



HAL
open science

Understanding the protohistorical territorial heritage by means of Iron Age settlement system analysis in GIS: a case study in the eastern Languedoc (France)

Laure Nuninger

► To cite this version:

Laure Nuninger. Understanding the protohistorical territorial heritage by means of Iron Age settlement system analysis in GIS: a case study in the eastern Languedoc (France). Enter the Past. The E-way into the four Dimensions of Cultural Heritage. CAA 2003, Computer Applications and Quantitative Methods in Archaeology., 2004, pp.286-289. halshs-00002947

HAL Id: halshs-00002947

<https://shs.hal.science/halshs-00002947>

Submitted on 27 Sep 2004

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Questions of protohistoric territorial heritage through the settlement systems during the Iron Age: a case study of the eastern Languedoc (France)

NUNINGER, Laure

Laboratory of Chrono-Ecology (National Scientific Research Centre, University of Franche-Comté, Besançon, France)

Centre For Spatial Studies (Scientific Research Centre of the Slovenian Academy of Sciences and Arts, Ljubljana, Slovenia)

INTRODUCTION

We often tackle the protohistoric territorial issue using a regressive analysis approach. This type of analysis is based on the basic assumption that "the memory of societies ensures the transmission of the inherited data, making it possible to return as far back as the first settlements" (Leveau 2002:9). Nevertheless, this principle could partially be called into question since it tends to enhance the status of settlements still seen nowadays as villages or towns. On the contrary, deserted agglomerations seem much less significant. In this case, the reasoning is highly influenced by the visible cultural heritage. Thus, if the situation of the pre-Roman peoples described by the authors of the Greek or Latin language during and after the Roman conquest can somehow enlighten us; it is also completely legitimate to think that it can deform reality or erase some aspects of pre-Roman territorial dynamics. For this reason, we must also apply a constructive and systematic approach to these territories by seeking their centres by way of archaeological witnesses in order to shed new light on the processes of territorial evolution. By combining several data, we can show how the protohistoric territorial pattern has contributed to our own territorial heritage. After a presentation of context, spatial models and methodology, we developed an applied example from the Nîmes region in France. Through it, this paper will focus on specific aspects of the results to emphasize how a methodological approach can impact our global perception of the protohistoric territorial system.

THE VOLQUES ARÉCOMIQUES AREA AND ITS "CAPITAL": NÎMES

The data set used in this case study is from the south of France in the Languedoc area, more precisely between the two towns of Nîmes and Montpellier (see figure 1). This space has a total surface area of about 1300 km². According to ancient sources (Christol and Goudineau 1987-1988), it was occupied by the pre-Roman people of Volques Arécomiques whose capital was located in Nîmes. From an archaeological point of view, since the second Iron Age, Nîmes position of power in comparison with other hillforts of the region is generally justified by: its surface area, the presence of the Spring of the Fountain which appears to have been a place of worship or pilgrimage, its active trade and its coinage. The territorial system controlled by Nîmes, however, is an important topic of discussion. Thus, it appears that during the protohistoric period, the status of Nîmes was not yet

clearly outlined. The evoked hypotheses rest on how we interpret some anachronistic texts from the second Iron Age¹, as well archaeological data which has proven to be rather weak. Besides these data seem to indicate that, in the end, Nîmes did not have the same status throughout the centuries; rather, it was the object of progressive construction. Under these conditions, it is necessary to situate the evolution of this community within the more general process of a regional settlement pattern, in order to verify if Nîmes actually played a dominant role and controlled a broad territory from its beginnings. If not, it is a matter of identifying the factors of its success in relation to other agglomerations in the region.

