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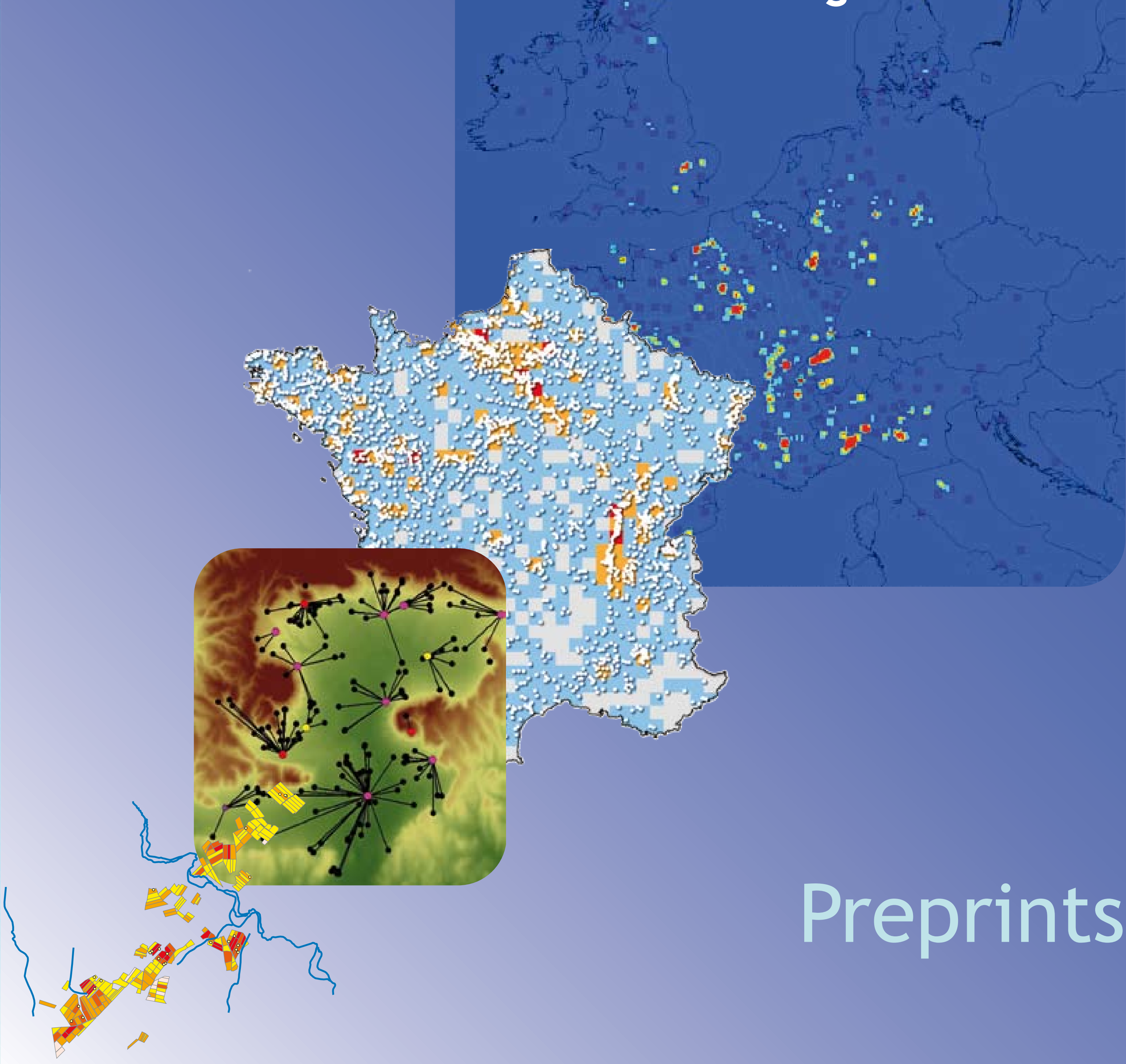
7 millennia of territorial dynamics

settlement pattern, production and trades from Neolithic to Middle Ages



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ACI « Spaces and territories » 2005-2007

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Spatial dynamics of settlement and natural ressources : toward an integrated analysis over the long term from Prehistory to Middle Ages

