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e-mail: mega@edituramega.ro

ARCHAEOLOGICAL MAPPING

RESTORING THE BARROW LANDSCAPE OF NE ROMANIA: INITIAL REFLECTIONS

Abstract: The northeastern region of Romania exhibits a notable concentration of burial mounds, many of which remain still unknown. Previous research in this area has shown that most of these monuments were constructed by Early Bronze Age communities, known as the Yamnaya culture, and were later reused by subsequent civilizations up until the early medieval period. However, there has been a distinct lack of systematic efforts to document these sites, determine their chronology, or study their geomorphological characteristics. Furthermore, many of these mounds are under constant threat from natural forces and human activity, leading to irreversible damage. The present study aims to fill some of these gaps by applying an innovative approach based on high-resolution airborne sensing techniques, including oblique and vertical aerial photography, photogrammetry, and LiDAR (Light Detection and Ranging). Our main objective was to accurately identify all of the burial mounds from the Jijia River's catchment, in order to attempt a restoration of the ancient barrow landscape of north-eastern Romania. In this sense, a preliminary review of the scientific literature revealed a discrepancy regarding the number of existing sites, their location, and their research. However, the availability of high-resolution digital elevation models from LiDAR measurements has allowed a significant increase in the number of identified sites (up to 1,660 burial mounds) and a reassessment of their spatial distribution within the workspace. Additionally, the research included an analysis of the old cartographic sources, improving the database with 131 lost sites, that are no longer visible, even when using the LiDAR measurements.

Keywords: *LiDAR-derived DEM, old maps, tumuli, landscape, NE Romania.*

INTRODUCTION

Ancient human communities are known today due to various elements regarding the manifested socio-economic behavior. Thus, they can be understood due to the preferences exhibited when settling, the resources exploited, the forms and decorations used in the process-making of tools, weapons, ceramic vessels, etc. A very important element in this regard is represented by the funeral rite and ritual practiced, which provides not only information about the religious beliefs of the human groups but also about their behavior, social categories, anthropological traits, population, etc. The significance of funerary practices becomes even more important in the case of archaeological cultures known exclusively through the lens of such discoveries. In the latter category are included some of the human groups that originated in the Eurasian steppe regions, known as Yamnaya, Catacombnya, etc. They are associated with the construction of an impressive number of burial mounds

Casandra BRAȘOVEANU

Institute of Interdisciplinary Research, "Alexandru Ioan Cuza" University of Iași, Romania
casandra.brasoveanu@uaic.ro

Andrei ASĂNDULESEI

Faculty of History / Institute of Interdisciplinary Research, "Alexandru Ioan Cuza" University of Iași, Romania
andrei.asandulesei@uaic.ro

Radu-Alexandru BRUNCHI

Institute of Interdisciplinary Research, "Alexandru Ioan Cuza" University of Iași, Romania
radu.brunchi@uaic.ro

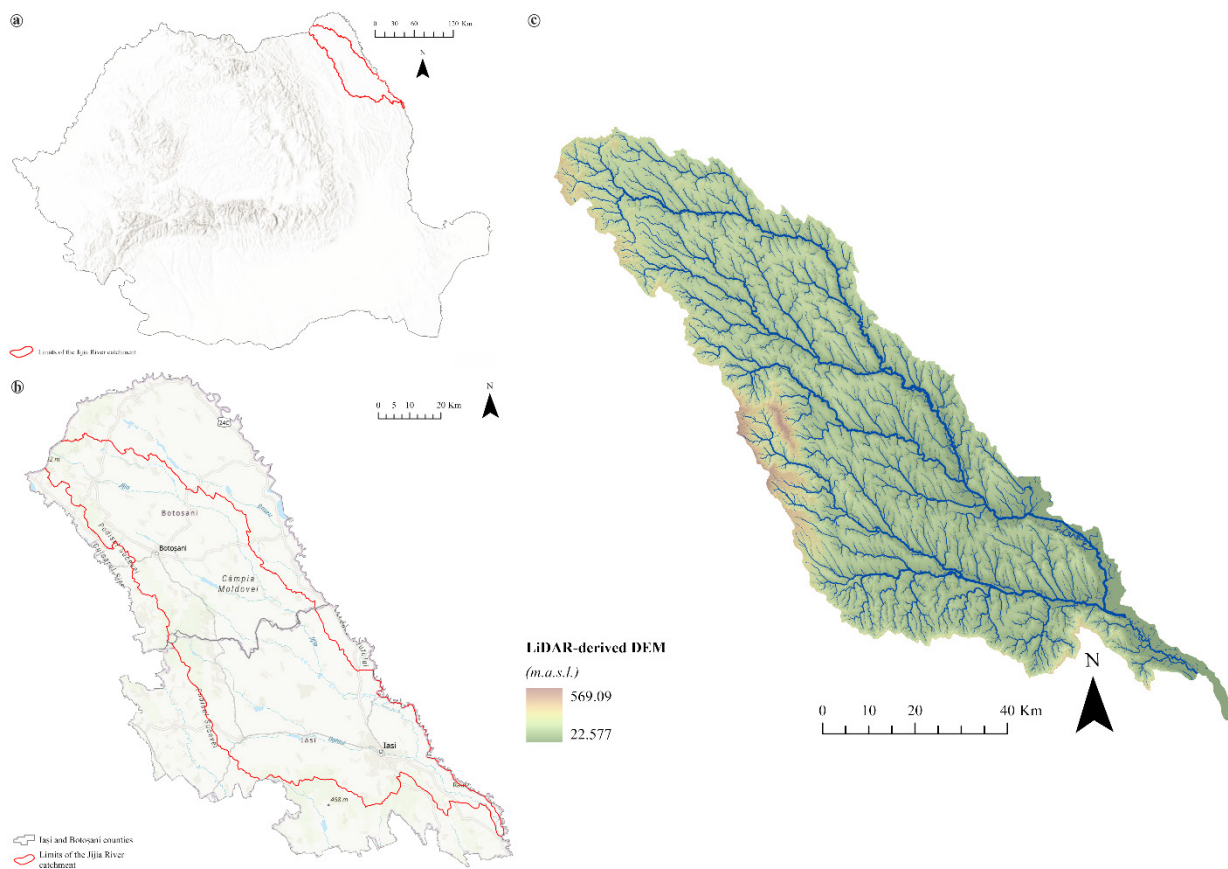


Fig. 1. The Jijia River's catchment within: **a** – the territory of Romania; **b** – the territory of Iași and Botoșani counties. **c** – LiDAR-derived DEM of the workspace (ArcGIS Pro 3.3.2; CorelDRAW 2021).

in southeastern Europe. The monuments, known by their original Latin name *tum(ēre),-ulus,-ule*, are not characteristic only to these communities, being found from the coasts of the Atlantic Ocean to Siberia and India, up to the shores of the Pacific, in America and Africa,¹ and chronologically being risen from the pastoral Neolithic period² to the beginning of the medieval period, which denotes the transmission of an important cultural heritage over several millennia and continents.

