

PALAEOLITHIC SITES OF PODILLYA (UKRAINE) AS GEOHERITAGE OBJECTS: KEY FEATURES AND CURRENT CHALLENGES

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Abstract. The article provides a comprehensive analysis of Palaeolithic sites as geoheritage objects. It also examines in detail the state of their preservation and the main problems related to the process of organising the protection of Palaeolithic heritage monuments in Ukraine (using the example of Palaeolithic sites in the Podillya region). The study focuses on the distinctive features of these geoheritage objects, emphasising their natural significance and unique historical features.

Based on a detailed analysis of natural conditions, as well as legal aspects, this article presents ideas and best practices that can significantly change the Ukrainian approach to the preservation and management of Palaeolithic heritage. It highlights the importance of Palaeolithic sites as natural and cultural monuments that deserve our utmost care and attention.

Key words: geoheritage, Palaeolithic monuments, loess-soil sequence, Ukraine, Podillya, natural value, archaeological sites, conservation problems

Introduction

There is a significant number of Palaeolithic sites in the territory of Ukraine, each of which holds great importance for a comprehensive study of the natural conditions of ancient people's habitats, as well as for the study of the history of Earth and humanity as a whole. Palaeolithic sites contain data about ancient nature and society. The analysis of this data gives reasons to consider their study an extremely important and relevant direction in modern scientific research. Comprehensive studies of Palaeolithic sites make it possible to obtain not only archaeological but also valuable natural (palaeogeographic, stratigraphic, geochronological, palaeontological, *etc.*) scientific information. This information primarily includes

substantive palaeogeographical conclusions regarding the processes of sediment accumulation, climatic changes, geomorphological processes and the development of flora and fauna during the Quaternary period. It also provides information about the appearance, evolution and lifestyle of ancient people.

The natural aspect is extremely important in the study of Palaeolithic sites, because, on the territory of the Podillya upland, these objects are mostly associated with loess-palaeosol sequences. These sequences contain important information about climate changes and palaeogeographic events of the past, including continental glaciations and interglacial periods (Bogucki *et al.* 2012; Łanczont *et al.* 2014a, 2015). This information is crucial for palaeogeographic reconstructions. The Palaeolithic sites in Podillya region

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are unique in terms of stratigraphic representativeness of the loess-palaeosol sequences (Bogucki *et al.* 2012, 2020; Łanczont *et al.* 2022). This uniqueness makes them important objects of scientific research not only in Ukraine but also in Europe. Traces of the development of deluvial-solifluction and palaeocryogenic processes are also recorded in the sections. These traces are evidence of ancient climatic changes and are important for the analysis of modern climate changes.

Palaeolithic sites, as objects of natural and cultural heritage, are vulnerable to the destructive effects of natural and anthropogenic processes and require protection. Improving the state of preservation of Palaeolithic sites is an important element in preventing the loss of valuable scientific information about the past of humanity and nature. Therefore, issues related to the preservation and protection of these monuments are extremely relevant, including for the Palaeolithic sites of Podillya. Despite some of them being included in the State Register of Immovable Monuments of Ukraine, their protection is being carried out improperly and needs to be improved by developing and implementing various measures. One of the central topics of this article is the study of the significant problems that various countries, especially Ukraine, are facing today in terms of protecting these valuable features of natural heritage. These challenges encompass a wide range of issues, including complex legislative and regulatory constraints, anthropogenic and environmental impacts on the organisation of appropriate conservation, and critical issues related to public awareness and access.

The ideas and practices related to the preservation of natural heritage presented in the article are important, as they pave the way for a more effective and sustainable conservation strategy for Palaeolithic sites, ensuring that these complex natural and cultural objects of natural heritage will continue to enrich Ukraine's geoheritage and contribute to our understanding of human history. This analysis can function as a resource for scientists, politicians and conservationists, offering an in-depth study of Palaeolithic heritage in Ukraine and providing guidance on how to overcome the challenges of its conservation. Palaeolithic sites, as valuable natural scientific objects, can be included in geotourist routes and contribute to the tourism development of the region, which is relevant in the conditions of today's challenges.

Location of sites and overview of studied problems

In this article, the main characteristics of such geoheritage objects as Palaeolithic sites and key features of their protection processes are considered using the example of Palaeolithic sites in the Podillya region in Ukraine.

The Podillya Upland is located in the south-west of the East European Plain and is especially rich in Palaeolithic sites, most of which also constitute valuable geological heritage. It is the location of world-famous multilayered Palaeolithic sites of the Middle Dnister region (Molodovo I–V, Korman, Ketrosy, *etc.*), a number of sites of the Halych Dnister region (an area in the Dnister River basin in the transition zone to the Forecarpathians) (Yezupil I–X, Mezhyhirska, Halych I, II, *etc.*), a number of sites on Ternopil Plateau (Pronyatyn I, Velykyi Glybochok I, Ihrovytsia I *etc.*), and sites on the Avratyn Upland (Bugliv V near Lanivtsi, Vanzhuliv I, VIII *etc.*) (Fig. 1). Some of them are well studied and published, while others still need further study and significant improvement to preservation processes (Bogucki *et al.* 2020, 2022).

Since the 1970s, archaeologists and geologists have discovered and comprehensively studied about 40 Palaeolithic sites in the Podillya region using a wide range of scientific research methods. The systematic study of the Middle Palaeolithic sites of Podillya by archaeologists and geologists began in 1977, after the creation of the Ternopil Palaeolithic Expedition under the leadership of Sytnyk, which for 20 years conducted seasonal field research of Palaeolithic sites, including joint research with geologists under the leadership of Bogucki.