Final Conference – University of Burgundy, Dijon, 23-25 june 2008

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7 millennia of territorial dynamics

settlement pattern, production and trades from Neolithic to Middle Ages

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SOMMAIRE CONTENTS

SPATIAL ANALYSIS OF SALT SPRINGS EXPLOITATION IN MOLDAVIAN PRE-CARPATIC PREHISTORY (ROMANIA)

Olivier Weller[1], Robin Brigand[2] and Laure Nuninger[2]

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Abstract:

This paper presents the first results of the spatial analysis concerning the dynamics and interaction between settlement patterns from the Neolithic to Chalcolithic times (6000-3500 BC) and a particular mineral resource exploited since the Early Neolithic, the salt springs in the Oriental Carpathian Mountains. Using kernel densities and viewsheds, we propose some natural and anthropological factors which structure this regional territory.

Key words : Settlement patterns, salt spring, Neolithic-Chalcolithic, Romania, Moldova

This paper aims at presenting part of an interdisciplinary French-Romanian project focusing on the dynamics and interactions between human societies and a particular mineral resource, the salt springs. The Oriental Carpathian Mountains in Romanian Moldova offer a perfect research area for studying the continued exploitation of salt springs from Neolithic times to the present. This poster focuses on the relation between Neolithic-Chalcolithic settlements (6000-3500 BC) and distribution of salt springs in the Neamt department, where we have direct evidence of their exploitation since the Early Neolithic (Weller, Dumitroaia, 2005).

1. Objectives and methodology

In order to better understand the evolution of the relation between Man and the environment, notably human settlements and salt springs, our general approach is interdisciplinary (Weller *et al.*, 2007a) and involves the following:

- Archaeological field-walking around the salt springs, identifying prehistoric techniques of exploitation , chronological and exploitation dynamics (Weller *et al.*, 2007b);
- Paleo-environmental analysis of pollen, charcoal and remains of soil combustion (Weller *et al.*, 2008a);
- Spatial analysis, using GIS to correlate archaeological and salt resource databases, settlement networks, viewshed and access (Weller, Nuninger, 2005; Weller *et al.*, 2008b);
- Ethnographic investigations around the salt resources (Alexianu, Weller, 2008);
- Geological and chemical analyses of the salt springs.

Among these approaches, this study focuses on the spatial archaeological approach involving GIS. The aim is to explore: 1) how did the salt springs, exploited or not, impact the settlement patterns during the Neolithic and Chalcolithic periods; 2) what are the ways in which the salt resources, production and circulation were controlled.

2. Settlement patterns over times

The first step of this project aims at analysing the relationship between settlement patterns and the distribution of salt springs over time. Our GIS includes an archaeological database (241 sites and 79 springs of which 58 are salty and 8 are exploited) mainly based on fieldwork records (GPS measurements), a digital elevation model with a resolution of 25 m made from satellite imagery by K. Ostir (IASS, ZRC SAZU, Slovenia) and the administrative district map on the level of the village (M. Consinschi, University of Lausanne).

First, we developed a mapping approach based on municipality units for the Neamt department (area 2, fig. 1). Using a selection of reliable archaeological sites (184 out of 241), we attempted to show the relationship between the settlement density and the

