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PROCEEDINGS OF THE WORKSHOP

DROWNING LANDSCAPES: MULTIDISCIPLINARY APPROACHES TO THE ARCHAEOLOGICAL HERITAGE OF DAM RESERVOIRS

XIII ICAANE Conference

Copenaghen, May 24th, 2023

The following papers are the results of a workshop entitled "Drowning Landscapes: Multidisciplinary Approaches to the Archaeological Heritage of Dam Reservoirs" held during the XIII ICAANE conference in Copenhagen on the 24th of May 2023 and organised by Paola Sconzo, Francesca Simi and Jesper Eidem.
We want to thank all the workshop participants and the scholars who contributed to these proceedings. We are also extremely grateful to the many reviewers who contributed to the quality of the contributions here presented.

THE EDITORS
Paola Sconzo - Francesca Simi - Jasper Eidem

Paola Sconzo - Francesca Simi*

WAITING FOR THE DELUGE? SOME THOUGHTS ON THE IMPACT OF DAMS ON THE HERITAGE IN SOUTHWEST ASIA

Abstract

Water resources are crucial for stability and economic prosperity in arid or semi-arid regions like Southwest Asia and North Africa, where water is scarce, and droughts are increasingly common due to climate change, demographic pressure, and unsustainable development. Therefore, from the second half of the 20th century onwards, the damming and impounding of rivers have become widespread practices to the detriment of localised communities and archaeological resources.

Building on data and experience so far acquired by the authors, this paper assesses some of the critical research trajectories related to the impact of dam construction on the local heritage to stimulate discussions on the use of modern technologies, such as remote sensing, in pre and post-flooding assessment, the monitoring protocols for the active protection of the flooded sites and the involvement of policymakers and local communities in the decision-making processes.

Keywords

Dam, cultural heritage, Southwest Asia, memoryscape, heritagescape, salvage excavations

1. Introduction: The Dam Revolution[1]

In the late 30s, Woodie Guthrie, America's pioneering modern folk singer, in the closing verse of 'Washington Talkin' Blues',[2] a symbolic song about the Great Depression that struck the United States in the second quarter of the last century, enthusiastically acknowledged the construction of a large dam as the solution to the poverty and unemployment of the small communities of Colorado and the road to the revival and rehabilitation of the whole country.[3]

The song heralds what was also defined as the 'Big Dam Era',[4] which was a crucial element in the New Deal policy, fuelling the creation of thousands of jobs across the country and enabling the United States to recover and transform its economy.[5]

In this instance, such radical waterway manipulation became integral to North American 'necessity'. However, thousands of people who lived along the banks of rivers were displaced, and countless villages, lands, and cultural and archaeological sites were flooded.[6]

Since the first 'big dams' were built in America in 1930s, similar enterprises - driven by analogous or alternative needs - have spread over the globe, experiencing an exponential increase from around 5000 in 1950 to almost 62,000 by 2023.[7] We can say that today most of the world's big rivers have been impounded,[8] thus submerging more than 400,000 km^2 of the world's most fertile lands.[9] Although the pace of construction has slowed in recent years, several new reservoirs (among which China's Baihetan Dam, completed in 2022) were built during the first two decades of the 21st century.[10]

Local governments have been actively promoting the construction of large dams as a development strategy. This has been justified on strategic, economic, social, and political grounds, with the endorsement of

* Paola Sconzo (University of Palermo), Francesca Simi (University of Udine).

[1] This contribution has been elaborated in its entirety by both authors together. The division of individual paragraphs refers just to the final drafting of the text. §§ "Introduction" and "Conclusions" are the common work of P. Sconzo and F. Simi, § "Flooding: First-phase Salvage" and "Peopling: Heritagescapes" were written by P. Sconzo, § "Damming the SWA region" and "Floating: Second-phase Salvage" are by F. Simi.

[2] The verse is: "… Now what we need is a great big dam, to throw a lot of water out acrost that land, people could work and the stuff would grow, and you could wave goodbye to the old skid row, work hard, raise all kinds of stuff, kids, too. Take it easy". The song belongs to the album 'The Columbia River Collection', released in 1941.

[3] Guthrie was apparently 'employed' by the federal government to write songs to promote government-built hydroelectric dams on the Columbia River in the Pacific Northwest (https://energyhistory.yale.edu/woody-guthrie-grand-coulee-dam-lyrics-1941/). See also Partington 2006.

[4] Ferrell 1993; also, Lee 2023.

[5] For a history of big dams in USA, see McCully 2001, 15-17; Lawrence 2005, 256-260; Ferrell 1993.

[6] Govaerts 2016, 288-302.

[7] Updated data to April 2023 from the International Commission on Large Dam website (https://www.icold-cigb.org/article/GB/world_register/general_synthesis/general-synthesis).

[8] "We dammed half our world's rivers at unprecedented rates of one per hour, and at unprecedented scales of over 45,000 [large] dams" (Asmal 2000, 1).

[9] McCully 2001, 1-8.

[10] On the rise and decline of big dams globally, see Khagram 2004, 5-11.

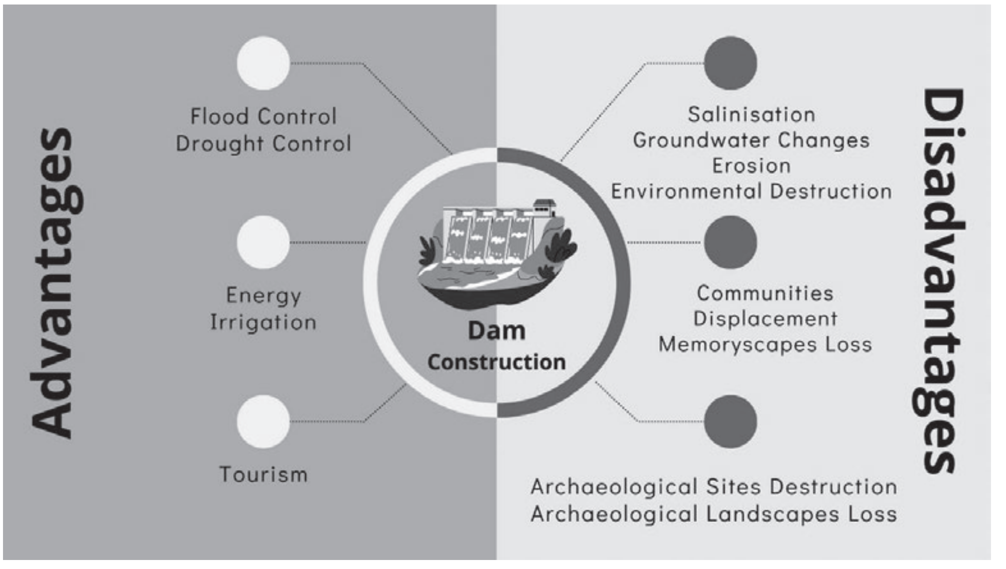

Fig. 1 - Dam construction benefits and costs.

powerful coalitions of internal, foreign, and multilateral financiers, among which often counted the World Bank, engineers, economists, development experts, and industrialists.[11] This well-structured caste has been controlling the terms of public debate, promoting dams as symbols of progress and patriotic pride. Through narrow cost-benefit analyses, the transformative potential of the hydroelectric projects has been strongly emphasised. Dams played a significant role in providing affordable energy to boost industrial production and bring power to areas that previously had no access to electricity. The harnessing of rivers promoted flood control and irrigation, facilitated navigation, and ensured urban water supply. Large dam enterprises further offered new employment opportunities and allowed reservoirs to become sources of recreation and tourism (Fig. 1).

In this way, big dams became expressions of a dominant ideology and symbols of economic development and scientific progress.

Beginning in the 1970s, this dominant narrative started to be challenged by several academics: large dams are flawed, they pointed out, with benefits often being propagandistically over-dimensioned compared to all the critical social, cultural, and ecological effects. The latter counts an irreversible environmental impact on the basin itself whenever the river's inability to flow freely creates devastating ecological and health effects: reservoirs flood fertile farmlands and rich forests and drown wildlife. Furthermore, altered flow patterns downstream can lead to erosion, fish population disruption, loss of secondary channels, and increased salinisation. Human populations living in the river valleys may suffer sharp spikes in waterborne diseases. In other words, dams tear all the interconnected webs of river valley life.[12]

Citing a crucial text issued by the World Dam Commission[13] at the beginning of this century:

> Large dams are invariably constructed in river basins where people have lived for long periods of time, often from the prehistoric past to the present. Large dams also impact very large areas encompassing one or more cultural regions and tribal or indigenous groups. […] the construction of large dams has also led to an incalculable loss, destruction, and damage of cultural resources ranging from shrines of local communities to world heritage monuments […].[14]

[11] Scudder 2005, 5-6.

[12] *Ibidem*, 211-241. For more general discussions, see Binger 1978; Goldsmith, Hildyard 1986.

[13] The World Commission on Dams (WCD) was established in 1997 and it delivered the most comprehensive guidelines for dam building. Its final report provides an innovative framework for planning hydroelectric basins that takes into consideration dam-affected communities and the environment, thus guaranteeing that dam benefits were more equitably distributed.

[14] WCD 2000, 2. In the crucial document delivered to clearly state what 'Cultural Heritage' is in a dam construction context, the following definition was provided: "1) Cultural resources of living populations (e.g., their mode of subsistence, social organization, religion, ideology, political organization, language, and the material expression of their ideas and practices which range from sacred elements of the natural landscape to artifacts and buildings); 2) Archaeological resources (e.g., occurrences and sites which may include artifacts, plant and animal remains associated with human activities, burials, and architectural elements) which may or may not be an integral part of the cultural heritage of the local inhabitants; and 3) Cultural landscapes which consist of landforms and biotic as well as non-biotic features of the land resulting from cultural practices over historical, or even prehistoric times, by generations of peoples of one or more cultural traditions. These resources constitute the cultural heritage of a people, a nation, of humanity".

The large reservoir deluge inevitably also leads to the obliteration of material and immaterial cultural resources, and entire landscapes, at once with unacceptable social costs. These are imposed on communities of the impacted areas forced to resettle and on downstream communities whose living standards are dependent on flood regimes. This process of annihilation severs crucial socio-cultural connections and wipes out interconnected memoryscapes and cultural heritage.[15]

On top of these irreversible losses, dams have a relatively short life.[16] Up to the present, notwithstanding the extensive literature on the topic, there is no comprehensive and unbiased study, even applied to a single hydroelectric project, that compares general long-term benefits and costs.[17]

Focusing on Syria, Iraq, and Turkey, the three countries crossed by the two major rivers of Southwest Asia (henceforth SWA) that have been part of the 'dam revolution'[18] of the past seventy years, this paper reviews some of the critical research trajectories related to the impact of dam construction on cultural landscapes and it proposes a new theoretical framework to view, understand and interpret the complexity and diversity of dam reservoir dynamic environments.

To provide context, the paper begins by exploring the historical and developmental trajectory of damming practices in the SWA region. It weighs the benefits against the pitfalls of such endeavours while scrutinizing their political and ideological ramifications. It seeks to foster discussion and reflection on the manifold and transformative effects of dams on landscapes, archaeology, and communities.

Subsequently, it delves into initial salvage excavation activities, offering a preliminary assessment of the purely archaeological consequences of dam construction while shedding light on inherent deficiencies of this approach.

This study is spurred by recent draughts caused by climate changes and political upheavals in the SWA region, where water has constantly been pivotal for stability and economic vitality. These events have led to the reemergence of heritage landscapes previously submerged by reservoirs (Fig. 2). These floating landscapes are the object of the following section, which lingers on the new wave of post-flooding initiatives aimed at documenting, monitoring and protecting their multifaceted values.

First and foremost, this contribution sheds light on the inadequacy of the studies concerning big dams phenomena mainly caused by the intrinsic fragmentation of research fields, approaches and interventions. To overcome such an impasse, the theoretical framework of 'Heritagescape' is introduced and discussed to look at the multifaceted domain affected by artificial reservoirs over time.

2. Damming the SWA region

A visual comparison of mid-20th century maps with today's Google Earth images reveals the dramatic hydrographic changes that have occurred across SWA countries, with ribbon-like rivers becoming a series of elongated lakes (Fig. 3). The practice of damming and enclosing rivers, following a global trend, became widespread starting from the 1960s. According to the Aquastat Database,[19] 759 dams are active in Turkey, Syria, Iran, and Iraq at present (Fig. 4).

This region, which includes Mesopotamia, literally the 'Land Between the Two Rivers', has a symbiotic relationship with water that spans millennia. Its history is intricately woven with the vital properties of the Tigris and Euphrates rivers, which have provided the foundation for one of the world's earliest civilisations. Here, settlements, agriculture, and complex societies have relied heavily on rivers for emergence and growth.

Although these rivers brought prosperity, they also presented challenges, and their periodic floods required the development of water control measures, including dams, canals, and levees. One of the oldest dams archaeologically known in Mesopotamia is a barrage on Wadi es-Souab, close to the ancient city of Mari (on the Middle Euphrates), possibly dating to the 3rd millennium B.C.[20] Several written sources also attest to the use of damming technology. Dams built with baked bricks, bitumen, and earth were mainly meant to raise the water level in the main canals.[21]

The collapse of ancient Mesopotamian civilisations is frequently attributed to environmental degradation, water scarcity, and changes in the river systems.[22]

[15] See also WCD (2000, 97-134); Lupu 2001; UN-ESCWA-BGR 2013: 13–14; Colson 1971, 43-72; Scudder 1997; 2005; 2019; McCully 2001, 65-100; Gleick 2014.

[16] Wieland 2010.

[17] McCully 2001, 24.

[18] Isaacman, Isaacman 2013, 19.

[19] The AQUASTAT dataset is the most important source of information available on dams in the SWA region. Unfortunately, it is not up to date. However, there are other more recent databases that collect information on reservoirs and dams globally, such as the Global Reservoir and Dam Database (GRanD) and the Global Geo-referenced Database of Dams (GOODD). These have been brought together by the Global Dam Watch organization to create a consensus database. Data are available at https://www.globaldamwatch.org/database (Accessed 20/01/2024).

[20] Viollet 2007, 39-40. The most ancient dam so far known, the Jawa Dam, dating to the end of the IV mill. B.C. is also located in the SWA, namely in Jordan (*Ibidem*, 31-36).

[21] Tamburrino 2010, 45.

[22] An example could be the debated fall of the Assyrian Empire (Sinha *et alii* 2019; Schneider, Adali 2014, 2016a, 2016b; contra Soltysiak 2016).

Fig. 2 - Bird view of the Mosul Dam with a resurfacing tell on the background (https://www.trevigroup.com/it/MediaGallery/cantieri-nel-mondo).

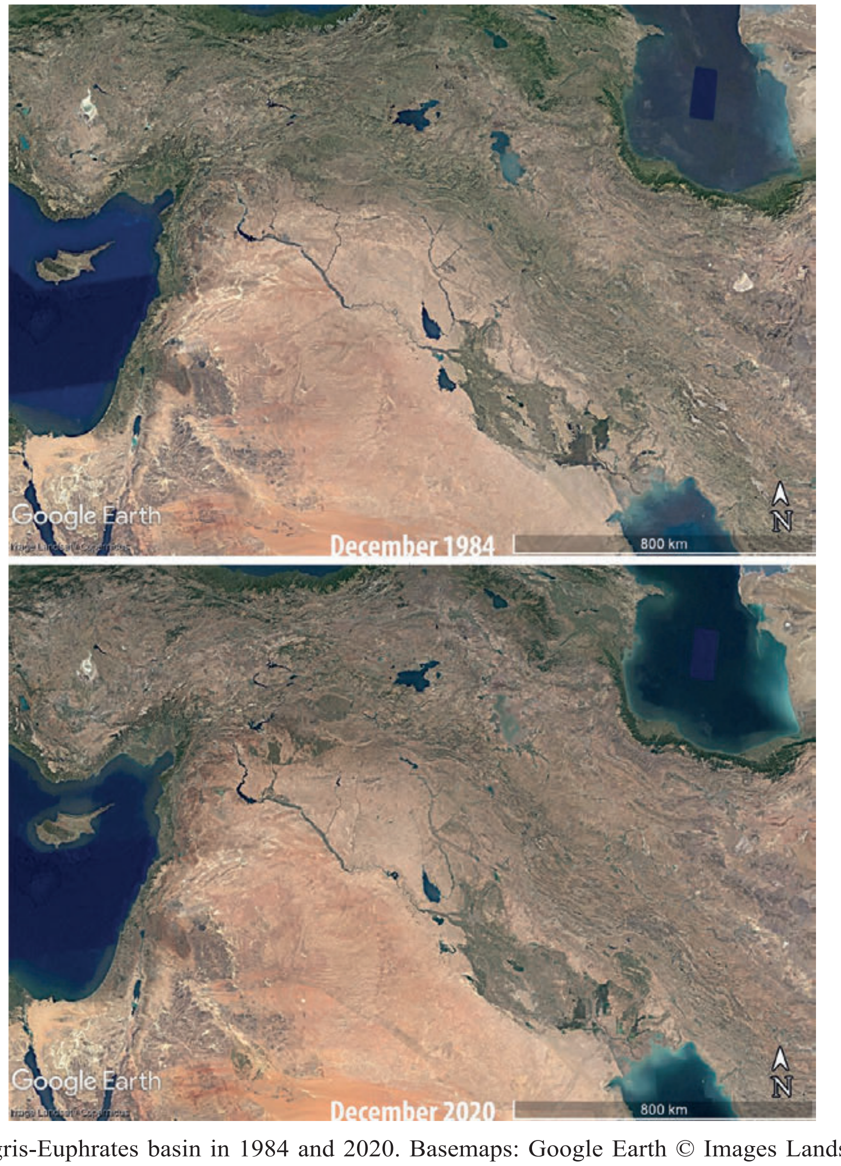

Fig. 3 - The Tigris-Euphrates basin in 1984 and 2020. Basemaps: Google Earth © Images Landsat/Copernicus.

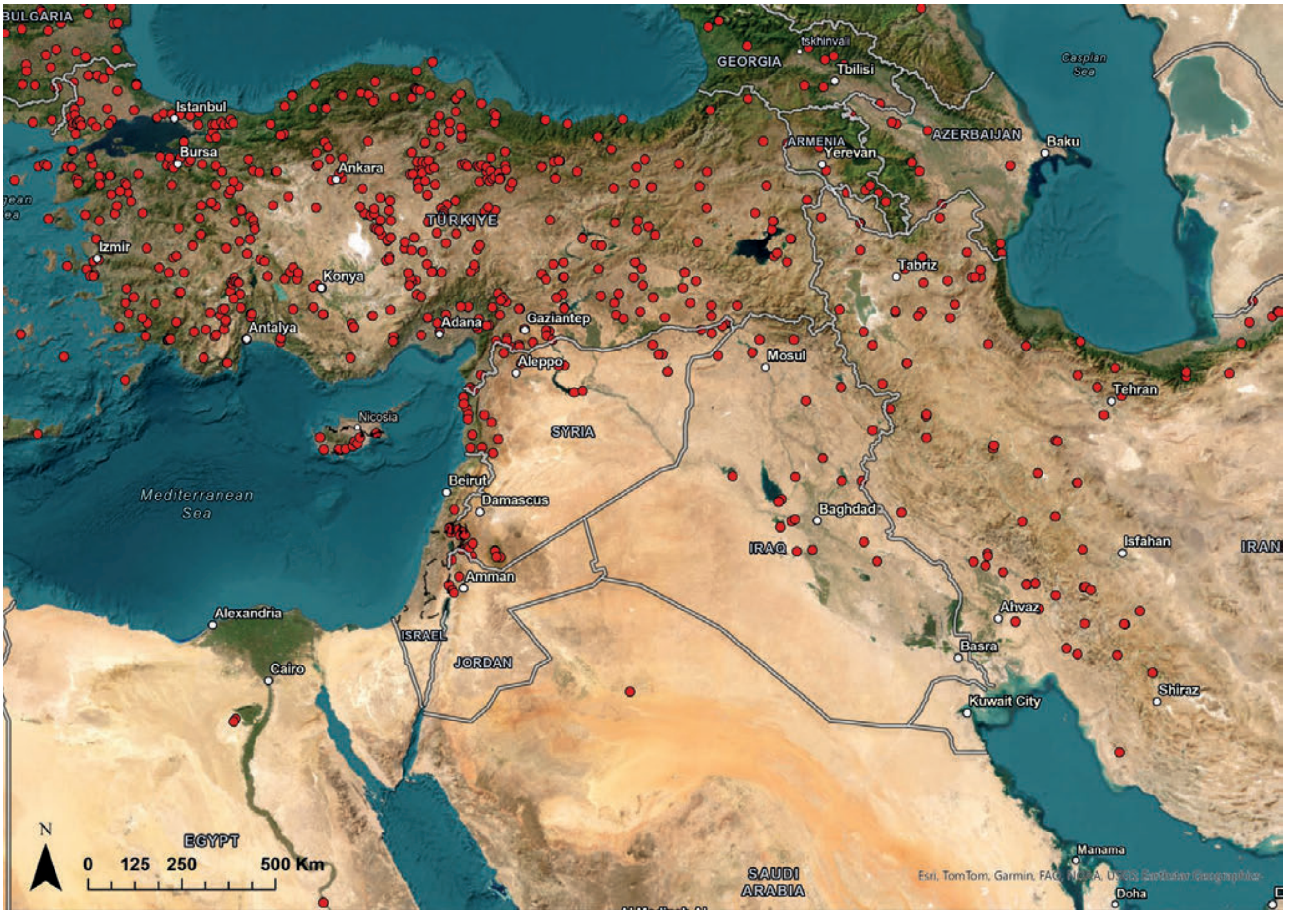

Fig. 4 - Dams in SWA according to AQUASTAT database (AQUASTAT 2015).

These same challenges continue to shape the intricate relationship between the people of the region and the Tigris and Euphrates rivers today.

In the SWA region, over the past 70 years, the development of modern hydroelectric reservoirs has provided numerous benefits, including generating electricity, enhancing agricultural output, and stimulating economic growth. By becoming symbols of modernity and development,[23] SWA dams have also been used to strengthen the state's control in rural areas [24] and, more generally, as tools of political empowerment.[25] Their inauguration has often been celebrated nationwide and recognised through various media outlets, as well as visually depicted on banknotes and stamps.[26]

As the control of water has always been a crucial means of exerting power, SWA political entities across millennia have grappled with the complex interplay of geopolitics and conflict surrounding their rivers.

In the history of ancient Mesopotamia, the events in which water triggered conflicts are numerous, as well as examples of when water was used as a weapon and suffered as a casualty of war.[27] The first recorded war in human history took place around 4500 years ago in Southern Mesopotamia: it was sparked by a water-related dispute between the neighbouring cit-

[23] In the race toward modernization, in all countries involved "communities were forced to abandon seasonal migration patterns to become 'settled' and 'proper' farmers and thus 'fix' their 'backwardness'" (LUKE, MESKELL 2023, 206).

[24] In SE Turkey (RONAYNAN 2005, 67-90), North Syria (LANGE 2019, 325) and North Iraq, moreover, water management has allowed for the further security and pacification of Kurdish areas along rivers, displacing in remote territories or in the suburbs of big cities most of the communities and quashing questions of Kurdish land rights, ownership, and national identity under the pressure of the professed necessity of dam construction and water and energy security.

[25] BROMBER, FÉAUX DE LA CROIX, LANGE 2014; DISSARD 2018.

[26] For example, the Dokan Dam was featured on the obverse of the 500 Iraqi dinar banknote made by Saddam Hussein to assert his commitment to the hinterland via major infrastructure that supplied water, food, and hydropower; in Syria, the Tabqa Dam was carved on the obverse of 1 lira coin and pictured in the 50 pound banknote that circulated between 1977 and 1991. See also SIMPSON 2022, 10.

[27] These criteria are also the ones used to record new events in a database created by the Pacific Institute on conflicts related to water throughout history (PACIFIC INSTITUTE 2003).

ies of Umma and Lagash.[28] An intriguing instance of water being used as a weapon is also found in an oracle tablet that describes how the king of Babylon Abi-Eshuh (1720-1684 B.C.) diverted the Tigris River with a dam to flood the fields as a military tactic to hinder the enemy's movement.[29] In a more well-known event, King Sennacherib of Assyria (704-681 B.C.) created a dam to inundate and destroy the enemies' capital Babylon.[30] His father Sargon II (721-705 B.C.), instead, specifically targeted and demolished the enemy's advanced irrigation system during his campaign in the Urartian Kingdom.[31]

Now more than ever, water conflict has become a critical issue in Southwest Asia.[32] Here, in fact, the planning and construction of big dams has been performed unilaterally, in a general vacuum of transnational water cooperation and management, thus leading to a zero-sum game that has made the rivers' resources an object of continuous rivalry and competition between riparian countries.[33]

This tension is worsened by the fact that only one country, Turkey, has control over 90% of the yearly flow of the Euphrates and almost half of that of the Tigris and has, therefore, a greater chance of exerting pressure and gaining leverage in negotiations with riparian countries, using water as precious bargaining chip.[34] The gigantic Southeastern Anatolia Dam construction program, also known as GAP (Guneydogu Anadolu Projesi in Turkish),[35] serves as an example of this, as it has provided this country with a powerful tool for hydro-hegemony.[36]

Despite the growing recognition of the weaponization of water as a threat to regional stability, the international community's appeals for dialogue, adherence to international water law, and mediation by organizations such as the United Nations have largely gone unanswered.[37]

The effects of climate change, coupled with growing demographic pressure, further exacerbate the water scarcity issue. Unforeseeable changing weather patterns, prolonged droughts, and unpredictable rainfall contribute to a weakening water supply, placing additional strain on a fragile population affected by decades of constant political struggles and unrest.[38]

The construction of dams in this region has only recently become a topic of debate, as academic discussions and civil movements have started to raise new concerns focusing primarily on the social losses caused by population displacement.[39] Endorsed by a fundamental absence of adequate protection policies, the debate on the dam's impact on the endangered heritage has instead received – apart from a few sensational cases – limited attention on social, political and scientific agendas (see below, § 3).

Consequently, despite international institutions (including the World Commission on Dams previously mentioned) having recognised cultural heritage as a crucial issue, existing national and supranational regulations are still limited and often too vague, thus making their effectiveness far from satisfactory.[40] The need for more robust cultural heritage preservation policies is increasingly urgent.

Awareness and safeguarding initiatives for endangered heritage are only now emerging in academic, institutional, and popular forums.[41] Despite that, the construction and activation of dams have not slowed down. For instance, in 2019, the aforementioned Ilisu Dam in Turkey was completed, notwithstanding solid criticism from both local and international observers and downstream countries on the river Tigris.[42] Only the lack of funding has prevented the construction of the strongly contested Makhoul Dam on the Middle Tigris in Iraq.[43] While, the Syrian conflict has delayed that of the Halabiyeh Dam on the Euphrates.[44]

In recent years, the scientific community has developed a new multifaceted interest in the damming

[28] Frayne 2008, RIME 1.09.05.01.

[29] Van Lerberghe *et alii* 2017.

[30] Frame 1992, 52-53.

[31] Melville 2016, 134-135.

[32] King 2020; De Biasi, Cruciati, Forti 2020. Also: https://www.worldwater.org/conflict/map/.

[33] Lorenz, Erickson 2023.

[34] Williams 2020.

[35] The GAP is one of the largest and most controversial dam projects existing worldwide, it includes 22 dams and 19 hydropower plants, among which the more recently constructed Ilisu and Cizre dams on the Tigris (Salameh, Alraggad, Harahsheh 2021). See also Ökse this volume.

[36] The term was first coined by Zeytoun, Warner (2006) to signify a country's favorable power and riparian position, and its "resource exploitation potential". On Turkey's hydro-hegemony, see Williams 2020; Chibani 2023; Mutin 2003. Beyond the economic benefits, GAP enterprise has allowed Ankara to control the flow of the Tigris and the Euphrates, impacting water availability in downstream Syria and Iraq, where reduced water flow and alterations in river ecology are having severe consequences for agriculture, food security, overall economic and social stability, and at humanitarian level (Arvanita *et alii* 2022).

[37] Ward, Ruckstuhl 2017, 210-238; Hamid 2020.

[38] Arif 2023; Sala, von Laffert, Mohammad 2021; De Biasi, Cruciati, Forti 2020.

[39] Lange 2019. Marchetti *et alii* 2020, with further bibliography.

[40] See Komurcu 2002 for a critique to the lack of policies at international funding bodies such as the World Bank or the International Monetary Fund.

[41] Sconzo, Simi, Titolo 2023; Simpson 2022; Eidem 2020; Marchetti *et alii* 2019; Cunliffe, de Gruchy, Stammitti 2012.

WCD 2000: 97-134; Lupu 2001; UN-ESCWA-BGR 2013: 13-14; Gleick 2014; Al-Ansari 2016; Luke, Meskell 2019: 4-6.

[42] Chibani 2023.

[43] In March 2023, Iraq informed the World Heritage Centre that all works related to the construction of Makhoul Dam have been stopped (WHC/23/45.COM/7A, 37).

[44] Leeming 2016.

of the Southwest Asia and North Africa regions: from understanding its impact after the reservoirs have been filled up[45] to finding new ways to mitigate it,[46] and from developing and applying new technologies for site documentation[47] and for the planning of targeted salvage activities,[48] to including the voices of local communities in the decision-making processes[49] and the search for possible more inclusive solutions.

3. Flooding: First-phase Salvage

Although the regions under examination hold significant archaeological value, the destruction of cultural patrimony has been underestimated and overlooked.[50] The loss started before the dam's activation, during the planning phase. When investigations of cultural or archaeological resources were not scheduled, such loss was complete; but even when local governments promoted what has been recently defined as **'first-phase'**[51] archaeological salvage projects, only a fraction of the impacted heritage before being flooded by the dam reservoir ended up being recorded.[52]

First-phase rescue operations have usually been conducted in the frame of large enterprises launched by local governments and substantiated through the international community's involvement. Trailblazers, in this sense, were the salvage campaigns conducted in the first half of the last century in Nubia at the First Nile's Cataract prompted by the subsequent erection of the low Aswan Dam.[53] This procedure was resumed in a more formal and structured fashion after the end of the World War II as the Egyptian authorities, to hold back the still ongoing Nile flood, decided to build a second giant dam a few hundred meters upstream, the Aswan High Dam (1960-1971), and called for international intervention. This last endeavour set the stage for a basic protocol of preventive archaeology that profited from thirty years of experience gained in the US during the aforementioned 'Big Dam Era'[54] and saw the first involvement of UNESCO with cultural heritage.[55] Despite being the object of a sustained debate lately, accompanied by several ethical concerns,[56] this enterprise was declared highly collaborative and revolutionised the appreciation of Nubia's heritage.

In the late 50s, new dam constructions in Iraq at Dokan (1954-1959)[57] and Darbandikhan (1956-1961)[58] on the Zab and the Diyala, respectively, led this protocol to spread throughout Southwest Asia[59] and then consolidate through the years, being more and more integrated into the dam planning phase, though with little methodological discussion and some regional differences reflecting governmental choices.[60]

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[45] Among these studies (Shoup 2006; Hafsaas-Tsakos 2011; Kleinitz, Näser 2011), only a few have presented and discussed quantitative data (Marchetti, Zaina 2018; Marchetti et alii 2019; 2020; Zaina 2019; ORIENTDAMS 2023).

[46] Eidem 2015; 2020; Cunliffe, de Gruchy, Stammitti 2012.

[47] Zaina, Tapete 2022; Titolo 2021.

[48] Sconzo, Simi, Titolo 2023.

[49] Zaaimi, Katheem 2022.

[50] In the broad literature concerning dam construction effects and pitfalls, the threats posed to cultural heritage are rarely even considered. When discussed, they are often solely the object of a postcolonial critique.

[51] Eidem 2020.

[52] In a comprehensive survey of archaeological and geographic sources concerning the Euphrates, Marchetti *et alii* (2020, 21-22, fig. 5) have shown that rescue projects have only involved 12 out of 23 dams along this River, c. half of them in Syria and Iraq. While these countries have invested greatly in archaeological surveys and excavations, only one-third of the reservoir areas along the Turkish Euphrates have been investigated, corresponding to 29% of the total reservoir surface along the river. On this matter, see M. Özdoğan (2000, 58-61) report about the situation in Turkey in the WCD document.

[53] The first barrage, or Low Aswan Dam, was completed in 1902; within three decades, growing economic needs backed by international political decisions led it to being raised twice (1912 and 1934) allowing the reservoir level to increase by ca. 14 additional meters. International concern for the likely submersion of archaeological sites and features located on the banks of the river inspired two successive enterprises, namely the First and Second Archaeological Surveys of Nubia. These were led by English, French, and Americans and included mapping and excavation of several monuments and cemeteries. The results proved important for studying the Middle Nile and Nubian history and archaeology (Hassan 2007).

[54] American expertise in salvage archaeology emerged during the New Deal from back-to-work programs for archaeologists and salvage contracts with the Tennessee Valley Authority (TVA). This expertise brought the SWANA major rivers to become fertile testing grounds for the development of the 'New Archaeology' (Luke, Meskell 2020, 196-199 with further references; Olson, Luke 2023).

[55] This first involvement in a call for salvaging endangered heritage has been considered the pivotal step that led UNESCO to a "shift from a globally oriented humanist organization toward a pragmatic intergovernmental organization focused on technical assistance rather than cultural and educational reform" (Meskell 2018, 72). This enterprise laid the foundation for the establishment of the modern system of World Heritage Sites (UNESCO 1972).

[56] There is a vast and articulated literature which critically deals with the High Dam construction and Western commitment and donor rhetoric: see Säve-Söderbergh 1987; Hassan 2007; Allais 2012; 2020; Carruthers 2022; Olson, Luke 2023 with further references.

[57] Solecki 1953; Eidem 2020, 101.

[58] Altaweel *et alii* 2012, 4.

[59] All these dams were constructed at a time of great political upheavals in the SWA and the wider world, as Egypt, Syria, Iraq and Turkey joined other nations in the call for independence from imperialism and Western hegemony (Luke, Meskell 2023).

[60] On one side of the spectrum stays Turkey, where according to a survey published by the Turkish Ministry of Culture and Tourism and by international projects, less than 5% of prospective reservoir areas have been investigated by archaeological projects (Marchetti *et alii* 2020, 20); on the other Iraq and Syria with most of the reservoir areas being investigated, though at different extents.

(a) (b) (c)

Fig. 5 - Historical photographs: (a-b) construction of the Mosul Dam, Iraq (available at www.trevispa.com.); (c) excavations at Mohammed ʻArab, Mosul Dam (courtesy of Robert Killick).

The Tabqa (1968-1973)[61] and Tishreen (1991-1999) Dams[62] on the Syrian Euphrates, the Haditha (1977-1987),[63] Hamrin (1976-1981),[64] Mosul (1981-1988, Fig. 5)[65] Dams in Iraq, and the GAP[66] in Turkey are all notable examples of how survey was integrated into the planning of the establishment of a new dam.

[61] Rihaoui 1965; Van Loon 1967; Bahnassi 1978; Freedman 1979; Margueron 1980.

[62] e.g. Olmo Lete, Fenollos 1999; Eidem 1999; also Sconzo, Simi, Titolo, this volume.

[63] All the Iraqi rescue projects were carried out jointly by the Iraqi State Board of Antiquities and Heritage and several international institutions. As for the Haditha Dam: Vv. Aa. 1983; al Shukri 1988; Kempinski, Lecomte, Tenu 2006; Simpson 2022, 5.

[64] Vv. Aa. 1981a; Huot 1987; Gibson ed. 1981, 11–27; Simpson 2022, 4-5.

[65] Vv. Aa. 1987; Sconzo, Simi 2020; Simpson 2022; Sconzo, Simi, Titolo 2023.

[66] Tuna, Öztürk 1999; Shoup 2006; Tunca, Öztürk, Velibeyoğlu 2004; and Ökse this volume.

The new enterprises entailed erratically a pre-flooding risk analysis of the area to be submerged, more often a preliminary survey aimed at identifying the threatened archaeological sites, and a subsequent selection of targeted locations for emergency excavations. In a few cases, in the wake of the UNESCO activities by the Aswan Dam in Egypt at iconic sites such as Philae and Abu Simbel,[67] the program featured historical monument conservation and relocation.

Mapping of the impacted heritage was usually sponsored by national antiquity organisations and accomplished either by local personnel (as in the case of the Mosul Dam in Iraq)[68] or with the support of foreign experts/archaeologists (as for the Tishreen and Tabqa Dam in Syria).[69] It was mainly a pedestrian, site-based reconnaissance involving little off-site activities and artefact collections,[70] it primarily concentrated on monumental and/or most noticeable and historically significant sites, such as tells and already known ancient cemeteries. At the same time, minor sites and features like rock-cut graves, ancient routes, hydraulic infrastructures, agro-pastoral installations, and smaller prehistoric settlements were often sidelined.[71] As we shall see later, the neglect of these more ephemeral elements stemmed from academic agendas and practical challenges. The latter were linked to identifying and documenting such sites, involving complex procedures of cross-checking vast amounts of geographical and archaeological data.[72] As correctly defined by Tony Wilkinson, these overlooked features are indeed ”fundamental components” of the ancient landscapes we strive to safeguard and understand.[73]

However, it must be admitted that most of the surveys undertaken in the last century lacked the opportunities offered by the substantial technological upturn in landscape archaeology that has taken place over the past two decades. The widespread use of remote sensing methods and specifically the use of satellite images has strongly influenced our understanding of ancient landscapes and how they can be recorded.[74] Today, thanks to declassified historical aerial and satellite imagery, it is possible to re-investigate the landscapes now drowned by reservoirs and thus partially mitigate the loss of archaeological data.[75] Today first-phase salvage operations benefit from new technologies and state-of-the-art methodologies.[76]

Salvage excavations have constituted the other main component of first-phase salvage operations.[77] Coordinated by national antiquities organisations and supported by the same institutions and several foreign universities, they varied within each rescue project in quantity and typology according to time schedules, academic interests, and financial resources.

In practice, they covered only a limited portion of the threatened heritage, focusing on the most monumental and prominent sites from a range of periods, as previously discussed.

Moreover, the lack of a well-defined pre-flood risk analysis often caused a consistent resource dispersion, as several sites initially considered threatened by the lakes were beyond the final inundation zones. As for the Tishreen Dam region in Syria solely, for example, 10 of the 23 excavated sites located in the upper sector of the dam were either only partially or fully spared by the lake at the end, allowing work to continue after the final impounding sometimes up to the beginning of the Syrian conflict.[78]

Since archaeology as a discipline is influenced by the aims of its practitioners (who are, in turn, deeply affected by contemporary intellectual, social and political agendas), the prioritisation of the sites to be salvaged was determined by the estimated scientific value given to them (e.g. the academic success of the enterprise)[79] and specific interests of the funding bodies.[80] In this way, rescue archaeology served

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[67] This large campaign launched by UNESCO with the involvement of a coalition of 50 countries ‘to Save the Monuments of Nubia’ led to the displacement between 1960 and 1980 of 22 monuments located between lower Egypt and Sudan (Säve-Söderbergh 1987. More critical, Allais 2012; 2018; Carruthers 2022).

[68] Sconzo, Simi 2020.

[69] Sconzo, Simi, Titolo, this volume.

[70] For most of the surveyed areas details about the adopted survey method (extensive/random survey, by car, by boat or on foot), can only be speculated.

[71] Cunliffe, De Gruchy, Stammitti 2012; Sconzo, Simi, Titolo 2023.

[72] Sconzo, Simi, Titolo 2023.

[73] Wilkinson 2003, 44.

[74] In particular freely available modern satellite images (accessible trough Google Earth, Bing Aerials, Apple Maps and other services), imagery provided with charges by commercial satellite companies (for instance DigitalGlobe) and declassified aerial and satellite images (U2, CORONA and HEXAGON programmes). See Philip *et alii* 2002; Kennedy, Bishop 2011; Casana, Cothren 2008, 2013; Ur 2013; Luo *et alii* 2018; Hammer, Ur 2019; Hammer, Fitzpatrick, Ur 2022.

[75] Sconzo, Simi 2020; Sconzo, Simi, Titolo 2023; Uildriks 2020; Marchetti *et alii* 2019; 2020; Zaina, Tapete 2022.

[76] For instance, for Halabiyeh dam: Zaina, Tapete 2022. While for Makhoul Dam: Marchetti *et alii* 2019, 23-25; Mühl, Sulaiman 2011; Hauslaiter 2003.

[77] Schwartz 1997.

[78] Like the sites of Jerablus Tahtani, Tell Amarneh, Tell Shiyukh Fawqani and Tell Shiyukh Tahtani (Falsone, Sconzo 2016, 277).

[79] The key issue related to the unbalance in the selection process of what is ‘worth’ to be excavated or even solely documented, inevitably stemmed from the definition that archaeologists, stakeholders, and governments have given to ‘archaeological site’ or even ‘heritage’. The lack of consensus on these definitions (Cunliffe, de Gruchy, Stammitti 2012; Sconzo, Simi, Titolo 2023) derives from both theoretical discussions in the discipline of archaeology/anthropology and political choices.

[80] Western academia’s funding and research decisions often favoured older sites, such as tells, at the expense of Late Antiquity and Islamic remains, which were deemed ‘too recent’. Conversely, when funding organizations corresponded with local Directorates of Antiquities, their preference for pre-modern history and archaeology was driven by a desire to utilize them for legitimization and propaganda purposes (Cunliffe, de Gruchy, Stammitti 2012).

either as a colonialist or imperialist practice or as a nationalistic and indigenous endeavour. This created a subtle yet long-term impact on how heritage was presented and used.[81]

Colonial practices were also reflected in the fact that the local Directorates of Antiquities offered inducements for foreign participation in salvage work in the form of local labour, equipment, housing, and even financial support (in the case of Iraq)[82] or permission to retain and/or exhibit a portion of the excavated museum-quality objects (as it happened in Syria with the Tabqa Dam) in order to ensure a secure response to the call for action.[83] To further focus the interventions, some countries like Syria did not grant new excavation permits outside rescue areas during the time of the active call.

Field operations were speedily organised and accomplished, sometimes in a race against the flood. In early 2000, as the last Turkish Euphrates barrage (Birecik) was closed, the media circulated images of the Zeugma mosaics that had already partially been washed over by the lake.[84] If, in that case, a ticking time-bomb narrative attracted generous aid from both private and government sources, allowing the removal of Zeugma's mosaics and their relocation to the neighbouring museum of Urfa,[85] in most other cases, as the water rose, sites were simply engulfed and drowned.

A few important monuments threatened by the flood were relocated, the most famous examples being the Hasankeyf minaret,[86] the already mentioned Roman mosaics at Zeugma in Turkey (Fig. 6),[87] the Meskene and Abu Hureyra minarets[88] and the tomb of Suleyman Shah in Syria.[89] Also, significant restoration projects took place, such as those involving the site of Qal'at Ja'bar on the Tabqa Lake in Syria.[90]

Certainly, the limitations inherent in short-term projects, such as the lack of large exposures and the challenge of revisiting sites for verification, have been evident.[91] However, the almost unbroken zone of archaeological interventions from the Tigris and Euphrates river's sources down to almost the Shatt al-'Arab brought a new impulse to research in the SWA regions. The proliferation of intensive efforts in relatively small areas and the consequent archaeological cooperation resulted in an abrupt increase in knowledge, facilitating an unusually comprehensive understanding and integrated perspective of the cultures of riverine regions.

Salvage excavations played a crucial role in shifting the focus from large mounds to smaller-scale sites and cemeteries, thus helping alter the spatial perspective on ancient Western Asia throughout history; at the same time, they revealed the potential of some previously neglected regions considered peripheral to the major sites in lower Mesopotamia or the Levant. Though short-lasting and not extensive, they gave the scientific community an idea of how much else had disappeared.

Fig. 6 - Zeugma Archaeological Site (from Wikimedia Commons, CC0).

To sum up, the first-phase salvage strategies implemented by different countries to document heritage sites and safeguard them from dam construction have been quite heterogeneous in the implementation of surveys, the prioritisation strategies, the overall number of excavated sites, and the methods employed.

Research outputs, in terms of publications and data dissemination, ranged from short excavation reports and summaries to less frequent complete monographs and open-access online databases.[92] Unfortunately, a considerable portion of these excavations has not been published at all.

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[81] "For foreign archaeologists, archaeological remains were considered as cognitive resources and as a universal heritage; for local authorities, they were primarily national heritage (and to a lesser extent world heritage) and tools of legitimization; for multilateral institutions, such as UNESCO, archaeological remains were sources of information and of collective memory of universal significance. Finally, for society, archaeological remains had economic and cultural values, but the appropriation of them as part of an 'official' history, and their recognition as part of their national identity, varied from community to community" (Gillot 2010).

[82] Schwartz 1997, 460.

[83] Bahnassi 1968, 61-62.

[84] https://www.archaeology.org/issues/44-1211/features/252-features-zeugma-after-the-flood

[85] Other small-scale relocation activities were accomplished in Syria and involved the displacement of Tomb 7 of Tell Banat on the Euphrates in the courtyard of the Aleppo Museum and one house of Abu Hureyra in the Raqqa Museum.

[86] Yilmaz, Sevgi 2020.

[87] Nardi 2005.

[88] Bahnassi 1978, 67-68.

[89] During the construction of the Tabqa Dam in 1973, when the area around the castle Qal'at Ja'bar was due to be flooded, the tomb by agreement between Turkey and Syria was moved 85 km northward along the Euphrates River, just in front of Tell Qara Qozaq (Burns 1999).

[90] Bahnassi 1978, 67-68; Luke, Meskell 2020.

[91] Schwartz 2007.

[92] Marchetti *et alii* 2019, 22.

4. Floating: Second-phase Salvage

First-phase Salvage has, at least implicitly, proceeded from the assumption that flooded sites were lost for good. This common notion continues to permeate the discussions surrounding archaeological features in reservoir flood zones so that heritage legislation, at both the domestic and international levels, still overlooks the pressing issue of monitoring the condition of the submerged heritage.[93]

The situation is instead more complex: water level in a dam environment is affected by a combination of interacting factors,[94] among which are routine dam management, increasing exploitation due to the escalating population pressure, rising temperatures and continuous aridification, in addition to political strife between the major riparian countries, as discussed before (§2), and the effects of conflict. A prime example of this is when, in 2014, the Mosul Dam was on the verge of being conquered by Daesh, and the dam engineers tried to release as much water as possible to limit the damage of a potential terrorist attempt to blow up the infrastructure.[95]

For this reason, in a reservoir, there is still a considerable portion of land that periodically re-emerges after inundation due to cyclical or erratic water fluctuation processes. This broad stretch of shoreline, also called drop-down zone, commonly holds archaeological sites, features and villages, which may regularly or occasionally re-emerge as well, thus intermittently revealing the spolia of their past (Fig. 7). While deeper water has been proved to provide the sites with increased physical protection, the cultural material of the shoreline fluctuation zones suffers significant damage in the cycles of exposure.[96]

One of the most paradigmatic events occurred when the site of Kemune, ancient Zahiku, a capital city of the Mitanni Empire, resurfaced from Lake Mosul in Iraq during a significant drought in 2018. At this site, water retraction had performed a sort of natural excavation, resulting in the total exposure of part of a large monumental mud-brick palace, with traces of wall paintings *in situ*.[97] Years before, another site, Tell el-ʻAbd, emerged as a small peninsula from the waters of the Tabqa Dam Lake in Syria and was excavated for three seasons by a German team.[98] In the first decade of the 21st century, at Tell Qumluq on the Tishreen Dam Lake excavations were devoted to the rescue of a series of Early Bronze Age tombs.[99] These situations illustrate instances where an impromptu rescue operation was carried out to great reward. However, research indicates[100] that hundreds of sites experience damage each year due to fluctuations in water levels. These examples also demonstrate that the issue has persisted for decades, but it has only recently been systematically and critically examined. It has now become part of a broader academic discussion on what is defined as '**second-phase salvage**'.[101] However, it goes beyond this for its primary objective and methodology.

'Second-phase salvage' involves various objectives, such as traditional surveys, geomorphological and geophysical studies. This approach expands to include flood impact assessment methods on archaeological landscapes, single sites, monuments, villages, and communities. By organizing and categorizing the observed damages, it aims to design and test protocols for monitoring and safeguarding resurfacing landscapes while developing new conservation techniques for waterlogged features. Emergency excavations are instead limited to targeted areas, particularly exposed to looting and destruction.

As shown below (§ 5), documenting memoryscapes and the new relations between the transformed landscapes and their communities sparks one of the most critical endeavours.

The accomplishment of all these objectives sets the ground for more inclusive understandings and reconstructions of the settlement land-use and life histories of the affected areas and serves to support the planning of long-term intervention strategies by the local Antiquities Directorate.

This holistic approach has been tested in the field thanks to the impulse given in the last years in the Kurdistan Region of Iraq, where single (at the Dokan[102] and Mosul[103]

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[93] Stammitti 2015, 2.

[94] Hasan *et alii* 2019.

[95] The Mosul Dam is considered to be one of the largest and most perilous dams in Southwest Asia. If the dam were to fail structurally or be intentionally destroyed, it could result in the loss of more than 500,000 lives and severe damage to infrastructure and property. In 2014, the Daesh briefly took control of the dam, recognizing its potential for destruction. However, it was retaken by the Kurdish Peshmerga ten days later as part of the Iraqi counter-offensive (Simpson 2022, 8).

[96] Lenihan *et alii* 1981a, 1981b; Sconzo, Simi, Titolo 2023; this volume; Sconzo, Qasim 2021; Eidem 2015; 2020; this volume.

[97] Surveyed and recorded in the frame of the EHAS 2018 survey, the site was right after excavated by a joint mission of the Tübingen University and Kurdish Archaeology Organization (Puljiz, Qasim 2019).

[98] Excavations were resumed by a German team from the Altorientalisches Seminar, under the direction of U. Finkbeiner. Since 1994 the mound has gone again mostly underwater with only a small portion of its top visible as a small islet in the middle of the lake (Sconzo 2019, 1-5).

[99] Jamieson, Kanjou 2009.

[100] Sconzo, Simi, Titolo 2023; Sconzo, Qasim 2021; Eidem 2015; 2020; Sconzo, Simi, Titolo this volume.

[101] Marchetti *et alii* 2020.

[102] Eidem 2020; Eidem this volume; Uildriks 2020.

[103] ReLand, Resurfacing Landscapes of the Mosul Dam Reservoir is a Kurdish-Italian cooperation project aimed at contributing to the development of a comprehensive research programme in a region containing over 300 heritage sites (Sconzo, Simi 2020; Sconzo, Qasim 2021; Sconzo, Simi, Titolo 2023; in press; this volume).

Fig. 7 - Tell Pashaya/ReL31 resurfacing as an island in October 2023 (©ReLand, photo F. Simi).

lakes) and cumulative[104] projects have recently found a positive and reactive response in the local antiquities departments, thus already increasing awareness among professionals and the general public.

5. Peopling: Heritagescapes

The closure of the dam and the subsequent rise in water levels prompted the implementation of state-directed migration plans for residents in the affected regions. In the SWA, especially in Syria and Iraq, people's displacement protest movement took on a distinctively less 'global' form compared to the one for heritage safeguarding. The relocation of people, organised and purposeful, was framed as a modern, progressive, and developed asset that promised enhanced social mobility at the local level. Actually, it initiates a complex interplay of imaginative and physical eviction.

Those most profoundly impacted were the ecosystem-dependent communities relying on the seasonal cycles of nearby environments for their survival.[105] On a broader scale, the flooding of densely populated villages brought forth an unavoidable "submerging of culture".[106] This displacement went beyond altering physical landscapes; it disrupted the intricate cultural fabric deeply embedded in these communities.

In regions inhabited by Kurdish groups across Turkey, Syria, and Iraq, additional ad hoc repopulation programs along the new lake banks served as the final stage of this process of cultural de-rooting.[107] This deliberate disruption severed the deep-seated connections that these communities held with their ancestral history and cultural legacy.

Over time, the formation of the new lakes has – moreover – dramatically altered the surrounding landscape, creating open spaces in the rural areas adjacent to the drop-down zone. These zones now typically exhibit a blend of wasteland and cultivated fields, often devoid of new settlements. The reservoir's fluctuating shorelines, spanning hundreds of meters, transformed into a zone of uncertainty, making long-term investments challenging. Former access routes to now-submerged villages fall into neglect.