The barrows present a remarkable potential for obtaining new information about ancient populations, and their investigation has represented, over time, an important objective for specialists from various parts of the world. Lately, archaeology has seen a constant effort to inventory these mounds,³ emerged in many cases from the effects of anthropogenic activities (numerous sites of this kind are destroyed or flattened by intense agricultural activities, constructions from various wars, or treasure hunters). On the territory of Romania, studies of this type are still in their early stages,⁴ but the results obtained so far prove to be promising.

¹ CIUBOTARIU 2004, 552.

² BROOKS *et alii* 2009; LINARES MATÁS 2023.

³ RILEY 2009; TRIER *et alii* 2012; STRÓZYK 2016; TOPAL *et alii* 2019; ORENGO *et alii* 2020; BERGANZO-BESGA *et alii* 2021; BERGANZO-BESGA *et alii* 2023; CHEN *et alii* 2021; CANEDO *et alii* 2023; JAROSZ *et alii* 2023; WHITTAKER 2023, etc.

⁴ BRUDIU 1991; TOPOLEANU *et alii* 2008; ȚENȚEA/RĂȚIU 2015; DIACONESCU *et alii* 2017; NICULIȚĂ 2020; NICULIȚĂ 2020a; DIACONU 2022; BRAȘOVEANU *et alii* 2023.

In this context, the present research aims primarily at reconstructing the tumulus landscape of northeastern Romania, on a scale as close as possible to that of ancient times, as a first step towards safeguarding the monuments in question. In this regard, LiDAR data were used as primary sources for the entire area, identifying all currently visible burial mounds. In addition, old topographic maps were studied, along with the Shooting Master Plans, for the purpose of including in the database the funerary monuments indicated on the mentioned cartographic supports, but whose identification is no longer possible today due to anthropogenic actions. Finally, hydro-geomorphological indicators were calculated for all the *tumuli* in question, in an attempt to capture the preferences exhibited by the human communities involved in the ritual of erecting burial mounds and, eventually, to postulate some hypotheses regarding the cultural-chronological attribution of the monuments. In this regard, the catchment of the Jijia River (Fig.1) was selected as a case study, covering an area of over 5.750 km², which constitutes approximately 70% of the 8.000 km² area of the so-called “Moldavian Plain”.⁵ This vast geographical subunit features a broadly undulating relief, with hilly interfluves, low hills, or small plateaus of reduced altitudes, the overall image of

⁵ The name of the physical-geographical unit does not imply anything related to the specifics of the relief or the morphology of the area, but rather refers to a region with numerous cereal crops (SÎRCU 1971, 366–367), which is why it has been given a new name, considered more geographically accurate, namely: Jijia Hills or the Jijia Depression (NICULIȚĂ 2021).



Fig. 2. Mounds from the Jijia River's catchment (e.g. Vlădeni administrative unit, Iași County): **a** – Iacobeni-Movila *de sub deal*, still presenting elevation; **b** – Broșteni-Movila *Hărbărau II*, nearly flattened, identifiable only due to LiDAR measurement (CorelDRAW 2021).

the area being that of a low surface.⁶ The geomorphological characteristics, both micro- and macro-regional, of the targeted territory have influenced its population, as well as the development of large-scale human groups in this space, and numerous discoveries of prehistoric archaeological sites,⁷ among others, stand as evidence.

The motivation behind this initiative arose, first and foremost, due to the existing discrepancies in the state of knowledge for this territory, but also from the need to highlight the high degree of destruction of the monuments of interest. Thus, two important working tools of the present study and the issues encountered in their use should be mentioned. The Jijia River's basin, as shown in the figure above (Fig. 1/b), occupies substantial portions of the territories of Botoșani and Iași counties, for which, fortunately, archaeological repertoires have been created.⁸ These, along with the National Archaeological Repertory (RAN),⁹ represent the starting point for conducting archaeological research. When studying barrows, however, the mentioned repertoires illustrate a stage of knowledge that is at least contradictory. Thus, at first glance, according to RAN, within Botoșani County one can find 1057 *tumuli* registered as archaeological sites, while in Iași County the number drastically decreases to only 21 such monuments. The discrepancy between the two administrative areas is purely bureaucratic, the reality of the field being much more similar, and in this regard, we note that the archaeological repertoires of both counties have identified a consistent number of mounds. The lack of registration in the existing national database and, implicitly, the inability to protect the monuments on the territory of Iași County made their irreversible destruction possible, caused by large-scale agricultural works (Fig. 2/b).

MATERIALS AND METHODS

Given the aforementioned, the present research primarily aims to compile all available information regarding the tumular monuments from the Jijia River's catchment and to

⁶ BĂCĂOANU 1968.

⁷ ZAHARIA *et alii* 1970; CHIRICA/TANASACHI 1984; CHIRICA/TANASACHI 1985; ȘOVAN 2016; BRAȘOVEANU *et alii* 2023a.

⁸ PĂUNESCU/ȘADURSCHI/CHIRICA 1976; CHIRICA/TANASACHI 1984; CHIRICA/TANASACHI 1985; ȘOVAN 2016.

⁹ <https://ran.cimec.ro/>. Accessed: 01 October 2024.

create a comprehensive and up-to-date repertoire, which can subsequently be analyzed to reconstruct the ancient tumular landscape. While recent studies¹⁰ have validated new methods for the automatic delineation of *tumuli* using high-resolution LiDAR-derived DEM (Digital Elevation Model) data from the Jijia Hills, our study centers on the archaeological narrative that arises from identifying and analyzing all burial mounds, including those that are unrecognizable and known only from historical cartographic sources. Using 1x1 km grids, the mounds from the workspace were mapped on a 1x1 m resolution LiDAR-derived DEM. Following this, the study also incorporated various topographic maps (Austrian 1:200,000, 1910 edition; Soviet 1:50,000, 1942 edition; Shooting Master Plans 1:20,000, 1958 edition; Romanian Topographic Map 1:25,000, 1984 edition) and orthomosaics from online portals such as InisViewer, Bing Maps, Here Maps, and Atlas Explorer. The database was compiled using Global Mapper 25.1 software, while the spatial analysis and map generation were conducted using ArcGIS Pro 3.3.2. Additionally, the Relief Visualization Toolbox 2.2.1 was employed to enhance relief representations in the micro-areas with numerous barrows. This catalog of discoveries will serve as a foundation for registering these monuments as archaeological sites within the National Archaeological Repertoire, thus contributing to their preservation. However, until then, we have included the 1660 sites, identified through the help of LiDAR measurements, on an online archaeoportol, which can be interrogated by specialists, as well as the interested public.

In terms of GIS analysis, the availability of LiDAR data enabled us to gather crucial information about the morphological features of the mounds, such as their shape, elevation, and diameters. Additionally, we calculated geomorphological indices, including absolute altitude, slope, and the Topographic Position Index (TPI), which provided new insights into the characteristics of the selected micro-areas. Absolute altitude was extracted from the LiDAR-derived DEM (Fig.1/c) using the ArcGIS *Extract Values to Points* function. For each point feature, representing the center of a burial mound, a corresponding value was recorded in the attribute table, allowing us to categorize altitudes into

¹⁰ NICULIȚĂ 2020; NICULIȚĂ 2020a.

