# BULETINUL MUZEULUI JUDEȚEAN TELEORMAN

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MUZEUL JUDEȚEAN TELEORMAN

CETATEA DE SCAUN
EDITURA

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***IN MEMORIAM*** **RADIAN ROMUS ANDREESCU**

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**S U M A R**

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# ARCHAEOLOGICAL AND GEOMORPHOLOGICAL CONTEXTS OF PREHISTORIC FLINT SCATTERS AT POIANA, LOWER DANUBE VALLEY, TELEORMAN COUNTY: RESULTS AND WIDER SIGNIFICANCE

Steve MILLS *
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***Rezumat:*** *Acest articol prezintă rezultatele preliminare ale investigaţiilor arheologice şi geomorfologice asupra zonelor preistorice de cioplire a silexului din jurul satului Poiana, aflate într-un bazin aluvionar major al Dunării de Jos, între Turnu Măgurele şi Zimnicea, în sudul judeţului Teleorman. Cercetările arheologice au identificat şi cartografiat aceste zone recent descoperite, furnizând consideraţii asupra contextelor de mediu şi analize ale pieselor prelucrate. Importantă în cadrul materialului este proporţia mare de nuclee, inclusiv de tipul 'bullet cores' (nuclee 'glonţ'), conice şi subconice cu o singură platformă. Studiile geomorfologice fluviale au inclus evaluări de teren şi cartografierea geomorfologică interpretativă, urmate de realizarea unor sondaje test şi datarea prin termoluminiscenţă a probelor de sedimente. Acest lucru a permis o cartografiere a văii Dunării, precum şi o înţelegere a proceselor geomorfologice petrecute în Holocen şi în Pleistocenul târziu din bazinul aluvial din jurul satului Poiana, oferind un context pentru localizarea şi distribuţia zonelor de cioplire a silexului, alături de datarea radiometrică iniţială. Cercetările combinate sunt integrate în contextul mai larg al arheologiei Holocenului timpuriu şi mijlociu din valea Dunării de Jos şi în regiunea înconjurătoare.*

***Abstract:*** *This paper presents preliminary results of combined archaeological and geomorphological investigation of prehistoric flint scatters around Poiana village located in a major alluvial basin of the Lower Danube Valley between Turnu Măgurele and Zimnicea in southern Teleorman County. Archaeological research has identified and mapped recently discovered flint scatters and provides consideration of the landscape contexts and analyses of the worked pieces. Important amongst the material is the high proportion of cores including single platform conical and sub-conical shaped 'bullet' cores. Fluvial geomorphological studies included field surveys, as well as interpretative geomorphological mapping, followed by excavation of test pits and OSL dating of sediment samples. This has enabled a mapping and zoning of local valley floor topography as well as an understanding of Holocene and Late Pleistocene geomorphological processes within the basin around Poiana that provides a landscape context to the location and distribution of flint scatters, alongside initial radiometric dating. The combined research is placed in the broader context of early-mid Holocene archaeology in the Lower Danube valley and the wider region.*

***Cuvinte cheie:*** *valea Dunării de Jos, nuclee 'glonţ', geomorfologie fluvială, zone de cioplire a silexului, Holocenul timpuriu şi mijlociu.*

***Key words:*** *Lower Danube Valley; 'bullet' cores; fluvial geomorphology; flint scatters; early-mid Holocene.*

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**Introduction**

Field research within a major alluvial basin of the Lower Danube Valley (Figure 1), from Turnu Măgurele in the west to Zimnicea in the east, focussed on the modern village of Poiana, formerly Flămânda (in Ciuperceni Commune, Teleorman County), identified 26 sites and/or find spots with archaeological material culture on the surface, dating to multiple periods but mostly prehistory. Following initial assessment as part of the General Urban Plan (= P.U.G) for Ciuperceni commune (Mirea *et al.* 2011), some of the find spots around Poiana contain worked flint and prehistoric pottery. This provided the impetus for a project that applies an alluvial archaeological approach (cf. Macklin and Needham 1992) to better understand the chronological, environmental, and social contexts of this material (for background and initial findings see Mills *et al.* 2017, 2018). To date, seasons of targeted field research have taken place between 2013 and 2022 (at different times of the year mostly in summer with some also in autumn). In this way the known find spots were further investigated and in the process flint scatters at surface were discovered with those labelled FLM 024 and FLM 025 being the largest and with highest density of worked and unworked flint material (FLM is prefix for Flămânda).

A striking aspect of these flint scatters, observed in the field and confirmed following analyses in the laboratory, is the high proportion of cores including single platform conical and sub-conical shaped cores (Figure 2). Particularly narrow variants of this type are sometimes termed 'nucleu fusiform', 'spindle-like', 'bullet' or 'pencil' cores (e.g., Păunescu 1970: 31; Boroneanţ 2005: 22). Conical cores of this type have narrow blades scars, usually only a few millimetres wide, and result from the application of the pressure technique to produce blades (Desrosiers 2012; Pelegrin 2012: 467-75 most likely produced using modes 1-3). Elsewhere in Romania, cores of this type occur in assemblages associated with the Mesolithic in Moldova (e.g., from Erbiceni and Ripiceni, Păunescu 1970: 145-7, 267, fig. 18; Păunescu 1990: 228; Păunescu 1999a: 264, fig. 86, 301) and Dobrogea (e.g., from Cuza Vodă and Medgidia, Păunescu 1990: 229, fig. 10; Păunescu 1999b: 108, fig. 26, 169, fig. 59) and in Neolithic Hamangia contexts in Dobrogea where the technique may derive from the local Mesolithic (Păunescu 1970: 289, fig. 29; Haşotti 1997: 34-35).

Further afield, cores of this type occur in Mesolithic contexts along the north and east coasts of the Black Sea in Ukraine, Crimea and Georgia; in Mesolithic and Neolithic contexts in Uzbekistan and Kazakhstan; in Mesolithic (Epipalaeolithic) and early Neolithic contexts in northwest Turkey; and Neolithic contexts on Aegean islands and in Iran (e.g., Biagi and Kiosak 2010; Brunet 2012; Chkhatarashvili and Manko 2020; Erdoğu 2017; Gatsov 2007; Gatsov and Nedelcheva 2016; Gatsov *et al.* 2017a; 2017b; Gurova and Bonsall 2014; Karul 2011; 2017; Kiosak 2016; Nezafati and Hessari 2016; Reingruber 2016; Templer 2016). The cores of this type found around Poiana potentially date to the Mesolithic (c. 9700 to 6100 cal BC) and/or early Neolithic (c. 6100 to 5700 cal BC) and to our knowledge similar cores have not previously been found within the Lower Danube valley, with the geographically closest examples being those from Mesolithic contexts in Dobrogea at Cuza Vodă and Medgidia and the one found on the Arven Plateau, near Varna, in Bulgaria which has been tentatively associated with the Neolithic (Gatsov *et al.* 2017a).

The presence of these cores over a wide area around the Black Sea provides evidence that suggest broad networks of communication, exchange and influence from at least the early Holocene onward (see Reingruber 2017 for early to mid-Holocene interactions between the Lower Danube and the north and west Pontic area). The importance of chipped stone networks as a conduit for communication and information transfer is further emphasised through the wide distribution of 'Balkan' flint across Bulgaria and along the Lower Danube (Gurova *et al.* 2016; 2021; 2022a; 2022b). It is therefore of interest to know if the scatters around Poiana were associated with these broader networks.

The potential for a Mesolithic presence in this alluvial basin is important given the absence of confirmed evidence for the Mesolithic elsewhere along the lower Danube corridor east of the Danube

Gorges. The considerable amount and, to date, unique character of the Mesolithic evidence from the Danube Gorges area is well known and published, alongside research that aims to determine the origins of and diverse interactions between hunter-fisher-gatherers and early farmers in the area and their diet and use of wild and domesticated resources in subsistence strategies (recent e.g., Bonsall and Boroneanţ 2016; 2018; Borić 2016; 2019; 2022; Borić and Cristiani 2022; Borić *et al.* 2018; Brami and Diekmann 2023; Cramp *et al*. 2019; Cristiani *et al*. 2016; 2021; de Becdelièvre *et al.* 2020; Jovanović *et al.* 2018; 2021; Mihailović 2021; Ottoni *et al*. 2021). This makes it even more surprising that there is so little evidence for the Mesolithic elsewhere in the lower Danube region and southeast Europe more generally. It seems very probable that people were using the coast and major river valleys for communication, travel and as a resource base given the likelihood that the interior was densely forested and therefore less attractive and sparsely populated (Gurova and Bonsall 2014; Pilaar and Vander Linden 2018). Alongside the aforementioned important chipped stone networks along the lower Danube, we should therefore expect there to be at least a sporadic Mesolithic signature (e.g., lithic find spots and scatters) along terraces and raised areas within major river valleys and at the edges of former wetland areas, including within the lower Danube valley, but perhaps buried beneath alluvium (Bailey 2007: 521; Mihailović 2021: 64) and /or subject to fluvial processes including erosion and sedimentation rendering it invisible, or disturbed and out of original archaeological context. Duffy *et al.* 2022 have used GIS to predict where Mesolithic sites might be located within the Carpathian Basin and identify a preference for wetland areas. While their study area extends into much of Romania the only Mesolithic sites from Romania included by Duffy *et al.* 2022 are limited to those in the Danube Gorges; their study does not extend further east into the lower Danube valley. There is therefore a requirement for a detailed investigation of the local environmental conditions associated with the flint scatters around Poiana if we are to better understand how river dynamics and patterns of (rapid) climate change, flooding events, erosion and alluviation may have impacted them through time.

The project aims to examine the interplay between river dynamics and the early to mid-Holocene (c. 9700-5500 cal BC) archaeological record in terms of:

1. the effects of river erosion and sedimentation on the preservation and visibility of archaeological sites and,

2. the impact of abrupt, climate-related changes in local hydrology and floodplain environments on prehistoric communities.

### Archaeology around Poiana and the lithic scatters

The area around Poiana is rich in archaeology with material dating from prehistory through to the Medieval period and later (Figure 3). Alongside the already known Roman *Limes Transalutanus* and fortress, a fourteenth century AD medieval settlement and the medieval fortress at Turnu Măgurele, the P.U.G. studies identified 26 new sites/find spots (prefixed FLM) within Ciuperceni commune and a further 3 new sites (prefixed TRM) nearby on the north bank of the former Lake Bercelui, east of Turnu Măgurele (for detail see Mirea *et al.* 2011; Mirea and Torcică 2014. For a summary see Mills *et al.* 2018). The sites or find spots were identified based on the presence of material culture (flint, pottery) at surface and include many of prehistoric date (Palaeolithic, possible Mesolithic, Neolithic, Eneolithic, Bronze Age and First Iron Age - Hallstatt). Material culture from later Geto-Dacian, Roman, post-Roman and Medieval periods is also present.

