

Natural and Anthropogenic Threats to Prehistoric Archaeological Sites in Southern Jordan: Comparison with Poland and a Call for the Exchange of Experiences

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Natural and Anthropogenic Threats to Prehistoric Archaeological sites in Southern Jordan. Comparison with Poland and Exchange of Experiences.

Jordan's rich archaeological heritage, encapsulating crucial chapters of human history, faces unprecedented threats from both natural and anthropogenic factors. This article elucidates the various challenges besieging Jordan's historical sites, ranging from climatic alterations to uninhibited urban expansion and intensified agricultural activities. Furthermore, it casts a spotlight on the detrimental impacts of mining activities, underscoring the urgent need for integrated conservation strategies. By fostering a symbiotic relationship between scientific research and practical conservation efforts, we advocate for a proactive approach to safeguard Jordan's irreplaceable treasures for future generations, thereby fostering sustainable tourism and empowering local communities. The article also posits that community education and the promotion of sustainable tourism stand as vital tools in this pressing endeavour, beckoning a wider appreciation for Jordan's affluent history and vibrant culture, while ensuring the endurance of its monumental legacy for ensuing generations.

In the face of escalating threats for a large number of archaeological sites, fostering international collaboration is paramount. The article explores the potential of forging ties with Polish researchers, who bring a rich background of experience in the meticulous conservation and management of archaeological heritage. By engaging in a vibrant exchange of experiences and knowledge as well as innovative protective methodologies, there is an avenue to enhance the robustness of preservation

strategies in place. This collaborative discourse not only promises fresh perspectives and solutions but also opens doors to capacity building through training and educational programmes dedicated to fragile archaeological relicts.

Keywords: archaeological heritage; Poland; Jordan; protection

Introduction: Regarding the archaeological resources of southern Jordan and Poland

There can be no doubt that the significance of capacity building and collaborative discourse is paramount in the protection of archaeological heritage worldwide. This process encompasses training, skill and knowledge enhancement, as well as institutional strengthening, pivotal in promoting and safeguarding cultural heritage. While methodologies and strategies for heritage conservation vary across countries¹, collaborative discourse is emerging as a universal element, fostering cooperation and dialogue among various groups and stakeholders².

At first glance, Poland and Jordan may seem entirely incomparable due to their environmental, historical and cultural differences. And yet, these two very different countries face the same global challenges, both natural and anthropogenic, that shape the status of their historical heritage. The aim of our reflection and research activities is therefore not only to identify threats but also to mutually verify the methods and legal regulations, as well as conservation, educational and promotional practices that influence both the present state and the future of their extensive heritage.

In countries which are rich in cultural and historical diversity like Poland and Jordan, capacity building takes multifaceted forms. In Poland, the country's historical tapestry – woven with most famous elements from the medieval era and the World Wars, but also from prehistoric periods – underpins the essential need for robust capacity-building programmes. Skills and knowledge enhancement in contemporary technologies, conservation methodologies and international cooperation are critical in safeguarding not only iconic sites such as Wawel Castle, Auschwitz Concentration Camp or Wieliczka Salt Mine, but in a particular way in relation to prehistoric sites, which are not as highly visible and where it is more difficult to secure elements of the heritage of the past.

Jordan, home to the illustrious Petra, Amman, Wadi Rum and an array of Nabatean, Roman and Byzantine ruins, faces similar and unique challenges. The arid climate, tourism pressure and, in some cases, insufficient local awareness necessitates enhanced capacity building. If we consider that Jordan is also a region with a vast number of archaeological sites from the oldest periods of human activity, crucial to our understanding of formative periods, we will surely see the need for a robust collaborative discourse. Such discourse can foster international partnerships, knowledge exchange and innovations that address these challenges much more effectively.

Education and training focused on elevating the awareness of local communities, governmental bodies, NGOs and other stakeholders is a common theme in both countries. Collaborative discourse nurtures international knowledge and experience exchange. It acts as a bridge connecting scientists, practitioners and local communities, enabling the development

¹ E.g. FORREST, C., *International Law and the Protection of Cultural Heritage*. Routledge 2010; WIŚNIEWSKI, M. & ŚWIDRAK, M. (eds.). *The Cultural Heritage Management and Protection in V4 Countries. Report*. Kraków 2021.

² E.g. MASINI, N. & SOLDVIERI, F. Cultural heritage sites and sustainable management strategies. In: N. Masini & F. Soldovieri (eds.), *Sensing the Past. From Artifact to Historical Site*. Springer, 2017, pp. 1–19.

of more effective and sustainable conservation strategies. Global collaboration accelerates decision-making processes and implementation of actions aimed at preserving heritage for future generations. Strengthening the capacity of institutions and communities to embrace appropriate methods is integral to the capacity-building process. This is the reason why we have taken action to combine the knowledge and experience of researchers from Poland and Jordan. We jointly recognise that international dialogue and cooperation are key elements in preserving the cultural and historical wealth of nations. Both Poland and Jordan, with their unique heritage, stand to benefit immensely from global collaborations and knowledge exchange to ensure the protection and preservation of their archaeological treasures for future generations.

In the wider southern Jordan, there are many traces of human presence throughout history. These include both well-known and spectacular places such as Petra, built by the Nabateans, as well as less visible sites little-frequented by tourists, which are no less important from a scientific but also an economic point of view. All of them deserve efforts to study them and ensure they are well protected.

The strategic location of the southern region of Jordan, at the intersection of important ancient trade routes, made this area a pivotal point for cultural and commercial exchange, fostering the introduction of technological and cultural innovations over millennia. The region's unique geographical and climatic character has facilitated relatively good preservation of many sites and artefacts, allowing for their deep multidisciplinary analysis today.

However, this region faces difficult challenges related to the protection of its archaeological heritage. Urban and agricultural expansion, mining activities and climate change are just some of the factors that threaten the durability of these priceless resources. Therefore, today more than ever, there is a need to intensify efforts to protect this heritage for all of humanity – not only because of their scientific value but also for how they can help local communities in improving their fate and building stable sources of income.

Striving to preserve the heritage of southern Jordan thus requires an integrated approach that combines scientific research with practical conservation actions. There is also a need to develop infrastructure to protect archaeological sites from destructive human activities and natural erosion processes. Such actions have already been taken in the past³, but the changing situation makes it necessary to go further.

Moreover, educating local communities and promoting sustainable tourism can prove to be key elements in striving to protect the region's heritage while encouraging a broader understanding of its rich history and culture.

Environmental threats in the western highlands of southern Jordan

On the basis of all these observations, some observations could be formulated based on, firstly, several multiperiod sites from the western highlands of southern Jordan. In this analysis, we will use as examples the archaeological sites investigated by the authors of the article⁴.

³ See e.g. AL BAWAB, A., ABDALLAH, R., BOZEYA, A., ODEH, F., AL ASHQAR, H. Jordan Conservation of Cultural Heritage in ERA. In: *Progress in Cultural Heritage Preservation-EUROMED 2012*, pp. 295–300.

