006 as part of two different programs: the Landscape Archaeology Project conducted by the joint UNIOR-BU archaeological expedition at Aksum, and the Ethiopian Cultural Heritage Project – Aksum branch – Site Planning and Conservation Component sponsored by the World Bank (WB). The WB survey project at Aksum was co-directed by Rodolfo Fattovich and Takla Hagos, and carried out with the contribution of Luisa Sernicola and Laurel Phillipson (2012, 2013*a*, 2013*b*). Technical reports of the survey campaigns have been prepared by Fattovich and Takla Hagos. For a discussion of the results see Fattovich, Takla Hagos 2005, 26 and Fattovich, Takla Hagos 2006, 327.

[4] Ethiopian Mapping Agency, 1992, 1:2000, sheets 2, 4, 5; Ethiopian Mapping Agency, 1997, 1:50.000, Series Eth4, sheets 1438 D3 (Axum) and 1438 D4 (Adwa).

[5] IKONOS (1 m res.), ASTER (15 m res.), Earthsat (30 m res.).

intense erosion phenomena that severely affected the archaeological sites located along the slopes or at the base of the hills. Most of these sites are only surface-observed and have never been excavated so far. The map of slopes degree will help targeting erosion-prone areas and sites to be checked by direct field observation and/or through remote sensing. Indeed, a further use of the GIS-based Archaeological Map of Aksum could be in the periodic monitoring of sites preservation through satellite images. This proved to be extremely fruitful in present Sudanese conflictual regions and in inaccessible areas of the Egyptian Eastern Desert, as we will see in the following section.

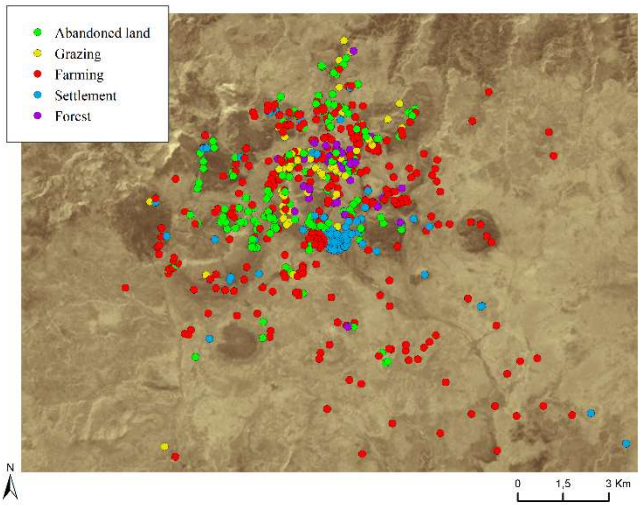


Fig. 4 - Archaeological sites in the Aksum area classified on the basis of disturbance

The GIS-based Archaeological Map of Aksum will also be used as a basemap in the Feasibility Study for the "Improvement of Axum Archaeological Site and Related Services" project recently initiated by the Agenzia Italiana per la Cooperazione allo Sviluppo.[6]

Monitoring

One of the most immediate consequences of political and military crises is the weakening of territorial control. It can lead to an increase in illegal excavations which is directly related to the illicit trade in antiquities. This has always been practised in countries such as Egypt, where there is awareness of the economic value of ancient objects, while it is more recent in the regions South of it, especially in Ethiopia. However, even there, the illegal trade in antiquities had already begun before the latest political and military crises, as evidenced by the laws enacted against it in both Sudan and Ethiopia. This illegal practice intensifies in times of economic difficulties that are very often linked, as a cause or effect, to political and military crises.

In the Eastern Desert of Egypt, a Roman Station in the lower Wadi Gasus was in good condition when it was surveyed in 2000 by the Italian-American team working at Mersa/Wadi Gawasis. Around 2010 it was hit by the first illegal excavations in search of antiquities and possibly gold, but the damage became more and more extensive from 2011 to 2013, during and immediately after the political crises (Fig. 6), when the site was investigated by the Italian Archaeological Mission in the Eastern Desert.[7] Illegal excavations continue to this day, encouraged by the never-ending economic crisis that drives people to look for additional sources of income. This is also evident at the ancient gold mining site of Wadi Rahaia, where damages took place after 2015, i.e. well after the end of the phases of political instability, when the site was

[6] This ongoing project is coordinated by 58th People&Projects and involves University of Naples Orientale and ISMEO.

[7] The Italian Archaeological Mission in the Eastern Desert of Egypt was a joint project including Italian and Egyptian institutions (University of Naples L'Orientale, University of Cairo - Faculty of Geology, and University of Helwan - Faculty of Archaeology), directed by Irene Bragantini funded by the University of Naples L'Orientale and the Italian Ministry of Foreign Affairs and International Cooperation. In 2022, the project was merged with the SAWW project, also investigating the site of Mersa/Wadi Gawasis. For a description of the Roman Station and a presentation of the first results of the project see Bragantini *et al.* 2018.