Locations around Ciuperceni and Poiana with worked and unworked flint dating to the Early Upper Palaeolithic (Aurignacian) have long been known. Three activity zones ('La Tir', 'La Vii' and 'La Carieră') within the loess terrace on the left bank of the Danube, 2 km north of Poiana, have been studied (e.g., Boroneanţ 1978; Păunescu 2000: 236-42, 244; Tuffreau *et al.* 2014), with one IRSL date of 30 ± 3 ka BP obtained from the upper loess layer at 'La Vii' (Dobrescu, Tuffreau and Balescu 2015).

Within the Danube floodplain, other lithic scatters have previously been identified but have not been subject to detailed study. The only exception was a lithic scatter to the NE of Poiana cemetery, identified and partially excavated by M. Bitiri and V. Boroneanţ in 1975, but which contained no stratigraphic context and hence the lithic material could not be chronologically constrained (Boroneanţ 1981: 23, nota 1). It has not been possible to identify the location of this lithic scatter (if any survives) as part of our project.

Following the 2011 archaeological assessment for the P.U.G., a field visit in 2013 identified well preserved Holocene/Pleistocene fluvial and aeolian landforms (including former river islands and paleochannels, and linear dunes) in the Poiana locale, with the potential to provide geomorphological and geochronological evidence for early to mid-Holocene river dynamics in this reach of the Lower Danube. During subsequent fieldwork, in the summers of 2016 and 2017, and autumn 2017, that focussed on the archaeological potential in the area around Poiana, the two flint scatters labelled FLM 024 and FLM 025 were discovered within recently ploughed or harvested fields.

**Methodology**

The project has applied a range of techniques and employed a variable methodology depending on the time of year fieldwork was conducted, progression in understanding from one fieldwork season to the next, and dependent on the crop regimes which determine the scope and kind of access to the land where the flint scatters are located. Following major landscape changes in the 1960s and 1970s to transform drainage and irrigation within the floodplain, much of the land around Poiana is now used for commercial agriculture, with large areas dedicated to corn, sunflowers, rape seed or cereals. Both flint scatters FLM 024 and FLM 025 are within plots of land used commercially for crops and it is therefore necessary to work around the agricultural calendar and crop regime, which can change year on year for each plot of land. The project is based at the Muzeul Judeţean Teleorman (= MJT) and material recovered from the field (flint, pottery, dating and environmental samples) is cleaned, processed as required, analysed and stored in its laboratories and storerooms (with dating samples sent to laboratories in Bucharest and the UK, see below). To date, study visits to MJT and fieldwork around Poiana for the project took place as follows: summer 2013 (9 days), summer 2016 (4 days), summer 2017 (6 days), autumn 2017 (26 days); summer 2018 (20 days), summer 2019 (19 days), summer 2022 (8 days), spring 2023 (6 days).

***2013 & 2016***

Following and guided by the work of the Ciuperceni P.U.G., in summer 2013 a walk over assessment around Poiana and test hand auguring in the area between FLM 003 and FLM 004/ FLM 024 (labelled as 'Valea lui Enache' on some of the historic maps) within a palaeochannel belt located on a Danube river terrace c. 3-6 m above present low flow river level, identified upstanding linear dunes and river islands as well as palaeochannels worthy of further investigation and with the potential to contain material suitable for dating and environmental samples. Fieldwalking in the area around Poiana in summer 2016 resulted in the discovery of the two flint scatters FLM 024 and FLM 025. Some collection of diagnostic flint material at surface from the two scatters helped established the high number of cores present.

***2017***

Although much land and was under crops, further fieldwalking around Poiana in summer 2017 confirmed that the highest concentrations of flint at surface appeared limited to the two identified scatters FLM 024 and FLM 025 (small amounts of flint material were identified at surface and collected from the area of FLM 007). A day fieldtrip was arranged to the Bulgarian side of the Danube in summer 2017 to see the flint nodules on the beach and outcropping in the limestone cliffs at Nikopol (Figure 4), 5 km southwest of Poiana (raw flint resources from the Nikopol area are prominent in studies of prehistoric chipped stone networks e.g., Gurova *et al.* 2016). The flint occurred in a range of colours including honey, red, brown, but, unlike around Poiana, there was very little of the black flint. No worked pieces of flint were identified at this location.

Based on a written agreement between Cardiff University and the MJT, in October 2017 the Romanian Ministry of Culture granted approval for the project enabling coring and small test or evaluation excavations in autumn 2017 and summer 2018.

Fieldwalking towards the eastern end of the alluvial basin as part of the Seaca P.U.G. was conducted in autumn 2017. This area of the basin to the south of Seaca is used for crops but there are also large areas of common land used for grazing livestock (cattle and sheep) with temporary shepherd huts and camps on the higher ground and ridges. The area has a series of upstanding linear dunes, trending broadly WNW-ESE, the crests of which are located up to c. 5 m above the river terrace on which they are developed. On several of these prehistoric burial mounds or magoulas were constructed. Small amounts of flint, building material and prehistoric and later pottery were identified at surface on some of the raised sandy areas within this zone but at a much lower concentration than encountered around Poiana. This work helped confirm that the area around Poiana should form the focus of the project's investigations.

At key part of the fieldwork in autumn 2017 was to gain a better understanding of the dimensions and variation in concentrations of flint material across the scatters FLM 024 and FLM 025 by applying a more systematic approach. At the time both scatters were clear of crops. Handheld GPS units and 50 m measuring tapes were used to record the perimeters of the scatters (based on a visual assessment of the limit of flint material visible at surface). A series of hand auger cores in a transect across each of the scatters were made to help in determining the depth of flint material below surface. Details of the material encountered at different depths within cores were entered on to record sheets at site and then into spreadsheets in the MJT (detail about the cores is provided below in the FLM 024 and FLM 025 sections).

To aid in quantifying variation in the density of flint material at surface, systematic sample counts were conducted in a transect across each scatter. Two 0.5 m by 0.5 m drawing frames (giving a total sample area of 1.0 m by 0.5 m, or 0.5 sq m) were positioned next to each other on the ground in line with and at set distances along each transect and all the flint material within the frames was counted, and worked material identified was collected. GPS points were taken at the centre point of the locations the drawing frames were positioned on the surface. At FLM 024 the transect ran diagonally across the scatter from NW to SE with 18 sample squares counted spaced 5.6 m apart. At FLM 025 the transect ran diagonally across the scatter from ESE to WSW with 9 sample squares counted spaced 5 m apart. This approach clearly identified where the densest concentration of flint material occurred within each scatter. Details of the flint counts per sample were entered on to record sheets at site and then into spreadsheets in the MJT (detail about the samples is provided below in the FLM 024 and FLM 025 sections).

In one of the MJT laboratories, in autumn 2017 analyses started of the flint collected to date from the two scatters, and some from other FLM locations within the study area for comparison. Data from the analyses were entered into spreadsheets. This included identifying and counting of cores and recording a range of attributes and metrics for the cores (colour, % cortex, core type, final reductions, min and max scar width, platform type and size, length, breadth, thickness, notes, provisional dating based on type). Counts of the cores, worked and unworked pieces were determined for all FLM sites within the study area.

***2018***

A key aim of the 2018 summer fieldwork season was to excavate test sondages at both scatters FLM 024 and FLM 025. Having already received approval for archaeological excavation from the Romanian Ministry of Culture, it was necessary to get local approval from the mayor and landowners.

Following a visit to the Marie (Mayor's office), in July 2018 the Mayor of Ciuperceni gave his approval for archaeological fieldwork involving excavation to go ahead at FLM 025. After the meeting with the mayor, one of the local councillors visited FLM 024 with us and, after a telephone call to a landowner, permission was granted for small scale excavations. It was confirmed that small excavations at both FLM 024 and FLM 025 would not require any financial compensation to the landowners.

The agricultural land at FLM 025 had recently been harvested of a cereal crop with only short stubble remaining and visibility of and access to the surface was good. As a guide to where to position a sondage, a handheld GPS was used to locate the positions of the hand auger cores drilled in 2017 which had encountered the compact layer at 30-35 cm depth at the southern edge of the scatter. The southern edge of the scatter is on the border of the agricultural land to the north and common land to the south (the common land surrounds a former cemetery of Ciuperceni village). At the location of hand auger core 4, a 2 m by 1 m sondage was positioned and excavated at the edge of the scatter with minimal intrusion into the area of land used for crops. Shovels were used to remove the topsoil and then hand trowels used below that. A sieve (4 mm) was used to aid finding smaller items (flint, pottery, bone). Material collected for analyses at MJT was bagged with labels to identify the relevant source excavation unit. The excavation took place over 2 days and backfilled and topsoil replaced afterward.

At FLM 024 the land was under a corn crop to head height and the access track immediately to the west between FLM 024 and FLM 003 was largely overgrown and not passable by the museum car. On foot it was possible to reach the area of the FLM 024 scatter. Once there, guided by a handheld GPS which had waypoints of the locations of the autumn 2017 hand auger cores, it was possible to locate the area of highest concentration of flint material within the corn crop. Given the density and height of the corn, it was decided best to commence with a 2 m by 1 m sondage at the western edge of the crop in the area bordering the track and in line with the highest concentration of flint material which was 24 m further to the east. This sondage was excavated in one day following a similar procedure to that outlined above for the sondage at FLM 025.

Guided by a handheld GPS, within the corn crop at FLM 024 a small clearing was identified (3 m by 3 m maximum extent and possibly resulting from wild pigs feeding) at a location 5m from the 2017 hand auger core 2 and at the centre of the highest concentration of flint material at surface. There was much flint at surface within this small clearing and a small 1 m by 1 m sondage was excavated at this location. As there had been recent rain, mosquitoes were a considerable problem at this location working in humid conditions with little wind in a confined space within a dense crop of corn. This sondage was excavated in one day, again following the procedure outlined above.

The location of all 2018 sondages was recorded using a handheld GPS to enable representation in the project GIS. Details of the dimensions, stratigraphy and material encountered in and collected from the sondages were entered on to context recording sheets at site and then into a project database at the MJT, and a photographic record was created (Figure 5, detail about the excavations is provided below in the FLM 024 and FLM 025 sections).

***2019***

The agreement between Cardiff University and the MJT was extended to enable coring and small test or evaluation excavations and geomorphological test pits during the summer of 2019. Authorisation for diagnostic archaeological fieldwork was received from the Archaeology Commission of the Romanian Ministry of Culture (dated 17/07/2019).

On seeing the authorisation from the Ministry of Culture, in July 2019 the Mayor of Ciuperceni granted further approval for fieldwork around Poiana that summer including geomorphological test pits by mechanical excavator. The Mayor confirmed that tracks on the floodplain within the study area are public land and that test pits within them could be excavated by mechanical excavator provided they are backfilled within a few hours. Following a check of local cadastral maps and list of landowners, Agricol Register staff in the Mayor's office were able to contact the landowner of the area of land where FLM 003 is located and permission was granted to excavate up to two geomorphological test pits on that land.

