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Wydział Humanistyczny
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A Complex of Prehistoric Fortifications in the Moldavian Subcarpathians (Eastern Romania). Contributions to the Understanding of the Middle Bronze Age

Abstract

Diaconu V., Gerea A., Tătaru D., Năstase E., Cerbu B., Sava G., Gâză O., Ilie M. 2025. A Complex of Prehistoric Fortifications in the Moldavian Subcarpathians (Eastern Romania). Contributions to the Understanding of the Middle Bronze Age. *Analecta Archaeologica Ressoviensia* 20, 99–113

This paper discusses three recently discovered fortified sites located in the Subcarpathian area of eastern Romania, investigated through LiDAR scanning and intrusive archaeological research. Chronologically, the fortifications analysed in this study date to the Middle Bronze Age and are attributed to the Costișa culture. The sites are situated in close proximity to one another and may have formed part of a wider defensive system marking the territorial limits of this cultural environment. At the same time, they appear to have held strategic local importance by controlling access routes to areas rich in salt resources. Excavations conducted at one of the sites provided absolute chronological data ranging between 2143–1531 cal BC, correlating well with previously obtained radiocarbon dates for the Costișa culture.

Keywords: fortifications, defensive system, Middle Bronze Age, eastern Romania, LiDAR, radiocarbon dating

Received: 18.10.2025; **Revised:** 06.11.2025; **Accepted:** 18.11.2025

Introduction

Over the past decade, systematic field surveys have led to the discovery of several prehistoric fortifications within the Subcarpathian area of eastern Romania. Most were initially identified on the basis of well-known toponyms, such as *Cetate* (Eng. fortress) or *Cetățuie* (Eng. small fortress), traditionally indicating the presence of ancient defensive structures (Matasă 1968; Ursulescu 2018; 2019; Diaconu 2019a). Because the majority of these sites are located in densely forested areas, their documentation required a complex, multidisciplinary approach, aimed both at accurately recording topographic features and establishing their chronological framework.

Geographically, the area belongs to the submontane zone along the eastern flank of the Carpathians, characterized by a succession of depressions, including the Tazlău-Cașin, Cracău-Bistrița, and Neamț depressions (Tufescu 1966).

The need for precise representation of these fortified sites led to their inclusion in the broader research initiative *For Tum – Geophysical Investigations in Archaeological Sites with Social Significance from Neamț County*, with the main objective of documenting prehistoric fortifications through LiDAR scanning. Complementary intrusive investigations aimed to obtain data regarding the cultural and chronological attribution of these sites.

This article focuses on a cluster of three fortified sites concentrated within a small geographic area in north-eastern Neamț County (Fig. 1: 1), located within the administrative boundaries of the communes of Păstrăveni and Țibucani. These fortifications were selected for detailed analysis because they share the same chronological horizon, lie in close proximity to one another, occupy distinct topographic settings, and exhibit different types of defensive systems.

Chronologically, the sites belong to the Middle Bronze Age. During this period, the Subcarpathian region was inhabited by communities associated with three cultural environments: the Costișa culture (in the central Subcarpathian zone), the Komarów culture (on the Suceava Plateau), and the Monteori culture (in the southern Subcarpathians) (Fig. 1: 2). Archaeological contexts and radiocarbon data indicate partial synchronisms between these three cultural manifestations (see Munteanu 2010; Bolohan *et al.* 2015).

Material and method

Field surveys conducted between 2021 and 2023 identified three sites with traces of defensive structures near Rădeni village (Păstrăveni commune). Two

were in forested areas, and one was located on a gentle hillslope (Diaconu *et al.* 2024; 2025) (Fig. 2: 1).

Airborne LiDAR (Light Detection and Ranging) has transformed archaeological prospection, especially in areas where dense vegetation limits traditional survey. In tropical environments, LiDAR has been used to map extensive urban and hydraulic landscapes at sites such as Caracol in the Maya lowlands and Angkor in Cambodia, revealing settlement layouts and infrastructure that were previously invisible beneath the forest canopy (Chase *et al.* 2011; Evans *et al.* 2013). In temperate forested regions of Europe, digital terrain models resulted from LiDAR data are now routinely used to detect low earthworks and fortification systems. Full-waveform airborne laser scanning in Austrian woodland, for example, has revealed complex assemblages of prehistoric and historic earthworks, hollow-ways and cultivation features beneath dense forest (Doneus *et al.* 2008; Doneus and Briese 2011). Under mixed deciduous woodland in Britain, LiDAR has demonstrated its potential to detect barrows, banks and ditches obscured by tree cover (Devereux *et al.* 2005; 2008). Large-scale LiDAR programmes have also been used to systematically map hillfort landscapes in Italy and across Europe, substantially expanding the known inventories of fortified sites (Fontana 2022; Landauer *et al.* 2025). Comparable work in the Slovenian Kras Plateau has documented Late Bronze and Iron Age hillforts and associated agro-pastoral features within an overgrown Mediterranean karst landscape (Ložić and Štular 2024). Together, these examples underline the particular suitability of LiDAR for identifying and characterising fortifications and other earthworks in densely vegetated terrain, such as the forested ridges of the Moldavian Subcarpathians.

LiDAR scanning was carried out to accurately document the topographic features of the three sites (Fig. 2: 2) by a team from the National Institute for Earth Physics. Each site was analysed individually using a Yellow Scan Mapper + LiDAR sensor, operating at a wavelength of 905 nm, with a precision of 25 mm and an accuracy of 30 mm. The scanner had a 70.4° horizontal and 4.5° vertical field of view, a pulse emission rate of 240,000 pulses per second, and up to three returns per pulse. The sensor was equipped with a Sony camera for imagery to facilitate point-cloud colourisation. The LiDAR unit was mounted on a DJI Matrice 300 RTK drone, with a DJI D-RTK2 GNSS base station providing real-time positional corrections.