⁴ See e.g. KOŁODZIEJCZYK, P. *HLC Project 2014–2019. Research activity of Jagiellonian University in southern Jordan, Discovering Edom. Polish archaeological activity in southern Jordan*. Uniwersytet Jagielloński, Fundacja Popularyzacji Nauki im. Euklidesa, 2019, pp. 31–50; KOŁODZIEJCZYK, P., NOWAK, M., WASILEWSKI, M., KARMOWSKI, J., CZARNOWICZ, M., WITKOWSKA, B., BRZESKA-ZASTAWNA, A. & ZAKRZEŃSKA, J. *On the Edge of a Changing World: Late Prehistory in Southern Jordan: Polish Research Project in the Years 2014–2023*, 2024, forthcoming volume.

The first sites lie in the contemporary landscapes of Faysaliyya and Umm Tuweyrat sites (Fig. 1), which are dominated by rolling hills cut with seasonal rivers valleys. The streams beds usually have a width of 5–7 m width and a depth of 1–2 m. The valleys are about 20–30 m deep and 100–200 m in width. The archaeological artefacts in this area have been dated from the Palaeolithic through all epochs to post-Medieval times. The area lies in the watershed of the Central Desert areas. Contemporary rivers and streams heading east have an ephemeral character. However, they allow seasonal agriculture in the so-called “steppe” zone⁵.



Fig. 1: *Umm Tuweyrat: Dolmen field in southern Jordan,* photo P. Kołodziejczyk.

Beside the rains, the area lacks permanent water flow or water sources. Contemporary periodic rivers are active from October through to March/April, but precipitation usually does not exceed 50 mm/month. However, as indicated by numerous authors⁶, even this level of precipitation significantly affects the geomorphology. The torrential rains also impact the region. They have become more frequent since 1990, but earlier episodes are known as well. The sheet floods and the subsequent runoff and slope erosion caused by this type of rain have a significant influence on slope morphology, the nature of sediments and soils, and the preservation or

destruction of archaeological sites. The erosive intensity of such phenomena not only results in the destruction of potential residential structures and the like but also obliterates traces of agricultural activity in river valleys⁷.

The second factor affecting the sedimentation are the intensive aeolian processes. The area under investigation is covered with desert pavement built mostly of cherts with an admixture of limestones. Intensive aeolian erosion is caused by the June–August winds, typically 20–30 km/h (50–80%), and the February–June winds of 30–50 km/h (10–15%). Very interesting in this perspective is the scarce or absent varnish (natural hard coating of exposed rock surfaces) and the high degree of roundness (degree of rounding of rock grains). This can be explained by the intensive rains and consecutive sheet floods. This factor has a substantial eroding-transporting potential.

The next sites explored – the Munqatta site (Fig. 2) and the Wadi Mashra area – are located in the marginal zone of the Wadi Araba Rift. The local tectonics substantially affects the hydrology, soil development and archaeological sites in this area. The rock layers are tiled by means of earthquakes and landslides and cut with water stream beds. Combined, these factors cause the step-like morphology. Rock walls (cliffs) of various highs are divided with steep to gentle slopes or even small plateaux. Contemporary precipitation in this area is as scarce as around Faysaliyya and Umm Tuweyrat; nevertheless fluvial erosion is and seems to have been important. This can

⁵ For precipitation data see: ABABSA, M. *Atlas of Jordan: History, Territories and Society*, Presses de l’Ifpo, 2014.

⁶ See e.g. RAHN, P. H. *Sheetfloods, Streamfloods, And the Formation of Pediments*. Annals of the Association of American Geographers, 1967.

⁷ See CONTRERAS-LÓPEZ, M., VERGARA CORTÉS, H., STERQUEL, R. F. Elementos de la historia natural del sistema de humedales el Yali. In: *Anales Museo de Historia Natural de Valparaíso* Vol. 27, 2014, 51–67; CORDOVA, C.E., *Millennial Landscape Change in Jordan: Geoarchaeology and Cultural Ecology*, University of Arizona Press, 2007, pp. 272.



Fig. 2: *Al-Munqata'a: Neolithic site in southern Jordan,* photo P. Kolodziejczyk.

be coupled with the observation that the older archaeological material is, the higher it is found (with Palaeolithic implements near the mountain ridges). The winter period is especially crucial to the erosional rate.

Al-Munqata'a archaeological site is located on the northern slope of the canyon directly beneath at-Tafleh city. The site was established on one of the rocks shelves around 80–100 m above contemporary river bed in the Kurnub sandstone layers. The shelf is plane or slightly inclined and is 200–400 m in width. The bedrock is covered with a very thin (0.3–3.0 m) colluvium layer.

The contemporary location is completely deprived of water (stream or sources); however, the character of on-site sediments confirms that the winter–spring rains affect the hillslope processes substantially. The contemporary geomorphology is very steep and the erosional processes are very intensive. The processes taking place here are analogous to the threats recorded in the Petra zone⁸. In the flatter parts of the canyon both scree and alluvial fans are formed. In addition, very intensive particle falls, rock falls, avalanches and topples were documented through whole year round. In the vicinity of the archaeological site the newly built road additionally triggers hillslope erosion. Pastoral influence on the flora cover⁹ also seems to be an important factor in the degradation of the site. Throughout the area trampling and animal paths not only follow the local morphology but also are the factor in its formation. Up to the present day the sheep and goat herds pass through several times a day. This small influence also causes visible changes in the geomorphology.

Another site studied by the authors, Huseyniya (Fig. 3), is located in a relatively flat area, in the bed of a seasonal river, in close proximity to a basaltoid lava dome and stream. This location exposes Huseyniya to minimal influence of fluvial factors compared to the other sites. Without a doubt, aeolian processes, both deflationary and dune-forming, are dominant here.

Another area and set of archaeological sites worth discussing are the Neolithic sites in the western highlands. These are significantly impacted by various factors. The architectural remains of these Neolithic sites are highly susceptible to weather conditions, particularly rainwater, which poses a significant threat to their integrity. Even recently excavated sites have already begun to experience natural deterioration, with portions of their walls collapsing. Some of these sites have been under excavation for over two decades yet continue to suffer from ongoing structural damage. These Neolithic villages display two distinct architectural building

⁸ DELMONACO, G., MARGOTTINI, C., SPIZZICHINO, D. Rock Slope Potential Failures in the Siq of Petra (Jordan). In: *Landslide Science for a Safer Geoenvironment*, Springer, 2014, pp. 341–347.

⁹ For historical perspective compare e.g. BARKER, G. Farmers, herders and miners in the Wadi Faynan, southern Jordan: A 10,000-year landscape archaeology. In Barker G., Gilbertson D. (eds.). *The Archaeology of drylands*. London-New York 2000, pp. 62–84.