To help interpret and represent the relationships between archaeology and geomorphology within the study area, the project has developed a GIS since 2013 integrating a range of modern and historical mapping sources and survey data recording the locations of fieldwork activities and archaeology encountered. For GIS the project uses ArcGIS Desktop 10.8 (now migrating to ArcGIS Pro) and QGIS 2.18 Las Palmas (and now 3.28 Firenze). Mapping used in the project GIS includes: ro25k20 (Romanian topographic mapping at 1:25,000 scale); Ortofotoplanuri ECW files of Teleorman County (mosaic of aerial photography of Teleorman County); Open DEM SRTM [linia Dunarii/Danube line] mosaic (www1); Historic Romanian Military mapping dating to 1928 and 1945; Environmental Systems Research Institute (ESRI) World Imagery; Sentinel 2 satellite images (see below).

Using the online resource Sentinelhub Playground (www2) suitable satellite imagery of the study area was discovered, visually assessed and downloaded. Sentinel 2 (L2A) imagery was selected to show the most up to date images of the study area (dating to early July 2019). Additional Sentinel 2 (L1C) imagery dating to 05/01/2016 when the study area was snow-covered was identified and with some adjustments to atmospheric correction, gain and gamma settings made to enhance visibility of geomorphological features, particularly palaeochannels, palaeoislands, river bar-forms and aeolian dunes. These downloaded satellite images were georeferenced in the project GIS and, combined with copies of modern and historical topographic mapping, print outs were produced suitable for use in the field to aid with locating and identifying geomorphological and topographical features in the field. These helped interpret the character, dimensions and phasing of Holocene and Pleistocene age geomorphological features around Poiana and in selecting locations suitable for test pits in these deposits.

Declassified Corona imagery (www3) dating to 1960s was also accessed providing a good visual resource and record of landscape transformations in the latter part of the 20$^{th}$ century. These clearly show the former extent of Lake Suhaia in the east of the study area and drainage of large parts of the eastern part of the study area in the late 1960s.

The project hired a mechanical excavator from a construction company near Ciuperceni for 2 days from 31/07 to 01/08/2019 to excavate the geomorphological test pits. Twelve pits were excavated at selected locations around Poiana, the locations and details of which are provided below (see Geomorphological and sedimentological investigations section). The sedimentology and stratigraphy of these test pits were recorded, any archaeological features present were documented, depths were measured using a hand tape from surface and a photographic record was created (Figure 6). Prior to the fieldwork, metal tubes of 42 mm internal diameter and 250 mm length for collecting and storing OSL dating samples were purchased in Alexandria and adapted for use at the MJT. OSL samples were collected from suitable sandy layers in two of the test pits. Details of the stratigraphy and material encountered at different depths within test pits were entered on to record sheets at site and then into spreadsheets in the MJT. The location of the test pits was recorded using Real Time Kinematic (RTK) GPS.

The project hired a RTK GPS unit with SIM card and mobile subscription for survey within the study area in summer 2019. The equipment by Hi-Target consisted of a V60 receiver with SIM card connection to gain position corrections and an iHand 20 controller with Hi-Target Road survey software. Mobile reception for position corrections was good within the study area. This enabled topographical survey within the study area to 1-2 cm average horizontal accuracy and 3-5 cm average vertical accuracy with resulting horizontal coordinates in the Stereo 70 coordinate system. The survey included: the locations and dimensions of geomorphological test pits; the locations and dimensions of sondage excavations and elevation levels within them; and a transect across the study area starting at the terrace top in the north down to and across the floodplain and then to the Danube bank in the south with survey points taken approximately every 40-50 m (total horizontal distance 3,840 m). All

RTK survey point data was available for download as CSV, shapefile and KML formats for use in GIS and Google Earth.

In addition to the geomorphological test pit dug at the southern edge of FLM 025, 5 m further west a 2 m x 2 m sondage was excavated at FLM 025 at the border between the common land and the agricultural land (which was in sunflowers) (Figure 7). The aim was to determine if the compact stone layer identified in the 2017 hand auger cores, the 2018 sondage and the 2019 geomorphological test pit continued further to the west. The sondage was excavated over 2 days and the excavation and recording method followed that employed for the sondages excavated in 2018. In addition to the flint and pottery collected for analysis, two pieces of animal bone were collected as potential samples for radiocarbon dating (detail about the excavation is provided below in the FLM 025 section).

***2022***

In the summer of 2022, the MJT was hired to carry out excavations at the site of the relict church (founded in 1880 and completed in 1882) that still stands at the former location of Ciuperceni village (Mirea 2022). This work is in advance of the construction of new buildings as the location is developed for use as a monastery. As expected, the excavations revealed post-medieval burials (19th century) around the church and given the number of burials, work continued across the summer and into the autumn (96 days in total). The excavations were to a maximum depth of 1.9 m through the topsoil and into the natural sub soil sediments. As well as the burials, the foundations of and features associated with an earlier pit-hut church, dating to end of the 18th century AD/beginning of 19th century AD, and a settlement pit for a probable semi-subterranean house, dating earliest to the 17th century AD, were revealed (Mirea and Torcica 2022). Although the church is sited on a raised area and near a large palaeochannel, very few lithic pieces were encountered during this work (one core was recovered) and this location did not have a concentration of unworked or worked lithic material such as that found at FLM 024 and FLM 025. As this location was part of the former village of Ciuperceni it would therefore have been disturbed and prehistoric material would most likely be out of context if it had been recovered. This excavation provided useful data for this project even though no significant lithic or prehistoric material was identified at this location. It highlights that the concentrations of lithic material, including the scatters at FLM 024 and FLM 025, around the cemetery at Poiana more generally and at the Ciuperceni quarry are very localised and the amount of lithic material in the surrounding areas is otherwise low.

The MJT has a drone, DJI model mini 2, which was used to take aerial photographs of the excavations at the Ciuperceni church site. During work at the church there were opportunities to fly the drone within the surrounding landscape. This enabled photographs to be captured of the landscape around FLM 025 and FLM 024 and the large palaeochannel to the north and west, a selection of which were georeferenced in the project GIS (Figure 8).

Further a field, from the village of Seaca, 8 km east of Poiana, a track leads south across the floodplain to the Danube embankment from where it is possible to take another track to Belina, an island in the Danube on the Romanian side. There are sand, gravel and pebble beaches on the south side of Belina beside the main channel of the Danube and where, during visits in 2016 and 2022, we have identified unworked and possible Palaeolithic worked pieces of flint, including large nodules similar to those found 12 km to the west on the opposite bank at Nikopol in Bulgaria (Figure 9). On Belina it is not clear if the presence of the flint on the beaches is a natural deposition or the consequence of the movement of material as part of the embankment and hydrological works during the 1960s and 1970s (there was a planned hydro station at this location but it was never completed). The presence of natural flint along the beaches, cliffs and banks of the Danube in the area between Nikopol in Bulgaria and Ciuperceni/Poiana/Seaca in Romania highlights the potential importance of this reach of the river as a flint resource. Raw flint samples from the outcrops at Nikopol, and outcrops elsewhere in Bulgaria, have been subject to petrographic and geochemical analysis and this has enabled the provenance of Neolithic worked flint material, and in particular 'Balkan flint', recovered from archaeological sites to be identified (Gurova *et al.* 2016). Similar petrographic and geochemical studies are required on samples of raw and worked material from around Poiana and elsewhere on the Romanian side of the Lower Danube region.

**FLM 024 flint scatter**

The FLM 024 scatter, discovered 20 July 2016, is located 1km east from the main north-south road through Poiana and 300 m south of the village cemetery (Figure 10). The Stereo 70 coordinates for the centre of the scatter are: E 497138, N 248814. The elevation at the centre of the scatter is 24 m above sea level. The scatter is in a field used for crops grown as a commercial enterprise which vary year on year on rotation and include sunflowers, cereals, rape and corn. This area of land rises gently towards the south to a ridge running west-east which is 27 m above sea level, after which the land slopes gently again to the south towards the Danube (which is a further 750 m due south and at 20.6 m above sea level). The furthest extent of the scatter to the south is about 80 m short of the top of the ridge. The scatter is therefore on a slope rising to the south.

To the west and northwest of the scatter is the palaeochannel labelled 'Valea lui Enache' which runs southwest to northeast. At its nearest point, the central line of the palaeochannel is approximately 100 m northwest of the centre of the scatter. The scatter was therefore probably originally on the right bank of a former channel of the Danube. 200 m to the northwest on the opposite side and left bank of the palaeochannel is FLM 003 which also has flint at surface. FLM 004, which also has flint at surface, is 150 m to the southwest on the same side of the palaeochannel as FLM 024. FLM 004 could be a further outcrop of flint material along the former right bank of the palaeochannel from FLM 024, although flint material does not appear to be as dense at FLM 004 as it is at FLM 024, and its occurrence between the two is intermittent rather than continuous.

Based on fieldwork to date at FLM 024, it was observed that there is a general low background amount of flint across the field but that the concentration at the scatter is much higher. Since the scatter was first discovered in 2016, the field has been ploughed by tractor at least once each year (to a depth of about 40 cm maximum) and this has enabled assessment of any resulting movement and spread of the material from the scatter. Based on visual assessment, the centre of and highest density of material in the scatter has remained in the same place and therefore the ploughing does not appear to have significantly altered the location, density and dimensions of the scatter. The ploughing runs along north and south lines alternately across the field and is turning over the scatter material in situ and only moving it very slightly along each north or south run, which is then reversed on the next run in the opposite direction and, year on year, effectively cancelling out any overall drift of material.

Drawing on observations of the very minimal impact of ploughing on the position of the scatter, it seems unlikely that its present location is the result of gradual erosion and creep downhill from a possible previously higher location nearer the top of the ridge to the south. In further support of this interpretation is the fact that there is no similar scatter of flint material on the south side of the ridge. It is more likely that the flint material in the FLM 024 scatter has been at the present location on a former bank of a palaeochannel since its original deposition. Our current working interpretation is that the location represents part of a former gravel-bar on the right bank of the palaeochannel which may have been active during the early to mid-Holocene and broadly contemporary with its use as a flint source by prehistoric people (see Conclusions below).

Based on the 2017 fieldwork, the scatter dimensions are maximum 95 m north to south and maximum 80m west to east. The systematic count of material (worked flint and pottery) at surface within the 18 samples (using 0.5 sq m drawing frame) positioned in a transect across the scatter showed the density varied from 1-2 pieces at the edges to 44 maximum within the area of highest concentration. The transect line was 113.2 m long (including the length of the sample squares) running northwest to southeast and the highest density of material (count range 18 to 44) occurred in samples 4 to 7 from 20 m to 46 m along the transect measured from the northwest. Based on this work, including the cores (see below), the area with the highest density of material within the scatter covers approximately 531 sq m.

