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# Neolithic and Chalcolithic settlement patterns in central Moldavia (Romania)

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**ABSTRACT** – *Despite a long tradition of studies of the Moldavian Neolithic and Chalcolithic cultures, the analysis of the territorial behaviour of human communities remains underexploited. This work combines concepts used in landscape archaeology with the potential of the Geographic Information System (GIS) to mobilise archaeological artefacts in a large-scale setting and for many thematic purposes. This paper aims to compare the spatial and temporal distributions of archaeological evidence in central Moldavia. Applying integrated approaches through GIS analysis, it explores the natural, economic and social phenomena involved in territorial trajectories during the Later Prehistory (6000–3500 BC). In the chronological framework of the Starčevo-Criș, Linear Pottery, Precucuteni and Cucuteni cultures, different types of spatial analysis are computed in order to underline territorial control and supply strategies in an area well known for its density of its fortified settlements, extremely rich soils and abundance of salt springs.*

**IZVLEČEK** – *Kljub dolgi tradiciji študija neolitskih in halkolitskih kultur v Moldaviji je delovanje človeških skupnosti v prostoru še vedno premalo raziskano. To omogočajo koncepti prostorske arheologije v povezavi z geografskimi informacijskimi sistemi (GIS), s katerimi povezujemo arheološke artefakte na večjem območju v mnoge tematske sklope. V članku primerjamo prostorsko in časovno razprostranjenost arheoloških zapisov v centralni Moldaviji. Z uporabo integriranega pristopa preko analize GIS raziskujemo naravne, ekološke in družbene fenomene, ki so bili vključeni v teritorialne trajektorije v mlajši prazgodovini (6000–3500 BC). Predstavljamo različne tipe prostorskih analiz v kontekstu kultur Starčevo - Criș, Linearno-trakaste keramike, Precucuteni in Cucuteni, da bi poudarili pomen nadzora skupnosti nad ozemljem in strategije oskrbe na področju, ki je znano po veliki gostoti utrjenih naselbin, po zelo rodovitni zemlji in številnih slanah izviroh.*

**KEY WORDS** – *Later Prehistory; territories; salt springs; Moldavia; GIS*

## Introduction

Towards the end of the 6<sup>th</sup> and especially during the 5<sup>th</sup> millennium, an evolution of social and economic needs is perceived in Romanian Moldavia. This is observed through the densification and diversification of settlement patterns, as well as an increasing exploitation of natural resources strictly correlated to the expansion of exchange networks. This transfer of ideas and objects occurs in the context of the assertion of major cultural groups of Cen-

tral and Eastern Balkans in a largely amended social and economic framework.

The intensification of agricultural production arising in a territorial framework largely organised around stable settlements, generally fortified and dispersed, is similar to a Neolithic 'second revolution'. From a terminological point of view, it leads to the Chalcolithic period (second half of the 5<sup>th</sup> millennium),

which corresponds to the thriving of economic structures and production processes. Our research consists in a global approach to Later Prehistory settlements patterns that persisted for almost three millennia, in order to underline the nature and dynamics of settlements in the long term. The study will first assess the structuring resources of settlements (primarily salt and soil), before offering viewpoints on how to broaden our understanding of the territorial strategies of Neolithic and Chalcolithic Moldavian communities.

### Study area

The study area covers 8900km<sup>2</sup>, from the Eastern Carpathians Mountains to the River Prut (Fig. 1). It covers Neamț and Iași Counties and clearly distinct geographical environments: the Eastern Carpathians Mountains (more precisely the flysch zone); the Carpathian Depression and Sub Carpathian hills (Suceava Plateau); and the Moldavian Plain. Yet, this study does not dwell on the mountainous zone of the Carpathians, as it was indeed little occupied by Later Prehistoric communities, due to rugged areas and steep slopes. The transitional area with the Carpathian Depression, bounded by the confluence of the Siret and Moldova rivers, is marked by outcrops of Aquitanian and Tortonian salt deposits (*Velcea, Savu 1982.239–243*).

Many salt springs (Fig. 2A) and chlorinated waters with sodium originate from this salt belt. Many old and recent studies (*Meruțiu 1912; Șandru 1952; Monah 2002; Weller, Brigand and Alexianu 2007; 2010*) have specified the nature, chemical composition and distribution of these resources. In the depression, the Sub Carpathian hills composed of sandstone, marl, clay and conglomerate deposits can be found between 200 and 300m a.s.l.; while they can be found up to 300 to 350m in the glacia areas (*Lupașcu 1996.17–28*). In structural terms, the Moldavian Plain is a monocline oriented NW-SE, bounded in the west and south by 'cuesta landforms', steep slopes exceeding 250m. Sarmatian deposits (clay and marl) can be found only on very steep slopes affected by erosive trends (*Băcăuanu 1968.77–82*). They are covered by loess deposits on ridges, plateaus or gentle slopes. To the south, the Central Plateau is made of more resistant sandstones and limestone bedrocks, thus explaining the more rugged relief.

Soils and their agronomic potential are a record of geological heritage and anthropic management. Two

main categories have been defined by climatic zoning (*Băcăuanu 1968; Lupașcu 1996*):

Type 1. The level of alluvial clay, made up of brown and grey steppe soils, occasionally found on the plateaus that limit the Moldavian Plain (west and south). They are most commonly found in the Carpathian Depression.

Type 2. The level of mollisols (chernozem) that predominate in the Moldavian Plain and the Bistrița Valley, which includes the backs of cuetas and low interfluves, terraces and lower parts. Steep slopes heighten the probability of landslides, more so in the Moldavian Plain. The intensification of agricultural and deforestation activities were the principal causes of accelerated erosion. In lower areas, hydro-morphic and saline soils are common (*Băcăuanu 1968.81*).