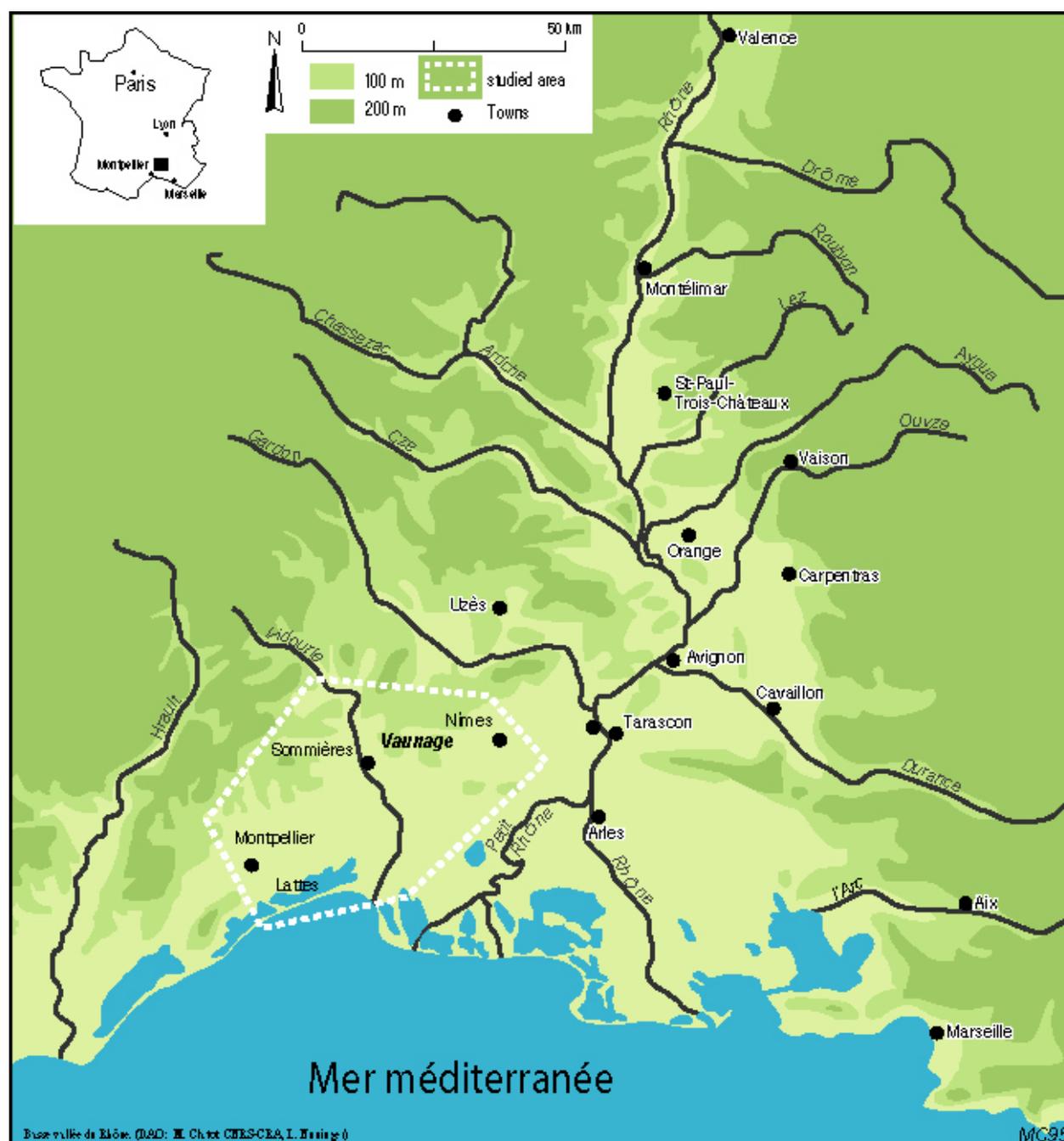


Figure 1: The eastern Languedoc study area

Unfortunately, we do not have exhaustive information on the entire Volque Arécomique area. According to several assumptions, it could cover the Eastern zone of the Hérault department and the whole of the Gard department with some extensions into Losère and Ardeche (Fiches 2002:119). Consequently, we simply studied the area around Nîmes which extends over nearly 900 km² (see figure 1). Additionally, this is the area best-known by archaeologists, for it has been intensively investigated since the 1970s. First, there was a program of excavations relating to almost all hillforts of the region (Py 1990), then a systematic prospecting of the entire zone, directed by C. Raynaud and F. Favory since 1992. This last operation tripled the number of known archaeological settlements, without counting the record of scattered indices interpreted like agrarian spread.

According to the issues raised above, suggested settlement analysis is based on a basic hypothesis, which holds that each settlement cannot be considered alone to define a territorial influence. Indeed, every settlement interacts with its neighbours, forming a constituent part of a dynamic system controlled by a centre. We can understand the geographical situation of each settlement, its hierarchical status and its capacity to endure, that is to say, to actively intervene in the territorial development, only when it is studied with other settlements which surround it. Taking this into account, the analysis aims at emphasizing the bonds which could maintain the various habitats between them and with the space exploited. Thus, we would like to try to rebuild the local networks of settlement, corresponding to the territorial influence of a rural community. On another scale, it is a question of grasping the established bonds between the various centres of these rural communities. In such a way, we believe to better understand how the people of the Volque Arécomique territory organized themselves and what is the real role of Nîmes in such a disposal.

In order to outline a response to these questions, we extracted several types of data. First, we used the comparable functional and chronological characteristics of each settlement in order to classify them according to their hierarchical level. Then, we utilized the distribution of the scattered indices, i.e. "off-sites," which made it possible to model the influence of the cultivated area by these communities. Lastly, the centres are analyzed according to their level of functional and symbolic development. This symbolic system is studied notably through ostentatious constructions signifying their capacity of territorial control in relation to the others.

ANALYSIS PROPOSAL

Initially, we tried to devise a classification system for the archaeological settlement in order to locate them on a hierarchical typology. With this intention, each settlement was described in a systematic and homogeneous way, thanks to a set of variables that was elaborated and tested within the framework of the Archaeomedes Program (Leeuw dir. 1995, Durand-Dastes et al. 1998, Favory et al. 1999). The most relevant variables—especially surface area, the nature of building

materials, the symbolic status—were processed through a factorial analysis of correspondences, followed by an ascending hierarchical classification (Nuninger 2002a:100-129). These analyses made it possible to establish seven classes of settlements: starting from the most modest ones, such as temporary installations or shelters like agrarian annexes, toward the most significant settlements, such as agglomerations which constitute the major centres of settlement (Nuninger 2002a:117-125). The projection of the settlements on the first axis of the factorial analysis, which is strongly structuring from the point of view of hierarchisation, enabled us to order all of the settlements. Thus, we can locate and evaluate the hierarchical weight, i.e. $H(i)$, of each one on a relative scale.

Attempting to define the links between the various settlements, we utilized a gravity model already experimented in the formalization of the networks of Gallo-Roman settlements (Durand-Dastes et al. 1998:203-217). This model makes it possible to attach each settlement to a centre according to distance and offers the possibility to reconstitute theoretical networks of settlement (Pumain and St Julien 2001:184), according to the following function:

$$F(i,j) = H(i) / (1 + \alpha D_{ij}^2),$$

where $F(i,j)$ corresponds to the influence of a place i on a place j according to its hierarchical level $H(i)$ and inversely proportional to the distance D_{ij} which separates it from the place j .