Of the four hand auger cores drilled in autumn 2017 (cores 1-3 spaced 10 m apart and core 4 spaced 20 m from core 3), cores one and two within the area of highest concentration of material at surface went through the ploughzone and topsoil and then encountered a compact layer with pebbles beneath at 40 cm depth and could go no deeper. Cores three and four were within the scatter but further south (nearer the top of the ridge with core 4 outside the area of highest concentration) and continued down to 220 cm and 120 cm respectively into finer silty material. Based on the cores, the topsoil is to depth 40-45 cm extending to 70 cm further south on the higher ground towards the top of the ridge. Cores three and four indicate that beneath the topsoil the material has less clay content and becomes increasingly yellow, finer and silty with some small stones and calcareous inclusions. With greater depth it also becomes stickier.

Two sondages were excavated at FLM 024 in summer 2018 but were constrained by the head high crop of corn. The first sondage (sondage 1), located at the western edge of the crop next to the north-south track, was 2 m by 1 m and excavated down to a maximum depth of 80 cm. This was beyond the main area of the scatter. The topsoil (stratigraphic unit 1), excavated using shovel and trowel, was 0-30 cm in depth and included some worked flint, modern bone, shell pieces, and medieval and modern pottery. The soil was brown with some calcareous inclusions. Excavation by trowel continued to 50 cm depth in the 1 sq m south side of the sondage where the soil became more yellow and silty with calcareous inclusions but no archaeological material was encountered (stratigraphic unit 2). A smaller area was excavated by trowel to 80 cm depth and again no archaeological material was encountered, and the layer became still more yellow and silty with calcareous inclusions. With no material at depth and being beyond the main scatter, the sondage was closed and backfilled.

Sondage 2 was in a small clearing within the corn crop and the area of highest concentration of material at surface in the scatter. This location was close to the position of hand auger core two in the area previously identified as promising for a test sondage because of the high density of worked flint at surface including cores. Although the working conditions in summer 2018 were confined and challenging because of the crop and recent rain (and mosquitoes) a small 1 m by 1 m sondage was attempted, excavated entirely by hand trowel (shovel only used to move excavated soil to a small area for spoil). The topsoil (stratigraphic unit 1) was 0-40 cm depth with the top 10 cm very muddy because of recent heavy rain but below which it was drier and easier to excavate. This layer contained much worked flint, including a core. It also included prehistoric, modern and medieval pottery, some animal bone and pieces of brick. The soil was brown with some calcareous inclusions with a mix of pebbles and worked and unworked flint but no distinct layer of this type of material. Excavation continued to 60 cm depth in the 0.5 sq m west side of the sondage (stratigraphic unit 2) where the soil became siltier with pebbles and contained mixed archaeological material including worked flint and pottery. No distinct layers of archaeological material or flint/pebbles were identified. Hand trowelling continued in one small section to 90 cm depth which had the same soil type and mixed range of archaeological material, as well as large unworked pieces of flint. Due to the confined space available to work in, it was not possible to excavate the sondage any further and it was closed and backfilled.

**FLM 025 flint scatter**

The FLM 025 scatter, also discovered 20 July 2016, is located 960 m north of Poiana and 100 m west of the north-south road leading into the village. The Stereo 70 coordinates for the centre of the scatter are: E 496203, N 250663. The elevation at the centre of the scatter is 22.7 m above sea level. The scatter is in a field used for crops grown as a commercial enterprise which vary year on year on rotation and include sunflowers, cereals and corn. The southern edge of this agricultural land borders common land that surrounds a raised area (approximately 1 m above the surrounding area, up to 23.7 m) where there is a cemetery which used to be associated with Ciuperceni village when it was in its former location. The cemetery is no longer in use. The scatter at FLM 025 extends a short distance south beyond the border between the field to the north and into the common land that surrounds the cemetery to the south.

The scatter is 395 m southeast of the relict church which was previously within Ciuperceni before the village was moved to higher ground 1.5 km to the west following the major Danube flood of 1942 (Figure 11). Based on historic mapping dating to the early 20$^{th}$ century (Romanian Military maps of 1910 and 1928), formerly, the church was located towards the eastern end of the village with the village extending west across the north-south road to Poiana and a further 830 m to the west. After the village moved all this land was converted to fields for agriculture. The FLM 025 scatter lies between the southern edge of the former village and the old cemetery.

Immediately to the southwest of the scatter the land rises by 1 m to the raised area of land on which the former cemetery is located. Otherwise, the scatter is within a relatively flat area of land (around 22.7 masl) which is slightly lower than the surrounding land to the north and south. The area of land that includes the field in which the scatter is located is within a small palaeochannel that arcs east-west to the north of Poiana, and which connects with a larger palaeochannel beyond it which arcs to the west, north and east. The scatter is located on the right bank of a former palaeochannel.

As with FLM 024, it was observed that there is a low background amount of flint across the field but that the concentration at the scatter is much higher. A similar regime of ploughing occurs at FLM 025 as at FLM 024 but in an east-west direction and, again, observations since 2016 confirm that this has had very limited impact on the location, density and dimensions of the scatter. It is probable, therefore, that the worked flint material in the gravel scatter has been in the present location since its manufacture, as is the case with FLM 024.

Based on the early 20$^{th}$ century historical mapping, the northern edge of the scatter lies approximately 15 m to the south of rectangular plots of land associated with the former village (these may have been garden plots for individual houses). The southwestern edge of the scatter intersects with the common land surrounding the former cemetery. In addition to more recent agricultural ploughing, it is highly likely that the area of land within which the scatter is located will have suffered some disturbance from human activity because it was so close to the former location of Ciuperceni village.

Fieldwork in 2017 determined the dimensions of the scatter as maximum 50 m east to west and maximum 25 m north to south. The systematic count of material (worked flint) at surface within the 9 samples (using 0.5 sq m drawing frame) positioned in a transect across the scatter showed the density varied from 1-7 pieces at the edges to 20 maximum within the area of highest concentration. The transect line was 49 m long (including the length of the sample squares) running ESE to WNW and the highest density of material (count range 12 to 20) occurred in samples 4 to 6 from 18 m to 31 m along the transect measured from the southeast. Based on this work the area with the highest density of material within the scatter covers approximately 169 sq m (Figure 12).

Five hand auger cores were dug in autumn 2017 at the southern edge of the scatter in the common land surrounding the old cemetery. Core 1 was positioned at the lowest point in the land that borders the agricultural field and the common land and immediately south of the area of the scatter with the highest concentration of material at surface. This core went through the topsoil (which included small pebbles, gravel and flint) and then encountered a compact layer with larger pebbles beneath at 30 cm depth and could go no deeper. A further four cores (2-5) were aligned on a transect running west-east spaced 5 m apart and located just within the common land surrounding the cemetery (the transect line was 1.5 m south and equidistant east and west of the location of core 1). In core 2 the topsoil layer was 40 cm depth after which two layers became more yellow, finer and silty to 93 cm depth, followed by two layers that were thicker, darker, clayey and wetter to 145 cm depth and then two more layers that were much wetter, more yellow and silty down to 160 cm depth. This was the maximum depth attained from any of the cores at FLM 025. Core 3 reached 110 cm depth with 4 layers similar to the top 4 layers in core 2. As with core 1, cores 4 and 5 both went through the topsoil with gravel and small pebbles and then hit a compact layer with larger pebbles at 30-35 cm depth and could go no deeper. Cores 1, 4 and 5 indicated the presence of a compact layer of pebbles and flint just below the ploughzone and test sondages would help learn more about this.

With the field having recently been harvested of a cereal crop and mostly clear with just short stubble remaining, the summer of 2018 provided an opportunity for a test sondage at the edge of the common land bordering the southern edge of the agricultural land. Using GPS, the approximate position of core 4 was located and a sondage 2 m x 1 m aligned east-west set out (FLM 025 sondage 1). The topsoil (stratigraphic unit 1), excavated using shovel and trowel with soil sieved, was 0-30 cm in depth and included some small pebbles, worked flint, and pieces of shell and animal bone. As expected, at 30 cm depth the compact layer with larger pebbles and flint was encountered (stratigraphic unit 2) (Figure 5.2). The part of this layer in the 1mx1m western half of the sondage was excavated by trowel with all soil sieved. The layer was a 5-6 cm in depth (30-36 cm below surface) composed mostly of pebbles with some unworked and worked flint and small pieces of chalk. As encountered elsewhere within the scatter at surface, the worked flint included whole cores, pieces of blades, some other retouched pieces, and chips and shatter. Other material in this layer included some medieval pottery, pieces of brick and building material, pieces of glass and some metal (all medieval or later). The presence of these other materials is most likely intrusive and suggests some disturbance of the layer by activities associated with the former village. The pebble layer is very distinct ending abruptly around 36 cm depth. Below this (stratigraphic unit 3, 36-45 cm depth) the next layer is more yellow with areas of white calcareous flecks, and stickier and more clayey than unit 2 above but becoming siltier with depth. No archaeological material was encountered in this layer and the excavation stopped at 45 cm depth and the sondage backfilled.

Although the agricultural land was in sunflowers, in 2019 it was possible to excavate a 2 m x 2 m sondage in the common land at the southern edge of the crop (FLM 025 sondage 2). This was located 6.7 m to the west of sondage 1 excavated in 2018 and 5 m west of the geomorphological test pit (GTP 8) excavated a few days earlier in 2019 (see Fluvial geomorphological research section below for detail about geomorphological test pits). The western side of sondage 2 was inline with core 2 from autumn 2017 which had been dug approximately 30 cm further to the south of sondage 2. Sondage 2 had a similar series of layers to that in sondage 1. Excavated using shovel with soil sieved from 23 cm depth, the topsoil (stratigraphic unit 1) was 0-32 cm in depth and included some small pebbles, worked flint, some modern and medieval pottery, pieces of glass, and some small pieces of metal including nails and a bolt. The compact layer with pebbles and flint (Figure 7) was encountered from 32 cm depth across the whole sondage (stratigraphic unit 2) and is interpreted as a continuation of the same layer 5 m to the east identified in GTP 8 and 6 m to the east in sondage 1. Excavated by hand trowel with all soil sieved, the layer was 7 cm in depth and composed mostly of pebbles with some unworked and worked flint. The worked flint included a core and a blade. In the centre of the sondage at the top of the layer there was a large nodule of unworked flint (approximately 10 cm by 10 cm), next to this was a piece of sandstone with similar dimensions which contained small fossils. A piece of animal bone at the top of the layer was collected as a potential radiocarbon dating sample (C/01). Another piece of animal bone was collected from within the pebble layer for radiocarbon dating (C/02). The top of the layer also contained some modern pottery and pieces of metal (also modern). As with sondage 1, the medieval and modern objects are likely intrusive indicating disturbance of the layer by activities associated with the former village. A more yellow and silty layer which contained no archaeological material (stratigraphic unit 3, from 40 cm depth) was immediately beneath the compact layer; this correlates with unit 3 in sondage 1. The excavation stopped at this layer and was backfilled.

While it shows evidence of being disturbed from the medieval period onward, the compact layer remains distinct at 30-40 cm below surface. It is possible that this layer was originally thicker reaching nearer the surface but has been disturbed and mixed by ploughing in the ploughzone in the top 30 cm (see Fluvial geomorphological research section below for further comments about this layer).