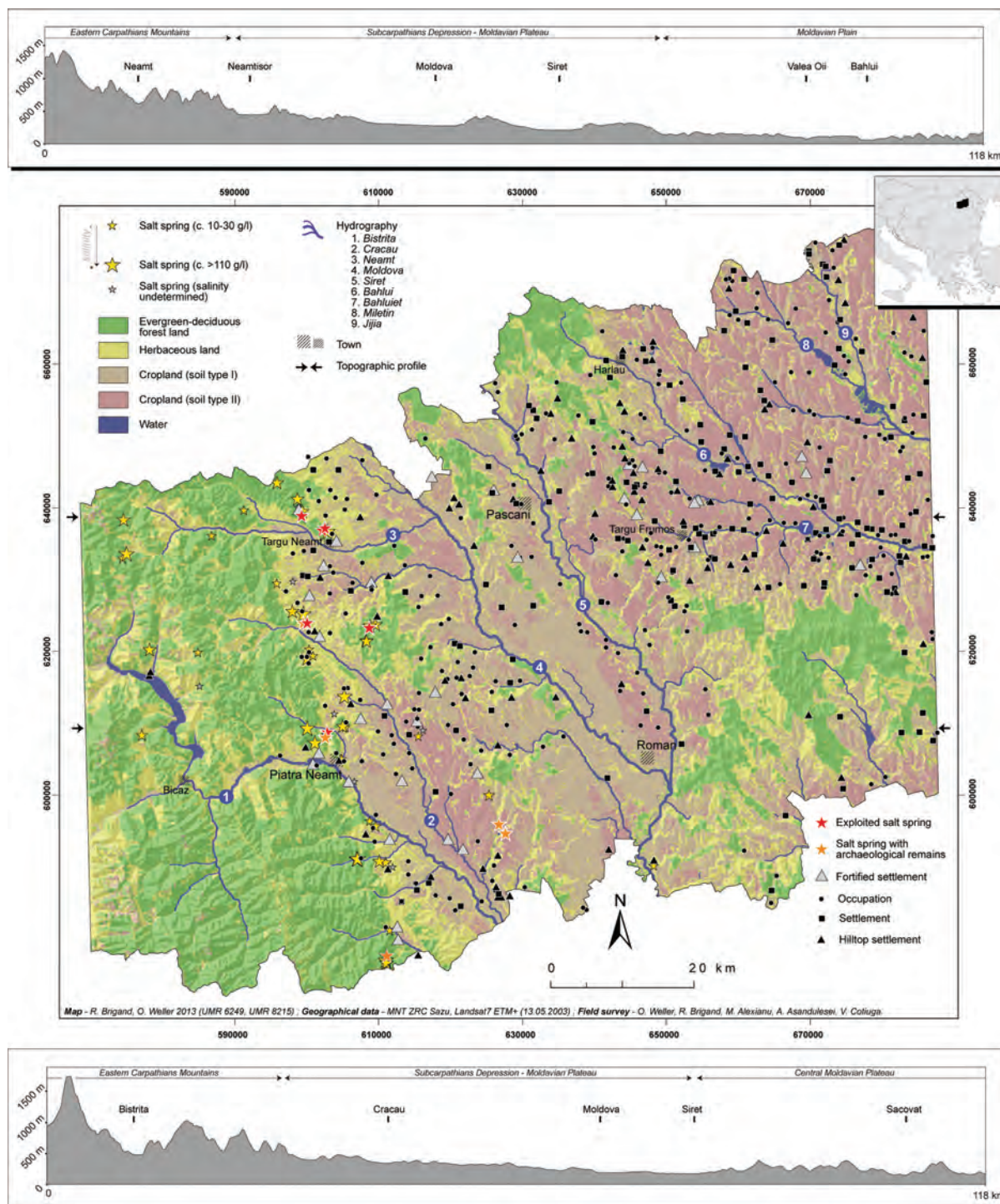
Landsat remote sensing data acquired on 05/13/2003 were used to distinguish soil patterns and current land use (Fig. 1). The enhanced multispectral image (using the 15m pixel size panchromatic image) and its classification, along with the use of a soil map published in 1990, enabled us to obtain good information on soil moisture and the main soil categories. Brown soils (soil type I) are commonly found in the Carpathian Depression; Chernozem (soils type II) seem to be widespread in the Moldavian Plain as well as in the Carpathian Depression alluvial plain.

The first clearings were made through slash-and-burn by the first farming groups in the Neolithic era. According to *Lupașcu (1996)*, the intensification of agriculture and pastoral land use since the Neolithic were the main cause for the processes that formed the specific characteristics of soil such as chernozem. Paleo-environmental analyses should probably enlighten us on this matter. Due in part to the lack of sampling areas likely to trap organic material in sediment cores to reconstruct changes in the Holocene, these are as yet too few to be significant (*Carciunaru, Monah 1987; Volontir 1990; Danu et al. 2010*). However, they suggest the long-term stability of forest composition, canopy coverage being reduced since the later sub-boreal climate.

### Archaeological data

The mapping and geographical analysis of settlement patterns has been made possible by the use of geographical information systems or GIS to put archaeological databases into a spatial framework. Since the





**Fig. 1. Study area: topographic profile, land cover, stream reconstruction, salt spring and archaeological sites (6000–3500 BC).**

end of the 19<sup>th</sup> century, various stakeholders have contributed to a general knowledge about the prehistoric archaeology of Moldavia. Important publications are now part of the institutional historiography of the Neolithic and Chalcolithic cultures (Zaharia et al. 1970; Chirica, Tanasachi 1984; Monah, Cucos 1985; Marinescu-Bilcu 1993; Cucos 1999; Popovici 2000; Ursulescu 2000; Văleanu 2003; Bog-

hian 2004; Bem 2007). Our study has benefited from these numerous inventories, while sharing with local researchers and field prospectors (among others, G. Dumitroaia, R. Munteanu and D. Garvăn from the History and Archaeology Museum of Piatra Neamț; D. Monah, V. Cotiugă and A. Asăndulesei from the Iași Institute and University). Given the complex history of research and the undeniable wealth of data,

an exhaustive yet critical database has been created for Neamţ and Iaşi counties. All the available information has been stored in an SQL environment database.