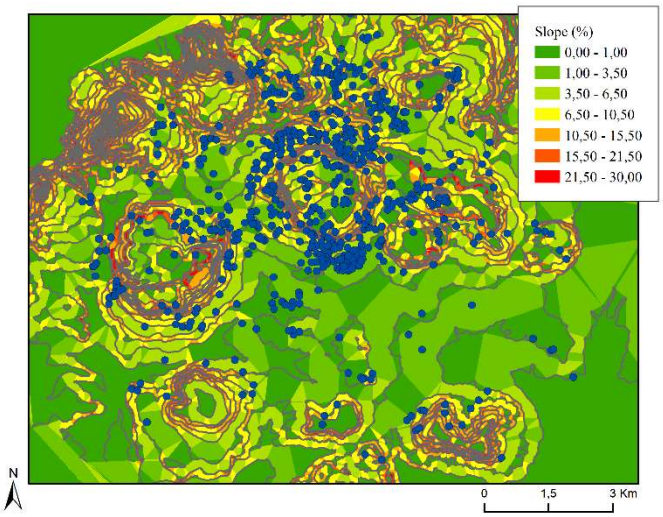


Fig. 5 - Map of slopes degree and sites distribution in the area of Aksum

visited for the first time by the Italian Mission (Bragantini *et al.* 2018). As archaeological expeditions are often involved by local authorities in the management of cultural heritage, in Egypt and Sudan we were regularly asked to inspect sites threatened or damaged by illegal excavations together with local representatives. Some of these sites were also visited year after year, to check whether illegal activities had ceased after reports were made to the police and local authorities. Obviously, on-site inspections of sites cannot be carried out during conflicts or political crises, although it is precisely at these times that they are most needed. In this case, the systematic use of satellite images may be a viable alternative, at least to record when the destruction of sites occurred and to report this to local authorities in order to plan measures to protect the intact parts of the sites (Fig. 6). This system has also recently been adopted by the Egyptian Ministry of Tourism and Antiquities to monitor sites in hard-to-reach areas.[8]

Closely related to the remote sensing of archaeological sites to counter illegal activities in conflict areas is the tracking of the sale of antiquities on the web. There are in fact several websites where you can buy antiques. These are also monitored by law enforcement agencies, but it can sometimes be difficult for them to investigate the authenticity and identify the possible origin of the antiquities offered for sale. For archaeologists specialised in certain areas or periods, it is easier to identify their provenance and to understand whether they may have come from areas where a political or military crisis is ongoing. Again, when a suspicious object is offered for sale, it is reported to the authorities.

Digitising

In North East Africa and the Horn, a specific factor limiting the possibility to tackle the risk of illicit trade in antiquities both in ordinary times and in times of political or military crisis is the lack of digital records of artefact collections. Indeed, the implementation of digital records should be considered a very effective action to limit theft and illicit trade in antiquities. Moreover, in times of crisis, museums and research institutes are often looted, damaged or destroyed, endangering not only the objects but also the analogue archives and the different types of preserved documentation. Here again, the systematic and extensive digitisation of documents should be considered an effective tool to mitigate the effect of the loss of historical objects and documents during periods of conflict.

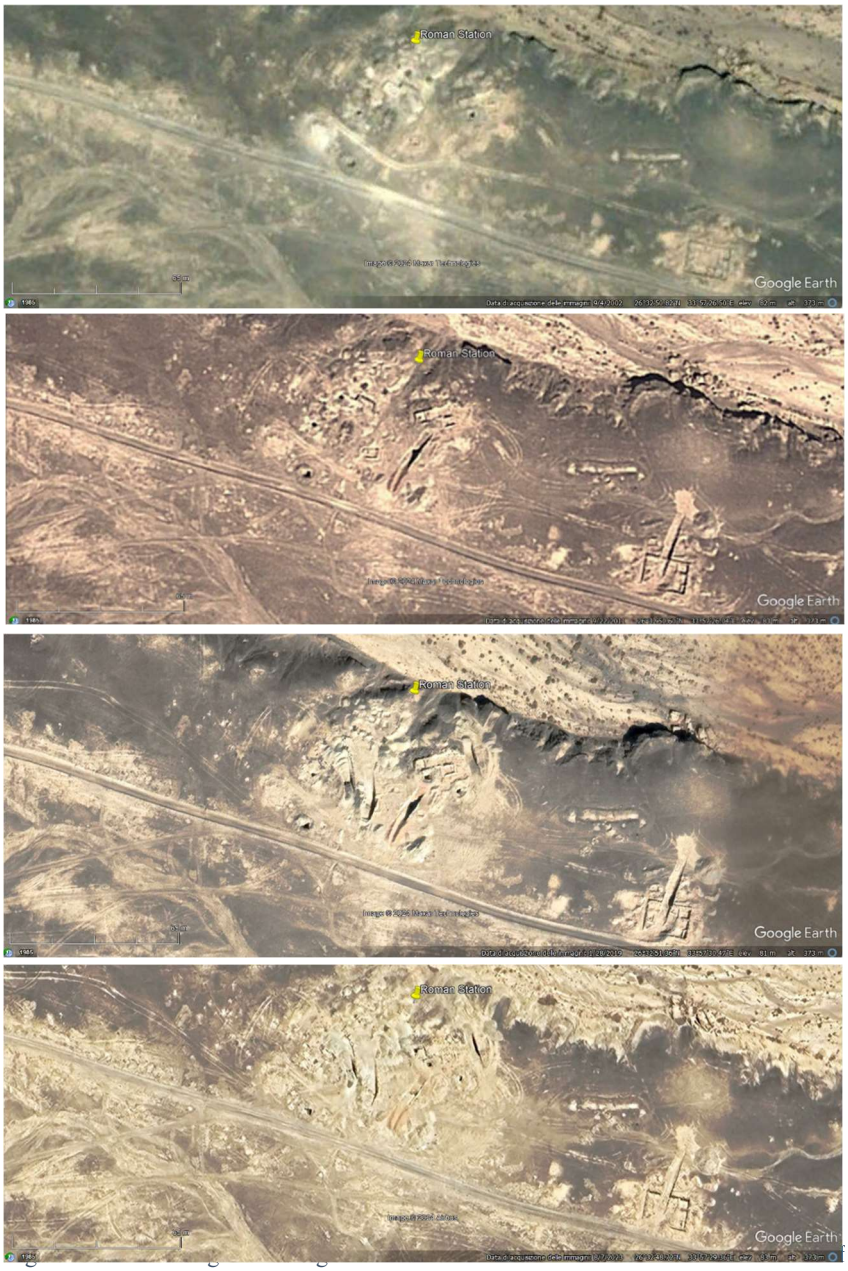
In a similar vein, as intangible heritage is also endangered in political and military crises, meticulous documentation of traditional knowledge should also be considered a priority by research programs. Indeed, mass forced migration and the dispersion of entire communities, if not the loss of life, especially among the most vulnerable, further exacerbates the erosion of traditions and knowledge. Digital technology provides