Data processing was performed with POS Pac and Yellow Scan Cloud Station. In a first step, flight

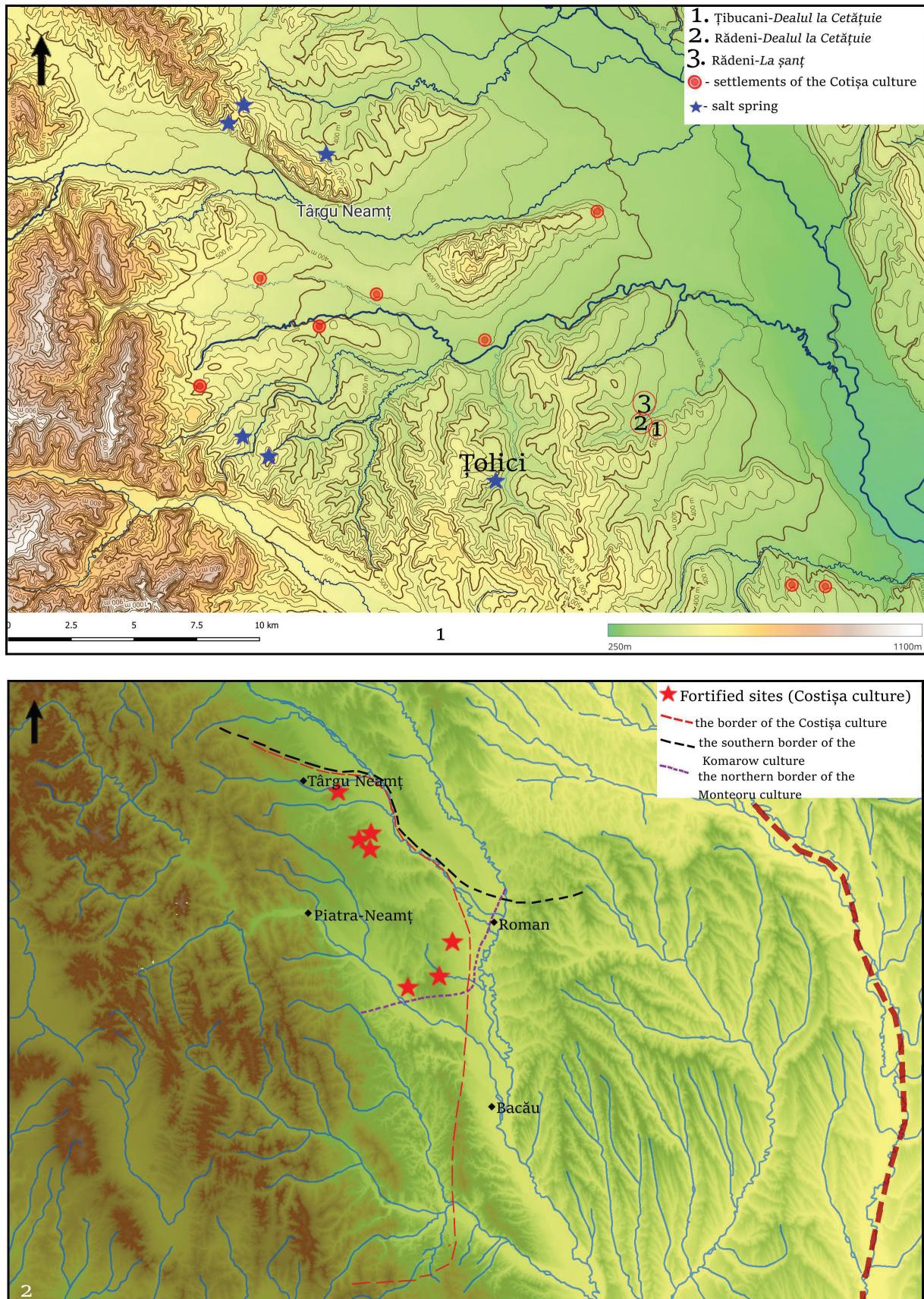


Fig. 1. Geographical and cultural context.
1 – Neamț Depression and the distribution of sites attributed to the Costișa culture; 2 – cultural manifestations of the Middle Bronze Age in the Subcarpathian region of Moldova (edited by V. Diaconu).