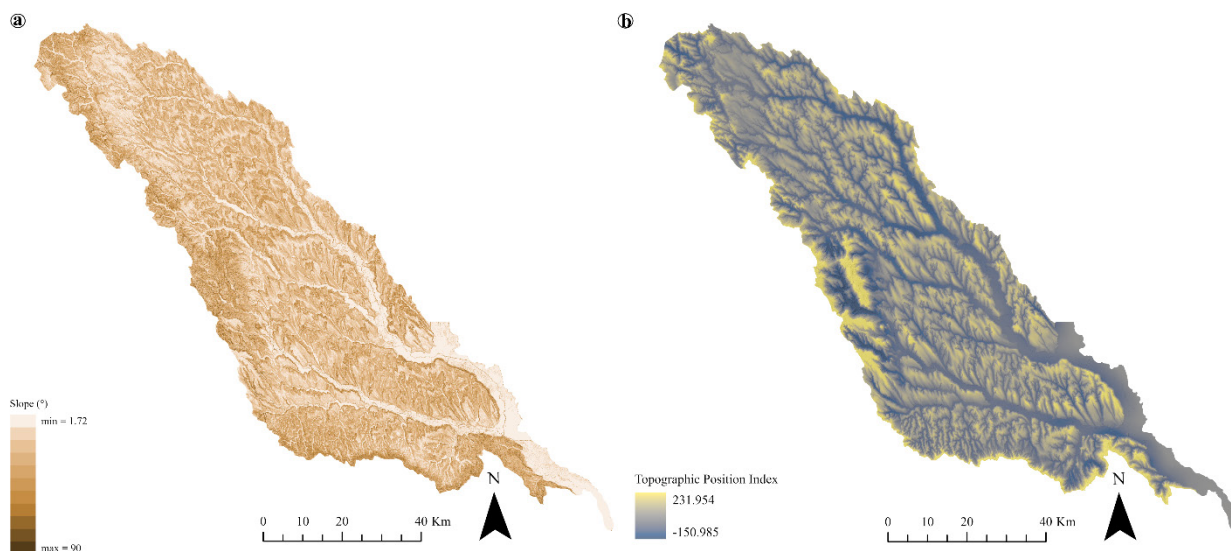


Fig. 3. The Jijia River's catchment. **a** – Slope map; **b** – Topographic Position Index map (ArcGIS Pro 3.3.2; CorelDRAW 2021).

four classes: below 100 m.a.s.l., 100–200 m.a.s.l., 200–300 m.a.s.l., and 300–400 m.a.s.l.

The slope map was automatically generated using the *Slope* tool within the Spatial Analyst toolbox of ArcGIS (Fig. 3/a). The values reflect the average slope calculated from a 3x3 pixel window (with the LiDAR-derived DEM at a 1x1 m resolution).¹¹ These slope values were then classified into four categories: 0–5°, 5–10°, 10–20° and 20–30°. The Topographic Position Index (Fig. 3/b), determined using the Relief Analysis toolbox, classified the landforms on which the mounds were built. By comparing the altitude of each DEM cell with the average altitude of a 500x500 m surrounding area, the TPI reveals key patterns: positive values indicate higher areas (hilltops), negative values denote lower areas (valleys), and values near zero correspond to either flat terrains (if slope is also close to zero) or continuous slopes (if slope inclination is higher).¹² We used a comparison radius of 500 m, which had proven effective in previous studies of the same region.¹³ Finally, the distance between *tumuli* was calculated using the *Near* tool, with the results categorized into four distance classes: less than 100 m, 100–500 m, 500–1000 m, and 1000–1500 m.

The next step in the spatial analysis involved calculating the aggregation coefficient and estimating site density. The first one was determined using the *Average Nearest Neighbor* function in ArcGIS Pro, which calculates the average distance between all analyzed sites and identifies the shortest distance to neighboring points. Based on the resulting values, the coefficient (denoted as R) indicates different distribution patterns: $R < 1$ suggests clustered distribution, $R = 1$ indicates random distribution, and $R > 1$ (up to the theoretical maximum of 2.15) reflects a more regular spacing of points.¹⁴ To estimate the density of burial mounds in the study area, we applied the *Kernel Density Estimation* (KDE) function. This method generates a smoothly curved surface

over each site, with the peak of the surface at the site itself, gradually decreasing as the distance from the site increases.¹⁵ For this analysis, we used a search radius (bandwidth) of 5000 meters, which has been shown in previous studies to yield reliable results.¹⁶

The information gathered through the methods described above was visualized through the creation of thematic maps, and the results contributed to the development of a new database. This database was subsequently analyzed statistically, with the conclusions presented in graphical form. The primary goal of this process was to identify the relationship between the burial mounds and their hinterland.

RESULTS

Perhaps the most important result obtained from this research is the creation of the database. Thus, the present study was able to document 1,791 mounds, out of which 131 are no longer visible today, not even with the help of LiDAR data, being known only through old cartographic sources (Fig. 4).

Although, at first glance, only the territory of Iași County appeared to need a reassessment of the number of burial mounds, we found it more useful to analyze the entire Jijia River's basin, and the situation turned out to be quite different from what had been presented in the specialized literature.¹⁷ Thus, a mere visualization of the spatial distribution map (Fig. 4) reveals not only a consistent number of sites (mostly aligned along major rivers or clustered near the confluence of key waterways of the workspace), but also a sizable region in the central-northern part of the catchment where these monuments appear to be scarce, with less than 30 *tumuli* identified. Also, if we were to overlay distribution maps of prehistoric sites belonging to various chronological intervals (e.g. Chalcolithic, Late Bronze Age, etc.),¹⁸ we

¹¹ KVAMME 1991.

¹² WEISS 2001; DE REU *et alii* 2013.

¹³ ASÂNDULESEI 2015; BRAȘOVEANU 2023.

¹⁴ CONNOLY/LAKE 2006.

¹⁵ BEARDAH/BAXTER 1996.

¹⁶ BRIGAND/WELLER 2018.

¹⁷ ȘOVAN 2016.

¹⁸ MIHU-PINTILIE/NICU 2019; BRAȘOVEANU *et alii* 2023a.