Middle Palaeolithic sites in Podillya are grouped by the archaeologist Sytnyk into several localised groups. First and foremost, two major regions of Middle Palaeolithic human habitation are distinguished: North Podillya and South Podillya. The North Podillya region is the best studied of these two, where sites are located within 50 kilometres to the north of Ternopil city. Within this territory, archaeologists identify two groups of sites localised in the valleys of the left tributaries of the Dnister River (the Ternopil group, comprising: the multilayered sites Pronyatyn I, Velykyi Glybochok I, Ihrovytsia I; the sites Dolishnyi Ivachiv I, Ternopil I, Berezhany V; and other small locations Malashivtsi I–V, Velykyi Glybochok II–XIII, Gorishnyi Ivachiv I,

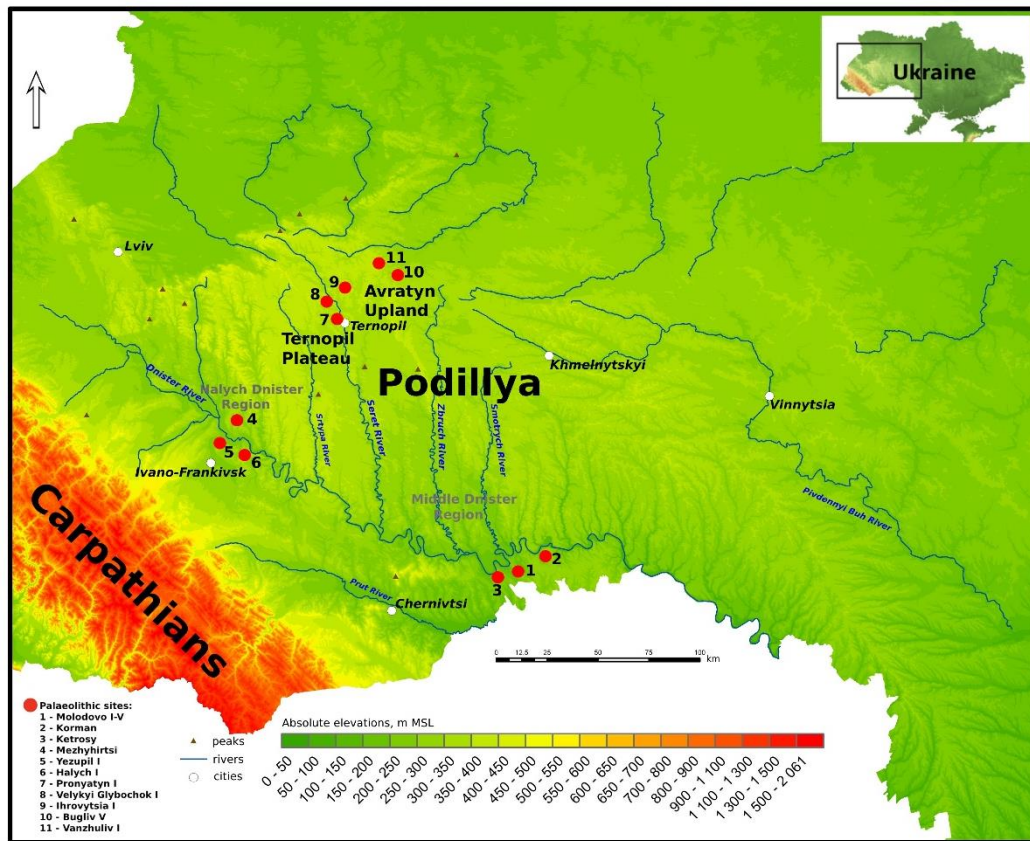


Fig. 1. Location of Palaeolithic sites in Podillya region

Ivankivtsi IV, Glyadky IV, IX, Ternopil II, Stry Zbarazh IV and Smykivtsi I) and the Horyn River (the Bugliv group, comprising: the multilayered sites Bugliv V and Vanzhuliv I–III; and the sites Vanzhuliv VIII (quarry), Vanzhuliv-Golda, Bugliv VI and Stry Vyshnivets I) (Sytnyk 2000).

A significant amount of materials from field archaeological and stratigraphic research was processed, and the state of protection of the most representative multilayered Palaeolithic sites of the Ternopil and Bugliv groups was analysed. This served as the basis for a more detailed study of issues related to the protection of Palaeolithic sites in Ukraine as a whole.

Characterising the study area, it is also appropriate to provide a brief description of natural conditions of this territory during the Middle Palaeolithic period and to emphasise their influence on the formation and preservation of the Palaeolithic sites cultural horizons, since the sites of that time period are analysed in more detail in the article.

The palaeolandscapes and palaeoclimatic conditions of the Middle Palaeolithic on the ter-

ritory of Podillya are reconstructed by researchers on the basis of data obtained as a result of complex naturalistic studies of site sections, namely:

- stratigraphic and palaeopedological studies of loess-soil sequences, including sections of Palaeolithic sites;
- reconstructions of ancient vegetation by palynological analysis of samples taken at site sections and key sections of the Podillya region;
- palaeontological analysis of samples of fossil fauna found in site sections, in particular large mammals.

Artefacts of the Palaeolithic sites of Podillya are mostly confined to the deposits of loess-palaeosol sequences, and in some cases they were actually discovered during geological and engineering-geological research of their sections. Loess-palaeosol sequences are extremely valuable from the point of view of the reconstruction of the palaeogeographic and palaeoclimatic conditions of past eras (Łanczont *et al.* 2014, 2022; Bogucki *et al.* 2021). In this article, the characteristics of fossil loesses and soil horizons are presented according to the stratigraphic scheme

of the loess-palaeosol sequence of Volyn-Podillya developed by Bogucki (Bogucki *et al.* 2021).

The first clearly recorded appearance of Palaeolithic humans on the territory of Podillya falls during the penultimate interglacial (MIS 7), so it is appropriate to describe the landscape and climatic conditions of the Palaeolithic, starting with the 8th oxygen isotope stage (MIS 8), which ended before the Korshiv interglacial. The period covered by MIS 8 lasted from about 305 to 243 thousand years (ka) ago. During the coldest period of MIS 8, the study area was typically a periglacial zone, as evidenced by the thick loess layer. Loess material of this stage fills the territory of the karst palaeo-concavity near Velykyi Glybochok I site, developed in carbonate sediments. The dates obtained for these loesses with thermoluminescence analysis vary between 247 and 307 ka (Łanczont *et al.* 2015).