In January 2020 the two bone samples were radiocarbon dated in the RoAMS laboratory at the Horia Hulubei National Institute for Research and Development in Physics and Nuclear Engineering (IFIN-HH), Bucharest. Both returned modern dates. Sample C/01 (RoAMS code: 1512.119) returned 1890-1909 cal AD at 65.0% probability and 1710 to 1957 at 95.4% probability. Sample C/02 (RoAMS code: 1513.119) returned 1809-1927 cal AD at 69.3% probability and 1688 to 1927 at 95.4% probability. These indicate that the bone samples were medieval or modern and likely derive from activities associated with Ciuperceni village when at its former location which became mixed with the compact layer, probably aided by the action of agricultural ploughing.

### Summary of flint material

An interim assessment of worked and unworked flint material collected during the 2013 to 2017 fieldwork seasons is reported elsewhere (see Mills *et al.* 2018), a summary of which is provided here. As already mentioned, of particular interest are the many cores and core fragments (10.5% of the 3832 worked pieces), particularly from the FLM 024 and FLM 025 scatters, some of which have narrow blade scars less than 3 mm width (Figure 2). These are single-platform conical-shaped cores that have been worked by a percussion technique to produce narrow blades or bladelets and similar to 'bullet' cores identified elsewhere. The colour of flint from the FLM 024 and FLM 025 scatters varies including black, dark grey, grey, brown, yellow and honey (similar to 'Balkan' flint), with a significant proportion of the flint within both scatters being dark grey and black and similar in colour to worked pieces that are probably Dudeşti in date found at other sites in Teleorman County. The quality of the raw material varies with some pieces having multiple flaws, characteristic of water borne flint, and there are cores with holes which have been worked around. Tool types from the scatters include scrapers, piercers and notched pieces but there are very few complete blades and bladelets and most worked pieces are chips and shatter. Of importance is the high ratio of cores and low number of blades which suggests that the scatters may have been the locations of flint workshops with blades and tools removed and reworked elsewhere.

Alongside more cores, preliminary assessment of other flint material collected during the 2018 and 2019 seasons, mostly from FLM 025, indicates that there are no microliths present and therefore nothing definitively of Mesolithic origin, but it does contain mixed flint material from later prehistory and likely the Neolithic onward. Further analyses of the flint collected to date will enable a fuller qualitive and quantitative assessment.

### Geomorphological and sedimentological investigations

The walk over assessment in 2013, plus the test hand auger cores in the palaeochannel belt labelled 'Valea lui Enache' between FLM 003 and FLM 004/FLM 024, had identified the potential for high-resolution palaeohydrological and possibly palaeobotanical records within the study area around Poiana and near the FLM 025 and FLM 024 scatters. This provisional understanding was enhanced in

2019 using the adjusted Sentinel 2 (L1C) imagery, alongside modern and historical mapping products, to better visualise paleochannels, palaeoislands and other geomorphological features digitally within the project GIS and as print outs when in the field. This helped interpret the likely Late Pleistocene and Holocene geomorphological development of the alluvial basin around Poiana (see below) as well as helping identify suitable locations for the geomorphological test pits (GTPs) by which to investigate the sedimentology and stratigraphy of fluvial and aeolian deposits.

Over two days in August 2019 using the hired mechanical excavator, twelve GTPs were excavated at select locations around Poiana, the precise positions of which were surveyed using the hired RTK GPS kit, with depths measured using hand tapes (Figures 6 & 13). All GTPs were 2 m by 1 m (except GTP 8 which was 7 m by 1 m) and were backfilled immediately after all observations, measurements, recording, and sample collection where relevant, were complete (within 1 hr of original excavation).

The first two (GTPs 1 & 2) were located along the east-west track 300 m to the north of the FLM 024 scatter and within the palaeochannel belt labelled 'Valea lui Enache'*.* GTP 1 was excavated through silts to a depth of 180 cm at which point it started filling with water and was stopped. A depth of 290 cm was reached in GTP 2 through silts, a soil with calcium carbonate concretions, followed by more silts. No material suitable for radiocarbon or OSL dating were identified in either GTP.

GTP 3 was located on the highest point of the raised area of FLM 003, 80 m west of the palaeochannel labelled 'Valea lui Enache' and on the opposite side from scatter FLM 024. Beneath the topsoil, between 60-100 cm depth this GTP encountered a feature cut (possible pit and ash layer) containing a layer with charcoal, shell and pieces of building material. This was followed by fluvially deposited yellow and brown silt layers from 100-238 cm depth until a fine to medium well sorted river sand appeared and continued to 275 cm, the maximum depth of the GTP. An OSL sample was taken from this sand layer at 260 cm depth (sample GTP 3/1).

GTPs 4 and 5 were excavated along the east-west track on the top of the ridge north of and 135 m from the FLM 024 scatter. Beneath the topsoil which reached 75 cm depth, GTP 4 was stopped at 90 cm depth because it encountered modern disturbance. GTP 5 was positioned 5 m to the east of GTP 4 and had topsoil followed by organic brown silts and then increasingly sandy silts down to 258 cm depth, the maximum depth for the GTP. The sand content was not high enough for an OSL sample. Located next to the north-south track leading to the Danube river, 410 m south of FLM 024 and 195 m north of the Danube embankment, GTP 6 had very compact topsoil followed by clayey silts to 230 cm depth. GTP 7 was located on the north-south track running just west of and 36 m from the centre of the FLM 024 scatter. Beneath the topsoil which reached 75 cm depth GTP 7 had brownish-yellow silts with some sand to 210 cm depth. No material suitable for dating samples were identified in GTPs 5, 6 and 7.

Positioned within the common land surrounding the old cemetery just south of the FLM 025 scatter, GTP 8 was 7 m by 1 m oriented with its long axis extending from near the edge of the cemetery at its south end to the edge of the agricultural land with sunflower crop at its north end. At its north end GTP 8 was just west (within 10 cm) of the western side of FLM 025 sondage 1 excavated in summer 2018. As with the hand auger cores and sondages at FLM 025, beneath the topsoil and sub soil, which reached to 36 cm depth, was the pebble layer down to 47 cm depth and which included some pieces of unworked and worked flint. The pebble layer was more distinct at the northern end of the GTP nearest the agricultural land and toward the area of the FLM 025 scatter. The pebbles were larger (maximum B-axis 140 mm) at the top of this layer with smaller gravel and more rounded pebbles beneath. Beneath the pebble layer were yellow clayey silts and silty clays down to 290 cm, the maximum depth of the GTP. An organic clay sample was collected toward the bottom of the GTP as a potential for future radiocarbon dating. There were very clear divisions between the topsoil/subsoil, the pebble layer and the yellow silts and clays beneath. This pebble-cobble unit is interpreted as a gravel splay associated with a major flood where coarse sediment has been deposited either across an upstanding floodplain bench or into a chute channel, or floodbasin, accreting fine-grained silts and clays (Macklin and Lewin 2003).

GTPs 9 and 10 were located next to a north-south track passing through agricultural land 160 m and 190 m east of Poiana and 230 m and 310 m north of the village cemetery respectively. This area of land has a series of upstanding linear dune features aligned WNW-ESE and GTP 9 was positioned at the lowest point between two of these features and GTP 10 at the top of one. Beneath the 70 cm of topsoil, GTP 9 had brown clayey silts and then silty clays but no material suitable for sampling was encountered. GTP 10, on the top of a linear dune feature, had a shallow topsoil to 35 cm depth and then encountered a possible pit feature cut into the dune sand at 35-70 cm depth that included within it charcoal, burnt clay and a dark brown organic soil. Beneath this were a silty sand layer followed by a layer of fine to medium well sorted sand to 235 cm depth. An OSL sample (GTP 10/1) was taken at 180 cm depth from this sand layer.

The final two GTPs, 11 and 12, from the 2019 season were located next to an east-west track across agricultural land to the west of Poiana and within the large palaeochannel system that arcs west to east passing north of the village. Within the large palaeochannel system, GTP 11 was in the furthest west, possibly youngest, channel 1435 m west of the village and near a former chemical works. The topsoil reached 90 cm depth and was followed by a deep sequence of yellow-brown silts with some sand becoming more clayey with depth down to 320 cm where the GTP was stopped. GTP 12 was located 860 m east of GTP 11, 575 m west of the village, within a wider, probably older, channel of the palaeochannel system. This GTP had a similar stratigraphic sequence to GTP 11 with topsoil to 80 cm depth followed by a deep sequence of brown and then grey silty clays to a maximum depth excavated of 320 cm. No material suitable for dating samples were identified in either GTP.

The thick fine-grained alluvial deposits evident in the GTPs from the 2019 season located within the low lying palaeochannels and palaeochannel belts on the low terrace of the river Danube beyond the current active channel zone demonstrate that they were subject to long-term and continuing inundation and sedimentation by major floods. The two GTPs (3 and 10) located on an upstanding Late Pleistocene river terrace (GTP 3) and Late Pleistocene dune (GTP 10) not significantly impacted by Holocene flooding both have archaeological features suggesting that these higher parts of the valley floor were preferentially selected by people for short or long-term habitation.

With appropriate permissions, in August 2019 the OSL sand samples collected from GTP 3 (GTP 3/1) and GTP 10 (GTP 10/1) were sent by courier to the School of Geography, University of Lincoln. They were then sent to the Luminescence Dating Laboratory, University of Oxford for dating and results and a report were received in May 2021 (Table 1). The samples were deemed to have good signal characteristics and excellent sensitivity.

| **Field code** | **Laboratory code** | **Burial depth (cm)** | **Palaeodose (Gy)** | **Dose rate (Gy/kyr)** | **OSL age estimate (years before 2020)** |
|---|---|---|---|---|---|
| GTP 10/1 | X7513 | 180 | 37.82 ± 2.24 | 1.37 ± 0.06 | 27,550 ± 2030 |
| GTP 3/1 | X7514 | 260 | 46.54 ± 2.99 | 1.53 ± 0.07 | 30,500 ± 2425 |

**Table 1.** Summary of the optically stimulated luminescence (OSL) dating.

Rezumatul datării prin metoda luminiscenţei stimulate optic (OSL).

Alongside helping with interpretation of the geomorphological sequence in the study area, this OSL dating outcome is encouraging and indicates it is worthwhile expanding the sample collection strategy and number and geographic range of GTPs in future seasons to target more of these sand layers. One such area is a prominent west-east dune ridge marking the boundary between the large palaeochannel system and the area of former Lake Bercelui (drained in the 20th century) to the west of Poiana (there are archaeological find spots with prehistoric and later pottery along this ridge). The ridge was visited in 2019 and sandy silts were observed coming from animal burrows dug into the steep south side of the ridge suggesting that a series of test pits excavated from the top of the ridge would be worthwhile.