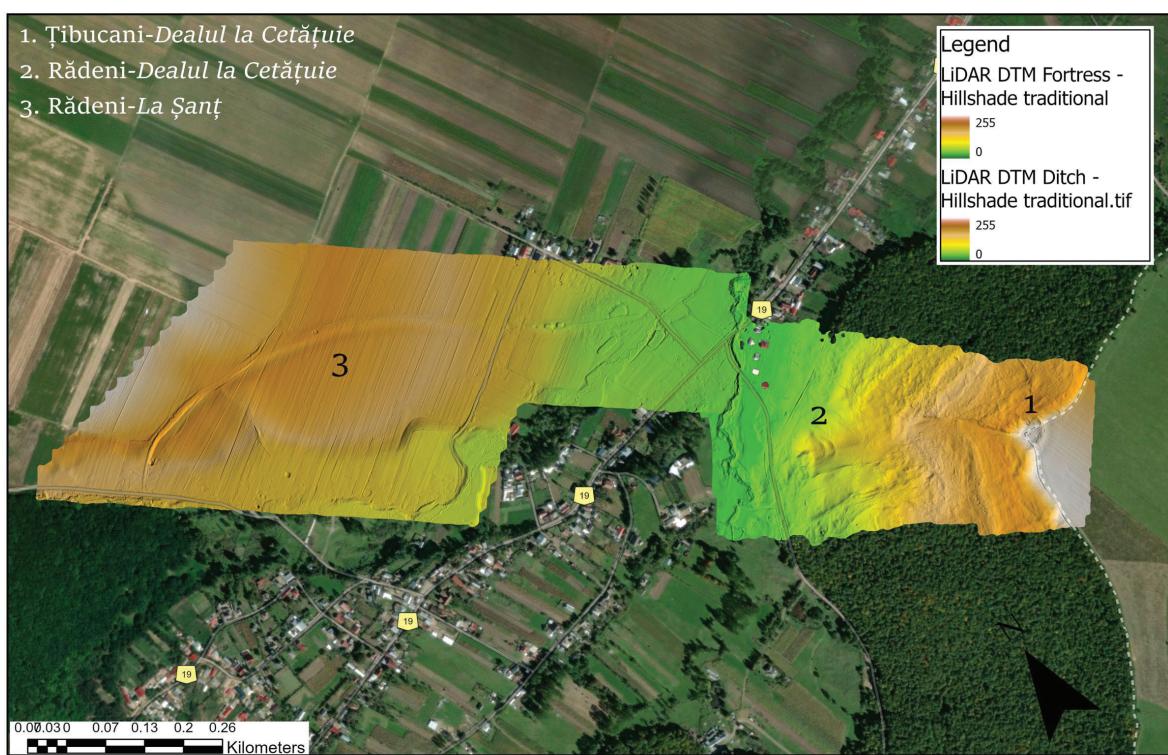


Fig. 2. Fortified sites in the Țibucani-Rădeni microzone.
1 – location of the fortifications at Țibucani-Dealul la Cetățuie and Rădeni-Dealul la Cetățuie;
2 – distribution of fortified sites (photo by INFP).

trajectories were adjusted to ensure correct spatial positioning. We then generated the point cloud and applied a simple two-classification (ground / non-ground). These data were interpolated to produce Digital Surface Models (DSM) and Digital Terrain Models (DTM). The DSM reflects the elevation of all surface objects (vegetation, buildings, terrain), while the DTM approximates bare earth elevations after removing above-ground objects. DTMs and DSMs were interpolated on regular grids with cell sizes between 0.20×0.20 m and 0.30×0.30 m (0.30 m at Rădeni Cetăuia, 0.20 m at the remaining sites), chosen to match the nominal point spacing of the LiDAR data. The LiDAR survey produced dense point clouds, with an average total point density of approximately 920 points/m². At the 0.20 – 0.30 m raster resolution used for the DSM/DTM, this corresponds to several dozen returns per grid cell, even in forested areas. Finally, the raster outputs (.tif) were colour-ramped by elevation and slope to emphasise the relief of the features of interest (e.g., ditches, banks, subtle micro-topography). Visualisation and additional manipulation were carried out in ArcGIS Pro. Intrusive excavations at one fortification aimed to determine its cultural and chronological attribution and to collect samples for absolute dating.

The interpretation of the LiDAR data was carried out on the DTM, using a combination of visualisations (multi-directional hillshade, slope, local relief) in ArcGIS Pro. The entire area covered by the LiDAR acquisition was systematically inspected at multiple scales (1:50–1:1500) in order to identify linear and curvilinear breaks of slope compatible with ditches, banks and scarps. Potential anthropogenic features were identified on the DTM's and cross-checked using topographic profiles extracted perpendicular and parallel to the presumed earthworks. Particular attention was paid to distinguishing continuous, morphologically coherent features from natural erosional forms and forestry tracks.

Results

Below, we present the most important details regarding the three sites with defensive systems, in order to later discuss the possible meanings and functions of these fortifications.

1. *Țibucani-Dealul la Cetăuie*. Located in northern Țibucani commune near Rădeni, this small fortification (395 m altitude) is partially forested and overlooks the Moldova River valley. LiDAR scanning indicates an enclosed area of approximately 700 m²,

demarcated by a shallow curving ditch connecting the steep western and northern slopes (8–10 m wide, 1.5 m deep) (Fig. 3).

Three small trenches, inside and outside the ditch, provided stratigraphic data. Trench 1 (8×1 m) sectioned part of the ditch's talus and the enclosure it delimits. At -0.15 m below the surface, a burnt horizon with charcoal flecks was exposed, 0.10–0.15 m thick. Beneath it lay a compact brown layer (~ 0.30 m thick) with sporadic charcoal, followed from -0.60 m by a clayey, archaeologically sterile level (Fig. 4: 1–3). Finds from this trench were scarce: a few small, atypical ceramic fragments, a sandstone core, and several flint flakes.

In the 2×2 m trenches opened outside the ditch, stratigraphy was simple: at -0.15 m a brownish-grey clay level (~ 10 cm thick) contained corroded ceramics and sporadic faunal remains; this was overlain by a very compact brown clay layer (~ 20 cm), above archaeologically sterile subsoil (Fig. 4: 4).

Ceramics typical of the Middle Bronze Age Costișa culture include open, truncated-conical vessels, amphorae, and small amphorae, decorated with alveolar bands, hatch-marked triangles, or irregular striations (known as "Besenstrich") (Fig. 5).