On the loess MIS 8, the Korshiv fossil soil developed during MIS 7 (243–191 ka ago) (Bogucki *et al.* 2021). Micromorphological studies of the upper part of this loess (Velykyi Glybochok I site section) indicate that it was subjected to deeply penetrating soil-forming processes of great intensity. A characteristic feature of this period was the climatic crisis in its middle, associated with the cooling and moistening of the climate and the appearance of periglacial conditions, which led to the inhibition of the processes of the older phase of soil formation (the lower horizon of the Korshiv fossil soil). After this break, another phase of the development of soil-forming processes took place (the upper horizon of the Korshiv fossil soil). These phases are recorded in several studied loess-soil sections of Palaeolithic sites in Podillya (Velykyi Glybochok I, Bugliv V) (Łanczont *et al.* 2014, 2015, 2022).

During MIS 6 is in the interval of 190–130 ka, the entire studied area was located in the periglacial zone. A milder interstadial climate prevailed in the middle part of this stage. The beginning of MIS 6 is associated with the intensive development of solifluction processes, which is recorded in the sections of the Velykyi Glybochok I and Bugliv V sites (Bogucki *et al.* 2012; Łanczont *et al.* 2014, 2015).

During the MIS 5 period (130–71 ka ago) the interglacial (5) and early glacial (5d–a) stages of the last glaciation changed. The complex climatic conditions of this stage were recorded primarily in the form of an intense stage of interglacial pedogenesis in the Eemian time (5e)

and a later phase of climate cooling during stage 5d–a (with several much shorter episodes of climate warming, during which soil-forming processes developed and were interrupted by episodes of cooling). As a result of these processes, the Horokhiv fossil soil complex was formed, the deposits of which have been documented and studied in most of the Palaeolithic sites sections in Podillya region (Łanczont *et al.* 2014; Bogucki *et al.* 2021).

The MIS 4 period has been established by scientists in the interval 71–57 ka ago (Łanczont *et al.* 2015). This is the older part of the pleni-glacial period of the last glaciation, to which the lower horizon of the Upper Pleistocene loess corresponds stratigraphically. In the sediments formed during MIS 4, a very clear climatic division is recorded – in the older parts, processes characteristic of periods with a cold and wet climate dominated, which later changed to a cold and dry environment. Geomorphological processes began to develop on a large scale (deluvial-solifluction, cryoturbation) with the participation of weak aeolian sedimentation. As a result of these processes, the cultural horizons of many Middle Palaeolithic sites in Podillya were destroyed and redeposited. The premixed loess-soil deposits flowed down the slopes, trapping and moving the artefacts. Artefacts of Ihrovytsia I, Pronyayn I, Vanzhuliv I and Velykyi Glybochok I were found in the materials redeposited by solifluction (Łanczont *et al.* 2014, 2022; Bogucki, Tome-niuk 2021, 2023).

In the area of the Ternopil Plateau and the Avratyn Upland, the MIS 3 (59–27 ka ago) period is usually associated with a thick soil, which in many places was disturbed by solifluction (at the beginning of MIS 2, 28–13 ka). A major role in the destruction of the Dubno soil was played by geomorphological processes that became more active during the cooling phase in the middle part of MIS 3.

Research methods and materials

Historically, human activity has often been concentrated in certain places, and, where it has been particularly active, numerous material traces of this activity have remained in the form of Palaeolithic artefacts. Areas that have not undergone significant external changes for a long time have always been landmarks for human movement

on the earth's surface, shelter from unfavourable natural processes and phenomena, hunting grounds, and areas where it is easier to farm and build housing. That is why a thorough complex analysis of the landforms, geological structure and archaeological characteristics of Palaeolithic sites is an extremely important part of their study. The landforms and geological structure of these sites have a significant impact on the state of preservation of artefacts (Bogucki *et al.* 2012, 2020).

In the course of investigating the issues addressed in this article and the study of Palaeolithic sites as complex geoheritage objects, a range of scientific research methods were applied, each contributing to a comprehensive and detailed analysis.

Field research was carried out to observe and analyse the current state of preservation and use of individual Palaeolithic sites of the Ternopil and Bugliv groups in Podillya region. These field studies included the collection of data and documentation of the current state of preservation of Palaeolithic sites with the aim of further registration of accounting documents that provide grounds for including the sites in the State Register of Immovable Monuments of Ukraine.

In the context of the study of Palaeolithic sites in Podillya region, the analysis method was applied to characterise the natural features, cultural layers, general geographic data and state of preservation with the aim of comprehensively characterising Palaeolithic sites as geoheritage objects.

The study of literary sources and laws was carried out, which includes a detailed study of historical records and analysis of scientific publications. This became the basis for the development of a protection strategy and proposals for specific measures for the present-day protection of Palaeolithic sites.

The cartographic method was applied to create a complex of maps for morphometric analysis of the landforms in the vicinity of the Ternopil and Bugliv groups of Palaeolithic sites. Cartographic materials were developed using geographic information systems (GIS), namely modern QGIS software (Shevtsova, Tomeniuk 2020; Chaskovsky 2021).

The morphometric analysis method is based on the characteristics of the external features of the landforms by quantitative indicators. "External features" (morphology) usually means landforms parameters, which are determined by di-

mensions, absolute height, the steepness and shape of slopes, and the degree of erosional dismemberment. The subject of landform morphology research is the external form of modern landforms, whose morphometry is characterised quantitatively (Shevtsova, Tomeniuk 2020). The study of the morphometric parameters of the landforms in the vicinity of specific Palaeolithic sites made it possible to draw conclusions about the factors that influenced the choice of these territories for habitation by ancient people.

The research covers both the cultural and natural significance of these geoheritage objects, especially the justification of the choice of these localities as places for habitation by ancient populations (the study of such factors as landforms, availability of resources, environmental conditions), and analysis of key factors of negative impact.

Due to the use of such a set of methods, this study provides a detailed characterisation of Palaeolithic sites as geoheritage objects and a specific analysis of the spectrum of challenges and problems associated with the protection and preservation of Palaeolithic sites in Ukraine.

The main practical result of such studies can be considered to be concretely outlined protective and preservation measures and protocols. These measures are not simply abstract proposals but are presented as actionable and clearly defined steps that can be taken to ensure the long-term preservation and protection of these valuable geoheritage objects.