Fig. 3: *Huseiniya: Chalcolithic site in southern Jordan, photo P. Kolodziejczyk.*

techniques¹⁰. The first technique involves the use of standing stones supported by soil and additional stones. These structures are particularly vulnerable to rain, as the soil holding the stones together breaks down, leading to their collapse. This deterioration occurs relatively quickly once the stones are exposed to natural elements, undermining the stability of the entire structure. This construction method was commonly employed during the earlier stages of the Neolithic period. The second technique, observed in pre-pottery Neolithic villages, entails the construction

of walls using multiple courses of semi-dressed stones held together with small chip stones and soil (Fig. 7). Similarly, these walls are highly susceptible to rainwater, which erodes the soil between the stones, resulting in the gradual collapse of sections of the wall. The site of Beidha (Fig. 4–5), which began to be excavated in 1958¹¹ (Kirkbride, 1968), serves as a prominent example of this situation. Unfortunately, it has not been adequately protected from natural factors and if one visits the site today there are significant challenges in identifying visible features



Fig. 4–5: *Beidha: Neolithic site in the vicinity of Petra, southern Jordan, photo P. Kolodziejczyk.*

documented in the published materials. This case at Beidha serves as a cautionary example illustrating the potential fate of many other excavated Neolithic villages in Jordan. Furthermore, it is noteworthy that Beidha is situated in a low-altitude region with lower annual precipitation compared to other sites. Moreover, the site has undergone a dedicated project centred around conservation and presentation¹².

The Neolithic villages in the western highlands face significant deterioration due to their geographical location, characterised by the highest annual precipitation in the region. These villages possess architectural remains that are distinct compared to those found in eastern Badia

¹⁰ KINZEL, M. Preservation and Presentation of Neolithic Sites: A Case Study of Shkarat Msaied, Southern Jordan. In: MARCHETTI, N. & THUESEN, I. (eds.). *ARCHAIA: Case Studies on Research Planning, Characterization, Conservation and Management of Archaeological Sites*. BAR ed. Oxford: Archaeopress, vol. 1877, 2008, pp. 331–338.

¹¹ KIRKBRIDE, D. Beidha: Early Neolithic village life south of the Dead Sea. In: *Antiquity* 42, 1968, pp. 263–274.

¹² As highlighted by DENNIS, S., FINLAYSON, B. & NAJJAR, M. Conservation and presentation of Neolithic Beidha, southern Jordan. In: *Antiquity* 76, 2002, pp. 933–934.



Fig. 6: *Basta: Neolithic site in southern Jordan*, photo M. B. Tarawneh.

this plaster is highly sensitive to both water and natural elements, as well as to human and animal activity. When examining the published material featuring many Neolithic villages, we



Fig. 7: *Shkarakat Msaied: Neolithic site in southern Jordan*, photo M.B. Tarawneh.

region of eastern Badia are relatively less affected by natural factors. Several reasons contribute to this.

The architectural remains found in the Neolithic sites of eastern Badia exhibit distinct characteristics (Fig. 8–10). The walls of these structures were constructed using undressed natural stones of various sizes, often without the use of soil as a fixing material. Instead, the large stones were positioned in a way that they interlocked with each other, creating a sturdy and resilient structure. This construction technique differs from that of the Neolithic villages, where soil and other materials were commonly used to secure the stones. As a result of this unique construction method, certain elements such as animal corrals and circular structures from the Chalcolithic period, which have been exposed on the surface for thousands of years, remain remarkably intact despite the exposure to the natural environment. Similarly, the walls of desert

(see section below). The walls of these villages are notably taller, often exceeding five metres in height. However, this increased height renders them more susceptible to damage from rainwater, making them delicate and prone to collapse within a relatively short period following excavations.

Certain monuments and artefacts within the Neolithic sites are exceptionally fragile, such as the plaster floors and walls that were common during that period. These surfaces were sometimes adorned with red-coloured paint made from red ochre. However, we often come across images showcasing extensive areas covered with painted or unpainted plaster. Yet, upon visiting these sites today, it is rare to find any remnants of plaster remaining. Instead, we are confronted with the sight of thorns and shrubs, which further contribute to the damage inflicted on these sites, especially after rainy seasons.

Natural threats in case of desert sites in southern Jordan

Using the example of Neolithic sites again, it can be concluded that in contrast to sites in the western highlands, these sites in the desert



Fig 8–10: *Desert sites in southeastern Badia region, photo M. B. Tarawneh and W. Abu-Azizeh.*



kites¹³, which date back to the Neolithic period, have endured for over 9000 years since their last use. These examples highlight the impressive resistance of these structures to natural factors. Moreover, the Neolithic occupational sites in eastern Badia primarily exist underground, with only the upper courses of the walls or standing stones barely visible on the surface. Even after excavation, this type of site demonstrates a higher level of resis-

tance to natural factors compared to the Neolithic villages. The unique construction techniques employed in eastern Badia, combined with the subterranean nature of some sites, contribute to their enhanced durability and resilience against the detrimental effects of natural factors. Nonetheless, ongoing conservation efforts and site management remain essential to ensure the continued preservation of these valuable archaeological sites.

The walls found at the Badia sites, in comparison to the Neolithic villages, are generally of a shallower height. However, in cases where deep walls exist, such as those observed at the cells of the desert kites, which can reach depths of over 2 m below the ground surface, they are constructed using robust techniques due to their function as final hunting areas for animals¹⁴. In these cases, soil is not used to fix the stones together. Instead, the entire wall leans against and is fully supported by compacted natural soil. The lower course of the wall may consist of standing stones, but their strength is reinforced by the upper courses, making it highly challenging for these standing stones to collapse. The cells within the wall are built in a rounded shape, which further enhances the strength and resistance of the structure against soil movement or even earthquakes. This rounded shape provides additional stability

¹³ Desert kites are large, stone structures found in arid and semi-arid regions, including Eastern Badia of Jordan. These enigmatic formations date back to the Neolithic were used primarily for hunting large herds of wild animals.

¹⁴ ABU-AZIZEH, W. & TARAWNEH, M.B. Out of the harra: Desert kites in south-eastern Jordan. New results from the South Eastern Badia Archaeological Project. In: *Arabian Archaeology and Epigraphy*, 26, 2015, pp. 95–119; TARAWNEH, M., ABU-AZIZEH, W., ABUDANAH, F. & CRASSARD, R. Desert Kites and Campsites in the South Eastern Badia of Jordan: Results of the South Eastern Badia Archaeological Project, Jordan. In: *Al-Hussein Bin Talal University Journal of Research*, 2(3), 2017, pp. 1–31.

and structural integrity, contributing to the overall durability of the walls. The construction techniques employed in these deep walls at the Badia sites are specifically designed to withstand external forces and ensure their long-term stability. The reliance on compacted natural soil, the support from upper courses, and the rounded shape all work in concert to create a robust and resilient wall structure. It is worth noting that despite their strength, ongoing monitoring and preservation efforts are still necessary to protect and conserve these important archaeological sites.

The eastern Badia region typically experiences extremely low annual rainfall, averaging around 50mm. This limited rainfall generally does not have a significant impact on archaeological remains. However, occasional flash floods can result in erosion, particularly affecting sites situated near wadis.