Based on the walk over assessments, the historical and modern mapping and Sentinel 2 (L1C) imagery, the hand auger cores, the GTPs, the elevation transect and the OSL dates, a provisional phasing of Late Pleistocene and Holocene river and dune development in the study area around Poiana is proposed (Figures 14 & 15). The extensive terrace located c. 6 m above the low flow level of the present river would appear to date from c. 30-27 ka BP, formed under cold climate conditions during Greenland Stadial event 5.1 and Greenland Interstadial event 3 (Rasmussen *et al.* 2014). River aggradation is recorded in many parts of central, eastern and southern Europe (Macklin *et al.* 2002; Starkel *et al.* 2015) during this period. Linear dune activity at c. 30 ka at Poiana also coincides very closely with loess deposition dated at 30 ± 3 ka BP from a nearby Danube terrace immediately north of the study area associated with Palaeolithic worked flint (Dobrescu *et al.* 2015). Following this major phase of river aggradation, the Danube incised its valley floor creating a series of entrenched channel belts separated by upstanding islands formed of earlier late Pleistocene fluvial and aeolian deposits. Based on dates on the nearby River Teleorman (Macklin *et al.* 2011), a major north bank tributary of the River Danube, this period of punctuated but progressive entrenchment took place from c. 21.6-11.3 ka BP and was largely complete by the beginning of the Holocene. In this proposed sequence, the two flint scatters FLM 024 and FLM 025 are located on what would have been gravel bars on the edge of a river channel that would have been flowing certainly during major floods large enough to transport pebble- and cobble-size material. This would suggest that this palaeochannel was part of the active-channel zone during the early to mid-Holocene period with people collecting flint for tool manufacture from gravel splays or sheets deposited by major floods at channel margin locations. Indeed, much of the archaeology visible at surface, evidenced by the location of many of the FLM find spots, are on the upstanding older (late Pleistocene and early Holocene age) surviving river terraces and dunes, which were not affected by later Holocene river erosion or sedimentation.

## Conclusions

This is a similar situation to that previously studied in the Teleorman Valley (Macklin *et al.* 2011), where Neolithic sites and findspots are also found on upstanding late Pleistocene and early Holocene river terraces. Implications of the proposed geomorphological sequence for the location, kind and preservation of archaeology in similar riverine contexts within the Lower Danube valley is that there is little chance of finding prehistoric (particularly related to the Mesolithic period) archaeology in low-lying valley floor areas. This is likely because of disturbance or destruction of archaeological sites and find spots by later flooding and erosion, and/or burial by alluvium rendering sites invisible from surface prospection. Rădoane *et al.* (2019) have shown through a meta-analysis of a large (>150 dates) countrywide database of radiocarbon dated Holocene fluvial units that rates of river erosion were higher in the period up to 10.7-4.5 ka, with accelerated sedimentation since 4.0 ka.

To date, no direct evidence has been identified in the study area for Holocene Rapid Climate Change (RCC) events including the 8.2 ka BP event, which is again similar to results from previous studies in the Teleorman Valley (Macklin *et al.* 2011). Further west and upstream in the Danube Gorges, recent research and discussions of stratigraphy and radiometric dating at sites including Lepenski Vir and Schela Cladovei have highlighted the potential impact of the 8.2 ka cal BP RCC event on local riverine environments, communities and lifeways around the time of the Mesolithic-Neolithic transition (Bonsall *et al.* 2015; 2016; Boric *et al.* 2018). Further research in the Poiana study area may help to establish if there is any geomorphological, sedimentological and archaeological evidence dating to the time of Holocene RCC events further downstream from the Gorges that could contribute to these recent debates.

Further east, downstream from Poiana, collaborations between archaeologists and geomorphologists within the Danube valley and delta have furthered understanding of environmental conditions and human-river interactions dating to the Neolithic and later. Good examples of this are from the sites of Pietrele (in the Danube valley e.g., Benecke *et al.* 2013; Hansen 2015) and Taraschina (in the Danube delta e.g., Carroza and Micu 2022). Elsewhere our knowledge of the lower Danube valley environment during the early to mid-Holocene (and later) is insufficient to further interpretations of human-river interactions. The possibility of a palaeolake in the east of Muntenia covering a large part of the Danube Valley and plain in the early Holocene may be a reason for the lack of early Neolithic evidence in that area (Benecke *et al.* 2013; Reingruber 2017: 103) and requires further study.

Based on research and evidence to date, our current interpretation for the FLM 024 and FLM 025 scatters is that they are located on gravel bars or splays on the edge of a river channel that would have been flowing certainly during major floods large enough to transport pebble- and cobble-size material. This would suggest that these palaeochannels were part of the active-channel zone during the early to mid-Holocene period with people collecting flint for tool manufacture from gravel splays or sheets deposited by major floods at channel margin locations. People expediently worked flint material in situ at these scatters, the locations were essentially flint workshops, then removed blades and tools for use elsewhere. As part of their lifeways, it is likely people were combing the area of the valley and wetlands after recent floods and identifying deposits of flint and using them. People will have been familiar with this area as a source of raw flint material since at least the upper Palaeolithic onward.

There is a considerable resource of raw flint accessible in the area including on extensive gravel bars (and cliffs) at Nikopol and Belina, in the north terrace of the Danube valley near Ciuperceni and the splays and findspots around Poiana studied as part of this project. As they have flint readily available, flint on gravel bars or exposed gravel in riverbanks could have been visited by prehistoric people on an opportunistic basis to acquire the resources and perhaps to begin to work the material. Given the proximity of the flint findspots FLM 003, FLM 004 and the scatter FLM 024 around the 'Valea lui Enache', it is possible that they were closely related activity areas in prehistory and frequently visited. The possibility that these locations might represent flint workshops is potentially important because such workshops are not known elsewhere in the area - none so far have been convincingly identified for 'Balkan' flint in the Nikopol outcrop area in Bulgaria which is a major source of raw flint material or at settlements (Gatsov *et al*. 2017a, Gurova and Bonsall 2014). As locations with evidence for in situ flint working within active channels of the Danube in the early Holocene, the flint scatters around Poiana may have been part of wider chipped stone networks in the lower Danube area perhaps linked to those for 'Balkan' flint. The presence of the single platform conical and sub-conical shaped cores might represent connections to broader communication networks extending widely around the Black Sea area.

Determining the exact chronology for use of these splay/scatter locations is challenging given the presence of much mixed worked flint material that can span the Palaeolithic through to later prehistory. The presence of the single platform conical and sub-conical shaped cores with narrow blade scars may indicate Mesolithic or early Neolithic activity but the absence so far of microliths precludes a definitive statement.

Research demonstrates the importance of riverine resources and rivers as modes of communication and conduits for exchange networks throughout (pre)history (e.g., Macklin and Lewin 2015). Our work extends this research to include the wetland areas in alluvial basins of the lower Danube valley indicating that prehistoric people were taking advantage of flint resources within the active channel zone and at the floodplain edge. Fishing in the Danube Gorges and the use of Early Neolithic pottery with fish residues indicate the importance of aquatic resources suggesting a continuation of Mesolithic traditions (Cramp *et al.* 2019). It is likely that similar traditions occurred along the length of the lower Danube valley east of the Danube gorges including in our study area.

To advance research in the study area future work should include:

1) Geophysics across the area of flint scatters and targeted elsewhere in the study area (ridge above former lake Becerlui), multispectral done flying with LiDAR to generate high-resolution imagery of the landscape.

2) Further test excavations and geomorphological test pits, with additional OSL and $^{14}C$ dating.

3) Flint provenancing and comparison with similar work in Bulgaria.

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WWW2: Sentinelhub Playground. https://apps.sentinel-hub.com/sentinel-playground/ [Accessed 08/12/2023]

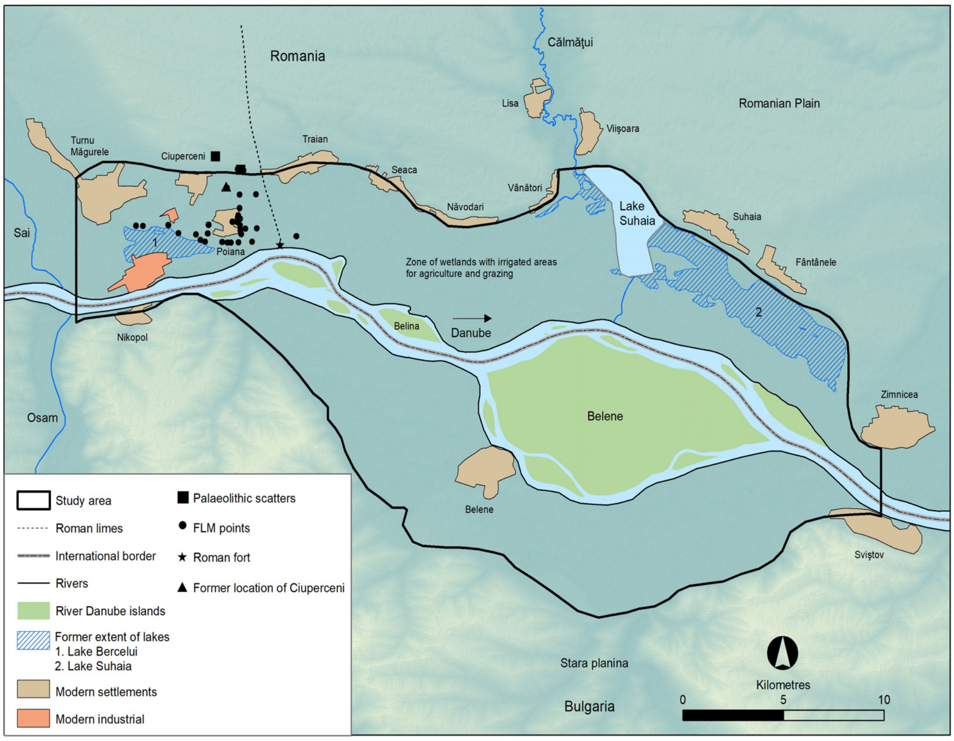
WWW3: Corona Cast. https://corona.cast.uark.edu/ [Accessed 08/12/2023]


**Figure 1.** Location of the study area, the alluvial basin of the Danube between Turnu Măgurele and Zimnicea. Base map made using the global digital elevation model (DEM) derived from GTOPO30, made available by the European Environment Agency at: https://www.eea.europa.eu/en/datahub/datahubitem-view/357f686f-1939-4652-8e79-c9ac7a1c5da6.

Amplasarea zonei de studiu, bazinul Dunării între Măgurele şi Zimnicea. Hartă realizată pe baza modelul global de modelare digitală a terenului (DEM) derivată din GTOPO30, pusă la dispoziţie de Agenţia Europeană a Mediului la: https://www.eea.europa.eu/en/datahub/datahubitem-view/357f686f-1939-4652-8e79-c9ac7a1c5da6.


**Figure 2.** Examples of single platform conical and sub-conical shaped 'bullet' cores from around Poiana.

Nuclee conice şi subconice cu o singură platformă de tip 'bullet cores' (nuclee 'glonţ') provenite din situri din jurul satului Poiana.