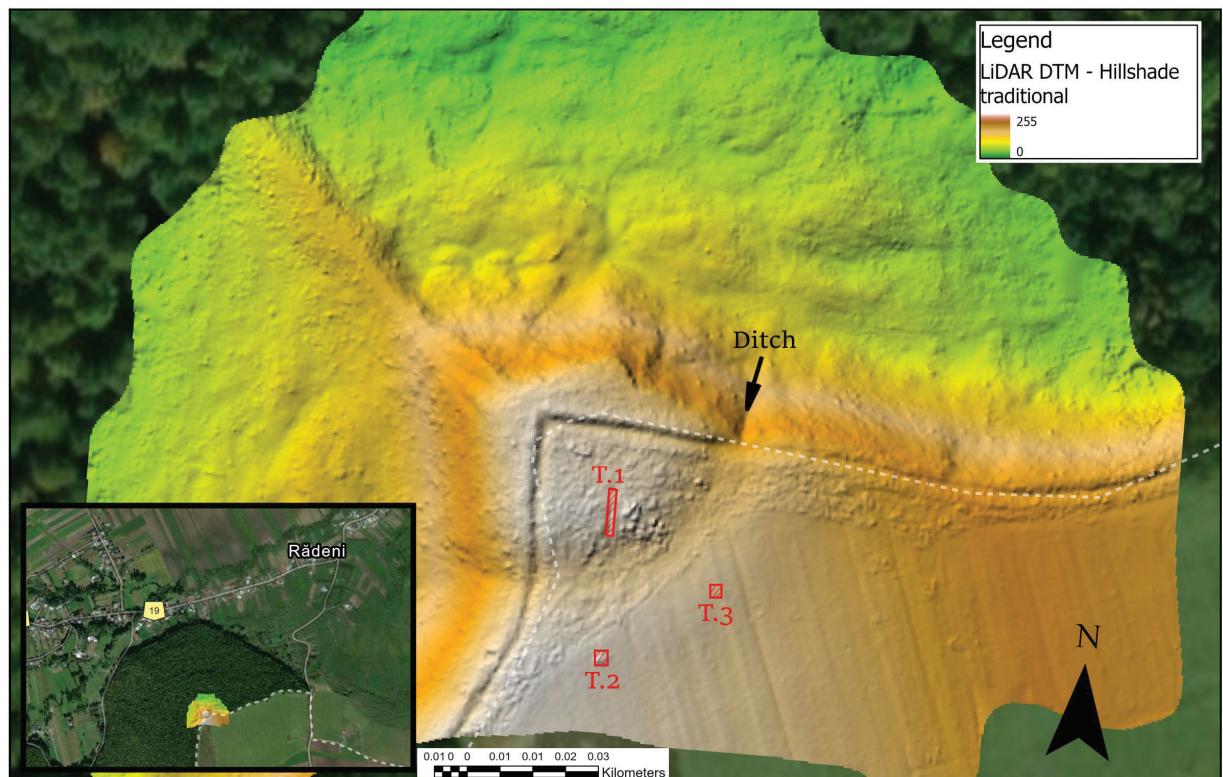
Based on bone samples taken from ceramic agglomerations identified in external test trenches, two absolute dates were obtained: (RoAMS-2766.89) 3673 ± 35 BP calibrated to 2143–1949 calBC (2σ) and (RoAMS-3369.89) 3356 ± 41 BP calibrated to 1743–1531 calBC (2σ) (Fig. 6).

2. *Rădeni-Dealul la Cetăuie*. About 300 m northwest of the previous site, a small fortification on a wooded promontory (340 m a.s.l.) is enclosed by two slightly curved ditches set 8 m apart, defining an area of ~ 800 m² (Fig. 7). The ditches are up to 10 m wide and 1.5 m deep. According to LiDAR data, the south-western part of the enclosure has been affected by a substantial landslide. Dense vegetation prevented conclusive excavation, though scattered sherds suggest a Middle Bronze Age date.

3. *Rădeni-La Șanț*. On the western side of the village, on the left bank of the Rădeni stream and near the forest edge, were recorded a large anthropic defensive structure consisting of a ditch and rampart, ~ 800 m in length, enclosing ~ 18 ha (altitude 340 m). The ditch and rampart follow a slightly curved course that begins and ends on the banks of the Rădeni stream. The ditch is ~ 10 – 12 m wide at the top and 1–1.5 m deep (Fig. 8; 9: 1); the rampart is 8–10 m wide and up to 1 m high but has been flattened by intensive agricultural activity. At its eastern extremity, the defensive



1



2

Fig. 3. The fortification at Tibucani-Dealul la Cetățuie.

1 – view of the defensive system (photo by V. Diaconu); 2 – LiDAR scan and location of the researched areas (edited by INFP).



Fig. 4. Aspects of the excavations at Tibucani-Dealul la Cetățuie (photo by V. Diaconu).

