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With the collaboration of
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Hierarchical Typology and Settlement Patterns Modelling at Interregional Scale

Abstract: This paper provides an overview of a collective work in progress, developed by the workgroup "Settlement patterns, networks and territories" of the ArchaeDyn project. The aim is to highlight the occupation's intensity and degree of stability in different regions of France and Slovenia on the long term, from the end of the Bronze Age to the Early Middle Ages. Using field survey data, a shared methodological and conceptual framework is drawn up in order to provide settlement pattern indicators allowing interregional comparisons.

This paper presents an overview of a collective work in progress started in 2005 and part of the ArchaeDyn project coordinated by F. Favory and L. Nuninger (Nuninger / Tourneux / Favory 2008). This program is organised in four thematic groups in order to study the spatial dynamics of settlement and natural resources on the long term. In this paper, we will focus on the research carried out by the workgroup "Settlement patterns, networks and territories". This workgroup research is mainly based on the Archaeomedes background but with more original and multicultural perspectives (Nuninger / Tourneux / Favory 2008).

The project focuses on 11 workshop areas[1]: 4 are located in Southern France, 6 in Central France *(Fig. 1)* and 1 in Slovenia.

Understanding Intensity and Stability of Settlement Pattern over the Long Term

The aim is to highlight the main trends of the settlement in various areas, from the end of the Bronze Age to the Early Middle Ages. A long term survey approach has been adopted, enabling to fully understand the perceptible changes and continuities in the settlement dynamics. The following questions are addressed: what are the dynamics and patterns of the habitat? Which are the occupied and abandoned areas? Are they occupied continually or not? Which are the relationships between the hierarchy of the habitat and the intensity and stability of occupation in the different areas? Therefore, this workgroup aims to develop indicators of settlement patterns, based on existent data, which will enable the comparison of different regional situations by using common methodological and conceptual frameworks.

Occupation of space is perceived through habitat remains. By habitat, we mean all types of settlement, including dwellings as well as agricultural or crafts buildings. Funerary areas were excluded because of uneven documentation in different periods and regions. Moreover, considering a long term perspective and multicultural entities, funerary data are too complex and as indicators would involve too much variability. Significant work was carried out around the concept of site and its perception on the ground.

[1] The team comprises 19 researchers from 8 laboratories of the universities or the CNRS: Auvergne-Limagne: B. Dousteyssier, M. Ségard, F. Trément (University of Clermont-Ferrand 2, EA 1001); Berry – Champagne berrichonne: C. Gandini (ENS, Paris, UMR 8546); Berry – Sancergues: N. Poirier (University of Tours, UMR 6173); Bourgogne – vallée de l'Yonne: P. Nouvel (University of Franche-Comté, UMR 6565); Languedoc – Vaunage/Combas: F. Favory, E. Fovet, L. Nuninger (University of Franche-Comté, UMR 6565), C. Raynaud (Lattes, UMR 5140); Provence – Argens-Maure: F. Bertoncello, M. Gazenbeek (Valbonne, UMR 6130); Provence – Préalpes de Grasse: L. Lautier (Valbonne, UMR 6130); Provence – Verdon: D. Garcia, F. Mocci (Aix, UMR 6573); Touraine – Neuvy-le-Roi: V. Hirn (University of Tours, UMR 6173); Touraine – Tavant, Îles Bouchard et Crousilles: A. Moreau (University of Tours, UMR 6173); Slovénie – Doljenska: K. Ostir, S. Tecco-Hvala (ZRC, SAZU, Ljubljana).