State of main geoheritage objects in Podillya region

As a result of field research conducted at Palaeolithic sites in Podillya region, the current state of the main multilayered geoheritage objects within the Ternopil and Bugliv groups was analysed. Brief descriptions of the natural and cultural value and current state of preservation of some geoheritage objects is provided below.

The Palaeolithic site Pronyatyn I belongs to the Ternopil group of Middle Palaeolithic sites and is valuable for dating the deposits and reproducing the palaeogeographical conditions of the Middle Palaeolithic period on surrounding territories. The cultural layer of the Pronyatyn I site lies in the sediments of the upper Horokhiv

solifluction material (a representative example of solifluction as a palaeocryogenic process) (Bogucki *et al.* 2012). The section of the Pronyatyn I site contains an extremely rich cultural layer (up to 45 cm thick), which is a vivid example of Levallois technology. In addition, the deposits of the Pronyatyn I site represent the classic Blake palaeomagnetic episode, a well-represented and detailed MIS 5 section (a complex of three interstadial Kolodiiv soils) (Bogucki *et al.* 2020). Now the object is weakly visible in the environment, being located on agricultural land in a forest. The material is sandy, loamy (fossil soils) and loess. Erosion processes in the vicinity of the site are developing with low intensity, and practically no economic activity is being carried out within the slope where the site is located. The main impact on the object was imparted by the operation of the quarry of a brick factory (until 1976). Potential threats to the preservation of Pronyatyn I are posed by erosion processes and intensive afforestation of the territory, which will significantly complicate its accessibility and visibility. The object has huge value of a scientific (artefacts of ancient humanity and the remains of ancient fauna), educational nature.

The multilayered Palaeolithic site Ihrovytsia I belongs to the Ternopil group of Middle Palaeolithic sites as well. Ihrovytsia I has independent geological significance, as it contains several fossil soils, a complex of deluvial-solifluction deposits, as well as palaeocryogenic structures (Bogucki *et al.* 2012; Sytnyk *et al.* 2013). Initially, the Ihrovytsia I site was considered by researchers to have two layers, but it was later established that these are in fact two sub-horizons within a single layer: I – stratigraphically undisturbed in the central part of the excavation, and I–A – a disturbed horizon of artefacts in the lower part of the Upper Pleistocene loess. Stratigraphic studies confirm the heterogeneity of materials in the central part of the excavation, where horizons I–A and II of the Mousterian period are redeposited by solifluction and mixed in a natural depression. The movement of the materials of the Mousterian layer II in the Pleistocene time by denudation factors indicates the probability of the existence of a settlement during the period of warming (Sytnyk *et al.* 2013; Bogucki *et al.* 2020). The material is sandy, loamy (fossil soils) and loess. The main destructive impact on this object was conducted during the operation of the sand quarry (during the 1970s–80s). Current potential threats to the site are posed by erosion processes, inten-

sive afforestation of the territory, and intensive agricultural processes in the vicinity of the site.

The Velykyi Glybochok I multilayered Palaeolithic site is also a part of the Ternopil group of Middle Palaeolithic sites. The object has huge scientific value. The Mousterian horizon, which lies above the destroyed Horokhiv fossil soil complex, and several Late Acheulean horizons, which in turn lie on the remains of the Korshiv fossil soil and in the Ternopil sub-horizon, were discovered on the territory of the Velykyi Glybochok I site (Łanczont *et al.* 2014). Remains of fossil organisms, particularly mammals and molluscs, were found in loess and palaeosol horizons and sub-horizons, which is extremely valuable in establishing the conditions of Palaeolithic humans' habitat here. The Middle Palaeolithic complexes of the Velykyi Glybochok I site are today the earliest stratigraphically marked Levallois geoheritage objects in Eastern Europe (Łanczont *et al.* 2014). The object was mainly affected (by movement of materials) during the operation of the stone quarry. Erosion processes are developing here with low intensity, and practically no economic activity is being carried out within the slope where the site is located. Currently, the state of preservation of the object is significantly influenced by an anthropogenic factor – periodic attempts by the local population to establish a landfill on the site.



Fig. 2. Velykyi Glybochok I, current state of the monument (photo by A. Shevtsova 2021)

The multilayered Palaeolithic site Bugliv V belongs to the Bugliv group of Middle Palaeolithic sites in the Podillya region. The excavated complex of the Bugliv V site is represented by two Palaeolithic cultural horizons (I, II) corresponding to the early (Acheulean) and late (Mousterian) stages of the Middle Palaeolithic time. Here were discovered reference horizons of the two main fossil soil complexes of Volyn–Podillya – Horokhiv and Korshiv – with palaeocryogenic structures (Bogucki *et al.* 2014) (Fig. 3). The discovery of archaeological materials was facilitated by the functioning of a small sand quarry (which the local population continues to use) in the territory of the geoheritage object during the Soviet period. Erosion processes are developing with low intensity, but the object is vulnerable to the impact of anthropogenic factors: local residents continue to extract sand material from the quarry quite intensively.



Fig. 3. Palaeocryogenic structures and solifluction horizon in the Bugliv V site section (photo by O. Tomeniuk 2014)

The Palaeolithic site Vanzhuliv I (Zamchysko) belongs to the Bugliv group of Middle Palaeolithic sites. The site is important for dating sediments and reproducing the palaeogeographi-

cal conditions of the surrounding territories. About 150 flint artefacts were found on the territory of the Vanzhuliv I site excavation, almost all of which were significantly damaged and redeposited. The material was destroyed, according to the researchers, during the period of intense cryogenic processes at the turn of the cold climatic shift of the Upper Pleistocene (Sytnyk *et al.* 2014). The historical stratifications should be classified as disharmonious, since they significantly worsened the condition of artefacts, though they helped them to be preserved. Anthropogenic activity (ploughing of the territory) contributed to the destruction of cultural layers and redeposition of materials. A potential threat to the object is posed by intensive agricultural processes, erosion processes and intensive afforestation of the territory. The object is preserved but vulnerable to the action of natural and anthropogenic factors.

A morphometric analysis of the landforms in the vicinity of some Palaeolithic sites was also carried out using cartographic materials created using QGIS (Shevtsova 2020; Shevtsova, Tomeniuk 2020). This article briefly analyses the morphometric indicators of the landforms in the vicinity of the Ternopil and Bugliv groups of Palaeolithic sites (Fig. 4, Fig. 5).