In these areas, seasonal agriculture, grazing, and fishing emerge as primary activities. New lakes now hold significant value for contemporary communities, whose sustenance relies heavily on these resources. Some lake banks, finally, evolved into recreational havens for families, equipped with restaurants and cafès, and that serve as departure points for boat tours, adding a leisurely dimension to the reservoir's surroundings.[108]

Yet, alongside their new vital role in livelihoods, these activities also pose a formidable challenge to the conservation of the reemerging archaeological sites in the vicinity.

In recent years, increasing droughts coupled with the effects of a persisting hydro-egemony by Turkey have resulted – Syria and Iraq – in the reduction of certain reservoirs to their original riverbeds. This process has further unveiled submerged modern villages and infrastructures previously situated directly along the riverbanks.

Given that local architecture in these areas predominantly employed mudbrick construction, the resurfaced villages bear a striking resemblance to ancient archaeological sites, with only the more solid stone foundations surviving the erosive effects of the receding lake waters (Fig. 8).[109]

Within this evolving panorama, concrete and asphalt infrastructures, such as roads and sporadic state buildings, stand as the sole contemporary links amidst the historical echoes (Fig. 9).

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[104] 'Floating Heritage: Second-phase salvage of flooded archaeological sites in the Middle East' a joint research project carried out by the Universities of Pisa and Palermo and funded by the Italian Ministry of Research in 2023 (PRIN 2022 - 2022KPAH9N).

[105] Often living in circumstances of adaptable mobility, their historical connection to the land was deep but legally informal.

[106] The pioneering work of the Keban Dam Rescue Project included also ethnographic and sociocultural research focused on recording the life of contemporary villages and documenting the intangible heritage (like carpet-weaving tradition) of the region (Dissard 2011, 11-13; 2019, 2).

[107] In the framework of the so-called 'Arab Belt–Scheme', see Lange 2019, 325 and note 4.

[108] On the case of Hasankayef, on the Ilisu dam in Turkey, see Elliot 2014, 193.

[109] https://youtu.be/S7sW3IEgShY?feature=shared.

Fig. 8 - The resurfaced village of Anzeh/ReL43 in October 2023 (©ReLand, Photo F. Simi).

Fig. 9 - The resurfaced village of Anzeh/ReL43 in October 2023 with the concrete school in the foreground (©ReLand, Photo F. Simi).

Fig. 10 - The village of Kharabok/ReL39 with layered stratigraphy revealed by the ebbing waters (©ReLand, Photo F. Simi).

Fig. 11 - Fishermen and a resurfacing mill (ReL35) in the area of Mishriefe (©ReLand, Photos P. Sconzo and F. Simi).

Moreover, some of these villages exhibit a layered history rooted in the distant past (mainly but not only in the Sasanian, Early to Late Islamic periods), which persists into the present moment (Fig. 10).

The juxtaposition of ancient and modern elements reveals a unique convergence of history and contemporary life, where the resilient foundations persist.

This complex interplay comes to life as traditional sites intersect with modern functions such as water extraction pumps, fishing stations, and recreational areas, creating a rich tapestry of past and present activities (Fig. 11).

To fully grasp the complexity and diversity of these dynamic environments, there is a pressing

Fig. 12 - Dam Heritagescape Mind Map (© P. Sconzo, F. Simi).

need for expanded and more inclusive definitions.

The heritagescape theoretical framework[110] aptly accommodates this need, offering a robust approach to understanding and interpreting these nuanced environments.

This neologism entwines the concepts of "heritage"[111] and "(land)scape"[112] functioning - from the perspective of this paper - as both a descriptor and methodology for discerning the dynamic processes unfolding in these spaces. Linguistically, it describes the interplay between being-and-becoming, conceived in both spatial and temporal dimensions. Methodologically, it furnishes a framework for the comprehensive observation of diverse processes involving history, time, memories, perceptions, and communities, thereby facilitating the construction of diverse and more inclusive narratives.

The term draws attention to the intrinsic ever-changing, dynamic quality of the heritage:

> Accepting the heritage site as a landscape locates these places in their rightful place as a fluid, changing space with which people regularly interact.[113]

The scenarios outlined above show how dam heritagescapes are indeed fascinating cultural constructs. They possess a rich history that expands over time and their significance is not fixed, but constantly under the pressures of change. They provide insights not solely into the past but also into contemporary politics and community relations, becoming valuable windows into ongoing socio-cultural dynamics.[114] They embody the visible, physical aspects of a place, along with the experiences that individuals or communities associated with it (Fig. 12).[115]

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[110] On the origin and development of the term heritagescape, see, Di Giovine 2019. The definition used in this paper follows more closely that of Garden 2004; 2006.

[111] From the theoretical point of view, the concepts of "archaeological site", "archaeological/cultural landscape", and "heritage" evolved and transformed in the past 70 years towards broader and more inclusive definitions, recently culminating in embracing, for instance, contemporary industrial or conflict related archaeological sites (Moura 2019) and local communities' voices (Zaaimi, Kathem 2022; Elliott 2014)

Notwithstanding the tremendous theoretical development, these novel inclusive definitions are still not uniformly received and absorbed, and this also represents an issue in the second-phase salvage.

[112] The suffix -scape occurs in the crucial essay of Appadurai "Disjuncture and difference in the global cultural economy", which popularises the concept of "global cultural flows" and categorised them into ethnoscapes, technoscapes, mediascapes, ideoscapes, and financescapes. This suffix is intended to link these flows to a "landscape", conveying their fluid and irregular nature and underscoring that they are "deeply perspectival constructs, influenced by the historical, linguistic, and political context of various actors: nation-states, multinationals, diasporic communities, as well as subnational groups and movements, such as villages, neighbourhoods, and families. These landscapes are ultimately navigated by agents who both experience and shape larger formations, partly based on their own understanding of what these landscapes offer" (Appadurai 1996, 33-34).

[113] Garden 2006, 407.

[114] Hart 2019.

[115] Garden 2004, 208-209.

The popular boat tour to explore the half-sunken minaret of Savaşan Koy in Halfeti is an example of the new relationship that people established with the transformed heritage places.[116] Once a flourishing historic city nestled along the Euphrates, Halfeti met its fate in the 1990s when it was engulfed by the waters of the Birecik Dam Lake. Despite its submerged status, Halfeti has emerged as an iconic tourist destination, drawing thousands of visitors annually. Travelers flock to rent small boats along the shore, navigating amidst the semi-submerged stone houses, trees, and historic landmarks like the old minaret, the castle and the palace. Here the annihilation of the monument becomes a poignant facet of a romantically idealised heritage, beckoning visitors from across the globe to witness its haunting allure.

In essence, heritage, history, archaeology, anthropology, and economics are all integral facets of the same societal framework in which individuals live. Compartmentalised academic disciplines often fail to capture the interconnectedness of the real world. Therefore, it would be incomplete to discuss the impact of inundation on cultural materials without considering its effects on people. Human responses to relocation and loss of access naturally lead to changes in archaeological evidence as individuals relocate or alter their activities in affected areas.

From this perspective, the dam itself, following its construction, emerges as a fundamental element of the heritagescape.

Serving as a tangible artefact within the archaeological record, the dam embodies the legacy of modernity and serves as a testament to prioritising 'nationalistic prosperity over local community' interests.[117]

6. Conclusion: Dams as a testament to modernity

This extensive review has guided us through the evolution of big dams in SWA, tracing their history from inception to the present day, with a specific focus on their profound impact on the cultural landscapes and heritage sites within the regions they affect.

Dams, in their essence, embody a dual symbolism of modernity: they symbolise both the destruction and loss of history, concurrently emerging as integral components of the modern cultural landscape.

Throughout this inquiry, we've delved into the interwoven dynamics surrounding dams in Southwest Asia, acknowledging the complexity and multifaceted nature of the issue. This complexity arises from the involvement of numerous stakeholders with diverse and often conflicting interests, resulting in enduring consequences for the affected regions.

Our exploration has revealed that reservoir landscapes are anything but static or unchangeable; they exist in a perpetual state of liminality, continually expanding and contracting, revealing and concealing various facets of their identity. This constant flux may evoke memories while simultaneously erasing others over time, thereby highlighting the intricate and evolving nature of heritage sites that they encompass.

The conceptual framework of heritagescape has proven instrumental in gaining insight into the diverse dimensions of the issue at hand. This framework captures the ongoing processes accompanying heritage sites as they evolve over time, providing invaluable perspective on the dynamic interplay between dams, cultural landscapes, communities, and heritage preservation.

Our examination of the evolution of the practice of 'salvage archaeology' has revealed a profound transformation over time, driven by shifts from colonial archaeology to post-colonial frameworks. This evolution has been influenced not only by theoretical paradigms but also by external factors, such as war, droughts, and earthquakes, which have significantly shaped archaeological methodologies and research priorities.

Acknowledging the heritage as a (land)-scape adds layers of complexity to archaeological endeavours, broadening the scope of research both spatially and temporally. There is a growing imperative for the development of new protocols that not only recognise but also actively engage with these evolving heritagescapes.

While we strongly advocate to avoid new dam construction, should such projects proceed, it's crucial to integrate the concept of heritagescape into the initial salvage phase as well. This necessitates comprehensive pre-flooding assessments that encompass archaeological sites, villages, monuments, installations, and intangible heritage. Engaging local communities in this process is essential to understanding their perspectives on what holds value in their heritage.

We have seen that post-flooding activities have spurred the development of multidisciplinary and innovative approaches within the archaeological discipline. These encompass a spectrum of methodologies, from landscape archaeology and site-based investigations to the formulation of cultural heritage monitoring plans, and the documentation of contemporary archaeology and memoryscapes. This concerted effort reflects a commitment to adapt methodologies to effectively address the broad impacts of dam construction.

Second-phase activities are poised to play a crucial role in both generating and disseminating knowledge

[116] Something similar is happening also at Hasankayef, on the Ilisu Dam.

[117] Garrett 2006, 63.

by drawing attention to individual sites and their surrounding spaces. These activities highlight the multifaceted value of these re-emerging sites across various scales while simultaneously advocating for their preservation. Furthermore, they emphasise the significance of visiting these interconnected sites, facilitating a deeper appreciation of their collective importance and fostering a participatory approach that prioritises shared responsibility.

We've noticed that recent movements opposing dam construction tend to be fragmented, with various groups championing either archaeological, environmental, or humanitarian concerns, yet often their voices remain unheard. Even when protests have gained international attention, such as with the Ilisu Dam,[118] the broader impact of the dam's construction has seldom been fully considered. The international public may focus more on the archaeological heritage at risk, while NGOs concentrate on the socioeconomic losses faced by communities. By rallying under the unifying cause of Heritagescape protection, these movements could unite, amplifying their dissent into a stronger, more impactful voice.

In this view, the heritagescape concept ultimately fits into a broader scheme aimed at 'responsibilizing' all stakeholders involved in its creation, protection, and consumption.[119]

In the decolonization discourse of Archaeology and Heritage Studies, the heritagescape framework emerges as a transformative tool. This examination of dam construction history in the SWA region reveals entrenched colonialist engagement, perpetuating epistemological injustices despite progress. Embracing the inclusive heritagescape framework can redress power imbalances and dismantle colonial legacies in heritage-related disciplines. Recognizing modern communities' pivotal role in shaping heritagescapes underscores the need for collaboration among stakeholders. This holistic approach if extended to Landscape Archaeology and Heritage Management, may foster interdisciplinary collaboration and finally offer a dynamic, community-oriented framework for preserving cultural heritage in diverse landscapes.

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[118] Emblematic in this sense was the rejection by the European Court for Human Rights (ECHR) of the appeal for safeguarding the archaeological site Hasankeyf and its surroundings along the Tigris Valley. The initiative was based on the assumption that the site's "destruction would constitute a violation of human rights because it would deprive people of their right to participate in and benefit from cultural heritage" (Aykan 2018). The Hasankeyf trial was highly significant, both for the attempt and what it represented, and also for the implications of the decision (ERN 2019).

[119] Di Giovine 2018.

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IN WINTER ON THE LAKE
THE 2023 SULAYMANIA-RAPARIN SURVEY IN THE DOKAN DAM SALVAGE ZONE

Abstract

In autumn 2023 water in the Dokan Lake (Kurdistan Region of Iraq) subsided to levels not seen since 2015, and inspired a new archaeological survey to document sites normally flooded and inaccesible. The survey was organised and executed by the Antiquity directorates of Sulaymania and Raparin in collaboration with the Pisa Archaeological Project on the Rania Plain, and took place 19-21/12. A total of 11 sites, 4 of which were not visited by archaeologists since the 1950s, and 4 sites never recorded previously, were visited and sampled. We provide here a first report on the results and attempt to contextualise these within the wider settlement history of the Rania Plain.

Keywords

Kurdistan, Rania, archaeology, survey

1. Introduction

The low level of Lake Dokan in autumn 2023 provided an opportunity to visit archaeological sites in the Dokan Dam Zone otherwise submerged and rarely accessible since 2015. Seizing the moment the Pisa University archaeological project active on the Rania Plain was pleased to be partner in a special survey conducted December 19-21, directed by Messrs. Amanj Amin (Sulaymania Directorate of Antiquities) and Barzan Baiz Ismail (Raparin Directorate of Antiquities), and with the kind permission of the Directorate-General of Antiquities in Erbil.[1] The survey, proceeding by car and boat, managed to visit and explore a total of 11 sites. 3 were sites visited previously by the Pisa Project in 2014-15, 4 were sites not visited after the formation of the Dokan Dam and Lake, and other 4 were apparently never recorded before. Although most of the sites are located in the SW part of the lake the survey did not attempt any complete coverage of a pre-defined zone. Instead it proceeded from the information available from the 1955 Iraqi survey and indications by the local fishermen, usually well-informed as to what sites have emerged from the water. The hundreds of ceramic sherds (- and some small finds) retrieved by the survey include a large portion of plain wares which are not easily datable at present, and in this preliminary report we present only a provisional overview of the data collected, and some equally provisional remarks on how the new evidence helps to shape our comprehension of the ancient settlement patterns on the Rania Plain.

The Rania Plain is located in a small valley of the Zagros foothills, and was surveyed by an Iraqi archaeological team in 1955 in preparation for salvage excavations to be undertaken prior to the closure of the Dokan Dam, then under construction.[2] The Iraqi survey team recorded some 40 ancient sites, and subsequently conducted excavations of varying scope in a handful of sites prior to the completion of the dam and the formation of the artificial Lake Dokan. A previous article sets out these procedures in some detail,[3] and need not detain us here, but it is important to recall that the Iraqi survey was not intended as a complete recording, and that the efforts, although sketchy by modern standards, did provide a good overview of the most prominent sites and their respective occupations. The subsequent salvage excavations also managed to explore some key sites, and although publication of the results has been less than exemplary, the whole project left an important legacy, yet to be fully exploited. Many additional records and materials kept in the museums of Baghdad, Sulaymania, and Erbil are yet to be studied and published.

Meanwhile the Rania Plain has in recent years become the target of several new research projects including fresh surveys which serve to complete the one performed in the 1950s. Among these efforts

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[1] Amin and Ismail organised and directed the fieldwork, assisted by Pshtiwan Ali (UAV pilot), Mala Ahmad (skipper), and Bahzad Mhamad Taib (driver). As co-initiating and co-sponsoring partner in the survey the Pisa Archaeological Project on the Rania Plain acted as consultant and has contributed to this report. Eidem and Amin produced the main text, and Coppini provided expert advise on the ceramics collected. Photos not captured by UAV were recorded by Amin, who also designed the ceramic plates. The authors are grateful for the kind permission and support of the work extended by the Director-General of Antiquities (Erbil), Kak Kaify Mustafa Ali and the Director of the Sulaymania Directorate, Kak Hussein Ghareib.

[2] As-Soof 1970.

[3] Eidem 2020, 101-104.

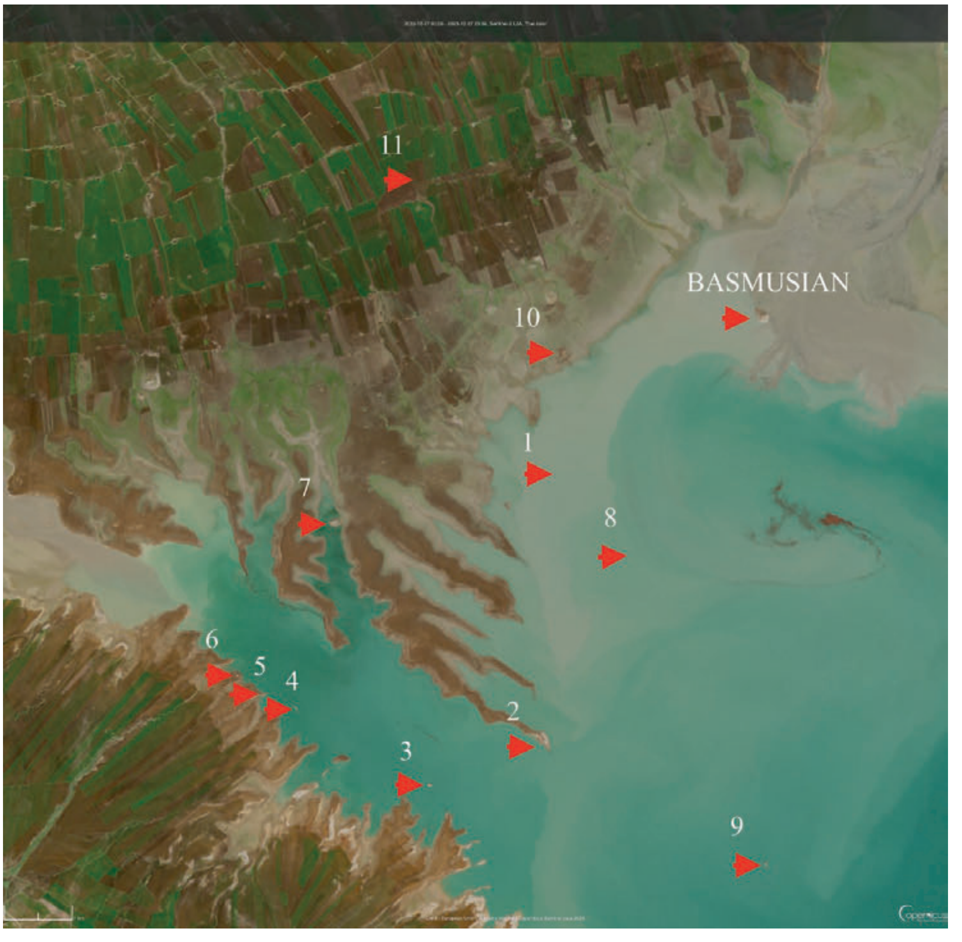

Fig. 1 - Map of SR Survey area with sites visited marked 1-11. Base map Sentinel-2 image 27/12, 2023. All sites visited (except nos. 1 and 8) are visible on the image (ca. 1 week after the survey).

Fig. 2 - Baiz Agha (SR2): general view from southeast.

we must mention the macro-survey of Sulaymania Governorate conducted by a French IFPO team (directed by J. Giraud) since 2012,[4] and more locally defined surveys by the DAEI (directed by T. B. B. Skuldbøl),[5] and the Pisa (formerly NINO) project, focussed principally on sites now in the "flood-risk" or "draw-down" zone, near the yearly and seasonally shifting perimeters of Lake Dokan. Initiating work on the Rania Plain in autumn 2012 the two latter projects found a favourable situation of relatively low water level, and this situation basically persisted the following 3 years, while a somewhat "wetter" regime intervened between 2016-2020. Both projects made good use of the initial "dry" period to conduct surveys, and have also subsequently attempted to collect more data when possible. Since 2021 autumn levels of Lake Dokan have again become fairly low, and in 2023 this trend continued, as we noted during field work at Tell Shemshara in October.

This observation inspired the small "winter" survey reported here, and which took place 19-21/12 (2023), when the level of Lake Dokan was 482.79 m amsl (19/12), 482.76 (20/12), and 482.72 (21/12). A comparable situation occurred in 2012 when the level of the lake the same days of the year were 481.83 - 482.02, so rising due to precipitation. Similarly from December 2023 the lake has subsequently reached 483.98 per 11/1, 2024. The new survey, although brief, has added significantly to our rooster of Rania Plain sites (Fig. 1). There still remain sites recorded by the 1955 survey in the very core of the lake and which cannot at present by re-visited. These sites include Qorashina, Kamarian and Ed-Deim which were excavated by the Iraqi salvage team during 1956-58, and for which we still have only the rather spare information published many years ago.[6] We hope conditions will allow additional surveys in coming years.

In the following sections we outline briefly the new evidence collected in 2023, providing an inventory of the sites visited, and an attempt to insert the new data in the wider context of settlement history on the Rania Plain.

2. Site inventory

The sites visited are divided into three categories. Those visited in recent times (A), those not (to our knowledge) visited since the Iraqi survey in 1955 (B), and finally those apparently never scientifically registered before (C). It is important to note that several of the sites were islands or peninsulas in the lake in December 2023, and only partially accessible for survey, and that this may account for lack of material recognised in 1955. Also that all the sites no doubt have experienced substantial erosion since the formation of the lake. Several sites were locations of villages or smaller settlements pre-flood, but traces of this seem entirely erased by the lake. Emphasis in this preliminary report is on the evidence from before ca. 600 BCE and its still provisional presentation. Many Rania Plain sites have later occupation, and especially Hellenistic/Parthian and Sasanian occupation was widespread, but closer analysis of this evidence, also from previous survey efforts, will be presented in a future study (cf. for now the Sasanian (- and Islamic) site of Gird Mamand[7]).

A. Sites (re-)surveyed recently

A.1. Baiz Agha (SR2, UTM 38S 490707E 3997115N)

Revisited by SRS 19/12. Previously visited by NINO 2015.[8] In 2015 the site, although substantially above the lake, was an island, while in December 2023 it was a peninsula (Fig. 2). The Baiz Agha mound, which was not noted by the 1955 survey, preserves stone foundations of substantial structures on surface. Rooms with very thick foundations, apparently flanking a central courtyard, can be seen, but erosion and displacement by the frequent inundations render it difficult to reconstruct a more comprehensive plan of the complex (Fig. 3-4). Inside the central courtyard is a large depression into the underlying level, full of burnt material, but whether this represents a localised feature or indicates an earlier destruction level will require further investigation, which may indeed prove possible in the near future. Surface sherds include specimens datable to the mid-2nd Mill. BCE (Pl. 2: 1-2),[9] and some rough, reddish sherds which may belong to a local mid-2nd Mill. horizon. Most of the sherds collected, however, belong to the Middle Assyrian period, confirming our previous assessment (Pl. 2: 3-7).[10] The surface sherds also include Neo-Assyrian examples (Pl. 2: 8-9).[11] Baiz Agha is rumoured to be the source of a group of cuneiform tablets (some in envelopes), and also a single Old Akkadian tablet. As always such claims cannot be verified, but clearly the site seems to have

[4] Giraud *et alii* 2019.

[5] Skuldbøl, Colantoni 2020.

[6] For these sites see below B.3 (Qorashina), Eidem 2020, 118, site 3 + Fig. 25 (Kamarian), and 119, site 5 (Ed-Deim).

[7] Presented in Eidem 2020, 115 and Figs. 19-21.

[8] Cf. *Ibidem*, 106 + 110 and Figs. 7-9.

[9] Pl. 2: 1 cf. Tell Brak level 6 (Oates, Oates, McDonald 1997, Fig. 189), and Nuzi level 2 (Starr 1939, Pl. 91.M). Pl. 2: 2 cf. Kurd Qaburstan Late Bronze Age levels (Schwartz *et alii* 2022, Fig. 30.2).

[10] For MA ceramics we refer in general to repertoires from Tell Sabi Abyad level 6 (dated to the reign of Tukulti-Ninurta I (1233-1207 BCE, Duistermaat 2008, 16), and Tell Sheikh Hamad's Mittelassyrische Stufe II (Pfälzner 1995, 238).

[11] For "Neo-Assyrian" (/local Iron Age) ceramics we refer in general to the material from Qalat-i Dinka (cf. Herr 2020 w. earlier literature).

Fig. 3 - Baiz Agha (SR2): foundations on surface.

Fig. 4 - Baiz Agha (SR2): close-up of central court within surface foundations.

Fig. 5 - Kamam (SR9): general view. In lower right shadows of brick walls visible under the surface foundations.

a substantial Middle Assyrian level, possibly that immediately below the visible stone foundations, and probably other important levels below that.

The 2023 survey retrieved two bronze arrowheads, lying close together in the central area of the site.

A.2. Gird Musa (SR10, UTM 38S 490973E 4001490N)

Revisited by SRS 20/12. Previously visited by NINO 2014. This site, which is very close to Babu-Kur, has also been surveyed by the DAEI, which refers to it as BabuKur South.[12] Surface ceramics are predominently post-Assyrian and Islamic. We leave further assessment of this site to the DAEI.

A.3. Kamam (SR9, UTM 38S 493217E 3995708N)

Revisited by SRS 21/12. Previously visited by NINO 2015.[13] Kamam is a fairly extensive site which pre-flood had some modern houses and a circular, high summit. Both in 2015 and 2023 only a small mudbank representing the top of the summit was above the water, preserving the stone foundation contours of a square structure, potentially a courtyard in a larger complex (Fig. 5). According to the 1955 survey surface sherds at Kamam were: "Prehistoric, Assyrian, Median, Sassanian, Early Islamic". The small collection made in 2023 includes some Uruk examples (Pl. 3: 3),[14] a painted sherd which may belong in the Ninevite 5 tradition, several rims which can be dated in the MBA (Pl. 3: 4-6)[15] and Middle Assyrian (Pl. 3: 7-8) periods, and post-Assyrian sherds. 3 iron objects were found on surface: a 44 cm long "ladle", and 2 arrowheads.

B. Sites not visited since the 1955 survey

B.1. Qurallu (SR3, UTM 38S 489434E 3996605N)

Visited by SRS 19/12. From its location this site must be identical with the southern of two sites with this name surveyed in 1955, and both sites were dated: "Ubaid, Uruk, Assyrian, Median". The Southern Qurallu was estimated as being 250 m long, 100 m wide, and 20 m high.[16] Clearly only the elongated

[12] Cf. Skuldbøl *et alii* 2021, 158.

[13] Cf. Eidem 2020, 124, site 31 + 125, Figs. 29-30.

[14] For "Uruk" (/LC 4-5) material we refer in general to Eidem, Giannessi 2021 w. further literature.

[15] For MBA material we refer in general to evidence from Tell Leilan (Northern Lower Town Palace, cf. Pulhan 2000), Tell al-Rimah Site C, Level 6 (Postgate, Oates, Oates 1997), and Tell Gomel phase 14 (Morandi Bonacossi *et alii* 2018).

[16] Cf. Eidem 2020, 124, sites 33-34.

Fig. 6 - Qurallu (SR3): general view.

Fig. 7 - Qurallu (SR3): bevelled rim bowl fragment (SR3/7).

Fig. 8 - Qurallu (SR3): “violin” figurine from surface (SR3-1).

Fig. 9 - Qurallu (SR3): MBA sherd (SR3/14).

high part of the site was above water when visited by the SRS, and the lower slopes covered by stones from eroded foundations (Fig. 6). The sherds collected by the SRS include many Uruk examples (Fig. 7), a good number of MBA pieces (Pl. 1: 6-7 and Fig. 9), some Middle (Pl. 1: 8) - and Neo-Assyrian (Pl. 1: 9) specimens, and post-Assyrian material. No Ubaid examples were found. The nice find of a complete "violin" figurine on surface on the northern part of the site (Fig. 8),[17] however, may indicate some mid-to-late 3rd Mill. occupation. This poses the question whether the "Ubaid" period noted by the 1955 survey may in reality be due to the presence of painted Ninevite 5 sherds (although none retrieved in 2023!), which could have been mistaken for "Ubaid" specimens. The same question mark applies to other alledged "Ubaid" sites in the Dokan Dam Zone, like Qorashina, for which see below sub B.2.

B.2. Kundu (SR7, UTM 38S 488343E 3999562N)

Visited by SRS 20/12. According to the 1955 survey this site was 300 m in circumference and 12 m high, and had surface material of the following periods: "Hassuna, Samarra, Ubaid, Assyrian, Hurrian, Median".[18] Pre-flood the site had a modern compound on its summit and a small stream skirted its western flank. In December 2023 most of the site was apparently dry, but certainly no longer 12 m above the surrounding terrain (Fig. 10). On surface could be observed isolated stone foundations and a feature with baked bricks, possibly a drain. The sherds collected include quite numerous Uruk pieces (Pl. 4:1-3), and a number of painted Ninevite 5 examples (Figs. 11-13)[19]. The MBA period is also represented (Pl. 4: 5-7), and a few sherds can be identified as of Middle Assyrian (Pl. 4: 8-10) and Neo-Assyrian (Pl. 4: 11-12) date. Finally the collection includes post-Assyrian material: some Hellenistic and glazed Islamic examples. The "missing" Hassuna/Samarra and Ubaid materials could be due to the limited area available for survey in 2023, and especially for the Ubaid mistaken identify with the well-represented Ninevite 5 material at the site (cf. above sub B.1). A quadruped, headless terracotta figurine, probably representing an equid, was found on the north part of the site.

B.3. Haiz (SR8, UTM 38S 492121E 3999256N)

Visited by SRS 21/12. From its location this site should be Haiz, where the 1955 survey noted surface sherds of Uruk date, and also "Prehistoric, Hurrian, Assyrian, Median".[20] Local informants in 2023 believed this site to be Qorashina, but that site is further to the SE, and near the very core of the lake. Qorashina was the object of quite extensive Iraqi excavations, and had a nearby village,[21] so would be better remembered than the fairly isolated Haiz. Indeed the SRS could only land on a small mudbank (Fig. 14), and the few and eroded sherds collected seem virtually all of Uruk period date (Fig. 15).

B.4. Khwaris (SR11, UTM 38S 489162E 4003373N)

Visited by SRS 21/12. Khwaris was briefly excavated in the 1950s to salvage a Sasanian mosaic which was removed to the museum in Baghdad.[22] The site indicated by local informants as Khwaris in 2023, just SW of the site of Golek, is rather different from the location reported in the 1950s (at the confluence of the Baselan and the Zab). In any case the very flat and plowed location visited yielded Sasanian and Early Islamic sherds, and a good deal of terracotta roof tile fragments. Either it is the real site of Khwaris – or another contemporary settlement.

C. Sites not previously surveyed

C.1. Pris (SR1, UTM 38S 490980E 4000320N)

Visited by SRS 19/12. This site, located south of Gird Musa (BabwKur South), seems otherwise undocumented. In 2023 it appeared only as a small mudbank in the lake with a scatter of loose stones and some sherds (Fig. 16). The rather few sherds which could be collected indicate Assyrian occupation (Pl. 1: 1-5), and post-Assyrian periods, possibly Parthian.

C.2. Krosk (SR4, UTM 38S 487921E 3997475N)

Visited by SRS 20/12. This and two following sites are all located fairly close together and attested occupations seem complementary. Krosk appeared as a long narrow mudbank in the lake, maximum a couple of metres above the water (Fig. 17). On surface were some stone foundations of an apparently fairly large building. The material collected include MBA sherds (Pl. 3: 1), some Assyrian (Pl. 3: 2), and Islamic examples (among those shown in Fig. 18).

In 2015 the Raparin Directorate received a number of objects said to come from Krosk. These included six iron arrowheads, and a small figurine of a hedgehog/porcupine, which can be dated to the 3rd or 2nd Mill. BCE.

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[17] See Tonussi 2019, 242-244. The general opinion is that this type of stylized stone (marble?) figurine, mostly found in sites east of the Tigris, betrays some Anatolian connection. Our specimen (7 cm high, 5 cm wide, 1.9 cm thick) is very similar to one from a grave near Kirkuk, and reportedly found with 3 other specimens and other objects which indicate an "Akkadian" (ARCANE ETG 7) date (*ibid*., 244 and Pl. 7.3, no. 12).

[18] Cf. Eidem 2020, 124, site 32 and Fig. 31.

[19] Parallels for these sherds are found at other Rania Plain sites, like prominently Gird Bardastee (see Eidem, Giannessi, Merlino, forthcoming).

[20] Eidem 2020, 120, site 11.

[21] *Ibidem*, 122f., site 19 and Fig. 27.

[22] Cf. *Ibidem*, 127, site 9a.

Fig. 10 - Kundu (SR7): general view from north.

Fig. 11 - Kundu (SR7): Ninevite 5 sherd (SR7/28).

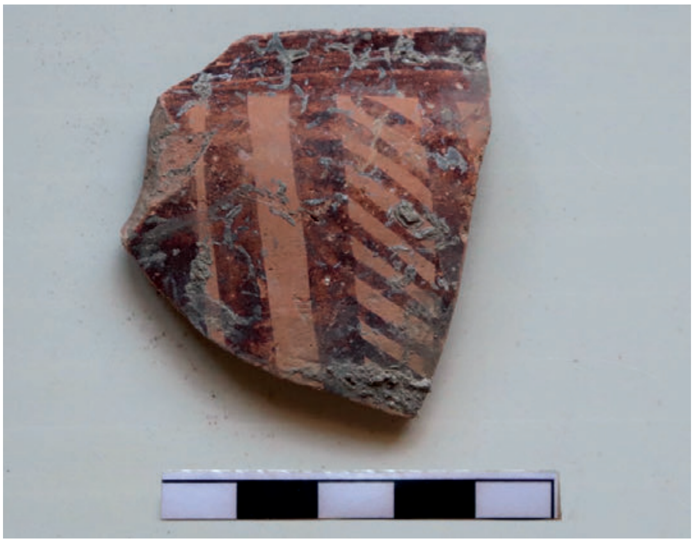

Fig. 12 - Kundu (SR7): Ninevite 5 sherd (SR7/29).

Fig. 13 - Kundu (SR7): Ninevite 5 sherd (SR7/27).

Fig. 14 - Haiz (SR8): general view.

Fig. 15 - Haiz (SR8): selection of surface sherds.

Fig. 16 - Pris (SR1): general view from southwest.

C.3. Khazem (SR5, UTM 38S 487538E 3997620N)

Visited by SRS 20/12. The site is low and situated on a ridge extending into the lake (Fig. 19). On the surface is a scatter of small limestones, and the scars of numerous circular pits (?). The material collected on this site seems to be entirely post-Assyrian and to include Sasanian and Islamic sherds (Fig. 20).

C.4. Rash (SR6, UTM 38S 487261E 3997843N)

Visited by SRS 20/12. Another low contour site located on a ridge extending into the lake in late 2023. On the highest point of the site was an accumulation of limestones, presumably the last eroding remains of structures (Fig. 21). The rather few sherds collected seem mostly post-Assyrian (cf. Fig. 22).

In 2015 the Raparin Directorate received a number of objects said to come from Girda Rash. These included a fragmentary fibula, and a seal impression with an apparent early 3rd Mill. BCE design.

3. Summary: New light on old Sites

The SR Survey was an improvised and clearly preliminary exercise exploiting the unexpected low level of Lake Dokan in autumn 2023. We hope that a similar situation will obtain in coming years so as to supplement and complete our efforts to charter the evolving settlement patterns on the Rania Plain. This summary report provides some first impressions, to be integrated in more mature studies in due course.

Lake Dokan with its shifting contours has been dubbed a "black hole" by another survey team,[23] but may rather be viewed as a "grayzone", dimly illuminated by the various information available from the Iraqi efforts in the 1950s and fresh evidence slowly accumulating from current and ongoing work. Integrating the new evidence with previous assessments it is now possible to provide some reinforced, albeit still preliminary statements on the settlement trajectories which the Rania Plain experienced in antiquity. The new survey, covering sites in the SW quarter of the Dokan Dam Zone, to some extent duplicates previous evidence. While it must be kept in mind that most of the sites surveyed in 2023 were not entirely accessible, it is still noteworthy that no pre-LC(/Uruk) occupation was identified. Hassuna/Samarra material is found on several sites in the Dokan Dam Zone, most prominently on Shemshara, Toba Koran, and Dugirdkan B. Halaf and Ubaid period sherds have been found on a small number of sites including Dugirdkan B, but are certainly not frequent.[24] As discussed above (sub B.1-2) the original survey may

[23] Giraud *et alii* 2019, 108f.
[24] *Ibidem*, 98.

Fig. 17 - Krosk (SR4): general view from northeast.

Fig. 18 - Krosk (SR4): selection of surface sherds.

Fig. 19 - Khazem (SR5): general view from northeast.

Fig. 20 - Khazem (SR5): selection of surface sherds.

Fig. 21 - Rash (SR6): general view from northeast.

Fig. 22 - Rash (SR6): selection of surface sherds.

have mistaken some painted Ninevite 5 sherds for Ubaid period specimens. Like for the rest of the Dokan region late LC (Uruk) occupation is well-attested at no less than four of the 11 sites visited (Kamam, Qurallu, Kundu, Haiz), confirming extensive contemporary settlement.[25] In a pattern characteristic for the Dokan zone, we find only one Uruk site where occupation is attested in the following Ninevite 5 period, namely Kundu (B.2, but cf. A.3). The revival of local settlement following the end of the extremely widespread Uruk period occupation in the region was apparently rather tentative. While most Ninevite 5 settlements were founded on Uruk period mounds, the site of Bardastee, close to Shemshara, features, so far uniquely, a Ninevite 5 settlement *ex novo*.[26] Very little later Ninevite 5 ceramics, in its incised/excised varieties, are attested on the Rania Plain, which may indicate a situation where the local revival simply failed, and the paucity of later 3rd Mill. evidence on the plain reinforces the image of a protracted crisis in relation to permanent settlement.[27] The precise reasons for this remain to be elucidated, but may relate to larger contexts of population movements, weak socio-political structures, and consequent insecurity in the Zagros foothills.

A certain degree of incremental settled occupation seems to accompany the period of interventions of southern imperial powers in the late 3rd Mill. BCE, when local society may have developed some coherence and security from the interactions with - and resistance to these interventions. The Bronze Age sequence at Tell Shemshara apparently begins in the Late - or Post-Akkadian period (Level X),[28] and later MBA occupation in the region seems fairly robust. Following the catastrophic deportations organised by Ishme-Dagan ca. 1780 BCE the Rania region again seems to have experienced a profound crisis.[29] One of the merits of the 2023 survey was to document the first clear Late Bronze Age occupation, at Baiz Agha (see A.1). The same site was clearly an important base for Middle Assyrian occupation, and the new survey has also documented this period on several other sites: Kamam, Qurallu, and Kundu. Given the location of these four sites it could be speculated that Middle Assyrian control was mostly confined to the SW portion of the plain, while attempts to establish a more central base at Basmusian/ancient Pakute remained precarious.[30]

The closing centuries of the 2nd Mill. BCE as well as the Iron Age are as yet poorly charted in the region, but focus for some recent or ongoing projects,[31] while finally assessment of "post-Assyrian" occupation (Hellenistic/Seleucid, Parthian, Sasanian), although widespread, will require further studies.[32]

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[25] See Skuldbøl, Colantoni 2020 and Eidem, Giannessi 2021.

[26] Eidem, Giannessi, Merlino, forthcoming.

[27] Eidem, Coppini 2020.

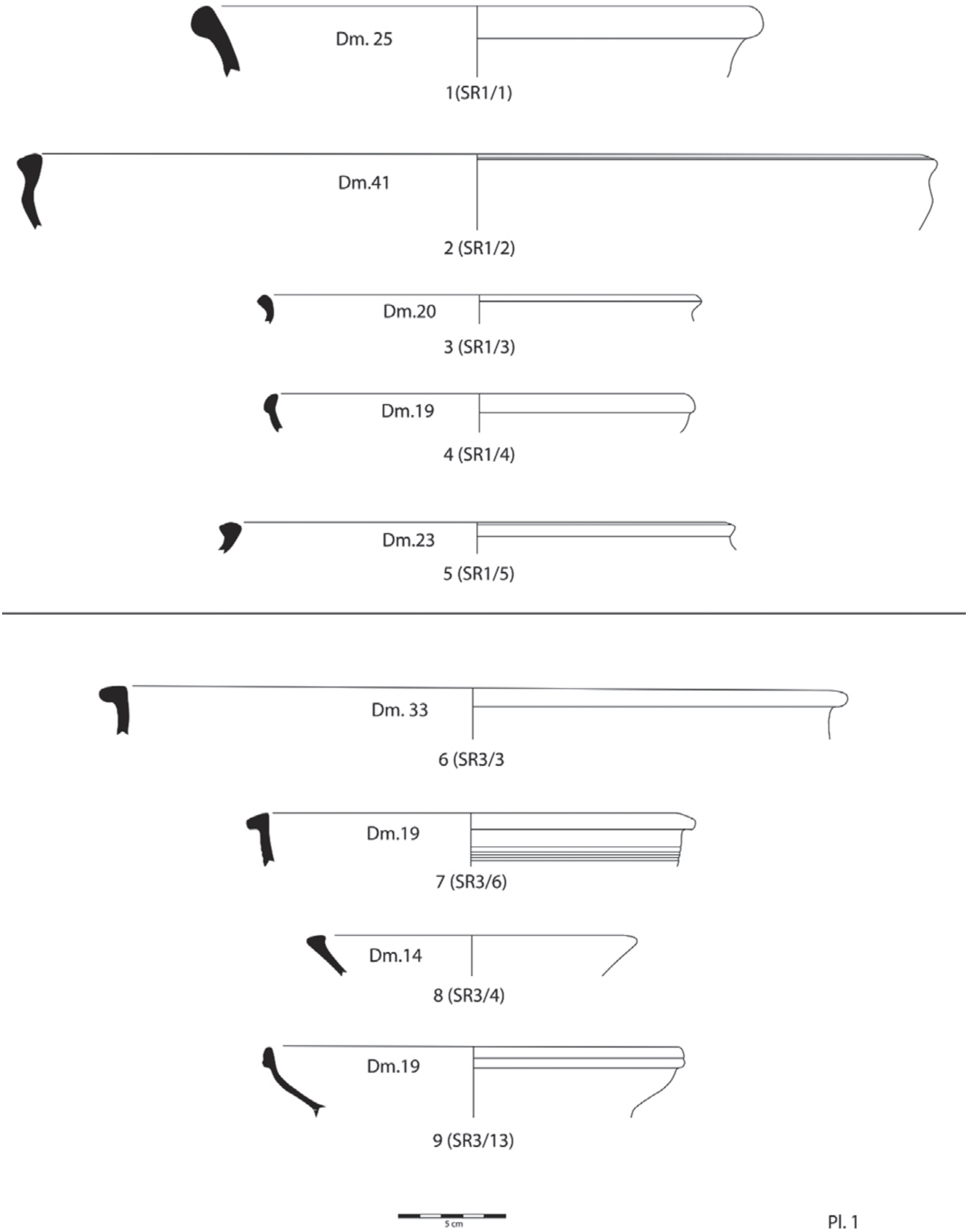
[28] Coppini, Eidem 2024.

[29] Eidem 2020, 105.

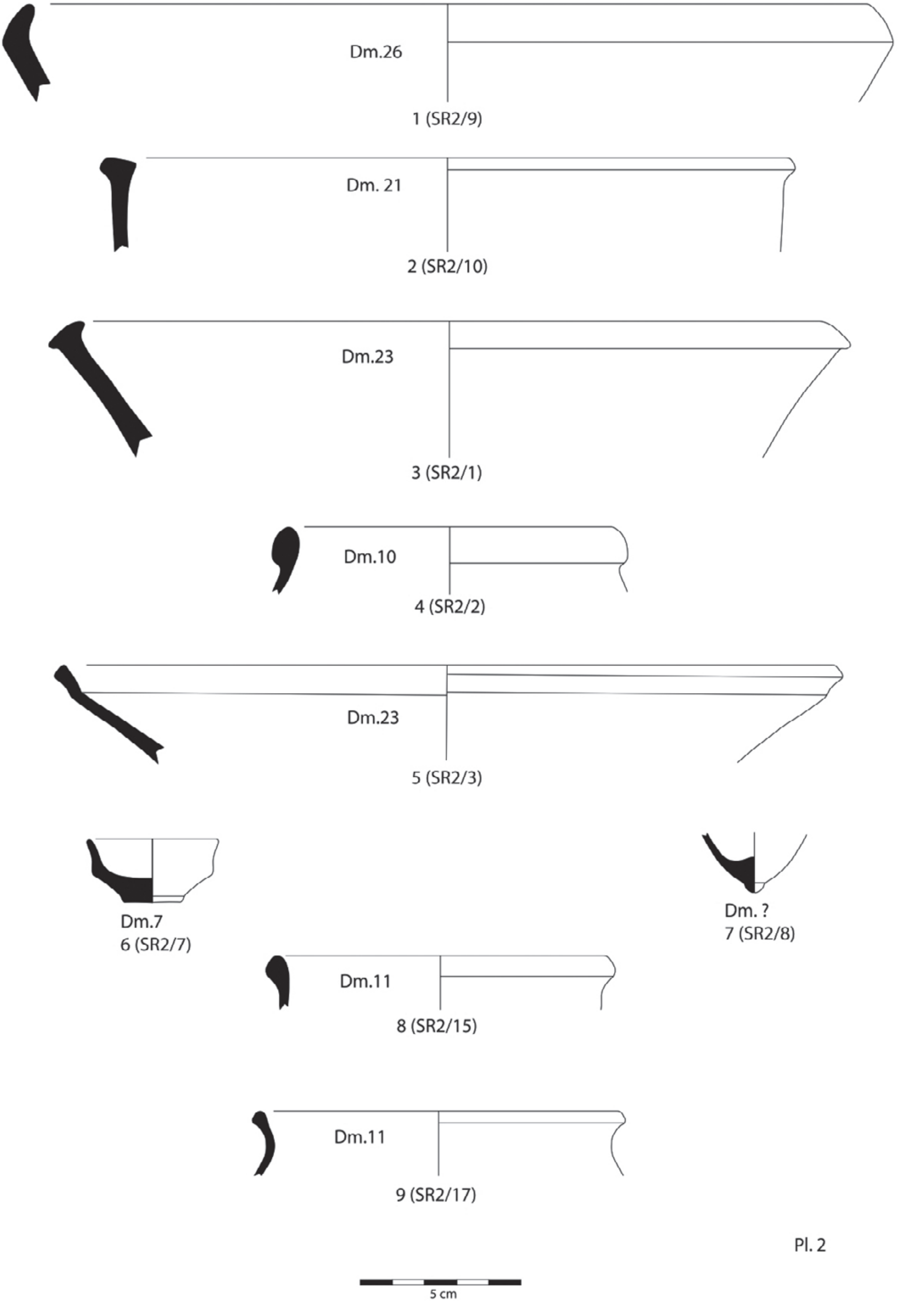
[30] Eidem 2018.

[31] For recent presentations of these project see the articles in Dezső, Kalla (eds.) 2021.

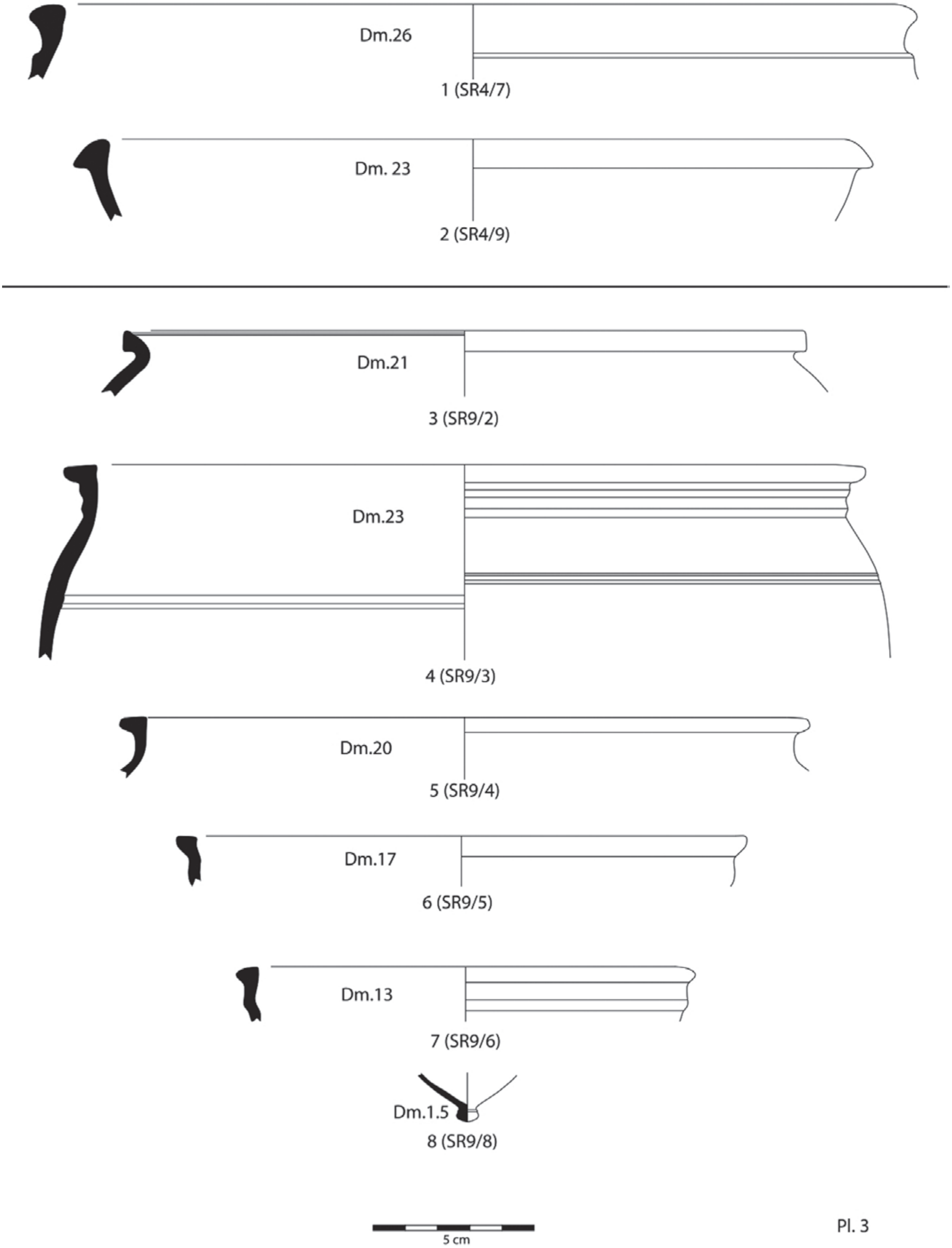
[32] R. Palermo has offered a recent overview for the East-Tigris region in Gavagnin, Iamoni, Palermo 2016, 146-157.