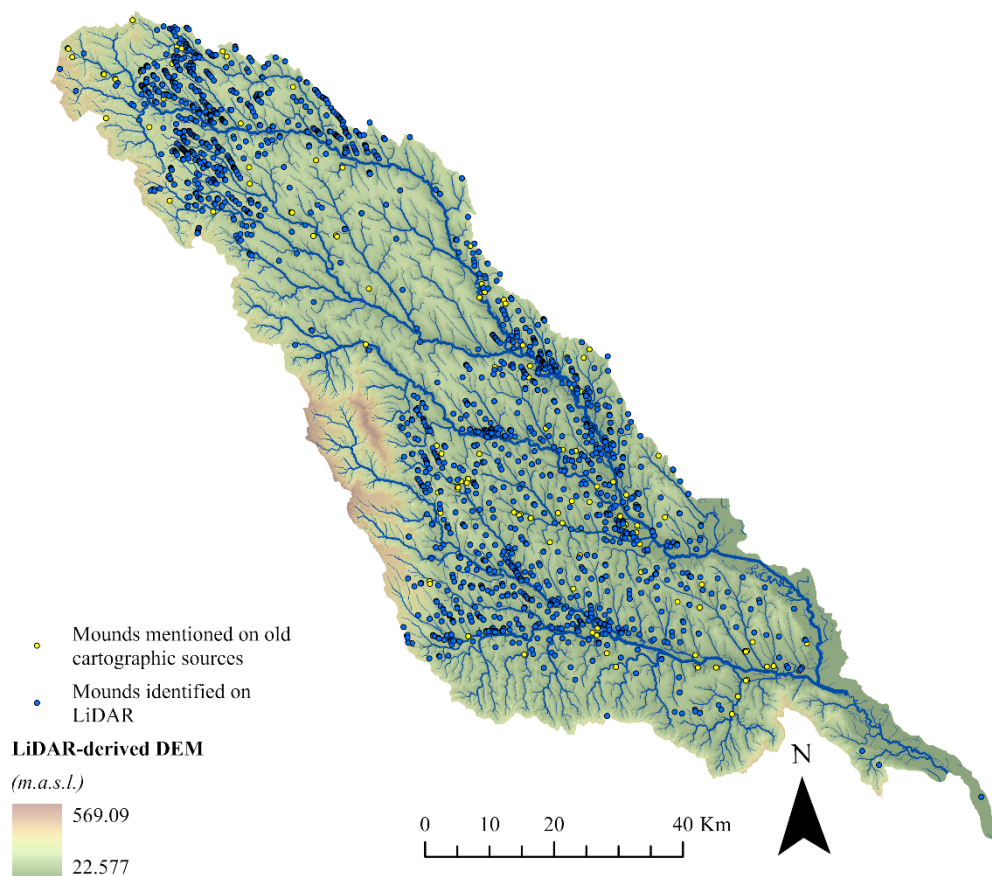


Fig. 4. Spatial distribution of the mounds identified within the Jijia River's catchment (ArcGIS Pro 3.3.2).

would notice that this area remains empty throughout many millennia. The explanation could reside in the pedological and geographical characteristics present, those of a wetland (in this region, several archaeological discoveries have been documented within peatbogs¹⁹), representing an inhospitable environment. In addition, this region benefits of a large number of copper and bronze hoards,²⁰ as well as isolated discoveries, suggesting a different behavior exhibited by the prehistoric communities, that could have made votive offerings in order to ensure themselves a safe passage.

In contrast to those discussed above, the most recent archaeological repertoire of Botoșani county²¹ seems to have identified more than a few burial mounds in the central-northern territory, which appear to fill the void left by the methodology used in this paper (Fig. 5). Unfortunately, on a closer look, one can see that the points mapped by O.L. Șovan coincide precisely with the topographical landmarks, thus providing archaeologists an erroneous archaeological map for almost 20 years. While the author's endeavor deserves appreciation, especially for inventorying 761 archaeological sites, when talking about barrows it illustrates the limitations that the studies performed on single-type data present. It is

¹⁹ TEODOR/ȘADURSCHI 1978; TEODOR/ȘADURSCHI 1981; TEODOR 1992, etc.

²⁰ BRAȘOVEANU 2023.

²¹ ȘOVAN 2016, available also via ArcGIS Online at: https://www.arcgis.com/apps/Embed/index.html?webmap=0a9bd50336a649a39693047e274287f4&extent=26.5359,47.6851,26.7895,47.7816&home=true&zoom=true&scale=true&search=true&searchextent=false&details=true&legend=true&active_panel=details&basemap_gallery=true&disable_scroll=false&theme=light [last accessed: 10.2024].

true that in many cases, the landmarks have been placed on top of the *tumuli*, during the topographer's quest for the highest point but, still, this cannot be extrapolated into considering all of these markings as notations for mounds.

Corroborating the LiDAR-dataset with multiple cartographic sources has allowed not only the identification of 131 disappeared barrows, but also the documentation of a few interesting situations regarding the toponyms of the area. First of all, we were able to signal 11 places with toponyms that suggest the presence of mounds (e.g. "Dealul la Movila cea Mare", "Dealul Movilei", "Dealul Movila", "Dealul Mogilița", "Movila Broșteanu", "Movila la Grădina lui Enache", "Dealul Movila Amară", "La movilă", "Poiana Movilei"), but that were not symbolized. This implies that these possible

sites were no longer visible at the beginning of the XXth century, representing only a reminiscence of oral history. In this case, given the fact that the available information is very vague, they were not included in the present study. Next, one of the barrows symbolized accordingly on the Shooting Master Plans has proven to belong to one Noua settlement with ashmounds (quasi-circular grey spots, with diameters between 15 and 45 m and maximum 50 cm elevations, resembling small mounds). It is most likely that one of the features presented higher elevation than all the others, being mistook for a burial mound. This situation provides proof for the need to use multiple sources, since it could have been mapped as a *tumulus* if it were not for the availability of LiDAR-data. Last but not least, there are toponyms that have the potential to offer more archaeological information. The first one, "Movila Arsă" (*the burnt mound*) suggests the type of funerary rite practiced by the communities, more precisely cremation, providing the archaeologists with a first clue regarding the chronological attribution of the monument. Next, the toponym "La Trei Pietre" (*the three stones*) and its location on the hilltop where three barrows have been identified, could suggest the presence of *stelae*. This may represent the only evidence regarding these features since it is clear that they used to be visible, while now they can no longer be identified. All of the above illustrate strong arguments in favor of performing this type of study, for various geographical spaces, in order to obtain as much information as possible regarding our ancestors and our own sacred landscape.