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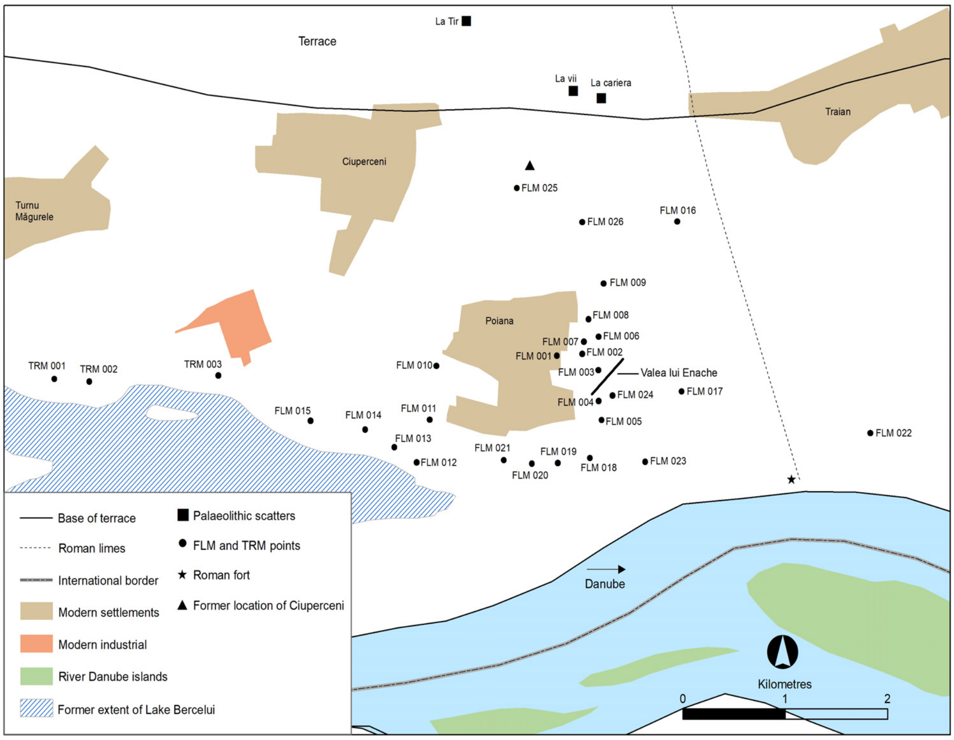
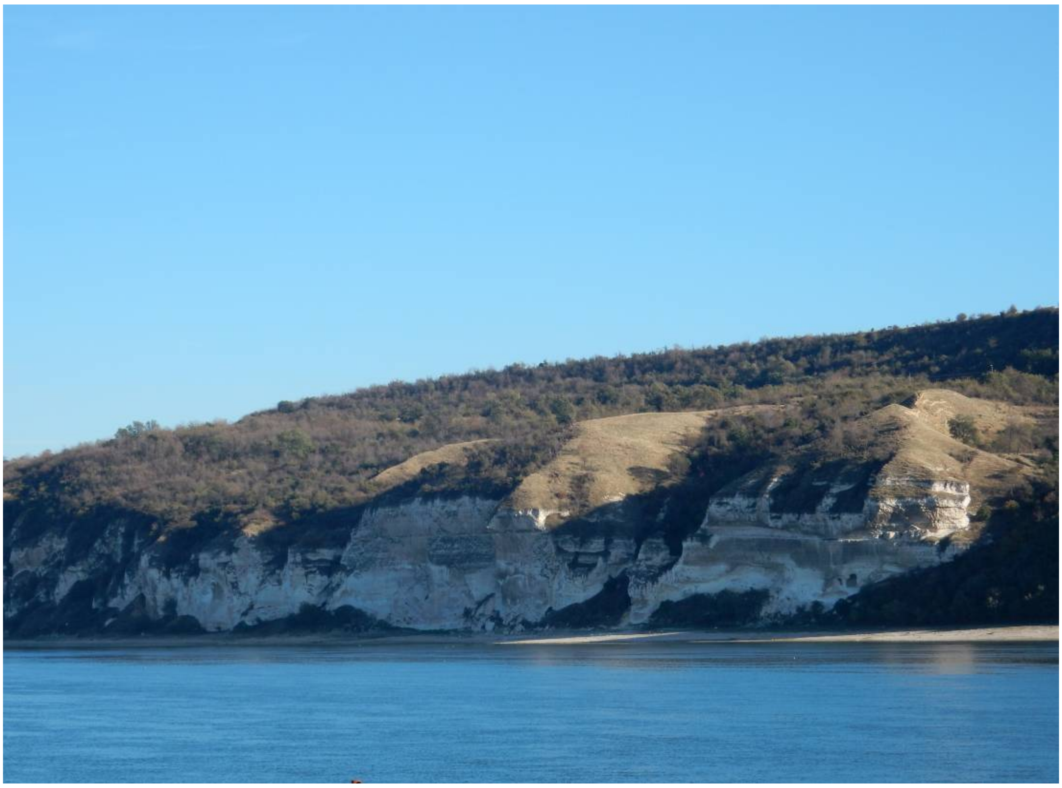



2

**Figure 3.** Maps of study area showing location of main features (1) and FLM sites/scatters (including 'Valea lui Enache', Belina and Nikopol) (2).

Hărţi ale zonei de studiu cu principalelor caracteristici geografice (1) şi cu locaţia siturilor/zonele de cioplire a silexului FLM (inclusiv 'Valea lui Enache', Belina şi Nikopol) (2).

1



2

**Figure 4.** Flint nodules on the beach (1) and outcropping in the limestone cliffs at Nikopol (2).

Noduli de silex pe malul Dunării (1) şi aflorimente la zi în rocile de calcar de la Nicopole (2).


1

2

**Figure 5.** Sondage excavations in summer 2018. FLM 024 sondages 1 and 2 (1); FLM 025 sondage 1 (2).

Sondaje excavate în vara anului 2018. FLM 024 sondajele 1 şi 2 (1); FLM 025 sondajul 1 (2).


1

2

**Figure 6.** Geomorphological test pits (GTP) 2019. GTP 1 being excavated (1); OSL sample being collected from GTP 10 (2).

Sondajele geomorfologice (GTP) excavate în 2019. GTP 1 în curs de cercetare (1); colectarea unei probe pentru datarea prin termoluminiscenţă (OSL) din GTP 10 (2).

1

2

**Figure 7.** FLM 025 Sondage 2/2019. The pebble layer with worked and unworked flint (1); sondage 2 being excavated (2).

FLM 025 sondajul 2/2019. Nivelul de pietriş, cu silex prelucrat şi neprelucrat (1); sondajul 2 în curs de cercetare (2).


1


2

**Figure 8.** Drone images from the study area. FLM 024 looking north showing area of the lithic scatter, ploughing lines and the 'Valea lui Enache' (1). FLM 025 looking south showing area of the lithic scatter, ploughing lines and the location of the former cemetery (2) (photographs by I. Torcică).

Imagini din dronă a zonei de studiu. FLM 024 văzut spre spre nord, cu zona de cioplire a silexului, brazdele de arătură şi 'Valea lui Enache' (1). FLM 025 văzut spre sud, cu zona de cioplire a silexului, brazdele de arătură şi amplasamentul fostului cimitir (2) (fotografii de I. Torcică).

**Figure 9.** Beach on the southern side of Belina island with unworked pieces of flint.

Malul Dunării în partea de sud a Insulei Belina, cu fragmente de galeţi de silex neprelucrate.

1


2

**Figure 10.** FLM 024 scatter. July 2016, view from area of highest concentration looking south towards the ridge with some of the flint collected in foreground (1). Map of FLM 024 showing area of scatter, area of highest density of material, and location of hand auger cores, sample count transect and sondages (background imagery ESRI World Imagery dated 2022) (2).

FLM 024, imagine din iulie 2016 a zonei cu cea mai mare concentrare de silex văzută spre sud, spre partea cea mai înaltă, cu o parte din silexul colectat, în prim plan (1). FLM 024, harta cu zona de cioplire a silexului, cu evidenţierea zonei cu cea mai mare densitate de material şi amplasarea punctelor în care s-au efectuat sondaje cu carotiera manuală, a traseului pe care s-a făcut cuantificarea probelor şi a sondajelor (imagine de fundal ESRI World Imagery, datată 2022) (2).

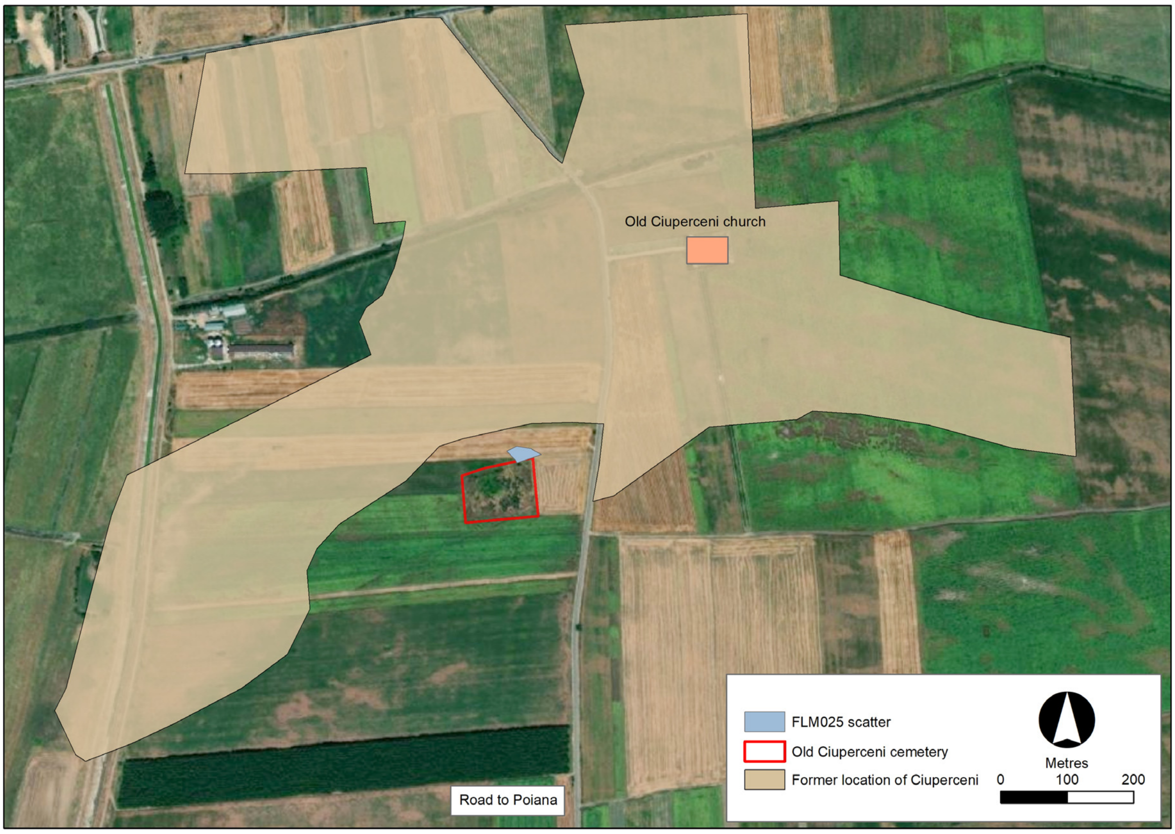



**Figure 11.** FLM 025 scatter relationship to the former location of Ciuperceni village, the old church and cemetery (background imagery ESRI World Imagery dated 2022).