Even so, this basic model posed two essential problems. On the one hand, the Euclidean distance usually used does not take into account the time of journey on foot depending on differences in topography. This was especially problematic in the areas with uneven landscapes. Thus, some settlements could be connected to a centre despite difficult accessibility. On the other hand, this model did not include any parameter relating to the visibility from the main centre. Nevertheless, visibility seems to be a significant criteria in the structuring of landscape and territory for ancient and traditional societies (Wheatley and Gilling 2000:2-4, Van Leusen 1999:218, Wheatley and Gilling 2001:26-28). According to this knowledge, the networks of settlement were later adjusted by the archaeologists, thanks to their experience on the landscape. Nonetheless, this last solution proved to be far from satisfactory since the human spirit cannot integrate a whole and precise vision of all the studied surface points so as to be systematic in the analysis. Furthermore, it poses the problem of lost remains, such as the towers, in which the residual elevation undeniably deform our point of view. In order to attempt a more systematic approach, taking into account also the elevation of monuments (fortification, towers, etc.) that one is able to evaluate, we analyzed the visibility from the settlement centres with GIS. From a practical point of view, developed model is rather simple. It takes again the principles of the gravity model while integrating a cost distance according to time of displacement by foot in function of the topography. This weighted distance was calculated with GIS, between each settlement and its contemporaries, using the following function:

$$D_p = D_r + d a$$

where D_r = Real (euclidean) Distance, d = relative altitude, a = coefficient of increase.

The coefficient a was determined in light of knowledge of the terrain and in keeping with "topoguide" references of great excursion under equivalent topographical conditions and with a load of 20 to 25 kg (FFRP 1994: 9).

The gravity model is then calibrated by the coefficient α for each period. Coefficient α is determined by two values: r and β . The first range (r) is a constant which defines the critical distance, i.e. "the distance where influence eliminates itself or becomes negligible". The second gradient (β) is an exponent measuring the frictional effects of distance. Usually, it favours the influence of the hierarchical weight of settlements. We chose to fix the critical distance at 10 km because on average it corresponds to the distance of the nearest neighbour between centres. Then, the value of β was defined in accordance with the visual influence from the centres and with the assumption that each settlement connected to a centre must be able to be controlled by that centre (Nuninger 2002a: 137-149) (see figure 2). The visual influence of each centre was calculated starting from the digital elevation model, without taking into account the height of vegetation. However, for each centre, the point of view selected corresponds to the highest tower on the site. Due to excavation, we can estimate the height to be about 15 m on average. Therefore, we assumed the vegetation cover impact could be neglected. The assumption would be different if we had chosen a model of co-visibility with the small rural settlements.

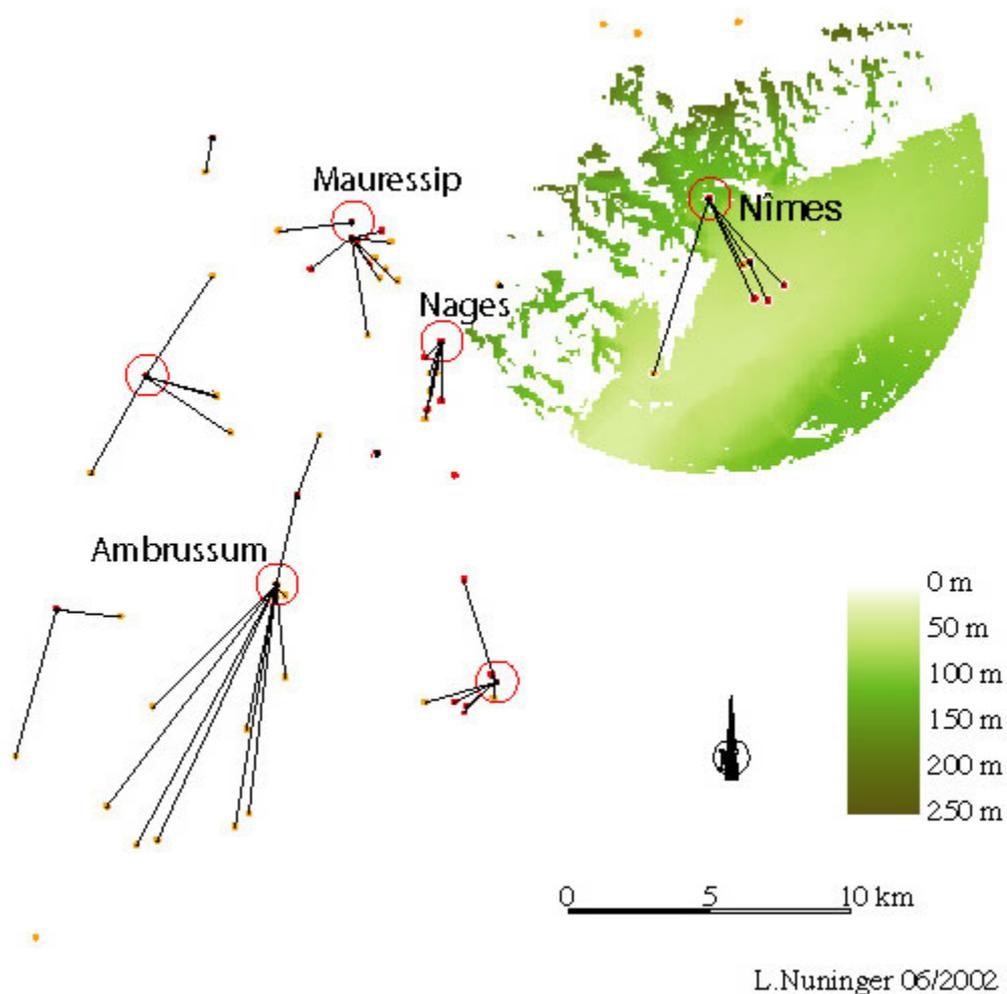


Figure 2: Visibility and calibration of the networks model: the example of Nîmes during the 2nd C. BC