Interestingly, the climate in eastern Badia also offers some positive aspects. We have observed that excavated sites in this region tend to accumulate windblown sand, which serves as a protective layer for the site and its floors after excavation. This natural process helps safeguard the archaeological site and contributes to its preservation.

Another advantage is that eastern Badia typically has sparse vegetation compared to the western highlands, which means there is less vegetation-induced damage to the archaeological sites. The absence of dense vegetation minimises the risk of roots infiltrating structures and causing physical harm.

Human factors as a threat in southern Jordan

We have to be aware of the fact that current human activity influences the southern Jordanian landscape in at least an equally significant way to natural processes. The drilling of deep wells, mechanised agriculture and, most recently, the erection of wind turbines, are causing acute changes to the geomorphology and historic–archaeological heritage. This activity mainly results in the destruction of the surface record of archaeological sites and those lying shallow under the ground. This mainly affects sites dating from the Palaeolithic to the Bronze Age, which are not characterised by the presence of visible architecture on the surface. In recent years, wind farms have been built covering larger and larger areas, for instance, in the vicinity of the abovementioned Faysaliyya archaeological site.

There are also other anthropogenic factors affecting the risk or destruction of archaeological sites. One of them is open-pit mining. A good example is the eastern and southeastern parts of Wadi Mashra, which are being destroyed by mining activities targeting the limestone and gypsum layers. In the valley below the Umm Tuweyrat site, there is an open-pit mine for phosphorites. Currently, it does not reach the area of the site itself, but it is uncertain whether it previously encompassed some of its undocumented parts.

An important factor influencing the condition of archaeological sites and monuments in southern Jordan is the activity of humans in this area. Primarily, it is vital to note the increased tourist traffic, clearly visible in places popular among tourists and tour operators. Ever since the “discovery” for Europeans of the most famous site in this region – Petra and its monuments – in the early nineteenth century, the presence of travellers and tourists has adversely affected many buildings related to the Petra region. It suffices to mention that many people who visited this place in the past, believing in circulated legends, blindly shot at the urn located above the central part of the pediment in the hopes of obtaining the supposed treasures contained within it. Today, no one allows themselves such extravagant liberties, however, the sheer enormity of

the tourist traffic – crowds of pedestrians marching daily through Siq and the centre of Petra, climbing to the “Monastery” (Deir) situated above the valley, sitting in the ever-expanding cafes



Fig. 11: *Umm Tuweyrat: General view on the dolmen field in southern Jordan, photo P. Kolodziejczyk.*

and leaving trash – adversely affects the state of preservation of the monuments. Additionally, tourist traffic generates a huge development of services offered in this region by local vendors, carriers and guides. Hundreds of tourists are transported daily in small carriages or on donkeys over the preserved fragments of the original Siq pavement or the soft-rock steps leading to the Deir, gradually causing their disappearance despite conservation efforts implemented by Jordanian services to care for the monuments. It should be noted that the Department of Antiquities of the Ministry of

Tourism and Antiquities of the Hashemite Kingdom of Jordan, which oversees more than 10,000 archaeological sites in the country, together with the management of the Petra National Park, conducts very intensive activities aimed at securing or reconstructing many facilities and areas of Petra. However, the scale of the area of southern Jordan and the diversity of the protective and conservation problems occurring there, combined with the difficult accessibility of many places and the huge financial resources needed to carry out these tasks, is massive and does not allow for many actions that seem urgently needed.

Another difficult-to-solve dilemma is the operation within the structures and many smaller historic objects of the region by the local population, where people have been utilising dolmen graves or Nabatean tombs and *triclinia* (Roman dining rooms typically furnished with three reclining couches) for economic or residential purposes for generations. Attempts to persuade people to move to other places, even supported by substantial financial resources and the construction of special settlements, have not fully brought the desired effects to date. It is difficult to be surprised by such attitudes from communities which have been living in this area for centuries and treat its buildings and objects as functional elements of the space they utilise. For instance, the current state of the dolmen structures in Umm Tuweyrat (Fig.11), especially their inner parts, is due to their use by the local population, notably by groups of shepherds, as shelters. In this case, it cannot be referred to as plundering activity since the site is situated on rocks and digging in search of hidden objects is not possible; however, the interiors of the dolmens have mostly been emptied over time. In this context, a lack of education among local communities plays a crucial role in not fostering the preservation of this archaeological heritage. People are not only unaware of the scientific value of these structures but also fail to see their potential in fostering tourism and enhancing the image of the city and its surroundings.

Aside from these activities, local communities surrounding archaeological sites, including Neolithic settlements, also contribute to their destruction following excavation. Regrettably, certain sites have experienced instances of stones being removed from their walls for reuse in modern construction. The stones are sought after due to their favourable shape and ready availability; the best example of this situation come from the Neolithic village of Basta, east of Petra. Furthermore, in cases where sites are situated within modern urban areas, people often disregard their historical significance and unknowingly contribute to their degradation by

discarding rubbish at these sites without recognising their importance (Fig. 6). These behaviours by local communities underscore the need for greater awareness and education regarding the value of preserving archaeological sites and their cultural heritage. Engaging with and involving local communities in site conservation efforts, as well as implementing stricter regulations and enforcement, can help mitigate the damage caused by these destructive practices. Ultimately, fostering a sense of pride and appreciation for the historical significance of these sites is crucial for their long-term protection and sustainability.

Another aspect related to the difficult situation faced by archaeological sites in this region is the scarce amount of land suitable for agricultural or industrial activities, which often leads to the occupation of areas of archaeological sites. One example is the intensive construction of wind farms in the area of southern Jordan. This is, of course, very important for the inhabitants of this region, due to the necessity of producing electricity, but it often happens at the expense of areas noted by researchers as strongly marked with archaeological relics.

The last key human-origin factor affecting the condition of archaeological sites in southern Jordan (although this phenomenon is common in other countries, including Poland), is the deliberate destruction of archaeological artefacts during illegal forays seeking valuable items. This unfortunate practice extends to many sites, primarily due to the limited understanding of these sites and their historical significance. For instance, in case of the Neolithic sites, cup-marked stones in particular tend to attract the attention of site looters, who mistakenly believe that these stones indicate the presence of gold or hidden treasures within caves. This tradition of illegal excavation is detrimental to the preservation and study of the archaeological heritage. It results in damage to the integrity of archaeological inventories. The extraction of artefacts without proper documentation and excavation protocols erases crucial information about original contexts, diminishing our understanding of the past. Such predatory actions are, of course, the result of two phenomena. On one hand, there is the ease with which the items obtained in this manner can be sold to antiquarians, who mainly take advantage of imprecise laws in neighbouring Israel, “legalising” these artefacts and then selling them on at a profit. However, the main cause is the economic situation in Jordan and the need for the local population to seek additional income. Difficult living conditions and problems with finding sources of income, along with rising living costs, drive people to search for artefacts that can be sold. It is hard to criticise or be surprised at such phenomena as they are natural and understandable, and also known from many similar examples from around the world.