[8] For this reason, in the 2023 field season at Mersa/Wadi Gawasis we were asked to give a short introductory course on this system for staff members of the Directorate of Antiquities in Safaga.

tools for the rapid documentation of all aspects of intangible heritage and the secure preservation of documents.

Exhibiting

Museums and cultural centres can play a crucial role in conflict-prone regions. By highlighting common cultural traits and historical interactions, these institutions can foster mutual understanding and a shared identity. This strategy can catalyse the path to lasting peace, which remains the most effective way to preserve our common history. For this reason, it is important that these institutions are kept working even in the times of crisis: virtual museums are the ideal solution in this case.



Wadi Gasus. Years 2002, 2011, 2019, 2023 (top to bottom). Based on Google Earth

It should be emphasised that, besides playing an important role in the areas directly affected by the conflict, the positive impact of virtual museums is on a global scale and in the long term. First of all, they can help raise awareness of the cultural richness of conflict areas in the rest of the world, thereby creating a more inclusive and suitable environment for refugees from those regions.

Furthermore, when the crisis is over, the digital contents generated for the implementation of virtual museums will also be useful to enhance the experience of visitors to the real museum and continue to spread knowledge of the cultural wealth of these regions via the web, which will also have a positive impact on their economy.

The culmination of a digital protocol aimed at the safeguarding and fruition of both tangible and intangible cultural heritage must inevitably lead to the creation of a virtual museum. The drafting of a shared thesaurus, along with the construction of a digital database capable of cataloguing various types of testimonies - preserving not only digital images (photos, videos, 3D models, etc.) but also related information - represents only the foundations of a more ambitious project. The ultimate goal must be to promote accessibility and usability of such resources to the widest and most diverse audience possible. In this perspective, archiving reliable information through data digitization is not only an essential step in the protocol but also the basis for disseminating accurate information. This function - which in itself represents an act of safeguarding cultural heritage—is a fundamental element of the very nature of a museum.

In addition to preserving important testimonies from the past, museums play a crucial role in educating the public by providing reliable and accessible information, thereby allowing for a more accurate understanding of historical and cultural events. These principles, which form the foundation of the definition of "museum" provided by ICOM (International Council of Museums), represent only a portion of the potential of a virtual museum. If designed appropriately, a virtual museum has the potential to overturn the traditional paradigms of the physical museum while maintaining its primary functions, such as the preservation of information related to the historical, artistic, and anthropological evidence of a given region or culture. Its digital nature makes it a crucial tool for the protection and enjoyment of heritage, as it allows for adaptation to a variety of needs and objectives. This makes it particularly versatile and indispensable in promoting fundamental concepts such as safeguarding, social cohesion, education, accessibility, and the enhancement of cultural heritage. Additionally, a virtual museum, with its multiple functions, offers the opportunity to optimally preserve and enhance the intangible cultural heritage of a region, which is often inadequately represented in material culture. This enables the protection of a rich array of experiences, folklore, customs, and traditions, which are central to the social and cultural life of a community. From this perspective, a virtual museum must acquire an innovative and functional dimension, going beyond the mere three-dimensional reproduction of objects or environments. Instead, it becomes a tool that allows users to fully understand the characteristics of a specific cultural testimony, placing it within a broader historical, cultural, and anthropological context, thus grasping its role and function more comprehensively. This vision, which should form the foundation of an innovative virtual museum aligned with the objectives of the protocol, was foresightedly anticipated as early as 1974 (Ragghianti 1974, 222) and later echoed by Antinucci in his work on virtual museums (Antinucci 2007, 136):

"Along the path of speculation, we can also, through drastic reversal, imagine a completely different museum, designed and constructed based on immediate, undeniable, and precise effects, that is, responding to the messages of the works on the spectator, even one who is not particularly prepared. A museum in which the visitor is immersed in a series of independent environments, each composed according to the

autonomous and individual reasons and visibility conditions of each artwork contained, thus restoring, from time to time, the artist's basic directive with the maximum possible rigor".[9]

As highlighted by Ragghianti, the possibility of a museum capable of subverting traditional standards and offering visitors personalized experiences was already proposed fifty years ago, anticipating concepts that are now extremely relevant.

These principles should form the basis for developing a tool with diverse characteristics and potentials, capable of integrating new technologies and adapting them to the different realities present in various regions of the world. A significant example is the increasingly widespread use of artificial intelligence (AI) in the context of the protection, monitoring, enjoyment, and promotion of global cultural heritage. The integration of AI and virtual museums allows for important outcomes, such as the creation of personalized experiences - a strategy already adopted by numerous museums - or the development of predictive models that can monitor and foresee potential damage to physical works preserved in museums worldwide. This is made possible through advanced simulation systems and sensors capable of detecting even minor changes in the works that are not visible to the human eye. In this perspective, the interaction between an innovative virtual environment and cultural heritage, both material and immaterial, emerges as a crucial element for safeguarding and enhancing the world's cultural heritage.