With attempt to give a spatial body to the information generated by the networks of settlement, which correspond to local communities, we used the data collected "off-site." These are scattered sherds that are generally rather fragmented with blunted edges due to the repeated action of agrarian work. It is important to clarify a heavy ambiguity: these sherds cannot be a result of a process of erosion. First, they are not localised only at the bottom of hills, but dispersed throughout the area in tight association with the settlement. Moreover, the quantity of material found, on average twelve sherds of amphora per hectare from the Iron Age and Roman period, as well as the regularity of their diffusion, imply an action which surpasses the only subsequent natural or anthropic phenomenon. Therefore, these scattered sherds are interpreted as the remains of agrarian spreading stemming from fertilization of domestic origin. Their spatial distribution can thus allow us to evaluate the cultivated space through protohistoric communities. However, while processing this data, we were confronted with two difficulties. The first one is related to the dating of these remains for which we can recognize the main different types of amphora according to the clay fabric, but which offers no precise form due to the extent of damage to the sherds. The chronological interval selected is thus, in the best case, longer than two centuries and, at times, extending to five. To

compensate this problem, we developed a chronological model based on a referential outcome of all the habitat excavations in a studied area. This referential permits us to evaluate the global proportions of the various types of amphora per century (Py 1990, Nuninger 2002a:163-170, Nuninger, in progress). The chronological dynamic restored to each agrarian spread zone could then be confronted with the spatial distribution of the settlement by century. Starting from ethnological references, we established an average radius for the spread zones that are considered contemporary. This radius can vary depending on the typology of settlements. The obtained result, however, does not represent the whole of agricultural territory exploited by the protohistoric communities. This is the second difficulty which we have to overcome. Indeed, different practices exist to enrich the fields which leave either no trace, or traces that are barely perceptible. Such is the case with burning, the burying of verdant fertilizer, or the night penning of animals, for example. Moreover, it is possible that certain cultivated lands in open country did not require a direct enrichment, but instead one period of rest, such as a fallow period, for example. Unfortunately, we do not know whether this kind of practice was applied during the Iron Age. It thus follows that the selected zones of spreading reflect only part of the space which could be cultivated. Nonetheless, these selected areas can constitute the backbone of all cultivated lands. From this hypothesis and idea that there are no inexplicable gaps within an infield zone², we modelled the influence of the infield zones by applying a buffer around each zone of spreading. In such a way, it permits the uninterrupted creation of homogeneous entities. These entities defined as above can constitute the theoretical finage (agrarian territories exploited by a rural community) of the communities whose evolution we can follow by century (see figure 3).

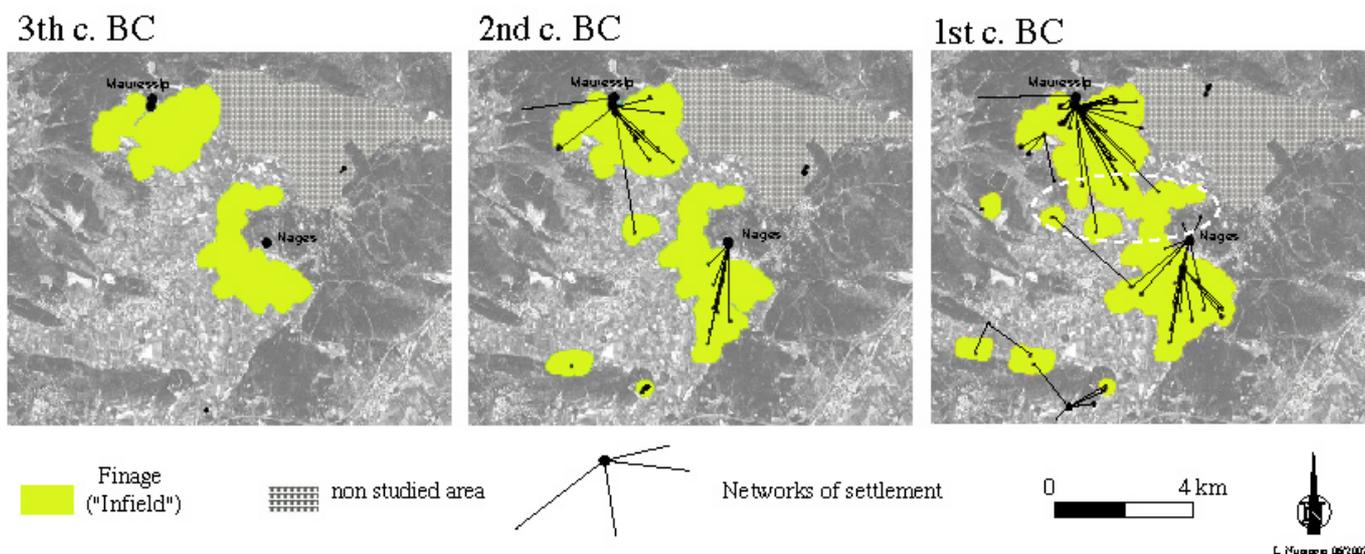


Figure 3: Networks of settlement and theoretical "finage" in Vaunage (Gard)