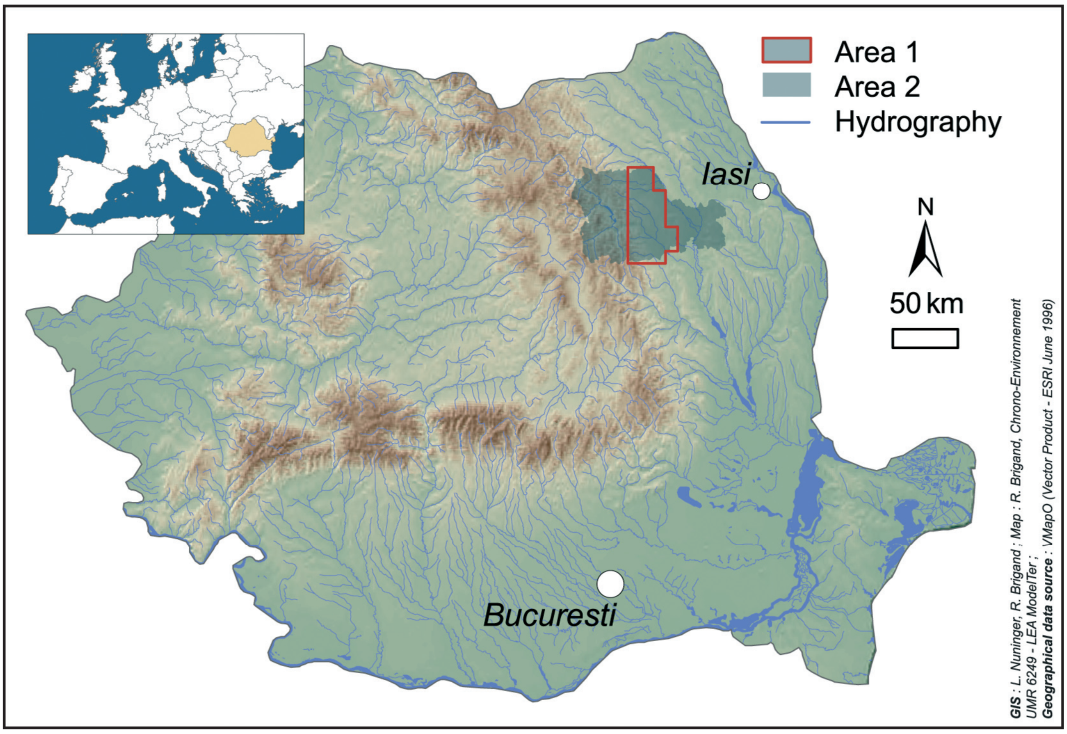

Fig. 1: Study areas in Romania

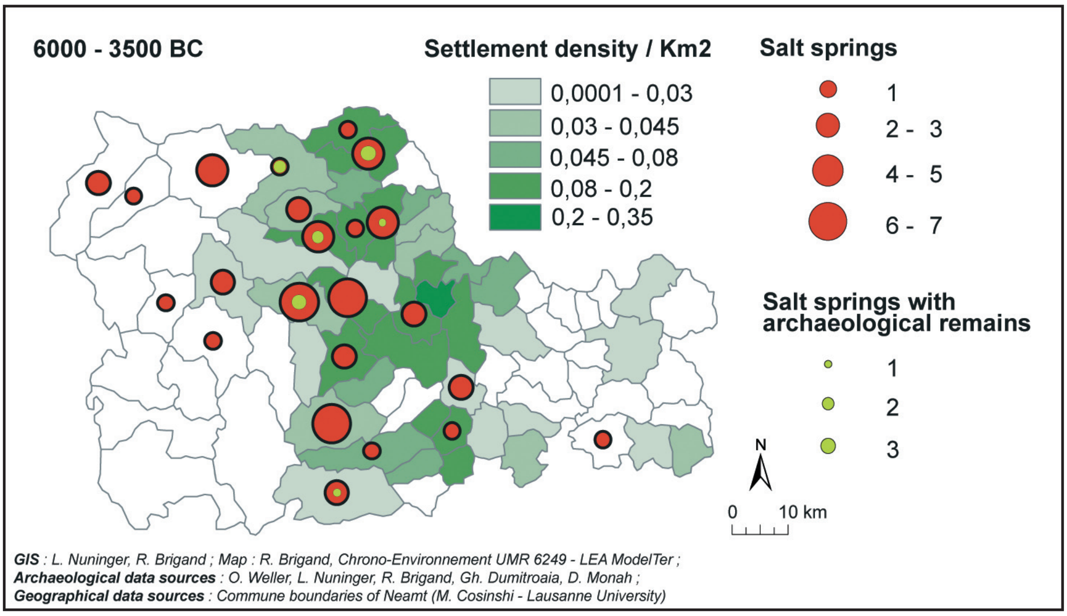

Fig. 2: Settlement density and salt springs

number of salt springs (fig. 2). With the exception of the area of the Carpathian Mountains, where the archaeological inventory is probably less reliable, this first map shows interesting results. In general, during the period studied, the high occupation density of salt springs is undoubtedly to the detriment of alluvial plains in the east and the Carpathian Mountains on the southwest. In detail, in the Pre-Carpathian Mountains, even if the higher number of salt springs is usually located within a settlement of high density, there is no strict correlation and some highly inhabited areas do not have any salt resources in their vicinity. Regarding occupation type, the settlements on high position are well linked to the location of salt springs. Such observations suggest a specific organisation of the settlement pattern which is in all likelihood associated to the salt resource economy, but probably complex and not directly linked to the exploitation of salt springs.