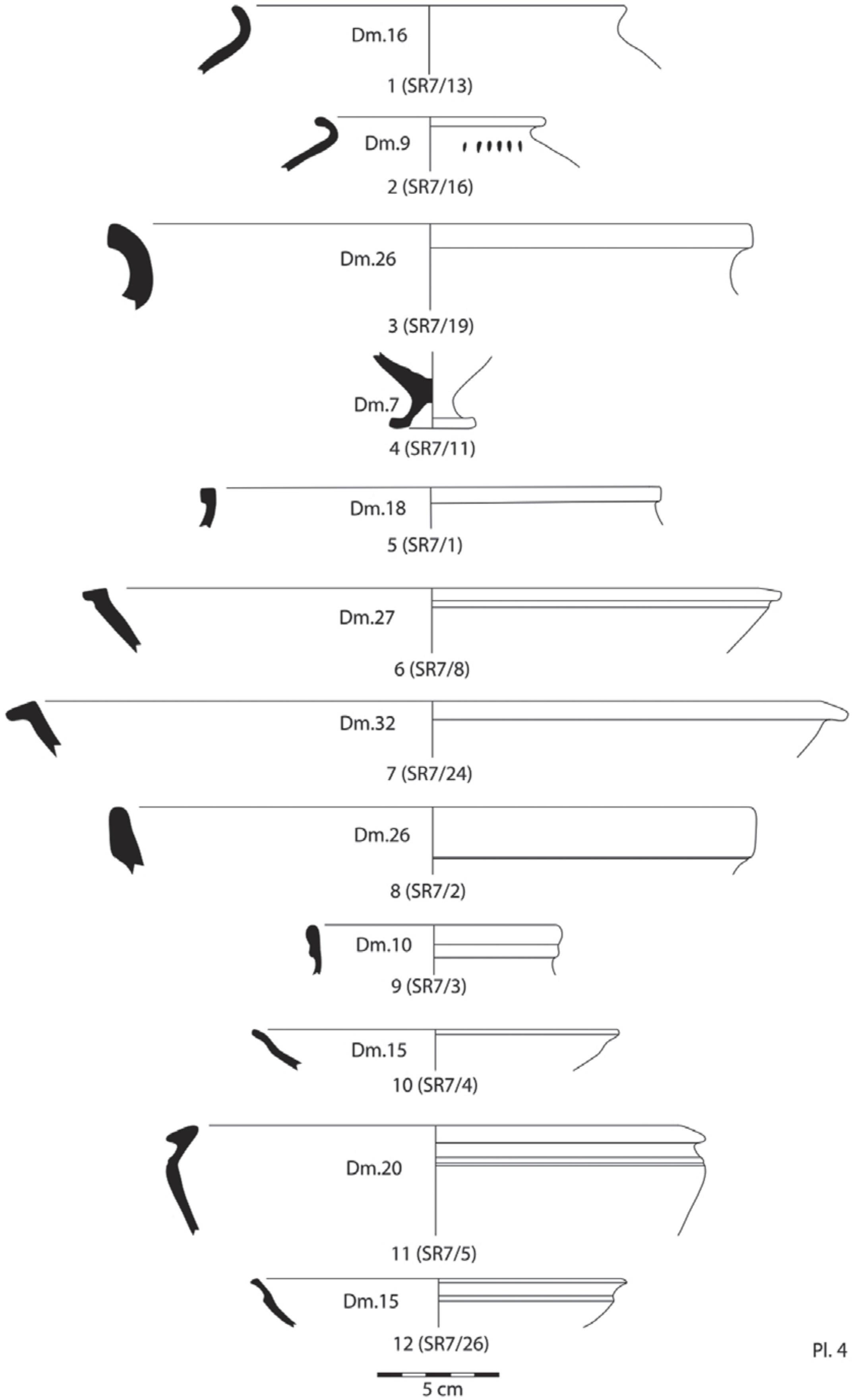
Pl. 1 - Selected sherds from Pris (SR1): 1-5 (Neo-Assyrian), and from Qurallu (SR3): 6-7 (MBA), 8 (Middle Assyrian), 9 (Neo-Assyrian).



Pl. 2 - Selected sherds from Baiz Agha (SR2): 1-2 (Mitanni), 3-7 (Middle Assyrian), 8-9 (Neo-Assyrian).



Pl. 3 - Selected sherds from Krosk (SR4): 1 (MBA), 2 (Neo-Assyrian), and from Kamam (SR9): 3 (Uruk), 4-6 (MBA), 7-8 (Middle Assyrian).



Pl. 4 - Selected sherds from Kundu (SR7): 1-3 (Uruk), 4 (Ninevite 5), 5-7 (MBA), 8-10 (Middle Assyrian), 11-12 (Neo-Assyrian).

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Jesper Eidem*

SECOND-PHASE HERITAGE SALVAGE IN THE DOKAN DAM ZONE

Abstract

This paper provides a short account of "second-phase" heritage salvage "in action", in the Dokan Dam zone in NE Iraq. Closure of the Dokan dam in 1959, which inundated a large portion of the Rania Plain, was preceded by archaeological survey and salvage excavations. Subsequently this area was long neglected due to other priorities and long-term political unrest. Since 2012 new heritage projects have been initiated on the Rania Plain, and are busy recording the impact of flooding, salvaging fast-eroding remains, contextualising displaced antiquities, and reconstructing the history of the area in all its dimensions.

Keywords

Kurdistan, heritage salvage, Rania Plain, Tell Shemshara

1. Introduction

The Rania Plain in northeastern Iraq (Fig.1), where our project has been active since 2012,[1] was the target of one of the earliest substantial archaeological salvage projects in a dam zone. The "first-phase" salvage was organised by the Iraqi Government, and included an initial survey of the archaeological sites in 1955, followed by extensive excavations from 1956 to 1959 when the new Lake Dokan began to form. Since then a large area of the Rania Plain is permanently or seasonally flooded. The Rania Plain thus offers the possibility to observe what kind of damage the archaeological sites have suffered from partial flooding during a longer period than elsewhere, an assessment assisted by the fact that we have some, although limited, information on sites collected during the first-phase salvage.[2]

This short paper will present some general observations on the Rania area, briefly mention some early visitors to the region, and summarise the first-phase salvage project. Subsequently it will describe the heritage situation as our project has observed it from 2012 and until December 2023, when we co-organised the first "winter-survey" conducted in the inundation zone, described in more detail in another article in this volume.[3]

2. The Rania Plain

The Rania Plain is located in the foothills of the Zagros mountains. The plain is a roughly triangular area defined by the surrounding mountains. The lower Zab river enters the plain through the pass at Darband-i Ramkan and crosses the plain before passing the gorge at Dokan to continue its course west towards the Tigris. It was at Dokan at the south end of the Plain that a dam was constructed 1954-59. The pass at Darband is a defining feature of the Rania Plain since it gives access to the next valley and other routes into - and beyond the Zagros. Its strategic importance throughout history is obvious and supported by numerous archaeological features in close association with it. One of these is the Assyrian fort of Usu Aska, recently investigated by a team from the British Museum.[4]

Another feature, high on the mountains south of the Darband Pass, is a long stretch of fortifications of uncertain date, but clearly built to defend the Rania Plain from attacks from the east. The ruins of this system was first observed in modern times by the British engineer Wheildon Brown in the 1950s,[5] and documented by our project in 2019 (Fig. 2).[6]

An even earlier British observer of the local area was C. J. Edmonds, who was posted as APO (assistant political officer) close to the Darband pass in 1922, and later published an account of his time there. At one point he witnessed an incident which

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[1] This work has proceeded with the kind permission of the Directorate-General in Erbil, and supported by the Directorates of Antiquities in Sulaimani and (from 2015) Raparin. We are grateful to these institutions as well as to our sponsors, from 2018 principally the Italian Ministry for Foreign Affairs and International Cooperation and the University of Pisa, in 2023 through the "ProArcheo 2023 - Call for co-funding of Archaeological Research at the University of Pisa". Our gratitude of course also extends to the many individuals, Kurdish, Italian, Danish, and Dutch, who have worked for our project or supported it in other ways.

[2] See Eidem 2020a for further details.

[3] Amin *et alii*, this volume.

[4] MacGinnis *et alii* 2021.

[5] Wheildon Brown 1957.

[6] Mariotti, Merlino 2019.

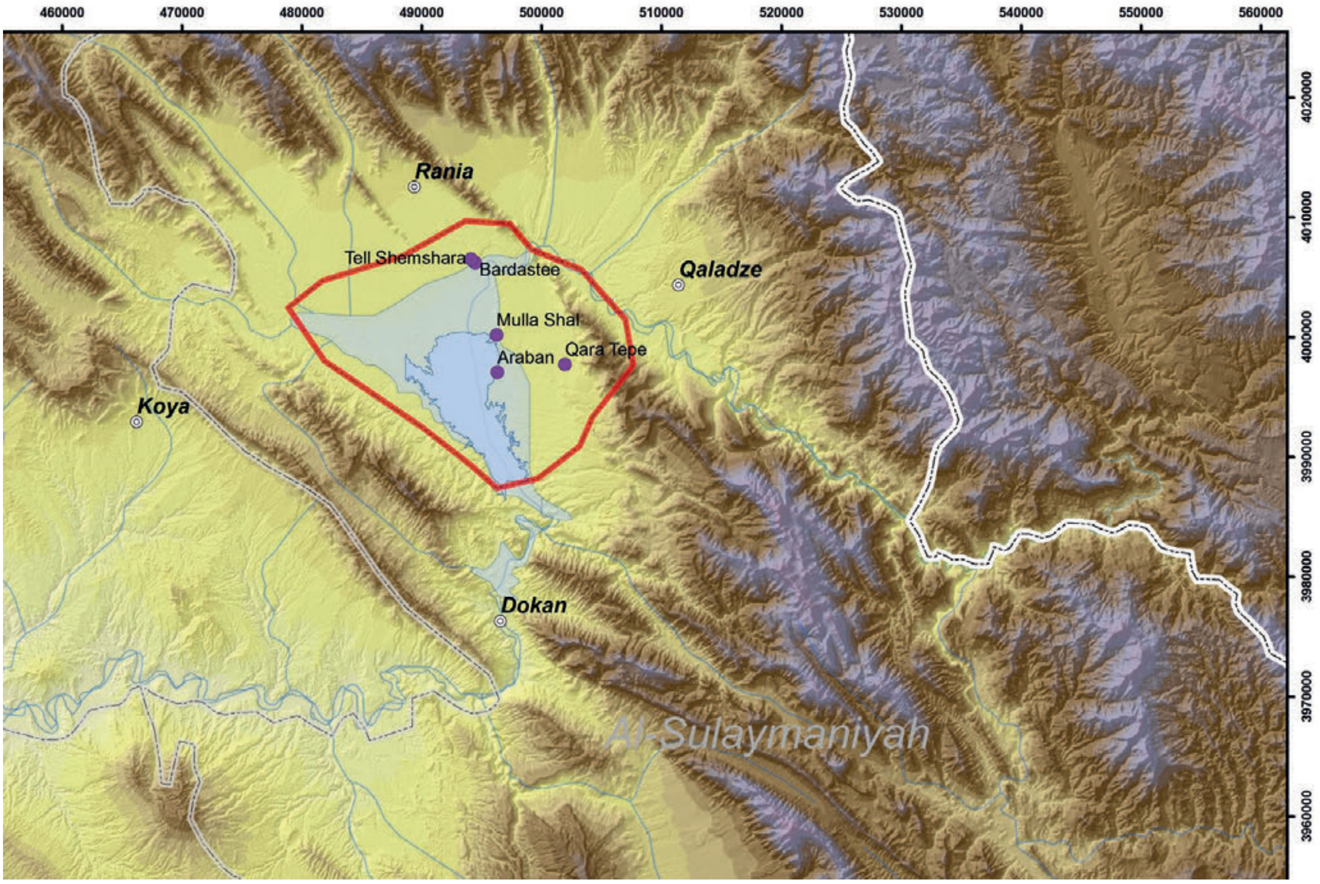

Fig. 1 - Map showing the research area of the Pisa Project (design A. Savioli).

Fig. 2 - View from SE over the mountains towards Darband-i Ramkan with Lake Dokan in flood on both the Rania and Pishdar (right) Plains (Oct. 2019). In foreground stone foundations of fortifications (photo E. Mariotti).

paints a vivid image of a probably perennial scene: in summer of 1922 Kurdish insurgents supported by Turkish agents attacked the Rania Plain from the east. A British force was posted close to the Darband pass and Edmonds recalls:

> On the morning of the 31st, an hour or so before daybreak, we were awakened by the crack of a rifle, followed by another, and another. As we hurried into our clothes it became clear that the piquet of twelve men of the 15th Sikhs on the first high crag of Asos on the far side of the river was being attacked. The firing developed into a furious fusillade, and before very long we could distinguish hand-grenades bursting not very far from the defenders. There was a sudden silence, and then figures began to appear high up on the sky line against the pale light of dawn – nine, ten, eleven, twelve ... and then, yes, a thirteenth and a fourteenth. So that was that. Bullets began to whistle about our ears, and plunging in the mule-lines showed that the transport was suffering the first casualties ... Two wounded Sikhs managed to cross the river and reported that their ten comrades had been killed.[7]

The point of this is that the Rania Plain, while offering fertile ground for local communicties, has always been strongly influenced by its strategic position, and the interaction between these two parameters has substantially shaped the settlement history of the area.

3. Pre-modern exploration

While some early European visitors to the Rania Plain observed an ancient ruined fort at Darband and earthern "tumuli" strewn across the plain, the first real archaeologist to pass by was the famous Ernst Herzfeld (1879-1948), who in 1916-7, while in the German army, did extensive surveying with a military detachment. With little time on hand Herzfeld still managed to note names of quite a few sites and even sketched some of them quickly, but with a good eye for their topography.[8] A few years later the aforementioned Edmonds settled for a while in Darband, and although keenly interested in ancient monuments, did not pay much attention to the "tumuli", which of course presented little of note except some sherds on their surface. Indeed the many *tells* in this remote region were largely left to themselves for the next decades, while extensive archaeological exploration and excavation proceeded in more opulent sites in lowland Iraq.

Still we know that not just Europeans had noticed the "tumuli" on the Rania Plain, since Ottoman records show that the local residents were well aware of them,[9] and we can easily imagine that here, as elsewhere in the Middle East, casual and perhaps not-so-casual finds made in the ancient sites could have found their way onto the antiquities' market. A market largely created by Europeans ready to pay for trinkets previously either discarded or kept solely if of intrinsic value or beauty, like typically cylinder seals, of which many were around in villages when the early travellers arrived.[10] Later archaeological activities on the Rania Plain have, not surprisingly, revealed that the sites here are not particularly rich in marketable objects, and I cannot point to any concrete example of a Rania Plain object unofficially retrieved prior to modern times, but have little doubt such examples exist. In any case the partial flooding of the plain has led to a very visible pilfering of portable objects flushed out from the archaeological sites (see below section 7).

4. First-phase salvage and after ...

A main guide to the pre-flood archaeology of the Rania Plain is the Iraqi survey conducted in 1955, which recorded some 40 sites within or close to the projected flood zone.[11] The Iraqi archaeologists also managed to conduct excavations in several major sites, like the apparently largest, centrally located, and multi-period site of Basmusian, which today is dramatically damaged by the lake (Fig. 3). The Iraqi survey and excavations provided a provisional, and sometimes confusing, overview of ancient settlement on the Rania Plain, but much of the documentation remains unpublished, and since focus was on major mounded sites many low-contour sites and other heritage features remained unidentified.[12]

In contrast to later salvage projects in Iraq, like the Hamrin and Mosul projects, and others in Turkey and Syria,[13] only a single foreign team participated in the Dokan salvage effort. This was the Danish Dokan Expedition, organised by Jørgen Læssøe and with Harald Ingholt as field director. The Danish project chose Tell Shemshara, located just a few kms southwest of the Darband Pass, and excavated here in summer 1957. The site is made up of a cluster of natural hills with ancient occupation (Fig. 4), and the Danish excavation was concentrated on "Main Hill", where a sequence of prehistoric,[14] Bronze Age and Islamic strata was investigated.[15] In a small trench opened towards the end of the season the Danes found the

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[7] Edmonds 1957, 255.

[8] For these "early birds" on the Rania Plain see Marf, Eidem 2024.

[9] I owe this information to my colleague D. Marf, who has studied the Ottoman records for the area.

[10] The famous T. E. Lawrence (of Arabia), e.g., was an eager "seal hunter" (cf. Sconzo 2013, 334).

[11] Al-Soof 1970; cf. the gazetteer in Eidem 2020a, 115-129.

[12] This is manifest from recent surveys on the Rania Plain, see below section 5.

[13] See Sconzo, Simi 2025 (this volume).

[14] For the new investigations of the Neolithic levels at Shemshara, dated ca. 7300-6000 BCE, see Matthews *et alii* 2020.

[15] See the summary in Eidem 2020b, 184-189.

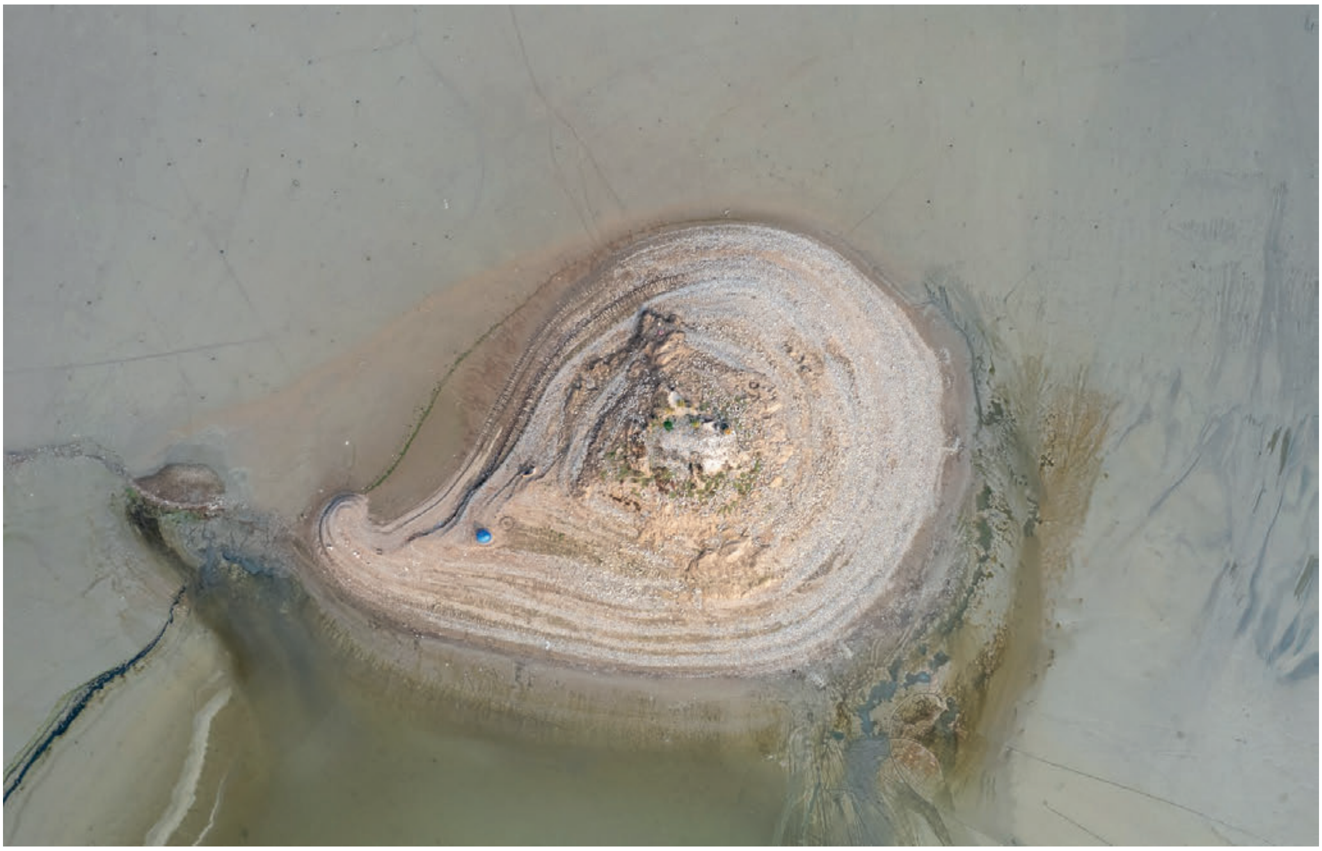

Fig. 3 - The site of Basmusian as it appeared 22/12, 2023, viewed from SW (photo Pshtiwan Ali).

Fig. 4 - The Hills of Shemshara: a) view from SE, Oct. 2022 (photo M. Merlino), b) model showing Main, North, and Camp Hills (design E. Mariotti).

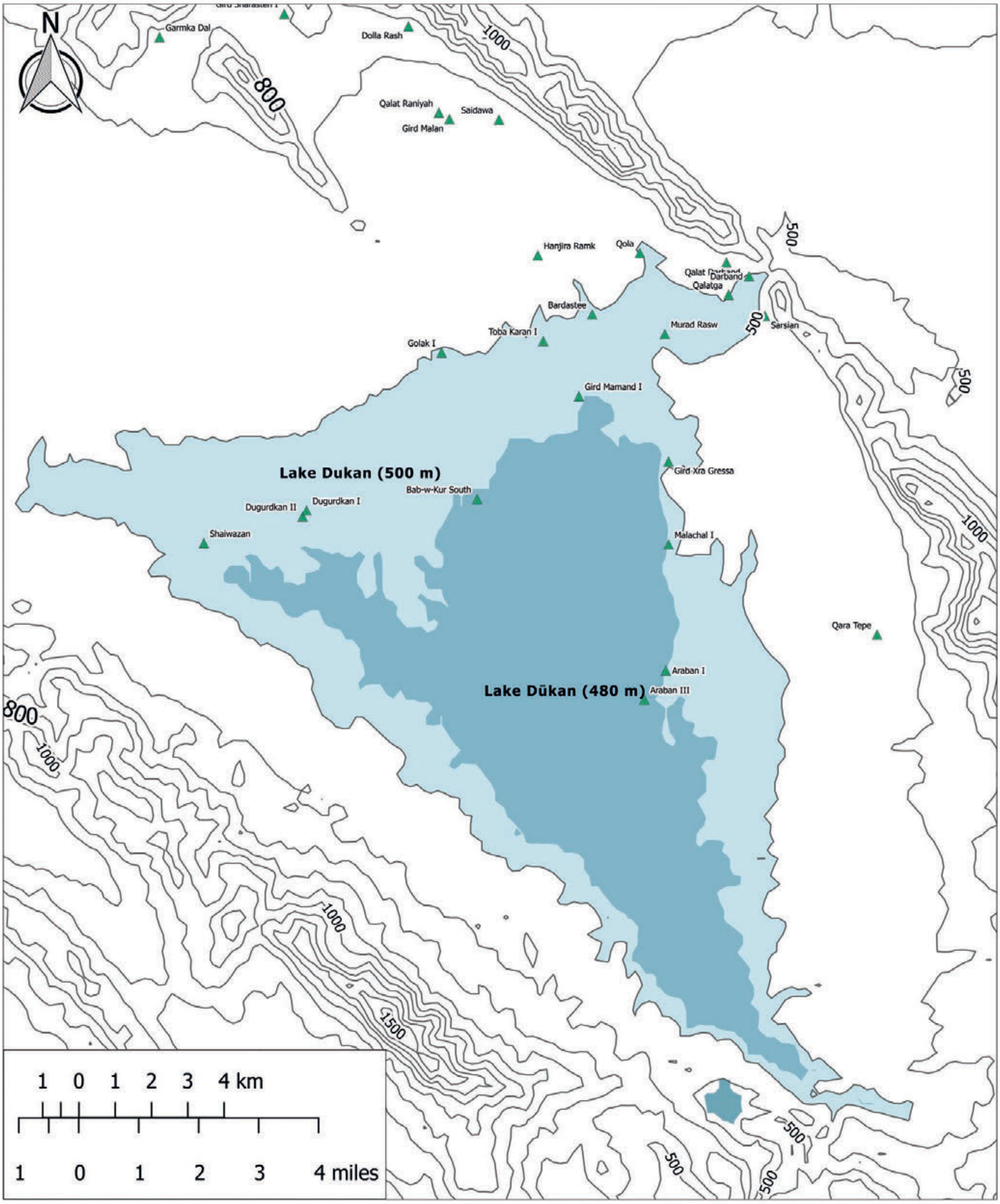

Fig. 5 - Map of Rania Plain and Lake Dokan with 480 and 500 m contours (design M. Uildriks).

"Archive of Kuwari", some 150 cuneiform tablets from the early 18th cent. BCE. As is now well-known this archive provides a good overview of the historical situation in the western Zagros during the time of the kingdom of Shamshi-Adad.[16] The very rich evidence it provides is not yet matched by finds from other sites in Kurdistan, but seems to predict other similar finds elsewhere in due course.

By 1959 the Dokan Lake was forming, and soon all official archaeological activity in the area came to a halt for decades, until new projects were initiated in 2012. The artificial lakes created by dams basically retain a deep permanent core surrounded by a "flood-risk" zone. The lake is at its lowest in late autumn, and the difference in water level can vary quite dramatically. On the map shown here (Fig. 5) the deeper blue is within the 480 m contour, and the lighter blue marks the 500 m contour. Until 2006 the recorded maximum and minimum elevations (amsl) of the lake were 510,77 m (28-29/4, 1974) and 441,91 m (15-16/12, 1988),[17] but the latter figure is clearly unusual, and a more average minimum elevation is ca. 485-490 m. Still the oscillation of ca. 20-25 m is considerable, and it is within the zone thus occasionally left dry that sites can be re-examined.

Our main observations on flood damage were presented in a book published in 2020,[18] and need not be repeated here, but some general considerations are worth mentioning. A first observation is that sites in the permanent core of the lake may now be embedded in sedimentation. A few years ago a bathymetric survey of Lake Dokan showed that sedimentation by 2014 had reduced the original storage capacity of the reservoir by 28 %.[19] It remains to be investigated how sites firmly embedded may concretely have fared, but at least they are now protected from wave-action.

Different for the sites in the outer - flood-risk or drawdown zone, the size of which depends on precipitation and planned outlet of water for irrigation and other purposes. Here the frequent movements of the water create serious and some time fatal damage to sites. Tell Shemshara is the site best documented pre-flood. The old Danish project produced a map of the central area, and thus we could remap this and compare it to the situation in 1957. In Fig. 6 the main mound of Shemshara as it was surveyed in 2013 is shown with brown contours and superimposed are the transparent contours of the 1957 map. Our surveyor M. Uildriks from this calculated that the loss of soil has been ca. 30.000 cubic meters![20] This figure sounds fairly catastrophic, and of course reflects serious damages, but the situation is not as bad as it sounds. The ancient settlements at Shemshara were terraced into natural hills, and a lot of the soil washed out is in fact natural soil, but also much of the ancient occupational levels have been flushed into the lake. This situation stresses the fact that the flood damage to archaeological sites must be viewed not just in a quantitative perspective, but also in a qualitative perspective specific to individual sites. In a qualitative perspective the worst damage to Shemshara is certainly that large portions of the slopes of the hills and ancient structures terraced into them have been washed away.[21]

A final observation is worth noting. Lake Dokan, like other dam reservoirs, has provided opportunites for recreational and touristic activities, and created new fishing grounds.[22] The former feature has been easily observed on our occasional visits to the town of Dokan, now full of hotels and holiday chalets, while during our two spring seasons (2013 and 2014) officers of the Forest Police were camped on the Shemshara hills to prevent fishing, the rest of the year widely practised on the lake.[23] Thus occasional visitors to sites in the flood-risk zone, especially the fishermen, have made a usually light, but occasionally important impact on these. More on that below (section 7).

5. Second-Phase Salvage on the Shemshara Hills

Arriving on the Rania Plain for the first time in 2012 we quickly realised that Tell Shemshara had suffered immense damage since the 1950s. The high northern part of the Main Hill, where the 1957 excavation was concentrated, was now some 4 m lower,[24] and below that we found denuded stone foundations of the building where the Danish and Iraqi teams had recovered the archives in the 1950s. On the east slope facing the lake the passing water had also washed out debris covering outlines of earlier walls. During the first and following seasons these observations largely dictated our 2nd phase strategies. Since no plan of the "Kuwari Palace" had ever been published we proceeded to clean and re-excavate the relevant area, and then received an welcome helping hand. Our colleague K. Ahmed (University of Sulaymania) kindly sent us an unpublished paper which included a series of photos from the 1958-9 Iraqi excavations at Shemshara, and combining these with our new

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[16] The archive retrieved by the Danish team at Shemshara, as well as another smaller, contemporary archive excavated by an Iraqi team in 1958, are published in Eidem 1992 and Eidem, Læssøe 2001.

[17] World Bank 2006, 35.

[18] Eidem 2020a; Uildriks 2020.

[19] Hassan *et alii* 2019.

[20] Uildriks 2020, 139-140.

[21] Eidem 2015.

[22] Sconzo, Simi, section 3, this volume.

[23] We are grateful to these officers for their help in guarding the sites and our equipment, and generally kind cooperation.

[24] Uildriks 2020, 138-139.

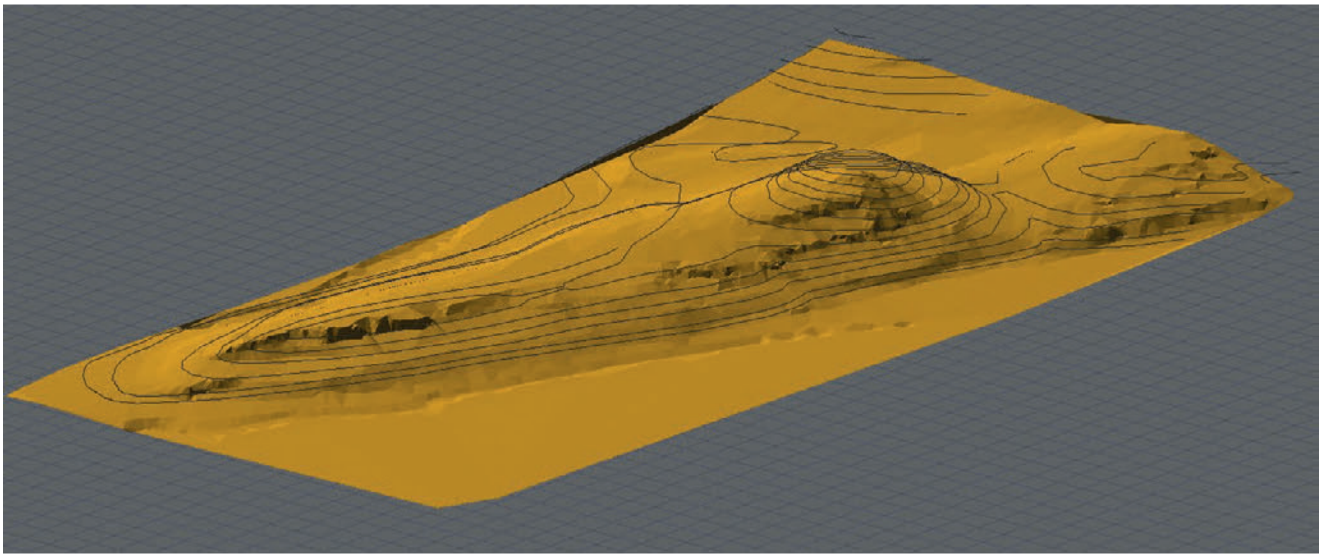

Fig. 6 - Erosion model of Shemshara Main Hill. Brown contours of survey 2012-13 overlaid by transparent contours from 1957 map (model by M. Uildriks).

Fig. 7 - Room in Level VIII "palace", excavated autumn 2022 (photo J. Eidem).

Fig. 8 - Bardastee: a) areas excavated 2013 and 2019, with stone foundations of terrace on south slope highlighted (map E. Mariotti), b) foundations of domestic structures in Level 3 (foreground) underlying Level 2 terrace foundations, Oct. 2019 (photo J. Eidem).

investigations we have been able to reconstruct a tentative plan of the palace, as far as still preserved in the 1950s.[25]

A second strategy was to pursue excavation of the structures washed out on the east slope of the site, and this work has revealed a probably complete sequence of five main Bronze Age levels *below* the Kuwari palace in Level V. This has enabled us to establish that occupation at the site, after a millennia-long hiatus, may have started in the late Akkadian period (Level X, ca. 2200 BCE), and continued, with some possible interruptions, into the 18th cent. BCE (Level V). The most prominent remains are found in Level VIII, which features a large building partly burnt and fairly well-preserved (Fig. 7). It seems to demonstrate that some 200 years before Kuwari, probably in the 20th cent. BCE, Shemshara also had an important role on the Rania Plain. The building in Level VIII has so far produced a single displaced cuneiform tablet, but others may appear as we pursue the investigation in coming seasons.[26]

A third strategy has been to investigate the other constituent hills of the Shemshara site, "Camp Hill", "North Hill", and Bardastee (Fig. 8). The results of these operations have been detailed elsewhere,[27] but in this context it is important to note especially the heavy damage observed on "North Hill", located immediately adjacent to the Main Hill, since this too has lost a lot of its ancient occupation, once terraced down the east slope.[28]

In addition to these strategies we have also conducted minor excavations in areas not directly or imminently threatened by the movements of the lake, to supplement comprehension of the overall stratigraphic and occupational history of the site. A small operation on the south end of Main Hill in 2023 thus finally revealed Iron Age occupation, apparently *in situ*. Even before any excavation took place at Shemshara the Iraqi survey in 1955 claimed that the site was occupied in the "Assyrian" era, but little trace of that period surfaced subsequently in the excavations.[29]

6. Second-phase Salvage in the Dokan Dam zone

On-the-ground assessment of damage is of course dependent on the level of the lake in any one particular year. We have been relatively lucky that the first phase of our project coincided with several years when the lake was fairly low in autumn. Our first season in 2012 therefore gave us the opportunity to see some of the damaged sites in the drawdown zone. Informed by this experience we then planned and executed more targeted surveys in 2014 and 2015, which were also fairly "dry" years.[30] After some "wetter" years the situation improved after 2020, and the last few years have been relatively favorable. The two maps Fig. 9 shows the area of the Shemshara Hills in July 2019 (left), when all of the Shemshara Hills except Bardastee were completely flooded, and the same area in December 2023 (right), when the "winter-survey" described elsewhere in this volume was conducted.

When our project started in 2012 the only site maps available were that of Tell Shemshara, mentioned above, and of two sites, Basmusian[31] and Ed-Deim,[32] excavated in the 1950s by Iraqi teams. This apparently left us in the dark as regards the pre-flood appearence of other sites since affected by the Lake, but help was nearer than expected. In the early 1950s, before the Dokan Dam was constructed, a British commercial company, "Hunting Aereosurveys", captured series of air photographs covering large areas of Iraq, including the Rania Plain. In 2014 we discovered that photos covering most of the Rania Plain were on file at the Dokan Dam offices, and thanks to the support of the Sulaymania Directorate of Antiquities our project was able to obtain high-resolution scans of these photos. Subsequently our surveyor merged and geo-referenced them to produce a fairly precise map of the pre-flood landscape (Fig. 10).[33] This map has provided us with interesting views of archaeological sites pre-flood (Fig. 11), and also guided us to some sites in the region not recognised previously, and now less apparent on satellite imagery.

Other projects have recently surveyed intensively smaller segments of the Rania Plain,[34] or very extensively in – and beyond it,[35] and all these efforts may hopefully coalesce to produce a more precise image of settlement patterns. Meanwhile we plan in coming years, aided by geomorphologists, to focus more on site erosion processes, so far only explored in a preliminary study.[36] We also plan new surveys on sites rarely accessible – whenever possible ...

7. Present and future challenges

But how to salvage more than the shadows provided by topography and surface sherds from the sites rarely accessible? Protective measures to halt erosion

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[25] Eidem 2020b, 163-171.
[26] Coppini, Eidem 2024.
[27] Eidem 2020b, 159. For Bardastee see Eidem, Giannessi 2021, and Eidem, Giannessi, Merlino, forthcoming.
[28] Eidem 2015, Eidem *et alii* 2019.
[29] Eidem 2020b, 189-190.
[30] See Eidem 2020a, 105.
[31] As-Soof 1970, Pl. II. The same article presents general photos of some sites (Pls. IV-VI).
[32] At-Tekriti 1960, Pl. 1.
[33] Uildriks 2020.
[34] Skuldbøl, Colantoni 2020.
[35] Giraud *et alii* 2019.
[36] Uildriks 2020.

Fig. 9 - Sentinel-2 L2a images showing area of Shemshara a) 8/7, 2019, and b) 27/12, 2023 (Copernicus Browser).

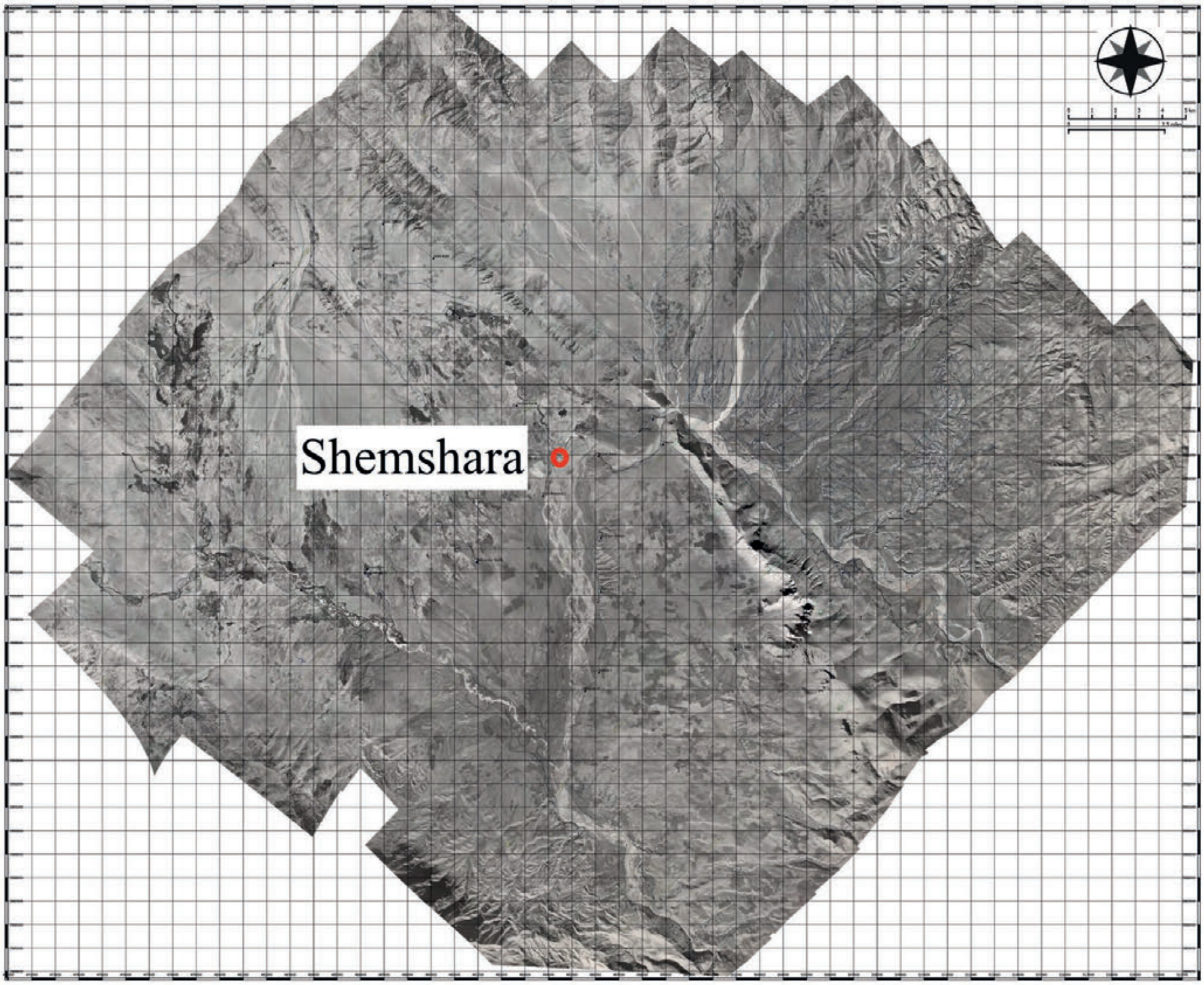

Fig. 10 - Geo-referenced aerial view of the Rania Plain, composed from "Hunting Aerosurveys" images captured 1951-1952 (M. Uildriks).

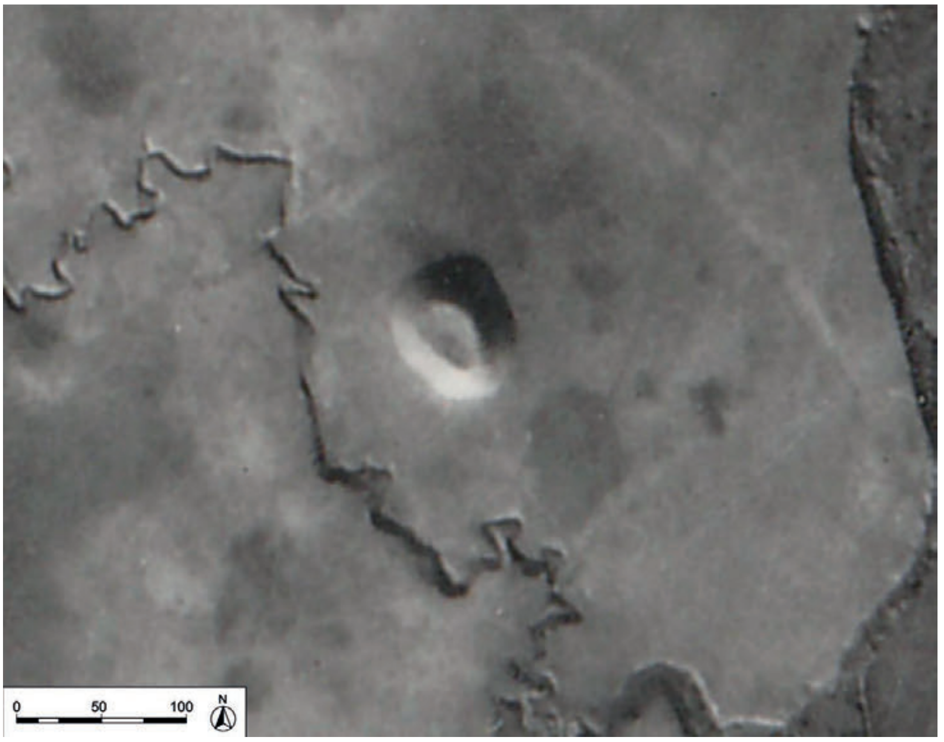

Fig. 11 - Segment of a "Hunting" image (Hunting 06527, 7/12, 1951) showing the site of Qorashina, almost permanently flooded. Note the contours of a possible ancient enceinte visible as light grey lines beyond the mound (cf. EIDEM 2020a, 122-3, site 19).

Fig. 12 - Objects from the surface of Girda Kullan found by casual visitors, and collected by the Raparin Directorate of Antiquities 2015 (photo J. Eidem).

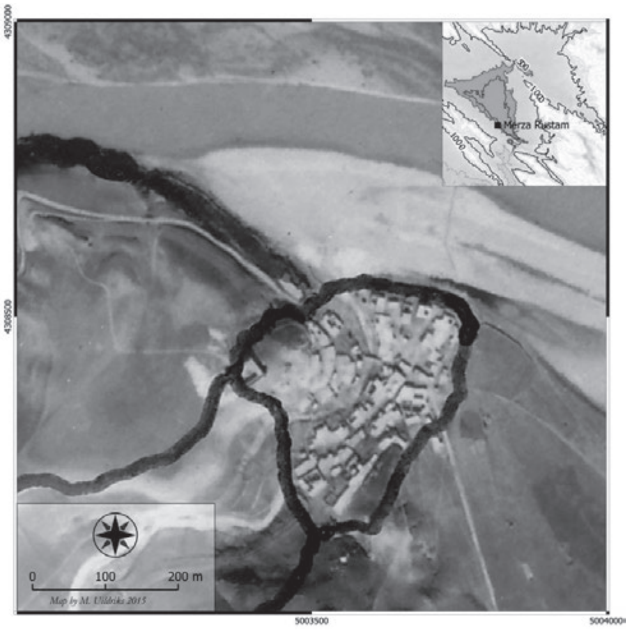

Fig. 13 - The village of Mirza Rustam in 1951 (design M. Uildriks).

seem, at least financially, unrealistic, and the future development of the Dokan reservoir is dependent on several, mostly unpredictable, factors. Very limited excavation probes on some sites in the periphery of the flood-risk zone may prove possible, but otherwise continued monitoring remotely and on the ground seem the only available options forseable.

And this brings us back to the fishermen, who regularly pass, land and camp on the island sites, when emerging. They have been a primary source for information on the state of sites before online satellite services like that provided by the Copernicus browser became available.[37] Over past decades, however, both fishermen and casual tourists have picked up many hundreds of objects on archaeological sites, flushed out by the movements of the water. Many of these objects are of modest importance, especially out of context, but others are important or exceptional. In the latter category belong the Middle Assyrian foundation tablets found some 30 years ago, almost certainly at the site of Basmusian. They were alledgedly sold for thousands of dollars and are now in private collections. They describe the building activities of Tiglath-pilesar I (1104-1085 BCE) at the site of Pakute, which can now confidently be identified with Basmusian.[38] In many other cases it is difficult to verify the true origin of the objects found unofficially on the island sites. In one case, however, we have been able to trace a significant object back to its findspot, and thus identified a new site.[39] Fortunately the local Raparin Antiquities Directorate has been able to collect many of these objects through their local networks, like the collection from Girda Kullan shown here in Fig. 12,[40] and we are currently working with the Raparin Directorate to develop improved protocols for monitoring and collection of these stray objects.

Another challenge, very urgent in the case of the Rania Plain, is to salvage the fast fading living memories of the ca. "50 villages and 1000-1200 families" displaced in the late 1950s by the formation of the Lake,[41] villages which we can identify remotely on the old aerial photographs (Fig. 13). For this aspect we have initiated a cooperation with the Raparin University and its "Raparin Renaissance project". This project, which includes systematic interviews with local residents, was initiated a few years ago, but stalled by the COVID crisis. We hope to revitalise it soon.

Finally flooding is obviously not the only threat to ancient sites and their landscapes. Other modern developments and constructions contribute significantly to destruction of heritage.[42] On the Rania Plain a high-profile example of this problem is provided by the city of Rania itself. The Old City today completely covers the core of a very substantial ancient *tell*-site, which we know had already been heavily damaged by the late 19th cent. AD.[43]

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[37] https://browser.dataspace.copernicus.eu
[38] Eidem 2018.
[39] Eidem, Coppini 2020.
[40] See Eidem 2020a, 124, site 30.
[41] Jwaideh 1996.
[42] See, e.g., Cunliffe 2016.
[43] Marf, Eidem 2024.

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SUBMERGED PAST: DAM CONSTRUCTION AND CULTURAL HERITAGE PROTECTION POLICY IN IRAN

Abstract

The Iranian plateau, characterised by its scarcity of water, has seen the development of historical settlements along river valleys and water resources, while nomadic communities have determined their migration routes based on water availability and pastures. Throughout its history, the region has implemented various water management solutions, including dams, qanats, and reservoirs, all contributing to Iran's diverse cultural heritage, with some still in use today.

Since the beginning of modern dam construction in the 1950s, Iran has emerged as one of the largest dam builders in Southwest Asia. However, this extensive dam construction has brought about adverse impacts on historical and cultural sites, landscapes, and intangible heritage. For several decades, there was no specific policy addressing the preservation of cultural heritage within dam projects. Concerns raised by cultural heritage experts eventually led to the mandatory inclusion of cultural and historical impact assessments, along with rescue operations, in the overall scope of construction projects.

Despite recent rescue archaeology efforts, they have not fully met the requirements of safeguarding cultural heritage. This paper scrutinises the existing policies related to dam construction and cultural heritage in Iran, offering suggestions to enhance the integration of cultural heritage considerations into development and dam construction programmes.

Keywords

Cultural heritage, Iran, dam construction, rescue archaeology, heritage management

Introduction

Water in Iran has not only been a crucial factor for the survival and expansion of civilisations throughout history but has also held significant political and cultural importance. Control over water resources has played a pivotal role in the formation of civilisations and conflicts on the Iranian plateau. Consequently, various political powers have consistently integrated water management into their political agendas, recognising it as a strategic and promotional element.

Conversely, life in a water-scarce plateau has given rise to tangible and intangible phenomena associated with the culture of water management, many aspects of which endure to this day. The inscription of Darius the Great (550-486 BCE) on the terrace walls of Persepolis illustrates his plea to Ahuramazda to safeguard the country from hostile armies, drought, and lies. Darius's acknowledgement of water scarcity in the Iranian plateau emphasises that even 2,500 years ago, drought posed a great threat to the land, and attention to water-related issues was integral to the central policies of Persian kings as a political agenda.

Archaeological discoveries from the Lower Palaeolithic era, particularly in sites associated with river terraces and lakeshores, such as the Kashafrud River basin in Razavi Khorasan, northeastern Iran, the Karun, Kargar, Mashkid, and Ladiz Rivers in the south and southeast, Sefidrud River in the North, and Mahabad River in the northwest[1], reveal the profound connection between civilisations and water resources. Significant civilisations, like the Jiroft civilisation along the Halil River (3rd millennium BCE)[2], those in the plains of Khuzestan[3], and settlements on the fringes of the Seimareh River in Lorestan[4], developed in tandem with rivers and water resources (Figure 1). The scarcity of water and recurring droughts, if not effectively addressed, led to extensive population migrations.

In response, communities innovated by constructing qanats (underground irrigation systems), dams, and bunds for water management. These innovative water management practices, including the construction of qanats[5] and bands (dams)[6], many of which exist to this day, were strategic responses to the challenges posed by water scarcity. Historical dams, such as the Achaemenid bridge-dam of "Sang-e Dokhtar" in Dorudzan, the Achaemenid and Sassanian dams in Khuzestan, notably the Shushtar Historical Hydraulic System dating from the 3rd century CE (probably on older bases from the 5th century BCE)[7], and the medieval dams of the Kurit (also Korit/ Koreyt) in Tabas[8], the Teimurid dam of Akhlamad in Mashhad,

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[1] Biglari, Shidrang 2006, 160.
[2] Saatsaz, Rezaei 2023, 4.
[3] *Ibidem,* 4.
[4] Niakan 2018.
[5] Unesco 2016.
[6] Planhol 1988.
[7] Ichhto 2008.
[8] Aminpoor, Asadi, Sadat Bashtani 2020, 19.

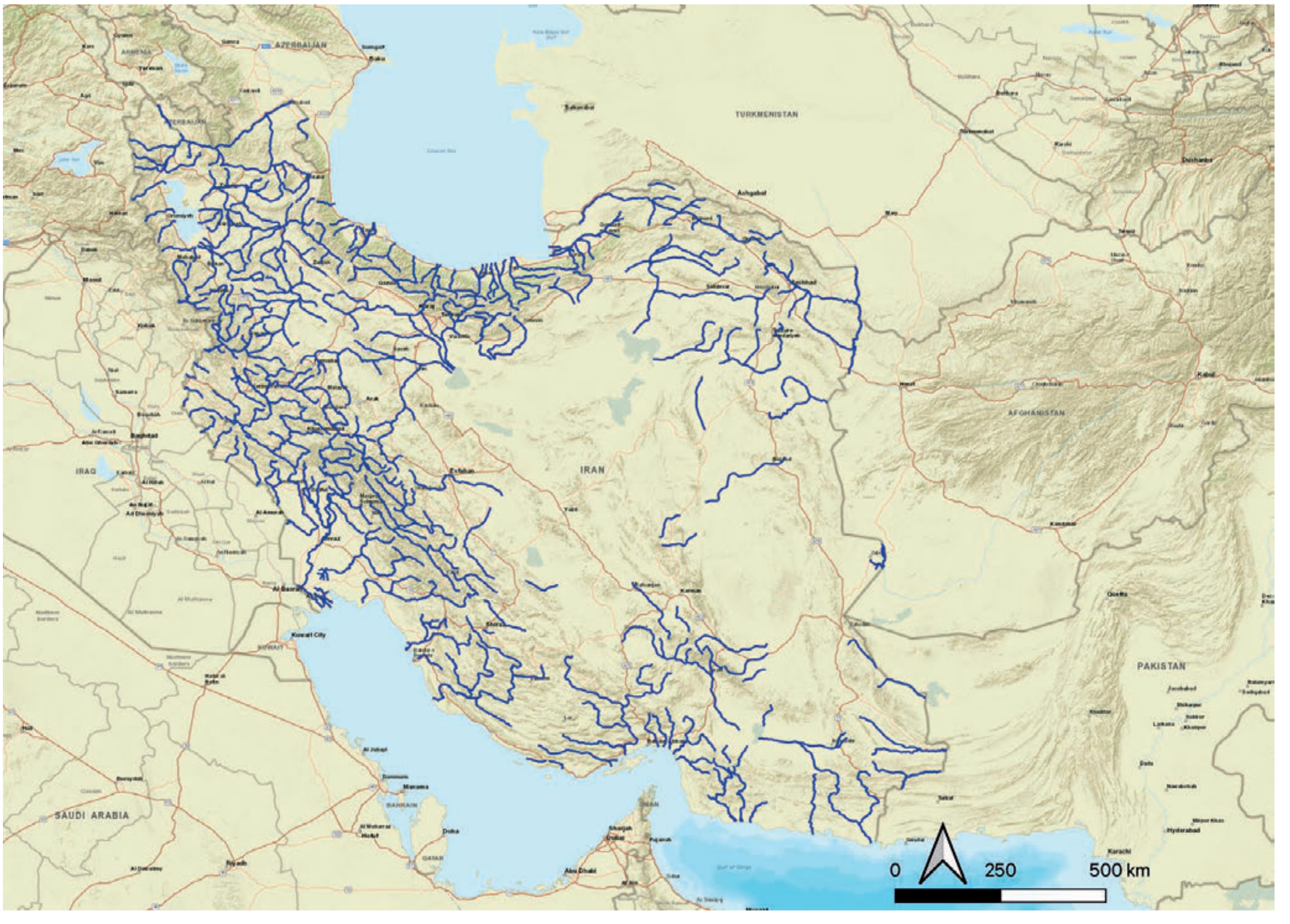

Fig. 1 - International Steering Committee for Global Mapping. Sāzmān-i Naqshah′bardārī-i Kishvar. Rivers, Iran, 2013. [Shapefile]. International Steering Committee for Global Mapping. Retrieved from https://maps.princeton.edu/catalog/stanford-qw969rj4750

Fig. 2 - Karaj (Amir Kabir) Dam featured on the 10 Rials Banknote, 1961. Source: Wikipedia.