### **Reliability**

The aim is to assess the validity of archaeological information. A confirmed settlement must be distinguished from a duplicate or uncertain one. As field surveys are rarely coordinated, a large set of points overlap, thus needing to be eliminated. For instance, only 603 archaeological sites referred to 6000–3500 BC out of a total of 737 could be calibrated to the Neolithic and Chalcolithic periods.

### **Quality**

This is an important section, as it allows the initial data classification to be built (Fig. 1). The issue of archaeological classification has greatly mobilised scientific communities. Researchers started to use topographical criteria in order to distinguish between different types of archaeological site in the 1970s (Zaharia et al. 1970:32–34; Monah, Cucuș 1985: 42–43). A look at former inventories shows a more or less elaborate classification between higher, lower and medium positions. These, however, are not always relevant, given that their variability depends

on territorial topography. A single topographical criterion cannot establish a valid hierarchy; it must necessarily be associated with other data, such as the nature and quantities of archaeological artefacts. Four standard types were retained in the study:

- Occupations (49%). The lowest level – also the largest group – is constituted by small sites that provided only a limited number of ceramic remains, with no obvious element of domestic architecture or materials of quality. This probably includes temporary sites characterised by high mobility. Yet, they are often poorly delineated and insufficiently surveyed.
- Settlements (42%). Simple settlements (28%) display architectural structures (benches or abundant clay wall) and artefacts of quality (figurines, painted ceramics, bone, millstone and flint tools). They differ from hilltop settlements (14%), which are limited by steep slopes forming a headland opening onto a wide site. Low terrace settlements, closed on one side, are considered as simple settlements rather than hilltop ones.
- Fortified settlements (7%). These include sites characterised by man-made fortifications, with abundant archaeological remains and house remains (Fig. 2B,



**Fig. 2. Fortified settlements, salt spring exploitation and current landscape: A Hălăbutoaia-Țolici (Petricani, Neamţ) salt spring and archaeological deposit in the background; B Ferma de Vacii Valea Seacă (Bălătești, Neamţ) dating to Cucuteni A; C Precucuteni and Cucuteni enclosed settlement of Văleni (Piatra Neamţ) up to Bistrița River; D the Bistrița valley in the southern part of Piatra Neamţ; E Valea Oii fluvial landform and two Cucuteni A settlements on low (bottom left corner) and high (right) eroded terraces (Filiași, Bălăți, Iași). Photo: O. Weller (A, B, C, D) and A. Asăndulesei (E).**



2C, 2E). Due to the temporary or reuse aspect of these constructions, numerous fortified structures can no longer be detected.

- Salt exploitation (2%). Eight salt springs give the most direct and accurate indications of salt exploitation, which dates to the Neolithic and Chalcolithic periods (Dumitroaia 1994; Weller, Dumitroaia 2005; Weller et al. 2007). The evidence of exploitation comprises salt moulds, ceramic containers for salt-water crystallisation, and charcoal (an indication of salt production by burning). Six other salt springs contained indirect remains of salt exploitation during Later Prehistory.

### Discovery

A reliable piece of evidence on research dynamics in this area has been provided by the relatively large number of excavated sites: 104 have been found (17%). The inclusion of surface surveyed sites is justified by the elaboration of archaeological mapping. However, difficulties arise when it comes to analysing the settlement pattern and comparing all sites because the data are uneven.

### Chronology

Site excavation provides a relative chronological framework. Dating a site from archaeological remains collected by field survey raises doubts as to how representative and reliable they are for periodic maps. Significant and recurring observations have been made for almost a century in Neamţ and Iaşi counties, making an evaluation of the dynamics of settlement patterns possible: Starčevo-Criş (10%), 6000–5300 BC; Linear Pottery (3%), 5300–5000 BC; Precucuteni (10%), 5000–4600 BC; Cucuteni (77%), 4600–3500 BC (Fig. 3). The Cucuteni period is divided into two or three phases.

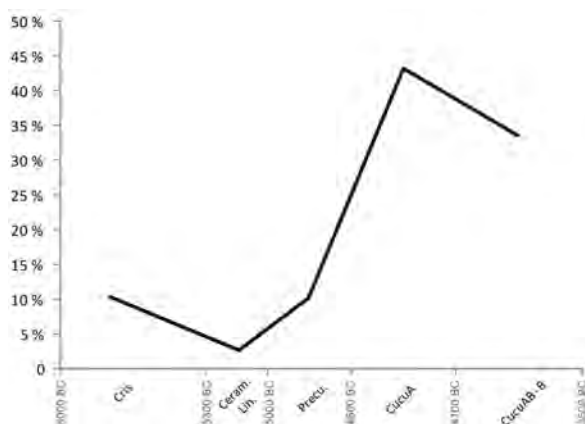


Fig. 3. Quantitative evolution of settlement numbers (in percentages) between Starčevo-Criş and Cucuteni A–B/B.

- The highest number of archaeological sites is in the Cucuteni A period (4600–4100 BC): 261 sites (43%), of which 184 are no longer occupied.

- Concerning the Cucuteni A–B period (4100–3850 BC), researchers have noted the very low number of sites for this period: 38 sites (6%) in our study. This reflects the lack of abundant painted ceramics, rather than a decline in the numbers of settlements (Zaharia et al. 1970.32–34; Monah-Cucoş 1985.42–43; Văleanu 2003.49–51). More than half of these sites were dated after scheduled archaeological excavation.

- As our study took a particular interest in the long term, it seemed appropriate to group together Cucuteni A–B and Cucuteni B sites (4100–3500 BC) with 193 sites (32%), because it is difficult to discriminate between both periods on the sole basis of material collected by field survey. Besides, almost all Cucuteni A–B sites extend to the Cucuteni B. Added to Cucuteni B, the number of sites is 203 (34%).

Almost 79 sites (17% from all Cucuteni sites) were occupied from the Cucuteni A to Cucuteni A–B/B period. These present stable, generally significant sites from an economic, social and territorial point of view due to their appeal over a thousand years.