In analysing the role of virtual museums in areas marked by current or recently concluded conflicts, it is essential to focus on two fundamental issues related to virtual musealization: the perception of the virtual environment and data security. It is important to note that, while it is preferable to use the term "evidence" rather than "artifact" – since a virtual museum allows for the preservation of testimonies that are difficult to display in a physical museum, such as reproductions of a tomb or a building – the term "artifact" will be used in this context as it is conventionally adopted in museum discourse. Although these topics, along with ethics, require in-depth analysis, it is crucial to highlight some key aspects to better understand the role that a virtual museum can play both in the local community and globally. In particular, this involves examining the importance of visitor perception regarding virtual scenarios and the crucial role that data security plays in this context. Indeed, for the virtual experience to be immersive and engaging, it is essential that visitors can interact with the environment securely. This implies the need to ensure that the exchanged information and sensitive data are protected from potential risks, which is particularly relevant in virtual museums, where data management is as central as the quality of the digital reproduction of the evidence. Although data security is primarily a technical issue, it is useful to consider the advanced technologies used by platforms and websites that manage sensitive information. Such technologies ensure the protection and privacy of users. Tools such as firewalls (digital barriers that filter traffic to block unauthorized access), identity and access management (IAM) systems, encryption, and intrusion detection systems are commonly employed to prevent external attacks and malfunctions. It is essential that these technological solutions are also applied to virtual museums to safeguard the preserved data (including 3d models) and ensure a safe experience for users. Regarding the perception of virtual museums and the works they house, it is true that we are dealing with a more complex aspect, often influenced by the personal tastes of the visitor. However, we can cite numerous museums that have succeeded in evoking positive emotions and generating educational impact on their users through the development of digital platforms. This demonstrates that various effective strategies can be adopted to engage a broad audience, educating them and creating a positive impact on the community, even in the context of digital cultural heritage.

[9] Translated from Italian by the authors, for a more detailed discussion see again Ragghianti 1974.

An example in this sense is represented by the virtual museum project conceived for the archaeological area of Seglamen, nearby Aksum, in Northern Ethiopia, which we will discuss shortly. To avoid unpleasant effects or negative emotions in visitors, two modes of interaction with the proposed works have been developed. The first, called "Showcase", offers a traditional and immersive experience: the visitor is transported into a 360° 3D room, wherein one can move freely in first-person perspective and observe each individual object through interactive tools, making the visit participatory (Fig. 7).

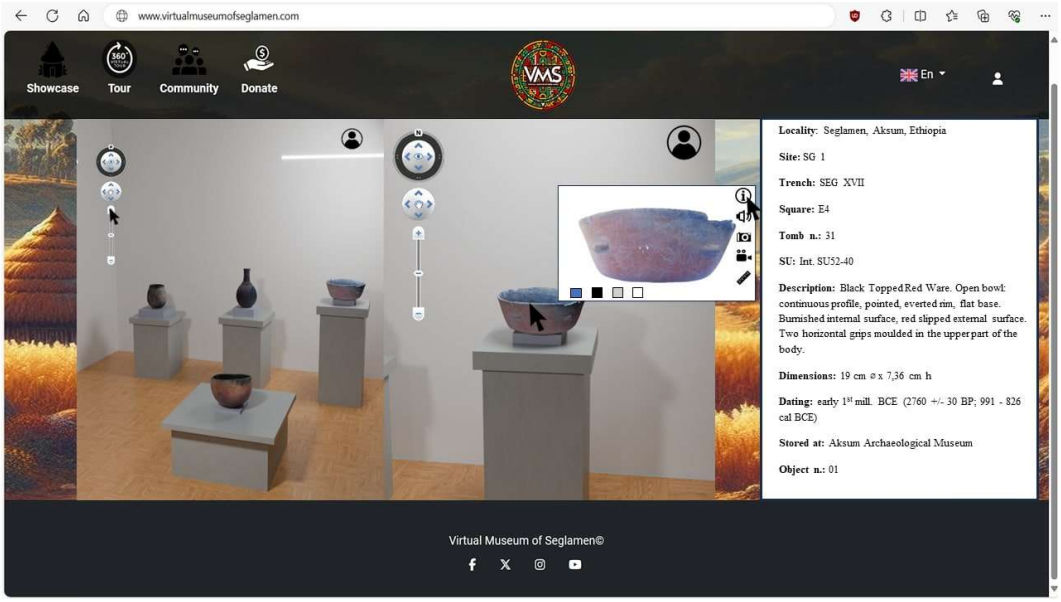


Fig. 7 – Seglamen, Virtual Museum Project, the "Showcase" mode

The second mode, termed "Tour", is the main innovation of the project. Here, the user is immersed in virtual scenarios reconstructed in collaboration with the local community and utilizing the landscapes of the region. These scenarios, presented through 360° videos, reconstruct historical events and processes, allowing the user to appreciate the objects in their context and delve into the processes that led to their manufacture and use in the past (Fig. 8).

This two-folds approach aims at shaping an experience that evokes positive emotions in the visitors. Thanks to the use of innovative technologies, the Seglamen Virtual Museum would offer new and engaging experiences. The goal is not only to educate but also to stimulate reflection on important themes such as peace, war, history, humanity, and its relationship with the environment and culture.