Fig. 3 - The medal awarded to the builders of the Mohammad Reza Pahlavi Dam (Dez Dam). The bronze medal awarded to Rajabali Pourfalatoon. Source: Wikipedia.

and the Kebar Dam in Qom (c. 1300 CE)[9], were strategically positioned on the fringes of deserts in Iran. These structures were primarily designed to regulate floods, harness seasonal waters, and prevent water from escaping and going to waste in the arid desert environment.

Dam construction in contemporary Iran

This paper aims to present a comprehensive overview of the impact of dam construction policies on Iran's cultural heritage during modern times, particularly focusing on the period from the rule of Mohammad Reza Shah Pahlavi (1941-1979) onwards. The initiation of modern dam construction during this era marked its significance as a strategic element in the nation's development programmes. Under the rule of Mohammad Reza Shah and the surge in oil revenues, dam construction became emblematic of progress and development.[10] Images capturing dam construction operations adorned banknotes, stamps, and government medals, symbolising achievements and modern advancements in Iran. Notably, the Kuhrang Tunnel and Karaj Dam (later Amir Kabir Dam) images were recurrently featured in various banknote editions (Figure 2). Mohammad Reza Shah Dam (later renamed Dez Dam) also found its place on government medals awarded to the dam project managers (Figure 3). Albert Lamorisse (1922-1970), the French filmmaker and producer, was commissioned to create the documentary "The Lovers' Wind," focusing on the landscape of Iran and showcasing its historical monuments, villages, and cities, as well as development and modernisation. After he completed filming, government officials summoned him back, citing his neglect of Iran's modern and industrial facets. They requested he finalise his film by incorporating elements showcasing Iran's progress, particularly in dam construction. While attempting to capture footage of the Karaj Dam, his aircraft crashed into the reservoir, leading to his tragic death.[11] "The Lovers' Wind" combines Iranian cultural heritage with the narrative of the nation's modernisation, especially highlighting dam construction as a central aspect of Iran's development. This emphasis not only aligns with Western economic interests by presenting these dams as hallmarks of progress but also utilises the timeless essence of poetry to forge a reimagined narrative of Iran's history. This story places the Shah's modernisation projects at the core of Iran's identity, thus reinforcing the Pahlavi's legitimacy through a harmonious blend of ancient prestige and modern accomplishments.[12]

Several dams were constructed during Mohammad Reza Shah's reign, including Shah Ismail Dam on the Anarbar River (construction started in 1954), Dez Dam on the Dez River (construction started in 1959), Ekbatan Dam (formerly Shahnaz) on the Abshineh River (construction started in 1954), Karaj or Amir Kabir Dam on the Karaj River (1961), Voshmgir Dam on the Gorgan River (construction started in 1964), Karun 1 or Shahid Abbaspour Dam on the Karun River (construction started in 1965), Dam on the Zarriné-Rud River (1967), Sefidrud or Manjil Dam on the Qezel Ozan River (1967), Latian Dam on the Jajrood River (1967), Zayandehrud Dam on the Zayandehrud River (1970), Aras Dam on the Aras River (1971), and Dorudzan Dam on the Kor River (1972).[13]

After the 1979 Islamic Revolution, which marked the end of the Persian monarchy, dam construction retained its significance as a key element in the development and nation-building efforts. Numerous high-ranking government officials viewed dam construction as a vital indicator of the country's progress, often drawing comparisons with the achievements of the Pahlavi era. In an interview with ISNA News Agency, the CEO of the National Water Management Company highlighted that before the 1979 Revolution, 19 operational dams had a total volume of 13 billion cubic meters (25% of the total), providing an annual adjustable water capacity of 14 billion cubic meters. However, this capacity significantly increased to 165 reservoirs with a total volume of approximately 51 billion cubic meters (75% of the total), offering an adjustable water capacity of 37 billion cubic meters by February 2017.[14] According to information from the Ministry of Energy featured in the media, between 2011 and 2017, under the fifth development plan, 48 new dams were brought into operation.[15] Presently, Iran boasts a total of 194 dam reservoirs, with projections indicating that this number will increase to 201 by 2025. As per the International Commission on Large Dams, Iran secured the eleventh global ranking in terms of large dams by the end of 2023, holding the top position in Southwest Asia and North Africa region.[16]

Despite gaining support from many in the energy sector, extensive dam construction has faced significant criticism due to its negative impacts on the environment, water, and soil resources, which are seen as irreparable.[17] The construction of certain dams in Iran has resulted in submerging forests, landscapes, gardens, and farmlands, leading to the loss of vibrant

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[9] Pashtun 2007, 43.
[10] Saatsaz 2020, 1764-1765.
[11] Naficy 1979, 229-230.
[12] Watson 2015, 58.
[13] Zolotov, Navayeneyah 1997, 324-325.
[14] Babai 2019.
[15] *Ibidem.*
[16] International Commission On Large Dams 2023.
[17] Heydari, Othman, Noori 2013.

ecosystems. The government's failure to implement watershed management plans to stabilise upstream slopes of the basins has also contributed to a reduced lifespan of dams, caused by the gradual accumulation of sediment in the reservoirs.

After the Iran-Iraq war of 1980-1988, Iran entered a period known as the 'Reconstruction Era' to repair war-related destruction and develop necessary infrastructures. The first Five-year Development Plan was approved and enacted by the Islamic Consultative Assembly in 1989, continuing the five-year development and urbanisation plans initiated earlier. These plans placed a strong emphasis on the development and expansion of water storage facilities for urban and rural consumption, electricity generation, agricultural irrigation, and industrial water supply. In this context, dam construction emerged as a key operational method to attain the aforementioned goals.

The law of the First Economic, Social, and Cultural Development Plan of the Islamic Republic of Iran, enacted in 1990, stipulated that "to maximise the utilisation of the country's water and power resources, the government is authorised to fund the construction of Karun 3, Karun 4, Karkheh, and Gavoshan dams, up to a limit of three billion (3,000,000,000) US dollars through long-term credit contracts".[18]

In the 1994 law of the second development plan, the construction of Karun 3, Karun 4, Karkheh, and Gavoshan dams was mandated.[19] In the third law, the government was obliged to construct multiple small and large dams through various feasible means with the goal of securing water resources.[20] Under the fourth development law, watershed management operations were mandated for implementation in areas where dams were under construction and in those already built.[21] Additionally, under the fifth development law of 2011, the government was mandated to expand the main and subsidiary networks of irrigation and drainage in the vicinity of constructed dams.[22] In the sixth programme law of 2017, ten percent of the annual budget of the National Development Fund was allocated to provide facilities for non-governmental investors in the agricultural sector, complementary industries within this sector, environmental issues related to agriculture and natural resources, as well as the construction of diversion dams and small dams.[23] In the seventh development plan approved in 2023 and in its eighth chapter, special emphasis has been placed on establishing an integrated water resource management system. This section requests the Ministry of Energy to coordinate with other ministries, including the Ministry of Cultural Heritage, Tourism, and Handicrafts, as well as the Department of Environment, to protect and manage wetlands and prevent unauthorised water withdrawals. However, in the chapter related to Cultural Heritage, Tourism, and Handicrafts, there is no mention of the need for coordination of other ministries with the Ministry of Cultural Heritage regarding development projects such as dam construction, leaving this issue unaddressed.[24]

Dam construction and risks to cultural and natural heritage

Despite the perceived benefits of dam construction, such as bolstering water reserves, generating electricity, expanding farmland, and enhancing fishery and water-related industries, there are significant concerns about the adverse political, social, cultural, and environmental impacts.[25]

Dam construction poses a critical strategic and political issue, historically centred around water preservation and management. This is evident in the regional significance of water, illustrated by disputes like those arising from the Helmand Dam in Afghanistan, which have underscored the strategic value of water in relations with the neighbouring country, Iran.[26]

Iran's shift to a province-based water resources management system has also increased competition over water retention within territories, notably in large basins like Karkheh and Sefidrud. This competition, driven by local and regional political motives, mirrors global conflicts over transboundary basins, potentially leading to significant socioeconomic and environmental impacts on interconnected societies and escalating further conflicts.[27]

The construction of dams brings substantial risks to cultural and natural heritage as well. In Iran, a country with a rich history of civilisations that flourished in valleys and along rivers, the building of dams has led to the submersion of archaeological sites and forced abandonment of villages with historical or prehistoric roots. These sites and settlements are emblematic of traditional knowledge tied to their geographical locations. Their abandonment not only leads to the degradation of tangible cultural heritage but also erodes intangible cultural aspects, such as knowledge of nature, traditional water management practices, and construction skills.[28]

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[18] The Islamic Consultative Assembly 1990.
[19] The Islamic Consultative Assembly 1994.
[20] The Islamic Consultative Assembly 2000.
[21] The Islamic Consultative Assembly 2004.
[22] The Islamic Consultative Assembly 2011.
[23] The Islamic Consultative Assembly 2017.
[24] The Islamic Consultative Assembly 2023.
[25] Marchetti, Zaina 2020.
[26] Abidi 1977; Aman 2016.
[27] Torabi *et alii* 2024, 245-246.
[28] Motevallian 2017; Malek Hosayni, Mirakzadeh, Lioutas 2017.

This trend exacerbates the decline of rural communities in Iran, as official statistics show an increasing shift towards urbanisation. Driven by the search for stable employment, improved living conditions, and access to urban amenities, rural populations migrate towards cities. As analysed by Fathi, urbanisation in Iran has been on the rise over the last fifty years, with the urban population exceeding two-thirds of the total population in 2011. Projections suggest that urbanisation will continue, potentially reaching 85% by 2050.[29] This shift is further fuelled by dam construction, which not only threatens natural and cultural landscapes that have witnessed millennia of human-nature coexistence but also prompts rural migration by altering climates and ecosystems.

The threat to Iran's cultural and natural heritage from dam construction is not new but has become more pronounced with recent projects. Instances like the Sivand Dam and the Seimareh Dam, completed in recent years, highlight the ongoing risk to ancient civilisations and settlements submerged in dam reservoirs. Older dams, built five or six decades ago, have yet to be fully evaluated for their impact on cultural heritage, leaving a gap in understanding the full extent of their consequences.

Cultural heritage institutional response and rescue initiatives

Early modern dams, such as Golpayegan, Amir Kabir in Karaj, Sefidroud, Dez, and Aras, lack comprehensive studies and published surveys regarding the destruction and submersion of cultural heritage during their construction and impoundment. The absence of historical documentation at the time of their construction further compounds our limited knowledge. Golpayegan Dam, considered Iran's first modern dam, had studies initiated in 1944, with construction commencing in 1947 and concluding in 1957.[30] This construction phase took place within the first decades after the 1930 enactment of the Antiquities Preservation Law. During this period, the Ministry of Culture and the Antiquities Administration concentrated on the identification and registration of key archaeological sites. However, their attention was confined to a relatively small number of significant sites, leaving many other areas within dam project zones unattended due to resource constraints. Additionally, civil society organisations dedicated to protecting cultural heritage were not well-established across the country.

During this time, Iran faced a marked lack of indigenous archaeologists, with the University of Tehran hosting the only archaeology department in the country. This shortage resulted in a dearth of professionals capable of carrying out archaeological surveys. In reaction to the continuous involvement of international archaeologists, the Iranian parliament saw the necessity for founding national archaeological bodies. Consequently, the 1940s saw the inception of the archaeology department at Tehran University. Only later, the government began awarding scholarships to archaeology students, which by the mid-1960s allowed the department to evolve into an academically robust entity staffed by experts educated in European and American universities.[31]

Analysing the statistics of registered buildings and sites on the National Heritage List highlights the evolving pace of documenting Iranian cultural heritage sites.[32] Between 1941 and 1961, a mere 89 cultural heritage sites were included on the list. The absence of a comprehensive list of cultural heritage sites from the 1940s to the 1960s contributes to the limited knowledge about the areas threatened by dam construction during that period, including the impact of Golpayegan and other early modern dams. The number of registered sites now stands at nearly thirty-five thousand, with the former head of Iran's Cultural Heritage Organisation, Seyyed Mohammad Beheshti, estimating there are over a million historical properties across Iran.[33]

Initiated in 1964 and finalised in 1972, the Darius the Great Dam (Dorudzan), situated on the Kor River in Fars Province approximately fifty kilometres northwest of Persepolis, was constructed to generate electrical power, manage floodwaters, and provide irrigation for downstream areas covering 1,100 km^2.[34] In close proximity to the modern dam stood the ancient Sang-e-Dokhtar dam dating back to the Achaemenid period. Shiraz University, formerly known as Pahlavi University, led a rescue operation, co-funded by Engineer Khalil Talighani, who generously allocated budgetary resources for the removal and reconstruction of the principal monument.[35] Talighani was a founder of Goodrich company in Iran. In a letter to Mehrdad Pahlbod, the then Minister of Art and Culture, he proposed a plan for a rescue operation at Dorudzan and offered a cheque of 300,000 Rials on behalf of Goodrich shareholders to support the operation.[36] The studies and relocation of the historical bridge-dam of Sang-e-Dokhtar was successfully executed by the Italian IsMEO (Italian Institute for the Middle and the Far East). This small ancient bridge dam was relocated from its original position on the eastern bank of the Kor River and was reconstructed at a new site,

[29] Fathi 2015.
[30] Noorbakhsh 2016.
[31] Papoli Yazdi, Garazhian 2012, 25.
[32] Pazooki, Shadmehr 2005.
[33] Beheshti 2001.
[34] Naderi 2020, 1554.
[35] Nicol 1970, 245.
[36] Talighani 1965, 51.

approximately three kilometres downstream in the same river valley, directly across from the modern Darius the Great Dam. The decision to relocate the bridge was prompted by the rising water level, aimed at preserving this historic structure. Examination of its blocks uncovered similarities to the Achaemenid technique employed at Persepolis.[37]

The expansive Marvdasht Plain, housing these ancient sites and monuments, stands as one of the oldest historical regions in Iran. Limited knowledge exists regarding land use in this area during ancient times, but the presence of numerous prehistoric mounds suggests a history of one of the longest and continuous habitation areas in this part of the world.[38]This plain, celebrated for its fertility and agricultural advancement facilitated by irrigation systems, stands out as one of the locations where some of the earliest historical dams on the Kor River in the Iranian Plateau were built. Four major dams (*bands*) on the Kor River in this region, tracing their origins to pre-Islamic times, played a crucial role in the primary irrigation of the Marvdasht Plain. All of them, except one, continued to be operational until the early 1970s. The historical dam that fell out of use was subsequently replaced by the Darius the Great Dam in the 1960s.[39] The dam was located near the village of Dorudzan, where the standalone historical dam in Ramjerd district existed. The water from this historical dam supplied agriculture around Persepolis.

As discussed by Marsden, the Dariush the Great Dam was initially designed and implemented to exert control over substantial portions of the Marvdasht Plain and the Ramjerd district, placing them under the jurisdiction of the government and large cooperative-affiliated companies. This initiative led to notable changes in traditional systems of water distribution, agriculture, ownership, and settlement within the region. The construction of dams triggered modifications in the irrigation management system, attracting significant attention from governmental agricultural agencies. Marvdasht experienced a rapid transformation, evolving from a small settlement into a sizable town.[40] Traditional settlements in the Marvdasht plain were typically fortified villages characterised by high mud brick square enclosures and towers. Additionally, scattered semi-subterranean stone enclosures served as the basis for the seasonal dwellings of pastoral nomads who utilised the plain during the winter.[41]

Personal efforts by Talighani to persuade the Ministry of Culture and Art and secure funding for rescue operations represent one of the earliest instances of such projects during the era of modern dam construction in Iran. During the Pahlavi era, Iran focused heavily on its ancient history, particularly the Achaemenid and Sassanian periods, highlighted by events like the 1971 Celebration of the 2,500th Anniversary of the Founding of the Persian Empire.[42] However, this period lacked an official, consistent policy to protect and salvage ancient sites amid development and dam construction projects.

After the 1979 Islamic Revolution, and even during the Iran-Iraq War (1980-1988), dam construction continued, although it gained tremendous momentum with the end of the war and the beginning of the 'Reconstruction Era'. In 1985, the Iranian Cultural Heritage Organisation (ICHO) was formed by merging several organisations, including the National Organisation for the Protection of Ancient Monuments, the Centre for Archaeological Research of Iran, the Museums Department, the Centre for Anthropology, and other organisations. The new organisation took on the responsibility of protecting, educating, and introducing Iranian cultural heritage, covering all historical and cultural periods.[43]

The Charter Law of the ICHO was approved by the Islamic Consultative Assembly in 1988, marking a significant step in the preservation of cultural heritage. The formal establishment of this organisation expanded cultural heritage activities, making it a crucial step in safeguarding heritage. Relying on its charter, the ICHO effectively participated in decisions related to the protection of historical and cultural heritage. In the section related to cultural heritage in the Islamic Penal Code, legal provisions supporting cultural heritage were enacted to prevent the destruction of cultural heritage, with various punishments specified according to the crimes committed, such as looting and intentional destruction.[44] Section J of Article 156 of the Third Development Plan mandated executive departments to "cooperate in the protection of historical and cultural structures and the prevention of their change of use".[45] This legal provision highlighted the importance of cultural heritage and its governance.

As large-scale projects progressed, potential threats and damages to historical sites increased. Therefore, Section J of Article 114 of the Fourth Development Plan mandated that the executive department carry out "identification and documentation of historical-cultural properties within the geographical area of the project" under the supervision and approval of the Cultural Heritage and Tourism Organisation.[46] This legal provision granted the ICHO the authority to oversee all large-scale projects to prevent potential negative consequences.

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[37] Ismeo 1973, 423.
[38] Frye 1984, 26.
[39] Kortum 1976, 105; Marsden 1981, 104.
[40] Marsden 1981, 87.
[41] *Ibidem*, 100.
[42] Abdi 2001.
[43] Samadi Rendi 1997, 2-9.
[44] *Ibidem*, 13-15.
[45] The Islamic Consultative Assembly 2000.
[46] The Islamic Consultative Assembly 2004.

During the initial years of the activities of the ICHO, coinciding with the Iran-Iraq War, several large dams were under construction. In 1987, the construction of the Baroon Dam posed a threat to the Dzordzor Chapel, built in the 14th century and located in the Qarasu River Valley in West Azerbaijan province of Iran. In collaboration with the Ministry of Energy and the Armenian Diocese of Iranian Azerbaijan, the ICHO relocated the chapel to a new location, 110 metres further up, and reconstructed it 600 metres away from its original location, saving it from submersion in the dam reservoir. Subsequently, in 2008, this chapel was registered as a World Heritage Site alongside other Armenian monastic ensembles in the north-west of Iran.[47]

The construction of dams and water transfer projects threatened numerous historical sites, particularly those linked to traditional water systems. As a countermeasure, the Ministry of Energy established the 'Iranian Water National Museum' in Tehran in 1995, dedicated to the research and preservation of these culturally significant sites.[48] The institution's purpose was to study, document, and preserve cultural heritage associated with water, including ancient water-related structures, qanats, and irrigation networks. It aimed to raise public awareness, preserve and restore water-related heritage, and transmit valuable knowledge to future generations.

Following the establishment of the ICHO and the enactment of the Islamic Penal Code and the Third and Fourth Development Plans, cultural heritage preservation did not adhere to a consistent pattern and pace. During the implementation of the Fourth Plan, there was relatively more cooperation among government agencies, and the supervision of heritage in large project implementations was more pronounced than in the subsequent years. In contrast to the Third and Fourth Plans, the Fifth Development Plan saw a decrease in the prominence and scope of the cultural heritage issue. While the ICHO continued to oversee large-scale projects as mandated by Section J of Article 114 of the Fourth Plan[49], its oversight was confined and primarily focused on dam construction projects.

The restructuring of the ICHO and its managerial structure had a significant impact on its heritage oversight mission. In 2003, the Iran Tourism Organisation and the ICHO merged[50], and within two years, the Handicrafts Organisation also joined this unified entity.[51] This consolidation resulted in the formation of Iran's Cultural Heritage, Handicrafts, and Tourism Organisation (ICHHTO), expanding its organisational structure. Previously, the ICHO was part of the Ministry of Science and later the Ministry of Culture and Islamic Guidance. Through integration with these organisations, it gained independence from the Ministry of Culture and Islamic Guidance, becoming an autonomous institution under the direct supervision of the President of the Islamic Republic. In 2019, the ICHHTO was further elevated to the status of the Ministry of Cultural Heritage, Tourism, and Handicrafts (MCTH)[52].

The ICHO, in its original form before merging and evolving into a ministry, functioned primarily as a research institution. This status afforded the organisation certain advantages, such as budgets not bound by the regulations governing executive government agencies, resembling the budgetary autonomy seen in universities. Moreover, individuals with higher education credentials contributed to the organisation's academic staff. However, with the amalgamation of the Iran Tourism and Handicrafts Organisations, the organisation's expansive structure underwent a transformation, shifting its emphasis from a research-oriented entity to an executive one. In response to this change, the Research Institute of Cultural Heritage and Tourism was established. This institute now oversees various research centres, with academic staff actively engaged in research activities. Notably, the Iranian Centre for Archaeological Research (ICAR)[53] operates within this framework, focusing on the rescue and preservation of sites impacted by large-scale development projects and dams.

When ICAR was established, its primary interactions and challenges were closely linked to the Ministry of Energy, particularly within the context of dam construction. The initial expectation was for ICAR, in collaboration with the Research Centre for Historical Buildings and Fabrics, to formulate comprehensive rescue and preservation programmes as one of its mandates. These programmes were envisioned to involve a thorough assessment and documentation of endangered sites before approving development projects, as well as the execution of salvage and rescue operations where necessary. However, an unexpected trend emerged as ICAR consistently engaged in negotiations on behalf of the Ministry of Cultural Heritage, Tourism, and Handicrafts (MCTH) with the Ministry of Energy and other entities. Consequently, ICAR gradually transformed into the representative of MCTH with full authority in these matters.

As a result, the overall goal of ICAR shifted and narrowed, focusing primarily on the identification, documentation, and rescue operations of sites within the scope of large development projects and dams. Unfortunately, these rescue efforts, often initiated late in the dam construction process or near completion, mainly involved documenting, preserving, and relo-

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[47] ICHHTO 2007.
[48] https://iwnm.wrm.ir/?l=EN
[49] The Islamic Consultative Assembly 2004.
[50] MCTH 2024.
[51] Iran's Supreme Administrative Council 2006.
[52] MCTH 2024.
[53] https://icar.richt.ir/richt

cating movable artefacts to museum repositories. The historical and natural landscapes, as well as monuments and sites themselves, were not the main focus of these operations. This approach led the research institute to approve most dam construction projects under the condition that the project executor covers the costs of identification, documentation, and rescue operations.

This practice, repeated over time, resulted in ICAR's dependency on financial resources from ministries, particularly the Ministry of Energy. Changes in management and fluctuations in MCTH's budgets in recent years further intensified ICAR's reliance on the financial resources of the Ministry of Energy and its associated rescue and salvage programmes. This reliance, however, hindered its supervisory role with veto power in large dam construction projects that could potentially cause irreparable damage to archaeological sites, as rescue operations in approved projects could generate income.

It is crucial to note that, despite being a developing country with rapid urbanisation and infrastructure development, Iran lacks a commercial archaeological structure and cultural resource management (CRM). While commercial archaeology is not contradictory to existing laws, in practice, archaeological excavations and surveys have predominantly been monopolised by the MCTH or specific higher education institutions. This shortfall has compelled ICAR to engage in salvage and rescue operations in development projects to address pressing needs.

Although conducted salvage and rescue missions have led to the discovery of remarkable archaeological sites and the rescue of some artefacts, the narrow focus on rescuing movable objects, the absence of a coherent policy, and the lack of scientific and technical solutions for preserving non-movable heritage sites, coupled with the neglect of intangible aspects of endangered heritage, continue to overshadow the overall objectives of such efforts.

Despite a significant portion of Iranian archaeology over the past three decades being dedicated to rescue operations conducted hastily due to the accelerated growth of dam constructions, precise statistics and scientific data on rescue excavations have not been published. Public understanding of these rescue operations typically stems from a limited number of studies published by involved archaeologists or from media reports. Without detailed information on rescue and salvage operations, a thorough assessment of their success remains challenging.

In this context, while rescue archaeology in Iran has followed a global trend, especially in Southwest Asia, of aligning with infrastructure modernisation programmes that prioritise river basins, it has transformed archaeologists into development consultants. This transformation has also led to a greater focus on heritage preservation legislation, as well as some contributions to academic and scientific research.[54]

However, rescue archaeology in Iran has fallen short of elevating archaeology and cultural heritage as integral components of development plans for addressing regional planning challenges. This shortfall is attributed to its often narrow perspective, limited scope, and lack of a comprehensive strategy. Rescue archaeology in Iran aligns with global practices, notably following UNESCO's shift in focus after the extensive Nubian monument rescue operations, affected by the Aswan High Dam Project in Egypt, which were launched in 1960 and concluded in 1980. This shift emphasises the preservation of tangible sites over the implementation of a vigorous research programme. Often, this approach overlooks the cultural practices and needs of local communities in areas affected by dam construction.[55] UNESCO's approach, which prioritised the physical integrity of monuments, groups of buildings, and sites, has led archaeology at UNESCO to pivot away from its traditional focus on excavation and contextual analysis towards an almost exclusive focus on monument conservation since the 1960s. This transition, favouring technical support over comprehensive field research, has exacerbated the divide between a technocratic approach and the pursuit of sustainable development objectives[56] – a trend that has been increasingly observed in Iranian archaeology as well.

Examples of dam construction and rescue operations

The adverse impact of dam construction on cultural heritage has triggered significant social protests, particularly highlighted by the case of the Sivand Dam, completed in 2007, and located near the World Heritage site of Pasargadae in the Bolaghi Gorge.[57] The project, initially planned in 1970, experienced interruptions, with construction starting in 1992, pausing for further planning, and resuming in 2003 without consulting the then ICHO.[58] The water diversion plan for the Sivand Dam generated substantial social issues, eliciting sensitive reactions and campaigns from media outlets, cultural heritage activists, and professionals.[59] Heritage activism in Iran gained significant momentum in the 21st century, notably due to disputes surrounding the Sivand Dam's construction.[60]

[54] Olson, Luke 2023, 15.
[55] Meskell 2018, 4.
[56] *Ibidem*, 4.
[57] Jones, Mozaffari, Jasper 2017, 6-8.
[58] *Ibidem*.
[59] Shamoradi, Abdollahzadeh, Mozaffari 2014.
[60] Mozaffari 2019, 179.

This activism showcases how heritage debates have played out across multiple media platforms, with new media like blogs and websites becoming key channels for activist communication.[61] Besides worries about the potential flooding of notable Achaemenid locations, including the Tomb of Cyrus the Great and the Royal Road, there were also concerns regarding the inundation of ancient settlements, cemeteries, iron-smelting sites, and water canals.[62] Doubts regarding the government's commitment to preserving pre-Islamic cultural heritage emerged, influenced by early post-revolutionary attitudes toward such heritage.[63]

Elevated groundwater levels in the region raised concerns about Pasargadae and the tomb of Cyrus the Great post-water diversion. Loss of historical villages, cultural landscapes, and disruption of Qashqai tribes' passage through the Bolaghi Gorge were also troubling. Environmental damage and potential hazards like earthquakes heightened sensitivity.

In response, petitions and public protests, even warning about the potential submergence of Persepolis, nearly 50 km away, took place in front of ministries and the Parliament. UNESCO and Iran called on international archaeologists, leading to several teams from countries like France, Germany, Italy, Japan, and Poland visiting the area.[64] During the rescue operations, archaeologists from Japan and Iran, under the leadership of Tsuneki and Zeidi, conducted explorations of caves and rock shelters. These sites covered a period transitioning from the Epipalaeolithic to the Early Neolithic.[65] Additional rescue archaeology activities in the Bolaghi Gorge revealed evidence of Achaemenid presence across multiple sites. Findings encompassed rural settlements, small pavilions, fortified structures, and rock-carved canals. These discoveries have offered unmatched perspectives on the rural landscape of the Achaemenid heartland.[66]However, limited time prevented a comprehensive salvage operation, and they could only conduct emergency work. This episode marked the emergence of 'rescue archaeology' as a common term in the Ministry of Energy and ICAR literature.

The Seimareh Dam archaeological rescue project in Ilam province, western Iran, exemplifies extensive rescue operations that yielded remarkable discoveries but fell short in salvaging numerous archaeological sites within the flooded area. This project, conducted prior to the construction of the Seimareh Dam, contributed to the resurgence of research into Iran's Neolithic period. This work included the excavation of the Early Neolithic site of East Chia Sabz by a team of Iranian archaeologists under the leadership of H. Darabi.[67]

The Seimareh Valley, part of Iran's historically rich landscape, hosts archaeological sites spanning prehistory to the Achaemenid, Parthian, Sassanian, and Islamic periods. The construction of a 180-meter-high concrete dam in this valley began in 2006, with the permit to fill the dam reservoir issued in 2011. The resulting lake, extending over 45 km and covering an area of 63.7 km2, boasts the capacity to generate an annual energy of 673 gigawatt-hours.[68] Despite initial dam studies in 1990, no comprehensive archaeological surveys or rescue operations were conducted or planned at that time. Rescue activities began in 2007, leading to the discovery of more than 103 archaeological sites in the Seimareh Valley, notably the Barz Ghavaleh/Qavaleh site, a significant Sassanian site in Lorestan, western Iran.[69] The subsequent selection of sites focused on those requiring urgent survey and documentation, yielding crucial insights into prehistoric, historical, and ancient periods. Following a two-year hiatus, archaeological research resumed in collaboration between the Research Institute of Cultural Heritage and Tourism and the Ministry of Energy until late 2013.[70] In late 2014, an Italian team, headed by the University of Naples, collaborated with ICAR on the archaeological site of Lelar Central in the Seimareh Dam region.[71]

While initial excavations at the Seimareh Dam uncovered 103 sites, it is believed that the true number exceeds this estimate. The identification and excavation of additional sites were hindered by several factors, such as unsuitable timing, resource shortages, and the pressing necessity to complete operations prior to the filling of the dam's reservoir.[72]After the water level receded, an opportunity for further excavation emerged. The excavation seasons produced diverse findings, including architectural remains, pottery pieces, stuccos, and glass artefacts. Unfortunately, a significant portion of the plaster and stucco decorations found within the architectural remains was lost due to submergence.[73] The rushed rescue excavations at the Seimareh Dam were inadequate and only uncovered a small portion of the extensive heritage of this vast site. Numerous significant sites, including the Sasanian Palace of Qaleh Guri in Ramavand, drowned in the dam lake. Despite assurances that dam filling would be postponed until the end of excavations, water impoundment began midway through the process, compelling archaeolo-

[61] *Ibidem,* 188.
[62] Helwing, Seyedin 2009, 1.
[63] Rouhani 2009; Tabasi 2022, 2.
[64] Jones, Mozaffari, Jasper 2017, 13.
[65] Matthews, Fazeli Nashli 2022, 55.
[66] Atayi, Boucharlat 2009; Askari Chaverdi, Callieri 2016; Matthews, Fazeli Nashli 2022, 473.
[67] Matthews, Fazeli Nashli 2022, 55.
[68] Niakan 2016, ش.
[69] Hourshid, Mousavi Haji 2015, 106.
[70] Niakan 2016, ش.
[71] Genito, Niakan 2016, 319.
[72] Seyyedin Boroojeni 2016, 5.
[73] Hassanpoor 2016, 263.

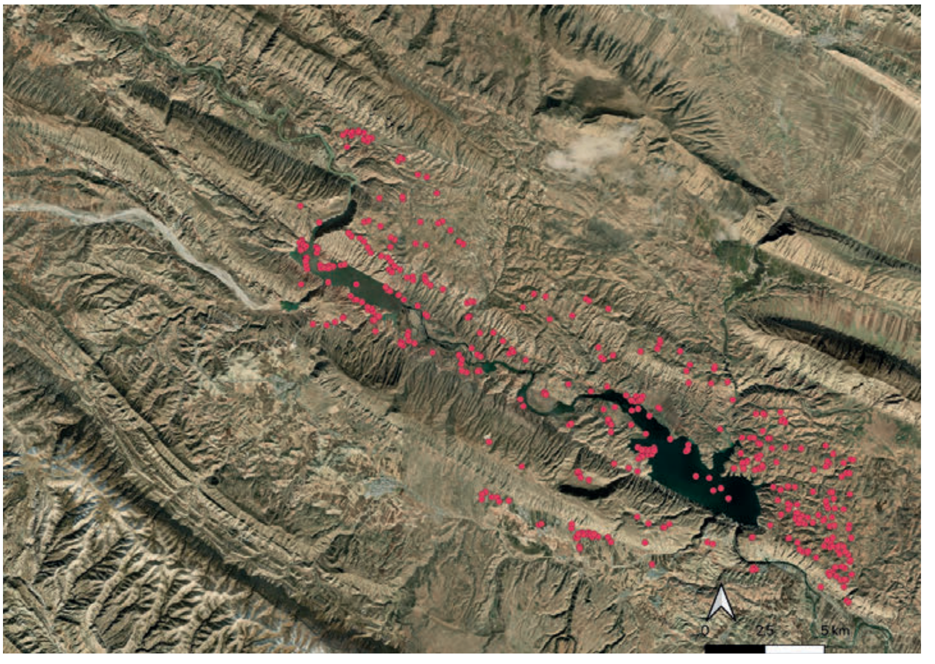

Fig. 4 - The potential heritage sites identified in the Seimareh Dam area, recorded in the EAMENA Database. https://database.eamena.org/

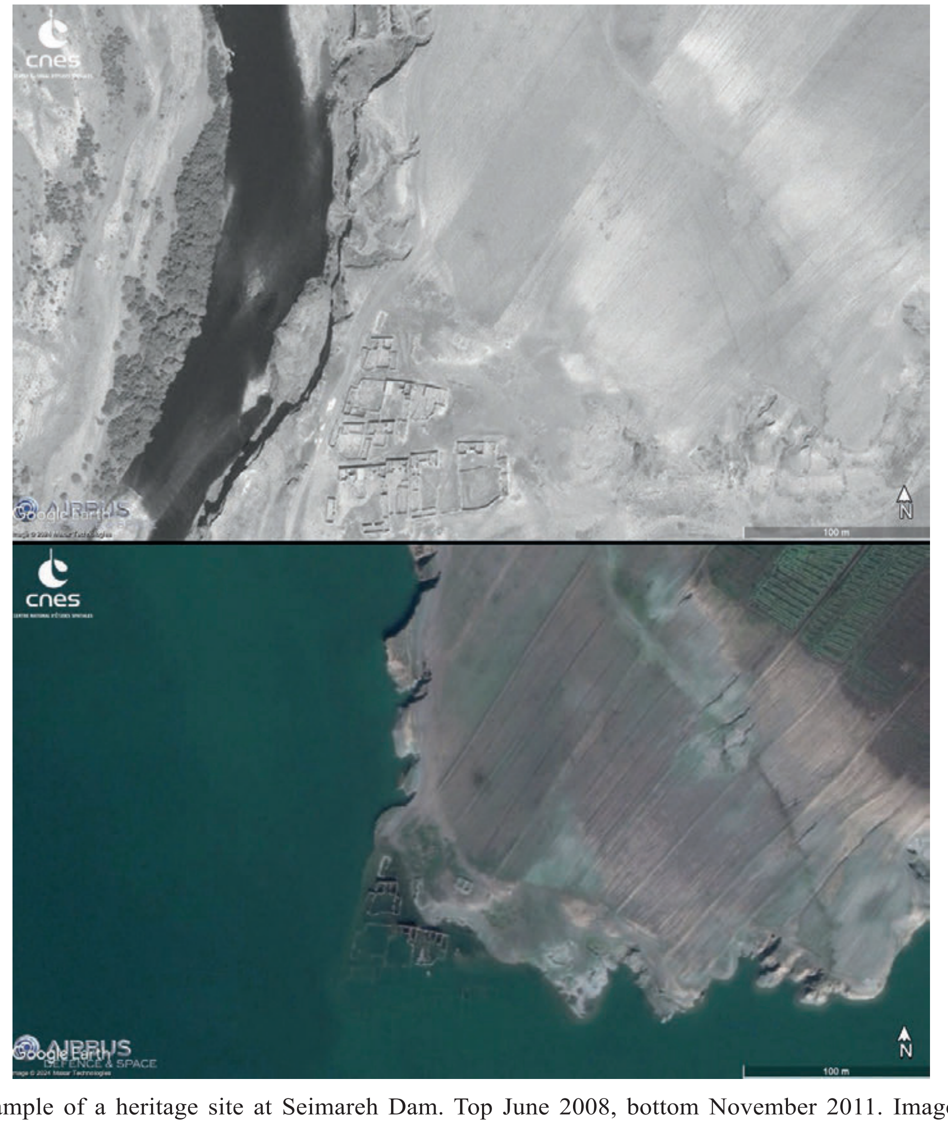

Fig. 5 - An example of a heritage site at Seimareh Dam. Top June 2008, bottom November 2011. Images © Google Earth.

gists to abandon the site. Hasanpoor, one of the archaeologists who excavated in this area, later told the media that a Sasanian city discovered alongside the palace also went underwater. Prehistoric caves dating back 12,000 years and some Neolithic sites were submerged as well.[74]

The submergence of natural landscapes, farms, orchards, and villages, followed by the forced migration of local people, has been another negative impact of this project, which has not yet received significant attention from cultural and social perspectives.[75]

Remote sensing is a highly effective technique for identifying and documenting endangered sites in dam construction and development projects, particularly for conducting rapid surveys over large areas. In Southwest Asia, remote sensing techniques have been used to examine the impacts of dam construction on cultural heritage[76] and to quantify the archaeological evidence within dam reservoir basins before dam construction.[77] In Iranian archaeology as well, some limited research has employed remote sensing methods to examine the impact of environmental changes on cultural heritage[78], to interpret the environmental characteristics of ancient landscapes[79], and also to assess various risks and damages that archaeological sites face.[80] Our analysis of diverse rescue archaeology initiatives and the corresponding published research shows that in Iran, the application of remote sensing techniques in rescue archaeology, particularly at an organisational level, is infrequent. Consequently, these techniques have not yet become significant in the emergency surveying of large areas at risk of flooding from dam projects.

The Endangered Archaeology in the Middle East and North Africa (EAMENA) project, hosted at the University of Oxford and in collaboration with the Universities of Durham and Leicester in the UK, utilises open-access satellite imagery and the web-based Arches database (https://database.eamena.org) to document endangered heritage sites across 20 countries from Afghanistan and Iran to Mauritania in the MENA region. The project has documented around 400 sites in the vicinity of the Seimareh Dam, showcasing the substantial potential of this methodology for creating accessible records of at-risk archaeological sites (Figure 4). Alarmingly, some of these recorded sites have now become submerged under the dam's reservoir (Figure 5).

The compilation of the dataset adheres to the EAMENA project's structured approach to identify and catalogue endangered archaeological sites. This process extensively employs open-access remote sensing data, predominantly from Google Earth satellite imagery, collected over time from providers, such as CNES/Airbus and Landsat/Copernicus, as well as published research and records. To ensure thorough coverage, the project area is systematically divided into grid squares, each measuring approximately 0.25 degrees by latitude and longitude, equivalent to about 25 by 27 kilometres. This gridding technique facilitates the systematic visual inspection of satellite images for each grid, enabling the detection and documentation of changes to heritage places, notably for areas impacted by the Seimareh Dam, analysed using Google Earth's historical imagery feature from 2008 to 2020.

All collected data is catalogued in the EAMENA database, which employs various resource models to detail heritage places, built components, bibliographic entries, and comprehensive condition assessments. Now in its fourth iteration, the EAMENA database serves as an advanced online geospatial platform hosted on the Arches platform. This open-source software is developed by the Getty Conservation Institute and the World Monuments Fund.

By applying the FAIR principles[81] to its online database, EAMENA enhances data management through the use of unique resource identifiers (making the data Findable), enabling open access (ensuring it is Accessible), and ensuring compliance with ontologies (making it Interoperable), which collectively make cultural heritage data shareable and Reusable.[82] The EAMENA database thus promotes collaboration, supports large-scale analysis, and aids in informed decision-making by improving data accessibility and reuse.

Discussion and conclusion

The extensive dam construction in Iran, particularly from the 1950s onwards, has catalysed a complex interplay between development objectives and the preservation of cultural heritage. This intersection presents both challenges and opportunities for enhancing the legislative framework and practices surrounding heritage conservation in the context of dam projects. Despite efforts by Iranian institutions such as ICAR, ICHHTO, and MCTH, significant gaps remain in integrating cultural heritage considerations effectively into dam construction policies and operations.

While recent developments in Iran's legal framework, such as the enactment of laws mandating the inclusion of cultural and historical impact assessments in development projects, represent progress,

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[74] Hassanpoor 2024.
[75] Seyyedin Boroojeni 2016, 5.
[76] Marchetti *et alii* 2019.
[77] Zaina, Tapete 2022.
[78] Rouhani, Huet 2024.
[79] Mortazavi, Mosapour Negari, Khosravi 2015.
[80] Zaina, Nabati Mazloumi 2021.
[81] https://www.go-fair.org/fair-principles/ (Accessed 08 April 2024)
[82] Rouhani, Huet 2024, 2.

there is still considerable room for enhancement. Legislation should explicitly require the integration of cultural heritage preservation into the lifecycle of dam projects, from planning and design to implementation. This integration could include mandating comprehensive cultural heritage impact assessments before project approval, establishing clear protocols for rescue archaeology, and ensuring adequate funding and resources for these activities. Furthermore, policies should facilitate the establishment of interdisciplinary teams comprising archaeologists, ecologists, engineers, and social scientists to ensure a holistic assessment and management of projects.

One of the critical shortcomings identified is the reactive nature of cultural heritage preservation efforts, often initiated in the later stages of dam construction. This approach has resulted in rushed and sometimes inadequate rescue operations, leading to the irreversible loss of both tangible and intangible heritage. The discussion underscores the necessity of embedding cultural heritage considerations into the early planning phases of dam projects, advocating for a proactive and integrated approach.

There is a need for a stronger research agenda that not only focuses on emergency rescue operations but also invests in understanding the broader impacts of dam construction on cultural landscapes. Incorporating heritage in sustainable development plans emerges as a pivotal strategy. This involves considering cultural heritage as an integral component of the environmental impact assessments (EIAs) for dams, ensuring that heritage preservation is not an afterthought but a fundamental consideration from the project's inception.

Intangible cultural heritage, including traditional knowledge systems and practices, is often inextricably linked with the physical landscape. The submergence of landscapes due to dam construction risks erasing these vital cultural narratives and identities. Highlighting the importance of intangible and living heritage, the paper advocates for a more inclusive approach to stakeholder consultation. The current approach, primarily focused on physical rescue operations, often overlooks the multifaceted impacts of dam projects on cultural landscapes and the social fabric of affected communities. This oversight calls for a broader, more holistic framework that encompasses not only the preservation of physical sites and artefacts but also the safeguarding of intangible cultural heritage and the well-being of local communities. Engaging local communities and stakeholders in the planning of dam projects is crucial. This engagement should aim to understand and incorporate their needs, values, cultures, and knowledge, particularly in relation to traditional water management systems and practices, into dam construction and heritage preservation efforts.

The advancement in remote sensing, online databases, and GIS technologies offers unprecedented opportunities for the identification, documentation, and monitoring of heritage sites. The adoption of these technologies should be accelerated and integrated into a national strategy for cultural heritage preservation in the context of development projects. This strategy could involve the creation of a centralised, accessible digital repository of heritage sites, incorporating both tangible and intangible aspects. Such a repository would not only facilitate the planning and implementation of dam construction projects but also enhance public awareness and education on Iran's cultural heritage.

Addressing the challenges posed by dam construction to cultural heritage preservation requires building institutional and professional capacity within Iran. This involves not only training in advanced archaeological and conservation techniques but also in project management, community engagement, and impact assessment methodologies. Establishing partnerships with international organisations, academic institutions, and NGOs could facilitate knowledge exchange and capacity building, offering Iranian professionals exposure to global best practices in heritage preservation.

In reimagining the approach to dam construction and cultural heritage preservation in Iran, it is clear that a shift towards more integrated, participatory, and technologically enabled practices is necessary. By embedding cultural heritage considerations into the DNA of development projects, engaging local communities as active stakeholders, and leveraging modern technologies for heritage documentation, Iran can navigate the path towards sustainable development that honours and preserves its rich cultural heritage. This comprehensive approach not only addresses the immediate impacts of dam construction on cultural heritage but also contributes to the long-term resilience and sustainability of Iran's cultural landscapes and communities.

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Farhad Nazari (1975-2024) passed away during the final stages of preparing this article. He dedicated over 20 years of his career to researching and actively protecting cultural heritage in Iran, both as a researcher and a heritage professional. RIP.

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Ayşe Tuba Ökse*

DAM PROJECTS AND ARCHAEOLOGICAL HERITAGE IN THE UPPER TIGRIS REGION

Abstract

The establishment of dams occupying wide areas causes large-scale risks to the cultural heritage. Flooding destroys submerged archaeological deposits, although the excavated areas are covered with geotextile and filled with earth. Since water disintegrates archaeological contexts, these sites cannot be excavated properly anymore. Moreover, the archaeological sites in the irrigation zones are also at risk. Salvage projects concerning the archaeological heritage submerged by a total of 15 dams constructed on the Upper Tigris region began in 1990. The excavations were carried out in the reservoir area of the Batman Dam and continued in the Ilısu Dam and affected more than 300 archaeological sites. During *ca*. 20 years, 42 sites have been excavated. In 2018 began salvage excavations at the Silvan Dam-Complex consisting of eight smaller reservoirs on northern tributaries of the Tigris River. Although intensive field surveys and salvage excavations have been carried out in all these dams, the time was too short for excavating sites with deep archaeological deposits. Although an immense amount of data is provided, only *ca*. 8% of several mounds have so far been excavated. In order to put forward a feasible work-plan and adequate budget for long-term fieldwork, intensive surveys, including remote sensing and measuring the depth of deposits should be conducted already during the planning of the dam. For instance, according to intensive surveys at the construction area of the Ilısu Dam, half of the sites have been rescued by re-designing the construction, and a feasible work-plan based on depths of archaeological deposits measured from drill cores enabled sufficient work at the remaining sites. A more effective solution would be bringing alternative ways into action, instead of constructing dams.

Keywords

Ilısu Dam, Ambar Dam, Silvan Dam, Batman Dam, salvage project, Upper Tigris

1. Introduction

Cultural Heritage, defined by the International Council on Monuments and Sites (ICOMOS) as "an expression of the ways of living developed by a community and passed on from generation to generation, including customs, practices, places, objects, artistic expressions and values", [1] is affected by large-scale development projects. Establishment and enlargement of urban settlements, industrial zones, ports, airports, power plant stations and dams occupying wide areas are vital needs for modern societies. These cause large-scale problems for Cultural Heritage, which provides crucial data on the history of humanity.

Dams meet the needs of society; however, the damage they cause to cultural and natural heritage is tremendous. These affect larger areas along the valleys, where the historical settlements were established and several data can be collected from their surroundings, witnessing how the settlers used their environment.

Several archaeological sites all over the world have disappeared because of the erection of dams[2]. Under the organisation of UNESCO, several temples and cemeteries in the flooding area of the High Dam ca. 7 kilometres south of the Aswan Dam on the Nile Valley have been moved to higher elevations;[3] on the other hand, archaeological fieldwork could not be organized properly. Similarly, 300 dams of different dimensions are under construction in Turkey; however, archaeological projects have only been carried out at nearly one-tenth.[4]

In Turkey, archaeological heritage projects concerning dam reservoirs began with the construction of the Keban Dam on the Upper Euphrates Valley and continued with a series of dams built along the Middle Euphrates and the Upper Tigris valleys, within the frame of the Southeast Anatolian Project. The project incorporates 22 dams on the Euphrates and Tigris rivers and tributaries, located in the contact zone of the North Mesopotamian plains and the intermontane plains of Eastern Anatolia, where significant archaeological heritage is concentrated.[5]

Prior to the Ilısu Dam rescue project, the South-Eastern Anatolia Project Regional Development Administration organized a Symposium on the "Protection, Survival and Promotion of Cultural Heritage in the Region".[6] The final declaration emphasizes the

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[1] Desvallées, Mairesse 2010, 15-21, 39-42.

[2] ICOMOS 2000, 10.

[3] Adams 1968; Säve-Söderbergh 1971-72.

[4] Kömürcü 2002, 274-275.

[5] Özdoğan 2000; 2006.

[6] Vv.Aa. 2000.

need to organize excavations following the "Keban Dam Model" to create a regional archive of diverse documents, offer comprehensive support to projects, establish a monitoring mechanism, and develop modern regional museums. Salvage excavations were organized by the General Directorate of Cultural Assets and Museums and funded by the State Waterworks.[7] Since 1990, freelance and professional archaeologists have been employed in order to carry out long-lasting excavations and documentation. Even then, although a significant amount of data was obtained in these projects, most of the archaeological heritage affected by dams remained unexcavated.

In this paper, the archaeological salvage investigations concerning the dams of the Upper Tigris basin and its tributaries are presented. The most effective impact of dams on the archaeological heritage is the execution of the research only in limited areas, based on timing and funding. To increase the competence of salvage projects, the necessary legislation procedural regulations and plans for the most efficient use of time are discussed. From the very beginning of construction projects, people from different fields of expertise should be included in the decision-making mechanism of these projects in order to protect some sites from large-scale investments. It is also argued, how these projects should be structured before, during and after the construction of the dams, and how collaboration between institutions and teams can be achieved.

2. Legal Framework and Conventions

In Turkey, the constitution established in 1982, Article 63, along with Law no. 2863 on Conservation of Cultural and Natural Property that came into force in 1983, and No. 3386 in 1987. Both of them define cultural and natural property as objects of public domain belonging to the state, and provide the legal framework for their protection and conservation.[8] For all these areas, Law no. 2863, Article 17 requires a 'Landscaping Project and Conservation Development Plan'. Accordingly, all registered sites are under protection by law, regulating any intervention, including change of status, destruction, construction, management, and rescue excavations.

Stressing the importance of international cooperation, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has adopted international conventions on the protection of Cultural Heritage.[9] The Turkish government signed the UNESCO Convention on the Protection of the Archaeological Heritage adopted in Paris in 1972.[10] The declaration deals with the protection of global cultural and natural heritage, defined as part of the world heritage of mankind as a whole. The convention emphasized the importance of "an effective system of collective protection of the cultural and natural heritage of outstanding universal value, organized on a permanent basis and in accordance with modern scientific methods". Countries that have signed this convention agree to take effective and active measures for the protection, preservation and presentation of the cultural and natural heritage in their territories.

The ICOMOS Charter for the Protection and Management of the Archaeological Heritage, held in Lausanne in 1990, emphasizes effective collaboration between professionals and academics, authorities, public institutions, private organizations, and the public itself, for the protection and proper management of the archaeological heritage belonging to all of humanity[11]. The principles relating to archaeological heritage management under the responsibility of public authorities and legislators include inventarisation of the heritage, survey, excavation, documentation, research, maintenance, conservation, preservation, reconstruction, information, presentation, public access and use. Article 2 emphasizes the development of cultural, environmental and educational policies relating to land use and development. The Paris Declaration on Heritage as a driver of development in 2011 proposes principal rules to prevent cultural heritage from being seen as an obstacle to development, and rather to become its part.[12]

The European Convention for the Protection of the Archaeological Heritage at Valetta in 1992[13] states that archaeological heritage is seriously threatened with deterioration due to increasing planning schemes, natural risks, unscientific excavations and insufficient public awareness, and emphasizes the creation of administrative and scientific supervision procedures for urban settlement planning and for investments. According to Article 2, each party undertakes the protection of the archaeological heritage including its inventory, preservation, reporting and making them available to the public.