### Geo-referencing

Surveyed sites have been mapped by differential GPS or precisely located on cadastral maps (14%). The other sites were located with the use of descriptions found in archaeological inventories, discussions with field prospectors, and with the combined use of topographical maps and orthophotographs. The position of 54% of archaeological points can be mapped within a spatial margin of error of about 50m. Some 28% of sites are located within a 50–200m spectrum, and 4% remain inaccurate. The latter are not taken into account for several spatial analyses, which require an accurate topographic precision, such as viewshed analyses.

Starting from this pattern of dots, a series of spatial analyses were undertaken, relying on a wealth of specialised literature (Wheatley, Gillings 2002; Connolly, Lake 2006; Rodier 2011), as well as on several European programmes on spatial process modelling (van der Leeuw et al. 2003; Gandini et al. 2012) and some experiments carried out in Neamţ County (Weller et al. 2011; Brigand, Weller 2012) and the Bahluiet Valley (Brigand et al. 2012, Asăndulesci et al. 2012).

## Spatial analysis

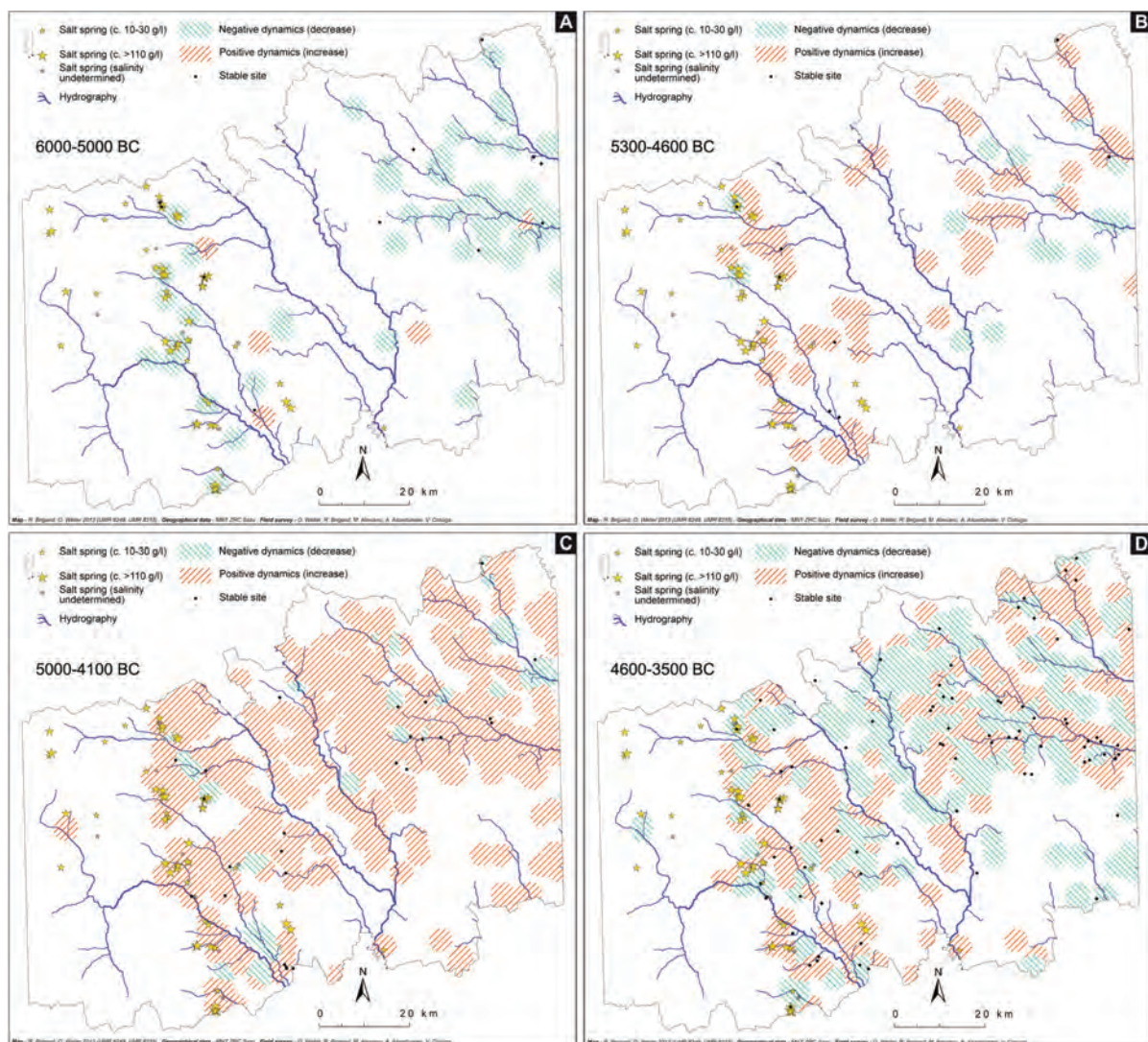
The study of Neolithic and Chalcolithic settlement patterns relies on several GIS tools that produce distribution and density maps, such as a visibility analysis. We should point out that these pioneering works on archaeological Moldavian data are essentially based on field survey results: their contemporaneity beyond wide chronological and cultural phases cannot be accurately assessed. The main point of this study is to go beyond the lack of available information in order to identify the multiple polarities and spatial/temporal dynamics of Late Prehistoric settlements. Let us briefly outline the spatial methodological background.

### Density and dynamics

A density study is based on kernel density estimation. It provides an estimate of site density defined

by a moving window. This method has been well known since the 1980s (*Silverman 1986*) and has been mainly used for archaeological applications in intra- or inter-sites analysis (*Baxter et al. 1995; Wheatley, Gillings 2002.186–187; Conolly, Lake 2006.175–177; Alexakis et al. 2011; Nuninger et al. 2012*). As this has been discussed elsewhere (*Weller et al. 2011.73–75; Brigand et al. 2012.19–21*), it is not presented in this article.