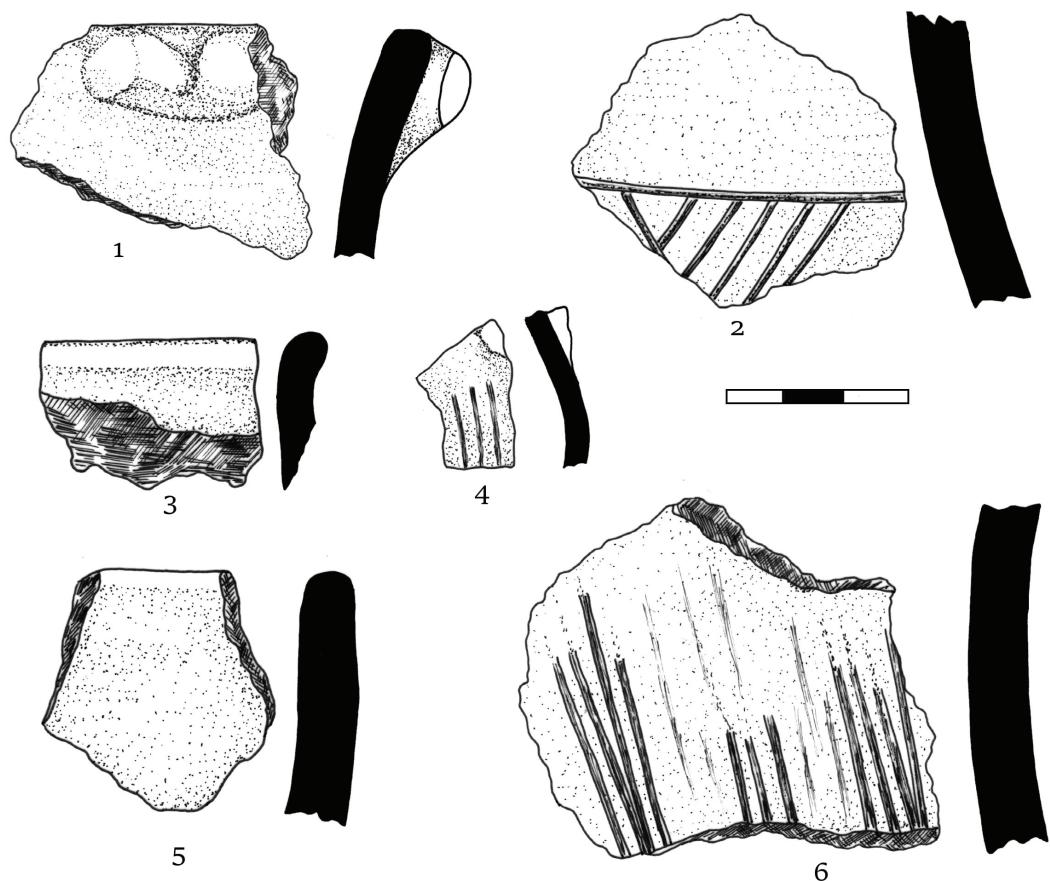


Fig. 5. Pottery from Tibucani-Dealul la Cetățuie (drawn by V. Diaconu).

line is overlain and disturbed by recent buildings. Occupation traces in the south-eastern part of the enclosure are attributed to the Costișa culture (20th–17th c. BC), including large bowls and amphorae decorated with hatch-marked triangles and irregular striations (Fig. 9: 2–6).

Discussion

Within the territories of Tibucani and Rădeni, where the three sites were identified, several Bronze Age archaeological discoveries are already known (Petrescu-Dîmbovița 1953, 465; Cucoș 1977, 34; 1985, 492; 1992, 56; Vulpe and Zamosteanu 1982; Dumitroaia 1985, 468; 1992, 137–138; Munteanu 2012; Diaconu 2014, 421–422; 2019b; 2021), yet to date no extensive investigations have been undertaken in this area.

The presence of these three fortifications within a limited territory, all belonging to the same chronological horizon, warrants detailed discussion, both regarding their relationship with contemporary remains in the region and their potential role within a broader

network of fortifications known from the Subcarpathian area.

The sites are situated along the upper course of the Rădeanca stream, a tributary of the Topolița River. Topographically, only one of the fortifications provided substantial potential for controlling a wide geographic area. We should mention here that the site at Tibucani-Dealul la Cetățuie has a relative altitude of approximately 80 m and occupies a high plateau, while the other two fortifications have relative altitudes of up to 20 m and are located in low-lying areas with limited visibility over the surrounding geographical area.

Despite their small footprint, intrusive investigations at the fortified site of Tibucani-Dealul la Cetățuie revealed that occupation within the enclosure was brief, with the Bronze Age community or communities primarily utilising the open areas of the settlement. Under these circumstances, it can be inferred that such a fortification had a preventive or deterrent function, constructed not in response to an immediate threat but rather to guard against a potential attack from neighbouring communities.