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[7] Özdoğan 2013, 4-7; Eroğlu 2022, 73 records 134.539.740 TL for the funding of the Ilısu Dam salvage excavations from 1998-2019. Salvage Excavations at Dams and Public Investment Areas licensed by the General Directorate of Cultural Assets and Museums. Available at https://kvmgm.ktb.gov.tr/TR-44150/kazi-ve-yuzey-arastirmalari-faaliyetleri.html (Accessed 25.07.2023)

[8] Kömürcü 2002, 270-273.

[9] UNESCO 2013; 1972; 2010.

[10] Available at https://whc.unesco.org/archive/convention-en.pdf (Accessed 01.07.2024)

[11] Hodder 2010, 262. See also Charter for the Protection and Management of the Archaeological Heritage (1990), available at https://www.icomos.org.tr/?Sayfa=Icomostuzukleri&dil=tr (Accessed 28.06.2024).

[12] Available at https://www.icomos.org.tr/?Sayfa=Icomostuzukleri&dil=tr (Accessed 28.06.2024).

[13] Available at https://rm.coe.int/168007bd25 (Accessed 01.07.2024)

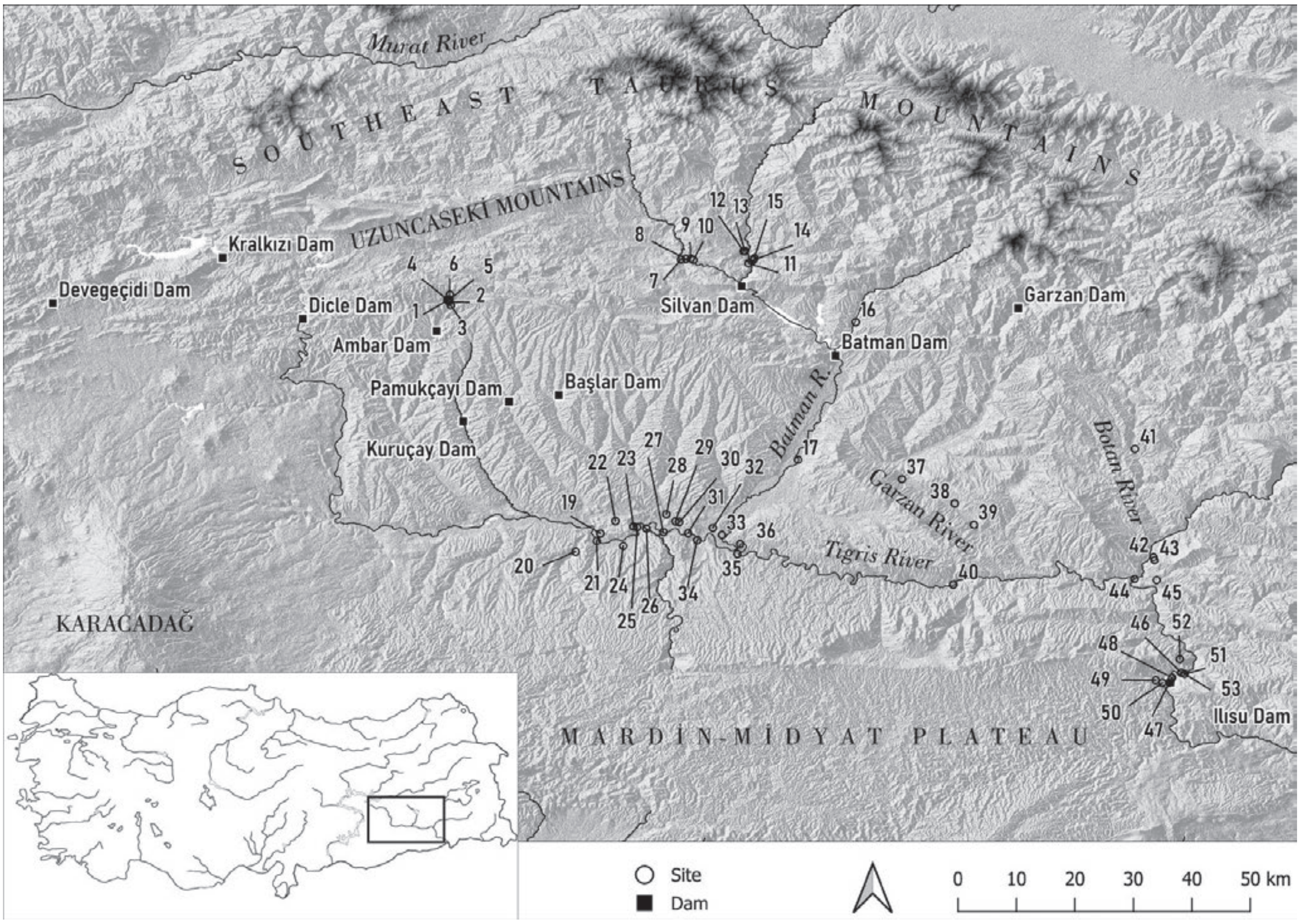

Fig. 1 - **Map of Sites Mentioned in the Text** (Prepared by Şakir Can): 1. Ambar Höyük, 2. Gre Fılla, 3. Kendale Hecala, 4. Ambar rock-cut tomb, 5. Şeyh Şerafettin rock-cut dwelling, 6. Şeyh Şerafettin watermill, 7. Taşköprü Goderne bridge, 8. Taşköprü rock-cut tomb, 9. Taşköprü fountain, 10. Taşköprü rock-cut tomb, 11. Güleç rock-cut tomb, 12. Güleç Church, 13. Güleç cistern, 14. İnkaya rock-cut tomb, 15. İnkaya cistern, 16. Hallan Çemi, 17. Demirköy, 18. Kavuşan Höyük, 19. Giricano, 20. Yenice Yanı, 21. Hakemi Use, 22. Boztepe, 23. Kenan Tepe, 24. Ziyaret Tepe, 25. Karavelyan, 26. Aluç, 27. Gre Abrudahman, 28. Talavaş Tepe, 29. Salat Cami Yanı, 30. Salat Tepe, 31. Aşağı Salat, 32. Gre Dimse, 33. Körtik Tepe, 34. Müslümantepe, 35. Hirbemerdon, 36. Kuriki Höyük, 37. Sumaki Höyük, 38. Gre Amer, 39. Çemialo, 40. Hasankeyf, 41. Başur Höyük, 42. Türbe Höyük, 43. Motit Kalesi, 44. Çattepe, 45. Gusir Höyük, 46. Zuraki 11Zeri, 47. Ilısu Höyük, 48. Kilokki Rabiseki, 49. Zeviya Tivilki, 50. Boncuklu Tarla, 51. Zeviya Kavla, 52. Tatıka, 53. Havuz Mevkii.

3. The Dams and Salvage Projects in the Upper Tigris Region

The Upper Tigris region, the subject of this paper, is at the northernmost part of Mesopotamia, bordered by the South-Eastern Taurus range, the Karacadağ Massif and the Mardin-Midyat Plateau. The region forms an agricultural area of ca. 700,000 ha, fed by several tributaries; the streams of Ambar, Kuruçay, Pamuk, Salat, Batman, Garzan, Botan, Hizan and Reşan flow from the north, and Göksu and Savur from the south.

Maden Suyu is one of the sources of the Tigris River, starting from the Hazarbaba Dağı. Kralkızı Dam was built on this stream in 1997, the Dicle Dam at the conjunction of Maden Suyu with the Dibni Çay in 1986,[14] and the Devegeçidi Dam on the Devegeçidi Çayı in 2010 (Figs. 1-2). The Tigris River creates a 120 m wide valley to the east of Diyarbakır, turns south from the conjunction of the Botan River, and flows through narrow canyons between the Mardin-Midyat Plateau and the Gabar Mountains. The valley is flooded by the Ilısu Dam, built 65 km upstream of the intersection of the Turkish, Syrian and Iraqi borders in 2019. The upper course of the Batman Çay is flooded by the Batman Dam in 1999, the upper course of the Garzan Çay by the Garzan Dam in 2012, and the Botan Çay by the Çetin Dam in 2020.

[14] For the metric information given on the dams, see: https://bolge10.dsi.gov.tr/Sayfa/Detay/1066.

Dam	Lake Area (km^2)	Irrigation Area (ha)	Salvage Project	Surveyed Sites	Excavated Sites
Batman	49.25	37.744	1991-1993	26	2
Ilısu	313.00	2.000.000	1999-2018	300	37
Ambar	5.30	123.25	2018-2022	10	10
Silvan	190.00	245.000	2022-2024	10	5

Fig. 2 - Table of Dams and Salvage Projects of the Upper Tigris Region (Source available at https://bolge10.dsi.gov.tr/; https://dsi.gov.tr/ Accessed on 28.07.2023).

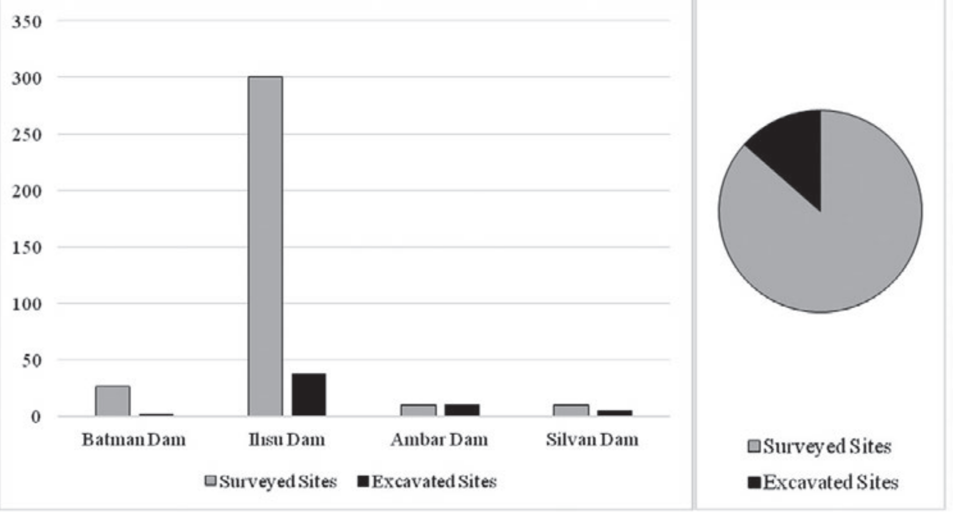

Fig. 3 - Frequency of Excavated Sites.

The Ambar Dam flooded the upper course of the Ambar Çay in 2023. The Silvan Dam Complex, built in 2011, is composed of small irrigation dams built on the small streams to the north of the Tigris Valley; the Silvan, Ergani, Çermik, Başlar, Kuruçay, Kıbrıs, Karacalar and Bulaklıdere. The reservoir areas of these dams were visited before the construction started, and cultural assets were identified only in the reservoirs of the Batman and Ilısu dams and the Silvan dam complex, including the Ambar Dam.

3.1 *Batman Dam*

The flooding area of the Batman Dam was surveyed in 1990 and 26 sites have been identified.[15] Excavations were carried out at two sites, making 7.7% of the total[16] (Figs. 2-3). Excavations at Hallan Çemi and Demirköy revealed the settlements of hunter-gatherer communities in Pre-Pottery Neolithic A. Only 11.5 % of Hallan Çemi and only 100 m^2 of Demirköy have been so far excavated (Figs. 4-5).

3.2 *Ilısu Dam*

The area to be flooded by the Ilısu Dam had been surveyed between 1989 and 2010, and about 300 sites have been discovered.[17] Unfortunately, it was not possible to excavate all archaeological deposits.[18] Salvage excavations were carried out in 37 sites between 1998 and 2018, making 13.3% of the total[19] (Figs. 2-3). Most of these are large multi-period mounds; in fact, excavations in these mounds should have lasted

[15] Rosenberg, Togul 1991.

[16] See Kazı Sonuçları Toplantısı vol. 14-16. Available at https://kvmgm.ktb.gov.tr/TR-238493/kazi-sonuclari-toplantisi-02---35.html (Accessed 25.07.2023)

[17] Algaze *et alii* 1991. For later survey reports see Araştırma Sonuçları Toplantısı vol. 22-27. Available at https://kvmgm.ktb.gov.tr/TR-44761/arastirma-sonuclari-toplantilari.html (Accessed 25.07.2023)

[18] Kitchen, Ronayne 2001; Shoup 2006; Hodder 2010, 878-879.

[19] Eroğlu 2022. The information given below is obtained from the preliminary reports in Tuna, Öztürk 1999; Tuna, Öztürk, Velibeyoğlu 2001; Tuna, Velibeyoğlu 2002; Tuna, Greenhalgh, Velibeyoğlu 2004; Tuna, Doonan 2011; Vv. Aa. 2013; 2018 and Kazı Sonuçları Toplantısı vol. 23-41. Available at https://kvmgm.ktb.gov.tr/TR-238493/kazi-sonuclari-toplantisi-02---35.html and https://kvmgm.ktb.gov.tr/TR-238494/kazi-sonuclari-toplantisi-36---.html (Accessed 25.07.2023) as well as monographic final reports Radner 2004; Laneri 2016; Ökse *et alii* 2014; 2015a; 2018; 2024; Schachner 2020; Özkaya, Coşkun, Soyukaya 2013; Matney *et alii* 2017.

Dam	Excavated Site			Excavated Area	
	Site Name	Height(m)	Area (m^2)	Height(m)	Area (m^2)
Batman	Hallan Çemi	4.3	7.500	4.3	612
	Demirköy	7	30.000	2	100
Ilısu (Western part)	Yenice Yanı	6	12.000	2	28
	Hakemi Use I-II	4	12.000	4	2.000
	Karavelyan	1	15.000	1	1.000
	Kavuşan Höyük	9	13.000		2.000
	Giricano	25	24.000	2	5.000
	Boztepe	4	?	2	1.200
	Kenan Tepe	33	45.000	3	2.200
	Ziyaret Tepe	22	320.000	5	8000
	Gre Abdurrahman	5	5.600	?	850
	Salat Cami Yanı	2	28.600	2	600
	Salat Tepe	30	11.500	10	1.500
	Aşağı Salat	3.5	15.000	3	1.500
	Müslüman Tepe	23	200.000	?	13.700
	Gre Dimse		31.400		2.000
	Körtik Tepe	5.5	15.000	5	3.325
	Kuriki Höyük 1-2	2	37.500	2	7.100
	Hirbemerdon	32	30.000		1.440
Ilısu (Garzan Valley)	Sumaki Höyük	3.5	37.500	2	2.180
	Gre Amer		90.000		6.500
	Çemialo Sırtı	2	70.000	2	3.700
Ilısu (Tigris Valley)	Hasankeyf		500.000		
	Hasankeyf Höyük	8	17.600	8	1000
Ilısu (Bothan Valley)	Başur Höyük	15	37.500	4	3.900
	Türbe Höyük	4	1.800	4	1.700
	Çattepe	9	50.000		1.200
	Gusir Höyük	8	18.000	3	2.500
Ilısu (Construction Area)	Ilısu Höyük	1.5	120.000	1.5	6.100
	Zeviya Kavla	1.5	32.500	1.5	500
	Kilokki Rabiseki	1.2	20.000	1.2	900
	Zeviya Tivilki (Kumru Tarlası)	1.5	5.000	1.5	5.000
	Çelebitepe	1.2	3.300	1.0	100
	Zuraki Zeri	1.2	93.000	1.2	200
	Tatıka	1.5	5.000	1.5	1.400
	Deşta Mira 1	1	3.500	1	100
	Havuz Mevkii	1	11.000	1	1.800
	Kavile Saruhan	2	51.000	2	100
	Boncuklu Tarla	2	26.000	2	150
Ambar Dam	Ambar Höyük	11	10.000	4	100
	Gre Fılla	6	15.000	6	1500
	Kendale Hecala	3.5	7.000	3.5	2000
	Rock-Cut House & Tomb, Winery				
Silvan Dam	Rock-Cut Tomb, Cistern, Church,				

Fig. 4 - Table of Excavated Sites within Dam Projects (Source in footnotes 17-18, 20, 23, 36-39).

Dam	Excavated Sites	1	2	3	4	5	6	7	8	9	10	11	12
Batman	Hallan Çemi	■											
	Demirköy	■											
Ilısu (Western part)	Yenice Yanı				■	■				■			
	Hakemi Use			■					■	■		■	
	Karavelyan			■									■
	Kavuşan Höyük						■	■	■	■	■	■	■
	Giricano				■	■	■	■	■	■	■	■	
	Boztepe			■						■	■		
	Kenan Tepe				■	■	■	■		■			
	Ziyaret Tepe						■	■	■	■			■
	Gre Abdurrahman									■		■	
	Salat Cami Yanı			■								■	
	Salat Tepe				■	■	■	■		■	■	■	■
	Aşağı Salat				■	■	■			■		■	
	Müslüman Tepe					■	■	■	■	■	■	■	
	Gre Dimse								■	■	■		
	Körtik Tepe	■											
	Kuriki Höyük				■	■				■	■	■	
	Hirbemerdon					■	■	■		■	■	■	
Ilısu (Garzan Valley)	Sumaki Höyük		■	■								■	
	Gre Amer						■	■		■	■		
	Çemialo Sırtı				■	■		■	■	■		■	
Ilısu (Tigris Valley)	Hasankeyf										■	■	■
	Hasankeyf Höyük	■								■	■		
Ilısu (Bothan Valley)	Başur Höyük				■	■	■	■	■	■	■	■	
	Türbe Höyük			■	■	■	■	■	■	■			■
	Çattepe					■	■	■		■	■	■	
	Gusir Höyük	■											
Ilısu (Construction Area)	Ilısu Höyük										■	■	■
	Zeviya Kavla										■	■	
	Kilokki Rabiseki									■	■		
	Zeviya Tivilki (Kumru Tarlası)									■			
	Çelebitepe									■			
	Zuraki Zeri							■		■	■	■	
	Tatıka						■						
	Deşta Mira 1					■							
	Havuz Mevkii				■								
	Kavile Saruhan			■								■	
	Boncuklu Tarla		■										
Ambar Dam	Ambar Höyük			■			■	■		■	■	■	■
	Gre Fılla	■	■	■							■	■	
	Kendale Hecala			■	■							■	
	Rock-cut House, Tomb, Winery											■	
Silvan Dam	Rock-cut Tomb, Cistern, Church,										■	■	

Fig. 5 - **Table of Periods:** 1. Pre-Pottery Neolithic A, 2. Pre-Pottery Neolithic B, 3. Pottery Neolithic A, 4. Early Chalcolithic, 5. Late Chalcolithic, 6. Early Bronze Age, 7. Middle Bronze Age, 8. Late Bronze Age, 9. Iron Age, 10. Hellenistic-Roman Period, 11. Middle Age, 12. New Age (Source in footnotes 17-18, 20, 23, 36-39).

decades. On the other hand, some small-scaled single-period sites with deposits between 0.5-0.7m and 1.0-1.5m on the bedrock, mostly recognizable as an archaeological site through intensive surveys, were also excavated (Figs 4-5). The excavations have been organized under the co-direction of three regional museums; 18 by the Diyarbakır Museum, 10 by the Batman Museum, and 11 by the Mardin Museum.

On the Tigris valley to the West of the Salat River, salvage excavations were conducted at 17 sites. Only 0.2% of Yenice Yanı, a site occupied during the Chalcolithic period and the Iron Age, has been excavated. About 17% of Hakemi Use I has been uncovered. The site was inhabited in the Pottery Neolithic period, and after a long gap, became a rural settlement in the Late Bronze and Iron Ages. In the Middle Ages, the mound became the graveyard of a rural settlement (Hakemi Use II) established nearby. The excavations at the nearby site of Karavelyan, occupied in the Late Pottery Neolithic period and recently used as a cemetery, cover only 6.6% of the archaeological deposits. About 13.3% of Kavuşan Höyük, a site occupied from the Early Bronze Age onwards, has been excavated. Giricano is a high mound inhabited from the Early Chalcolithic until the end of the Middle Ages; the excavations have covered 10% of the archaeological deposits. At Boztepe, only a small area has been uncovered; the site was occupied in the Pottery Neolithic period, and after a long gap, re-occupied in the Iron Age and in the Hellenistic period. The settlement at Kenantepe began in the Early Chalcolithic Period, continued until the end of the Middle Bronze Age, and after a gap, once more in the Iron Age. Ziyaret Tepe, the provincial centre *Tušhan* of the Neo-Assyrian period, was occupied throughout the Bronze and Iron Ages; the site became a winter pasture of nomadic communities in Middle Age and in modern times. Only 2.5% of the urban settlement with an area of 32 ha could have been excavated. Gre Abdurrahman, a small rural settlement established in the Neo-Assyrian period became a graveyard in the Middle Ages; 15% of the mound could be excavated.

Three mounds are established on the Salat River. The Pottery Neolithic settlement at Salat Cami Yanı became a cemetery in the Middle Age. Since the settlement is overlaid by the modern town, only 2% of the site has been uncovered. The high mound of Salat Tepe was inhabited from the Early Chalcolithic period onwards; ca. 13% of the mound has been recovered. Aşağı Salat is also inhabited during the Chalcolithic period, the Iron Age and the Middle Ages, and an Early Bronze Age cemetery was located at its foot; excavations cover ca. 10% of the mound.

On the Tigris River to the East of the Salat River, the short-lived excavations carried out in a small area at the high mound of Gre Dimse revealed levels from the Late Bronze Age until the end of the Hellenistic period. Körtik Tepe is a Pre-Pottery Neolithic A site located at the conjunction of the Sinan and Tigris rivers; ca. 22% of the site has been recovered.

Three sites are located on the southern shore of the Tigris River. Müslüman Tepe is a large urban site composed of three sectors, Müslümantepe, Hıristiyantepe, and the Early Bronze Age cemetery. The mounds are occupied from the Late Chalcolithic period until the end of the Middle Age. Only 6.8% of the site has been uncovered. The high mound of Hirbemerdon and its lower settlement revealed a sequence from the Late Chalcolithic period until the end of the Middle Age; only 4.8% of the site has been so far excavated. At Kuriki Höyük I-II, levels dating to the Chalcolithic period, the Iron Age, Roman Period and the Middle Age have been recovered at 19% of the total area.

On the Tigris valley to the East of the Batman River and on the Garzan valley, five mounds have been excavated. The Pre-Pottery and Pottery Neolithic site of Sumaki Höyük became a cemetery in the Middle Ages; 5.8% of the mound has been uncovered. The excavations carried out at ca. 16.3% of Gre Amer brought out settlement levels dating from the Early and Middle Bronze Ages, the Iron Age and Hellenistic period within 7.2% of the total area. At Çemialo, Chalcolithic period, Middle and Late Bronze Ages, Iron Age and Middle Age levels have been recovered in an excavated area of 5.2%. Hasankeyf, the capital of the Artuqids has been excavated since 1986, and a total of 808 historical buildings have been inventoried. The Pre-Pottery Neolithic site of Hasankeyf Höyük, located opposite to the ancient city, was occupied further in the Iron Age and the Hellenistic period; excavated area is ca. 6% of the total.

Five sites are located on the Botan valley. The excavations at Başur Höyük, covering ca. 10.3% of the mound, revealed a complete sequence from the Early Chalcolithic period to the Middle Age, and at Türbe Höyük, excavations covered ca. 94% of the mound from the Pottery Neolithic period until the Iron Age. Çattepe (Tilli, Tell-Fafan) appeared to had been a fortified port-castle from the Late Roman Period onwards. Within 2.4% of the total area, settlement levels dating to the Late Chalcolithic period, Early and Middle Bronze Ages, and the Iron Age have been recovered. Gusir Höyük is a Pre-Pottery Neolithic A site; the excavations have been carried out at ca. 14% of the mound.

At the construction area of the Ilısu Dam, 11 sites have been excavated[20]. At the northern ridge of Ilısu Höyük, a Roman castellum, and at the eastern slope, a rural Middle Age settlement associated with smelting ovens have been recovered; the excavated areas make ca. 5% of the mound. The modern village is

[20] Ökse 2019.

relocated.[21] The villages of Ilısu and Kavile Saruhan, a water mill and two thermae represent the traditional rural architecture. A rural Roman settlement is recovered at Zeviya Kavla (ca. 1.5% of the mound), and three rural sites were inhabited by indigenous communities in the Neo-Assyrian period. Zeviya Tivilki (Kumru Tarlası) is completely excavated, the excavations at Kilokki Rabiseki cover ca. 4.5% of the site, and at Çelebitepe 3%. The Middle Bronze Age settlement at Zuraki Zeri is only excavated at ca. 0.2% of the mound. According to ca. 28% excavated area, Tatıka appears to have been a graveyard associated with mortuary structures in the first half of the Early Bronze Age. At Havuz Mevkii, a small rural settlement inhabited in the Early Chalcolithic Period, 16.5% of the mound has been uncovered. Small areas have been excavated at three sites. Deşta Mira 1 (ca. 3%) revealed Late Chalcolithic material, Kavile Saruhan, Pottery Neolithic and Middle Age material. At Boncuklu Tarla having *ca*. 2 m high archaeological deposit dating to the Pre-pottery Neolithic B is uncovered within an area of ca. 800 m^2; the site is still being excavated.

3.3 *Ambar Dam and the Silvan Dam Complex*

Excavations at the reservoir area of the Ambar Dam were undertaken at three mounds, six rock-cut tombs, a rock-cut dwelling, a winery and a mill in 2018-2022, and at the Silvan Dam Complex at ten sites including rock-cut tombs, cisterns and a church since 2021[22] (Figs 2-5). Gre Fılla was inhabited throughout the Pre-Pottery Neolithic Period, and became a graveyard during the Roman period and the Middle Age; about 10% of the site is excavated. Kendale Hecala was inhabited during the Late Pottery Neolithic and Early Chalcolithic periods, and after a hiatus, in the Middle Age; about 28.5% of the site is uncovered. At Ambar Höyük, only one trench on the eastern terrace is excavated, revealing inhabitancy from the Pottery Neolithic period onwards.

4. Structuring Archaeological Salvage Projects

Salvage projects require a long time to excavate all layers of settlements. The archaeological sites comprise deep archaeological deposits and may extend several kilometres, needing excavations lasting decades. Since the budgets for public investments are allocated only during the construction period, salvage projects cannot start years before the construction, and the time is always too short until the construction is completed, and most of the sites submerge without being sufficiently excavated. Moreover, modern agricultural activities, irrigation canals and new settlements destroy an even larger area around reservoirs. Thus, research and complete documentation become the only method of preserving the cultural heritage.

The impact of dam construction projects on cultural heritage can only be avoided by archaeological research initiated while the dam construction is being planned, and the investments must continue throughout the construction period and after the flood. Essentially, archaeological excavations should continue throughout the year and should be carried out for a long time. At this point, it is important to ensure the employment of a sufficient number of experts and workers. Of course, this is possible with well-planned projects with sufficient budgets.

4.1 *Field Surveys*

Dam reservoirs affect alluvial valleys used by agricultural communities throughout the ages. Thus, intensive surveys must be completed before the construction projects start, and all elements of cultural heritage at risk – archaeological, architectural, areal and tangible – must be documented. According to the European Convention for the Protection of the Archaeological Heritage, Article 7 and ICOMOS Charter, Article 4, each party undertakes the surveys, inventories and maps of archaeological sites for a complete data collection to be used before public investments. The first step for dam projects must be intensive field surveys throughout the whole reservoir and the impact area where new settlements, infrastructure and irrigation systems will be built. Based on this data, either the investment can be relocated, or salvage excavations started.

Mapping the sites in the impact areas by means of satellite imagery, aerial photographs and scanning the area with magnetic resonance devices can enable a better planning of the salvage projects[23]. For instance, the archaeological deposits of the sites can be measured by core drillings, in order to organize the excavation timing. Drill cores taken from the small one-period sites in the construction area of the Ilısu Dam yielded archaeological deposits between 0.5-0.7m and 1.0-1.5m on the bedrock[24]. Accordingly, the excavations have been carried out with a better timetable, and seven sites were entirely excavated before the flood.

[21] Eroğlu 2022,70-80.

[22] Kazı Sonuçları Toplantısı vol. 41 onwards. Available at https://kvmgm.ktb.gov.tr/TR-238493/kazi-sonuclari-toplantisi-02---35.html ; https://kvmgm.ktb.gov.tr/TR-238494/kazi-sonuclari-toplantisi-36---.html (Accessed 25.07.2023)

[23] Cunliffe, De Gruchy, Stammitti 2012, 225; Zaina, Tapete 2022.

[24] Ökse 2015.

4.2 *Excavations*

The European Convention, Article 3-4 and ICOMOS Charter 1990, Article 5 deal with the necessity of preserving archaeological heritage and systematic excavations at sites threatened by development. These are usually intensive long-term studies carried out within a limited period of time. In this context, the Ilısu Dam Project enjoyed only 18 years of fieldwork, and Ambar Dam only five years. Despite this, also small sites – rural settlements or seasonal dwellings – which would generally not have been preferred for excavation otherwise, were integrated into the archaeological data.

The technical equipment may help the excavation teams to save time. At the construction area of the Ilısu Dam, photogrammetric methods were used for architectural plans.[25] The grids were divided into subunits depending on the inclination and dimensions of the area in order to achieve the best right-angle overhead shots. The coordinate points were marked in each sub-unit as clearly visible reference points, allowing subsequent digital merging of photographic segments. These photographs were digitised by a computer design program. Such photographs were taken by drones at the Ambar dam excavations.

4.3 *Material Analysis*

During the fieldwork, only the documentation and restoration of small finds to be delivered to the museum can be completed. If a sufficient number of experts are employed, the other findings such as lithic items, potsherds, animal and human bones or seeds can be classified and statistics can be carried out. Also, context deposits can be washed by flotation, to prepare these for micro-archaeological sorting, depending on the volume of the material.

Lithic items and pot sherds must be described in detail, technical drawings of each one should be made, and photographs should be taken. Also, defining human and animal bones and seeds as well as micro-archaeological sorting of floated material, will require long run times depending on their quantity. Moreover, the data obtained from these studies should be entered into the database, and lists, digitalization of drawings, editing photos, creating typology, combining architectural plans of each level, etc. should be carried out. Thus, the work on documentation and material can be performed after the fieldwork; more precisely, these works need at least as much time as the time spent for working in the field. The processing of information enables the creation of scientific final reports.

4.4 *Preservation*

Preserving archaeological heritage by means of conservation processes and closing the excavated areas is stated in Articles 3-4 of the European Convention. Accordingly, after the excavations end, all excavated areas are covered with geotextiles and the trenches filled with the soil removed during the excavations. This work is supposed to protect the unexcavated archaeological deposits from erosion and from the effects of water. However, archaeological deposits suffer the water pressure and flow. The wave action caused by water level fluctuations, fill rate, slope angle, stability and mechanized agriculture destroys the submerged deposits. The mud brick architecture dissolves as soon as it comes into contact with water, and the architecture becomes like a cairn over time. The contexts diverge and no longer allow reconstructions. Moreover, some dissolved sediments and organic matter may cause chemical reactions that would affect the archaeological findings.[26]

On the other hand, some submerged sites preserved by thick sand layers seem to have been preserved.[27] Likewise, levels of sedimentation deposited in a reservoir may preserve some types of materials, since silt compilation can protect the archaeological remains against biochemical and physical forces.[28] In this way, deeper archaeological deposits can be preserved to a certain extent.

The waters of the lake of Kılıçkaya Dam withdrew due to drought in 2011, and Sıradur Höyük became visible after 21 years. The mound lost half of its height, and the slopes were destroyed to a great extent.[29] In the upper part of the mound, as a result of the soft archaeological deposits turning into mud and being dragged away from its position due to the movements of water, a layer of sand and stones was accumulated on the surface. The archaeological layers beneath was also turned into mud, and the architectural remains were deformed. In 2001, the lake of the Keban Dam receded due to a dry period, and the mounds of Tepecik and Şıh Hacı became visible.[30] Tepecik remained as a pile of stones, without any cohesive contexts. The water affected the unexcavated deposits, and sherds of Neolithic pottery came to light, indicating its earliest settlement period.

As the water of the Tahtaköprü Dam at Yesemek/İslahiye was discharged for a new construction after 42 years, the remains of Hamamlar Höyük became visible. The mound has a 2 m high deposit overlaid by a thick layer of sand and stones. Accordingly, from the executive institution, a budged has been allocated for salvage excavations. A Late Iron Age building was recovered at Hamamlar Höyük, and Late Epi-

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[25] Atay, Ökse 2011.
[26] Stammitti 2015, 54-58, 110-114, 119-125, 356.
[27] Cunliffe De Gruchy, Stammitti 2012, 223.
[28] Stammitti 2015, 91-93, 117-118, 127-131.
[29] Engin 2015, 136.
[30] Özdoğan 2021.

palaeolithic subterranean structures at the basalt formation in its vicinity.[31] Since such projects have not been foreseen for the dams constructed within the Southeast Anatolia Project, no regulations for post-flood phase can be planned.

The impact of the Atatürk, Birecik and Karkamış dams built for several decades on the Middle Euphrates valley on hundreds of archaeological sites has been investigated with Remote Satellite Sensing Systems.[32] According to this investigation, only 11% of the archaeological heritage affected by these dams was excavated. Relocation of architecture is also a method for leaving the heritage to the next generations; however, in this way, only a small part of the archaeological heritage would be considered worth saving, and archaeologists would serve only tourism.[33] This situation, once again, reveals the importance of prioritizing the completion of excavations at the expense of postponing the filling of dams.

4.5 *Publications*

Meanwhile, salvage projects delivered valuable data for the early history of the contact zone of Anatolian and Mesopotamian cultures. These data should be transformed into scientific publications. Both Law no. 2863, the European Convention, Article 7, and the ICOMOS Charter, Article 5, state the necessity of publishing scientific reports of archaeological investigations; also, this work needs time and funding.

Concerning the Upper Tigris Salvage projects, preliminary reports of the 1999-2001 seasons have been published by the Centre for Research and Assessment of Historical Environment of the Middle East Technical University[34] as well as preliminary reports of all excavation seasons have been published in the annual proceedings of the "International Symposium of Excavations, Surveys and Archaeometry" of the General Direction of Cultural Assets and Museums.[35] The Diyarbakır Museum[36] and the Batman Museum[37] have each published a book containing the general results of the excavations carried out within their territories. Also several articles and papers as well as monographic final reports of some excavations have also been published.[38] Moreover, the cultural inventory of the provinces to be affected by dams,[39] and the settlement pattern of the region throughout the ages[40] became monographic publications. Several MA and PhD theses have been prepared on archaeological finds from several mounds[41] or those analysing specific period of the whole region respectively.[42] Unfortunately, no budgets are allocated for preparing and publishing monographic final reports of each site.

4.6 *Museums and Exhibitions for Public Awareness*

The Ministry of Culture and Tourism established new regional museums with the basic concept of presenting the submerged archaeological heritage to the public, and to present information on the archaeological history of the region.[43] The artefacts obtained from the Ilısu Dam Salvage Excavations are preserved in the museums in Diyarbakır (ca. 9000 artefacts), Batman (ca. 3500 artefacts), Mardin (ca. 700 artefacts) and Hasankeyf (ca. 1360 artefacts).

The curators prepared reconstructions, models, and graphics and used multimedia techniques, to present to the visitors how and for which purposes or in which places the findings were used. The architecture is reconstructed by illustrations or scaled-down models, and the historic environment by animations. The archaeological finds are displayed in showcases in chronological order, accompanied by information panels enriched with pictures and drawings within a didactic approach.[44] These coincide with the European Convention, Article 9, and the ICOMOS Charter, Article 7, stating the importance of raising public awareness.

Also archaeoparks are established at open-air exhibition areas, in order to convey the archaeological heritage to the visitors. Life-size models of structures recovered during salvage excavations have been erected, so that visitors can feel the living spaces of

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[31] Engin *et alii* 2022, 1855-1856.

[32] Marchetti *et alii* 2020, 32-33, 42-43; Zaina, Tapete 2022.

[33] Shoup 2006, 248; Stammitti 2015, 107-108.

[34] Tuna, Öztürk 1999; Tuna, Öztürk, Velibeyoğlu 2001; Tuna, Velibeyoğlu 2002; Tuna, Greenhalgh, Velibeyoğlu 2004; Tuna, Doonan 2011.

[35] Proceedings of the International Symposium of Excavations, Surveys and Archaeometry. Available at https://kvmgm.ktb.gov.tr/TR-44760/kazi-sonuclari-toplantilari.html; https://kvmgm.ktb.gov.tr/TR-44761/arastirma-sonuclari-toplantilari.html ; https://kvmgm.ktb.gov.tr/TR-44762/arkeometri-sonuclari-toplantilari.html (Accessed 25.07.2023)

[36] Vv. Aa. 2013.

[37] Vv. Aa. 2018.

[38] Radner 2004; Laneri 2016; Ökse *et alii* 2014; 2015; 2018; Schachner 2020; Özkaya, Coşkun, Soyukaya 2013; Matney *et alii* 2017.

[39] Kozbe 2017; Kozbe, Güngör 2022.

[40] Brancato 2017.

[41] For example, the excavations at Salat Tepe yielded two PhD (Yaşin Meier 2014; Silibolatlaz Baykara 2014) and four MA (Önen 2006; Emanet 2019; Bozkurt 2020; Çetinkaya 2021) theses. Available at https://tez.yok.gov.tr/UlusalTezMerkezi/ (Accessed 27.07.2023).

[42] For example, Guarducci 2018 as well as Erdalkiran 2010; Baştürk 2014; Kalkan 2020. Available at https://tez.yok.gov.tr/UlusalTezMerkezi/ (Accessed 27.07.2023).

[43] WEB sites of aforementioned museums: https://kvmgm.ktb.gov.tr/TR-44082/diyarbakir-muze-mudurlugu.html ; https://kvmgm.ktb.gov.tr/TR-281298/batman-batman-muze-mudurlugu.html ; https://kvmgm.ktb.gov.tr/TR-44122/mardin-muze-mudurlugu.html ; https://kvmgm.ktb.gov.tr/TR-281299/batman-hasankeyf-muze-mudurlugu.html ; https://muze.gov.tr/ (Accessed 27.07.2023).

[44] Ökse 2023.

that period in three dimensions. Workshops are organized to revive the ancient lifestyles and production processes, and artificial excavation areas is used to help the participants for understanding excavations. All these events aim to raise awareness of cultural heritage in society.

According to the European Convention, Article 5, and ICOMOS Charter, Article 6, the sites and monuments should be preserved in their original context, and the relocation of architectural elements violates this principle. Despite, in 2020, seven historical buildings at Hasankeyf are relocated by a self-propelled modular system moving on ca. 100 wheels.[45] In 2023, three communal pit-structures uncovered in the Pre-Pottery Neolithic B settlement at Gre Fılla, in the Ambar Dam, were transported to the new Museum Complex in Diyarbakır, in order to be reinstalled at an open-air exhibition area of ca. 3 acres, since the site will be submerged. Indeed, historical structures lose their meaning as they are removed from their natural environment. Moreover, the relocated structures constitute a very small part of the submerged buildings; so, a significant part of them is not inherited for the future. A better solution should be re-planning dam constructions in such a way, that these can be preserved and/or exhibited in their original locations.

5. Suggestions for Planning Dam Projects

Salvage projects became a significant stimulus to archaeological research in Turkey. These provided opportunities for a new generation of archaeologists to receive field experience and experiment with new methods and techniques, for bringing international and multi-disciplinary teams to study the region from different disciplinary points of view. Although only a very small part of surveyed sites (16%) could be excavated (Figs 2-3), small sites, which would generally not have been preferred to be excavated otherwise, are also introduced to the archaeological data. Nevertheless, almost none of these sites have been excavated completely.

To overcome this situation, committees composed of experts in several aspects concerning cultural heritage should be involved in planning large-scale investments. These should operate with plans and sufficient action protocols that should provide the rules of research quality, and the implementation of legislation, financing, capacity building and raising public awareness[46]. Dam projects are suggested to include three phases of work concerning salvage projects at reservoirs[47]. The pre-construction risk assessment phase involves a planning in which cultural heritage will be protected as effective as possible. The second phase comprises intensive surveys and remote sensing for exploring and identifying the heritage of the entire area of the reservoir, excavating small areas at all determined sites for understanding the character of each site, so that a detailed documentation can be prepared and the whole cultural heritage documented. Henceforth, sites requiring salvage excavations can be determined, and excavations performed during construction. The post-flooding phase deals with damage assessment planning for further excavations at partly submerged sites and for creating conservation projects at damaged sites. Excavations can also be carried out during this phase, in cases of decrease in water level.

5.1 *Coordination and Teams in Decision Mechanism*

Salvage projects require a considerable amount of intensively excavated sites, despite tight deadlines and involving of archaeologists after the construction of dams begins.[48] In order to complete all these investigations, archaeologists should be part of the team from the beginning of the projects onwards, so that some modifications in the construction projects can be executed. As stated in the European Convention, Article 5, the participation of multi-disciplinary experts for consulting on developing strategies is essential while planning settlements and investments. A central coordination is also essential for planning and execution of all investigations, in order to prevent some not homogeneous and arbitrary practices of the local organizations and different excavation teams.

The coordination should manage the process from determining the area where the dam will be built to the area the reservoir will affect. These should also determine the time span, the number of personnel and funding required for each site, together with the research teams. The coordination should ensure that the investigations of different teams will be carried out with the same high scientific standards, whether it is surface survey, excavation or material study (see § 4.1-3). The coordination and the teams must also be included in the planning for the works after flooding (see § 4.4) as well as for the preparation of monographic final reports (see § 4.5) and the display of the finds in museums (see § 4.6).

5.2 *Working Time and Staff*

The teams should work as intensively as possible throughout the year. Since sufficient time and budget cannot be allocated for surface surveys and excavations in dam projects, a significant part of the archaeological heritage cannot be investigated. The European Convention, Article 5 states that sufficient time and

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[45] Eroğlu 2022, 49-80.
[46] Kömürcü 2002; Shoup 2006; Marchetti *et alii* 2019.
[47] Marchetti *et alii* 2020, 45-46.
[48] Cunliffe De Gruchy, Stammitti 2012, 224.

funding should be maintained for scientific study and publications as well as for opening archaeological sites to the public.

Unfortunately, a proper timing has not yet emerged in any of the dam projects, and several sites were submerged without sufficient exploration. In Keban Dam only 29% of the sites[49] were excavated in 1968-1976, and in the Karakaya and Atatürk dams, 3,5% in 1974-1986[50]. Excavations have been carried out at 18% of surveyed sites[51] in the Birecik and Carchemish dams, and at only 6% of all registered sites in the Ilısu Dam[52]. Although the planning of the Ilısu dam salvage project was more successful than the previous projects, this time, a very large area of *ca*. 37.000 ha was affected, and it was not possible to investigate all of them sufficiently.

Due to limited time, technical methods such as photogrammetry, remote sensing and drill cores can be used for architectural plans, to continue the fieldwork without interruption (see §§ 4.1- 4.2). The study of findings must also be carried out simultaneously during the excavation. Considering the amount and size of material to be obtained from excavations, a realistic time period should be anticipated for documentation and material studies. Cleaning, preserving, and documenting small finds, as well as creating technical drawings, cataloging, compiling statistics, and forming typological sequences, require significant time, often exceeding the duration of the fieldwork itself (see § 4.3). Sufficient study time should be allocated to convert these studies into comprehensive monographic final reports (see § 4.5). Additionally, restarting excavations if dam water levels drop (see § 4.4) and transporting important architectural elements that will be submerged (see § 4.6) are generally not planned within salvage projects. Therefore, a time period for these phases should also be included in the planning. The sites at the shoreline and in areas of higher water flow rates will continue to be eroded, or the sites may be exposed when reservoir levels drop. Also, the enlargement of urban settlements, and construction of infrastructure such as roads, cables, pipelines as well as irrigation projects can destroy the sites around the reservoir. Thus, a Post-Flooding management is essential, in order to collect data on the further effects of the reservoir[53].

5.3 *Funding*

The work defined above requires large budgets, and in order to carry out all these works properly, the protocols between the executive and financing institutions must be arranged to ensure that all work is completed. Raising awareness of other parties, such as executive institutions, governors, and policy-makers, can lead to change in the project plans when cultural heritage is at risk.[54] This subject is stated in the European Convention, Article 6, and ICOMOS Charter, Article 3, emphasizing the importance of adequate funds for effective heritage management, including research and conservation.

The protocols so far have generally been prepared on the basis of field studies (see §§ 4.1- 4.2), and the budget is usually not enough for material studies (see § 4.3). The State Hydraulic Works generally do not allocate a budget for material studies and publishing monographic final reports (see § 4.5). Thus, funds are either sought from other sources or these works cannot be carried out. In addition to transporting small finds to museums, the transportation of architectural elements in open-air museums should also be ensured (see § 4.6). Moreover, funds for archaeological research after the flood should also be provided for observing the submerged sites and for further excavations at these sites, in case the water level drops (see § 4.4).

The funds for protecting the cultural heritage affected by the dams should be covered by the authorized institution. In cases where the budget of the sponsor institution is insufficient, either this institution or the state itself should search for new resources, in order to preserve the archaeological heritage properly for future generations.

6. Concluding Remarks

In Turkey, the laws, regulations and conventions were created and signed for the protection of the archaeological heritage (see § 2). Despite this, a complete inventory of cultural property is not prepared yet. Although the General Directorate for the Preservation of the Cultural and Natural Heritage continues to work for a long time, 24.031 archaeological sites are registered.[55] Completing the cultural inventory will pave the way for determining the areas to be affected by urban settlements and public investments in advance, enabling better structured projects.

During salvage projects carried out at the reservoir areas of the dams constructed in the Upper Tigris region, only ca. 8% of the surveyed sites have been excavated to ca. 10%, due to insufficient time and funds (see §§ 5.2-5.3). In order to prevent such situations, archaeologists along with town and regional planners should be involved in the entire planning

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[49] Whallon 1979.
[50] Özdoğan 1977.
[51] Algaze *et alii* 1994.
[52] Ökse 2015, 112.
[53] Cunliffe, De Gruchy, Stammitti 2012, 223.
[54] *Ibidem*, 225; Marchetti *et alii* 2019.
[55] Özdoğan 2001; 2006; 2013, 1-3; Kömürcü 2002, 281. Current site list available at https://kvmgm.ktb.gov.tr/TR-44973/turkiye-geneli-sit-alanlari-istatistikleri.html (Accessed 05.07.2024)

process of large scale projects, and consult one another for modifications (see § 5.1).

In 1978, the Turkish Ministry of Culture declared the ancient cities of Hasankeyf and Zeugma, as "first degree (completely) protected areas". On the contrary, both sites were not included in list of the World Heritage Convention in 1999.[56] Despite the recommendation of the European Convention Article 5, concerning preservation *in situ* as far as feasible, and despite the attempts of Local Councils for the Conservation of Immovable Cultural and Natural Property as well as several civil society organizations to change the design of the construction project, both ancient cities are submerged. Thus, it is essential for countries to implement the conditions of the international conventions they have signed. For this purpose, detailed legal regulations should be composed and meticulously followed by all institutions of the state. Only in this way can the technological development of countries be achieved without destroying cultural heritage, and the heritage of the whole humanity will be transferred to future generations. We hope that future projects can be planned earlier, or a more effective solution can bring alternative ways into action, instead of constructing dams.

[56] Kömürcü 2002, 262-263, 270-275.

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Andrea Titolo*

NORMALIZED DIFFERENCE WATER INDEX FOR CULTURAL HERITAGE. A REPRODUCIBLE METHOD FOR MONITORING FLOODED ARCHAEOLOGICAL SITES

Abstract

This paper presents a reproducible and adaptable methodology for monitoring and analyzing archaeological sites that resurface from fluctuating lake waters. This innovative workflow addresses a growing need for a second-phase salvage approach by utilizing spectral indices extracted by free medium-resolution satellite images combined with zonal statistics to analyze the resurfaced area of archaeological sites. The methodology incorporates cloud-computing, open-source GIS, and programming languages tailored for reuse, ensuring reproducibility and ease of use. Thanks to the results available, the different applications in which the workflow was already tested, and the future possibilities, the paper will show how a tool like the one presented here can fill a gap in the current archaeological workflow regarding emerging cultural heritage.

Keywords

Remote sensing, change detection, R, Google Earth Engine, QGIS

1. Introduction

The construction of dams and subsequent creation of artificial reservoirs is one of the significant threats to archaeological sites in Western Asia, together with conflicts and natural catastrophes.[1] For decades, local institutions, governments, and international organizations have sponsored archaeological rescue project prior to the submersion of archaeological sites.[2] Even if a large number of projects took place, recent studies highlighted how the knowledge of potential cultural heritage loss due to dam construction is less than optimal.[3] Most importantly, it has been pointed out that there is a growing need for a post-flooding assessment of cultural heritage and a continuous monitoring of archaeological sites. This need arises from the knowledge that sites, even if submerged, are not necessarily lost for good.[4] Multiple pieces of evidence show how cultural heritage can re-emerge due to cyclical or episodic reservoir water fluctuations, urging for a need for so-called second-phase salvage approaches.[5]

This paper wants to address the topic by describing a reliable, adaptable, and reproducible tool and workflow for monitoring the resurfacing of archaeological sites at a larger scale on a multitemporal basis, bringing examples from two recent case studies that relied on it: the Mosul Dam and the Tishreen Dam. The workflow was created to answer the following research questions:

- How can we identify which sites have been affected by water level fluctuations?
- Can we identify sites more at risk of damage and erosion among those affected by water fluctuations?
- How can we document and monitor these sites in the long term and in the future?
- Can we make this process reproducible and adaptable to multiple case studies?

This workflow was initially tested in an early-stage shape on three different dams in Iraq in order to check whether the issues above could be tackled efficiently or not.[6] The second iteration, presented here, is considered to be more mature, as it draws from the experiences (both in code quality and methodology) of the Mosul Dam[7] and the Tishreen Dam[8] applications, and is now integrated in a still in development tool with a broader scope, such that a new presentation of the computational methods underpinning it seemed necessary. While the two case studies are described in separate papers,[9] the detailed methods behind the workflow will be presented in detail here. A summary of the outcomes that the workflow can deliver will also be described (based on the aforementioned applications), followed by a discussion on the workflow's potential, usefulness, and reproducibility.

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[1] On the conflicts generated by water management, see e.g. Lupu 2001; Gleick 2014; Al-Ansari 2016. For archaeology and dam construction, see e.g. Luke, Meskell, 2019; Marchetti *et alii* 2019; Eidem 2020.

[2] Eidem 1999; Wilkinson 2004.

[3] Marchetti *et alii* 2018; 2019.

[4] See e.g. Eidem 2015; Eidem *et alii* 2019; Eidem 2020; Sconzo, Qasim 2021; Sconzo, Simi, Titolo 2023.

[5] See Sconzo, Simi, Titolo 2023; this volume; Sconzo, Simi this volume.

[6] Titolo 2021.

[7] Sconzo, Simi, Titolo 2023.

[8] Sconzo, Simi, Titolo this volume.

[9] Sconzo, Simi, Titolo 2023; this volume.