Analysing the hypsometric map of the wide area of the Ternopil group sites (Fig. 4), the terrain of the research area is clearly highly fragmented, the height difference here is more than 90 m. The highest areas, marked at 390–395 m, are located in the western and eastern parts of the territory, in particular to the east and west of the valley of the Seret River. Towards the river valley, the heights gradually decrease and reach 310–320 m. The Seret River valley, which is in the central part of the studied area, has the absolute height marks of 300–310 m. The Palaeolithic sites Ihrovytsia I, Velykyi Glybochok I and Pronyatyń I are located almost at the same level, at an altitude of 350–360 m.

Analysing the hypsometric map of the wider area of the Bugliv group sites (Fig. 5), it should be noted that the terrain of the research area is highly fragmented, the height difference being more than 70 m. The highest areas, with heights of 330–340 m, are located in the western and eastern parts of the territory, in particular to the east and west of river valleys. Towards the central part, where the rather large settlements of Vanzhuliv and Bugliv and the Buglivka river valley are located, the heights gradually decrease and reach 280–290 m. The river valley, which is in the cen-

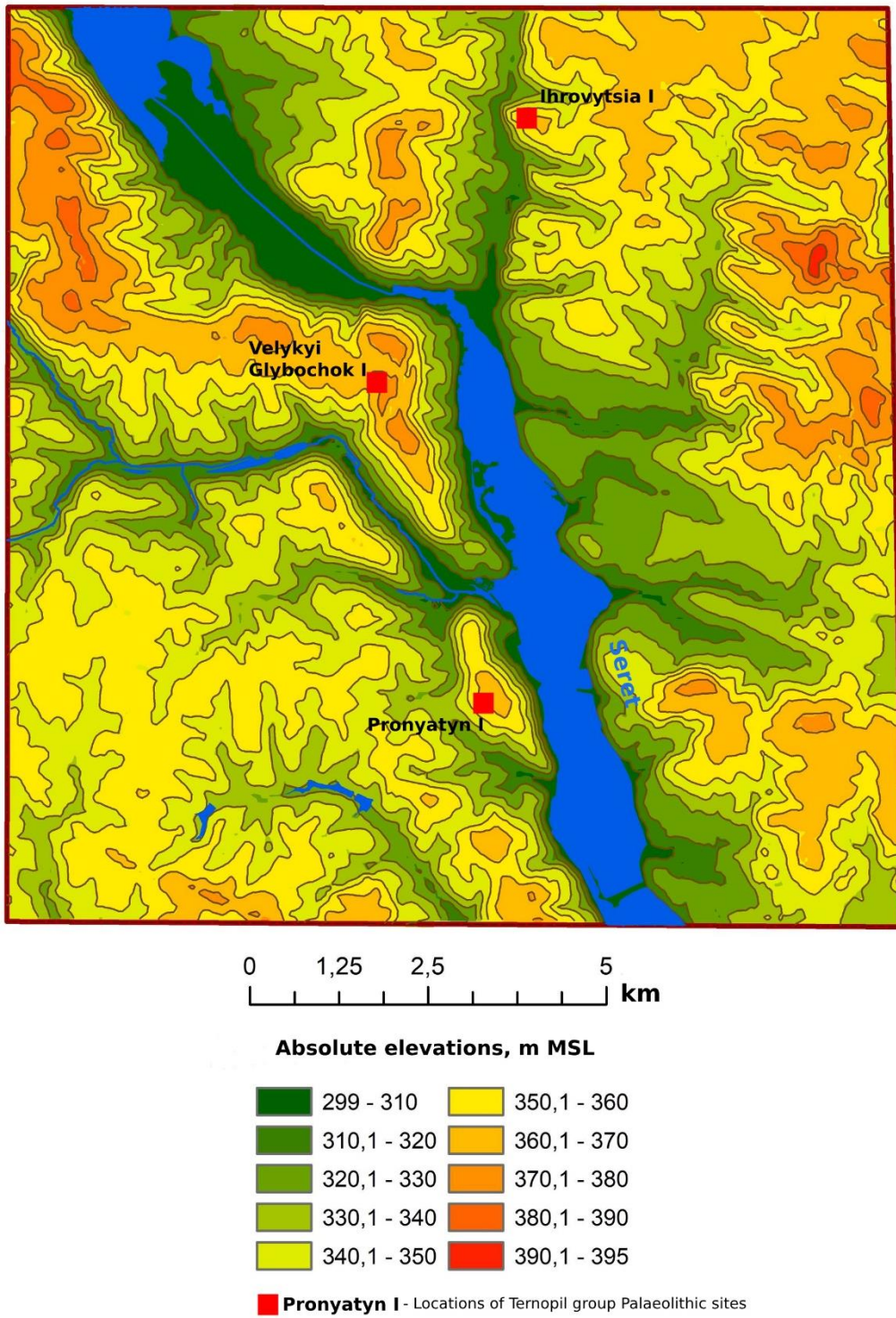


Fig. 4. Digital elevation model of the vicinity of the Ternopil group of Palaeolithic sites