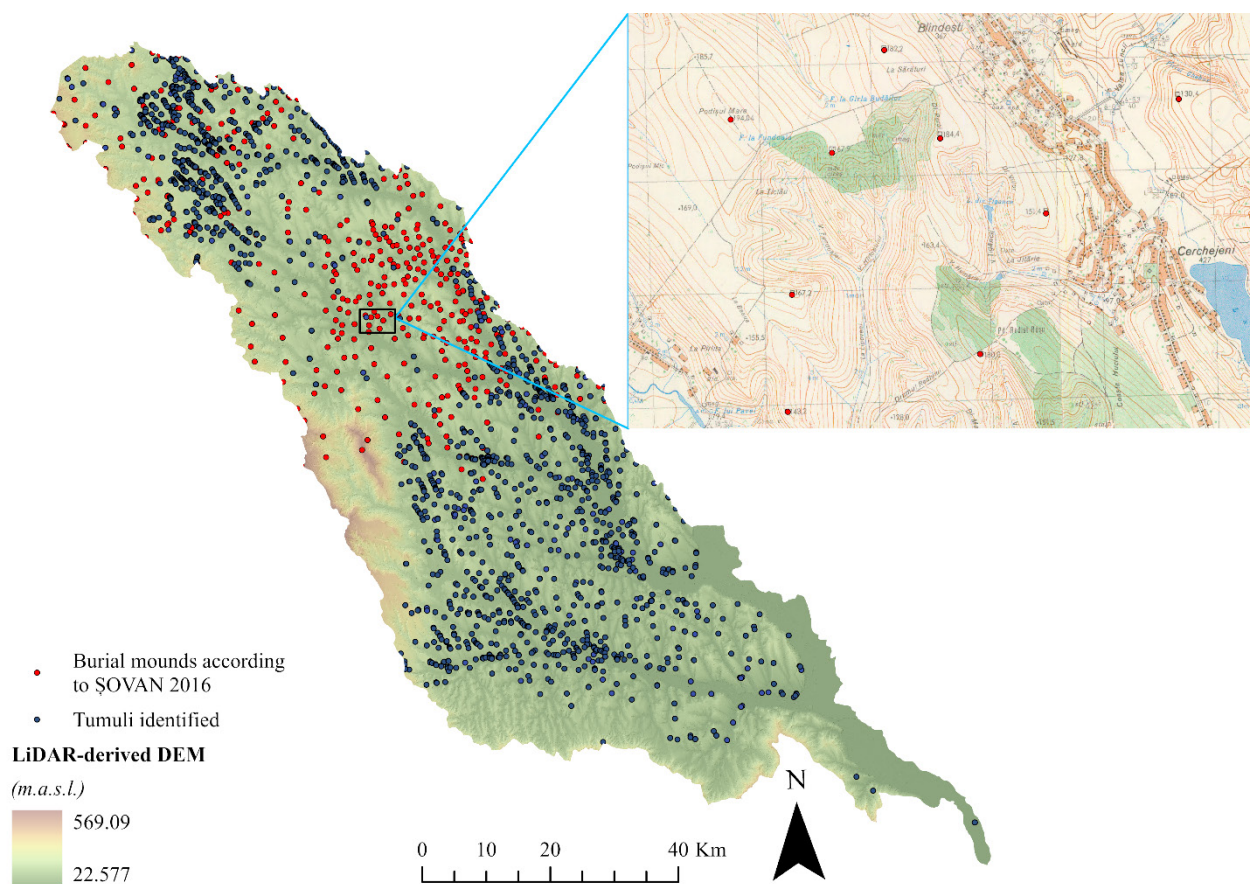


Fig. 5. Spatial distribution of the mounds according to the archaeological repertoire of Botoșani county. Detail for the central region of Jijia River's catchment, where the mounds mapped by ȘOVAN 2016 coincide precisely with the topographical landmarks, not being visible on LiDAR (ArcGIS Pro 3.3.2).

The GIS analysis highlighted a series of important aspects regarding the preferences of prehistoric and/or ancient communities, in terms of choosing certain areas where the barrows could be erected. Thus, on what concerns the absolute altitude (Fig. 4, 6/a), we noticed a pattern in choosing high territories, especially located between 100–200 m.a.s.l. (59.6%). While there is an important number of sites documented at altitudes lower than 100 m.a.s.l. (17.5%), the average of all values is 164.1 m.a.s.l., higher than the mean elevation of the entire catchment (according to LiDAR-derived DEM), namely 159.25 m.a.s.l. Of course, this does not come as a surprise considering that, usually, such archaeological structures were built on high terrains, increasing their visibility within the micro-area. If we study the spatial distribution of the obtained classes, we can see that most of the terrains' altitudes are in accordance with the topography of the entire area (in the southern half of the workspace are found most of the sites placed at altitudes ranging between 100–200 m.a.s.l., while the ones corresponding to the classes 200–300 m.a.s.l. and 300–400 m.a.s.l. are located in the northern extremity), but there are also a few concentration groups that should be mentioned. Thus, the barrows erected on low terrains (< 100 m.a.s.l.) are grouped close to important rivers, such as Jijia, Bahlui, Miletin, and near the confluence of Jijioara and Miletin Rivers with Jijia. Also, the highest points (300–400 m.a.s.l.) were identified on the western limits of the catchment, near the boundary with

Suceava Plateau, as well as in the north-eastern region, close to the Bașeu River's catchment.

Regarding the slope analysis (Fig. 3/a, 6/b), a certain preference can be observed regarding the areas characterized by smooth slopes (less than 5°) (82.8%), followed by those between 5° and 10° (12.7%), considered medium slopes. Nevertheless, 88 mounds are located on steeper slopes, and they are distributed throughout the workspace, but in the proximity of the main river valleys (Jijia, Bahlui, Miletin).

The next calculus performed was the Topographic Position Index (Fig. 3/b, 6/c). As mentioned before, being closely related to the slope inclination, this tool can offer information on the relation of the site's position with the surrounding area (dominant/lower/continuous slope/flat area). Unsurprisingly, most of the burial mounds (72.8%) presented positive values (max = 149.2), symbolizing dominant places. However, there is still an important number of sites located on lowlands (26%), characterized by a negative index value (min = -65.9), that could indicate either a different status of the deceased or a different chronological period in which the monument was raised. Only 1% of the mounds were documented on continuous slopes, while in only two situations, the old communities decided to erect the barrows on flat terrains.

After analyzing the distances existing between sites (Fig. 6/d), a preference for erecting the mounds at distances between 500 and 1000 m (55.6%) was observed, followed by