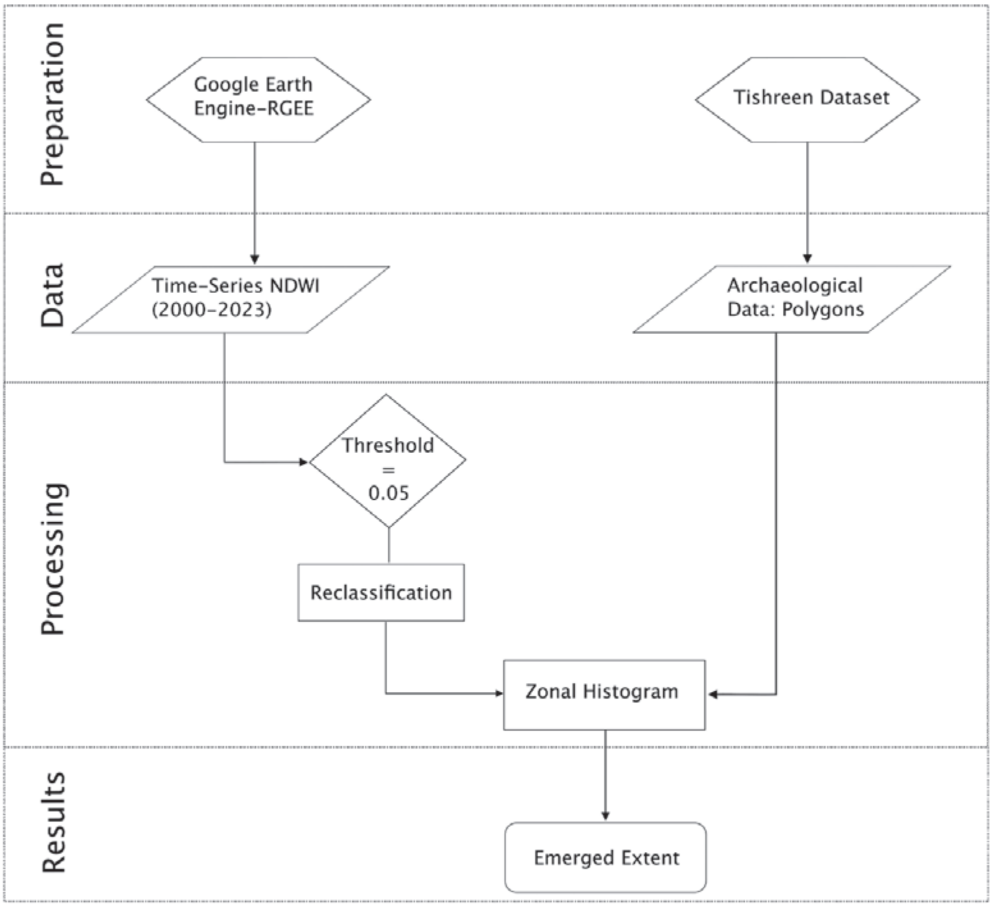

Fig. 1 - Conceptual workflow for extracting resurfaced area information from archaeological sites polygons.

2. The Workflow

While the main objective of this workflow, namely to distinguish water from other surfaces on satellite images, seems relatively simple, the reality is quite different. Various methods are listed in the scientific literature, and each tends to account for different environmental situations (see below). Multiple approaches exist because the identification relies on how the water absorbs the sunlight at different wavelengths and frequencies of the electromagnetic spectrum, and the surrounding landscape highly influences the results. The idea behind the workflow is rather straightforward: remote sensing offers a method to distinguish between water and non-water surfaces, which is usually aimed at delimiting water surfaces, but for archaeological sites, this is not always enough and will merely show if a site is under the water or not. However, once we have this information, we can revert the question and quantify the resurfaced site area based on available information. In order to obtain these results, several steps are required and described below (see also Fig. 1), namely:

- The choice of appropriate method of delineating water on satellite images.
- The application of a change detection technique, which is divided into:
  - Choice of suitable satellite images and a timeframe for the analysis.
  - Processing of the satellite images using a change detection algorithm.
  - Post-processing to remove noise and false positives/negatives.
- The calculation of the percentage of the resurfaced area and the creation of an output dataset.

2.1 *Spectral Indices*

Several alternatives have been proposed for extracting water surfaces from satellite images.[10] One is density slicing. This single-band method relies on the Near-Infrared (NIR) band to obtain information about

[10] Du *et alii* 2014; Li *et alii* 2013, for a more recent application see Pang *et alii* 2024.

water surfaces.[11] The downsides of density slicing approaches are their sensibility to shadows (either from reliefs, clouds, or urban areas) and the resulting risk of introducing errors. Another method is the Tasselated Cap Transformation, which compresses all the information into three bands (greeness, brightness, wetness), thus enhancing spectral band information. However, this process tends to overestimate the presence of water, and it does not behave reliably when shadows are present.

A more common method involves the use of spectral indices (SI). SI are widely used in a myriad of applications, both in archaeology and not.[12] SI are combinations of two or more bands, and they indicate the relative abundance of the element of interest inside the image. SI have some advantages over the methods mentioned before, as they are usually easier to obtain and tend to lead to more robust results.[13] There are different indices available, but for the workflow, the Normalized Difference Water Index (NDWI)[14] was chosen, as it is generally agreed that it performs better at delineating water masses.[15] In particular, a variation of the original known as mNDWI (Modified NDWI)[16] was employed, because, thanks to the use of the Short-wave Infrared Band instead of the original Near Infrared one, it can perform better than the regular NDWI (see below). The mNDWI is expressed by the following formula (in round brackets are the names of the spectral bands used).

$$mNDWI = \frac{(Green) - (SWIR)}{(Green) + (SWIR)}$$

This formula was chosen because it can avoid registering urban elements as water surfaces (having a similar spectral response, they can often get mixed), and it performs better in areas without dense vegetation. While the formula is sensible to snow,[17] which can sometimes be wrongly registered as water, the study areas in which this workflow has been applied are unlikely to be extensively covered in snow, or at least in a measure that would hamper the identification of water. These choices worked for the Iraqi and Syrian dams on which the workflow was tested (see below). However, the interplay between natural and anthropic elements and their effect on satellite images must always be carefully evaluated before proceeding.

The equation will generate a singleband image with pixel values between -1 and 1. The interpretation of this index is based on an arbitrary conventional threshold of 0, meaning that all pixel values above zero are considered water surfaces, and below zero are considered land or, more correctly, non-water surfaces. While the NDWI is used to identify water bodies, if the extension of an archaeological site is known, then it can be used to check if the surface is underwater or not by simply counting the number of land and water pixels inside the site area. In fact, the difference between an emerged and a submerged archaeological site on satellite images will be whether pixels can be identified as representing water or not.

2.2 *Change Detection Technique*

2.2.1 *Choice of Satellite Images and Timeframe*

At its core, change detection comprises a series of methods of identifying and quantifying changes in the pixels on a raster image (drone, satellite, or aerial). The aim is to detect changes in the same geographical area over time by comparing pixel values of each image and applying change detection algorithms according to the application's need. There are a variety of change detection methods,[18] but they all follow a similar workflow: pre-processing of the chosen satellite images to remove noise and inaccuracies, application of the change detection algorithm, and post-processing.[19]

After deciding how to extract water surfaces (see above), a choice regarding which satellite images to use has to be made. Since the idea is to be as affordable and reliable as possible, the workflow relies on freely available medium-resolution images, i.e., Landsat and Sentinel-2 images. While their medium resolution might not be ideal for smaller-scale analyzes, the advantages in accessibility, costs, processing time, and disk space vastly outweigh the downsides.[20] Moreover, many artificial lakes were constructed years before most commercial satellites came into operation. Thus, Landsat images are almost a necessary choice for a multi-temporal analysis. Images were taken at the Bottom-of-Atmosphere reflectance to minimize the impact of atmospheric reflectance on the resulting spectral index.[21] There is also a need to define a time frame and interval to acquire the satellite images. In the first iteration of the workflow, the analysis was conducted with one image per year from

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[11] For an archaeological application see Marchetti *et alii* 2019.

[12] see e.g. Agapiou, Hadjimitsis, Alexakis 2012; Calleja *et alii* 2018; Fuldain González, Varón Hernández 2019; Kalayci *et alii* 2019.

[13] Du *et alii* 2014.

[14] McFeeters 1996.

[15] Du *et alii* 2014; Qiao *et alii* 2012; Li *et alii* 2013; Acharya *et alii* 2016.

[16] Xu 2006.

[17] Acharya *et alii* 2016.

[18] For a comprehensive review, see e.g. Lu *et alii* 2004; Cheng *et alii* 2023.

[19] Cheng *et alii* 2023, 3-4.

[20] In particular, regarding issues and costs for archaeologists and remote sensing specialist working in SWA, see Rayne *et alii* 2020 with related bibliography.

[21] Agapiou *et alii* 2011; Hadjimitsis *et alii* 2010.

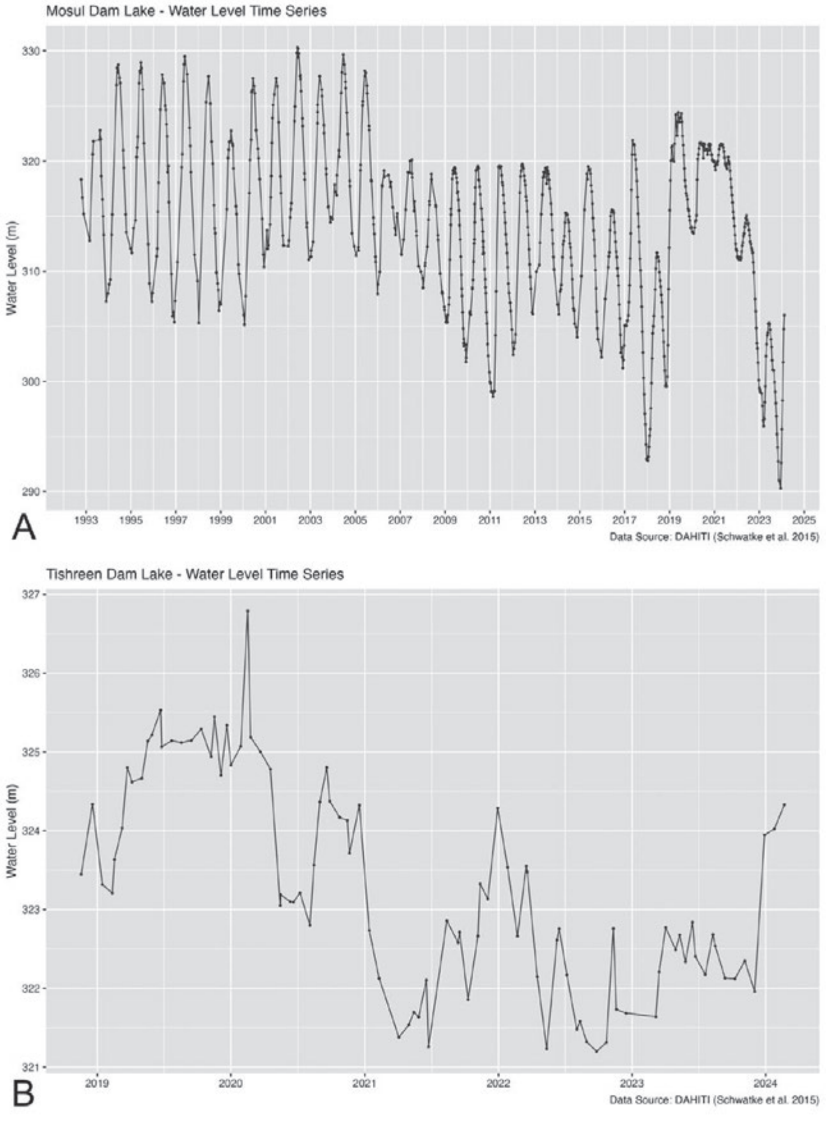

Fig. 2 - Example of information gathered from the DAHITI. A) Mosul Dam water level plot. B) Tishreen Dam water level plot.

the filling of the reservoir to the present day. However, this choice might be limiting and not helpful in highlighting water fluctuations within the same year. For this reason, the workflow relied on quantitative data of reservoir water level variations provided by the Database for Hydrological Time Series of Inland Waters (DAHITI).[22] The DAHITI registers water level and other lake characteristics through remote sensing over several years (Fig. 2). Data on the water level were leveraged in order to link the results of the analysis to a precise value. Thus, the time frame was usually limited to the available coverage of the DAHITI for our study area. Since the DAHITI records water levels throughout the year, but not necessarily for all the months, a decision was made to extract minimum and maximum water levels for each year and to limit our analyses to two instances per year. This means that in the current workflow, we take two images per year, one for the months with minimum water level and one for the maximum water level based on the DAHITI data.

2.2.2 *Processing of Satellite Images*

Usually, the larger the time period, the larger the number of satellite images to utilize. Manual processing of all these images would take a long time; thus, the workflow relies on cloud computing to quickly apply different processes over multiple images. The most commonly used platform for remote sensing

[22] Schwatke *et alii* 2015.

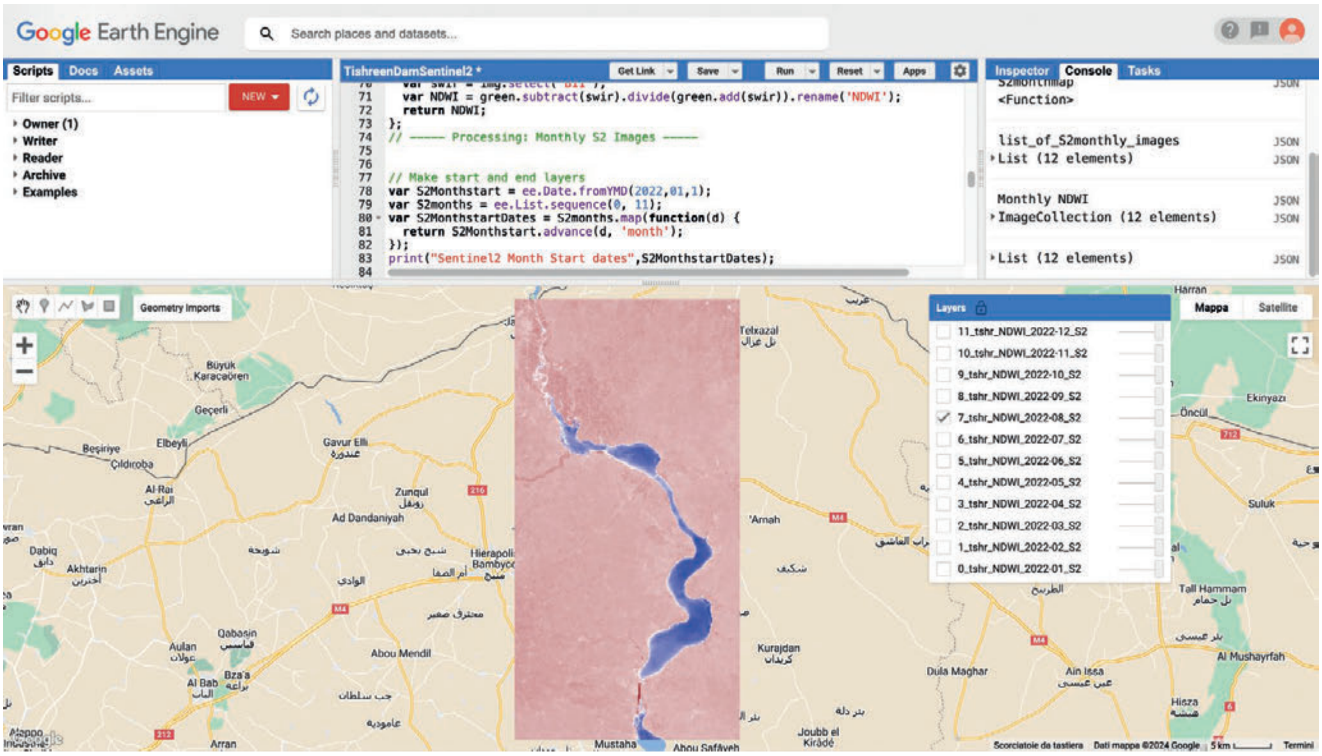

Fig. 3 - Google Earth Engine Code Editor interface and NDWI composites.

cloud-computing is Google Earth Engine (hereafter GEE).[23] The platform, launched in 2017, offers petabytes of geospatial data and allows the quick application of different and complex algorithms. The platform has seen a growing number of easily accessible web apps; however, a basic understanding of Javascript is still required for specialized applications, to write the code necessary for the analyses. Two scripts were written to generate NDWI images for Landsat and Sentinel-2 data.[24] The NDWI images were generated as monthly composites by applying first a cloud filter to avoid cloudy images, a cloud-masking function to mask out clouds and unwanted pixels, and then by averaging the NDWI values for each pixel of each image that fell within the monthly range.[25] Using monthly composites instead of single images has some advantages as it helps, for example, to reduce the impact of clouds or reliefs shadows.[26] The GEE scripts generates images for all 12 months of each year. The images then go through a manual visual inspection to assess if the algorithm outputs valid images or not (Fig. 3).[27] While generated composite images were selected for the months highlighted by the DAHITI, if a composite was not available for the selected months, or its quality was not good enough, the closest month with the highest/ lowest water level was selected, and so on. As stated above, the generated images will contain pixels ranging from -1 to 1.

2.2.3 *Post-processing*

As mentioned before, the interpretation of the NDWI relies on an arbitrary threshold, with values above this threshold counted as water surfaces and below as non-water surfaces. This threshold is usually set at 0, but during the reclassification process (see below), it is essential and generally advisable to experiment with different values in order to ensure a better-quality output and avoid errors.[28] Most er-

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[23] Gorelick *et alii* 2017.

[24] The scripts are available at: https://github.com/ReLandProject/ReLandTishreen and https://github.com/ReLandProject/MosulDrownedLandscapes. The same scripts were merged and translated in R (see discussion) for enhanced reproducibility.

[25] Monthly composites are pixel operations on multiple satellite images acquired during a selected time frame. All the images within the timeframe are combined using specific mathematical operations (in our case the median) called *reducers* in GEE, to generate a single (usually clearer) image. Of course, usually the more images available, the better the results.

[26] Rayne *et alii* 2020; Sagar *et alii* 2017.

[27] It might happen, for example, that not enough images are present for the selected time frame, and that missing pixels removed from the cloud-masking function are not filled with other data from the same period because of the lack of images. In this case, a different month was selected, to avoid potentially missing information that could alter the final result.

[28] Acharya *et alii* 2016; Fisher, Danaher 2013; Ji, Zhang, Wylie 2009.

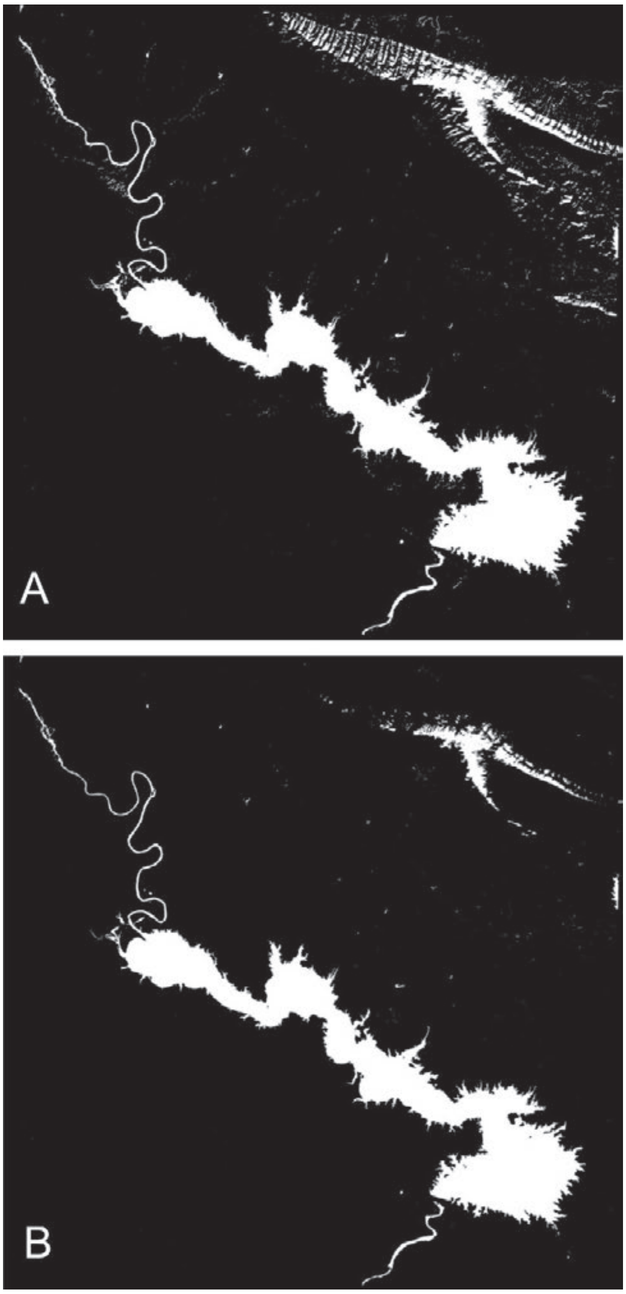

Fig. 4 - Example of difference results on applying a 0 threshold (A) and a 0.05 threshold (B) to the reclassification process.

rors, especially with the formula employed here, are caused by shadows and snow, which typically have a similar spectral signature to water in the SWIR band. An example is the images generated in one of the two major case studies to which this workflow was applied, i.e., the Mosul Dam. Here, tweaking the threshold to 0.05 instead of plain 0 helped minimize errors, bringing sensible improvement visible also at the naked eye (Fig. 4). For the Tishreen Dam, on the other hand, a threshold of 0 seemed accurate enough. As briefly noted by these two examples, while a threshold set at 0 can still lead to useful results, it is likely that different areas will require different tweaks and an accurate inspection before proceeding with the reclassification.

The threshold is essential for the next step of the post-processing. The generated NDWI images contain different pixel values ranging from -1 to 1; however, to calculate the temporal change within each site area, it is necessary to have unique values to quantify (i.e., to calculate the percentage of each single value). This involves reclassifying images to a set of values, in our case two: non-water and water surfaces. The workflow leverages the open-source programming language R to do that.[29] An R script was written to reclassify the generated composites based on the selected threshold quickly.[30] As mentioned before, to interpret the NDWI, values above the threshold are considered water and values below are considered non-water surfaces. Thus, citing the example of the Mosul Dam above, in the reclassification script, all pixel values below 0.05 are reclassified as 0 or non-water surface, and all those above or equal to 0.05 are reclassified as 1 or water surface.

However, a visual inspection of the resulting reclassification output is not enough, and there is a need for a qualitative measurement of the reclassified results. This is crucial because it will inform on how good the distinction between water and non-water features is and how effectively the workflow is identifying emerged site areas. The process for obtaining this qualitative measure is called accuracy assessment and is evaluated using a confusion or error matrix.[31] The accuracy assessment also aids with another common issue of reclassification of medium-resolution images, i.e., mixed pixels. Inaccuracies may occur when more than one class (in this case, land/water) is present within a single pixel, thus possibly resulting in an incorrect pixel attribution or a failure of change detection. This is usually addressed by manually inspecting several sample pixels against a higher resolution image from the same time and area of the

[29] https://www.r-project.org/ (last accessed 2024-03-07).

[30] This is done leveraging the {raster} package (https://cran.r-project.org/web/packages/raster/index.html, last accessed 2024-03-07).

[31] The error matrix is a way of comparing the expected results (the one from the reclassification) with actual pixel information from either ground truth or higher-resolution reference images (Congalton 1991; Congalton, Green 2019). In the error matrix, there are three main pieces of information present: Overall Accuracy (which measures how accurate is the overall reclassification of the entire image), Producer's Accuracy (measures the "omission errors", i.e., false negatives, answering the question "how likely is it that a pixel known to be water has been mapped as such in the reclassified image), and User's Accuracy (measures the"commission errors", i.e., false positives, answering the question of how likely it is that a pixel counted as water in the reclassified image is also water in the reference image).

Satellite Images	Overall Accuracy	Producer's Accuracy	User's Accuracy
Landsat 5	98.01%	98.63%	94.74%
Landsat 7	98.59%	100%	95.22%
Landsat 8	98.36%	99.24%	95.08%
Sentinel-2	98.36%	99.24%	94.99%

Tab. 1 - Confusion Matrix for the Mosul Dam Dataset.

Satellite Images	Overall Accuracy	Producer's Accuracy	User's Accuracy
Landsat 7	98.74%	98.57%	97.18%
Landsat 8	98.31%	98.48%	95.59%
Sentinel-2	99.16%	98.57%	98.57%

Tab. 2 - Confusion Matrix for the Tishreen Dam dataset.

reclassified one, registering classification errors, or using ground validation of reclassified areas. Generally, it is quite problematic to carry out an accuracy assessment for time-series change detection images, the main reason being that usually there are no higher resolution images for most of the analyzed periods and no field data.[32] This, in turn, means that the accuracy assessment needs to use the same data that were employed for generating the NDWI, which is not always optimal. However, when a limited number of classes is used (in this case, as explained, just two), it has been proven that these images can still yield optimal results.[33] During this workflow, validation has been carried out for two images per sensor, one with a lower water level, and one with a higher water level. All the images used for validation were true-color composites, pansharpened for Landsat 8, or at a higher resolution for Sentinel-2.[34] Sampling is carried out at the per-pixel level using a stratified random sampling[35] with two classes: water and non-water pixels. This method allows for allocating enough samples for each class depending on their area proportion, thus accounting for the lake area variation between images. Validation is conducted in QGIS using the open-source Semi-Automatic Classification Plugin.[36] When mixed pixels were detected, the reference class was assigned to either water or non-water, depending on the most prevalent class inside the sample. Overall, the NDWI showed promising results for both the case studies of Tishreen and the Mosul Dam and for all the satellites, confirming that the reclassification and the threshold choice were appropriate for the two regions.[37] In particular, with a minimum overall accuracy of 98% (see Tab. 1 and Tab. 2 for details on both dams) the reclassification can be considered good quality enough. With these results, we can be quite confident that the reclassification works as expected, but again, each new application should engage in some sort of accuracy assessment to find the optimum threshold[38].

After the image reclassification and the accuracy assessment of the results, the next step is to calculate the percentage of emerged area for each site under investigation. The workflow leverages the Zonal Histogram Algorithm, which counts each unique value from a raster layer contained within polygon features, which is why there is a need for a set of unique values (the reclassification output) (Fig. 5). The zonal histogram is a QGIS algorithm and was used in all the case studies mentioned above.[39] The output of a zonal histogram is a series of shapefiles (the same number as the satellite images used) with the count of each unique pixel in their attribute table. After applying the Zonal Histogram, there is a need to convert the counts for each monthly image in percentages, merge the results, and obtain a single shapefile with the amount of resurfaced extent for each site. The whole procedure is carried out again using the R programming lan-

[32] Congalton, Green 2019; Olofsson *et alii* 2014.

[33] Özelkan 2020; Sagar *et alii* 2017.

[34] The resolution of the reclassified Sentinel-2 NDWI composites is 20m (because of the use of the SWIR band), while the true color composites are 10m.

[35] Congalton, Green 2019.

[36] Congedo 2021.

[37] Generally, when there are only two classes in the reclassified image and the separation between the lake and its surroundings is clear, good results are expected (Fisher, Danaher 2013).

[38] The lower User's accuracy compared to the Overall and Producer's accuracy is usually tied to the medium-resolution nature of the satellite images and the difficulty of dealing with mixed pixels. If this value is lower, it might also indicate a need to tweak the threshold further.

[39] The algorithm documentation is available at: https://docs.qgis.org/latest/en/docs/user_manual/processing_algs/qgis/rasteranalysis.html#zonal-histogram (last accessed 2024-03-07).

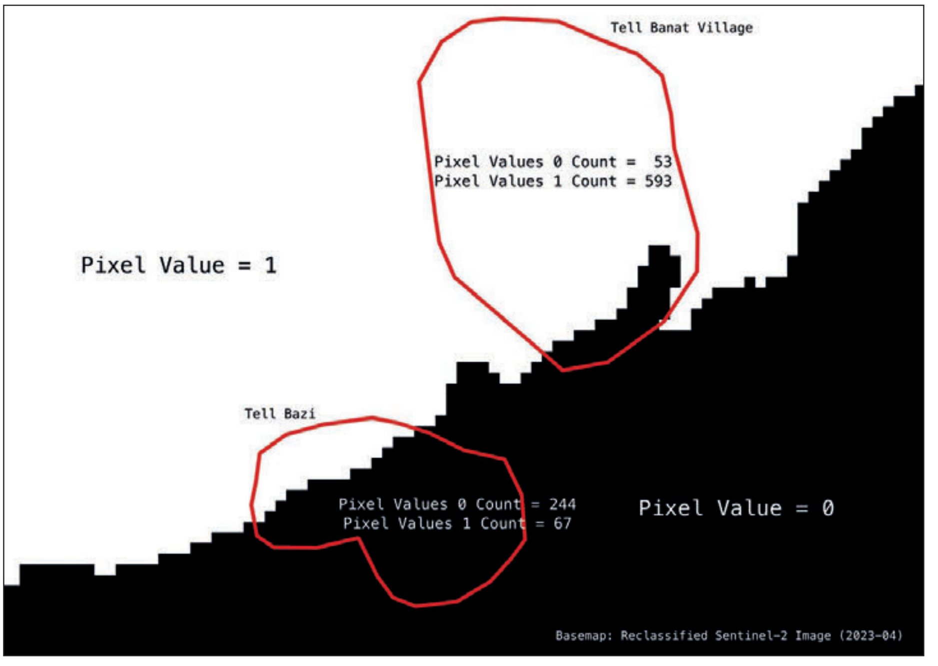

Fig. 5 - Conceptual model of the Zonal Histogram Algorithm.

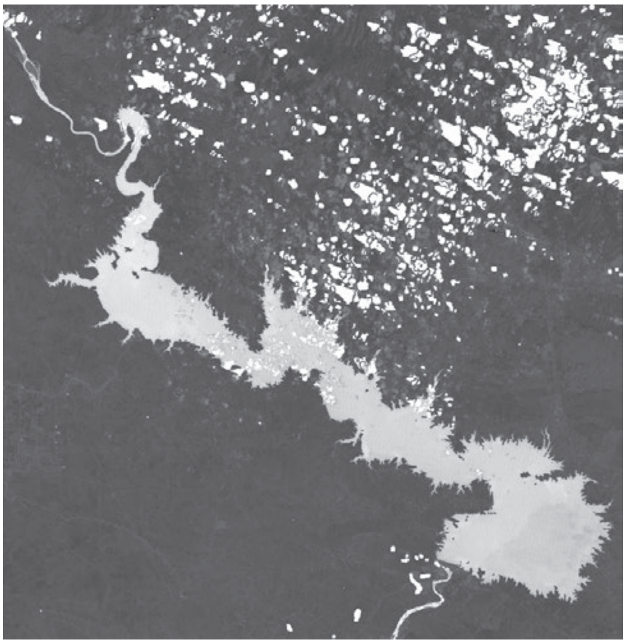

Fig. 6 - Example of missing information due to clouds and lack of enough images for the median reducer to fill missing pixels.

Fig. 7 - Example of area that might be classified as non-water surface but not necessarily accessible on foot.

guage, and specifically the {qgisprocess} package,[40] which allows to run QGIS algorithms inside R. A script (also available in the project repository, see below) was written that apply the algorithm, converts the results to percentages and merge the results, calculating also other fields useful for a classification of the results, which will be discussed below.

2.3 *Technical Limitations*

Change detection is a complex challenge that depends on many factors according to the chosen method. There are, thus, some technical limitations that even threshold tweaking and accuracy assessment cannot overcome. Firstly, a solid archaeological dataset is highly advised. In the Mosul Dam case study, this was already prepared thanks to a recent work of literature review, remote and ground surveys,[41] and was further improved for the case study in question.[42]

[40] Dunnington *et alii* 2023.
[41] Sconzo, Simi 2020.
[42] Sconzo, Simi, Titolo 2023.

Name	2020-08	2021-05	AlwaysEm	AlwaysSub	Affected	NeverEm	NeverSub
Duluk	100	100	1	0	0	0	0
Hammam Saghir N	41	100	0	0	1	0	0
Tell Ahmar	53	91	0	0	1	0	0
Tell El-Kebir	0	0	0	1	0	1	0

Tab. 3 - Partial example of attribute table of the output shapefile with quantitative columns.

The same care for a dataset creation was applied for the Tishreen dam case study.[43] The main reason as to why an accurate dataset is needed is twofold. First, the major complication to the dataset comes in the case of overlapping and contradictory information in published data. This issue can affect the effective reconstruction of the site areas, and in return make the resurfaces calculation less effective. A second issue comes from the types of sites recorded during the past archaeological surveys and it is also linked to how this workflow operate. All the processes highlighted above assume that a site extends horizontally on a (relatively) limited and identifiable area. This poses a challenge when dealing with types of sites for which the extension cannot be practically reconstructed. A primary example of this is the burial caves in the Tishreen Dam, which, while recorded and analyzed, are likely not correctly represented in the results.[44] This is not a limitation of the workflow per se, as the latter operates correctly, but something to keep in mind when applying it.

Due to being based on multispectral images, the workflow is also sensible to clouds. This means that in regions where clouds are heavily present, they can impact the availability of satellite images and, thus, the applicability of the workflow to the entire selected period. Another element that was identified during the work on the Tishreen Dam is that the workflow can be exposed to errors induced by null (or NA) values. NA values are missing data present in the satellite images due to registration errors, other factors, or sometimes the removal of clouds from the cloud masking process (Fig. 6). While NA values are not a substantial issue if recognized early, they can impact the quantitative calculation if that is not the case.[45] Currently, a manual inspection is in place to remove any NA value before this calculation are made, but in the future, this will be automated.[46]

Lastly, the tool discriminates between water and non-water surfaces, but it does not return any information about the surroundings of a site or its accessibility. The NDWI correctly identifies a terrain as non-water surface. However, that terrain might still be inaccessible due to river deposits, for example (Fig. 7). This is not an error in the reclassification or index extraction. However, sometimes, this factor needs to be accounted for if field surveys are planned based on the results. For this reason, inspecting recent true-color satellite images before or during field surveys is always advisable.

3. Results

This section will briefly explain what potential results the workflow can produce. However, an entire case study is not included below, as each application with the respective results has been presented separately.[47] Therefore, only a general presentation of all the possible outcomes from applying the workflow will follow. Primarily, the workflow will produce quantitative results, which can be connected to qualitative information to enhance the understanding or expectations regarding, for example, sites survival rates, as discussed below.

First and foremost, the workflow outputs two shapefiles (one for the maximum water levels and one for the minimum water levels) with an identical structure. An attribute table contains the emerged percentage of each site for each observation, i.e. as many columns as satellite images utilized. Appended to this table are also five more qualitative columns with records in a binary format (0 or 1) (Tab. 3): two of these are relative to the whole study period and have identical values in both shapefiles (NeverEm, NeverSub). These two columns record whether a site was never exposed or never touched by the waters. The other three columns are relative to the water level period (i.e., minimum or maximum water level) and record whether a site has been affected by the water fluctuations (Affected), if it has always been outside or under the water in the respective water level period (AlwaysEm, AlwaysSub).

[43] Sconzo Simi, Titolo, this volume.

[44] See the discussion in Sconzo, Simi, Titolo, this volume.

[45] This is because the NA values, if not removed or accounted for, can distort the percentage calculation.

[46] See also Sconzo, Simi, Titolo, this volume, note 56 on another limitation specific for the Tishreen Dam, that is not however directly related to the methods presented here, but to the lack of DAHITI data for the years of analysis.

[47] See Sconzo, Simi, Titolo 2023 for the Mosul Dam case study and Sconzo Simi, this volume, for the Tishreen Dam Case study.

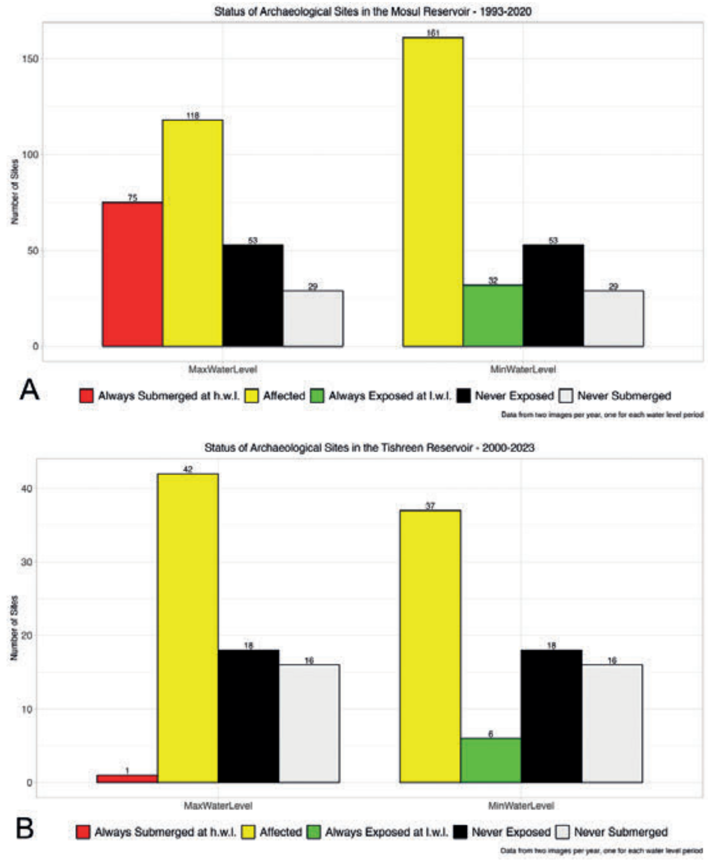

Fig. 8 - Example of quantitative results: emergence pattern categories for the Mosul Dam (A) and the Tishreen Dam (B).

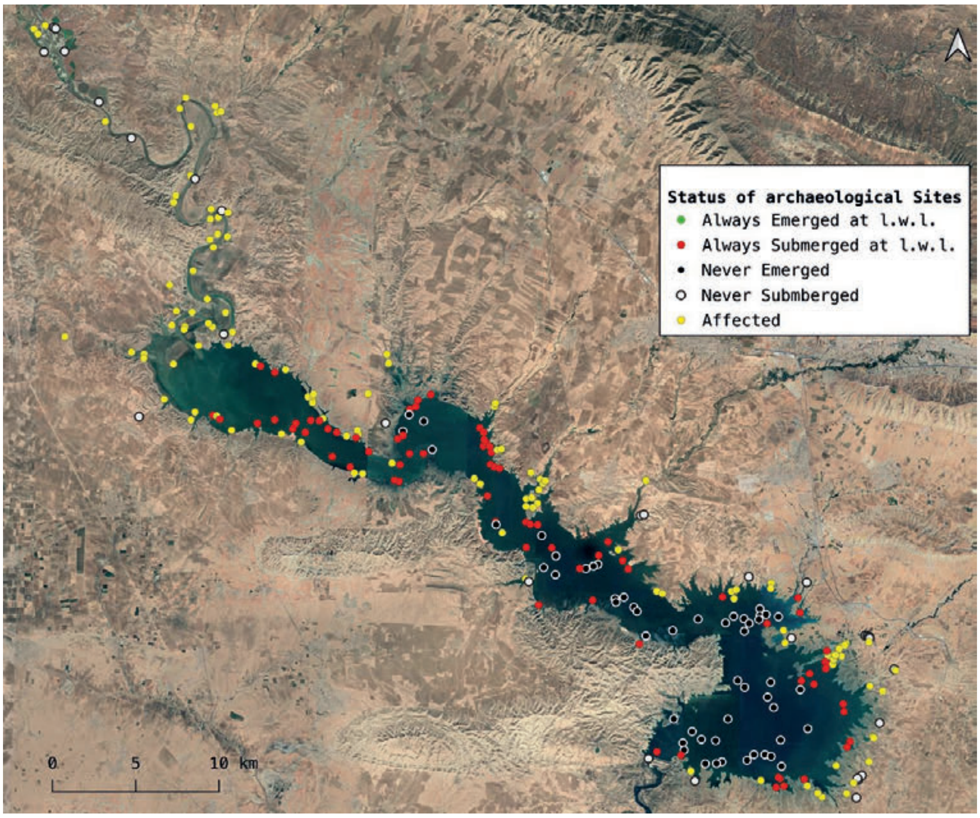

Fig. 9 - Example of quantitative results coupled with spatial data: spatial distribution map with emergence pattern categories for archaeological sites in the Mosul Dam.

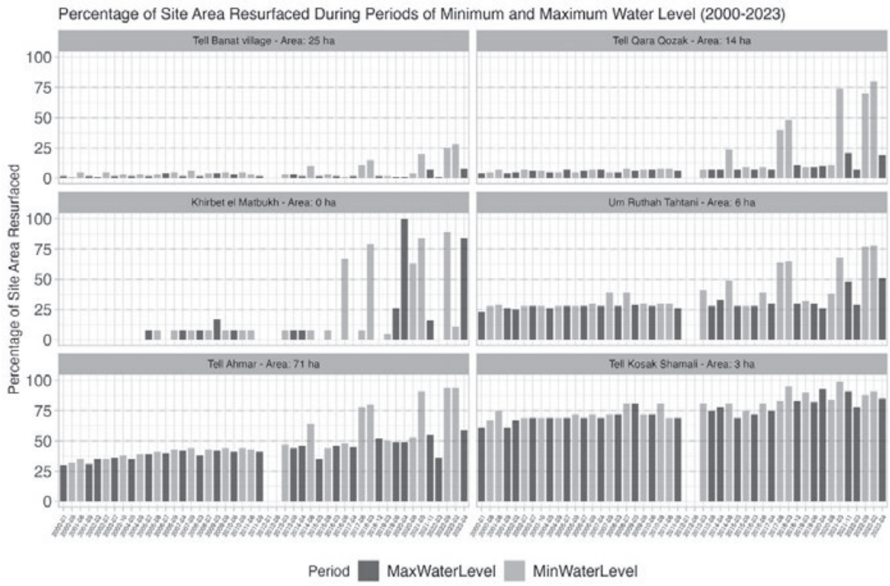

Fig. 10 - Example of single sites analysis results: emergence patterns for selected sites in the Tishreen Dam.

One of the immediate data that can be extracted from this shapefile are quantitative information obtained by counting the number of sites that in the period under examination have never been exposed, those that have never been touched by the ebbing waters, and those that are instead still affected by the water fluctuation processes (Fig. 8). Moreover, by dividing the inspection years in minimum and maximum water level periods, the workflow is able to assess how many sites are outside the water when the lake is at its lower levels, and those which are generally easily submerged when the water is higher.

The creation of a shapefile with this information also means that the spatial distribution of the site categories mentioned before can be observed to further understand behaviors and patterns (Fig. 9). At this point, one could also factor in qualitative data, such as the site type, to inspect whether a site's morphology can influence its emersion patterns. Moreover, understanding site morphology can also help to understand possible damages and survival rates further down the line.

Thanks to the time-series images, the workflow can also quantify emerged archaeological features per year, according to water level periods. This temporal quantification, especially when coupled with water level data (e.g., from DAHITI), can help understand emersion patterns across different years. It is possible to highlight years in which significant reductions in water level occurred and associate these numbers with the number of resurfaced sites. This inspection is useful not only to assess past behaviors but also to plan safeguarding activities. In fact, similar reductions in water level are expected to bring a similar number of sites outside the water. This element is particularly evident when the number of exposed sites and years with similar water levels is associated with the spatial location of the same archaeological features. This association shows how it is possible to leverage the history of the lake to understand emersion patterns and prepare salvage operations in the future. Another outcome of the time-series analysis is also the identification of any sudden changes in the lake's surface and their impact on the cultural heritage. While typically the changes in the lake level are gradual, sudden changes might happen due to water management choices or other external events not always linked to the natural behavior of the reservoir.[48] Knowing how and which sites are more prone to resurface also in this occasion in another valuable information for salvage activities.

While general data are definitely useful, the workflow also allows for the inspection of single sites. General trends might hide local behaviors that are only visible when inspecting each site on its own. We can, in fact, group sites based on their resurface history (Fig. 10). Knowing that, for example, a group of sites will resurface only when there is a substantial reduction in the water level is another valuable addition to the planning of salvage activities. This knowledge can, in fact, help in the prioritization process and lead to more informed undertakings.

Lastly, on a smaller scale, the workflow is also useful for analyzing single sites without the need to examine a larger region or a group of different sites. Inspecting a single site can help understand

[48] For a review, see Sconzo, Simi, this volume.

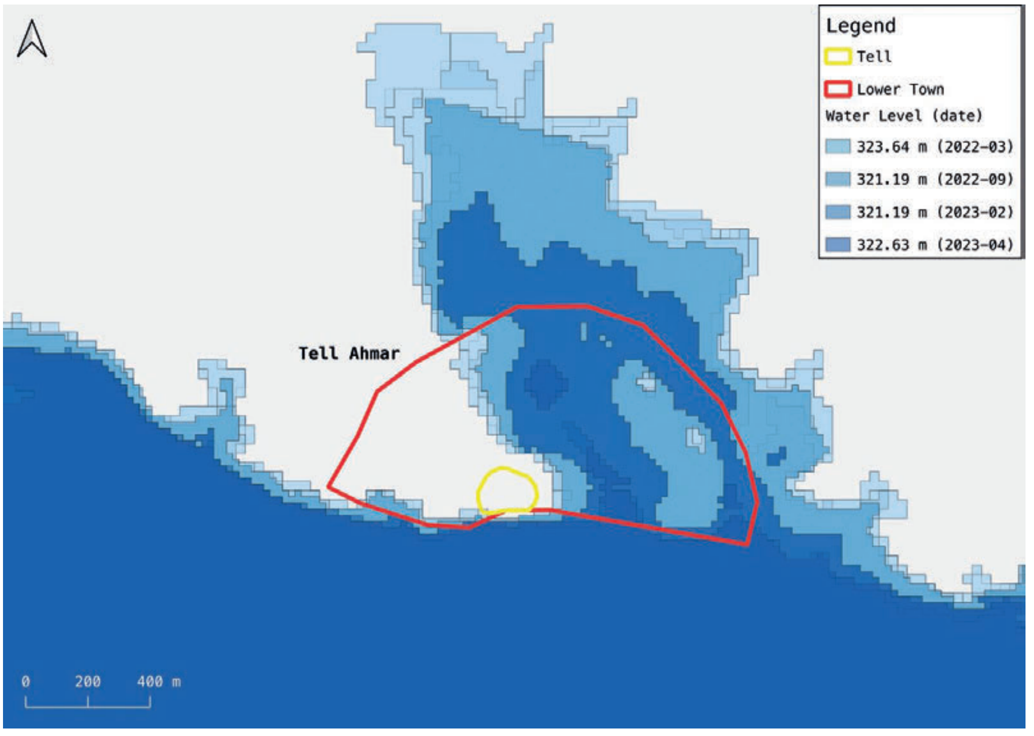

Fig. 11 - Example of single sites results and spatial visualisation: different stages of submersion in the lower town of Tell Ahmar (Tishreen Dam). Water extent extracted from reclassifed NDWI composites.

if there have been different phases of emersion and submersion and if the site was affected by known water fluctuations or similar events. This can also be coupled with a remote sensing analysis to understand the spatial location of the impacted area (Fig. 11). All this information can be gathered to understand, e.g., possible damages to a specific site or to plan field visits.

4. Discussion

It is possible to observe how the tool is flexible and adaptable to non-identical situations and needs. As a matter of fact, the tool provides many different outputs that can be adapted to the needs of each application. At the general level, the tool can distinguish between sites that will never resurface even at the lowest lake reduction, sites that were never touched by the lake, and those still affected by the reservoir's fluctuating dynamics. These data already provide important information as it can lead, thanks to spatial mapping, to more informed ground reconnaissance and rescue projects by prioritizing sites endangered by water fluctuations. Adding to this, having a time-series view of the number of sites resurfaced at each water level period allows to further plan the aforementioned undertakings, as generally speaking, years with similar water levels brings a similar number of sites out of the water. Thus, future periods of water reduction might lead to similar results. The two case studies in which the tool was applied also showed how the results can highlight the complex interplay of natural water fluctuations, water management, and political and strategic factors impacting the resurfacing of archaeological sites.[49]

However, the tool also works at different scales, which can be helpful when a more fine-grained approach is needed. By highlighting a site's (or a group of sites') resurfacing history, the tool can inform a more detailed evaluation of a small-scale rescue effort or a better understanding of potential erosion damages.

The tool is also a first of its kind as a companion to a survey project. In fact, it has been successfully applied at different stages before and during the fieldwork activities of the ReLand Project in Iraqi Kurdistan. Most importantly, this application allowed for a ground validation of the results, which can now be considered accurate beyond the error matrix results. Moreover, thanks to the relative ease of use, the tool helped choose a prioritization strategy that fit the time constraints of an archaeological survey project. In fact, depending on the analyses run every

[49] Sconzo, Simi, Titolo, 2023; this volume.

five days (the time of each Sentinel-2 acquisition), the project could direct its effort to either endangered sites or others that have not been known to resurface before.

There are, of course, technical limitations that must be kept in mind. As mentioned before, a solid archaeological dataset is best suited as an input to this kind of application, as it will necessarily lead to better results. The same goes for the remote sensing data (unprocessed and processed), which must be checked for any missing data or inaccuracies. While the two case studies relied on two observations per year, this is not mandatory, and the workflow can easily be adapted to more complex monitoring processes, for example, using one image per month or week. In fact, a weekly/five-day monitoring was put in place when on the ground during the ReLand fieldwork.

4.1 *Reproducibility and Open-Source*

This tool is not necessarily the easiest to adopt among the scientific community due to the technical knowledge that is still required (see below). However, means have been put in place to enhance reproducibility and understanding behind the technical process, as open sourcing and ease of use have been an integral part of the project since the beginning. First, the workflow is designed to use freely and globally available datasets, ensuring that costs and availability will not be a concern when applying the tool elsewhere. Second, almost all the analyses have been carried out using the R programming language, a powerful scripting language that has become quite popular among archaeologists.[50] The code for Google Earth Engine is instead written in Javascript, but also reproducible in R for scholars more familiar with it (see below). The GEE code is also easily shareable, as it usually requires just one link to share and run the analysis.[51] The use of plain text scripts has been proven to be a suitable method of ensuring reproducibility and transparency in the analysis, especially regarding the Open Science applications.[52] However, just providing the code is not always enough, especially if the application requires a good knowledge of a scripting language. While not all barriers can be torn down, commenting the code, enabling the selection of analysis variables for users, and providing guides and directions is a valuable practice to guide other scholars in re-using the scripts.[53] The code itself is written in a way that users only need to tweak some few initial parameters (variables), while all the processing takes place after these tweaks. This approach is applied where most of the decision-making is necessary, i.e., during the image choice and processing phase. For example, user can select beforehand the area to be analyzed, the satellite images to use, the temporal range, whether to produce NDWI or True Color composites (useful for accuracy assessment), the Google Drive folder name to save the images, their names, and their reference system.[54] This stage is carried out using the GEE scripts, but the same scripts were also converted (and tested) in R, thanks to the {rgee} package,[55] which act as an interface between R and GEE. This ensures further reproducibility and allows for the entire analysis to be carried out in R, for those unfamiliar with JavaScript or GEE.[56] When decision-making is not strictly required (i.e., in the image post-processing and shapefiles creation phase), user-defined variables are not set, but the code is extensively documented to better guide towards its use, with an explanation of functions and operations carried out.[57] The use of GEE, R and QGIS also means that one can choose the more familiar tool to do most analyses and that the entire workflow can potentially be platform-agnostic.[58]

The code is made available on Github, using a GitHub organization profile for the ReLand project where future code, data, and analysis will be hosted.[59] Of course, future datasets, when associated with a published paper, can also be hosted on platforms like Zenodo, for improved sharing between the academic community and long-term archiving through unique IDs.

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[50] Marwick 2018.

[51] Rayne *et alii* 2020.

[52] Marwick 2017.

[53] See Orengo, Petrie 2017; Rayne *et alii* 2020 for good examples of well-documented code available with the publication.

[54] These parameters are common to the GEE and R scripts, while unique to R are options to display images in an interactive map (only for visualization purposes), and to limit the images to a certain amount (useful for testing purposes).

[55] Aybar *et alii* 2020.

[56] The only downside of the combination of R/rgee is the lack of interactivity, and the slower support for some GEE features, such as choosing a subset of a series of images, which would make the process smoother. For now the user, once all the variables are set, needs to save on Google Drive all the images generated and then select the ones needed. On the other hand, in Google Earth Engine one can inspect the images before running the export function, and only save those that are needed or met chosen criteria.

[57] The R code comprises four scripts: one for the google earth engine application, one for the image reclassification, one for the application of the zonal histogram algorithm and one for the generation of the final shapefiles with quantitative informations. The name of the script files also follows a progressive number from 1 to 4 to indicate the order in which they should be run. For now the scripts assumes a specific directory structure similar to the one found in the online repository, but in the future more flexibility is planned.