Using density maps that allow a broad view by chronological-cultural period, differential density maps have been proposed in order to visualise evolutions between two sequences (Fig. 4). These maps, whether the instability is negative or positive, are obtained by subtracting site density. Negative values correspond to decreasing sites or abandonment areas; conversely, positive values correspond to increasing sites (new site or a rise in a site's status). Medium



**Fig. 4.** Maps of the change in occupation density between: A Starčevo-Criș and Linear Pottery; B Linear Pottery and Precucuteni; C Precucuteni and Cucuteni A; D Cucuteni A and Cucuteni A–B/B.



values emphasise the overall stability in a given place; hence the location of stable sites has been specified.

### Visibility analysis

Viewshed analyses are among the classic tools offered by the GIS in order to highlight territorial control and areas of strategic interest (Wheatley, Gilling 2002.202–216; Conolly, Lake 2006.225–233). Visibility analyses determine areas that can theoretically be seen from one or different observation points. The DEM resolution (25m), elaborated by Krištof Oštir at the Research Centre of the Slovenian Academy of Sciences and Arts allows for accurate and precise results. Several analyses have been carried out based on the theoretical assumption of an observer 1.7m above ground, according to a standard offset. The field of vision is limited to 12km, according to field observation and ethnographic information. This paper assumes that a village, a small group of domestic units, or a herd located in an open landscape are clearly visible from 12km in favourable weather conditions.

- The simplest means of visibility calculation is a binary map that distinguishes between visible or invisible target cells from a specified viewpoint. The visible spectrum might be quantified in square kilometres, or in percentages: its classification offers a first hierarchy according to the importance of theoretical visibilities. The average viewshed by chronological-cultural period allows for a discussion of its evolution in the long term (Fig. 5). Counting sites that are seen by a contemporary observer offers the possibility of evaluating the viewshed quality and its evolution (Fig. 6). Associating one or more viewshed maps shows which visible values can be seen from at least one viewpoint (Fig. 7).

- The algebraic sum of two or more viewshed maps creates a cumulative viewshed (Fig. 8). The cell values are then integrated, ranging from 0 to a theoretical maximum number of viewpoints. This occurs if

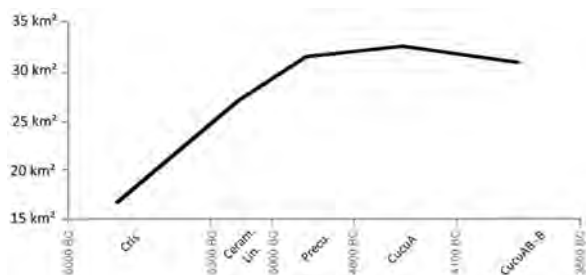


Fig. 5. Changes in the average viewshed by chronological phase.

at least one cell is visible from all viewpoints. The field of view being given, the maximum values cannot be equal to the number of archaeological sites.

Spatial analysis methodology needs to be put into perspective at several levels. The first assesses the spatial organisation of archaeological sites in the light of discriminating environmental parameters: topography, hydrography, soil qualities and salt resources. The second highlights the issue of spatial analysis as part of a more general thought process on settlement pattern dynamics between 6000–3500 BC.

### Results and discussion

This study aims to show settlement organisation and strategies in an area actively surveyed by the Piatra Neamţ Museum and Iaşi University field researches.

#### Regional distribution

Late Prehistoric settlements developed to the east of the Carpathian Mountains. Indeed, the surfacing zone of salt water in the Piedmont area constitutes the western margin of settlements. To the south, the heights of the Central Plateau are not occupied. The vegetation canopies, covering these areas, make field surveys more difficult. Is it possible to suggest that a settlement was absent above an elevation of 500m in currently forested areas?

At most, one may assume that climate, altitude and scarcity of resources for agriculture contributed to low occupation in this area. Yet, in the absence of systematic field surveys of forest land, this hypothesis is hard to demonstrate. The few major rescue excavations that have been carried out suggest a limited occupation in semi-mountainous environments. The building of Bicz Lake dam on the Bistriţa exposed two Cucuteni A sites (Nicolăescu-Ploşor, Petrescu-Dîmboviţa 1959). The distribution map raises the question of the visibility of archaeological remains. In the agricultural fields of the Moldavian Plain, where anthropogenic pressure on the environment – and consequently on archaeological research – is greatest, a consistent number of sites have been found. Conversely, where land use is dedicated to herbaceous or forests land, the intensity of settlement is low or absent. It may thus be inferred that in this case the distribution map does not effectively translate the actual occupation/settlement in Later Prehistory. Despite this fundamental limitation, the settlement pattern characteristics highlighted by this map should be studied (Fig. 1).



In accordance with the standards of Later Prehistory, settlements are closely tied to the stream channels, since they usually stand on the edges of alluvial or eroded terraces, as well as on the ridges of cuesta landforms running alongside watercourses (Monah, Cucos 1985.41–42; Marinescu-Bîlciu 1993; Popovici 2000.33; Lazarovici, Lazarovici 2003; Boghian 2004.55–58).

- On the Moldavian Plain (the eastern stretch of the River Siret), settlements cluster along the Bahlui and Bahluiet valleys and in the downstream part of Târgu Frumos. To the south of the Central Plateau, and more precisely on the right bank of the River Bahluiet, loose settlement patterns have been observed. They do not reach the concentration of other settlements close to Târgu Frumos. To the north, a significant difference appears in the central and northern part of the Moldavian Plain: occupation is structured around several centres (the high valley of Valea Oii – around the eponymous site of Cucuteni culture, the Hârlău area, the Jijia Valley and its major tributaries). On the interfluvium of the Bahlui/Jijia, several sites correspond to more diffuse territorial networks. Few settlements have been documented in the area between the Siret and Moldova rivers. These sites are strategically located between the Suceava Plateau and the Moldavian Plain, halfway between the Carpathian Mountains and the high Bahlui/Bahluiet valleys.