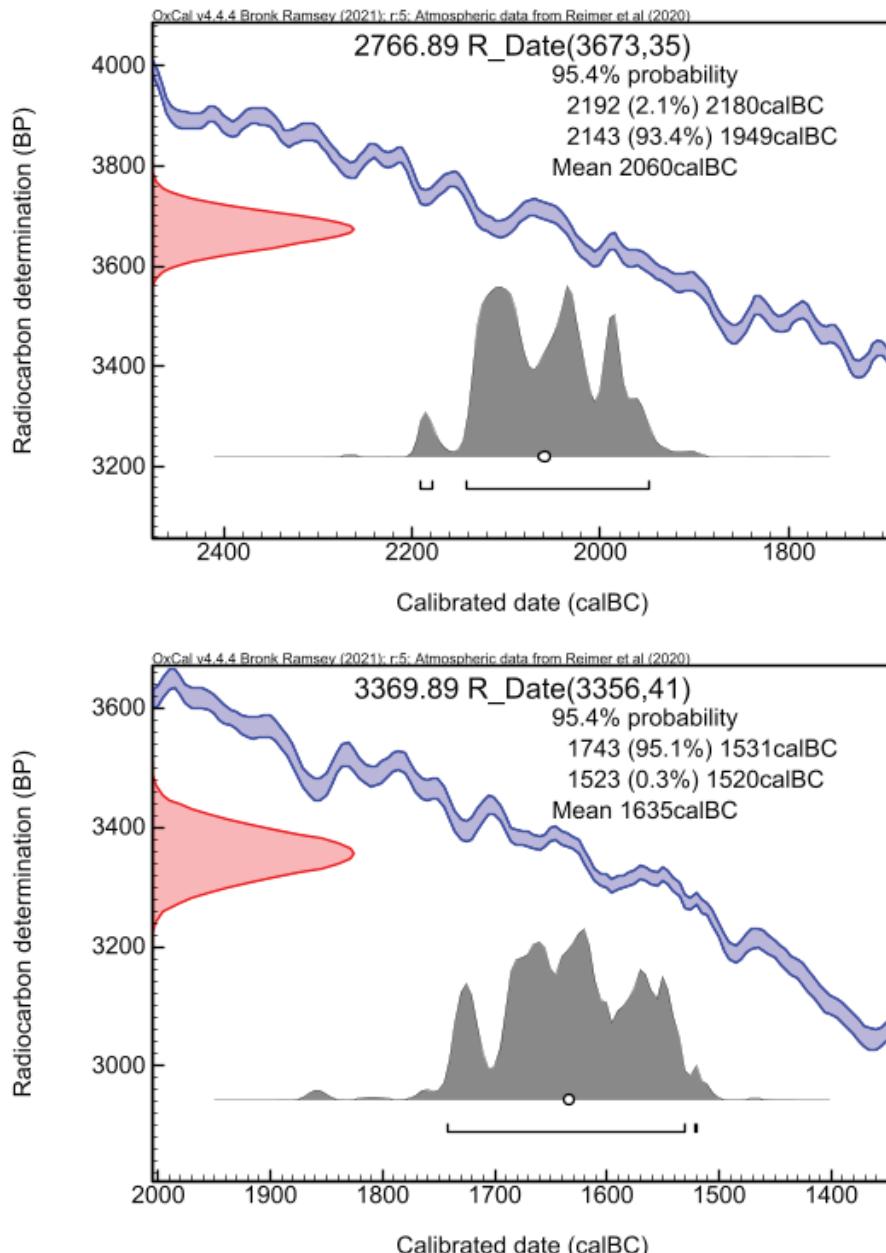


Fig. 6. Absolute data from the site Tibucani-Dealul la Cetățuie.

Building upon this interpretation, it may be suggested that the nearby site of Rădeni-Dealul la Cetățuie, where no substantial traces of occupation were found, functioned as an outpost for a Bronze Age community.

Regarding the fortification at Rădeni-La Șanț, the size of the enclosure and the complexity of its defensive system indicate that it was likely designed to provide refuge for a large community.

The presence of this complex of fortifications raises questions concerning the rationale behind their construction in this location. Considering that the nearest Middle Bronze Age settlements were lo-

cated 8–10 km away, one must ask: what exactly were these fortifications protecting? Any answer must take into account the settlement dynamics of the Middle Bronze Age in the Subcarpathian region, particularly the communities associated with the Costișa culture.

Over the seven decades of research on the Costișa culture, numerous sites have been identified in the peripheral Subcarpathian zone, including both fortified sites and open settlements. Most are situated in marginal depressions east of the Carpathians (Cracău-Bistrița Depression and Neamț Depression) (Cavruc and Dumitroaia 2001, 14–15; Munteanu 2010, fig. 2).