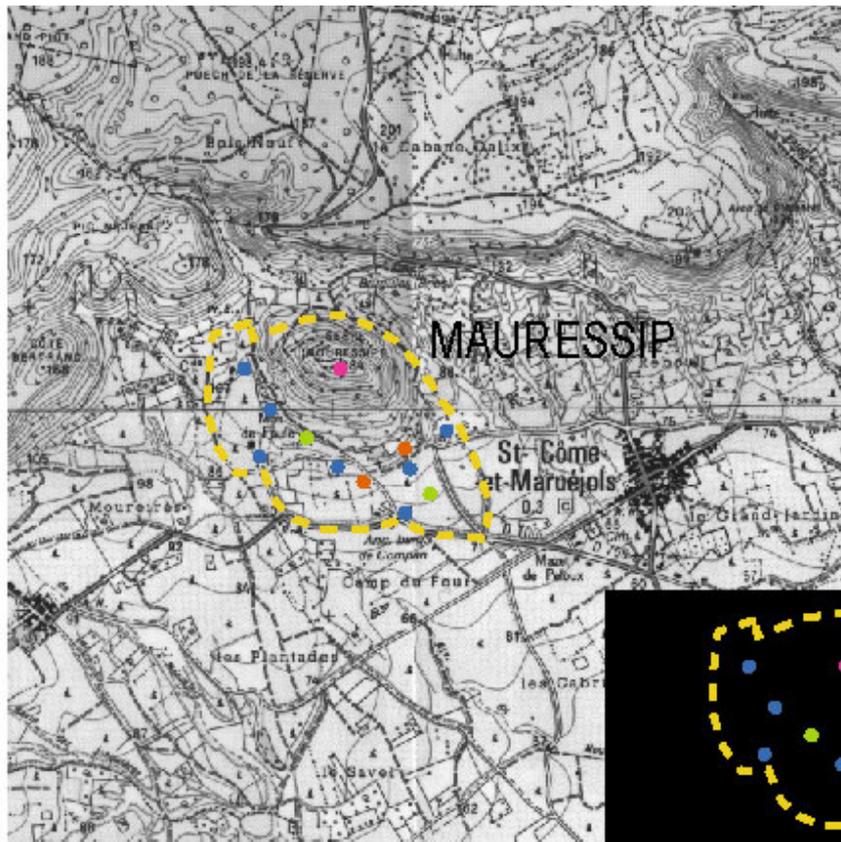
Lastly, to attempt to perceive the basis in spatial occupation through each community, we worked out a final variable which corresponds to the visual competition between contemporary centres. This layer is simply obtained from boolean cumulative of zones with visual hold over each centre.

The confrontation between these various archaeological or derived findings within a dynamic analysis of the settlement in the region, then enabled us to shed new light on the problem of protohistoric territories, supplementing the classical regressive reasoning.

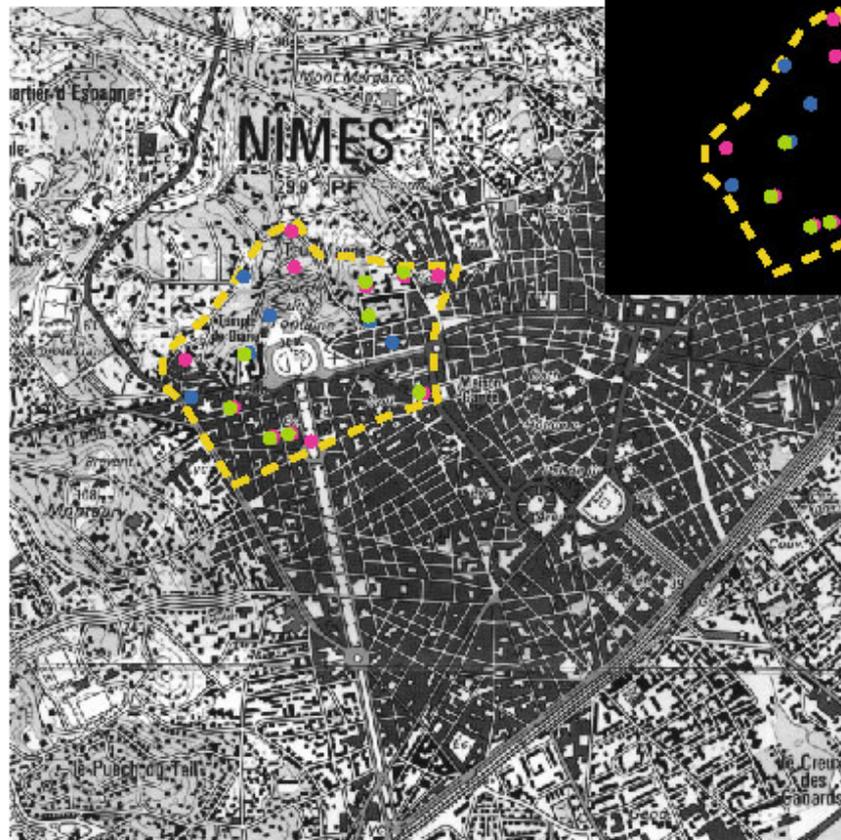
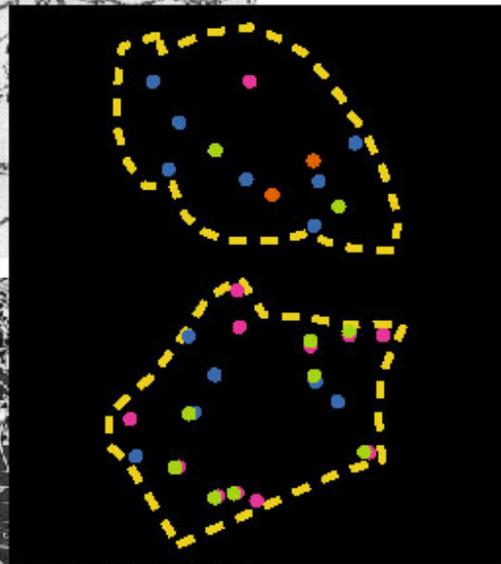
TOWARDS NEW OBSERVATIONS OF PROTOHISTORIC TERRITORIAL DYNAMICS IN THE AREA OF NÎMES

To illustrate our intention, we present an example in the Nîmes area, a particular case study revealed by the modelling and centred around three hillforts situated in the micro-region of Vaunage: MaureSSIP, Roques de Viou and Nages. Concerning this space occupied by the Volque Arécomique during the protohistoric period, the goal was to understand how the territory of these people was organized. Beside, we are interested in knowing from which date the hillfort of Nîmes played the role of capital, or at least, of central place.