- To the west of the Siret, the situation is more diverse. On the one hand, the settlements in the Cracău and Bistrița valleys are clustered along fluvial corridors. On the other, settlements generally form a more diffuse framework. A greater density of occupation can be observed in areas with salt resources (the Carpathian foothills). In the south of the Bi-

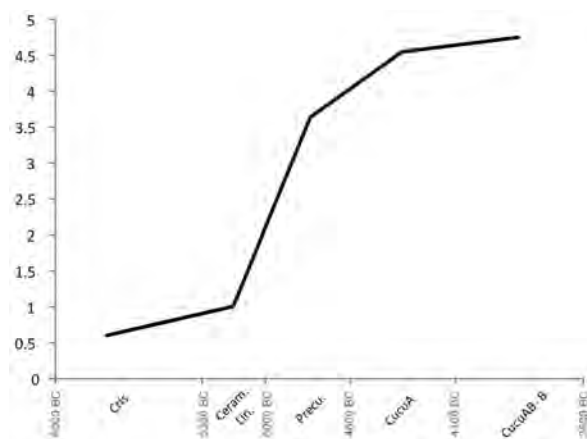


Fig. 6. Changes in the average of visual links by chronological phase.

strița Valley, two salt springs with high salinity have remained isolated, with nearby sites situated between 6 and 8 km away. The question arises as to why these salt springs remained separated from the nearest settlements since the settlements in the Cracău/Bistrița valley were located close to the stream confluence. This fact might indicate that control of access to a resource was more important than direct settlement near that resource. This fact is confirmed by observation alongside Târgu Neamț or Piatra Neamț: hilltop and fortified settlements are located downstream, at the mouth of the valleys that lead to salt springs, even though the edges of river terraces are in general preferred to marshlands and flood plains.

Most settlements are located where agricultural prospects are more favourable to cultivation. Whether on the Moldavian Plain or in the Sub Carpathian Depression, archaeological sites are strictly linked to the availability of soils suitable for agriculture (Fig. 1). Areas of settlement are generally established on chernozem (soil type II), more precisely along the eastern bank of the Siret. In the western part, brown soils (soil type I) are favoured over chernozem for settlement. Whatever the area, the establishment of sites was always made at a meeting point between several types of soil, in order to use various and optimal ways to exploit resources.

Proximity of fluvial corridors and availability of water, as well as easier territorial control were sought. Viewshed maps, whether multiple (Fig. 7) or cumulative (Fig. 8), tend to show this fact, although a general trend towards hilltop settlement is observed between the earlier Neolithic and Chalcolithic periods.

### Settlement pattern dynamics

The evolution of settlement patterns between 6000 and 3500 BC is well established (Fig. 3, Fig. 4). The principal phases of occupation are as follows: 1. a marked decline in the number of sites between Starčevo-Criș and Linear Pottery; 2. a continuous increase during the mid-Neolithic up to the Early Chalcolithic (Precucuteni); 3. a true explosion in the number of sites during the first stage of the Cucuteni period; 4. a marked decline between 4100 and 3500 BC (Cucuteni A-B/B).

- The *Starčevo-Criș* (6000–5300 BC) is characterised by settlements occurring on fertile lowlands and first terraces close to stream confluences. Viewsheds are reduced (Fig. 5), the average viewshed being

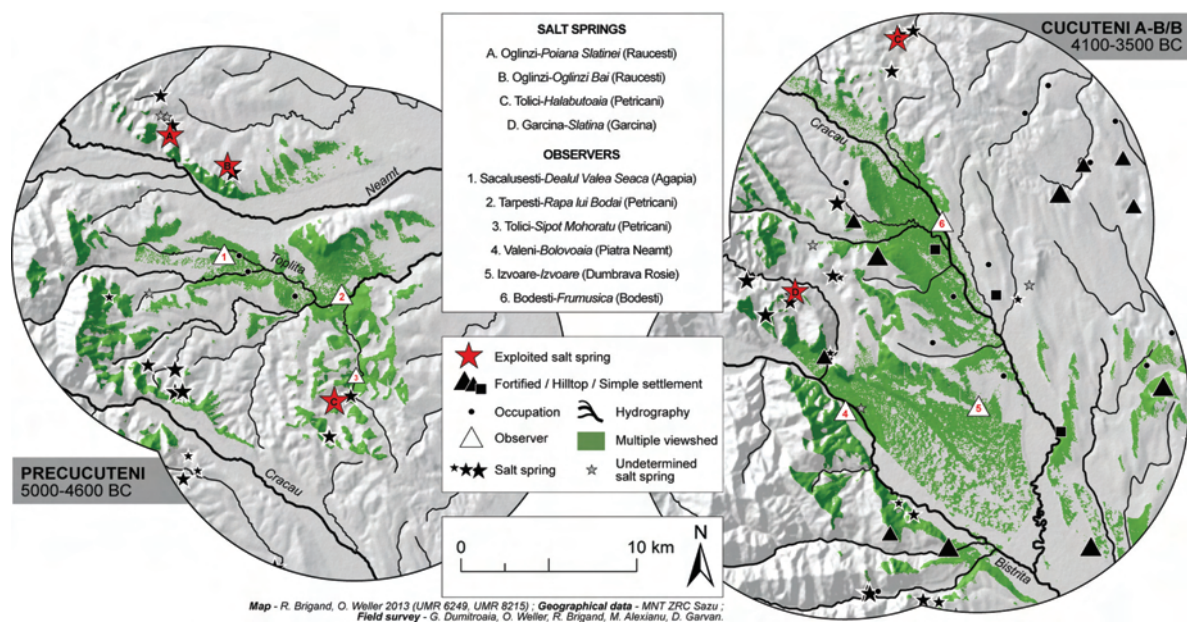


Fig. 7. Multiple viewshed map in the Târgu Neamț (left) and Pietra Neamț areas (right) respectively during Precucuteni and Cucuteni A–B/B.

close to 18km<sup>2</sup>, and the need for intervisibility is almost non-existent (Fig. 6) as the average level of visual links is close to 0.6. This type of pioneering front is structured by a rural sprawl along major streams – the Bahluieț, Bahlui, Jijia – of the Moldavian plain (Fig. 8A).