To address this issue, it is crucial to raise awareness about the importance of preserving archaeological sites and the scientific value of proper excavation and documentation. Strengthening legal measures and enforcement, along with engaging local communities in site protection and heritage awareness initiatives, can contribute to curbing illegal excavation and safeguarding the cultural heritage of archaeological sites in Jordan.

When analysing the examples cited earlier in terms of the problem at hand, it is important to emphasise that the impact of human activities on the Badia sites is minimal, for several reasons. Firstly, they are located at a considerable distance from modern settlements, reducing the likelihood of interference. Additionally, the nature of the Badia sites, particularly the circular structures, does not immediately suggest they are ancient sites to potential looters. The same is true for *rujum* (stone mound) sites, as this type of burial is still in use by modern Bedouin communities. However, it is worth noting that even in eastern Badia certain sites have experienced looting, and one of the primary reasons for this is the presence of cup-marked

stones on the surface. An example of this can be seen at site F19 in Jibal al-Khashabiyeh, east of al-Jafer¹⁵. The distinctive appearance of these stones attracts the attention of looters.

Comparison with natural and anthropogenic threats to prehistoric sites in Poland

In the lands of present-day Poland, we are faced with threats that, for various reasons, are different from those found in Jordan, but there are also some whose nature is very similar. Clearly, the environmental conditions, especially climate, are different. There are no desert or semi-desert landscapes in Poland, which are typical for the majority of Jordan's territory. As we already know, these conditions themselves are a certain threat to prehistoric sites, causing spontaneous, gravitational destruction of various kinds of prehistoric structures, especially stone ones. In the much more humid climatic conditions of Poland or, more broadly, the so-called "forest Europe", there are practically no areas devoid of permanent vegetation cover and a developed humus layer on the surface¹⁶. Naturally, these conditions mainly keep both immovable and movable monuments in the same place. This also applies to prehistoric stone structures, although there are vastly fewer of them in Poland compared to Jordan. Again, due to climatic differences, but also geological and geomorphological ones, wood was used much more often as a building material in Polish prehistoric sites compared to those in Jordan, where stone was more common.

However, the abovementioned climatic conditions are the cause of a whole set of taphonomic and sedimentary phenomena affecting the degree and manner of preservation of archaeological monuments and artefacts. Much higher and more regular precipitation than in Jordan brings water erosion, especially on slopes, and fluvial phenomena to the fore among the morphogenic factors¹⁷. Watercourses and their associated sediments not only provide attractive places for humans to live: river valleys are areas of sediment accumulation and erosion too. Rivers create terraces made of gravel, sand and silt-clay. During periods of increased flow dynamics, these may be blurred and removed, hence the location of archaeological sites near rivers or on flood plains and fluvial terraces has resulted in exposure to floods, burial and, in some cases, destruction by erosion¹⁸.

¹⁵ TARAWNEH, M., ABU-AZIZEH, W., ABUDANAH, F. & CRASSARD, R. Desert Kites and Campsites in the South Eastern Badia of Jordan: Results of the South Eastern Badia Archaeological Project, Jordan. In: *Al-Hussein Bin Talal University Journal of Research*, 2(3), 2017, p. 15.

¹⁶ SZAFER, W., ZARZYCKI, K. *Szata roślinna Polski* T.I/II, Państwowe Wydawnictwo Naukowe 1997; RALSKA-JASIEWICZOWA, M. Ewolucja szaty roślinnej. In: L. Starkel (ed.), *Geografia Polski. Środowisko przyrodnicze*. Państwowe Wydawnictwo Naukowe, Warszawa, 1991, pp. 106–127; STARKEL, L. (ed.). *Geografia Polski. Środowisko przyrodnicze* (2nd edition). Warszawa: Wydawnictwo Naukowe PWN, 1999; RALSKA-JASIEWICZOWA, M., LATAŁOWA, M., WASYLIKOWA, K., TOBOLSKI, K., MADEYSKA, E., WRIGHT, H. E. JR. & TURNER, C. (eds.). *Late Glacial and Holocene history of vegetation in Poland based on isopollen maps*. W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków, 2004, pp. 1–444; HARMATA, K., KALINOVYČ, N., BUDEK, A., STARKEL, L., JACYŚYŃ, A. Environmental changes during the Holocene. In: K. Harmata, J. Machnik, L. Starkel (eds.). *Environment and man at the Carpathian Foreland in the Upper Dnister catchment from Neolithic to Early Mediaeval period*. Kraków, 2006, pp. 66–82; RICHLING, A., SOLON J., MACIAS A., BALON J., BORZYSZKOWSKI J., KISTOWSKI M. (eds.). *Regionalna geografia fizyczna Polski*. Poznań: Bogucki Wydawnictwo Naukowe 2021.

¹⁷ E.g. BRUD, S. Palaeogeography of the Western Sandomierz basin in the Late Neogene and Early Quaternary Times (Carpathian foredeep, South Poland). In: *Annales Societatis Geologorum Poloniae* 74, 2004, pp. 63–93.

¹⁸ DOBRZAŃSKA, H., KALICKI, T., SZMONIEWSKI, SZ. *Przemiany środowiska geograficznego w okolicach Krakowa w okresie rzymskim i we wczesnym średniowieczu*. Prace Komisji Paleogeografii Czwartorzędu PAU 7, 2009, pp. 9–32.



Fig. 12: *Mozgawa: Neolithic site in southern Poland*, photo S. Kotynia.



Fig. 13: *Miechów: Neolithic site in southern Poland*, photo M. M. Przybyła.

The effects of erosion and accumulation activities of rivers are similarly numerous¹⁹. As is known, fluvial transport can affect every category of particles and artefacts of every size, including buildings²⁰. It causes fragmentation, abrasion and even dissolution of the transported fragments. Equally important, however, is movement itself and accumulation, which on the one hand destroys archaeological sites, but on the other hand may lead to the creation of pseudo-sites by deposition of carried material in specific zones of river beds. Water erosion is also significantly increased by various agricultural activities related not only to ploughing but primarily to deforestation²¹. The exposure of large areas to wind also causes a radical increase in aeolian erosion, similarly to the Jordanian areas discussed in the previous section.

All these kinds of threats increase immensely in power if they operate in an area subject to human intervention and transformed by it to varying degrees (Fig.12–13). In this context, it is necessary to mention ploughed fields, especially if they are located on slopes. Such action greatly accelerates erosion processes (due to the removal of of natural vegetation cover) and leaves the terrain susceptibility to violent phenomena such as flash floods. This threat has been systematically intensifying for the last three or four decades due to the mass transition by farmers to deep ploughing as a result of the widespread use of mechanical traction force and heavy ploughs. This type of ploughing can often reach over 1 m deep, even reaching the bedrock (which is also disadvantageous for the farmer himself, as it results in lower yields)²². For obvious reasons, such a situation causes the destruction of archaeological sites, affecting both cultural layers and anthropogenic objects, and often not only their upper parts but entire sites. Deep ploughing, especially in the highlands and mountainous southern Poland, results

¹⁹ TURNBAUGH, W.A. *Floods and archaeology*. American Antiquity 43(4), 1978, pp. 593–607.