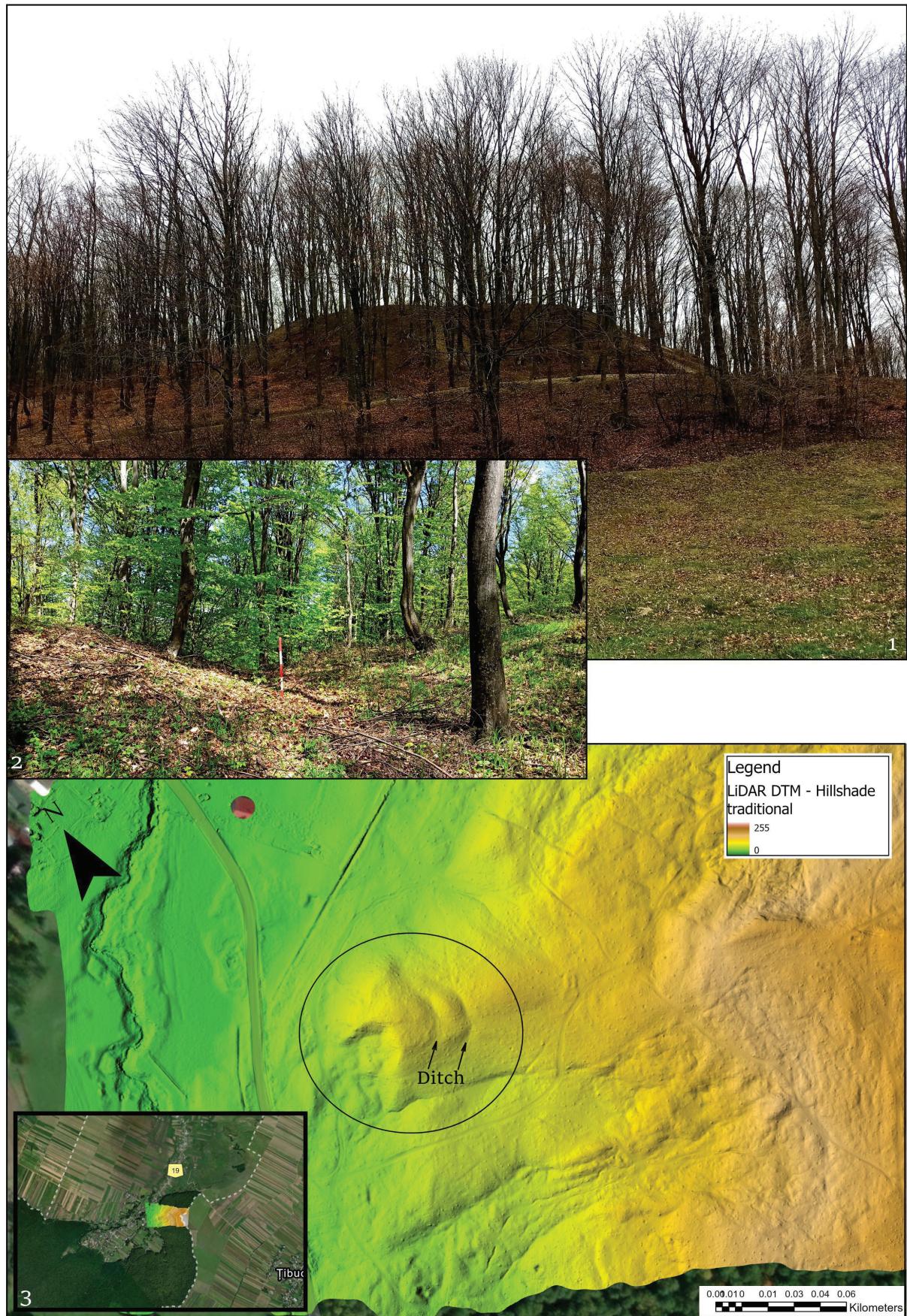
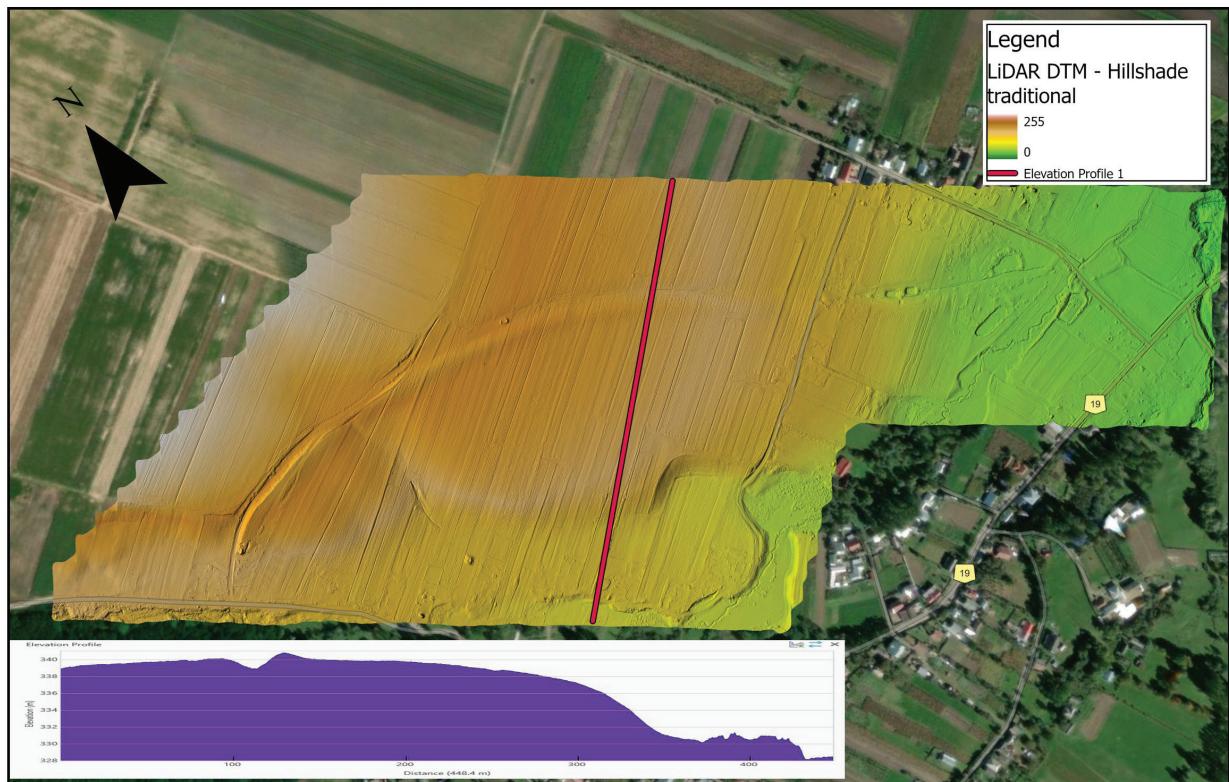


Fig. 7. The fortification at Rădeni-Dealul la Cetățuie.

1, 2 – images of the fortification and defensive system (photo by V. Diaconu); 3 – LiDAR scan of the site (edited by INFP).



1



2

Fig. 8. The site at Rădeni-La Șanț.
1 – aerial view of the site; 2 – LiDAR scan of the site (edited by INFP).