The first settlements of the highest hierarchical level were created in the region starting from the end of the 6th and at the beginning of the 5th c. BC. Among these latter centuries, we can note that the hillforts of Nîmes and MaureSSIP appeared during this period as a rather loose cluster of housing. Starting from the 4th c. BC, these two agglomerations seem to have developed in the manner of urbanization and begin to show some ostentatious marks of territorial control, such as towers or fortifications. However, these developments do not seem to translate the superiority of Nîmes over the other hillforts. In addition, the distribution of habitat indices and agrarian activities throughout the agglomerations of Nîmes and MaureSSIP seem to show that the influence of the two centres is similar, at least until the beginning of the 2nd c. BC (see figure 4). These few observations encourage us to envisage a mosaic of communities whose emergent centres convey the capacity and the control in each part of the territory. In this period, no centre seems to have clearly dominated the others. Even if we can consider a system of alliances between these communities in the form of a confederation, it is extremely probable that it had been sufficiently supple to authorise a relationship that, if not conflictual, was at least competitive. This assumption is reinforced by the evolution of ostentatious expressions. They followed one another and they continued to increase between the fourth and the 1st c. BC, with the construction of still more massive fortifications and higher and higher towers on each regional hillfort (Nuninger 2002b). Moreover, a spatial anomaly in the settlement regular pattern, situated in the hillfort region of MaureSSIP, attracts our attention and seems to raise a certain number of questions going in this direction.



- Settlement (excavation)
- Settlement (surface)
- Indices
- agrarian spreads



Nîmes : assumption of pre-roman enclosure (Monteil 1999)

Mauressip : area with vestiges and indices of settlements (surface poteries)



0 1km

conception et DAO : L. Nuninger 05/2000
 © IGN, France for the background map

Figure 4: Nîmes and Mauressip from the 5th to the 3th c. BC

Indeed, until the beginning of the 4th c. BC, this hillfort was undoubtedly the only nucleated settlement within the Vaunage micro-region. Its strategic implantation, on a residual mound, also enabled it to visually control all of the inlier. In addition, it can manage each one of the entries of the inlier to the south, the northwest and the northeast towards Nîmes. During the same period, we can note that this settlement follows a considerable development and is accompanied by a network of piedmont plains including at least six establishments (Nuninger and Raynaud 2000:45). The primacy of the nucleated settlement of MaureSSIP seems quite fixed to this epoch in the Vaunage. Nonetheless, from 375 BC, the landscape changes due to a new habitat, Roque de Viou that takes residence on a hill which faces the MaureSSIP mound. Since the date of its construction, this settlement, which extends to nearly six hectares, is equipped with an impressive stone rampart. (Py 1990:308). The choice of this site, at less than 5 km from MaureSSIP on a headland easily accessible from Nîmes - while others could have satisfied the same requirements: the Liquière or the Roc of Gachonne, for example - appears rather unusual. The ostentatious character of the surrounding elevated wall toward MaureSSIP³, and the vast surface area enclosing Roque de Viou, renders this settlement still not easily conceivable without a rather sharp reaction from the MaureSSIP community or without a tacit agreement due to the external support of the newly installed community. Thus, this development site could signify territorial dispute between these communities of Vaunage and may be indirectly linked with Nîmes. Of course, we could consider another assumption where Roque de Viou might have been a part of the population belonging to the MaureSSIP community in order to reinforce the control of the pathways in the Vaunage basin. Thus, it could assert the territoriality of the MaureSSIP's community in relation to the community of Nîmes. However, spatial and monumental evolution of these two centres within the Vaunage makes this last hypothesis more improbable. Indeed, we witness successively, from the middle of the 4th c. BC to the end of the 2nd c. BC, the deployment of increasingly significant and prestigious fortifications. Moreover, it is necessary to note a significant phenomenon: at the end of the 4th c. BC, the community of Roque de Viou moved a few hundred meters to the neighbouring hill in Nages without any archaeological explanation: there was no destruction and it happened rather rapidly. Even if that in itself does not constitute an explanation, we can nevertheless emphasize that the displacement of the settlement is done from a place located within a zone of visual control in the hillfort of MaureSSIP to a protected site. The hill which dominates the present village of Nages, being oriented toward the south, at the foot of the spur of Roque de Viou, is no longer visible from MaureSSIP. If we cross the various zones of visibility from each of these hillforts, we can perceive that the zone of visibility from Roque de Viou makes contact with practically all the space controlled by MaureSSIP (see figure 5). On the contrary, the visual influence of Nages encroaches upon only half of the zone seen from MaureSSIP (see figure 5). The chronological succession of these settlements then enables us to suggest the following hypothesis: The site development of the Roque de Viou community, during the 4th c. BC, could have become a threat, a rival in the face of MaureSSIP, whose creation in the fifth century BC would ensure a certainly older and better anchored control of the land. In addition, from the end of

the 5th and 4th c. BC, we can observe the distribution of agrarian spread indices. It is showing a context of extension of cultivated space and regression of the zones available for the development of new grounds. This phenomenon could culminate in a relatively equitable division of the zone of influence between the two communities of Mauessip and Roque de Viou/Nages, especially starting from the 3rd c. BC. The absence of violent destruction in the agglomeration of Roque de Viou could indicate the existence of a relatively peaceful, though widely unfavourable, agreement in the community of Roque de Viou. The latter, indeed, sees itself obliged to reinvest in the construction of a new agglomeration and surely in the development of new grounds for the construction of the territory. This interpretation of the event would signify that Mauessip is still able to oppose a sufficiently strong force of other communities to preserve its territorial base. Even so, this latter appears weakened by the division of the zones of influences in Vaunage.