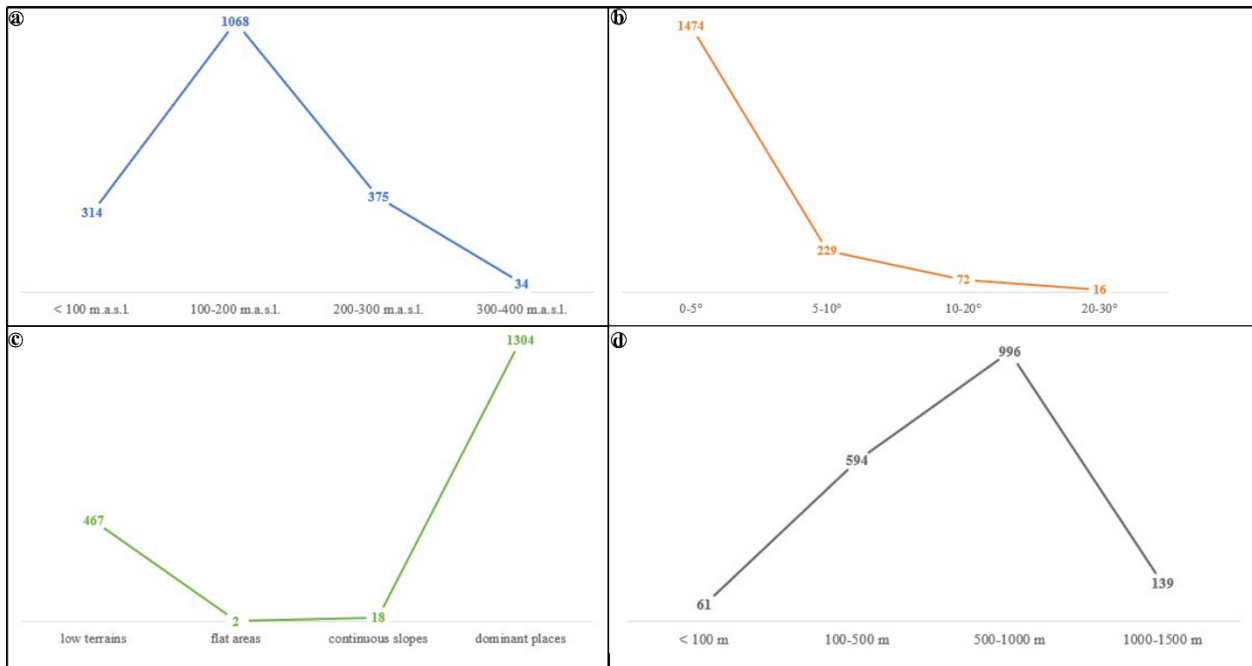


Fig. 6. Graphical representations of the geomorphological indices calculated. **a** – absolute altitude; **b** – slope; **c** – TPI; **d** – distance to the nearest mound.

the ones found at 100–500 m between each other (33.1%). Since, for now, no chronological data is available for the *tumuli* in question, we cannot say which and if any of the closer sites belong to the same communities but, even if

to the ones already existent. This analysis is directly related to the following two methods used, namely *Average Nearest neighbor* and *Kernel Density Estimation*, representing the foundation of the spatial distribution analysis.

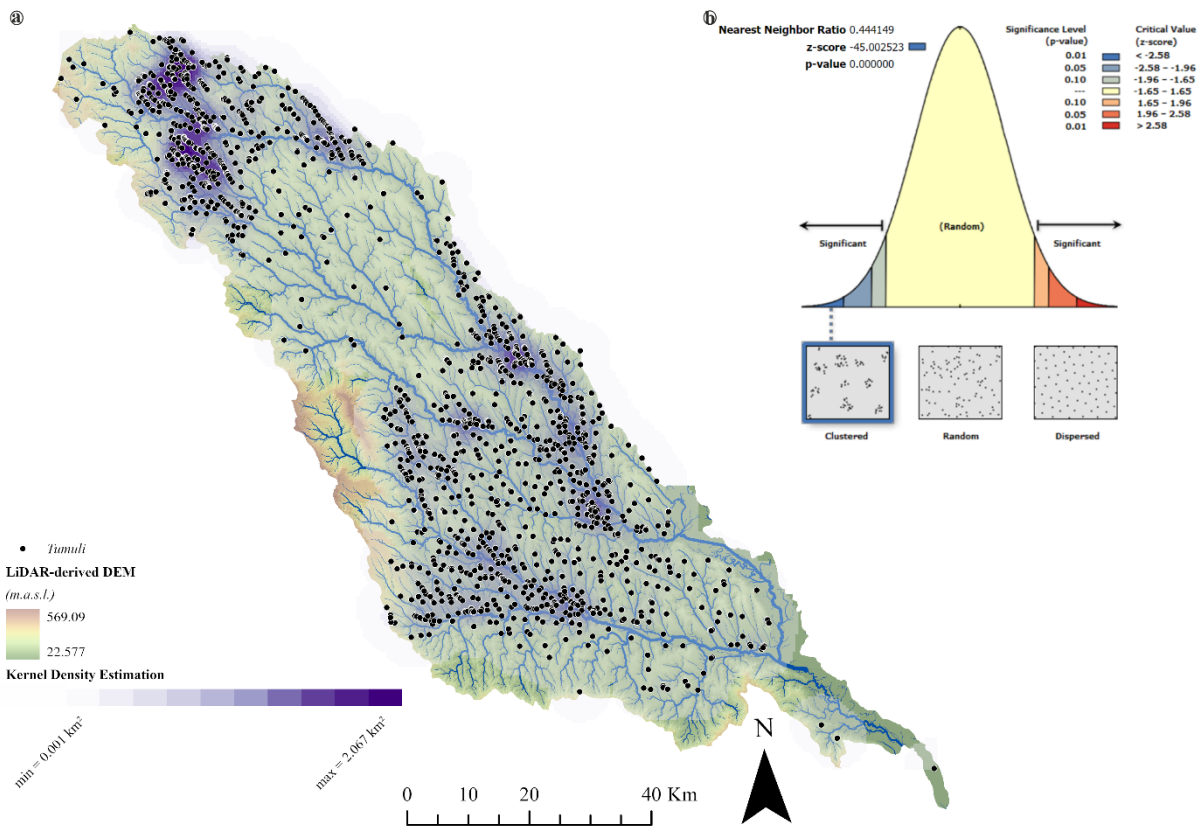


Fig. 7. **a** – Kernel Density Estimation map overlapped by the *tumuli* from Jijia River's catchment; **b** – Nearest Neighbor Report (ArcGIS Pro 3.3.2).

that is not the case, it is probable that later human groups constructed new mounds in territories located in proximity

The values obtained from the calculation of the aggregation coefficient ($R < 1$) (Fig. 7/b) suggest that the burial mounds