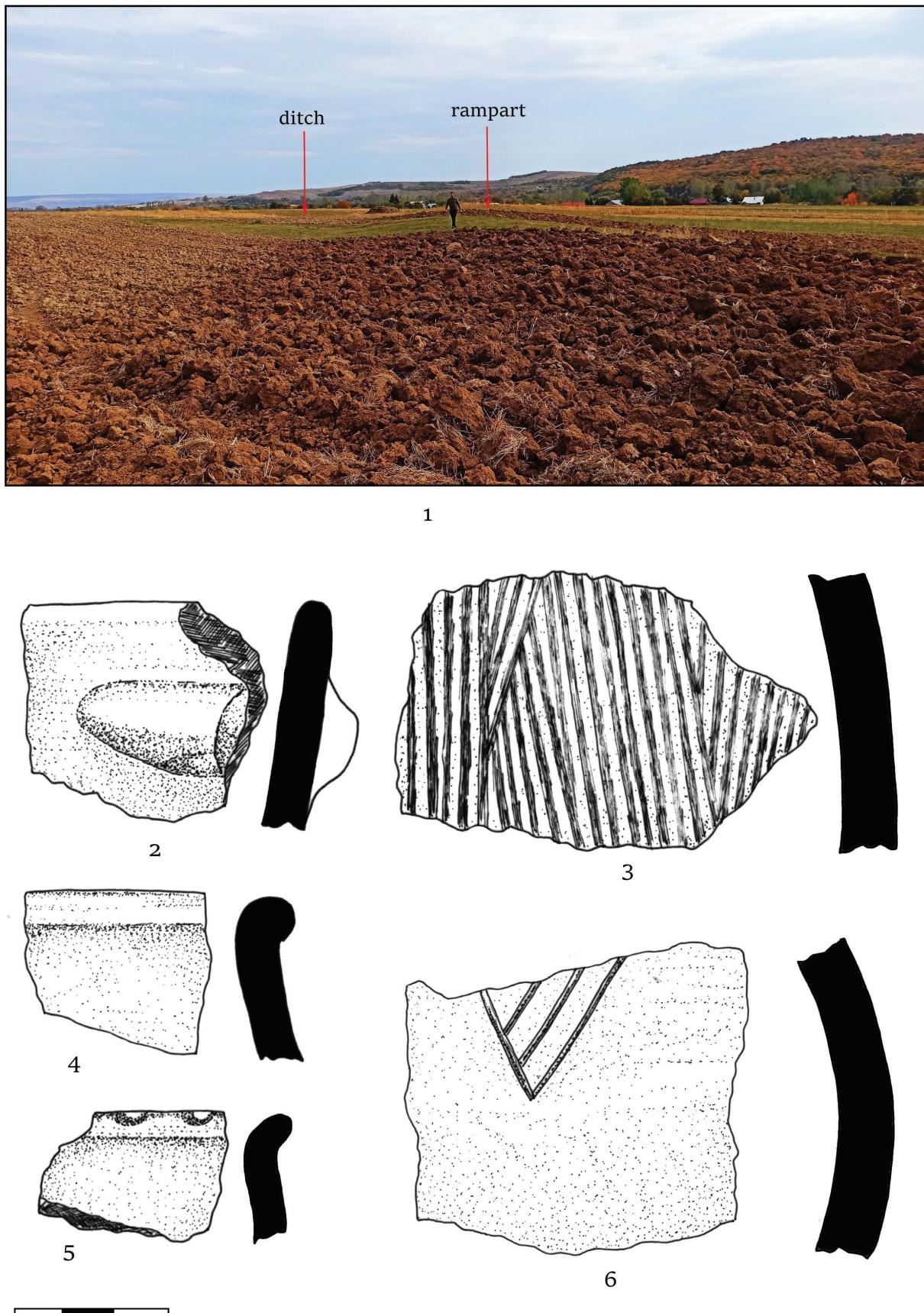


Fig. 9. The site at Rădeni-La Șanț.
1 – view of the defensive system (photo by V. Diaconu); 2–6 – pottery (drawn by V. Diaconu).

The situation differs markedly in the contact area between the Subcarpathians and the plateau, where open settlements are extremely rare. In contrast, several fortifications in this area appear to have marked the eastern boundary of the territory occupied by the Costișa culture (Fig. 1: 2), including Siliștea-Pe *Cetățuie* (Bolohan 2005), Văleni-Dealul *Cetății* (Gafincu and Diaconu 2021) Petricani-Dealul *Cetățuia* (Diaconu *et al.* 2021), in addition to the three defended sites at Țibucani and Rădeni. In this context, it can be inferred that these fortifications functioned primarily as control and defence points for Costișa communities inhabiting the Subcarpathian zone (Fig. 1: 2).

Furthermore, the group of fortifications at Țibucani and Rădeni, strategically located along a secondary watercourse at the interface between the depression and the Moldova river corridor within a narrow valley, may indicate control over a route leading to significant salt sources, located only 7 km to the west in the territory of Țolicivillage (Fig. 1: 1).

A separate discussion is warranted concerning the two absolute dates obtained from the Țibucani-Dealul la *Cetățuie* site. Previously, only a few absolute dates were available for the Costișa culture east of the Carpathians, deriving from the eponymous site (Popescu 2013) and the fortification at Siliștea-Pe *Cetățuie* (Bolohan 2010). These broadly fall between 1977–1619 cal BC (2 σ) (Diaconu 2016, 96–97), whereas the Țibucani dates range from 2143–1531 cal BC (2 σ). One sample from Țibucani-Dealul la *Cetățuie* appears to represent the earliest known date for the Costișa area east of the Carpathians (2143–1949 cal BC, mean 2046), almost a century earlier than the earliest dates from the eponymous site (1977–1879 cal BC) and Siliștea-Pe *Cetățuie* (1956–1862 cal BC).

Notably, this earliest date partially overlaps with the Ciomortan settlement at Păuleni-Dâmbul *Cetății*, considered a regional variant of the Costișa culture in south-eastern Transylvania (Kavruk *et al.* 2022, 106–107, fig. 2).

The second Țibucani date (1743–1531 cal BC, mean 1637) closely aligns with the latest dates from Costișa and Siliștea sites. It is also partially contemporaneous with absolute dates from the Komarów cultural sphere, recorded at Lunca-Poiana Slatinei (Weller and Dumitroaia 2005, fig. 5) and Adâncata-Imaș (Niculică 2015, 259).

Finally, the two Țibucani dates suggest that the fortification was inhabited over a period of nearly four centuries. Nevertheless, the limited intensity of archaeological remains indicates low-intensity, periodic occupation.

Conclusions

The *For Tum* project successfully produced LiDAR data for forested fortified sites, providing detailed topographic models that clarify the complexity of defensive systems and the social effort required to construct them.

The identification of three Middle Bronze Age fortifications in the Țibucani – Rădeni micro-region significantly enhances understanding of local defensive strategies. Beyond their potential role in a regional defensive network, these sites also functioned as control points for key access routes to natural resources, particularly salt.

The absolute dates obtained for Țibucani complement the limited chronological dataset for the Costișa culture, refining the temporal framework of Middle Bronze Age communities in the Subcarpathian region of Moldavia.

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