The settlement pattern changes over time (fig. 3) were quantified by using mapping and the kernel density estimation method (KDE) to improve the first approach in the Carpathian foothills (area 1, fig. 1). The KDE method provides an estimation of density for a surface using the value from a starting point which decreases as soon as the distance increases, and according to the model of curve chosen (kernel function). The kernel function used is based on a quadratic kernel function (Silverman, 1986). Since the result of the analysis is not strongly influenced by the kernel function as long as the function

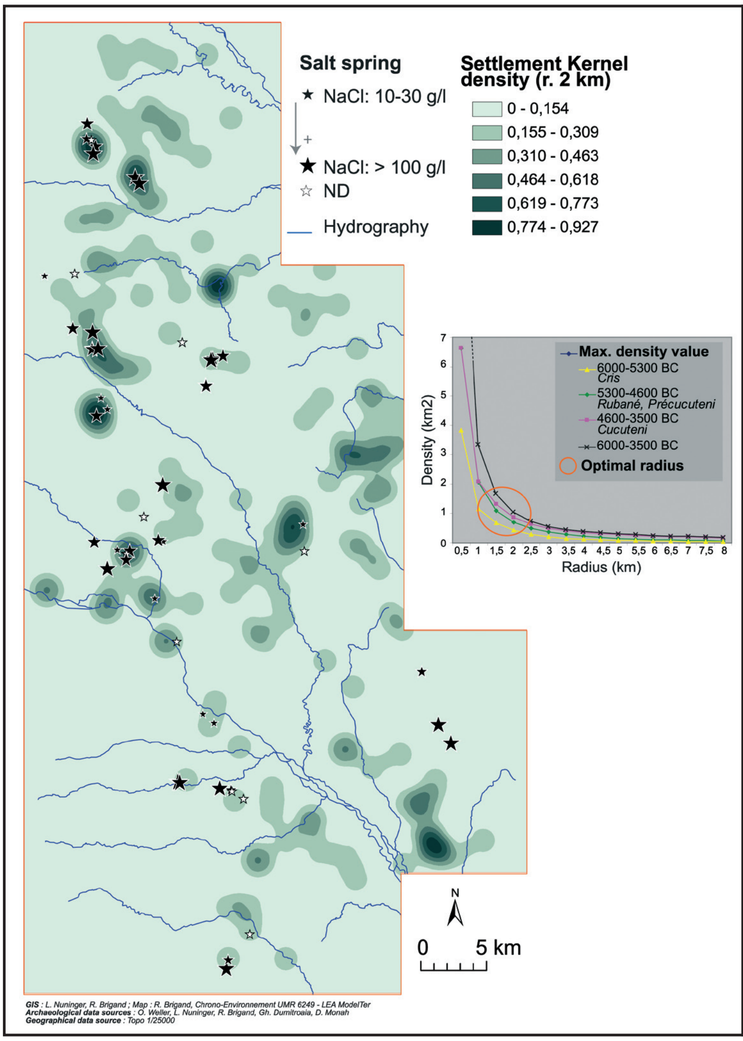

Fig. 3: Spring salinity and occupation density between 6000-3500 BC

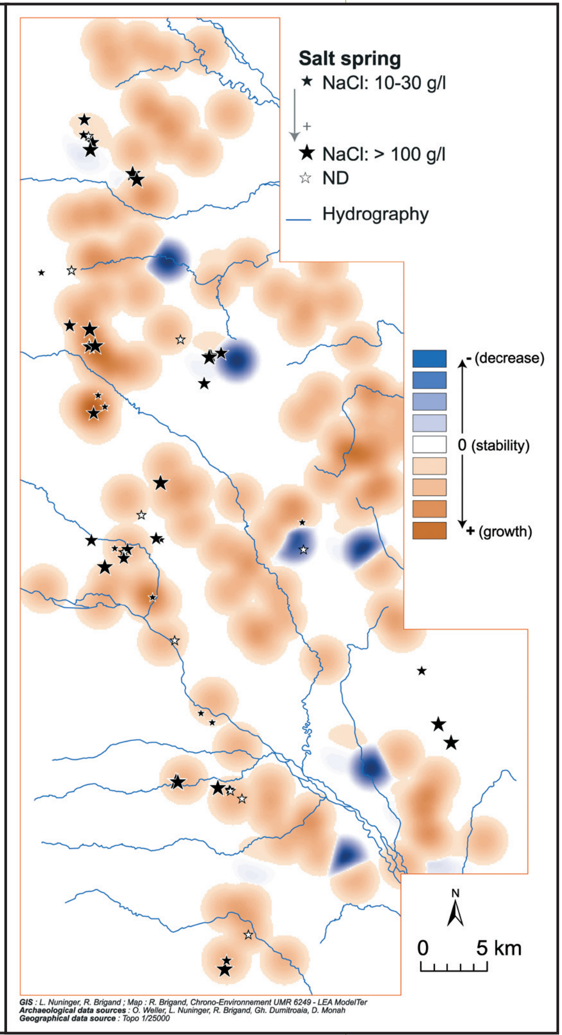

Fig. 4: Settlement dynamics between 5300 and 3500 BC

is symmetrical (Silverman, 1978), we did not do any tests with other kernel functions. On the other hand, the choice of the width of the window and the radius is very important (Silverman, 1978). Since our approach was exploratory, we used the graphical method defined by F. Tolle, ThéMA (UMR 6049) to determine the optimal radius. Thus, the final choice in our case was a radius between 1.5 and 2 km (fig.3). The results show that most of the salt springs are located in prehistoric settlements of higher density during the entire period. In reality, the Neolithic archaeological sites show the main background tendencies which insure the Chalcolithic demographic development.

The same KDE method was used to compute density per chrono-cultural period (about 1 millennium for each period). By subtracting the values of the KDEs of the Middle-Late Neolithic (5300-4600 BC) from these of the Cucutenian period (4600-3500 BC), an overview of the settlement pattern dynamics is obtained according to its stability or instability (fig. 4). The main axes of circulation and a majority of the highly salted springs are the object of settlement densification, in particular during the first period of Cucuteni (4600-4000 BC).