[58] The tool was tested on macOS and Linux (Ubuntu-based) with no differences except for the required installation of some missing GDAL and other packages on the Linux machine.

[59] https://github.com/ReLandProject (last accessed 2024-03-07).

5. Conclusions

The tool presented here showed how spectral indices applied to multitemporal satellite images can be used to analyze the phenomenon of archaeological sites resurfacing from artificial reservoirs. The tool offers clear advantages regarding reliability, scale, and cost-efficency, and it is a first-of-its-kind regarding the semi-automation of such an endeavour. The phenomenon of resurfacing sites has been mostly unknown, but much evidence has shown that there is a need to act to avoid further destruction and carry out proper documentation and safeguarding of the emerging cultural heritage.[60] The workflow has matured since its first iteration, and have been successfully tested in two different areas, while also employed during a field survey, confirming its usefulness for different types of analyses and requirements.

There is, however, still room for improvement. The tool still requires a considerable amount of manual work and knowledge of the area and remote sensing to be applied to other regions. Accuracy assessment must also be done individually and manually, which is usually not an easy task. Moreover, the installation and use of programming software like R should not be taken for granted, and the same goes for knowledge of JavaScript. To address these issues, ideal solutions and a possible next step for the tool would be to lean more towards web apps and less towards desk-based software. Google Earth Engine and the Shiny library[61] for R both offer possible and viable alternatives that would further enhance the accessibility of this workflow. Another option to be explored could be the creation of an R package to further standardize and enhance the ease of use through R.

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[60] Eidem 2015; Titolo 2021; Sconzo, Qasim 2021; Sconzo, Simi, Titolo 2023.

[61] https://shiny.posit.co/ (last accessed 2024-03-07).

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Paola Sconzo - Francesca Simi - Andrea Titolo*

FROM THE TIGRIS TO THE BANKS OF THE EUPHRATES: POST-FLOODING ASSESSMENT AT THE TISHREEN DAM RESERVOIR, NORTH SYRIA

Abstract

The paper presents the application of a reproducible tool, already tested by the authors on Lake Mosul, for the post-flooding assessment of the heritage sites impacted by the construction of dam reservoirs. This study examines the Tishreen Dam Reservoir (Syria) on the Middle Euphrates as a case study. The dam's construction lasted from 1991 to 1999, resulting in a 60 km long artificial lake. Salvage surveys and excavations were carried out during the construction period, shedding light on the richness of the region's cultural heritage. This area has gained attention in recent years due to an unprecedented drought that revealed several archaeological sites and villages that were believed to be lost for good. Based on the results of a new set of cost-efficient tools for observing the 'emersion patterns' of archaeological sites, we present an overview of the dam construction impact and an assessment of damage timescales and extent at the various sites involved.

Keywords

Remote sensing, Change Detection Technique, Syria; Middle Euphrates, Tishreen Dam, Heritagescape

1. Introduction[1]

Dam construction constitutes a critical focal topic within contemporary archaeological discourse on Western Asia. Alongside major events like natural disasters and armed conflicts, it catalyses the transformation or obliteration of entire heritagescapes.[2] A single dam project has in fact the potential to wipe out countless archaeological sites and villages that once thrived along riverbanks. Many of these sites will remain submerged indefinitely, while others face a different destiny as they intermittently resurface due to fluctuating lake water levels. These sites suffer from water erosion processes and may become vulnerable to new threats. Their ongoing destruction demands urgent attention, emphasizing the necessity for a 'second phase' of salvage efforts. These initiatives must encompass multidisciplinary documentation, constant damage assessment through the development of monitoring programmes, and – when requested – salvage operations.

This paper explores this topic by testing a reproducible change-detection technique for post-flooding assessment in the area of the Tishreen Dam Reservoir in North Syria.

This tool is not entirely novel, having originally been conceived for a comparable dam environment in the Lake Mosul region of Iraq. Its inception was prompted by the onset of a series of droughts affecting the Tigris valley since 2018, spanning from its headwaters in the Taurus Mountains of central Turkey to the marshlands of southern Iraq, that starkly transformed half of the Fertile Crescent into a desolate expanse of sand and dust.

As a consequence of these environmental shifts and the sudden lowering of lake levels, several archaeological sites and villages previously deemed lost forever have resurfaced, thus unveiling a drastically altered – yet newly imperilled – landscape.

At these sites, the ebbing waters had performed a sort of natural excavation through continuous erosive action, thus exposing structures and related material cultural remains – to the benefit of research but also that of professional and occasional looters.

In 2018, with the onset of the initial drastic reduction in the water level of Lake Mosul, the two survey teams operating along its western shore, specifically in the Kurdistan Region of Iraq (henceforth KRI) – the Eastern Ḫabur Archaeological Survey (EHAS)[3] and the Land of Nineveh Archaeological Project (LoNAP),[4] – documented and catalogued over 70 previously unrecorded archaeological features.

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[1] The authors share the full responsibility of the content of the present contribution, §§ Introduction, Results, Discussion and Conclusions were written by the three authors; § The Tishreen Dam was written by Sconzo; § Dataset Creation by Simi; Workflow-Change Detection by Titolo.

[2] Regarding the concept of 'heritagescape' applied to dam reservoir landscapes, see Sconzo, Simi, this volume.

[3] On the EHAS work along the Mosul Dam: Sconzo 2019; Sconzo, Qasim 2021.

[4] On the LoNAP survey project: Morandi Bonacossi, Iamoni 2015.

This event has brought to the forefront a series of pressing inquiries: How can we swiftly and accurately identify archaeological sites affected by fluctuations in water levels? What are the consequences of prolonged submersion, such as erosion or sediment deposition? Is there a standardized protocol, a 'best practice', for documenting, monitoring, protecting, or even planning salvage operations in this evolving environmental context?

A novel approach was devised to address some of these challenges.

Firstly, we designed and compiled what could be deemed the most extensive archaeological dataset currently available for the Upper Tigris region of Iraq. This incorporated legacy data from earlier archaeological surveys and excavations, the results of the aforementioned EHAS and LoNAP endeavours, and a new remote survey specifically conducted across the inundated expanse of the lake basin.

This operation yielded an unprecedentedly detailed overview of the loss and rediscovery of a particularly significant landscape and culminated in the identification of 275 archaeological sites.

In the subsequent phase, to analyze the emergence patterns of these sites, we employed a bespoke change-detection technique tailored to this dataset that combines medium-resolution satellite images, a cloud computing platform and vegetation indexes.[5] In the context of Lake Mosul, this method emerged as a potent post-flooding assessment tool, characterized by its ease of reproducibility and affordability.[6] At a macroscopic level, it enabled precise delineation between sites potentially lost irretrievably and those still subject to water level fluctuations. Given the idiosyncratic response of each site to the lake's complex dynamics, this approach facilitated the identification – and subsequent awareness – of sites that resurface at varying water levels, and assessment of the extent to which this occurs. This had several practical implications, notably for refining field monitoring programs, guiding future targeted investigations, and enhancing comprehension of the survival mechanisms of submerged archaeological sites.

To test the applicability of this tool to other flooded landscapes beyond the Upper Tigris region of Iraq, particularly in South-West Asia (SWA) and beyond, we conducted a parallel investigation of the Tishreen Dam Reservoir in North Syria using the same methodology (Fig. 1).[7]

This area has been in the spotlight recently due to its increasingly dry environment and an unprecedented minimum of the lake water level. In 2023, the dam was temporarily closed as the water level plummeted to what is colloquially referred to as the 'dead zone'.

2. The Tishreen Dam

The construction of the Tishreen Dam on the northernmost stretch of the Syrian Euphrates lasted from 1991 to 1999, resulting in the creation of a 60 km long artificial lake that impacted – according to our final estimate – over 75 archaeological sites and a dozen villages (Fig. 2).

In the late 1980s, following established precedents,[8] the Syrian Directorate General for Antiquities and Museums called for an international rescue programme to help recover information from all threatened archaeological sites in the area affected by the new reservoir, in what is defined as 'first-phase salvage'.[9] It is noteworthy that prior to these interventions, the archaeological significance of this particular stretch of the river had been largely overlooked and neglected. Intermittently visited in the 19th and early 20th centuries by pioneering explorers and travellers such as F. R. Chesney,[10] George Smith,[11] Max von Oppenheim,[12] D. Hogarth,[13] and G. Bell,[14] the region only saw large-

[5] Titolo 2021; Titolo, this volume.

[6] Sconzo, Simi, Titolo 2023.

[7] The selection of this small reservoir was a natural homecoming for two of the authors, as PS worked for 17 years in the Euphrates Valley and AT focused his PhD research on the Iron Age occupation of this region.

[8] Reference is here made to the call on the occasion of the construction of the Tabqa Dam, built in the early 70s immediately downstream, at the behest of the Baath party and its president Hafiz al-Assad. On this occasion, Assad invoked the ancient civilizations and later Islamic history, utilizing cultural mobilization to construct an image of Greater Syria that contested existing political borders (Jones 2018). Additionally, he strategically linked modernity and the dam to demonstrate his dedication to Syria's future (Luke, Meskell 2019). For a reassessment of salvage excavations in the SWA region, see also Sconzo, Simi, this volume.

[9] Eidem 2020; Sconzo, Simi, this volume.

[10] Chesney in 1832 visited the region on a survey of the Tigris and Euphrates rivers (Chesney 1850).

[11] It was during this second journey in the Middle East in 1876 that G. Smith solved the controversial issue of the location of Carchemish, the last rich capital of the Hittites, and paved the way for further explorations and excavations at the site.

[12] Oppenheim 1899 cursorily mention the region in the account of a journey in 1898 from Aleppo to Abu Qalqal.

[13] This scholar visited the region in 1908 the year before applying to excavate the mound of Carchemish (Hogarth 1909).

[14] G. Bell 1910; 1911 embarked on a long journey along the Euphrates in 1909. After visiting Tell Ahmar, ancient Til Barsip, and Carchemish, she worked her way down the course of the river, passing through some of the sites which have later been submerged by the lake (Qubba, Dja'de el-Mughara, Qara Qozaq (her Kara Kazâk), Tell 'Abr, Tell Qumluq, Qalat Nejem, Tell Banat, etc.). Bell's photographic account of the riverbank and its villages offers valuable insights into a landscape that is now entirely transformed or lost. On the Euphrates journey, Cooper 2016, 42-59.

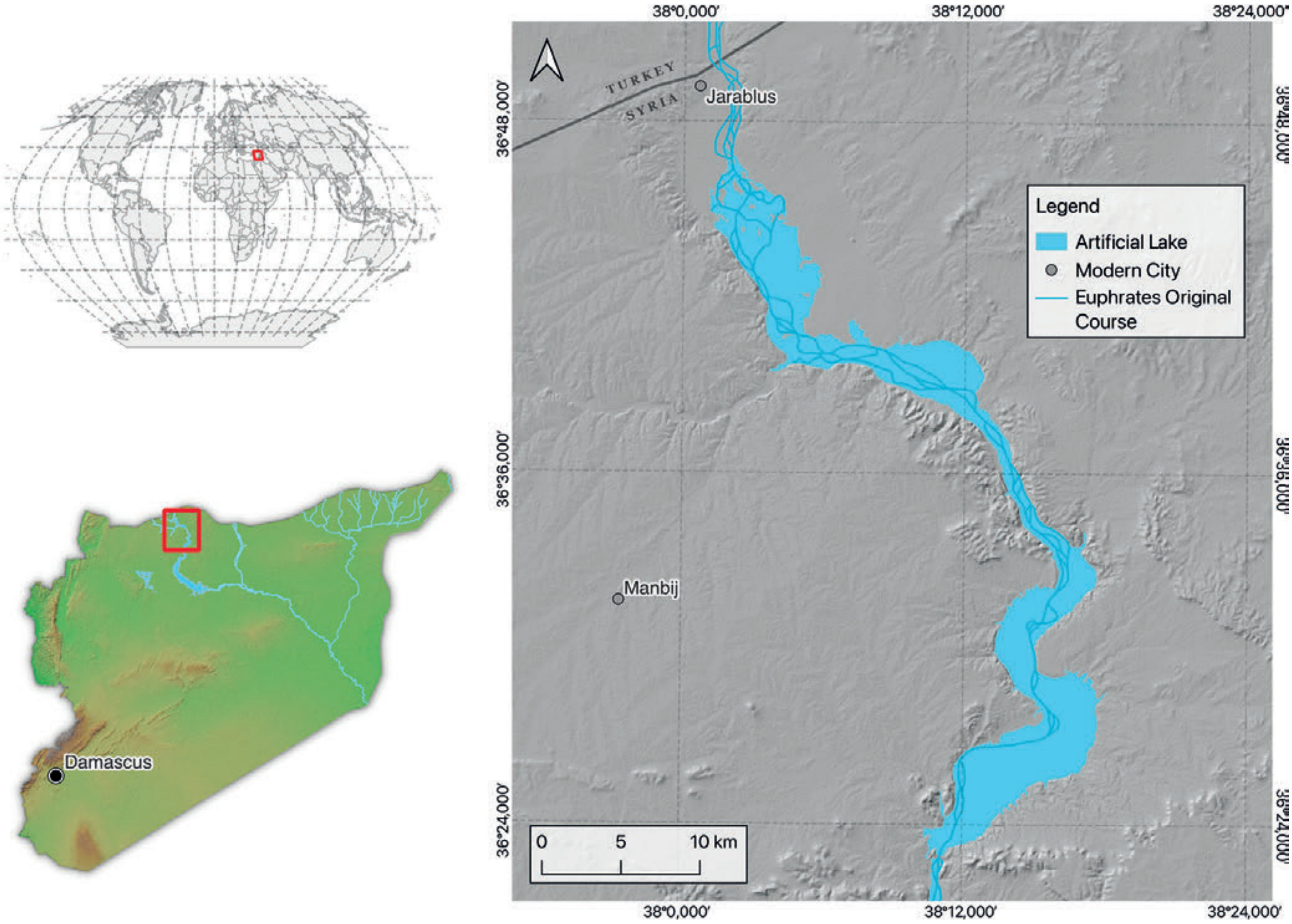

Fig. 1 - The Tishreen Dam in Northern Syria.

Fig. 2 - Resurfacing houses in the area of Tell Qumluq (courtesy of P. Sconzo).

scale excavations with the onset of the Carchemish[15] and Til Barsip[16] projects in the first three decades of the 20th century. Although these sites had very long occupation histories, originating sometime in the fifth millennium BC, early excavations focused mainly on the remains of the Iron Age,[17] a period in which both were important cities, respectively of the Neo-Hittite empire and the Aramean tribal kingdom of Bît Adini.[18]

Insights into earlier settlement patterns in the region, particularly during the Early and Middle Bronze Age, were derived from a significant collection of artefacts. These objects were primarily acquired by L. Woolley and T.H. Lawrence, and largely originated from burials that had been plundered by locals in the region, including sites such as Kara Hasan, Amarna, Qara Qosaq, and Hammam Saghir.[19]

The end of these pioneering excavations closed the first research phase. The region remained excluded from further investigations until the 1970s, when a major geomorphological and two systematic archaeological surveys were carried out.[20]

With the construction of the Dam, the Tishreen sector gained renewed interest from the international scientific community. A survey in the reservoir area conducted by T. McLellan and A. Porter[21] represented the primary method for selecting sites to be rescued. In the following years, other similar enterprises covered more limited areas[22] and/or had specific chronological targets (Fig. 3).[23] Given the urgency of the circumstances and the research objectives at the time, these endeavours primarily prioritized sites deemed most significant from both scientific and chronological standpoints, focusing particularly on tells and cemeteries.

During dam construction, excavations were conducted at 23 different archaeological sites.

The results, along with those obtained in nearby dam reservoirs such as Birecik and Carchemish to the north in Turkey, and Tabqa Dam downstream, provided a comprehensive picture of the settlement history of the Middle Euphrates region.[24] They emphasised the vital role of the river valley as major corridor for trade and communication throughout history.[25] They also underline its unity and uniqueness, strengthening its central position instead of considering it as a peripheral area at the socio-political frontier between great powers. Salvage excavations, moreover, played a crucial role in shifting the research focus from large mounds to smaller-scale sites and cemeteries, thus helping alter the spatial perspective on ancient Western Asia throughout its history. This was particularly significant for a reappraisal of the pre-and proto-historic periods, which led to significant progress in the reevaluation of the emergence of complex societies and the role played by the dynamic interaction between pastoral and sedentary elements in the shaping of this process. Regarding the third millennium BC, these excavations contributed to refining the relative and absolute chronology of the region by means of radiometric data and compared chrono-stratigraphies[26], leading to greater understanding of the phenomenon of 'second-urbanization in the Levant'.[27] Furthermore, it helped specify the role of Amorrite tribes in the formation of second-millennium state societies.[28]

With the completion of the barrage in 1999, some of the rescued sites disappeared underwater, and the first phase of salvage was concluded. A reservoir with a storage capacity of 1.9 km³ was created, thus generating 1.6 billion kWh of electricity annually (Fig. 4).

Due to the absence of a pre-flooding risk assessment for the areas designated to be submerged,[29] 10 out of 23 excavated sites initially deemed vulnerable to inundation were found to lie outside the actual flood zones. As a result, the majority of these sites continued to be investigated until the onset of the Syrian civil war in 2011, leading to a significant dispersion of resources at the expense of other submerged ar-

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[15] The archaeological site of Carchemish, capital city of the second and first millennium BC, underwent thorough investigation under the auspices of the British Museum. The initial exploration was led by D.G. Hogarth in 1911 (Hogarth 1914) followed by subsequent excavations conducted by L. Woolley between 1911-1914 and 1920 (Woolley 1921; Woolley, Barnett 1952). Prior to these extensive excavations, preliminary soundings had been conducted at the site between 1878 and 1881 by P. Henderson, who served as the British Consul in Aleppo (Hogarth 1909).

[16] Tell Ahmar, ancient Til Barsip, opposite and downstream from Carchemish, was excavated between 1929 and 1931 on behalf of the Louvre by F. Thureau-Dangin, M. Dunand (1936). See also Bunnens 2022, with recent bibliography.

[17] Remains dating back to the beginning of the 3rd millennium BC were unearthed at Carchemish in cist burials recorded at the base of a deep sounding dug in the core of the citadel mound (Woolley, Barnett 1952; Falsone, Sconzo 2007). Til Barsip yielded a hypogeum approximately 500 years later in date, containing abundant funerary offerings (Thureau-Dangin, Dunand 1932; Bunnens 2022, with further bibliography).

[18] Both cities were then conquered and absorbed into the Assyrian empire at different times, Til Barsip in 865 BC and Carchemish more than a century later in 717 BC.

[19] Woolley 1914; Sconzo 2013; 2015.

[20] Besançon, Sanlaville 1981; Sanlaville 1985.

[21] McClellan, Porter n.d.

[22] Einwag 1994; Eidem, Pütt 2001.

[23] Vivancos 2005; Gaborit 2012.

[24] For a reappraisal of the significance of salvage excavation in Syria see Eidem 1998; for an overview of the main results: Mcclellan 1997.

[25] Cooper 2006.

[26] A valuable example is the work conducted by a multidisciplinary team as part of the ARCANE project, Finkbeiner *et alii* 2013.

[27] Akkermans, Schwartz 2003, 233-287.

[28] Cooper 2006; Peltenburg 2007; Porter 2012.

[29] On this issue and the possible consequences, see Marchetti *et alii* 2020.

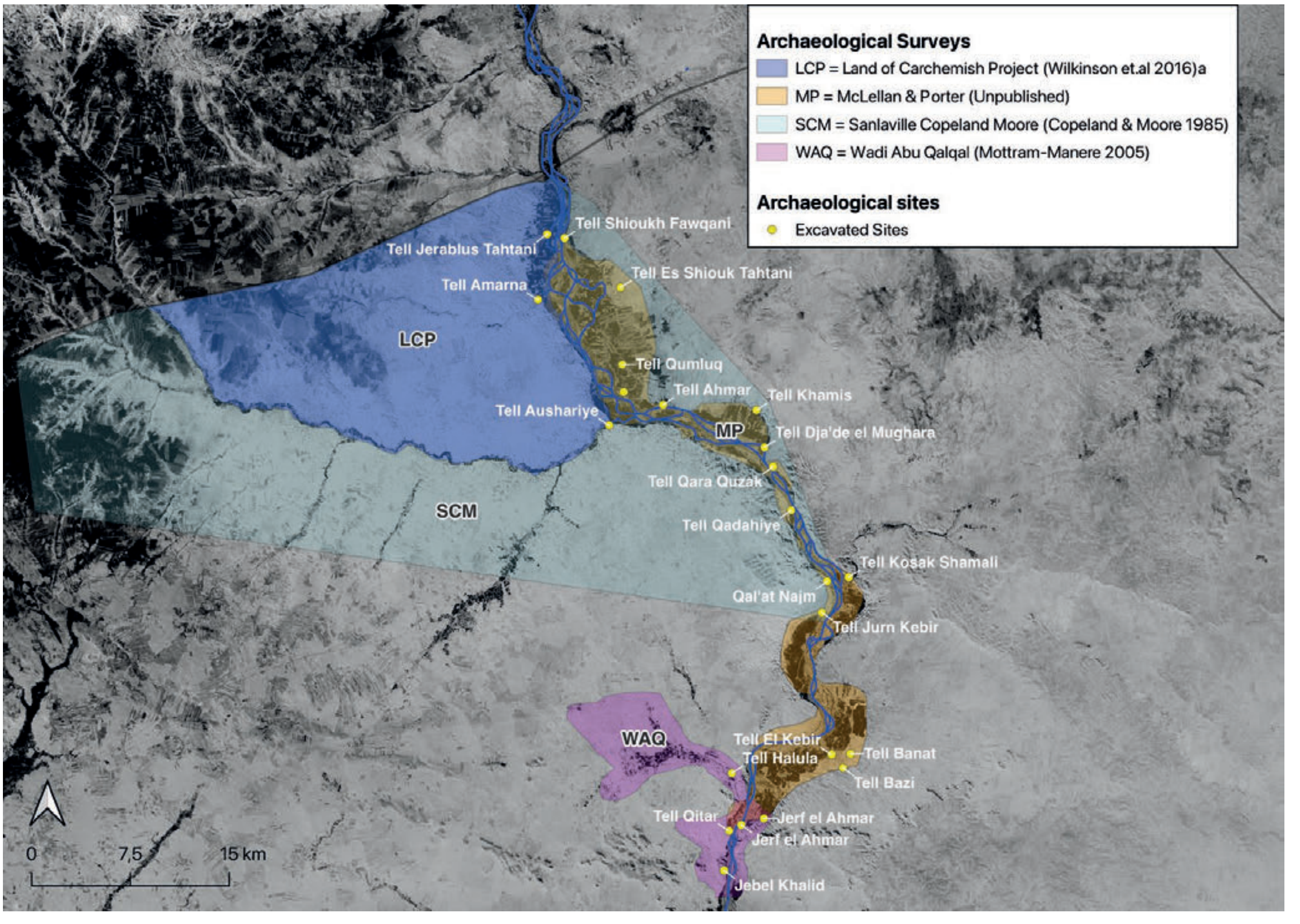

Fig. 3 - Map of the Tishreen Dam region showing the coverage of showing the coverage of five of the archaeological surveys (not represented on the map: Eidem, Putt 2001, Gaborit 2012, Vivancos 2005, Einwag 1994) and the excavated sites (basemap: CORONA 1105-1109 images, Nov 1968, from the Center for Advanced Spatial Technologies, University of Arkansas/U.S. Geological Survey).

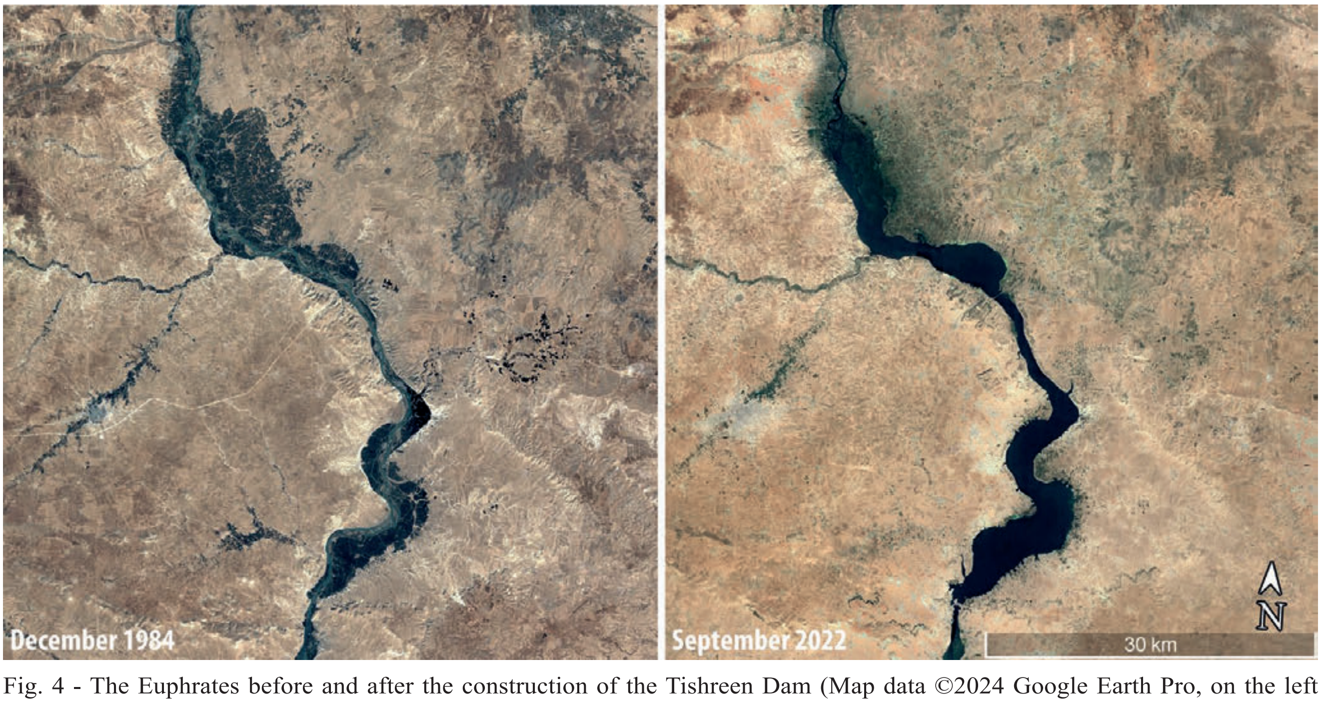

Fig. 4 - The Euphrates before and after the construction of the Tishreen Dam (Map data ©2024 Google Earth Pro, on the left Landsat/Copernicus imagery and on the right CNES/Airbus, Maxar Technologies.

chaeological sites that had yet to be explored. Notable examples include Tell Jerablus Tahtani, Tell Amarne, Tell Shiyukh Fawqani, and Tell Shiyukh Tahtani.[30] Additionally, some sites became geographically isolated, forming peninsulas or even islands within the reservoir, as observed in the cases of Tell Qumluq, Tell Qara Qozaq, and Tell Jurn Kebir (Fig. 5).

Subsequently, as we will explore later, these sites suffered significantly from the fluctuating lake water levels, leading to the exposure of architectural remains and artefacts to both erosion and looting. For instance, at Tell Qumluq, several Early Bronze Age graves with their accompanying inventories, as well as a section of a monumental Early Bronze Age structure, were exposed and documented in the early 21st century.[31]

In the first decade of this century, a final survey, the Land of Carchemish Project, introduced a change of perspective and methodology (Fig. 3).[32] By using remote sensing and intensive collection methodologies, it allowed the identification of several small new sites, thus extending our knowledge of the region beyond just tells.[33]

The period around the construction of the dam marked a significant era of heightened archaeological activity. An extensive international research network was established and rapidly solidified, facilitated in part by the organisation of numerous conferences and workshops held in Syria and abroad.

While the Lake Mosul area has undergone a new wave of archaeological ventures in the past ten years, the Tishreen region experienced the opposite trend. The onset of the Syrian civil conflict in 2011 effectively halted all archaeological activities in the country,[34] also significantly impacting related scientific study. Consequently, since 2015 only a few new publications have been dedicated to the region.[35]

Amid the same conflict, the Tishreen sector turned into a battleground between various groups vying for control over northern Syria. Among other consequences, this led to the displacement of many people,[36] and the loss of the community's memoryscape.

Additionally, as experienced in many conflict areas, looting and military destruction spread across the archaeological sites of the reservoir (Fig. 6).

The Tishreen Dam itself was one of the strategic targets during the conflict: initially seized by the Free Syrian Army rebels in 2012,[37] two years later it was taken over by Daesh.[38] In 2015, a significant push by the SDF, supported by the US coalition, succeeded in reclaiming control of the dam.[39] In late 2018, a Russian press agency reported that the Syrian Government had regained control of the dam.[40] However, this allegation has been denied by the Autonomous Administration of North and East Syria (AANES), which now controls the area and has renamed it 'Rojava Dam'.[41]

In the past few years, droughts have intensified, and the reservoir water level has dropped, often to the point that curtails electricity production.[42] In 2023, the Tishreen Lake reached the 'dead zone' several times, resulting in the dam being closed. This had disastrous consequences for the hundreds of villages that relied on it for their electricity.

This abrupt lake water-level reduction also entails the re-emergence of several archaeological sites, as our analysis has shown.

3. Methodology

3.1 *Dataset creation*

Under the pressure of the news concerning this severe drought that was hitting northern Syria and the consequential threat to all the heritagescapes of the Middle Euphrates valley, it became imperative to test the previously mentioned change detection system in this region as well.

To apply this tool in the Tishreen Dam context, it was first essential to assemble a robust archaeological dataset. The initial stage involved defining the research area, which was delineated on the basis of a buffer zone extending 250 metres from the maximum recorded lake margin (January 2000).

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[30] Falsone, Sconzo 2016.

[31] Jamieson, Kanjou 2009, 21-22, figs. 5-8.

[32] The survey focused on the Euphrates north-west bank and its hinterland, an area less affected by flooding.

[33] Ricci 2023.

[34] These have been slowly resuming, mainly thanks to the contribution of local archaeologists and communities, Sabrine, Montgomery, this volume.

[35] An exception is the final report of the Tell Ahmar excavation (Bunnens 2022).

[36] Since the beginning of the conflict, military operations in north-east Syria forced more than 900,000 persons to flee their homes (UNOCHA 2019). In the Tishreen Dam area most of the impacted villages were located in the southern sector of the reservoir, close to the dam itself. Despite prior notification, the sudden rise of the lake waters caught many off guard, compelling entire communities to hastily vacate their ancestral lands. They were mainly resettled in the area of Mimbej and Damascus. In the periphery of the latter city, they were still living in tents a decade later.

[37] Mroue 2012.

[38] As part of its expansion strategy, Daesh has taken control of several key water infrastructures along the Euphrates and Tigris rivers in Syria and Iraq, weaponizing both water resources and dams (von Lossow 2016).

[39] Reuters 2015.

[40] Enab Baladi 2019.

[41] ANHA 2019.

[42] Several reports suggest that the unprecedented decrease in the flow of the Euphrates is linked to Turkey's persistent pursuit of hydro-hegemony. Accusations have been made against Turkey for failing to adhere to the 1987 water control agreement, thereby jeopardizing food security, energy production, and the overall health of downstream populations (Zeitoun, Warner 2006; Sconzo, Simi, this volume).

Fig. 5 - Various phases of submergence of Jurn Kebir (courtesy of J. Eidem).

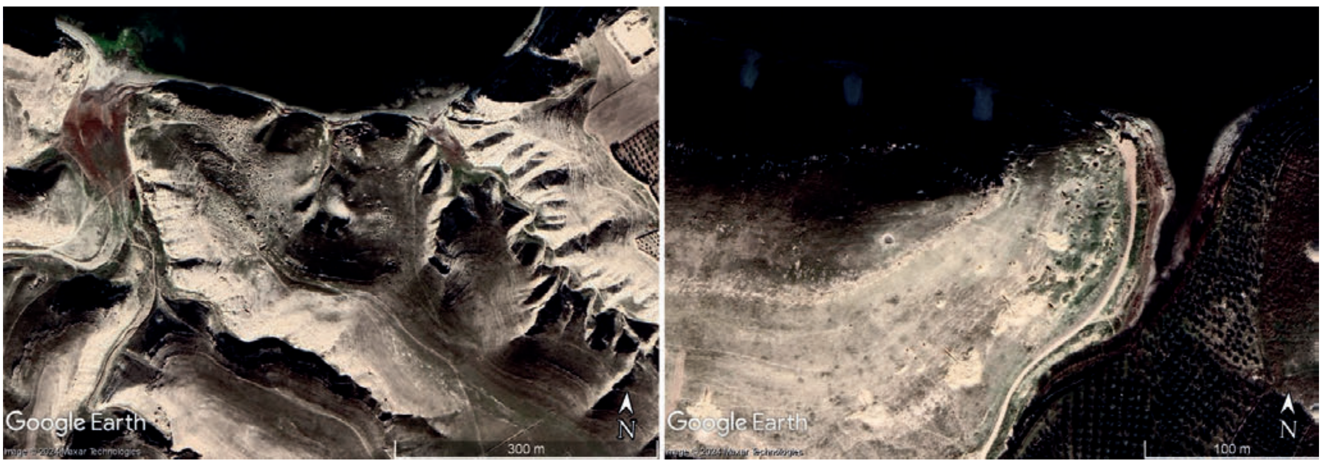

Fig. 6 - Extensive evidence of looting activities on the west bank of the lake (01/03/2021, Map data ©2024 Google Earth Pro and Maxar Technologies).

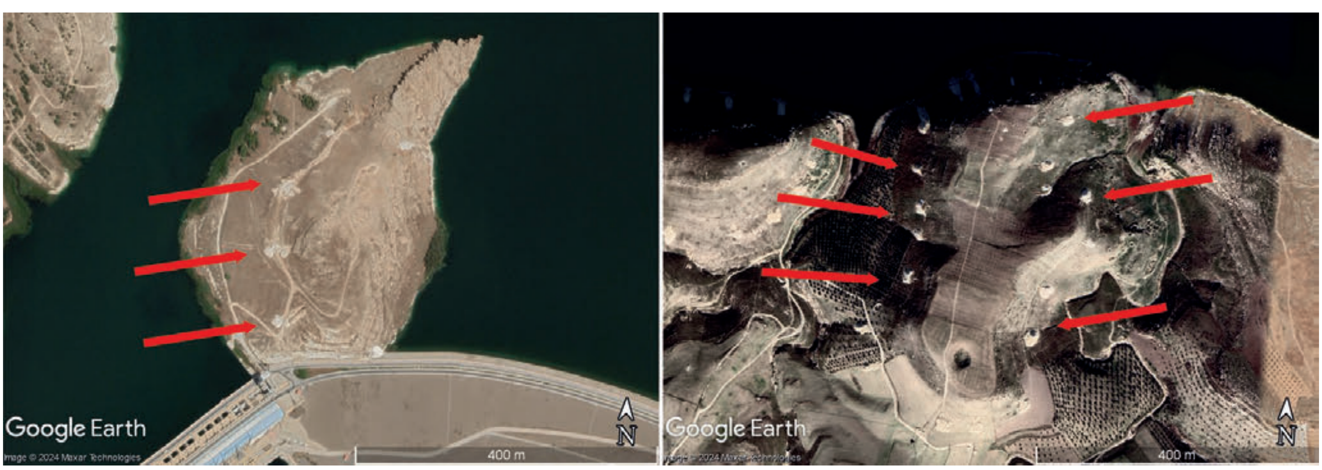

Fig. 7 - Militarization evidence at Tell Qitar (left image) and at a Tishreen Dam Remote Survey potential site (TDRS-3) (01/03/2021, Map data ©2024 Google Earth Pro and Maxar Technologies).

The dataset was compiled and enriched using CORONA declassified satellite images predating the flooding of the Tishreen Dam reservoir,[43] along with contemporary imagery accessible through Google Earth Pro.[44] The CORONA photointerpretation played a pivotal role in identifying and mapping all known and potential sites currently submerged. Meanwhile, the latest Google Earth Pro images aided in the general identification and precise positioning of potential sites, as well as in assessing the extension of some known sites and evaluating their state of preserva-

[43] Concerning the use of CORONA satellite imagery for archaeological site identification, see Casana, Cothren, Kalayci 2012 and Ur 2013.

[44] For a recent overview of Google Earth as a tool for archaeological investigations and heritage applications, see Luo *et alii* 2018.

Site Location or Identification	Surveys	Salanville (Copeland 1985; Moore 1985), Einwag 1984; Mclellan, Porter (unpublished); Eidem, Putt 2001; Wadi Abu Qalqal (Mottram-Manere 2005), Vivancos 2005; Gaborit 2012; Wilkinson *et alii* 2016
	Excavations	Published Reports
	CORONA Historical Satellite Imagery	Missions 1104 (August 1968) and 1038 (January 1967). Courtesy US Geological Survey
	Google Earth Imagery	2004-2021 (several third-party data providers) https://earth.google.com/

Tab. 1 - Archaeological data sources.

tion.[45] Given the region's recent conflict, the imagery also helped document numerous disturbances, ranging from extensive looting[46] to various forms of destruction due to the recent militarization (Fig. 7). These have been widely documented by several reports covering the entire country.[47]

Legacy data collection posed significant challenges due to the uneven, chaotic, and occasionally contradictory nature of the survey data available. These data stemmed from nine separate archaeological reconnaissance efforts conducted over more than 40 years in the same area, often resulting in overlapping or redundant surveys of previously identified sites (Table 1).

One particularly challenging aspect was identifying and mapping a specific funerary landscape, namely that of rock-cut tombs. Scattered either individually or in clusters, these tombs are distributed along the terrace cliffs directly overlooking the lake. While some of the previously mentioned surveys provided rough positioning information, they lacked details regarding their extent and absolute altitudes, which are crucial for evaluating the lake's fluctuating impact. Moreover, due to their vertical nature, integrating them into a 2D GIS environment proved difficult, requiring them to be represented as polygons. This methodological constraint has significant implications for analysis.

In contrast to the situation at Lake Mosul, where the majority of potential sites that emerged in the last decade could be verified on the ground by the new field surveys operating in the region, the sites identified in the Tishreen sector by the new remote survey could not yet be ground-truthed.[48] Consequently, the assessment of potential sites relies primarily on detecting soil colour changes and/or mounding,[49] with the presence of looting pits occasionally utilised to estimate site size.

A dataset consisting of 77 records was compiled, encompassing all known archaeological sites within the research area as well as those newly identified through the remote survey (totalling 15) (Fig. 8).

It included information such as coordinates, toponyms, typology, chronology, state of preservation and survey/excavation references. Additionally, it also contains a confidence indicator for site location[50] and extension.[51]

3.2 *Workflow - Change Detection*

The detection of the emergence patterns of archaeological sites was accomplished through the application of a change detection technique that integrates freely available medium-resolution satellite images, cloud-processing platforms, open-source GIS tools, and the NDWI Spectral Index to differentiate between water and land surfaces.

During the testing of this technique at the Tishreen Dam, a primary challenge arose from the extremely limited availability of water level data. This data is essential for extracting three key pieces of information: the years for analysis, the months corresponding to minimum (low water level - l.w.l.) and maximum (high water level - h.w.l.) water levels, and the actual water level measurements themselves.

While the Database for Hydrological Time Series of Inland Waters (DAHITI)[52] offered comprehensive data for the Mosul Dam spanning nearly its entire existence, the situation differed for the Tishreen Dam, for which the earliest available DAHITI data extended back only five years.

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[45] E.g. Parcak 2009; Lasaponara, Masini 2011; Bewley *et alii* 2016; Danti, Branting, Penacho 2017; Tapete, Cigna 2018; 2019; Rayne *et alii* 2018. Critical in this regard were the widespread looting activities (Fig. 7).

[46] Social and political instability, resulting from prolonged conflict, can encourage illegal excavation, looting, and trafficking of antiquities due to the breakdown of law-and-order institutions (Boylan 2002; Mahnad 2017).

[47] Casana 2015; Danti 2015; Cunliffe, Muhesen, Lostal 2016; Tapete *et alii* 2016; Casana, Laugier 2017; Masini, Lasaponara 2020; Mamo *et alii* 2022.

[48] This constitutes the most prominent difference from the Mosul Dam dataset, that instead has widely benefited from new field activities.

[49] For site signatures on historical satellite and aerial images see Ur 2010, 60-64.

[50] 'High', 'medium' and 'low'.

[51] 1= high, 2 = medium, 3 = low, 4 = buffer created automatically 5 = area identified through looting activities. In the most difficult cases for which it was completely impossible to determine the site area, due to the inaccuracy of its location or the impossibility of identifying its limits through photointerpretation, an arbitrary circular area of 1 ha was assigned to the site (only 15 sites).

[52] Schwatke *et alii* 2015.

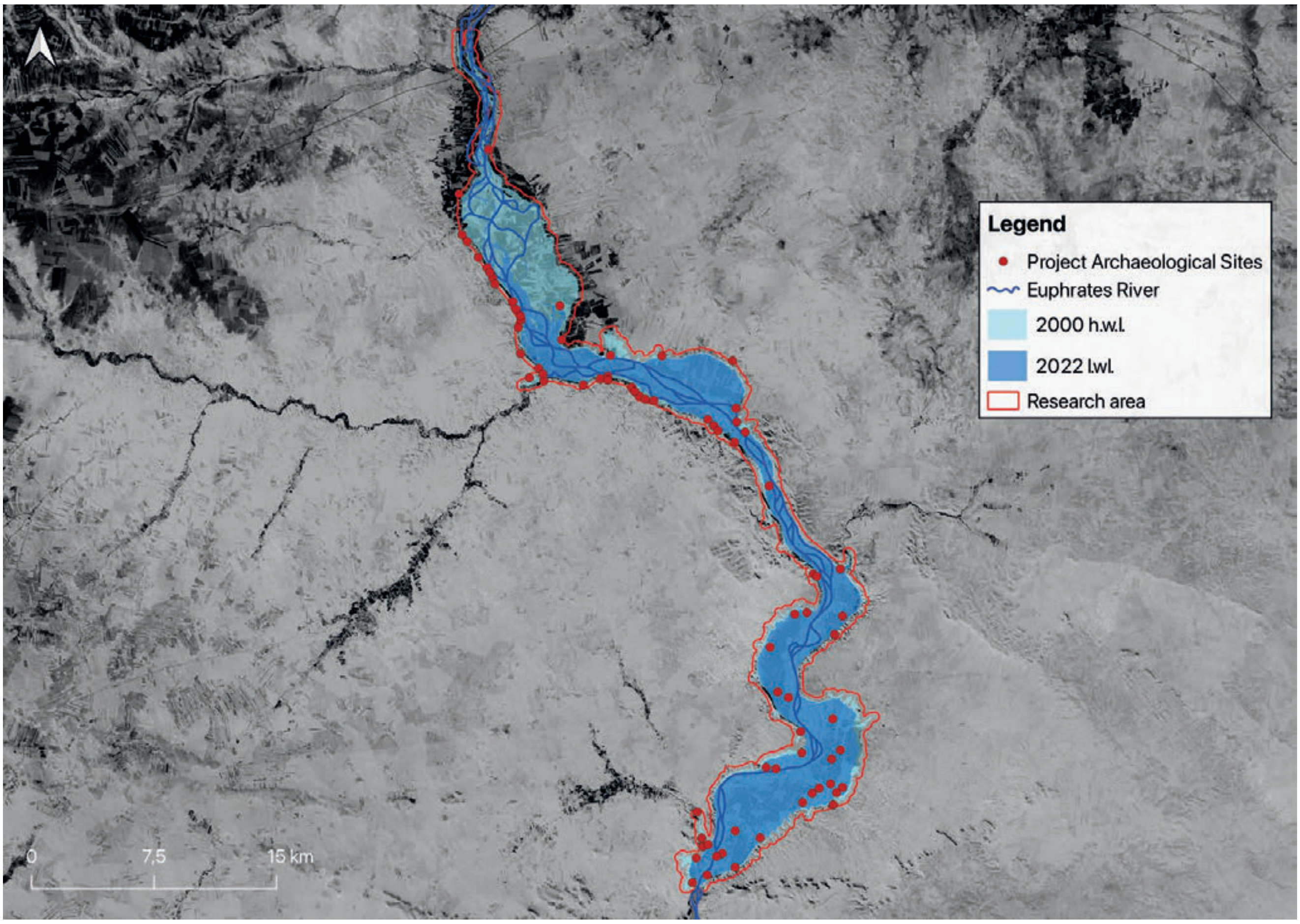

Fig. 8 - Area covered by Lake Tishreen at its maximum (2000) and minimum (2022). Basemap CORONA declassified satellite imagery (Mission 1102, Dec. 11, 1967), Center for Advanced Spatial Technologies, University of Arkansas/U.S. Geological Survey. (Map by A. Titolo).

Satellite (Sensor)	Date Range	Spatial Resolution	Temporal Resolution	Total Number of Images
Landsat 5 (TM)	2000-2011	30 m	16 days	24
Landsat 8 (OLI)	2013-2017	30 m	16 days	10
Sentinel-2 (MSI)	2018-2023	20 m	5 days	12

Tab. 2 - Satellite images used with their respective coverage, spatial and temporal resolution, and total number of images acquired.

To face this issue and to account for the missing information, the approximate lake surface was extracted by polygonising the Normalized Difference Water Index (NDWI) composites.[53] These were created in Google Earth Engine using a dynamic low cloud filter, a cloud-masking function and a median reducer on a collection of images taken at the Bottom-Of-Atmosphere (BOA) reflectance.[54] The NDWI composites were then reclassified using a threshold of 0.[55]

This enabled the acquisition of vector polygons representing the lake surface extension for each month, filling the gap for the years not covered by DAHITI (2000-2018), and facilitating the calculation of the corresponding lake surface area.

Subsequently, these data informed the selection of months with high and low water levels, thereby guiding the choice of images for each year.[56] For the remaining timeframe, the available DAHITI data was utilized.

As a result, the dataset comprises 46 images spanning the entire reservoir lifespan, with the exception of 2012 (Table 2).

[53] NDWI was used to discriminate between water and land surfaces. The raster NDWI images were converted to vectors using the 'Polygonize' algorithm in QGIS.

[54] Rayne *et alii* 2020; Sagar *et alii* 2017.

[55] This means that all the pixel values between -1 and 0 were counted as land, while all the values between 0 and 1 were counted as water. The resulting images were accurate enough that further tweaks seemed unnecessary.

[56] This solution was not ideal as the surface area does not represent the most precise indicator of lake variations. While

To obtain the percentage of resurfaced area, the calculations involving site polygons and raster images made use of the QGIS Zonal Histogram algorithm in R software facilitated by the Qgisprocess package.[57] The change detection procedure applied to these images is described in detail elsewhere.[58]

4. Results

4.1 *Water Level Observation*

The Tishreen Reservoir has demonstrated relatively stable water levels throughout its lifespan,[59] in contrast to Lake Mosul, which has undergone fluctuations of nearly 40 metres over the past four decades. Nonetheless, satellite imagery[60] and data from the past five years obtained from DAHITI[61] suggest a trend towards a reduction in the reservoir's water level since 2014.

Due to the overall steadiness of the water levels, each year approximately 47% of the total number of sites emerged from the water. However, with the onset of the new trend of decreasing water levels since 2014, this percentage has risen to 55%, as observed in 2021.

Additionally, Lake Tishreen exhibits minimal water level oscillation within the same year. This, combined with the aforementioned factors, has significant implications for the emergence pattern of archaeological sites, as discussed below.

4.2 *Categorization of the sites*

The Tishreen Dam Research Area was examined both at large and individual site scales. Employing the workflow facilitated the categorization of the 77 sites into three distinct groups based on their emergence patterns, allowing the determination of their frequency (Fig. 9):

- Sites that during the entire study period (2000-2023) were permanently submerged (*never exposed, **in black***) (n. 18)
- Sites that were constantly exposed (*never submerged, **in grey***) (n. 16)
- Sites that in the study period were affected by water-level fluctuation *(cyclically affected)* (n. 43), further subdivided into:
  - Sites always submerged at the year's h.w.l (*always submerged at h.w.l., **in red***) (n. 1)
  - Sites that emerged cyclically (*affected, **in yellow***) (n. 42 at h.w.l; n. 37 at l.w.l)
  - Sites that always re-emerged at the year's l.w.l (*always exposed at l.w.l., **in green***) (n. 6)

The primary focus of the analyses that we conducted has been centred on sites impacted by water fluctuations (*cyclically affected*). Given their heightened vulnerability to damage or destruction, these sites require particular emphasis on scientific documentation and protection measures. As part of the second phase salvage efforts, it is imperative to promptly integrate these sites into a comprehensive monitoring program. Such a program should include thorough documentation and emergency excavations in certain cases.

4.3 *Cumulative Results of the Time-Series Analysis*

The time-series analysis revealed that 18 out of 77 sites remained submerged by the artificial reservoir throughout the study period (2000-2023) (*never exposed*). These sites are all located at the end of the reservoir, close to the dam itself (Fig. 10a). Although the majority are mounded settlements/tells (Table 3), only one (Tell el-Kebir) was excavated during the first-phase salvage.

On the other hand, 16 sites remained untouched by the floodwaters, not even at the lake's maximum water level (*never submerged*) (Fig. 10b). These sites are predominantly situated in the north-west sector of the reservoir, perched upon elevated cliffs with commanding views of the lake below. Characterized by their flat terrain and modest size, they mainly date – on the basis of surface collections – to the Roman period onwards. Many of them were identified through modern surveys, notably the Land of Carchemish Project. One of the southernmost sites is Qal'at Najm, nestled atop a ford in the Qara Qozak gorge, and Tell Khamis, on the opposite bank of the river.

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the water level of a lake measures the vertical movement of water, the surface area of the lake measures the horizontal water movement and is influenced by the topography of the lake shores. If the shoreline is steep, the water will have less space to move horizontally, resulting in a minimal change in surface area, even if the water level drops significantly. On the other hand, if the shoreline is mostly flat, even a slight drop in water level can cause a more significant horizontal movement of the lake shores. Note that this solution may lead to a less accurate choice regarding the months of analysis. However, the validity of the tool itself and its results are guaranteed by the robustness of the change detection method.

[57] Dunnington *et alii* 2023. The code for the analysis is archived at: https://github.com/ReLandProject/ReLandTishreen.

[58] Sconzo, Simi, Titolo 2023; Titolo, this volume.

[59] According to DAHITI that provides data only for the last 5 years, the lake water level oscillated of only 5-6 metres between the highest (326.87 m in February 2020) and lowest (321.191 m in September 2022) levels recorded.

[60] It is important to note that the water surface plot replicates the water fluctuation pattern registered by DAHITI, providing proof that changes in the water surface reflect those in water level.

[61] A first phase (2018-beginning 2020) shows overall stability of the reservoir, with very minimal variation in water levels. The following second phase (until the end of 2022) is characterized by greater variations, with water level often dropping 3 metres in a few months. A third phase (from the beginning of 2023) again shows stabilization of the reservoir, at a lower water level and with a more consistent pattern of water fluctuation.