To conclude, the relationship between the user and the digital object represents a crucial aspect in the context of virtual musealization. In an increasingly digitized cultural landscape that leans towards the use of AI, it is essential to overcome the traditional barriers that separate the public from the enjoyment of historical evidence. To achieve this goal the virtual musealization should not only employ advanced technologies but also integrate interactive and immersive strategies. Such strategies can facilitate a participatory experience, stimulating users' curiosity and interest, ensuring that enjoyment does not remain a mere act of passive viewing. An innovative approach to virtual musealization must consider the adoption of interactive and narrative models that can attract visitors of different ages and backgrounds, making the educational experience more accessible and engaging. Through the use of technologies like augmented reality and virtual reality, it is possible to create dynamic environments in which users are not just observers

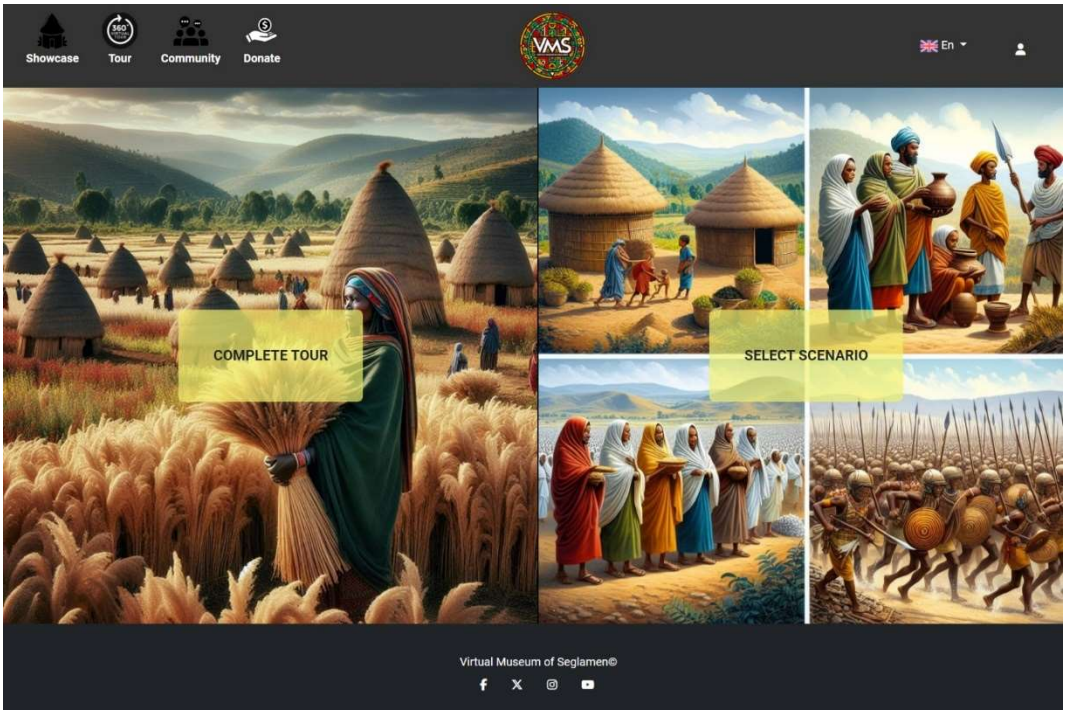


Fig. 8 - Seglamen Virtual Museum Project, the "Tour" mode

but active participants in the reconstruction of historical and cultural events. These environments, capable of evoking emotions and reflections, can break down the traditional barriers of musealization, making cultural heritage not only a field of study but also a source of inspiration and dialogue. Therefore, innovation in virtual musealization must not be limited to a mere digitization of works but should evolve into an approach that fosters interaction and connection between the user and cultural heritage. Only in this way will it be possible to build a meaningful bridge between the virtual museum and the visitor, making museum experiences more relevant and stimulating for future generations, ultimately developing new platforms that can ensure fundamental concepts like the enjoyment and safeguarding of world cultural heritage.

A particularly complex reality that urgently requires the definition of a dedicated protocol of heritage protection involves all those countries affected by conflicts or recently emerging from them. In these regions, historical, cultural, and archaeological heritage, along with the population, is constantly threatened by bombings, invasions, and acts of cultural terrorism aimed at erasing entire segments of historical and artistic memory, as witnessed during the two world wars or more recently in Iraq, in the cities of Baghdad and Mosul. In these contexts, a virtual museum can gain even greater relevance, evolving from a simple tool for the safeguarding and enjoyment of cultural heritage into a platform capable of conveying messages of understanding and mutual tolerance through immersive and engaging experiences. The creation of an interconnected network of virtual museums that can communicate with one another can prove to be an effective strategy to counter prejudice and promote educational and awareness campaigns on global cultural heritage, both material and immaterial, constantly at risk from conflicts, political instability, and large public and private works. Although physical museums have already played and will continue to play a crucial role in the political and social dynamics of conflict areas, they present intrinsic limitations due to their physical nature. The first and perhaps most significant of these is accessibility, understood as the