²⁰ See e.g. SELLEY, R.C. *Applied Sedimentology*. Academic Press, 2000; LEGUT-PINTAL, M. LiDAR w badaniach nad średniowiecznymi fortyfikacjami i siedzibami obronnymi. Przykład założeń obronnych księstwa biskupów wrocławskich. In: K. Stala (ed.). *III Forum Architecturae Poloniae Medievalis*, vol. 1, Kraków, 2013, pp. 209–222.

²¹ KLIMEK, K., LANCZOT, M., NOGAJ-CHACHAJ, J. *Historical deforestation as a cause of alluviation in small valleys, subcarpathian loess plateau, Poland*. Regional Environmental Change 6, 2006, pp. 52–61; DOTTERWEICH, M. *The history of soil erosion and fluvial deposits in small catchments of central Europe: Deciphering the long-term interaction between humans and the environment – A review*. Geomorphology 101, 2008, pp. 192–208; DOTTERWEICH, M., DREIBRODT, S. *Past land use and soil erosion processes in central Europe*. In: *PAGES news* 19(2), 2011, pp. 49–51; PIETRZAK, M. *Geomorfologiczne skutki zmian użytkowania ziemi na Pogórzu Wiśnickim*. Kraków: Instytut Geografii i Gospodarki Przemysłowej Uniwersytetu Jagiellońskiego, 2002.

²² Ibidem.

in the systematic throwing of artefacts to the surface and their displacement beyond the scope of their original location due to intensifying erosion. This type of threat is very difficult to control by conservation authorities, even if ploughing takes place within the identified archaeological site. It is not related to construction investments and occurs on an almost daily basis. Undoubtedly, threats of this kind also affect immovable monuments still visible on the surface, such as embankments, mounds, barrows, etc. Very often, despite formal bans, they are cultivated, in situations when they are located on private owners' lands.

Other threats are posed by mining and the damage caused by such activity. Whereas mines from the Neolithic or Bronze Ages and even the Middle Ages can be treated as monuments²³, modern activities of this type are posing a significant risk to Poland's archaeological heritage. An obvious example is the destruction of archaeological sites in the processes of open-pit mining²⁴; however underground mining is also starting to cause problems. An example here is the recently high-profile case of sinkholes caused by the closed underground mines of Trzebinia-Chrzanów zone in southern Poland²⁵.

As a side note, it can be added that speleological sports (caving) and non-archaeological exploration activities have been and are a threat to archaeological cave sites in Poland. This applies primarily to the Tatra Mountains and the Kraków-Częstochowa Upland, where examples of such destruction (old and new) are known²⁶. In this context, damage tend to be accidental but should not be underestimated.

In contrast to Jordan, the threat to archaeological heritage comes not so much from robberies (although they obviously occur) but from people who call themselves treasure hunters and practice their activities semi-openly²⁷. This activity is primarily aimed at metal artefacts thanks to the widespread use of metal detectors, but to a lesser extent it also affects stone monuments and those made from other materials. This situation is caused by a number of factors. First of all, the legal provisions related to monument protection are not fully precise. While they prohibit such activity, on the other hand, they provide for compensation for finders of more valuable monuments. The relevant local authorities are not fully aware of the illegality of treasure hunting and therefore do nothing about it. Even if they are aware, they often, for various reasons, turn a blind eye. The heritage conservation community tries to counteract this activity – which is, after all, illegal – but predictably it is not always possible. Moreover, there is no uniform, worked-out and widely accepted line of action. Some conservators and other professional archaeologists believe that it is necessary to strive to establish reasonably good relations with treasure seekers. In this way, there is a chance to obtain information about the finds and their contexts. Others, however, oppose this approach, indicating that such an attitude de facto legalises illegal exploratory activity²⁸. There are, admittedly, a few examples of fruitful

²³ See e.g. PIOTROWSKA, D., PIOTROWSKI, W., KAPTUR, K., JEDYNAK, A. (eds.). *Górnictwo z epoki kamienia: Krzemionki – Polska – Europa. W 90. Rocznice odkrycia kopalni w Krzemionkach*. Ostrowiec Świętokrzyski, 2014.

²⁴ See e.g. GRYGIEL, R. (ed.). *Badania archeologiczne na terenie odkrywki Szczęrców Kopalni Węgla Brunatnego Bełchatów S.A., Tom 2*. Poznań 2002.

²⁵ Państwowy Instytut Geologiczny, Zapadliska, accessed January 2024, <https://www.pgi.gov.pl/zapadliska.html>

²⁶ WOJENKA, M. Medieval and post-medieval archaeological heritage in Polish caves and the problems of its protection. In: *Archaeologia Historica Polona* 29, 2021, pp. 175–195.

²⁷ BIEL, R. *PZE i SNAP o karach za nielegalne poszukiwania zabytków*, Archeologia Żywa, 2018, accessed January 2024, <https://archeologia.com.pl/pze-i-snap-o-karach-za-nielegalne-poszukiwania-zabytkow/>

²⁸ FLOREK, M. *Badania archeologiczne, poszukiwanie zabytków, wydawanie pozwoleń na nie. Absurdy, wewnętrzne sprzeczności, niekonsekwencje i braki w przepisach prawnych ich dotyczących oraz propozycje zmian*. In: *Raport* 14, 2019, pp. 137–149; FLOREK, M., KOKOWSKI A. *Archeologia w skupie złomu*. In: *Raport* 15, 2020, pp. 317–323.

cooperation, in which treasure seekers cooperate with local archaeologists from the outset, by design. Their activity is not then profit-oriented (artefacts are transferred to local museums or research institutions), but only aimed at the satisfaction of finding rare, exceptional remains of the past.

Protection methods used in Jordan and Poland: the need for cooperation

The Jordanian Department of Antiquities, acting on behalf of the Jordanian authorities in protecting and managing archaeological sites, has enacted the Antiquities Law²⁹, which dates back to 1934 and has undergone several amendments. This law provides comprehensive legal and administrative guidelines, delineating the responsibilities of the Department of Antiquities (DOA) in overseeing archaeological projects and safeguarding Jordan's historical artifacts. It also contains crucial provisions to prevent unauthorised excavation and looting of archaeological sites by treasure hunters. Additionally, this law includes specific regulations, such as Article 26.2 and 13.3, to protect archaeological sites from different human activities. Additionally, it includes regulations that govern new construction and industrial activities in proximity to archaeological sites, with the goal of creating buffer zones around these sites to ensure their protection and preservation. Moreover, it involves the purchase of sites from landowners and the protection of newly discovered sites by local communities. The law also incorporates Instructions for Archaeological Projects, which outline the overall strategy for scientific research activities in archaeology. These regulations require project directors to implement protective and preservation measures at the end of each archaeological excavation season to ensure the site's safeguarding for the future. These measures may include full backfilling the site with soil to ensure its preservation for the future.