Situl FLM 025 pus în relaţie cu fostul amplasament al satului Ciuperceni, vechea biserică şi cimitirul (imagine de fundal ESRI World Imagery, datată 2022).

1

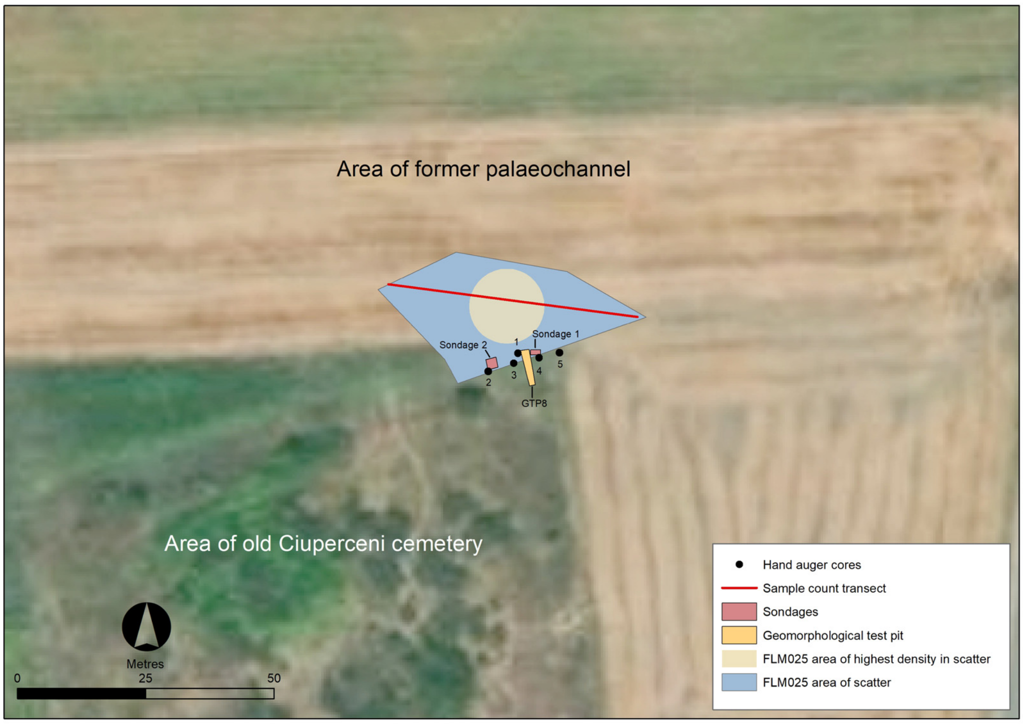



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**Figure 12.** FLM 025 scatter. November 2017, view from the Poiana road looking west towards the field with the scatter and the old Ciuperceni cemetery on the left (1). Map of FLM 025 showing area of scatter, area of highest density of material, and location of hand auger cores, sample count transect and sondages (background imagery ESRI World Imagery dated 2022) (2).

FLM 025, noiembrie 2017, vedere spre vest, din drumul spre Poiana către zona de cioplire a silexului, cu cimitirul vechi al satului Ciuperceni în stânga (1). FLM 025, harta cu zona de cioplire a silexului, cu evidenţierea zonei cu cea mai mare densitate de material şi amplasarea punctelor în care s-au efectuat sondaje cu carotiera manuală, a traseului pe care s-a făcut cuantificarea probelor şi a sondajelor (imagine de fundal ESRI World Imagery, datată 2022) (2).


**Figure 13.** Location of the 2019 Geomorphological test pits (GTP) (background imagery ESRI World Imagery dated 2022).

Amplasarea sondajelor geomorfologice (GTP) făcute în anul 2019 (imaginea de fundal ESRI World Imagery, datată 2022) (2).

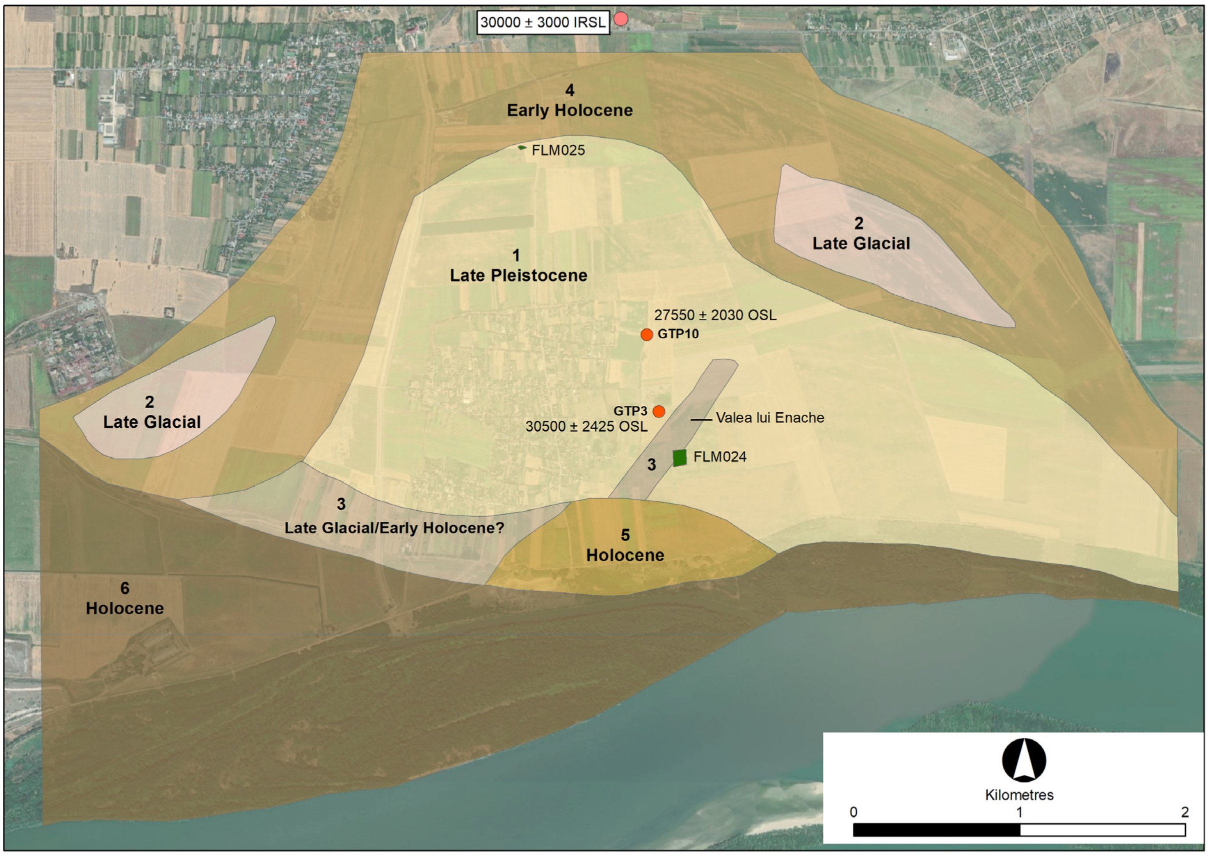


**Figure 14.** Map showing the provisional phasing of Late Pleistocene and Holocene river and dune development in the study area around Poiana, and the locations from which OSL dates were obtained as part of this project and the IRSL date reported in Dobrescu *et al.* 2015.

Hartă care prezintă evoluţia ipotetică a fluviului şi a dunelor în Pleistocenul târziu şi în Holocen în zona de studiu din jurul satului Poiana, precum şi locaţiile din care au fost obţinute datele OSL în cadrul acestui proiect şi data IRSL raportată în Dobrescu *et al.* 2015.

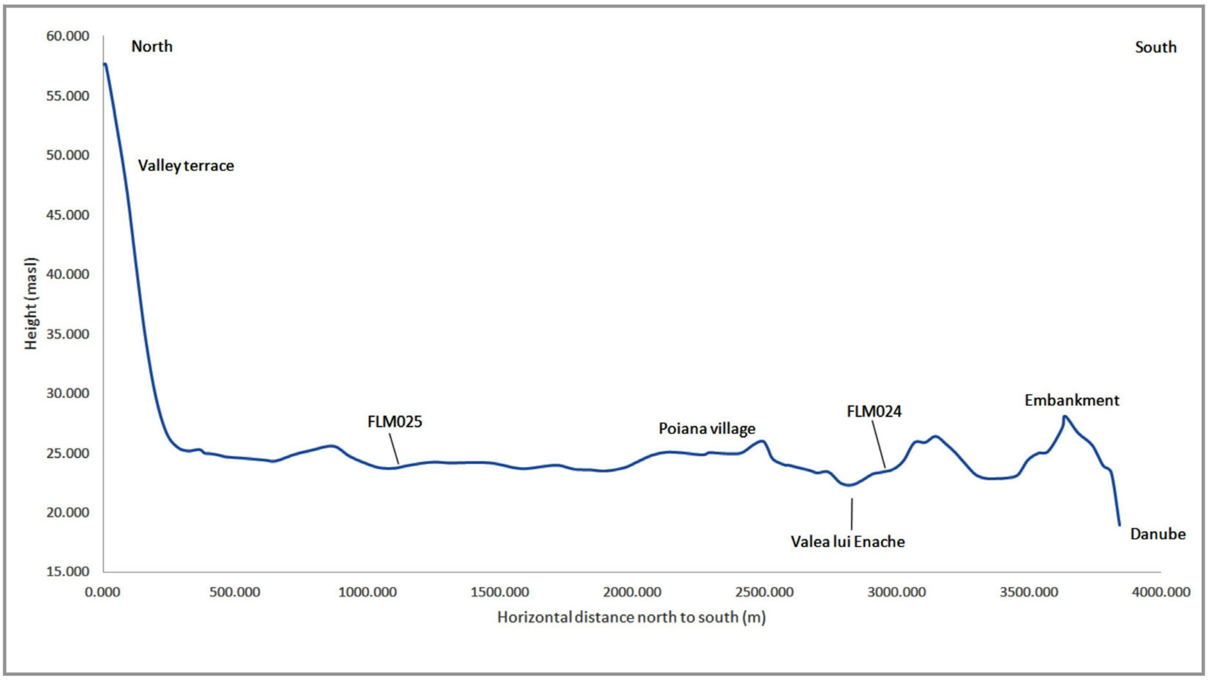


**Figure 15.** Plot of the elevation transect across the study area.

Graficul altitudinilor printr-o secţiune a zonei de studiu (valea Dunării).