ability to freely access the museum even during periods of conflict.[10] This feature is crucial in the case of virtual museums, as it allows anyone with an internet connection to access the museum at any time, regardless of the political situation in the region, the time of day, the visitor's geographical location, or any temporary or chronic health issues the user may have. Thus, accessibility translates into inclusion, communication, and the exchange of ideas - concepts that represent the beating heart of a healthy society aware of the value of its cultural heritage, both locally and in an international perspective, when this heritage is related to other cultures. The absence of physical barriers and the immaterial nature of these "non-places", understood as non-physical spaces, give virtual museums essential characteristics to implement strategies aimed at preserving at-risk cultures. A virtual museum is, in fact, an archive without shelves or walls, capable of preserving memories and anthropological, historical, artistic, and cultural testimonies related to both material and immaterial traditions and artworks, thus ensuring the safeguarding of their role in human affairs. This approach allows for continuous enjoyment of cultural heritage even when it is exposed to dangers or extreme situations. This characteristic should not be underestimated, as it can play a significant role in educating the public, who often overlook the critical conditions faced by essential elements of cultural heritage – considered as part of the heritage of Humanity – and the threats they encounter. These issues are not necessarily or directly linked to armed conflicts; they also include other processes that jeopardize the safeguarding of a region's heritage, such as neglect due to problems in managing archaeological and cultural sites. These challenges are a constant in countries facing or recently emerging from economic crises, which frequently occurs in nations involved in conflicts or that have just come out of them. The ability to raise awareness and inform the public about crucial issues concerning both local and global cultural heritage contributes directly to its promotion, often stimulating significant tourist flows.

A notable example, though from a different context, is the media impact of films such as *Lawrence of Arabia* and *Indiana Jones and the Raiders of the Lost Ark*. These movies, through effective storytelling, increased interest in regions like the Near East, generating notable tourism in areas previously infrequently visited. This methodology can be effectively applied today in the context of virtual musealization. By leveraging the power of the Internet, users worldwide can access resources related to the preservation and understanding of cultural heritage, fostering greater global awareness and participation in its protection. Technology plays a crucial role in conflict-affected areas, as achieving preservation, promotion, awareness, and education can be challenging in extreme contexts. However, an effective virtual musealization process can ensure the continuity of cultural heritage protection, enjoyment, and enhancement even in times of crisis. In this context, the transport of artworks, especially in regions facing insecurity or authoritarian regimes, poses significant challenges that can be addressed through virtual musealization and the creation of digital collections. Such limitations have often led to tensions between museums and governments. For instance, in 2011, the Louvre refused to loan the Mona Lisa to Florence due to security concerns (Larcan 2018). Similarly, in 2022, the National Museum of Damascus withheld a 7th-century manuscript, citing safety issues in Syria. These cases highlight how security concerns hinder artwork access and transfer, an issue significantly mitigated by virtual museums, which enhance accessibility while eliminating transportation and security costs. Although it is now evident that a proper approach to virtual musealization can contribute to the preservation, use, and monitoring of our cultural heritage, there is still an important aspect to consider: the economic one. The creation of a multimedia platform represents an additional opportunity to promote initiatives aimed at fundraising, both for heritage management and to support populations affected by crises or conflicts. In this way, besides reducing significant costs associated with

[10] See e.g. the recent example of virtualization of the Sudan National Museum by the National Corporation for Antiquities and Museums and the Section Française de la Direction des Antiquités du Sudan: https://archeologie.culture.gouv.fr/sudan-museum.

managing a physical museum - especially in conflict contexts - the virtual museum becomes a tool capable of involving a broad and diverse community. It facilitates collaboration between experts and enthusiasts through the organization of online meetings and the dissemination of high-quality digital contents. This strategy addresses a highly relevant and timely issue, generating multiple outcomes with significant impacts on various aspects of the community, such as the economy (directly or indirectly linked to tourism), social cohesion, and culture. These mechanisms acquire added value especially in societies characterized by a fragmented social setting or marked by conflicts and crises.

After a general overview of the role of virtual museums in safeguarding, managing, and valorising cultural heritage, especially in conflict areas, this final section presents a virtual musealization proposal for the archaeological area of Seglamen, in the Tigray region of northern Ethiopia.

Located on a flat cultivated terrace about 12 km to the south-west of Aksum, the archaeological site of Seglamen has evidence dated to the first half of the 1st millennium BCE. Awareness of the possibility of an archaeological site in this area dating back to this period came about in the early 1970s, when a royal inscription commemorating the foundation of a temple was found by a farmer in the southeastern sector of the modern village.[11] Preliminary excavations aimed at detecting archaeological remains chronologically and culturally related to the inscription were carried out in 1974.[12] These brought to light evidence of a much later occupation of the area built over earlier structures (Ricci, Fattovich 1987, 117-169).

The actual location of the Pre-Aksumite settlement was determined in 2006, during the systematic survey of Aksum and its vicinities conducted in the framework of the World Bank Ethiopian Cultural Heritage Project (Bard *et al.* 2014, 285-316). The ancient site extends over an area of about 7 hectares in the easternmost sector of the modern village, overlooking the river gorge. It encompasses the present-day areas of Amda Tsion, where the ancient settlement was located, and Mogareb, north-west of the settlement, where the remains of the ancient cemetery have been detected and investigated.

Excavations conducted between 2010 and 2019 by UNIOR and ISMEO uncovered in the settlement area the remains of overlapping stone buildings belonging to three major occupational phases dated between ca. 980 and 450 BCE (Sernicola 2021, 150-152); investigations in the cemetery have so far exposed the remains of 37 tombs consisting of circular and roughly rectangular shafts, some of them marked by a sandstone stela. Small votive deposits characterized by shallow pits are located around the graves, in the proximity of outcropping natural boulders (Sernicola 2021, 150-154).