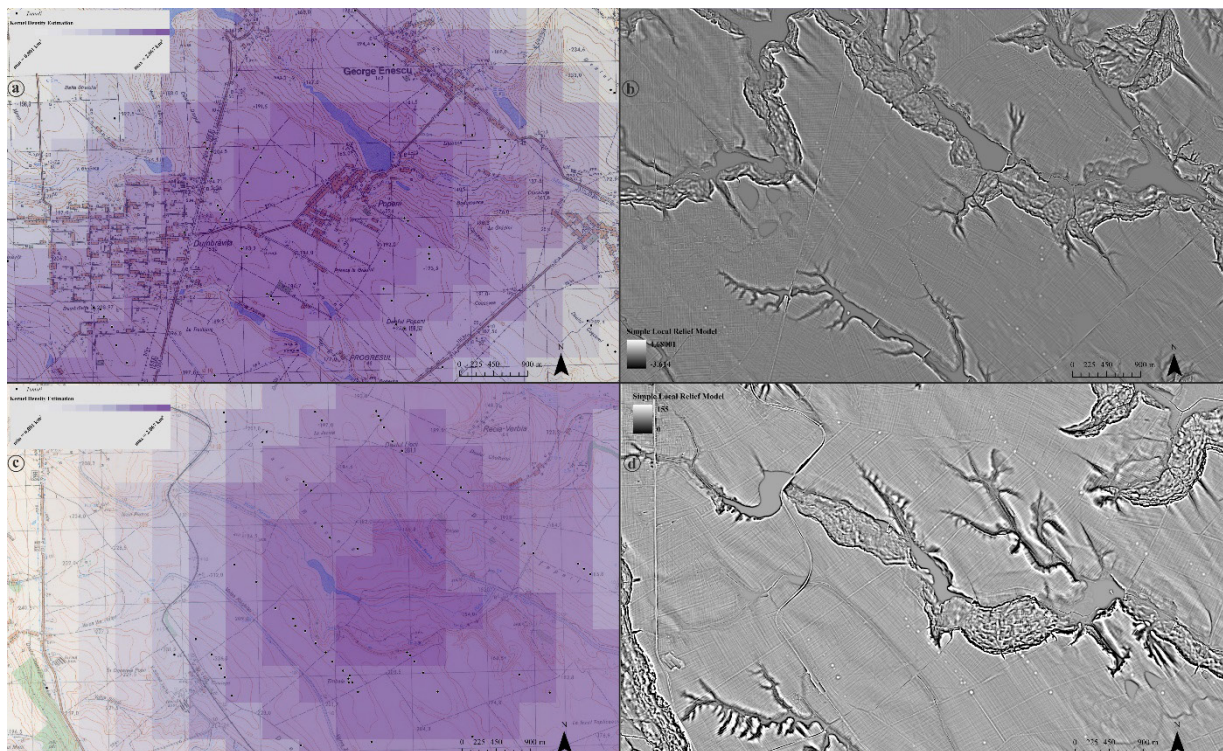


Fig. 8. **a** – Area 1 (SW of George Enescu village); **b** – Area 1. *Simple Local Relief Model*; **c** – Area 2 (SW of Recia-Verbia village); **d** – Area 2. *Simple Local Relief Model* (ArcGIS Pro 3.3.2; RVT 2.2.1).

present within the Jijia River catchment are organized in large, concentrated groups, placed in relation. Next, the *Kernel Density Estimation* function (Fig. 7/a) revealed important data about the main areas of site concentration. Besides the overall preference for the most important river valleys of the workspace, we can observe a few areas of concentration, especially within the northern part of the catchment.

In general, it can be stated that the *tumuli* from the Jijia River catchment seem to have been erected on high terrains (usually hilltops), near the important river valleys of the workspace, such as Jijia and his main tributaries (Bahlui, Miletin, Jijioara). Even from a general overview of the spatial distribution map (Fig. 4, 7/a), it can be noticed that most of the sites form smaller or larger linear groups,

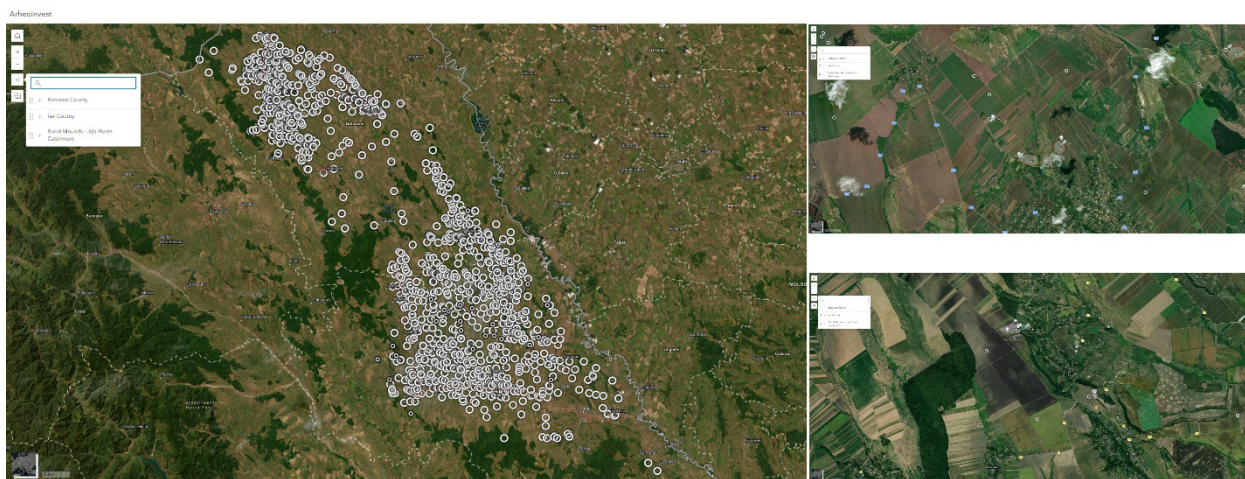


Fig. 9. Screenshots showing the ArchaeoPortal’s interface, and the representation of the identified burial mounds (ArcGIS Online).

Thus, the territory located southwest of George Enescu village (Botoșani county) benefits of up to 65 burial mounds, most of them forming linear arrangements in an area of approx. 24 km² (Fig.8/a-b). Also in this region, south-west of the Recia-Verbia village (Dimăcheni administrative unit, Botoșani county) were identified 62 mounds, comprised in less than 20 km², and grouped in five main lines, across the hilltops of the micro-area (Fig.8/c-d).

along watercourses. These alignments consist, usually, of 3 to 8 mounds, out of which we can distinguish one or two bigger *tumuli*, followed by smaller mounds, nearly flattened.

Last but not least, as mentioned above, until all of the sites will be included in the National Archaeological Repertoire, our team has added the database obtained (compiling only the 1660 mounds signaled with the help of LiDAR

measurements) in the already-existent archaeoportals²² of the Arheoinvest Centre (Fig. 9). Thus, the specialists, as well as the public interested in this subject, will be able to visualize the location of the sites discussed in this paper.

Also, in time, our team's objective is to update the information regarding each of the sites listed online, with details such as: name, toponym, history of research and references (if necessary), thus improving the database's relevance and efficiency.

DISCUSSIONS

As previously stated, the main objective of the present study was to identify the funerary mounds from the Jijia River's catchment, which came as a necessity given the danger that these monuments face day-to-day, mostly due to intensive agriculture. This paper represents a first step in their inclusion within the National Archaeological Repertory and, hopefully, in their protection. The availability of LiDAR measurements, and the correlation made with various cartographic supports, as well as with satellite images and aerial photographs, has assured the performance of an objective analysis, allowing us to obtain a more accurate database regarding the tumular landscape of the Jijia River's catchment, including nearly flattened mounds, as well as sites signaled on the topographic maps of the previous century. This endeavor is part of a larger project that aims to perform interdisciplinary research on various *tumuli* from northeastern Romania. This comes as a natural consequence to the fact that, as shown above, during the last years archaeology has seen an increase in focusing on the interdisciplinary study of burial mounds, especially due to the multiple risk factors that threaten the integrity of the monuments in question. Thus, it is truly important that the region located east of the Carpathians, that benefits of an impressive number of such sites, should not be left unexplored and misunderstood. So far, our team's results are illustrated by a similar study, performed for a smaller part of the current workspace,²³ representing the starting point of this research direction. Also, we have managed to perform interdisciplinary investigations for a few barrows from Târgu-Frumos and Lungani administrative units (Iași county),²⁴ using both non-invasive (aerial photographs, photogrammetry, geophysical prospecting), and intrusive (archaeological excavation) research methods.