While these laws are effectively enforced at some archaeological sites, unfortunately, they encounter challenges and obstacles in many areas. The presence of treasure hunters and ongoing construction activities poses a significant threat, particularly given the multitude of archaeological sites in Jordan. The large number of these sites makes monitoring and protection an exceedingly challenging task. Moreover, the absence of ongoing maintenance efforts after archaeological excavations, particularly at delicate sites like Neolithic villages, is not addressed by these regulations, creating further risks to the sustainability of these sites. Furthermore, the law does not account for the impact of natural environmental factors on archaeological sites, as it primarily focuses on human-related issues.

It is important to note that while the sites in eastern Badia are relatively less affected by natural factors, they still require attention and conservation measures to ensure their long-term preservation and protection. On the other hand, it is evident that prehistoric sites, especially those with built structures in the western highlands of Jordan, require greater care and improved preservation plans after excavation. While excavation teams typically have limited resources to protect sites adequately, the Department of Antiquities of Jordan also faces challenges in safeguarding all prehistoric excavated sites from various factors.

Given this situation, it is crucial for all stakeholders to collaborate and find viable solutions. One possible approach is to develop comprehensive plans to protect sites after excavation, ensuring their long-term preservation. Another option could involve full backfilling of the entire excavated areas. Previous experiences with Neolithic sites have clearly demonstrated

²⁹ Jordan, National Cultural Heritage Laws, UNESCO Database of National Cultural Heritage Laws, accessed January 2024, UNESCO/CLT/Natlaws <https://whc.unesco.org/en/statesparties/jo/Laws>

the significant risks these sites face if they are not adequately protected from both human and natural factors. This holds true for all prehistoric sites with architectural remains that may be susceptible to these influences.

By implementing effective preservation measures and fostering cooperation among stakeholders, it is possible to mitigate the threats posed to these valuable archaeological sites and ensure their continued existence for future generations.

The works conducted here should be minimalistic and largely focused on conservation, so that the scale of archaeological research does not deepen the state of destruction of the buildings nor accelerate weathering processes, for instance, through unnecessary exposure of objects. The identification of conservational threats must be the first step in any activity undertaken here and should lead to collaboration between experts from many disciplines. Care for cultural heritage (which undoubtedly includes monuments associated with the Nabateans), understood as holistic, coherent research, conservation, and revitalisation actions, should become a significant consideration in the development of theoretical–practical principles of protecting cultural heritage objects of global significance. The region of southern Jordan (with special consideration for Petra) can become a model example in this regard, based on the conviction that properly researched and secured cultural heritage can also be a carrier of innovation and offer “returns” to society with benefits for further civilizational development, for example, through stimulating tourism, education, etc.

Protection of archaeological heritage in Poland, like in most European countries, is regulated by legal provisions which mandate appropriate protective procedures³⁰. These procedures refer to:

- i) heritage sites, predominantly immovable, known and acknowledged in public consciousness, yet not subject to scientific research or threatened by construction investments or other activities so far;
- ii) heritage sites at risk due to accidental discoveries or due to planned and implemented investments; and
- iii) heritage sites acquired during scientific research.

Currently, the Act on the Protection of Heritage Sites of 23 July 2003 with later amendments³¹ is in force in Poland. It concerns the protection and care of monuments and is in fact based on a law dating back to 1962. It applies to all monuments, including archaeological ones, which are treated as a specific category of monuments (designated category C).

According to the Act, there were formally five forms of monument protection:

- i) entry into the Heritage Register;
- ii) entry onto the List of Heritage Treasures;
- iii) recognition as a historic monument;
- iv) establishment of a cultural park; and
- v) establishing protection requirements in the local spatial development plan or in the location decision, resulting from entry into the national register of archaeological monuments.

³⁰ KOBYLŃSKI, Z. *Zarządzanie dziedzictwem kulturowym*. Warszawa: Wydawnictwo Naukowe UKSW, 2020.

³¹ Obwieszczenie Marszałka Sejmu Rzeczypospolitej Polskiej z dnia 23 marca 2022 r. w sprawie ogłoszenia jednolitego tekstu ustawy o ochronie zabytków i opiece nad zabytkami; Ustawa z dnia 23 lipca 2003 r. o ochronie zabytków i opiece nad zabytkami (Dz. U. 2022, poz. 840), 2022; see also ZALASIŃSKA, K., Ustawa o ochronie zabytków i opiece nad zabytkami. Komentarz. Warszawa: CH Beck, 2020.

Among other things, this Act specifies conservation structures and their functions, namely, that in each province there should be a provincial heritage conservator office which includes an archaeological unit. There is also, of course, the central level of this structure in the form of the General Monuments Conservator, which is, unfortunately, an office occupied by a government-appointed political figure rather than a heritage expert. The head of this office is usually a secretary or undersecretary of state in the Ministry of Culture and National Heritage. The substantive backing of the aforementioned bodies is provided by the National Heritage Institute (*Narodowy Instytut Dziedzictwa* – NID)³², which also reports to the Ministry of Culture and National Heritage. It comprises the Department of Archaeological Heritage and also has branches in all provinces. Among the many tasks of this institution, it is important to mention a very significant duty related to the issue discussed in this article – collecting, organizing and managing the National Heritage Register documentation and National Heritage Registry.

The Act clearly adopts the principle ‘the one who destroys, pays,’ meaning it imposes the costs of rescue research on investors, both individuals and legal entities. Of course, this does not enthrall investors, especially smaller ones. The financial burdens resulting from it can be particularly troublesome in the case of small investments, such as building a single-family house, garage, utility building, and so on. However, the Act has more apparent deficiencies, for example, it does not very precisely regulate the issue of archaeological research and searches undertaken by people who are not professional archaeologists (see above).

Poland also signed and ratified the European Convention on the Protection of Archaeological Heritage in 1996, also known as the Malta Convention³³, which was prepared under the auspices of the Council of Europe. It imposes on the signatories the obligation to protect archaeological heritage, including through the principle that no investment can cause the destruction of archaeological sites without conducting preliminary rescue research, and such work must be carried out by qualified, authorised personnel. However, this convention, full of just and appropriate solutions, recommendations and postulates, is also not perfect. Unlike the aforementioned Polish law, it does not regulate completely clearly the issue of who should cover the costs of conducting rescue research. In other words, investors are not unequivocally indicated here.

Identified archaeological sites are entered into the national register of archaeological monuments, currently managed in practice by the NID. The data transferred by the NID operate on three levels: central, provincial and municipal. This is to determine the protection requirements in local spatial development plans or in location decisions, as already signalled. Currently, almost 500,000 archaeological sites have been recorded in this register. Sites of large, above-average scientific and historical value are usually entered into the Heritage Register, by the decision of the provincial conservator of monuments. Currently, nearly 8,000 archaeological sites have been entered into this register³⁴.