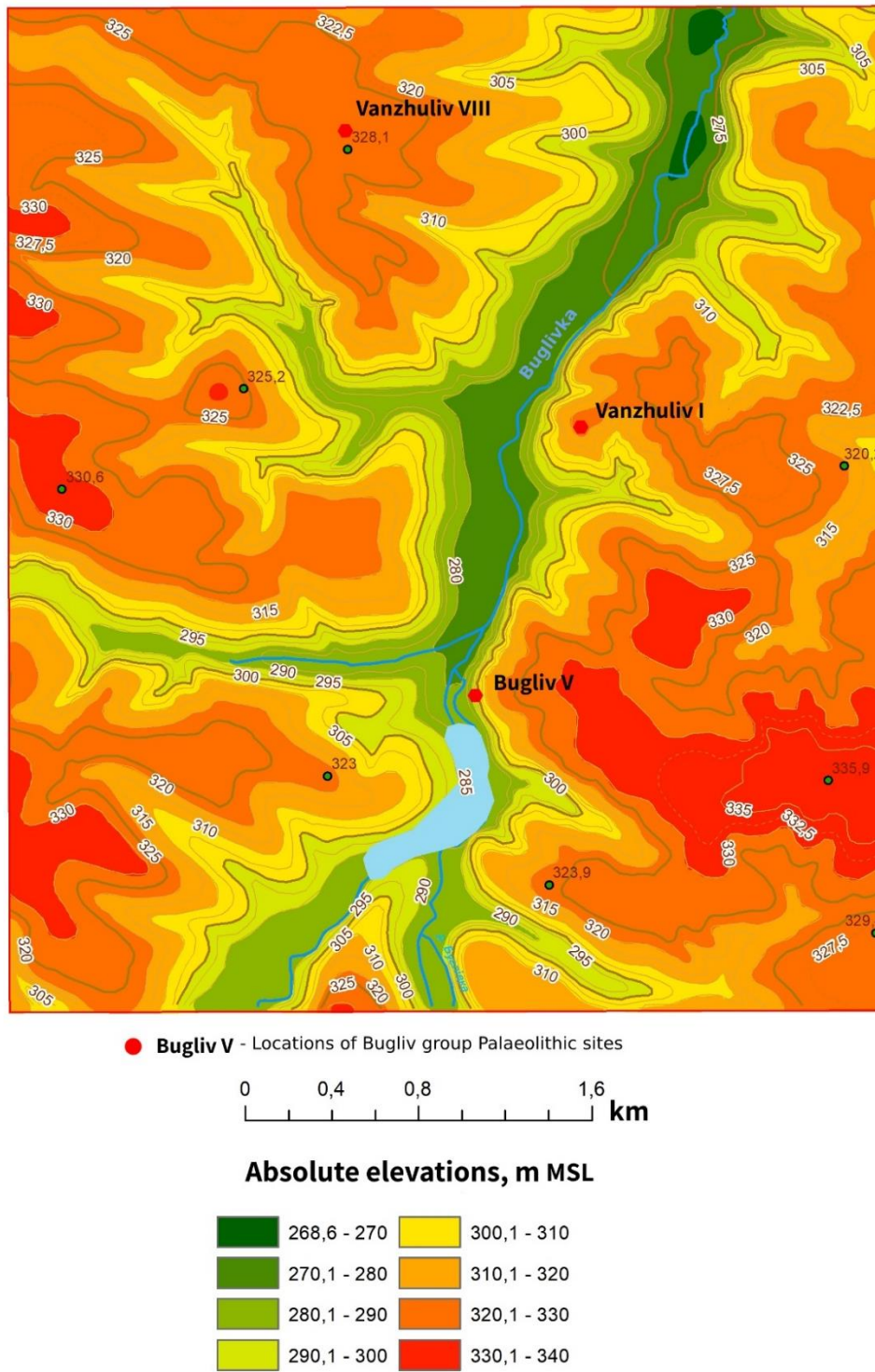


Fig. 5. Digital elevation model of the vicinity of the Bugliv group of Palaeolithic sites

tral part of the map sheet, has the absolute height marks of 270–280 m, and the Palaeolithic sites themselves are located in the upper parts of the slopes of the river valley and within the quarry in the north-western part of the map sheet and reach heights of 300 m (Bugliv V), 325 m (Vanzhuliv I) and 330 m (Vanzhuliv VIII) (Fig. 6).

Based on morphometric analysis results, clear patterns of the location of ancient settlements

can be observed, namely: sites are mostly located on elevated areas (absolute heights reach 390–395 m in the vicinity of Ternopil group Palaeolithic sites and 330–340 m in the vicinity of Bugliv group sites), near rivers (valleys of the Seret and Buglivka), and on windward slopes with a slight steepness (mostly 1–6°). (Shevtsova, Tomeniuk 2020). This enabled ancient people to efficiently use resources, provide protection and adapt to environmental conditions.

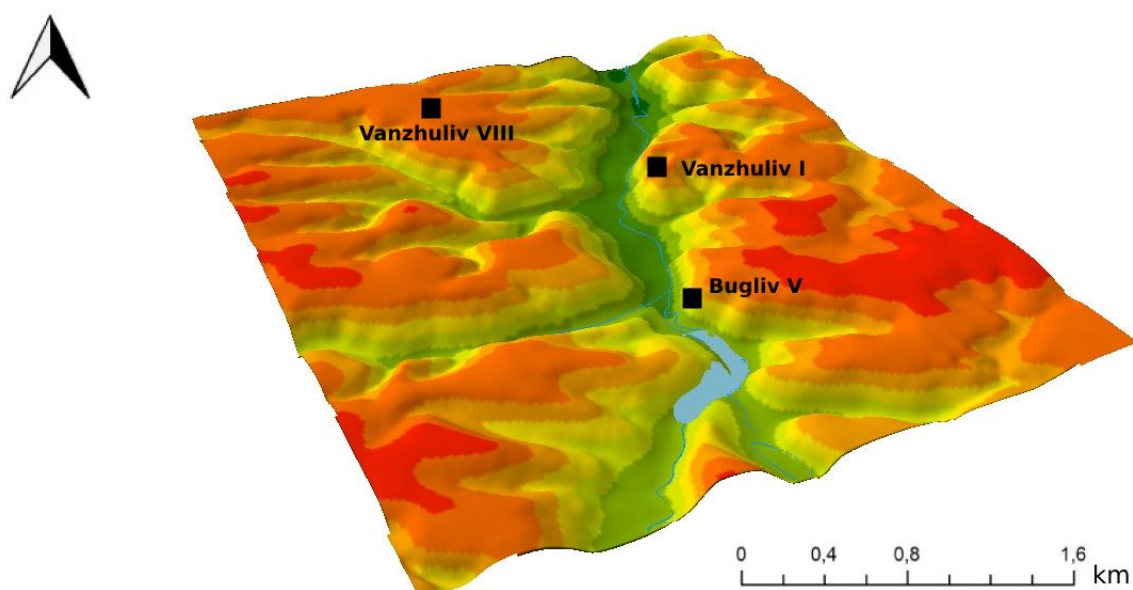


Fig. 6. 3D model of the Bugliv group Palaeolithic sites vicinity

Legal aspects

Currently, one of the urgent issues of the conservation business in Ukraine, as a component of nature protection, comprises of the inventory, environmental assessment and development of recommendations for the protection of geological and geomorphological heritage and its rational (primarily scientific, recreational and eco-educational) use. An important prerequisite for this is the drafting of inventory documentation for geoheritage objects (Chernets 2012). These objects also include Palaeolithic sites, the conservation of which is crucial for the global community – particularly institutions responsible for preserving geoheritage.