The few, scarcely distributed, archaeological investigations performed for the mounds of the workspace (most of them dating from the XXth century) show a predominance of sites erected during the beginning of the Bronze Age, more precisely belonging to Yamnaya and Catacombnya human groups, later being re-utilized by various other communities.²⁵ However, there are still some important exceptions, such as the site of Băiceni-Dealul Gosanu,²⁶ an impressive con-

struction of stone that guarded the cremation remains of an important Geto-Dacian ruler. Also, some of the sites present characteristics that differentiate them from the rest, either regarding their location (mounds found in river meadows, such as the ones from Larga Jijia-La Grădină, Iași county), their morphology (the "twin"-mounds from Movileni, Iași county), or their auxiliary features (the necropolis of Borșa-La Cișmele²⁷, Iași county, comprising six mounds, four of which are connected by semi-circular earthworks). All of these imply the existence of various behaviors and practices, suggesting different prehistorical and/or historical communities, but also illustrate the immense archaeological potential of the workspace, and, in this case, of the Iași county (from where all of these exceptions emerge), thought to benefit of 21 mounds, as shown by the National Archaeological Repertory.

The results obtained within the current paper show that the barrows from the Jijia River's catchment are organized in large, concentrated groups, probably interconnected, as shown by the *Nearest Neighbor* analysis, but also by calculating the distances between sites, which are, usually, lower than 1 km. However, since the majority of sites have not been thoroughly investigated and their cultural-chronological attribution remains unknown, it is challenging to determine which mounds are contemporary and which are not. Nevertheless, even if their construction dates vary significantly, it is clear that later communities would not have overlooked their presence. Also, given that our study has identified several micro-areas containing more than a few *tumuli* within a relatively small region, it is plausible to consider that these could represent tumular necropolises belonging to contemporary communities.

In terms of density estimation, the results not only provide information regarding the many areas with a high density of sites, but also about the most 'avoided' areas, as is the case of the central-northern and western territories of our workspace. For now, it seems that the most plausible hypotheses rely on the presence of wetlands in the upper basin of Miletin River and the lower basin of Sitna River (the central-northern area), as well as of the higher terrains, as is the case of the contact region with the Suceava Plateau (the western bounds of the workspace). Of course, there is still a possibility that field research could identify more mounds within these territories, especially in the forested areas, where the LiDAR measurements precision decreases, even more so if the sites are nearly flattened.

To date, it has been noted that the burial mounds exhibit various characteristics depending on the period in which they were constructed. Specifically, mounds associated with the Horodiștea-Foltești cultural complex are typically located on slopes or hilltops, with only rare instances of construction in lower areas. Regardless of their location, the mounds are generally circular, with diameters ranging from 10 to 30 meters and heights between 1 and 4 meters. They are often built near settlements.²⁸ Sites associated with the Yamnaya culture were constructed on a variety of landforms, featuring both necropolises consisting of 3–5

LÁSZLÓ 1976.

²⁷ BRAȘOVEANU *et alii* 2024.

²⁸ ȘTEFĂNESCU 1999, 332–333.

²² <https://arheoinvest.maps.arcgis.com/apps/instant/basic/index.html?appid=e07be90f5a8e41c185994276eed163db>. Accessed: 15 November 2024.

²³ BRAȘOVEANU *et alii* 2023.

²⁴ BOGHIAN *et alii* 2019; BOGHIAN *et alii* 2020; ENEA *et alii* 2021; ENEA *et alii* 2022; TENCARIU *et alii* 2024.

²⁵ PETRESCU-DÎMBOVIȚA 1954; PETRESCU-DÎMBOVIȚA *et alii* 1955; DINU 1957; DINU 1959; DINU 1959a; BOGHIAN *et alii* 2019; ENEA *et alii* 2021; ENEA *et alii* 2022; TENCARIU *et alii* 2024, etc.

²⁶ PETRESCU-DÎMBOVIȚA 1953; PETRESCU-DÎMBOVIȚA/DINU 1975;

mounds arranged in rows or clustered in “nests”,²⁹ as well as isolated monuments. Most of these mounds have small to medium heights, ranging from 1 to 3 meters, and diameters between 20 and 40 meters. However, there are exceptions, with some mounds exceeding 4 meters in height and measuring 40 to 60 meters in diameter. A few mounds are oval-shaped, with their long axis oriented north-south and featuring steep slopes.³⁰ This configuration is characteristic of a large proportion of Bronze Age *tumuli* across the North Pontic steppe, which can be attributed either to natural factors³¹ or to practical or religious purposes.³² Lastly, the monuments built between the 6th century BC and the 4th century AD are primarily situated on the lower halves of slopes, close to contemporary settlements. In necropolises consisting of multiple mounds, the distances between them range from 20 to 80 meters, with diameters spanning 10 to 70 meters and heights between 1 and 3 meters.³³

Based on these considerations, it is evident that the current state of knowledge does not allow us to make any definitive cultural-chronological attributions regarding the burial mounds in question. However, it is clear that within the Jijia River’s catchment, there are both isolated monuments and groups of mounds (aligned or clustered in “nests”), the location of the sites varying from hilltops and slopes to the lower areas of the river valleys, indicating different practices that suggest the mounds belong to different, non-contemporary communities.

CONCLUSIONS

The advantages of applying modern interdisciplinary methods to archaeology are well-established. However, in some regions, the introduction of these techniques has been delayed, leaving archaeology focused primarily on excavation. While this is not the case across all of Romania, burial mounds located east of the Carpathians have, until recently, lacked advanced investigations. In this study, we used LiDAR measurements, aerial photography, and various cartographic tools to pin-point 1791 sites, out of which 131 are currently completely destroyed. This initiative arose from observations during fieldwalks, which revealed a significant number of sites heavily impacted by human activity, particularly agriculture. Our primary goal was to properly document these sites, marking the first step in the longer process of ensuring their preservation. Although it was not yet possible to establish their chronological attribution, several conclusions about their spatial distribution were drawn. The mounds are located throughout most of the catchment, the area being known as beneficial for communities to settle and, consequently, to bury their beloved. They are arranged in large, concentrated groups, likely interconnected, and are predominantly found at higher altitudes on hilltops or gentle slopes along river valleys. These groups often form linear or circular patterns, consisting of up to eight mounds, with

one or two prominent *tumuli* followed by smaller, nearly flattened mounds.

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²⁹ BURTĂNESCU 2002, 224.

³⁰ BURTĂNESCU 2002, 224–226.

³¹ ŠAPOŠNIKOVA/PHOMENKO 1986, 11.

³² TOŠČEV/SAMAR 1990, 63, *apud* BURTĂNESCU 2002, 224.

³³ ȘTEFĂNESCU 1999, 333.

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