The economy of the ancient people inhabiting the site was based on the cultivation and processing of cereal and legumes and the breeding and butchering of cattle, sheep, and goats. A variety of crafts and possibly industrial activities were also performed at the site, including stone knapping, pottery making, cleaning and refining of animal skins, and wood-working (Phillipson 2012, 509-530; 2013*b*, 283-303). Imported materials suggest that the site was included in medium-to-long distance exchanges and trades with the Nile Valley and the Red Sea regions (Sernicola 2021, 149-150).

Two crucial aspects justify this choice of implementing a Virtual Museum of the site of Seglamen. First, the project is rooted in a long-lasting collaboration between the Ethiopian Governmental Institutions, UNIOR and ISMEO, ensuring a strong scientific foundation. Second, the region faces recurrent social challenges, such as ethnic fragmentation and economic underdevelopment, exacerbated by a recent conflict. This makes Seglamen particularly suitable for applying a virtual museum model that can address many of the challenges faced by the local community. Despite its small size and agriculture-based economy,

[11] See note 3.

[12] Investigations were conducted by Sapienza University of Rome under the direction of Lanfranco Ricci.

Seglamen holds significant evidence related to the emergence and evolution of complex societies in this region. Preserving these testimonies could foster cultural and socio-economic revitalization for the community.

The objectives of Seglamen Virtual Museum Project are clear and well-defined: access, accuracy, preservation, and information diversification. The goal is to go beyond simple 3D reproductions of museums or collections by creating a platform that allows users to interact with artifacts and immerse themselves in realistic environments recreated using advanced technologies like photogrammetry, 360° videos, and 3D modelling. The project aims to transform the museum experience into active learning, making users integral participants, engaging with the artifact and its context, while overcoming social and ethnic barriers (Fig. 9).

Fig. 9 - Seglamen Virtual Museum Project, Homepage

A key element of this project is the accurate profiling of users, allowing the information provided to be tailored based on each visitor's interests and expertise. This data diversification strategy prevents overloading the user with excessive information or offering a limited experience. It ensures a balanced and engaging experience, catering to various levels of knowledge while avoiding negative reactions from inadequate information loads. The adoption of real-world models also aims to actively involve the local community, encouraging their participation in creating digital contents. This exercise holds crucial importance, as the involvement of the local community not only offers opportunities for employment and education but also allows the community to connect deeply with its own history. This process encourages self-reflection, linking individuals with both their personal and collective heritage and, ultimately, with the broader regional context. Such an approach fosters a greater awareness of shared cultural values, strengthening identity and belonging to a universal culture that transcends political boundaries, which often serve as artificial divisions of a single people. To further enrich the museum experience, carefully selected audio, video, and photographic materials will be integrated, enriched with specific information. These elements will allow users to immerse themselves fully in the production or discovery context of an object, offering a learning experience that goes beyond mere observation. The digital supports not only facilitate user navigation within the scenarios but also mark a significant advancement in the evolution of the Seglamen Virtual Museum. By conveying brief yet meaningful messages filtered through various profiling

levels, the Seglamen museum can effectively narrate the history of a particular object through storytelling. The use of audio supports is not only an important resource for visually impaired users but also adds a sensory dimension, making the visit more immersive and engaging. Similarly, dedicating a specific space for children offers significant opportunities. By incorporating diverse approaches like educational games, the goal is to stimulate curiosity and create a welcoming environment that encourages exploration. The playful approach helps facilitate information transfer in an accessible way while promoting active engagement. The storytelling process aims to evoke curiosity, empathy, and wonder, creating a deep connection with cultural heritage. The project is based on the "concept-driven" approach, focusing on how visitors want and can interact with museum contents. In this context, a careful analysis of visitors' interests and needs was of paramount importance in order to fully understand their expectations. Only through this investigation it has been possible to design a virtual museum that not only met these expectations, but was also an effective tool to promote essential values such as the preservation of heritage and its valorisation, in a territory marked by internal conflicts and high rates of poverty. The collection that was planned to be presented in our museum also reflects the policy of the project as a tool to mitigate conflicts. For instance, the idea of presenting ceramic types that are attested in this area as well as in the neighbouring territories of Sudan, Egypt and Eritrea, is dictated precisely by the aim of emphasising common and convergent cultural traits rather than divisive and distinctive ones. In this perspective, the objects in the collection also take on a new meaning: they become powerful tools for promoting the values of social cohesion and highlighting the intercultural relationships of the past. It is evident how all the choices behind the realisation of Seglamen Virtual Museum are guided by a common ultimate goal, although the specific objectives are different. The strategies implemented in the museum, such as the use of audio-visual gimmicks, 3D manipulation and accurate storytelling, serve as a guiding tool to help the visitor orientate and move within the history of the region in an active way.

To conclude, it is useful to recall once again the words of Antinucci: "The museum is perceived also, and not secondarily, with the body and not only with the eyes: one moves through the rooms, around and in front of the objects, one has a sense of position and space – crucial in the perception of volumes, of sizes – that contributes fundamentally to the appreciation of the experience one is having [...]. The common visitor, especially today's visitor, must be taken by the hand and guided along a safe path, where he does not have to choose between things about which he does not know and cannot choose, and where the information that is truly essential to the understanding of the object in front of him is communicated in a comprehensible manner, in an effective and also captivating way, that is, aimed at stimulating motivation."[13]

These principles form the foundation of the Seglamen Virtual Museum, which, while allowing freedom of movement and access to information, ensures that the user is never alone. Information is presented in a way that is filtered and adapted to the specific needs of the user, ensuring an experience that is as engaging and informative.