One of the key stages in the process of organising the protection of Palaeolithic sites in Ukraine

is the determination of a special usage regime and the delineation of protection zones for these objects. Such zones are defined through corresponding scientific and project documentation and are approved as follows: for geoheritage objects of national significance, by the central executive authority in the field of cultural heritage protection (the Ministry of Culture and Information Policy of Ukraine), and for geoheritage objects of local significance, by the cultural heritage protection authority of the regional state administration (the Department of Culture and Tourism of the regional state administration) (*The Law of Ukraine... 2004*).

An essential component of preserving and safeguarding Palaeolithic heritage in any country worldwide is the dissemination of information about geoheritage sites. This procedure is carried out through:

- publishing a unified Register of Cultural Heritage Objects and any changes made to it;
- installing protective plaques, signs, and other informational markers on the heritage sites or within their territories, irrespective of ownership.

Typically, the publication of such a register and its updates is managed by the central government authority responsible for cultural heritage preservation (Shevtsova 2019).

According to Ukrainian legislation, one of the key components of the protection and preservation of Palaeolithic sites, as in any country in the world, is the dissemination of information about heritage objects. To ensure public awareness about such objects, there is a unified State Register of Immovable Monuments of Ukraine, which is regularly updated and amended. Local self-government authorities use information from this registry to organise further public awareness efforts. This includes the installation of protective signs, markers and other informational signage on objects or within their territories, regardless of ownership forms (Shevtsova 2019).

To include objects in the State Register of Immovable Monuments of Ukraine, an inventory (passportisation) of objects is carried out, which involves preparing and completing a set of documents specified by legislation and submitting these documents to the Ministry of Culture and Information Policy of Ukraine. The list of these documents primarily includes a heritage object passport (which is filled out according to the sample approved by the state at the legislative level), as well as several other protective documents necessary for a comprehensive description of the object. For the organisation of the protection of Palaeolithic sites, in particular, these documents include:

- a record card for the object, containing its basic brief description (information about: precise location; determination of type, subtype and category according to established standards; spatial characteristics; role in the environment; functional use; assessment of the object's authenticity; a list of factors threatening its preservation; and a concise list of recommendations for protection);
- a historical reference, providing a brief overview of the stages of research into the object;
- an act of visual inspection or a technical inspection report (containing information obtained through direct monitoring of the current

condition of the use and preservation of the object).

Some of the Palaeolithic sites in Podillya region characterised above are currently included in the State Register of Immovable Monuments of Ukraine, namely Pronyatyn I, Bugliv V (2010, heritage objects of local importance), Velykyi Glybochok I (2009, a heritage object of national importance). In addition, the State Register of Immovable Monuments of Ukraine also includes other Palaeolithic sites in Podillia region (Pronyatyn II–V, Ternopil I, Berezhany VII, Gynovychi II, Poruchyn I – heritage objects of local importance). However, due to the lack of inventory documentation for these objects, their monitoring and protection are not ensured by local self-government authorities. This pattern of use has a negative impact on the state of conservation of Palaeolithic sites (slope ploughing, mining sandy and loess deposits of sites by the local population, dumping of household waste, etc.) and increases the risk of destruction of these valuable geoheritage objects.

Discussion

Areas of localities that have not undergone significant external changes for a long time have always served as landmarks for humans' movement on the Earth's surface, shelter from undesirable natural processes and phenomena, hunting grounds, as well as territories where it is easier to run an economy and build housing. That is why a thorough analysis of the landforms in the vicinity of Palaeolithic sites is an essential aspect of their study (Shevtsova, Tomeniuk 2020).

The key aspects of landforms' influence on the location of ancient settlements can be outlined as follows:

- protection from hazards – certain types of landforms may have been attractive for the location of ancient settlements from the point of view of safety, namely protection from wild animals and attacks by other social groups. Rivers in the vicinity of the settlement, in addition to providing protection against attacks, could be used to transport food and other resources to safe places;
- availability of resources – ancient settlements are often situated on the banks of rivers or other water bodies, providing easy access to water sources and other natural resources. Areas with

a flat landscape could also be chosen for settlements, due to the relatively easy access to resources they offer and their facilitating the cultivation of edible plants and hunting;

- weather conditions – the landforms exerted a significant influence on the climatic conditions in the vicinity of Palaeolithic sites. For instance, ancient settlements could be situated at higher altitudes where the climate was cooler, ensuring food preservation and reducing the risk of disease. Conversely, they might be located in lowlands with a warmer climate in order to access more resources and facilitate labour. Placing settlements on the slopes reduced the effects of winds;
- opportunities for hunting and gathering food – lowlands and flat landscapes typically offered more opportunities for hunting animals such as deer, wild boar, hares, foxes and others found in lowland forests, forest steppes or steppes. The ability to cultivate and gather plants that thrive in lowland environments also played a significant role. Situating settlements near or on the banks of rivers and other water bodies provided excellent opportunities for hunting and fishing.

Thus, the topography of the area significantly influenced the locations of settlements, shaping the life and culture of ancient people.

Palaeolithic sites are objects of both historical and natural value as they contain artefacts and are often confined to the loess-palaeosol sequences that have been comprehensively studied by scientists and whose archaeology and stratigraphy have been described in detail. Cultural horizons are in fact stratigraphic benchmarks, which is very important for the development and refinement of stratigraphic schemes. Very important, but weakly studied, are the processes of deluvial-solifluction redeposition of cultural horizons and the assessment of the role of palaeocryogenesis in these processes (Bogucki *et al.* 2012, 2020). Thus, at Palaeolithic sites, natural and cultural components are closely connected, and it is appropriate to interpret these as geoheritage objects.