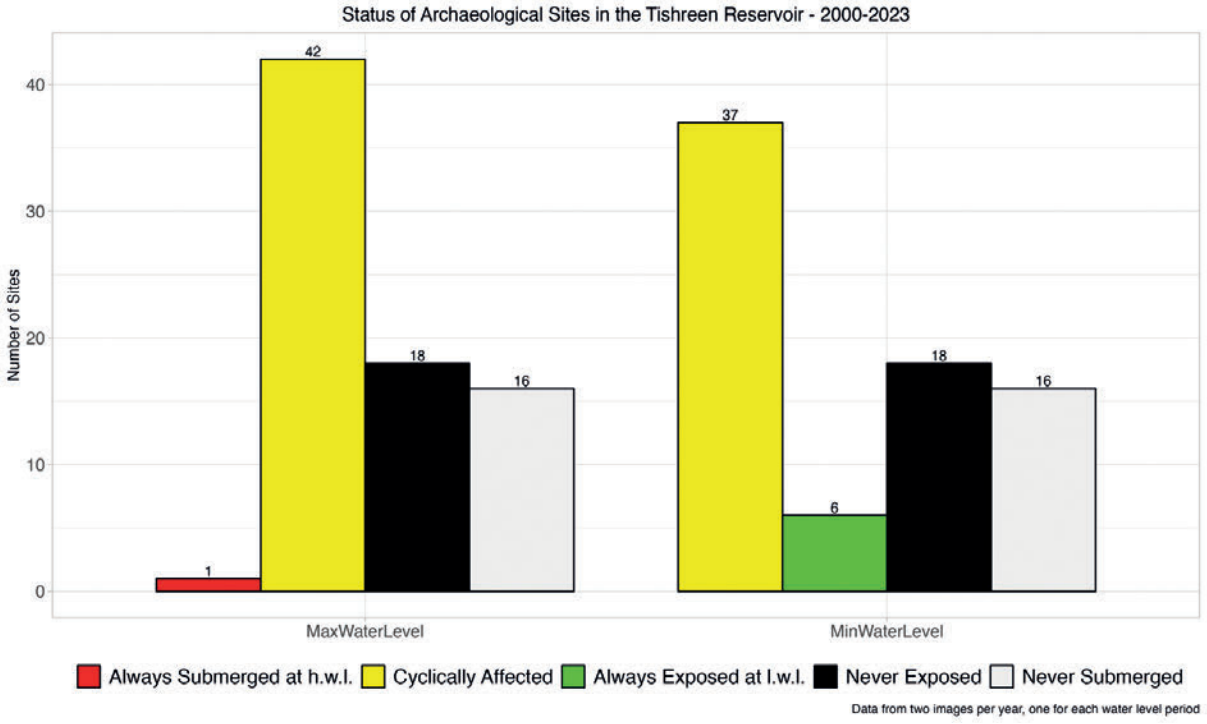

Fig. 9 - Emergence pattern categories.

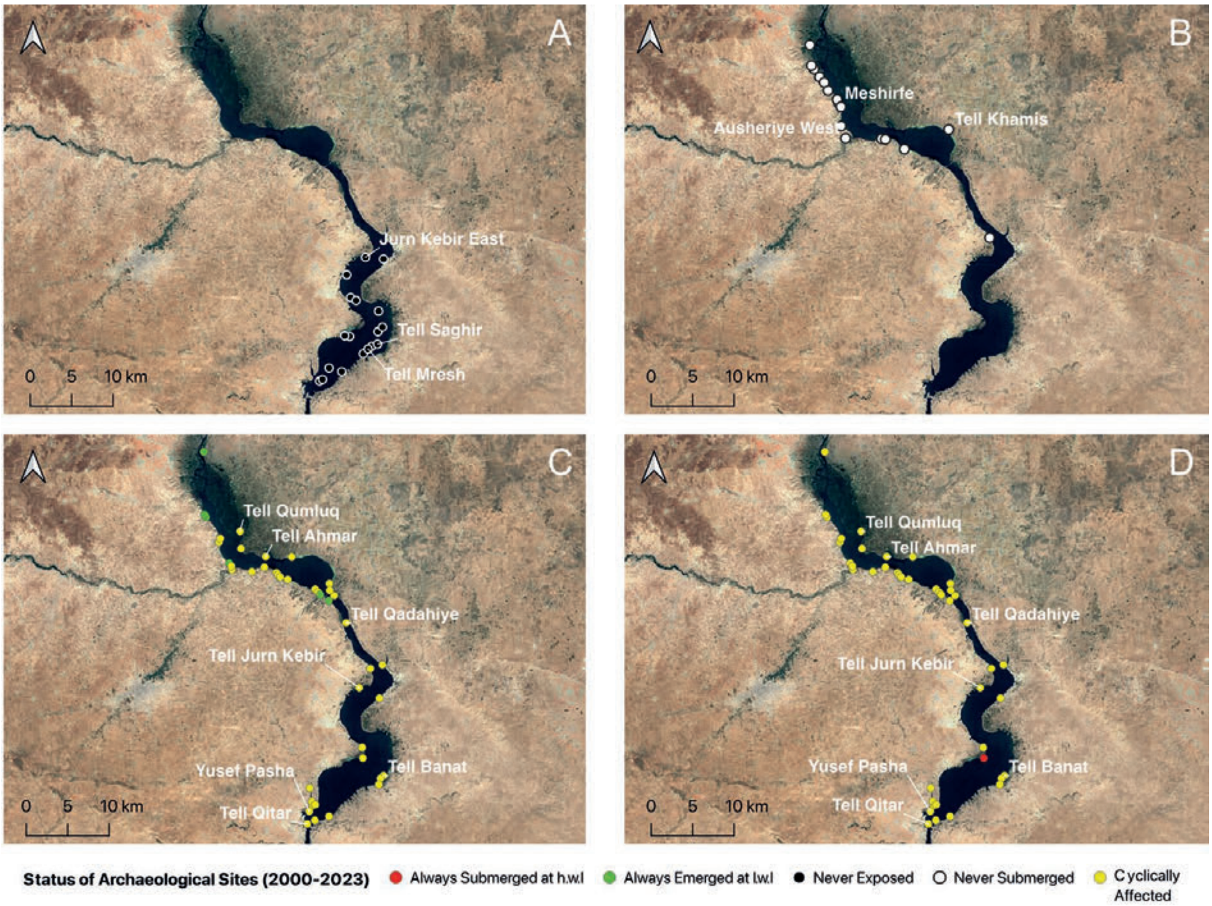

Fig. 10 - Spatial distribution of emersion pattern categories: (a) never exposed; (b) never submerged; (c) affected and always exposed at l.w.l.; (d) affected and always submerged at h.w.l. (Maps by A. Titolo).

	Mounded Sites	Flat Sites	Fortresses	Rock-Cut Tombs	Sherd Scatters	Uncertain	Total
Cyclically Affected	28	10	2	2	0	1	43
Never Exposed	15	2	0	0	1	0	18
Never Submerged	3	9	1	1	0	2	16
Total	46	21	3	3	1	3	

Tab. 3 - Number of Sites for Each Category and Each Site Type.

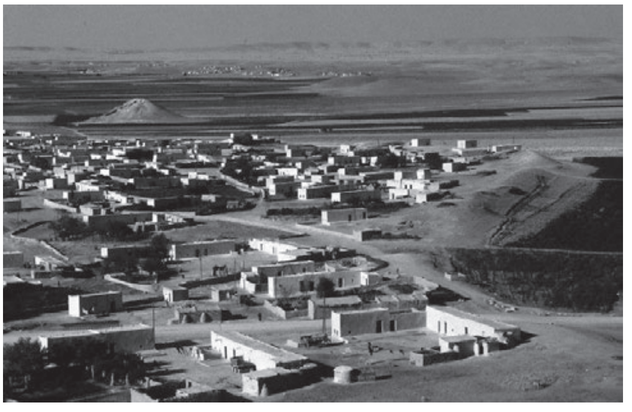

Fig. 11 - Tell Banat (Courtesy of McLellan).

The remaining 43 sites are affected by the water fluctuation process (*cyclically affected*) to different extents depending on the minimum (n. 37) or maximum water level (n. 42).[62]

As the lake level appears to have remained relatively stable, these sites undergo only minor variation in their exposure between minimum and maximum lake water levels each year. This consistency ensures that they can all be effectively incorporated into a regular monitoring and safeguarding program without significant challenges.

The *cyclically affected* sites are spread throughout the reservoir: during h.w.l. phases, the only site *always submerged* is located in a wadi gorge close to the old riverbed (Fig. 10d); in periods of l.w.l, *always exposed* sites lie in the northern sector of the reservoir or on the terraces close to the Qara Qozaq gorge (Fig. 10c). *Cyclically affected* sites include mostly multi-period mounds/tells, with some flat settlements and also clusters of rock-cut tombs (Table 3).[63]

4.4 *Reconstructing Site Histories*

Finally, the tool also facilitated the quantification of the exposed area for each of the 77 sites, carrying several practical implications, particularly for future targeted investigations and our comprehension of the survival of submerged archaeological features.

At one end of the spectrum, there exists a group of sites that have maintained at least 50% of their surface area above water since the reservoir's inception. These sites demonstrate a consistent pattern of emergence and submergence. Among them are Tell Qitar and Tell Qumluq. Conversely, at the other end of the spectrum, there are sites that resurfaced only during significant reductions in the lake volume, a trend that began in 2014 and peaked in 2018, 2021, and 2023. Examples from this group include the white monument at Tell Banat (Fig. 11), Tell Jurn Kebir, and Tell Qadahiye.

In between are additional sites that partially emerge each year, with less than 50% of their surface area exposed. However, over the past decade these sites have become more exposed due to the general reduction in water levels. Examples include Tell Qara Qozak and Tell Ahmar, particularly impacted in their extensive Lower Towns (Fig. 12).

Tell Ahmar provides valuable insights into analysis at individual site level. The bar chart depicting the resurfaced area of the site illustrates two significant phases (Fig. 13). From the initial filling of the reservoir until 2014, the site consistently remained above water, exhibiting a gradual but consistent increase in the total area exposed (from 32% to 47% of its surface). However, after 2014, the site data show significant fluctuations. During periods of low water level (minimum in 2014, 2017, 2018, 2021, 2022, and 2023), with 90% of the site revealed, it appears to have almost entirely resurfaced.

From satellite imagery, it became evident that the most recent fluctuations in the lake primarily impacted the site's lower town. Before 2014, the latter remained consistently underwater (Fig. 14:1-2). However, over the past decade, this area has experienced cyclical resurfacing (Fig. 14:3-8), with peaks of exposure occurring notably in September 2022 and February 2023. It's noteworthy that the rising water level can quickly submerge the lower town area; within just two months in 2023, the exposed surface of the site decreased from over 90% in February to slightly over 50% in April (Fig. 13 and Fig. 14:7-8). This observation raises the possibility that the site has undergone significant erosion and damage since 2014.

[62] Within this large group, six sites consistently resurface (*always exposed at l.w.l.*) yearly at the time of minimum water level (usually spring or autumn), while only one (Sandalyie Kebir) is constantly underwater during high water level periods (*always submerged at h.w.l.*).

[63] As already mentioned above, the reliability of the results of change detection applied to this specific type of site is biased by the lack of basic/determining data concerning their extension and altitude.

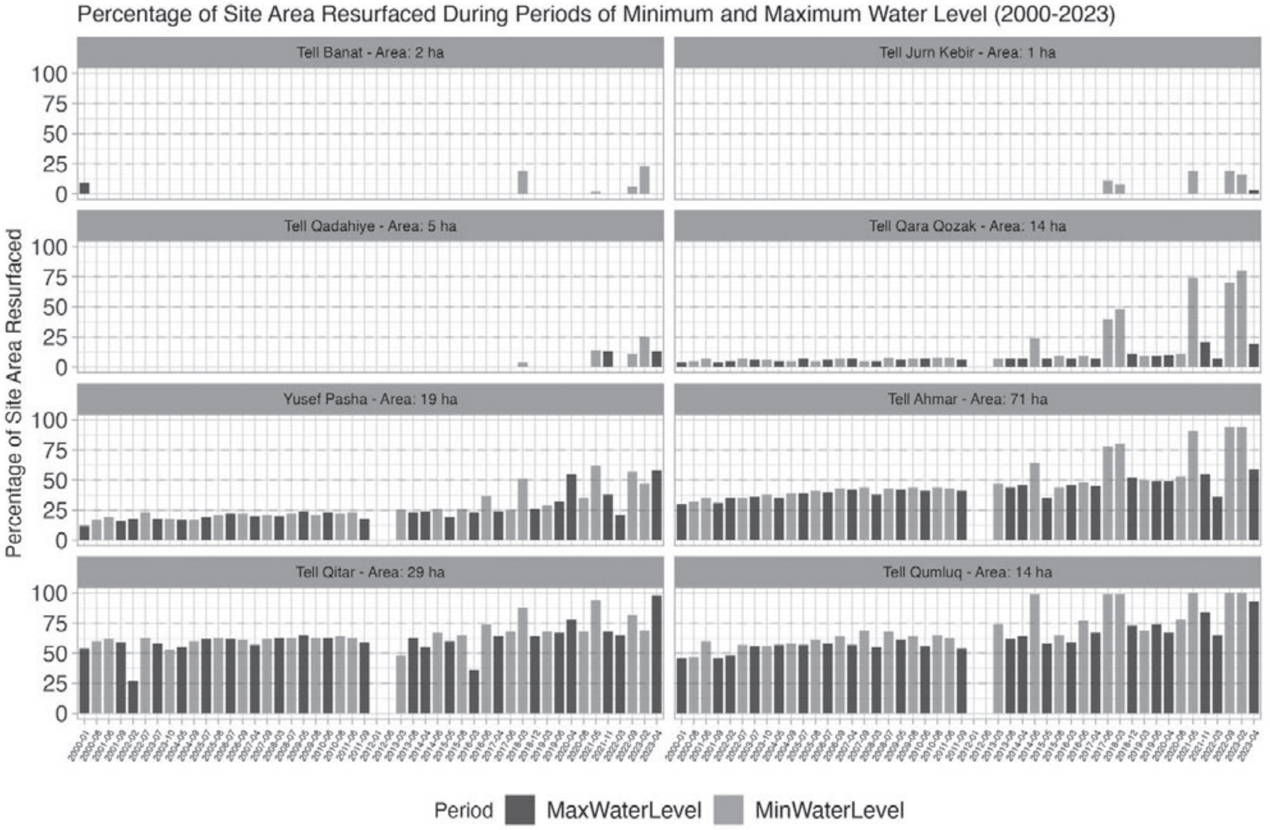

Fig. 12 - Emergence patterns of selected sites (Chart by A. Titolo).

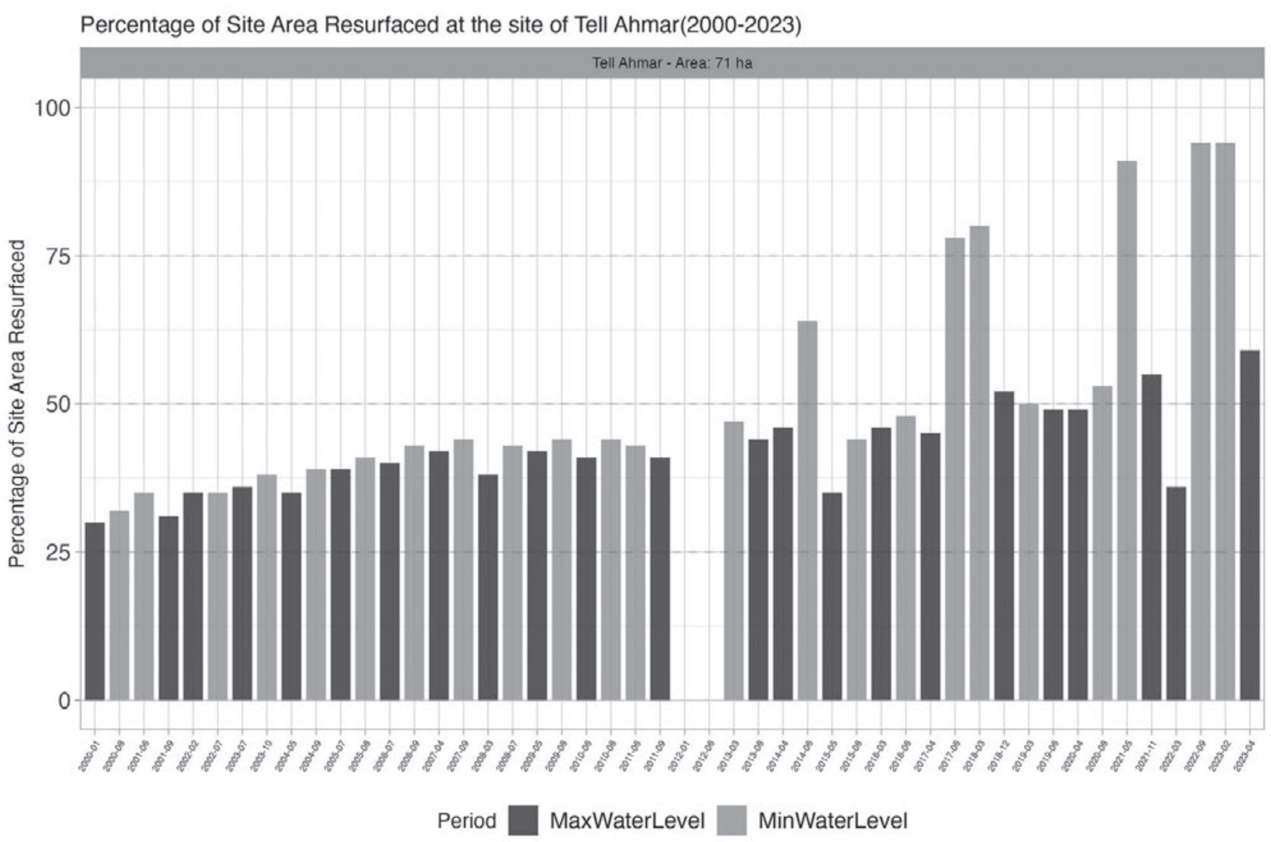

Fig. 13 - Emergence patterns at Tell Ahmar (2001–2023). Bar plot with resurfaced site area percentages (Chart by A. Titolo).

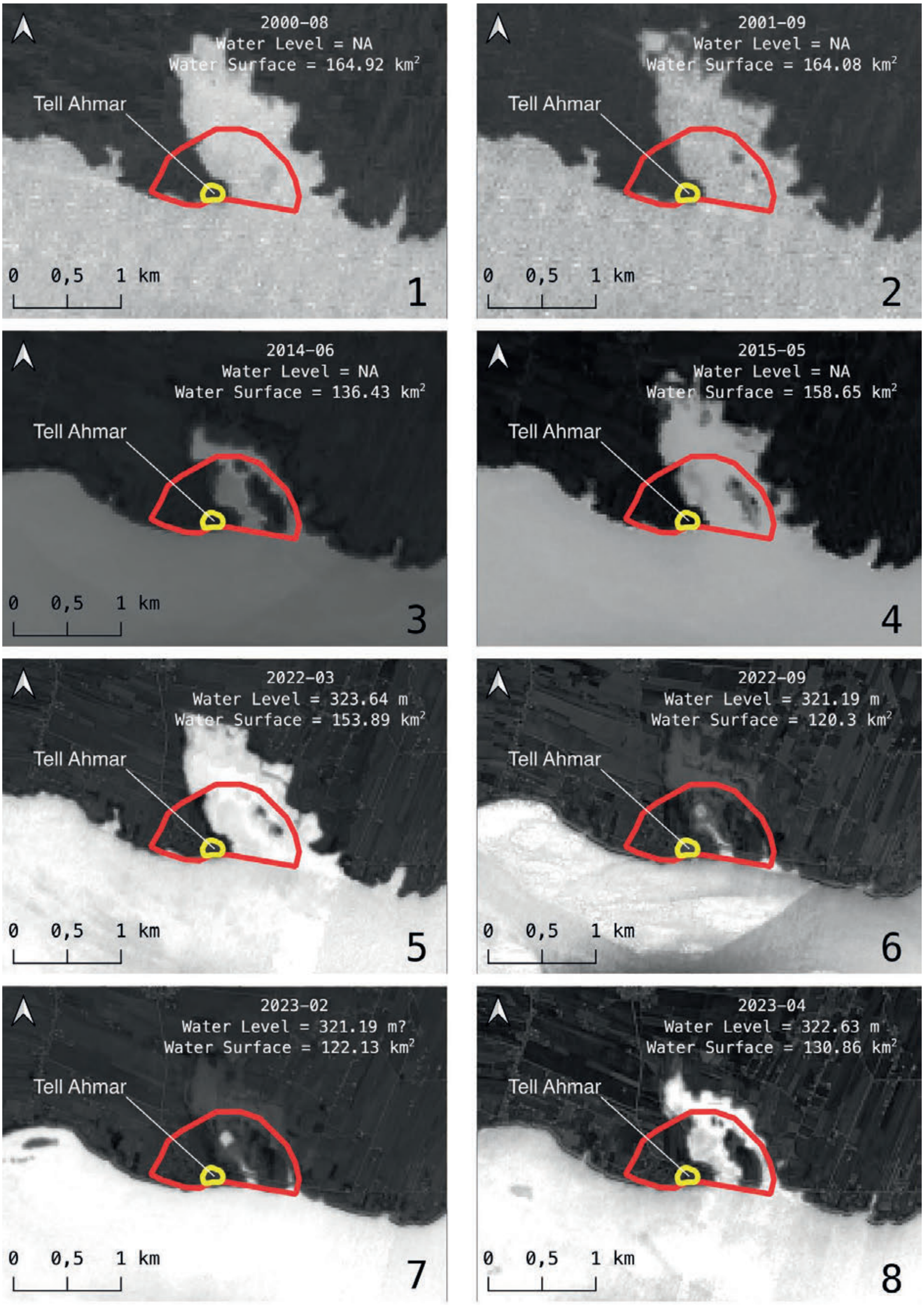

Fig. 14 - Emergence patterns at Tell Ahmar (2000–2023). Satellite images showing the exposed site areas at different water levels (Map by A. Titolo).

	Total Site No.	Cyclically Affected	Never Exposed	Never Submerged
Tishreen Dam	77	43 (55.84%)	18 (23.38%)	16 (20.78%)
Mosul Dam	275	193 (70.18%)	53 (19.27%)	29 (10.55%)

Tab. 4 - Comparative Results of the Emergence Pattern Categories.

Fig. 15 - Tweet showing some resurfacing rock-cut tombs in the Tishreen region.

5. Discussion

The results presented above have clearly shown that the tool first developed for the Mosul Dam case study may be successfully applied to other flooded landscapes in the SWA region and beyond. This tool has demonstrated remarkable flexibility and adaptability. However, it is crucial that the qualitative criteria for creating archaeological and remote sensing datasets are met, although this does not necessarily mean that these criteria must be uniform in every context or case study.

For instance, in the case of the Tishreen Dam, the absence of DAHITI data for absolute water level has been easily bypassed, not affecting the final results of the analysis.

The application of change detection to two reservoirs allowed us to compare the results from the two dams.

What is immediately evident (Table 4) is that the percentage of cyclically affected sites is much lower in the Tishreen Dam. This is possibly due in large part to the topography of the area that resulted in 20% of never submerged sites and on the other hand also to the different behaviour of the lake water level fluctuations. The latter might also be related to the different socio-political contexts of the two regions; as we will see below, politics has had an important impact on the Tishreen Dam lake's history.

The research across the two reservoirs, which share similarities yet exhibit different behaviours over the past 25 years, has highlighted its effectiveness and relevance at both macro and micro scales.

At the macro or landscape level, the tool adeptly identified sites that are always submerged, those that are constantly exposed, and those which resurface according to the fluctuations in water levels, even if minimal. On a micro or site scale, it enabled the reconstruction of a site's history of emergence and submersion. This allowed us to observe the destructive/erosive impact of water level oscillations, as exemplified by the case of Tell Ahmar Lower Town mentioned earlier.

An unavoidable loss of detail and precision, instead, resulted from the almost complete lack of recent surveys employing state-of-the-art methodologies and technologies.[64] This was observed in the case of the rock-cut tombs, which constitute a landmark of the Tishreen region's heritagescape (Fig. 15). The lack of data concerning their altitudes and horizontal and vertical extension, coupled with the absence of information on the lake water level usually supplied by DAHITI, have, in fact, hampered our ability to record and understand the impact of water fluctuations on each of these features. In the future, site visits and in-field monitoring could help overcome this issue.

The imperative to compile a dataset that integrated modern remote surveys of the area under investigation has, moreover, uncovered yet another dimension linked to the devastation of local heritage. As previously emphasized, the utilization of recent satellite imagery has exposed the extensive damage stemming from the regional social and political upheaval instigated by the Syrian Civil War. The widespread looting and militarization of numerous archaeological sites bear testament to the vulnerability of these peripheral regions. Situated beyond the reach of centralized authority, these areas have been caught in the crosshairs of various factions vying for control along contested borders. This underscores the urgent need for concerted efforts to safeguard cultural heritage in such precarious environments.

Furthermore, beyond its immediate relevance for other flooded landscapes, the tool has proved to be useful in understanding the relations between the reservoir water level changes and the events driving them.

[64] An exception is the Land of Carchemish Project mentioned above.

The fluctuating dynamics of dam lakes on a global scale, alongside the intermittent re-exposure of formerly submerged archaeological sites, reflect the interplay of overarching aridification trends and the regular management of dams. However, in Southwest Asia, notably Syria and Iraq, the sway of military and political forces is profound.

Our investigation into the emersion history of Tishreen's heritage sites unveils the historical roots of the lake's recent behaviour, elucidating the intricate interplay between dam operations and periods of conflict. This examination has revealed the connection between past events and their environmental aftermath, spotlighting the pervasive influence of geopolitical and strategic factors.

Specifically, we are inclined to link the notable decrease in Lake Tishreen's water level noted from 2017 to 2018, with what happened at the Tabqa Dam, immediately downstream, around the same time.

Tabqa Dam, situated just 40 km upstream of the city of Raqqa, is Syria's largest dam. Much like the Tishreen Dam, control over it has been a strategic goal for all factions entangled in the Syrian conflict. In 2014, ISIS seized control of the dam, prompting efforts by SDF/US forces and the Syrian government to reclaim it. Despite being on the no-strike list, the dam was bombed by the US in 2017.[65] An unexpected truce was brokered between the Islamic State, US forces, and the Syrian government to allow engineers to conduct urgent repairs on the dam, which faced the threat of failure.[66] Turkish authorities lent support by coordinating the closure of upstream dams including those feeding Lake Tishreen, to prevent downstream calamity.[67]

This deliberate water management likely contributed to the observed decline in Lake Tishreen's water level, leading to the re-exposure of archaeological sites. This event highlights the intricate interplay between hydrological infrastructure, conflict, and environmental impacts, directly affecting cultural heritage preservation efforts in the region.

Understanding these connections is crucial for assessing the broader implications of historical events on the region's water resources and ecosystems and developing integrated management strategies that address immediate crises while prioritizing long-term sustainability. At a broader level, this emphasizes the crucial role that archaeology can currently play in the broader discussion on climate change in these landscapes.

6. Conclusions

This study has shed much-needed light on a region that had been overshadowed since the onset of the Syrian Civil War, yet which urgently requires attention for protection and further investigation.

Among the archaeological sites that have recently begun to emerge, several had been already recognised and extensively studied for their pivotal role in reconstructing the heritagescape of the region, such as the Bronze Age Banat-Bazi Complex and the Iron Age capital city of Tell Ahmar/Til Barsip. Their resurfacing underscores the critical need for the immediate implementation of a comprehensive framework for on-the-ground documentation of the damage incurred and the establishment of new safeguarding practices. Besides these sites, many more that have never been investigated are being flagged by the change detection tool as potentially under threat. These sites deserve a comparable effort in future endeavours to avoid further losses.

Moreover, it is important to recognize that comprehensive work on the impact of dams on heritagescapes and subsequent preservation activities can no longer rely only on standard archaeological approaches. As the research has shown, it is advantageous to make use of the full toolkits available (remote sensing, fieldwork, etc.), also including a careful reconstruction of recent water history and environmental events.

The recent implementation of second-phase salvage projects along the banks of Mosul and Dokan Lakes offers a promising model that could be effectively adapted to address similar challenges in the context of the Tishreen Dam region. Here, in the last few years, local archaeologists have already started fieldwork-based documentation to record the sites' preservation states and potential illegal activities that have affected the region.[68]

While our current work on the Tishreen Dam has only addressed the first of the research questions outlined at the beginning of this paper, the authors are optimistic that the results, when shared with Syrian colleagues, will serve as a foundation for the implementation of a systematic monitoring program aimed at preserving this invaluable heritage.

The ultimate goal of testing the change detection technique presented in this paper is to demonstrate how such a cost-efficient tool may be used by all local antiquities departments and international institutions involved in cultural protection efforts worldwide.

By fostering collaboration and knowledge sharing, this initiative will empower stakeholders to effectively safeguard and manage cultural heritage sites amidst ongoing challenges and disruptions.

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[65] Philipps *et alii* 2023.
[66] BBC 2017.
[67] UNOCHA 2017.
[68] Sabrine, Montgomery, this volume.

Fig. 16 -Two pics taken by Tell Qumuq at the Tishreen Lake (left) and by Wadi Baqaq at the Mosul Lake (right) the same day (19/4/2024, courtesy P. Sconzo).

Addendum

The torrential rains of the past months have raised exponentially both the Tishreen and Mosul Dam lakes water levels, thus once more submerging many previously exposed archaeological sites, villages and communication routes (Fig. 16). Rampant vegetation has taken over the adjacent fields. A drastic change in the lakeside landscapes is occurring. Acknowledging the devastating impact of this new deluge, we also hope that this unexpected abundance of water will bring relief to the communities living around and also downstream of the reservoirs. Added on the 19/04/24.

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Isber Sabrine - Meghan Clorinda Montgomery*

TISHREEN BASIN HERITAGE: THE INTERSECTION OF CONFLICT, CLIMATE CHANGE, AND HUMAN DAMAGES

Abstract

This article details the results of a preliminary study of 15 heritage sites on the banks of the Euphrates river within the Tishreen Basin in northeastern Syria. This activity, conducted between 2019 and 2024, documented human damages caused to these previously submerged sites, all of which had recently resurfaced due to the receding water levels of the reservoir as a consequence of climate change. For the first time, this article demonstrates how the intertwined factors of political conflict and climate change in the region have combined to exacerbate ongoing socio-economic and heritage management issues. This has fostered an environment in which heritage sites are exceptionally vulnerable to illicit human activity, from encroachments on sites to illegal excavations and looting.

Keywords

Tishreen Basin, Syrian heritage, climate change, conflict, looting

1. Introduction

Since the onset of civil war in 2011, Syria has undergone massive political, cultural, and economic changes. The resulting displacement of many of its citizens, breakdown of traditional governance systems, and rise of various militant actors has had major consequences for the country's cultural heritage. Since 2011, hundreds of archaeological sites have been illegally excavated (Fig. 1) and thousands of archaeological artifacts have been smuggled outside Syria and sold via black market transactions.[1] Simultaneous to these threats to Syrian heritage are the growing dangers of climate change, particularly apparent in northeastern Syria's Tishreen Basin, along the banks of the Euphrates. This article sheds light on the dozens of heritage sites there that have recently become exposed to looting as the Euphrates water levels recede at alarming rates.

The Euphrates River is both the longest and one of the most historically important rivers in Western Asia. Together with the Tigris, it is one of the two defining rivers of Mesopotamia, literally 'the Land between the Rivers'. Originating in Turkey, the 2,800-kilometers-long Euphrates flows through Syria and Iraq to join the Tigris in the Shatt al-Arab, which empties into the Persian Gulf. This powerful river fueled the rise and flourishing of countless civilizations, owing to the richness of archaeological sites along its banks. Over the past three decades, the region has experienced higher temperatures and increased evapotranspiration rates, as well as limitations on the river imposed by the Turkish authorities, that have decreased the Euphrates flow.[2] Combined with the political turmoil and increase in the illicit antiquities trade in Syria during and since the civil war, the sites along the banks of the Euphrates have become especially vulnerable.

Though the looting across Syria since 2011 has been documented both remotely and on-the-ground.[3] no specific attention has been paid to the human damages to archaeological sites uncovered by the lowering water level of the Tishreen Basin. This report fills that gap in scholarship, outlining a four-year assessment and documentation of illegal excavations of archaeological sites along the Euphrates conducted between 2019 and 2024. A group of civil society activists in collaboration with the NGO Heritage For Peace visited and documented the current condition of sites along the banks of the artificial lake created by the Tishreen Dam, about 130 kilometers starting from Tel Qumluq in the north to Tel Halawa in the south. This article highlights 15 of the sites most impacted by the combined effects of conflict, climate change, and human damages. They were selected based on importance, ease of access for initial documentation, and an interest in covering the main archaeological periods of the region. Significantly, this study demonstrates for the first time that a perfect storm of global climate change and civil conflict is providing new opportunities and incentives for illicit activities at sites along the Euphrates River, calling for their further monitoring and protection.

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[1] Sabrine *et alii* 2022.

[2] Adamo *et alii* 2018, 61-62.

[3] Brodie, Sabrine 2017.

Fig. 1 - Illegal excavations at Tel Halula (credit: Mohammed Farees).

Fig. 2 - Stela found in one of the homes of an IS member in Manbij after the liberation of the city (credit: Ristam Abdo).

Fig. 3 - Illegal excavation at the Aushariya archaeological site (credit: Mohammed Farees).

Fig. 4 - Illegal excavation at the Tel Bujak site (credit: Ristam Abdo).

2. The political, environmental, and heritage context

Over the last decade and a half, Syria has become the prototype for a phenomenon in which the forces of global climate change and political conflict are combining to place extreme stress on the world's most vulnerable populations and their cultural heritage, both tangible and intangible. Indeed, the issues are themselves deeply intertwined, with the impact of the climate crisis amplifying regional political tensions in the most affected areas. The self-reinforcing cycle formed by climate and conflict issues in turn places heritage at risk, whether from destruction, deterioration, or looting.

The Euphrates river and its heritage-rich valley in Syria has proven especially susceptible to the effects of climate change. For decades, decreasing rainfall and increasing evapotranspiration caused by global warming have been reducing the volume of Euphrates water flow,[4] as much as 50% in drought years.[5] Such conditions are predicted to worsen in the next decades, with even lower precipitation rates combining with average higher temperatures to produce yet more severe and frequent periods of drought.[6] Additionally, in 2013, the Intergovernmental Panel on Climate Change estimated that Euphrates flow would decline by a further 73% in the near future as a direct result of decreasing rainfall in the Turkish highlands, where the Euphrates originates.[7] Regional political tensions are exacerbating these climatic changes. In June 2022, the Autonomous Administration of North and East Syria (AANES) accused Turkey of reneging upon the terms of the 1987 Euphrates River Agreement by reducing water flow into Syria, which is now said to be less than half of what was agreed.[8]

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[4] Adamo *et alii* 2020, 61.
[5] Ozguler, Yildiz, 2020, 30.
[6] Hameed, Ahmadalipour, Moradkhani 2018.
[7] Voss *et alii* 2013, 910.
[8] Hardan 2022.

Political tensions are not only a cause of climate issues but also a side effect of them. Following the extreme drought in Syria that occurred from 2006 to 2010, more than 1.5 million people migrated from rural areas, such as those in the Euphrates basin, to Syrian cities due to food and water scarcity.[9] The Syrian civil war, which started in 2011, is believed to have at least partially been catalyzed by economic and social instability that arose as a direct impact of this drought.[10] Furthermore, the increasing pressures on state governments, and those governments' inability to meet them, can lead to "the proliferation of ungoverned spaces where armed factions operate without being able to assert central political control (i.e. the emergence of groups like Islamic State (IS))".[11] Such political instability has proven to pose a major threat to the cultural heritage of Syria over the past decade.

Looting of heritage sites and the illicit trade of antiquities has become a salient issue in Syria since the onset of the civil war, fueled by the rise of independent armed groups like Da'esh (IS) and the breakdown of structures meant to combat such activities (Fig. 2).[12] Since the outbreak of conflict in 2011, Syrian archaeological sites have been badly looted, with artifacts smuggled into Iraq, Lebanon, Jordan and Turkey to be sold on the international black market. As early as 2014, Da'esh encouraged the illegal excavation of sites (Fig. 3) and the trade of artifacts in their controlled territories in Syria through a permit and taxation system from which they profited.[13] The internet has greatly expanded the scale of looting and the illicit trade by facilitating direct communication between looters and buyers and by transforming the kinds of objects being traded.[14] A 2017 study demonstrated the centrality of coins and other small, portable artifacts to the illicit antiquities trade and the wartime economy in Syria.[15] Such objects are contained within the many ancient burial sites spread throughout the Euphrates basin, now vulnerable as the result of these intertwined forces.

3. The Tishreen Basin: impacts to heritage

The culturally rich area on the banks of the Euphrates north and south of the Tishreen Dam, known as the Tishreen Basin, has been particularly susceptible to the fluctuating water levels of the river over the past two decades. Since 2019, a group of civil society activists in collaboration with the NGO Heritage For Peace has inspected the condition of sites along the banks of a northerly stretch of the Euphrates river. Starting from the Turkish border in the north to the southern end of Lake Assad, a distance of about 130 kilometers, the project has so far inspected 15 sites comprising heritage from a range of historical periods. Many of the sites contain ancient burials dating as far back as the Neolithic period (c. 7800 BCE), while some provide evidence of human settlement across a range of periods, from the Roman up through to the Mamluk. These complex human histories and their material remnants are now at serious risk.

This visit of the riverbank sites of the Tishreen Basin documents the current state of damage and offers a preliminary assessment of risk. It paves the way for a more detailed and comprehensive study of the sites in the future, and the development of a plan for their protection. Finally, it highlights the intertwined nature of the effects of climate change, political conflict, and human damage to archaeological sites in the region via currently unfolding issues.

3.1 *Site Exposure*

Constructed between 1991 and 1999, the Tishreen Dam created an artificial lake 60 kilometers long that impacted as many as 75 archaeological sites, completely submerging many of them.[16] Since 2014, there has been a clear gradual trend towards reduction of the reservoir's water levels, with seasonal fluctuations in water levels growing more extreme as the result of climate change and increased evapotranspiration. At the most basic level, these increasingly frequent fluctuations pose a threat to the physical integrity of archaeological sites, exposing them to gradual erosion. Furthermore, during years of bad drought, which are occurring with higher frequency, more than half of the heritage sites in the reservoir area have become exposed due to dropping water levels, with up to 90% of the total area of certain sites resurfacing.[17]

First the construction of the dam, and later the civil war, prevented a comprehensive archaeological survey of this region. Archaeological missions were cut short or canceled before they ever began, meaning that many of the Tishreen Basin sites have only been partially excavated or never excavated at all. There are still several archaeological sites in the Tishreen Basin yet to be excavated, according to a survey of the archaeological missions in the area. These undiscovered sites rich with artifacts are now resurfacing in an infinitely more fraught human context than when they were last seen three decades ago. This offers attractive opportunities for the illicit activities that have recently increased in number due to socio-economic factors, particularly looting and illegal excavations.

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[9] Gleick 2014, 334.
[10] Barder 2017, 140.
[11] *Ibidem*, 143.
[12] Hemeier, Sabrine 2021, 11.
[13] Sabrine *et alii* 2022, 118.
[14] Brodie *et alii* 2022, 121.
[15] Brodie, Sabrine 2017, 9.
[16] Sconzo, Simi, Titolo, this volume.
[17] *Ibidem*.

3.2 *Management Issues*

The new and worsening challenges faced by the Tishreen Basin sites as the result of climate change are exacerbated by issues surrounding the management of heritage in the region since the onset of the civil war and its ensuing political turmoil. This northeastern part of Syria in particular has faced difficulties in managing and protecting sites due to a continued absence of established political structures. Simultaneously as sites were being physically exposed due to dropping water levels, they were also left vulnerable by the heritage management vacuum, a direct result of human conflict.

Prior to the onset of civil war in 2011, Syria's cultural heritage and archaeological sites were managed by the Directorate-General of Antiquities and Museums (DGAM). Since 1946, this ministry was responsible for the broad spectrum of heritage-related concerns, including archaeological excavations and research, the administration and preservation of sites, and preventing illegal excavations and the illicit trade of archaeological objects. The DGAM's work on archaeological sites in particular was significantly supported by international research teams. Prior to 2011, the majority of archaeological missions in Syria were either entirely run by foreign teams or were joint missions between Syrian and international teams. There were extremely few entirely Syrian archaeological missions.[18]

When war broke out, these foreign missions necessarily ceased, both due to safety concerns and restrictions placed on teams by their foreign governments, many of which had placed sanctions on the Syrian government. The DGAM itself majorly deprioritized archaeological research, both due to security concerns and decreases in budget as government funding was directed away from heritage and culture.[19] A major consequence of this situation has been the inability of Syrian archaeology students to be trained on excavations, greatly decreasing the number of trained personnel ready to steward Syria's heritage now and in the future.

Particular challenges are faced by northeastern Syria, home to the Tishreen Basin, as since 2018 this part of the country falls under the de facto autonomous region known as the Autonomous Administration of North and East Syria (AANES). This de facto government is not officially recognized by any foreign states, making collaborations between Syrian and international archaeological teams virtually impossible. AANES's lack of official recognition also extends to international organizations such as UNESCO, inhibiting access to resources and funding.

Another major issue stemming from the conflict's heritage management vacuum is sites' increased exposure to local human threats as the result of a disconnect between local communities and the heritage itself. A lack of community pride and involvement in heritage sites was already an issue for the DGAM prior to the civil war. In addition to the organization having no budget to encourage community engagement, the Syrian Antiquities Law, the main legal framework for heritage management in the country, largely excluded community stakeholders from having any say in the use and preservation of their local heritage sites, nor were they compensated when the protection and administration of sites prevented local building and economic activities from taking place.[20]

As a result, community resentment towards the DGAM and feelings of disconnect from their cultural heritage sowed the seeds for sites being exposed to physical danger at the onset of war. This is particularly true under AANES, where nascent heritage management institutions struggle to implement on-the-ground projects. As the physical presence of the DGAM and foreign teams receded, locals sometimes felt empowered to conduct illegal building or agriculture on or very close to archaeological sites. The lack of preservation infrastructure at sites combined with the desperation of local communities as the result of the war's crushing social and economic impacts, and in some cases locals turned to illegally excavating and looting sites as a source of income. The willingness to do so was exacerbated by an absence of local awareness of and pride in heritage, from which they had largely been excluded in the past. Where heritage management infrastructure is not strong enough to work with local communities, it hardly stands a chance against the systematic illegal excavation, looting, and damage of sites in the Tishreen Basin that has exploded since the conflict began.

3.3 *Illicit Activities at Sites*

The review of newly exposed archaeological sites in the Tishreen Basin overwhelmingly demonstrates a trend of human damage to heritage across various forms. As climate and conflict issues converge, a range of illicit activities have become increasingly realizable, whether by locals attempting to survive under challenging conditions or by organized criminal actors.

The most common illicit activity found to be carried out among the selected sites of the Tishreen Basin is unauthorized excavations (Figs. 4-6), affecting at least 11 out of 15 visited sites. As the waters of the Euphrates recede, new sites become uncovered and even previously legally excavated sites reveal new surface area that becomes a ripe target for illegal excavation. Such activity is most clearly indicated by the presence of excavation pits (Fig. 5), often num-

[18] Sabrine 2022, 222.
[19] *Ibidem*, 226.
[20] *Ibidem*, 216.

Fig. 5 - Illegal excavation at the Aushariya archaeological site (credit: Mohammed Farees).

Fig. 6 - One of the looted tombs at the Tel Qumluq site, east of Aleppo (credit: Ristam Abdo).

Fig. 7 - A looted burial ground at the Shash Hamdan site (credit: Ristam Abdo).

Fig. 8 - Damage at Tel Halula (credit: Mohammed Farees).

bering in the many dozens. They are sometimes so numerous as to completely transform the appearance of a site in aerial images, making the land appear pock-marked.[21] In the case of Wadi al-Fitra, a site on the western bank of the Euphrates, just to the north-east of the city of Manbij, the illegal excavations appear to be ongoing, with dozens of recently created pits spread across different sections of the site.

Naturally, the ultimate goal of illegal excavations is the discovery and extraction of artifacts to be illicitly traded for profit. As such, many of these sites have fallen victim to looting (Fig. 6), a serious form of damage that destroys the integrity of the site. Even on the rare occasions in which looted items are able to be located and returned to their country of origin, their undocumented removal means that their original context within the site can never be fully understood. Thus far, visits have found evidence of looting from at least six of the sites. The number of looted sites could be much higher in reality. It is not always easy to identify concrete evidence that artifacts have been removed from a site. This is particularly the case in the Tishreen Basin given that many sites here were only partially excavated, not excavated at all, or have incomplete excavation records as the result of difficulties in information sharing between foreign missions and Syrian archaeologists during the conflict.

A particularly pertinent example of looting occurred at the Tel Halula site, located near the city of Manbij and covering an area of 7 hectares. Excavations at this site, which contains evidence of more than 2000 years of Neolithic settlement, were initially carried out by a Spanish mission between 1991 and 2011,[22] cut short by the onset of the civil war. As such, many of the artifacts recovered from the site remained in an archaeological mission house nearby. Since 2011, in addition to numerous illegal excavations on the site itself, the remaining finds in the archaeological mission house were looted. The case

[21] Sconzo, Simi, Titolo, this volume.
[22] Molist *et alii* 2012.

of Tel Halula unfortunately demonstrates the physical threat to sites posed by ongoing heritage management challenges in the region, in which a lack of on-site personnel and resources led to a significant loss of heritage that should have been preventable.

Physical damage at newly exposed sites can arise not just from criminal actors seeking artifacts for illicit trade. Indeed, the examined sites have suffered encroachments of various forms that are seemingly unrelated to acquiring artifacts. At least 7 of the 15 visited sites have suffered various forms of damage or partial destruction at human hands since 2011. In some cases, this damage appears to be directly caused by armed actors during conflict, who have used archaeological sites as strategic locations for their operations. For example, Shash Hamdan, a site on the western bank of the Euphrates containing Roman-era tombs (Fig. 7), was used as a military base by IS, suffering bulldozing and constructions as a result. Additionally, the site was vandalized by IS, with sculptural elements being intentionally smashed per IS's iconoclastic approach to much of Syria's heritage. Similar acts seem to have taken place at Tel Qumluq, a site on the eastern riverbank, where animal motifs in a mosaic floor were systematically destroyed. At Tell Ahmar, also on the eastern bank, heavy bulldozing took place and tunnels were constructed within the site.

Human encroachments on the examined sites have also occurred partially as the result of community detachment from heritage, as local communities have at times repurposed archaeological sites as a coping mechanism. For example, illegal agricultural works have been conducted at Tel Halula (Fig. 8), and at Mount Khalid, a large, rocky plateau with a Seleucid-era fortification, the archaeological site was encroached upon for quarrying. A road was also constructed through the latter site to gain access to the riverbank.

In these cases, the dire consequences of intersecting climactic and political factors become clear, as local communities resort to illegal encroachments in search of income. The cultivation of agricultural plants on these archaeological sites is a particularly pertinent indicator of the intertwined nature of the threats to such heritage. The dire food insecurity that northeastern Syria has suffered as the result of prolonged climatic changes and droughts combines with reduced economic opportunities due to ongoing conflict to create a desperate human situation. Newly resurfaced archaeological sites, left virtually unprotected due to a lack of AANES resources and preservation infrastructure and the absence of the international scientific and heritage communities, become ripe opportunities for cultivation by a distressed local community fundamentally disconnected from their own heritage.

4. The way forward for Tishreen heritage: recommendations and current projects

Having identified the serious threats faced by the dozens of archaeological sites in the Tishreen Basin via the combined forces of climate, conflict, and illicit human activity, it is imperative that swift action is taken to secure the future of heritage in this region. Unfortunately, past preservation initiatives have often been postponed until an unknown later date when the region would be more secure or conflict had 'ended'. However, the intertwining of the current conflict and climate change factors has created a distinct emergency situation that necessitates on-the-ground action as soon as possible. Heritage For Peace has been working on numerous heritage documentation and preservation projects at other sites in northern Syria that serve as examples of the kind of initiatives that should be put into place for Tishreen Basin sites.

The most immediate need is for a more comprehensive archaeological survey and documentation project expanding upon the data collected during the site visits discussed here. These should record all Basin sites in a scientific manner while also assessing all the damage they have incurred, whether directly from conflict, climate change, illicit human activity, or a combination of the three. Such documentation is necessary to formulate plans for the protection and preservation of the sites. Heritage For Peace is currently working with University of Durham Endangered Archaeology of the Middle East and North Africa (EAMENA) Project as their partner organization in Syria on the continued development and expansion of their database of heritage at risk. Significantly, the most recent phase of the project focuses on the intersection of climate change and conflict, expanding the database's capacity to record climate threats and damages to heritage sites.

Heritage For Peace is facilitating EAMENA's collaboration with Syrian heritage workers and local NGOs not only to record these damages, but also to create a pool of 30 Syrian trained database users, integrating this resource in government-level heritage practice. This is one of the crucial early moves towards rehabilitating Syria's domestic heritage workforce, which suffered as the results of sanctions by foreign governments and the inability of foreign archaeological and research teams to work and share training resources in Syria. If Tishreen Basin sites are to be protected from ongoing threats, it is imperative that local heritage professionals have the adequate skills and training to implement preservation initiatives themselves.

In addition to sharing new technological and documentation resources such as the EAMENA database, Heritage for Peace is also working directly with Syrian heritage professionals in the Tishreen Basin region to train them in emergency response to heritage in crisis, including structural stabilization and the digitization of both sites and artifacts found in situ. Between April 2023 and June 2024, the project titled 'Emergency intervention and damage assessment in Manbij, Syria' worked in collaboration with the Directorate of Antiquities of the Manbij region to produce detailed documentation and physically secure three heritage sites that had suffered damage and looting during and after IS occupation of the area between 2014 and 2016. In the project's final phase, Heritage For Peace implemented a multifaceted awareness program that focused on engaging the local community with both the project and sites themselves, including brochures, free workshops, and the production of a short film. Crucially, the 15 local heritage professionals trained and working on the project will continue to serve as ambassadors for the heritage sites within the local community after its completion. These initiatives not only prevent communities from feeling alienated from the ongoing preservation work, but they also educate locals on the history of the sites, fostering a sense of pride in local heritage.

Involving local communities in heritage preservation is often considered a form of long-term site security. However, in the case of the Tishreen Basin and other regions where ongoing conflict and climate change issues intertwine, the engagement of local communities is essential to current efforts as well. When locals feel a connection to their heritage, they are more likely to take an active role in its protection from looting and other illicit activities. Localized protection of sites is imperative in the Tishreen Basin in particular, where AANES has limited capacity for prolonged on-site protection at this time. Effective community engagement initiatives can additionally create local jobs in building, restoration, documentation, and, eventually, tourism, as well as raising awareness of the potential long-term economic benefits of heritage preservation. These provide desperately needed alternatives to illicit economic activities such as looting that have taken place at sites previously.

A 2023 project undertaken in the Manbij region by Heritage For Peace also demonstrated the invaluable specialized knowledge of local communities. When documenting buildings damaged by the 2023 earthquake that severely impacted northern Syria, locals were instrumental in directing heritage professionals to affected sites, providing eyewitness testimonies of the kinds of damages suffered by structures, and participating in the dialogue surrounding future preservation of the sites. Thanks to the overwhelming enthusiasm of local communities, Heritage For Peace was able to make a much more detailed report than they had initially expected.

The data described here demonstrate the need for such initiatives to be imminently implemented at the Tishreen Basin in order to document and secure sites at risk. Heritage for Peace has made inroads in the region, working with heritage professionals, NGOs, government institutions, and local communities, laying an important groundwork of resources and communication networks that will prove essential to the future of the Tishreen Basin's outstanding heritage.

5. Conclusion

Northeastern Syria's Tishreen Basin is home to an incredible array of heritage, expanding from evidence of Neolithic settlements to the Ottoman period. Ironically, the human culture nurtured in this region for thousands of years thanks to its proximity to the mighty Euphrates river is now endangered by none other than human activity and the changing face of the river itself. The ongoing Syrian political conflict since the outbreak of civil war in 2011 and the worsening effects of climate change have combined to create a perfect storm that exposes Tishreen Basin heritage sites to serious human threats. In addition to damage to heritage caused by the conflict itself or by erosion from shifting water levels, the distinct circumstances produced by these combined factors leave sites ripe for illegal excavations, encroachments, and looting.

This preliminary review of 15 sites in the Tishreen Basin highlights the imminent danger faced by heritage in this region that has been particularly hard-hit by the effects of civil war, ongoing political instability, and a rapidly warming and drying climate. It indicates the urgent need for more comprehensive documentation and assessment of the entire heritage landscape so that preservation plans can be implemented. However, the implications of the study reach far beyond the Tishreen Basin, or even Syria. In a world increasingly wracked by human conflict and facing a climate challenge that is truly global in scope, the 'perfect storm' currently experienced by Tishreen Basin heritage is bound to crop up in other heritage landscapes. This article has demonstrated the deeply intertwined nature of conflict, climate change, and damage to heritage in hopes that a newfound awareness of this issue can be applied to preservation efforts across the globe.

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