Close to the Carpathian Mountains, occupations, few in number, are concentrated close to salt springs (with maximum distance of 7km). The first indications of crystallised salt production have been documented at some of them (3 certain, 2 uncertain) located on the north side. These production centres are not connected to major settlements; the springs are neither visually controlled in a direct way, nor are their accesses particularly under control. Regarding salt production, we believe that it is not the structuring element of the settlement pattern, even if the availability of this resource is well known and clearly integrated with salt and brine supply networks. This situation may suggest the existence of seasonal or temporary movements in search of salt water, as in transhumance. Only a few settlements would be stable (Bistrița Valley), perhaps at the end of this first phase of Neolithisation.

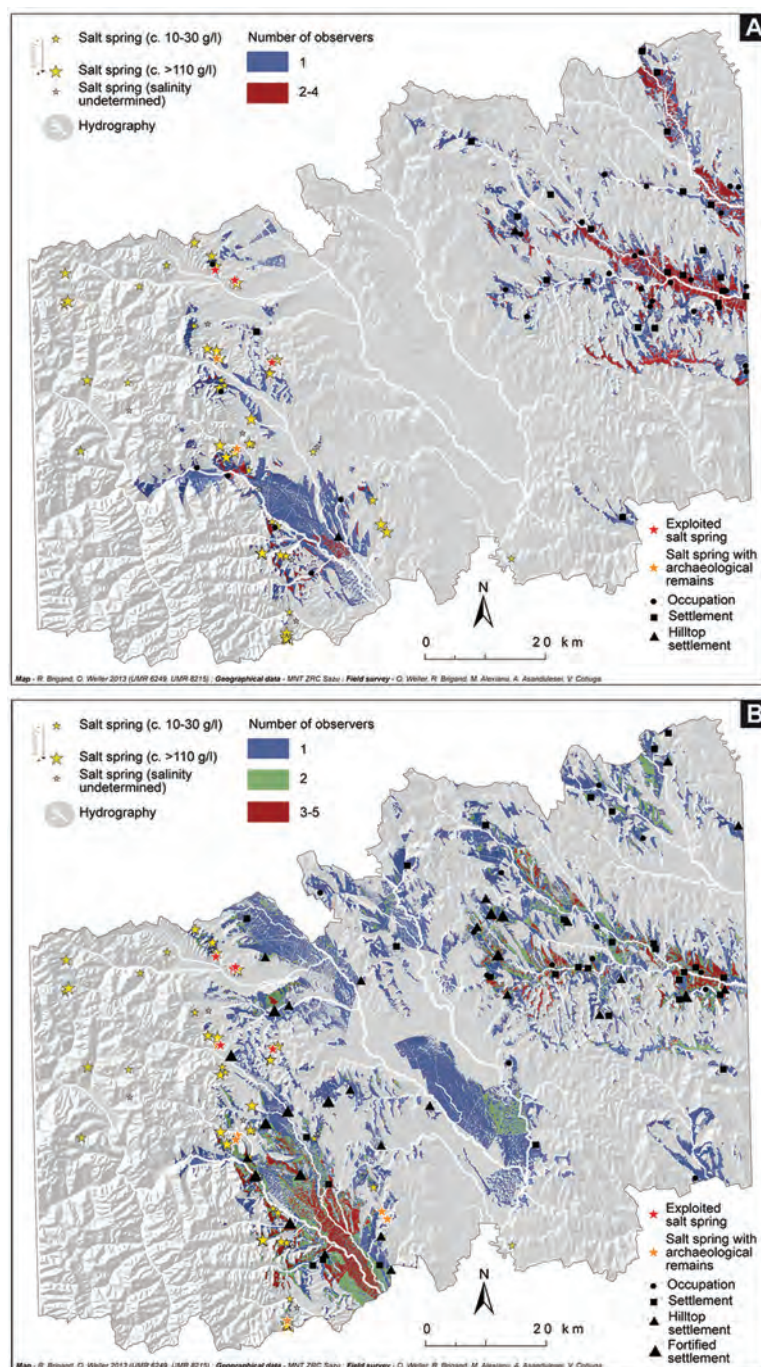
- Between Starčevo-Criș and **Linear Pottery** (5300–5000 BC), a significant general reduction is observed in the number of sites (Fig. 4A), including those close to salt springs. The scarcity of Linear Pottery archaeological sites may be due to the research conditions rather than an actual decline in settlement numbers.

Despite the low number, the emergence of the first important settlements can be observed. These are located strategically: on hilltops and locations close to stream confluences, with good visibility of the surrounding area – average visibility coverage is close to 27km<sup>2</sup> (Fig. 5). Implantations are scarcely distributed, which in turn produces a low level of intervisibility (Fig. 6) – the average level of visual links is close to 1.

Compared to the Starčevo-Criș period, the end of the 6<sup>th</sup> millennium shows a strengthening of territorial control over river corridors. Salt resources are also exploited in the northern and central foothill area, even if few dwellings have been documented close to it, except for the early occupation of Târpești-Râpa lui Bodai which relates to contemporary and continuous salt exploitation from Hălăbutoaia at Țolci; Traian-Dealul Viei and Dealul Fântânilor connected to the Bistrița/Cracău confluence on one hand and the proximity of the Negrițești salt springs on the other. Small and probably seasonal occupations emerge during this period. This reflects the first settlement differentiation, where major sites were surrounded by small occupations.

- The **Precucuteni** period (5000–4600 BC), is characterised by a slight increase in the number of sites (Fig. 4B), which takes the numbers back to the Starčevo-Criș site numbers through an intensification of previous dynamics. Increased territorial control is observed, since the viewshed average (33km<sup>2</sup>) is at its highest level (Fig. 5). Most high terraces are





**Fig. 8. Cumulative viewshed of the Starčevo-Criș sites (A) and Cucuteni sites stable between 4600 and 3500 (B).**

occupied, especially in stream confluence areas, but also on the western Carpathian terraces. On the Moldavian Plain, settlement patterns were strengthened along major rivers (Bahluieț, Bahlui, Jijia), as if in a refocusing of settlements.