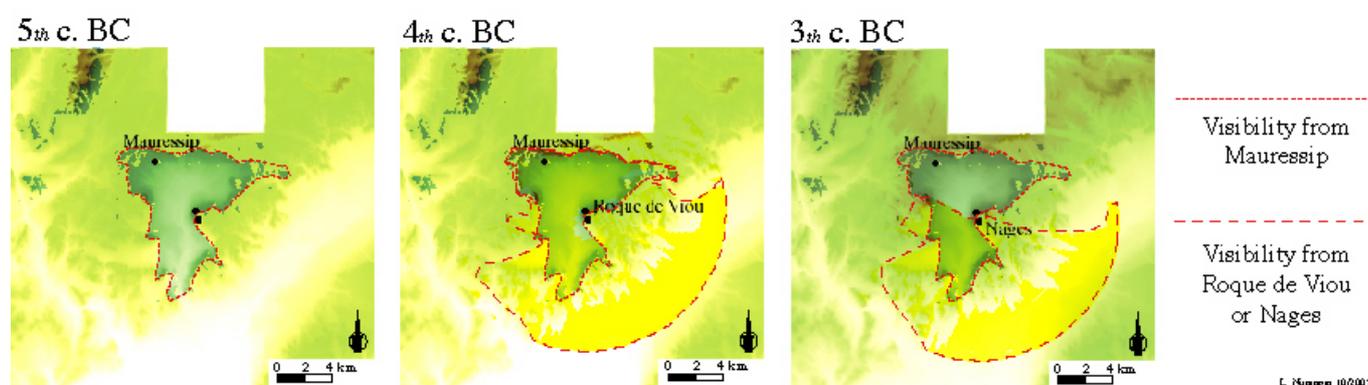


Figure 5: Visibility from the hillforts of Mauessip, Roque de Viou and Nages

Consequently, if we admit this hypothesis, the example of Mauessip - Roque de Viou/Nages, would imply the relations of a politico-economic order between the communities which one can assimilate to the tribes. A question remains, however, concerning this type of territorial conflict: could it be settled between the two communities? Did it presuppose the intervention of an external body, in the form of an "inter-tribal council" or of a "dominant leadership"? The state of the archaeological knowledge unfortunately does not permit us to resolve this question, but it militates in the sense of a rather limited regional political organization. Under these conditions, we can ask ourselves which agglomerations within this area could be favoured by such a situation. Of course, we think of Nîmes which in the same period keeps all necessary space to develop itself. Then, it's interesting to follow the extension of each centre through networks of settlement and cultivated areas. Indeed, beginning in the 2nd and especially in 1st c. BC, competition between the centres seems to have reached its acme, and while certain communities mutually contribute to their own stifling, others on the contrary affirm their development. Since the 2nd c. BC, one observes the creation of small establishments, classified as agrarian annexes or small habitats. They are not very durable, but they are organised themselves within a network of settlement from the existing centres present in the 3rd c. BC. These nebulas of modest settlements can be seen as the expansion of the

centres. This is notably the case concerning Mauressip, Nages and Nîmes. As for this last point, however, the map does not seem very representative of what probably can be explained by the gaps in information. This commune cannot easily be the subject of systematic prospection, particularly centred around the protohistoric agglomeration. The expansive character of this new occupation of the ground is remarkable in the evolution which occurs between the 2nd and 1st c. BC (see figure 6). Indeed, the nebula constituted by the ensemble of small establishments seems to expand, to gradually diffuse itself. All in all, each centre appears to control the space of its ambitions. Only those of Mauressip and Nages have seen their progression rapidly limited by one or another, all the more so that they are the most "productive" centres as far as the small establishments are concerned. Moreover, for these two communities, it is necessary to emphasize the extension of their cultivated area which ends up meeting some time in the 1st c. BC, pointing out new signs of conflicts (see figure 6).

CONCLUSION

To sum up our reasoning, with help of the joining of different developed models and with analysing the visibility area from each centre, we can observe some interesting zones, a kind of anomalies which definitely reveals conflictual areas. Moreover, it is possible to analyse their evolution, suggesting that the territorial protohistoric history is not a continual process of development until the Roman conquest. Versus, it seems to be a system more complex and more interactive. Finally, our assumption is that the protohistoric territorial system is too difficult to be understood solely by way of regressive reasoning, because this system probably does not follow a strict hierarchical pattern with territories fitted together. On the contrary, we can think about territorial dynamics pattern, based on a network of settlement and different types of alliances between the centres. According to this model, we could envisage a triangular balance of power where Nîmes could be associated with the community of Roque de Viou/Nages in order to indirectly weaken the MaureSSIP's influence. First, MaureSSIP would be able to resist, to react before the threat and it would be strong enough to force the moving of Roque de Viou/Nages community. However, this event could mark the beginning of MaureSSIP's decline compared to Nîmes which could have no local problems concerning its own territory. During the 1st c. BC, MaureSSIP again makes a conflictual contact against the Nages community, provoking its decline. At the same time, Nîmes increases, putting it in a good position to develop its contact with the Romans. Then, the Romans could lean on Nîmes to develop their own conquest. In exchange, during the Augustean period, they gave to Nîmes an official capitale statut and the monumental architecture which we know today. On the other hand, we can stress that MaureSSIP was totally deserted during the 2nd c. BC, whereas the other hillforts have settled themselves on the foothills of their hill and endured.