Comprehensive studies of the Palaeolithic sites of Podillya region allowed for an analysis of their current state and the identification of the main problems related to their protection now. The protection of this kind of geoheritage objects in Ukraine currently faces several problems, which affect preservation processes:

- environmental factors – natural processes such as weathering, erosion and vegetation growth can affect the physical condition of Palaeolithic

sites. Erosion processes and territory afforestation are intensively developing in the vicinity of the Pronyatyn I, Ihrovytsia I and Vanzhuliv I Palaeolithic sites;

- agricultural processes – ploughing of land and infrastructure development can damage territories containing geoheritage objects, leading to their destruction or degradation. These processes are intensively developing in the vicinity of the Ihrovytsia I and Vanzhuliv I Palaeolithic sites;
- documentation and record-keeping – many Palaeolithic sites in the Podillya region are not included into the State Register of Immovable Monuments of Ukraine and lack comprehensive documentation, making it difficult to fully understand their natural and cultural significance. It is worth noting that some of the Palaeolithic sites considered in detail in this article have already been included in the State Register of Immovable Monuments of Ukraine (Pronyatyn I, Bugliv V). However, due to the lack of properly prepared accounting documentation, their protection and preservation are not ensured;
- public awareness and education – raising public awareness of the importance of preserving geoheritage objects is an ongoing challenge. Greater awareness can help prevent the destruction and misuse of land by citizens, which will have a positive effect on the preservation of Palaeolithic sites. To date, protective signs and information boards have not been installed on any of the Palaeolithic sites considered in this article. The absence of such signs and boards would significantly impact the use of these territories by the local population. Currently, a landfill has been created on the territory of Velykyi Glybochok I Palaeolithic site, and loess material is being extracted from the Bugliv V site, posing a risk of the sites' cultural layers being destroyed;
- legislation and enforcement – effective legislation and enforcement mechanisms are critical to the protection of Palaeolithic monuments. Legislative sources in the field of geoheritage protection need to be detailed and updated using modern practices and approaches. First and foremost, the protocol for including Palaeolithic sites into the State Register of Immovable Monuments of Ukraine and taking them under protection needs careful revision and improvement (Shevtsova 2019);
- international cooperation – corporate scientific research and programmes for the exchange

of experience with the participation of international organisations and partner countries in this area will increase the pace of development of environmental protection processes in Ukraine;

- underfunding – conservation efforts often suffer from insufficient funding and resources. Palaeolithic sites may lack adequate monitoring, security and preservation measures.

It is important to note that conservation efforts may vary by region and site in Ukraine, and there are ongoing initiatives by both local and international organisations to address these issues and protect the country's geoheritage sites.

Considering the key problems related to the current geoheritage objects protection state, it is possible to determine the main steps of their proper protection and preservation organisation. These steps are:

- conducting field research and examination in order to determine the condition and usage of Palaeolithic site territories;
- ensuring constant monitoring of the Palaeolithic sites' state of preservation;
- preparation of inventory documentation to add undocumented sites to the State Register of Immovable Monuments of Ukraine;
- production and installation of security signs and information boards to inform the local population about the special usage regime of territories taken under protection;
- prohibition of economic activity on the geoheritage object territories;
- provision of opportunities to use the Palaeolithic site territories for conducting scientific research, student practices and excursions, as well as for other scientific and educational purposes;
- adding Palaeolithic sites to regional geotourist routes;
- increasing the scope of international cooperation in the field of geoheritage protection.

Proper implementation of these processes will significantly increase the resistance of valuable objects to the destructive influence of various factors and ensure a significant improvement of the state of preservation of these geoheritage objects.

Conclusions

The territory of Ukraine, especially Podillya Upland, contains many Palaeolithic sites (geoheritage

objects), which are an extremely valuable source for studying the palaeogeographic conditions of past periods and the history of individual nations and humanity as a whole. The problems of protection and preservation of valuable geoheritage objects, which include Palaeolithic sites, are becoming increasingly relevant in modern realities. A common challenge is that of insufficient research having been conducted on Palaeolithic sites and their adjacent territories, from archaeological and geological-geomorphological perspectives alike.

The landscape and climatic conditions of the Middle Palaeolithic period in the territory of Podillya are determined by alternating periods of climate cooling and warming, as evidenced by the analysis of the development of fossil soil-forming processes, the analysis of ancient vegetation and fossil fauna, as well as the analysis of the development of palaeocryogenic processes (Łanczont *et al.* 2015). The climate that prevailed in the research area during the Middle Palaeolithic period was colder than today.

The analysis of Palaeolithic sites' topography is a key parameter in studying the interaction between humans and their environment. It reveals the influence of nearby landforms on settlement locations, which were determined taking into account factors such as the availability of natural resources, climatic conditions, hunting and gathering opportunities, and protection from potential dangers.

As a result of field research, the current state of preservation and protection of the Palaeolithic sites of Ternopil group (Velikiy Glybochok I, Pronyatyn I, Ihrovytsia I) and Bugliv group (Bugliv V, Vanzhuliv I [Zamchysko], and Vanzhuliv VIII [quarry]) was analysed. Palaeolithic sites are significantly affected by both natural and anthropogenic factors. The monitoring and protection of these sites are nowadays almost entirely lacking, which could lead to the destruction of these valuable objects.

A protocol aimed at enhancing the preservation and protection of Palaeolithic sites is outlined. This protocol includes conducting scientific research on the sites, monitoring and analysing the impact of natural processes on their preservation, documenting and registering previously undocumented monuments, installing protection signs to inform the public, prohibiting economic activities in associated territories, incorporation of sites into regional geotourist routes, and expanding international cooperation related to their protection.

Palaeolithic sites, as complex geoheritage ob-

jects, need proper protection and preservation because natural and cultural heritage is a national value for every state. The activity in the field of organising the protection of natural and cultural (including geological and archaeological) objects of heritage is an current direction of modern scientific research in Ukraine and other countries (Niculiță, Mărgărint 2018; Shevtsova, Tomeniuk 2020).

In cases where the protection and preservation of geoheritage objects are poorly provided for, intensive anthropogenic activities and natural processes can gradually lead to the loss of valuable material evidence of human history.

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