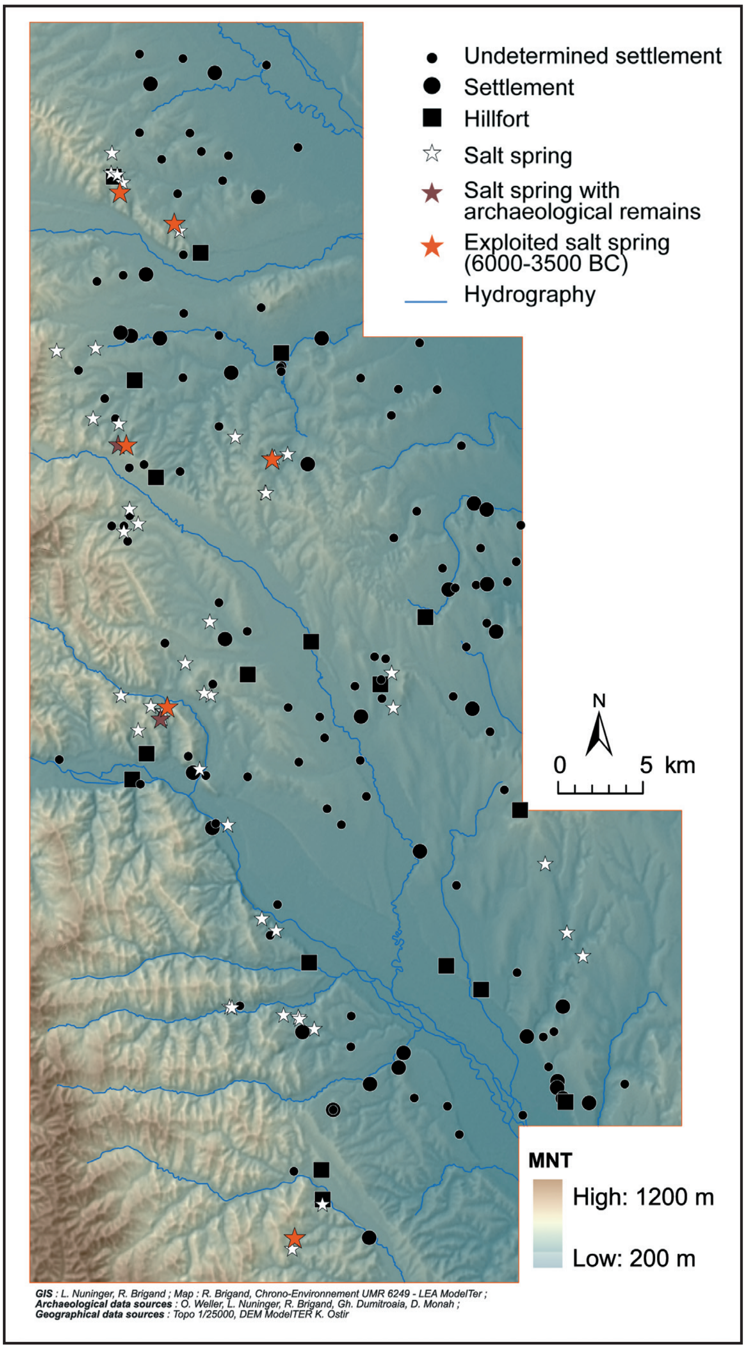

Fig. 5: Fortified villages, settlements and salt springs

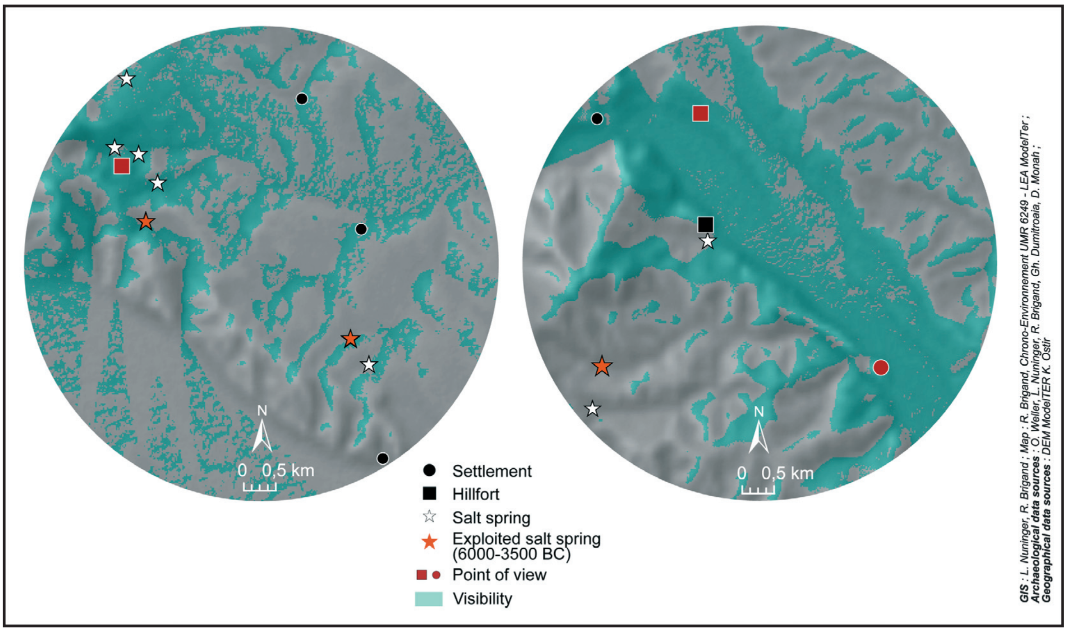

Fig. 6: Viewshed analysis: 2 types of visual control

3. Territorial control

A qualitative approach is in progress in order to qualify the type of control practised on salt resources, production and circulation. First, we mapped the distribution of salt springs, with or without archaeological remains of exploitation, and the distribution of high ground settlements in area 1 (fig. 5). Direct and systematic links were not observed, except in some cases.

With the 25 m Digital Elevation Model, a simple viewshed analysis was processed from the perspective of archaeological sites. The preliminary results show that two modes of visual control can be defined: 1) a direct visual control of the salt springs (example of Cetatuia promontory village, fig. 6-left); 2) an indirect visual control which impacts the main access (example of Tazlau valley, fig. 6-right). In this last case, the fortified sites of Cucuteni A located on the right and left sides of the Tazlau River (Cetatuia and La Coboras) were taken into account. Their visibilities were overlaid to define the visual control area. The visual control of the salt springs is null from both settlements, even from the exploited ones where archaeological remains have been found, but the control of the Tazlau Valley and the access to the salt spring valley seems to be optimal. A third one, a promontory settlement, within the visual control of both main settlements, is well located to control a secondary access to the salt spring. It is probably an intermediate settlement which served as a relay for more accurate territorial control.