On the whole Languedoc coast, other arguments can reinforce the assumption that the capital status of Nîmes could be quite recent and could result from the Roman political conquest. The Romans could have taken advantage of the conflicts between the protohistoric communities so as to instal their own power. Besides, if we use the principle of regressive analyses with spatial tools, it becomes interesting to observe how MaureSSIP was in a better geographical position inside the limits of the anticipating territory of the Roman civitas of Nîmes (the limits are defined according to Jean-Luc Fiches, Fiches 2002: 121). Indeed, although MaureSSIP appears practically almost in the middle of the territory, Nîmes lies a bit on the outskirts (see figure 8). This last remark does not prove anything, but in reverse, it does contribute to a reconsideration of the protohistoric capital status of Nîmes. Thus, with the reasoning that include several approaches presented in this paper, we are far from the continuity principle which is often used through regressive analysis, due to poor archaeological indices. By this means, the spatial archaeology and modelling can complete our perception of territorial dynamics.

CHRISTOL, M. and GOUDINEAU, C., 1987-1988. Nîmes et les Volques Arécomiques au 1er s. av. J.-C. Gallia 45:87-103.

DURAND-DASTES, F. et al., 1998. Des oppida aux métropoles. Coll. Villes, Anthropos, Paris.

FAVORY, F. et al., 1999. Archaeomedes II: une étude de la dynamique de l'habitat rural en France méridionale, dans la longue durée (800 av. J.-C. - 1600 ap. J.-C.). AGER 9:15-35.

FICHES, J.-L., 2002. Volques Arécomiques et cité de Nîmes: évolution des idées, évolution des territoires. Territoires celtiques: Espaces ethniques et territoires des agglomérations protohistoriques d'Europe occidentale, Proceedings of the XXIVth International Conference, Martigues, France, 7-11 June 2000, Errance, Paris:119-128.

FFRP., 1994. Des Vosges au Jura, topo-guide des sentiers de Grande Randonnée (GR59). Topo-Guides, French federation of hiking, Paris.

LEEuw, S.V.D. (ed.), 1995. Volume 3: dégradation et impact humain dans la moyenne et basse vallée du Rhône dans l'Antiquité, partie II: la mobilité de l'habitat rural dans la moyenne et basse vallée du Rhône dans l'Antiquité. The Archaeomedes project: understanding the natural and anthropogenic causes of soil degradation in the mediterranean basin, European Union, unpubl.

LEVEAU, P., 2002. Les territoires. Un bilan des méthodes d'étude. Territoires celtiques: Espaces ethniques et territoires des agglomérations protohistoriques d'Europe occidentale, Proceedings of the XXIVth International Conference, Martigues, France, 7-11 June 2000, Errance, Paris:9-17.

NUNINGER, L., 2002a. Peuplement et territoires protohistoriques du VIIIe au 1er s. av. J.-C. en Languedoc oriental (Gard-Hérault). PhD. thesis, defended on december 2002, University of Franche-Comté, France (http://tel.ccsd.cnrs.fr/documents/archives0/00/00/29/81/index_fr.html).

NUNINGER, L., 2002b. Pôles de peuplement et organisation territoriale au second âge du fer en Vaunage, Vidourlenque et Vistrenque (Gard). Territoires celtiques: Espaces ethniques et territoires des agglomérations protohistoriques d'Europe occidentale, Proceedings of the XXIVth International Conference, Martigues, France, 7-11 June 2000, Errance, Paris:139-149.

NUNINGER, L., 2003. Approche méthodologique d'un espace agraire protohistorique: la Vaunage (Gard). Actualité de la recherche en Histoire et Archéologie agraires, Proceedings of the 5th International Conference of AGER, Besançon, France, 19-20 September 2000, University Press of Franche-Comté, Besançon.

NUNINGER, L. and RAYNAUD, R., 2000. Dynamique et système de peuplement en Vaunage (Gard) du VIIIe au IVe avant J.-C. Mailhac et le premier âge du fer en europe occidentale, Proceedings of the International Conference, Carcassone, France, 17-20 September 1997, Monographie d'Archéologie Méditerranéenne 7, Lattes: 35-52.

PUMAIN, D. and SAINT-JULIEN, T., 2001. Les interactions spatiales. *Cursus géographie*, Armand Colin, Paris. PY, M., 1990. Culture, économie et société protohistoriques dans la région nîmoise. French School of Rome, Paris-Rome.

WHEATLEY, D. and GILLING, M., 2000. Vision perception and GIS: developing enriched approaches to the study of archaeological visibility. *Beyond the map*, Proceedings of the NATO Advanced Research Workshop, Ravello, Italy, 1-2 October 1999, Nato science series, IOS press, Oxford: 1-27.

WHEATLEY, D. and GILLING, M., 2001. Seeing is not believing: Unresolved issues in archaeological visibility analysis. *Cost Action G2, On the good use of geographic information systems in archaeological landscape studies*, European Communities edition: 25-36.

VAN LEUSEN, P.-M., 1999. Viewshed and Cost Surface Analysis Using GIS (Cartographic Modelling in a Cell-Based GIS II). *Computer Applications and Quantitative Methods in Archaeology*, Proceedings of the 26th CAA International Conference, Barcelona, Spain, March 1998, BAR int., Archaeopress, Oxford.

¹ Notably those by César, Strabon and the Pliny the Elder, between the middle of the 1st c. BC and the middle of the 1st c. AD.

² that is to say, in a space cultivated in a permanent or semi-permanent manner,

³ Since the creation of the Roque de Viou site.