Final remarks

Safeguarding heritage, both tangible and intangible, is a challenge we cannot shirk to ensure that the cultural legacy of our predecessors is passed on to future generations. It involves a set of well-established and standardized procedures nowadays complemented by a rich variety of digital tools that help making documentation, protection and promotion faster and more efficient. They prove to be extremely useful in those areas that are inaccessible due to environmental conditions or the occurrence of periods of conflict

[13] This passage summarizes concepts expressed by Antinucci in several of his writings, but which are most clearly and concisely presented in Antinucci 2007, pp. 104-121.

and political instability as they speed up data collection and facilitate the remote monitoring of sites and tracking of objects involved in illegal trafficking. In addition, the possibility of creating virtual museums – as an alternative or complement to real museums– constitutes a unique opportunity to disseminate the cultural heritage of conflict-prone regions. This can help in raising international awareness of the richness of the cultural heritage of these areas and the need to protect it.

Taking action to mitigate the impact of conflicts on the cultural heritage of northeastern Africa and the Horn is increasingly becoming a priority step in the archaeological research programmes that UNIOR and ISMEO conduct in Egypt, the Eritrean-Sudanese lowlands, and Ethiopia. Attention to this aspect is leading to the experimentation, sometimes planned and sometimes opportunistic, of tools and procedures that will hopefully contribute to generating a protocol of systematic actions geared towards the protection and promotion of the rich and varied heritage of these regions.

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REFERENCES

Antinucci, F. (2007) *Musei virtuali. Come non fare innovazione tecnologica*. Bari.

Bard, K.A., R. Fattovich, eds. (2007) *Harbor of the Pharaohs to the Land of Punt: Archaeological Investigations at Mersa/Wadi Gawasis, Egypt, 2001-2005*. Napoli.

Bard, K.A., R. Fattovich, A. Manzo, C. Perlingieri (2014) The Chronology of Aksum (Tigray, Ethiopia): A View from Bieta Giyorgis, *Azania* 49/3, pp. 285-316.

Bard, K.A., R. Fattovich, A. Manzo, eds. (2022) *Harbor of the Pharaohs to the Land of Punt II: Archaeological Investigations at Mersa/Wadi Gawasis, Egypt, 2006-2011*. Napoli.

Bard, K.A., A. Manzo 2025 Excavations on Bieta Giyorgis Hill, Aksum and Evidence for the Origins and Development of the Aksumite Kingdom, *Journal of Field Archaeology* 50, pp. 239-259.

Bernand, É., A.J. Drewes, R. Schneider (1991) *Recueil des inscriptions de l'Éthiopie des périodes pré-axoumite et axoumite. I: Les documents*. Paris.

Bragantini, I., G. Lucarini, A. Manzo, R. Pirelli (2018) *The Italian Archaeological Mission in the Eastern Desert: First Results from the Area of Wâdi Gasus, in The Eastern Desert of Egypt during the Greco-Roman Period: Archaeological Reports*. Paris.

Fattovich, R., K.A. Bard, L. Petrassi, V. Pisano (2000) The Aksum Archaeological Area: A Preliminary Assessment. *Working Paper* 1. Napoli.

Fattovich, R., Takla Hagos (2005) *Archaeological Survey – Report of Activity, October-November 2005*. [Technical Report]. Florence.

Fattovich, R., Takla Hagos (2006) *Archaeological Survey – Report of Activity, March-May 2006 and Aksum World Heritage Site Management Plan*. [Technical Report]. Florence.

Larcan, L. (2018) Louvre, "Prestare la Gioconda di Leonardo non è più un tabù". Il ministro francese cambia le regole. *Il Messaggero*
https://www.ilmessaggero.it/primopiano/esteri/louvre_prestare_la_gioconda_di_leonardo_non_e_piu_un_tabu_il_ministro_francese_cambia_le_regole-3510911.html [29 gennaio 2018].

Manzo, A. (2017) *Eastern Sudan in its Setting: The Archaeology of a Region Far from the Nile Valley*. Oxford.

Phillipson, L. (2012) Grindstones and related artefacts from Pre-Aksumite Seglamen, northern Ethiopia and their wider implications, *Azania* 47/4, pp. 509-530.

Phillipson, L. (2013*a*) Lithic Tools Used in the Manufacture of Pre-Aksumite Ceramics, *Azania* 48/3, pp. 380-402.

Phillipson, L. (2013*b*) Parchment production in the first millennium BC at Seglamen, northern Ethiopia, *African Archaeological Review* 30/3, pp. 283-303.

Ragghianti, C.L. (1974) *Arte, fare e vedere. Dall'arte al museo*. Firenze.

Ricci, L., R. Fattovich (1987) Scavi archeologici nella zona di Aksum. A. Seglamen, *Rassegna di Studi Etiopici* 30, pp. 117-169.

Schofield, E.J., ed. (1991) *Interpreting Artefact Scatters: Contributions to Ploughzone Archaeology* (Oxbow Monographs in Archaeology 4). Oxford.

Sernicola, L. (2017) *Ancient Settlement Patterns in the Area of Aksum (Tigray, Northern Ethiopia) – ca. 900 BCE – 800/850 CE* (BAR International Series 2860). Oxford.

Sernicola, L. (2021) On the origins of Aksum and the "Proto-Aksumite Culture": an overall reconsideration in the light of recent finds at Seglamen and Medogwe, *Rassegna di Studi Etiopici* 5 (Terza Serie), pp. 139-175.