Settlement patterns during the Precucuteni period seem to be strictly integrated into a territorial organisation in which fortified sites are surrounded by secondary occupations, which are probably seasonal and directly visible, as highlighted by the high ave-

rage of visual links  $\sim 3.6$  (Fig. 6). Settlements are clearly concentrated in several key areas: near stream confluences, river terraces, and salt springs. Incorporated in a well-structured settlement network, exploited salt springs are under the strict supervision of communities, which appear to have specialised to some extent in salt production.

The hilltop settlement of Țolici-Sipot Mohorâtu, for instance, is located upstream from the confluence of the 'salt' valley - Valea Slatina - and the Țolici Valley, which leads to the Târpești-Râpa lui Bodai fortified settlement, located 4km downstream (Fig. 7, left). Close to the salt spring, this site appears to have served as an intermediate point between the exploited spring and the main settlement of Râpa lui Bodai. Further examples underline the fact that, while salt springs do not need to be clearly visible from settlements, control of their accessibility and the main valley is still more or less ensured.

Always in the northeastern part of Piatra Neamț - the southeastern part of Targu Neamț - the central Topolița Valley is totally controlled by the Râpa lui Bodai and Dealul Valea Seacă sites, which are mutually visible. This settlement model is not only related to control of the salt springs exploited upstream, but also to those along the main river corridor - for example, in the lower Bistrița/Cra-cău Valley. Conversely, several salt rich areas, such as Oglinzi salt

springs, are poorly connected to the main settlement pattern.

- Between the Precucuteni and the *Cucuteni A* period (4600–4100 BC) some sites in secondary valley sectors were abandoned, but many new sites were created, colonising the entire regional ecosystem, either near salt springs or along major river systems and their tributaries (Fig. 4C). A substantial increase in settlement numbers and above all the spread of new colonies in semi-mountainous areas (such as wet-



land ecosystems) is noticeable. Cucutenian settlements were generally established on the edges of river terraces, above marshlands and floodplains, for optimal control of fluvial corridors, as evidenced in the high average visibility – 32km<sup>2</sup> (Fig. 6).

The emergence of a new territorial organisation can be observed. It was based on a strong hierarchy, highlighted by a variety of archaeological sites, whether fortified, hilltop or open settlements, and several satellite occupations. Between the Cucuteni A and Cucuteni A-B/B period (Fig. 3, Fig. 4D), a significant decline in the number of settlements suggests, both in the foothill areas and in the Moldavian Plain, a shrinkage and concentration of settlements according to specific choices regarding territorial control and land resources. Numerous sites were indeed deserted, even in areas with several salt springs, yet many new settlements appeared in adjacent sectors, as if the population had moved then resettled elsewhere (Fig. 7, right). High, middle and low terraces are consistently favoured, although a slight reduction in the average viewshed might be observed – 31km<sup>2</sup> (Fig. 5). Nonetheless, the highest average visual link (4.7) would seem to imply that specialisation and complementary sites were continuing and even progressing (Fig. 6).

The distribution of stable settlements over the Cucuteni period underlines that territorial trends between the Cucuteni A and Cucuteni A-B/B period were in accordance with a very well organised territorial network. These new spatial configurations were not the result of new organisational models, but rather of the strengthening of past trends. This is clear from a comparison of settlement patterns during the Early Neolithic (6000–5300 BC) and Chalcolithic (4600–3500 BC), in which the polarities are more or less the same (Fig. 8B). The evolving trends were more precise territorial control in relation to exchange networks and an enhancement of the appropriation of natural resources corresponding to the development of craft specialisations (specific pastoralism, crop production, salt production, *etc.*).

## Conclusion

It has been asserted that the penetration and dissemination of early Moldavian agro-pastoral communities followed the general trends observed in Eastern and southeastern Europe (*Ursulescu 1995; Tasić 2002*): a Neolithisation process closely connected with salt springs and rich soils. The distribution of salt resources in the foothills of the Carpathian

Mountains marks the western limit of a settlement pattern structured by salt and brine supplies and salt production areas in the upper reaches of secondary valleys. The importance of fortified settlements close to salt resource is explained by the need to control accesses to salt production sites and circulation networks through the main fluvial corridors.

To the west of the Siret Valley, *e.g.*, in areas characterised by fertile, well-drained black soils, agricultural colonisation has been observed, especially during the Cucuteni A period. This region was thus able to support a very dense settlement pattern established around high and fortified settlements. Being located in a dominant position, they controlled both hydrographic networks and a set of secondary settlements.

The increase in settlement numbers during the second part of the 5<sup>th</sup> millennium was caused by three simultaneous factors: population growth released new agents of settlement; the evolution of agricultural and pastoral practices led to greater mobility and specialisation in farming methods; the intensification of territorial hierarchies led to the emergence of federating centres and formalised trade (*Lichardus, Lichardus-Itten 1985*).

Land use between the Carpathian Mountains and River Prut was highly dependent on two factors: the availability of highly productive soils and the accessibility of easily exploitable salt springs. Forms of human settlement seem to have differed, depending on these resources.

In the Moldavian Plain, groups of different status have been observed. Hilltop or fortified settlements enjoy specific access to land resources that is quite different from that found in open sites close to floodplain river channels. Several seasonal agricultural and/or pastoral occupations gravitate around these two distinct types of settlement. In the foothills area, salt springs were surrounded by many modest occupations, for example in the northern area of the study.

Ethno-archaeological approaches (*Alexianu et al. 2011*) allow us to reassess this specific settlement organisation. Indeed, an association of agents who specialised in seasonal salt exploitation may be suggested in relation to pastoral activities. This study of the structural process leading to the intensification of environmental uses during the Late Prehistory must be deepened through a global approach aimed at a better understanding of land appropriation processes.

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