This preliminary analysis has to be improved by testing several types of viewshed processing, and generalized for all the study areas in order to characterize the visual system of control (hierarchical organization of sites according to the size of visual space, the number of visible sites and the number of sites which can be seen from each site).

On the scale of the Pre-Carpatic Mountains, the results of the spatial analysis suggest that the Chalcolithic occupation (4600-3500 BC) integrates a complex settlement pattern in which the network and hierarchical organization of settlement has to be recognized. Apprehending these networks, still in its forward-looking phase, brings to light the importance of areas under visual control or densely inhabited, even if there is no direct relationship with the location of salt springs. In a region known for the important economical role of salt (Weller, Dumitroaia, 2005; Alexianu, Weller, 2008), the study of such “disconnected” areas is promising for territorial issues since their presence likely underlines a high level of social organisation.

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Pin consumption on the shores of Lake Neuchâtel (Switzerland) during the palafittic Late Bronze Age

Viktoria Fischer

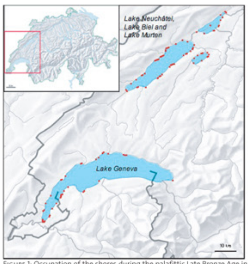

Figure 1: Occupation of the shores during the palafittic Late Bronze Age in western Switzerland (ARNOLD 1990: 124-125, CORBOUD 1993). (c) Swisstopo 2004

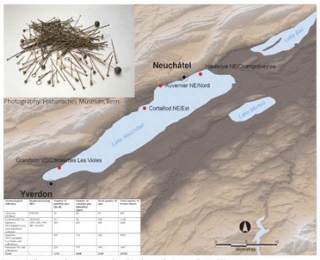

Figure 2: Shore settlements considered in the analysis. Map base: STRM 90/V3.

Problematics and sample

We have chosen pins to approach bronze consumption in Western Switzerland during the palafittic Late Bronze Age, as these were deposited in large quantities on littoral settlement areas, and because their forms evolved quickly and homogeneously from one site to another at a regional scale (DAVID-ELBIALI 2000: 140). We are specifically interested in Lake Neuchâtel and the identification of time dynamics in pin consumption is emphasised.

Our sample contains 1111 palafittic pins (excluding fragments of rods and unidentified types), which belong to 5 archaeological collections (Fig. 2). However, this sample can be considered representative of occupancy in the whole of Lake Neuchâtel's shores (Fig. 1). The heterogeneity of the sample should be highlighted: the collections differ in size and are not systematically dated by dendrochronology. This is partly explained by the fact that they are either resulting of recent or of XIXth century excavations.

The old collections of Auvernier NE, which have been mainly discovered during the second part of the XIXth century (RYCHNER 1979: 17), are also part of our sample. Unfortunately, their origin could not be precisely located (Fig. 2).

Methods

Managing chronological uncertainties

To make our data comparable and independent from the inaccuracy of chronotypological dating, we estimated real numbers by relative numbers. Every pin was allocated a weighting in the analysis, according to the reliability of its dating. The weighting was calculated by taking into account the probability by which each object belonged to a particular phase of the palafittic Late Bronze Age or Ha B (Fig. 3). Each of the 5 phases of Ha B was assumed to last 50 years (DAVID-ELBIALI, MOINAT 2005: 613-623).

For example, 90 pins of the collections of Grandson VD/Corcelettes-Les Violes have been attributed to phase Ha B1 by typochronology. To obtain the relative number of pins for the analysed phases, we assigned 45 of them to the former Ha B1 and 45 to the classic Ha B1. Indeed, the probability of a pin being dated from Ha B1 belonging to either the former Ha B1 or to the classic Ha B1 is 50%.

	former Ha B1 (1050-1000 B.C.)	classic Ha B1 (1000-950 B.C.)	Ha B2 (950-900 B.C.)	former Ha B3 (900-850 B.C.)	recent Ha B3 (850-800 B.C.)
Pin dated from Ha B1	1/2	1/2	0	0	0
Pin dated from Ha B2	0	0	1	0	0
Pin dated from Ha B3	0	0	0	1/2	1/2
Pin dated from the palafittic Late Bronze Age (Ha B)	1/5	1/5	1/5	1/5	1/5

Figure 3: Weighting allocated to a pin in each phase of the palafittic Late Bronze Age, according to the reliability of its dating.