³² NID, Zarządzenie nr 32 Ministra Kultury i Dziedzictwa Narodowego z dnia 23 grudnia 2010 r. w sprawie zmiany nazwy i zakresu działania Krajowego Ośrodka Badań i Dokumentacji Zabytków; Zarządzenie nr 32 Ministra Kultury i Dziedzictwa Narodowego z dnia 30 stycznia 2020 r. w sprawie nadania statutu Narodowemu Instytutowi Dziedzictwa.

³³ *European Convention on the Protection of the Archaeological Heritage* (Revised, ETS No. 143, 1992), accessed December 2023, <https://www.coe.int/en/web/conventions/full-list?module=treaty-detail&treaty-num=14>.

³⁴ Serwis Rzeczypospolitej Polskiej, Rejestr zabytków archeologicznych, accessed December 2023, <http://dane.gov.pl/dataset/210>

The protection of archaeological monuments in Poland also includes the creation of zones with a special protected status. One such form is cultural parks, which aim to protect a specific cultural landscape along with immovable monuments characteristic of local architectural and settlement traditions. Cultural parks are most often established by local governments in agreement with the provincial conservator of monuments. Currently, there are 40 of them in Poland, including a few strictly archaeological ones, such as Wietrzychowice Cultural Park in Kujawy³⁵, which protects a group of megalithic tombs from the fourth millennium BCE, or the Seal Hunters' Settlement Cultural Park in Rzućewo, Eastern Pomerania³⁶, encompassing a Mesolithic and Neolithic settlement from the fourth and third millennia BCE. However, practically every cultural park protects certain local elements of archaeological heritage.

In the area of cultural parks and historical monuments, prohibitions and restrictions concerning agricultural, industrial, commercial and service activities (among others) can be established, including stipulations regarding building permits or waste storage. In practice, their status varies depending on the details of the resolution establishing the object. There are ones where virtually any human activity is suspended, such as the Neolithic and early Bronze Age flint mine in Krzemionki, which was inscribed to the UNESCO list of the World Cultural and Natural Heritage in 2019³⁷.

Conclusions

In summary, as has already been noted in other studies on the protection of the Jordanian archaeological landscape³⁸, the main threats to the archaeological monuments of the southern region of Jordan are natural phenomena, especially intense erosion during flash floods and sheet floods. These cause not only the destruction of architectural remains and other archaeological objects but also the displacement of movable artefacts, associated with their intensive abrasion and fragmentation³⁹. In the border areas of the Wadi Araba Rift, neotectonic phenomena and mass movements⁴⁰ are equally important. They lead to significant displacements of large amounts of rock material, which results in substantial damage to the archaeological sites of this region, such as the areas of Sela, Petra, Dana, among others⁴¹. Finally, in arid and semi-arid

³⁵ PAPIERNIK, P., PŁAZA D.K. *Park kulturowy Wietrzychowice. Na europejskim szlaku megalitów*. Łódź: Fundacja Badań Archeologicznych Im. K. Jazdzewskiego & Muzeum Archeologiczne i Etnograficzne w Łodzi, 2017; PAPIERNIK, P., WICHA J., BRZEJSZCZAK R., KITTEL P., WRONIECKI P. *Źródła archeologiczne w rejonie Parku Kulturowego Wietrzychowice*. Tom I: Prospekcje nieinwazyjne i abiotyczne elementy środowiska geograficznego. Łódź: Fundacja im. K. Jazdzewskiego & Muzeum Archeologiczne i Etnograficzne w Łodzi, 2020.

³⁶ KRÓL, D. (ed.). *Zespół osadniczy z epoki kamienia - Rzućewo, gmina Puck, stanowisko 1*, Gdańsk: Muzeum Archeologiczne w Gdańsku, 2018.

³⁷ UNESCO, Krzemionki Prehistoric Striped Flint Mining Region, accessed December 2023, <https://whc.unesco.org/en/list/1599/>

³⁸ E.g. ABU-JABER, N., AL-SAAD, Z. (eds.). *Landscapes, provenance and conservation of stone sources from selected archaeological sites in Jordan*. Irbid, 2007.

³⁹ See POESEN, J., TORRI, D., BUNTE, K. Effects of rock fragments on soil erosion by water at different spatial scales: A review. in: *CATENA* 23 (1–2), 1994, pp. 141–166; RIEKE-ZAPP, D., POESEN, J., NEARING, M.A. Effects of rock fragments incorporated in the soil matrix on concentrated flow hydraulics and erosion. In: *Earth Surface Processes and Landforms*, 32(7), 2007, pp. 1063–1076.

⁴⁰ MUHSIN AWABDEH, M.A. *Quaternary tectonic activity of the Amma-Hallabat structure and the Shueib structure NW Jordan*. Unpublished PhD Thesis University of Granada, Granada 2015.

⁴¹ Ibidem; DELMONACO, G., MARGOTTINI, C., SPIZZICHINO, D. Rock Slope Potential Failures in the Siq of Petra (Jordan). In: *Landslide Science for a Safer Geoenvironment*. Springer, 2014, pp. 341–347.

conditions, phenomena of salt weathering and insolation contribute to the rapid destruction of architectural remains, including sites carved into rock layers (e.g., Petra, quarries).

Moreover, destruction of surface sites also takes place as a consequence of intense contemporary engineering activities. Due to the incomplete archaeological reconnaissance of the described areas and the poor visibility of archaeological sites on the surface (especially older sites), such destruction is essentially inevitable. We must make it clear at this point that every community has the right to use its land and its resources. Monuments cannot be placed above people's lives and ability to ensure their survival. The task of the authorities and institutions responsible for protecting heritage cannot be to separate the local population from its land; rather, they must build strategies that ensure the archaeological heritage is protected – but not at the expense of the local community. In addition, it is necessary to act in such a way that this heritage serves the local community, developing its economic potential. This is all possible, but it requires sensitive actions based on respect for the local culture and an understanding of the problems of the local community. Therefore, investment or infrastructure development activities cannot be blocked. Methods of heritage protection should be sought which ensure that archaeological relics are researched and secured, but also that community development is possible.

The experience of Polish and Jordanian researchers and conservators in this field constitutes a large group of different ideas and implementations. These include attempts to protect the most sensitive sites because they are unspectacular, and very often located in areas attractive for agriculture or investment. The biggest problem in this regard seems to be state policies and existing laws, which often put the local community and archaeologists on opposing and conflicting sides. Action should therefore be taken to change this situation.

It is obvious that each country has its own laws and regulations, based on local experiences and traditions, as well as on their history and political system. However, this does not change the fact that there should be international cooperation, as archaeological heritage is part of humankind's identity. In regions as important for the development of civilisation as the Jordanian area, this is particularly important. Of course, this issue should also develop the activity of financial and logistical support for countries whose resources do not allow them to act alone. Any activity that leads to collaboration between researchers and better mutual understanding should therefore be developed. This provides unprecedented opportunity to gain inspiration for activities tailored to a specific region and its problems.

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