Dendrochronological correction

For those sites dated by dendrochronology, it was possible to introduce time intervals of human settlement, thus refining chronotypological dating with absolute dating. A pin attributed by typology to Ha B1, for example, but which was discovered in a layer dated between 990 and 980 B.C., was allocated to phase 1000-950 B.C. (classic Ha B1). Unfortunately, this correction could not be made for the rest of the sites.

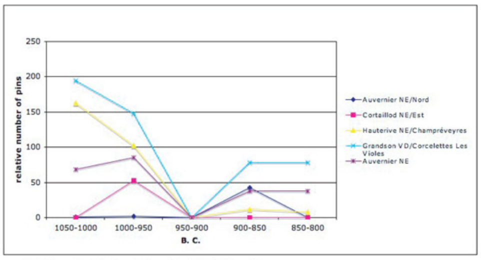

Figure 4: Relative number of pins for each site over the palafittic Late Bronze Age.

Identifying "temporal trajectories"

Having taken the chronological uncertainties into account, we studied the evolution in time of pin consumption for all sites in our sample. This evolution can be easily plotted on a time-scaled graph showing relative number of pins for each site (Fig. 4).

Recognizing "temporal trajectories" in palafittic collections leads either to identify global tendencies in pin consumption during the palafittic Late Bronze Age or to put forward some local phenomena, which can be due to cultural or environmental factors, for example.

For Lake Neuchâtel, we noticed an interruption of bronze consumption during Ha B2. This can be explained by the desertion of the shores caused by rising water levels. Following this phase, some villages were reoccupied, others were abandoned, and new ones appeared. Moreover, there seemed to be a transfer of consumption centres. Auvernier NE/Nord, for example, grew in importance after phase Ha B2, whereas the activity in Hauterive NE/Champréveyres decreased.

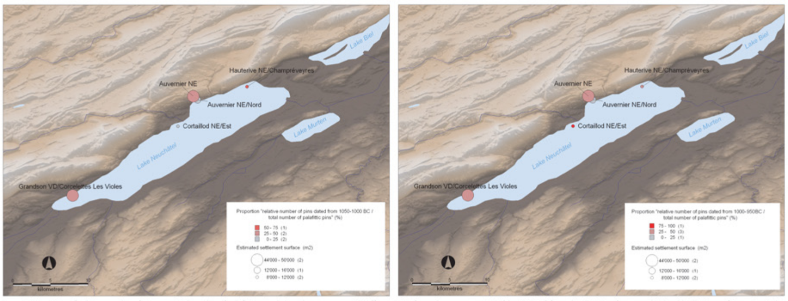

Figure 5: Proportion of relative number of pins over total number of palafittic pins during phase 1050-1000 B. C. (former Ha B1) ans phase 1000-950 B. C. (classic Ha B1) for each collection of our sample. The old collections of Auvernier NE have been located arbitrarly in the disctrict centre of Auvernier NE. Maps have been realised with MapInfo Professional 6.5. Map base: SRTM 90/V3.

Spatial dynamics

The maps proposed in Figure 5 show the evolution of pin consumption for each site over phases 1050-1000 B.C. (former Ha B1) and 1000-950 B.C. (classic Ha B1). Each site is represented by a circle whose size is proportional to the estimated settlement surface.

It can be seen that there was no serious evolution, except for Cortaillod NE/Est where the consumption increased dramatically.

Diagrams showing the subsequent phases of the palafittic Late Bronze Age would complete our comprehension of the evolution of bronze consumption around Lake Neuchâtel.

Conclusions and perspectives

Our analysis shows that temporal and spatial approaches can be combined to understand the evolution of pin consumption in various locations. Although our study is only on 5 sites, the same exercise could be extended to all the sites of Lake Neuchâtel, as well as the lakes of western Switzerland, in order to gain a more accurate appreciation.

In order to observe the evolution of bronze consumption in time or space, the estimation of real numbers by relative numbers could be based on other categories of bronze objects, as long as they are sufficiently numerous and show a quick type evolution. This calculation could also be applied to other time scales.

The diversity of collections in our sample, consisting of old and recently discovered ones, can create difficulties when interpreting maps and graphs.

Comparing bronze consumption between littoral villages and other site categories, such as ground deposits, would allow us to analyse the role of these sites. This could bring us to question whether palafittic bronze objects should be considered as lost and discarded household items or if they were intentionally deposited for ritual purposes.

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