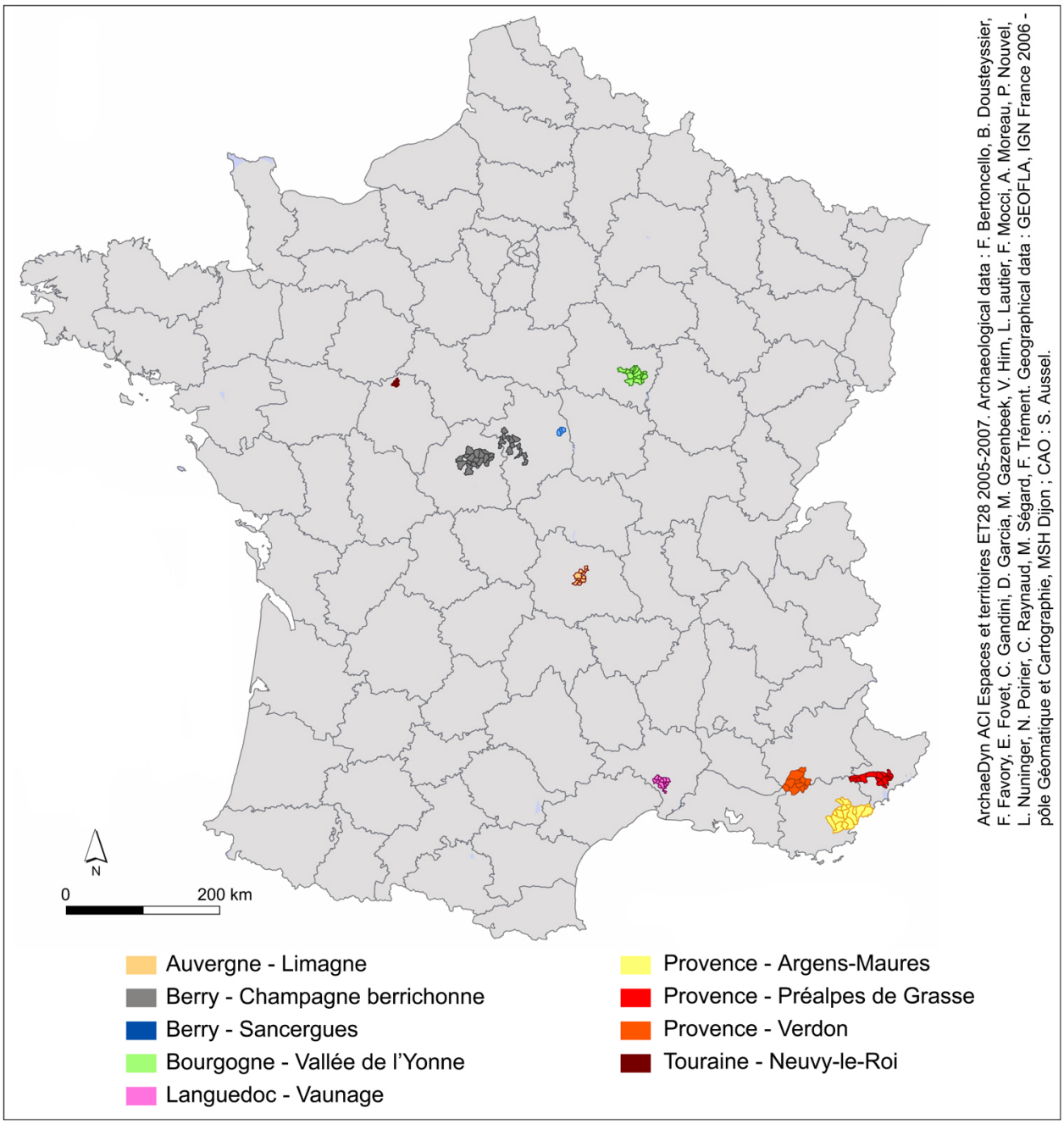


Fig. 1. Location of the French studied areas (CAM: S. Aussel).

A clear distinction was made between site and settlement:

- A site is a concentration of archaeological remains that are localised, delimitated and dated. The site corresponds to a data gathering unit and to a geographical reference: it is a spatial entity, a point in space;
- A settlement is a place where people settled at a particular moment in time more or less durably. A settlement can correspond to a site or part of a site: several occupations (settlements) could have followed each other in the same geographical location.

As our purpose is to analyse the intensity and stability of occupation in various areas on the long term, it was logical to focus on the settlements. It is then possible to take into account, for each settlement, the presence or absence of a previous occupation on the same site, which allows us to estimate the "opportunism" of settlements.

Comparing Data at an Interregional Scale

The study is based on data from field survey. Their heterogeneity was one of the main difficulties encountered in this comparative approach. This heterogeneity derives from several factors:

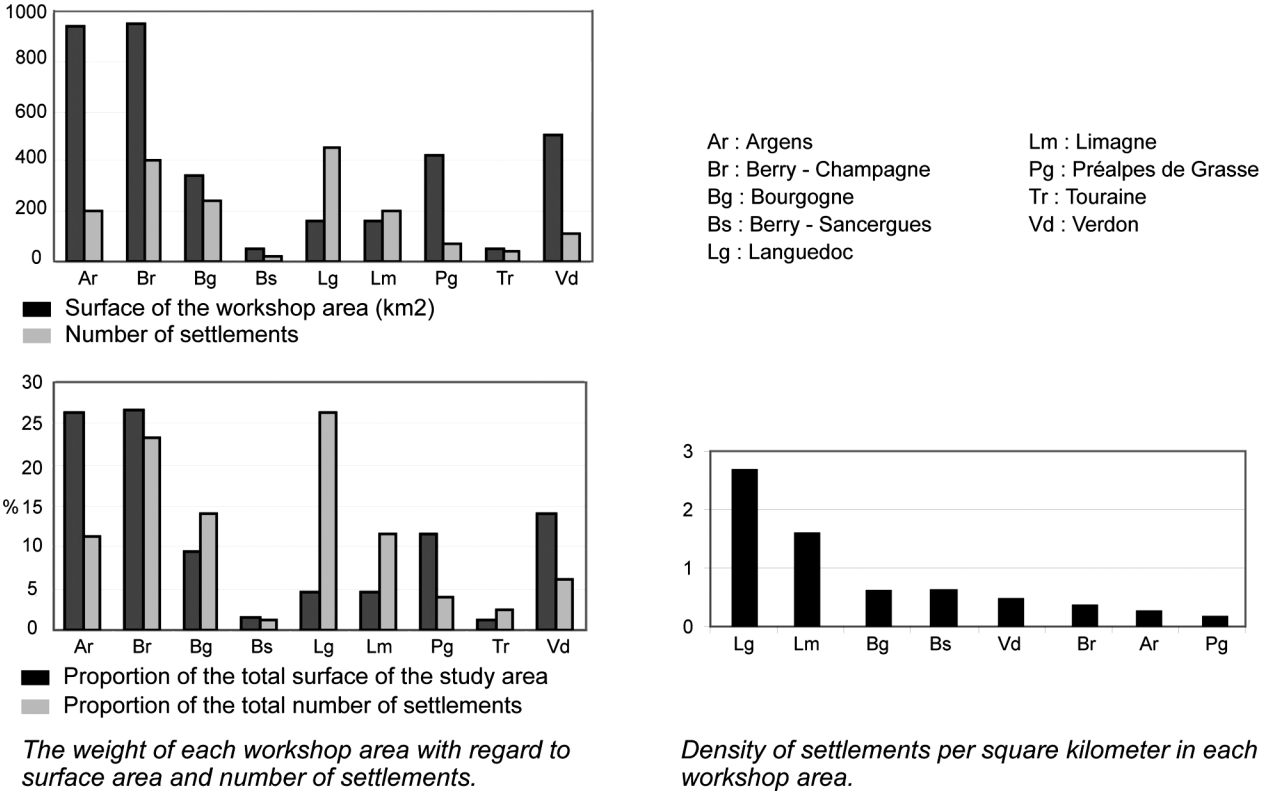
- geographical diversity of the studied regions (topography, geology, land-use);
- variability of the spatial scales involved in the studied areas: from the scale of the commune about tens square kilometers, to the scale of the region covering several hundreds of square kilometers;
- diversity in the data-gathering procedure. Indeed, most of the studied areas have been systematically surveyed, but some have only been partially (like in Berry) or selectively (like in Prealpes or Doljenska) investigated.

These factors must be considered when analysing the diversity of regional situations, as shown by the bar charts in *Fig. 2*.

Likewise, there are variations in the density of artefacts per site depending on the studied regions. For example, the average density of artefacts per 100 m^2 is 50 in Limagne and less than 5 in Touraine, the Préalpes de Grasse or Verdon.

This heterogeneity has led the team to homogenize the data and estimate their reliability. The corpus of settlements studied has been redefined to the most intensively fieldwalked areas and to the best documented period in all the workshop areas, that is to say between 800 BC and 800 AD. Reliability maps have been made in order to assess the data's spatial continuity in each area (see Oštir et al. 2008). Although the issue of the archaeological data's reliability has been underlined a long time ago (for example by Hodder / Orton 1976), maps estimating the representativeness of the dataset used are seldom produced. This parameter is however crucial for the comparison of the time-space dynamics in various areas. Three levels of data reliability were established to produce the maps:

- Level 1 (reliable data) corresponds to areas where systematic investigations were carried out with a maximum spacing of 10 m between the surveyors and areas presenting optimal conditions for surface reading (ploughing, vineyards, lavender, etc.);
- Level 2 (partly reliable data) corresponds to areas where systematic investigations were carried out but with a spacing larger than 10 m or areas presenting partial surface reading due to a more



The weight of each workshop area with regard to surface area and number of settlements.

Density of settlements per square kilometer in each workshop area.

Fig. 2. Density of settlements in the studied areas (graph: C. Gandini, F. Trément; data see footnote: 1).

dense vegetation cover (fallow land, untilled land, meadow, woodland);
- Level 3 (not very reliable data) corresponds to areas only partially investigated and/or presenting poor surface reading due to a very dense vegetation cover and/or taphonomic problems of erosion or sedimentary cover.

The Berry database is a good example on how we focused on the most reliable areas revealing a certain spatial continuity of the data. Initially comprising of 2275 settlements spread over 18,000 km^2, it was reduced to 537 settlements on an area of 3000 km^2.

Analysis of the Settlement Patterns

After measuring and mapping the reliability of the data in every studied area, it was possible to start analysing the settlement patterns' evolution.

To evaluate the stability or instability of settlement patterns, three types of indicators were considered:

1) Chronological and quantitative indicators, revealing the settlement patterns' dynamics;
2) Quantitative analysis of the settlement hierarchy to identify the habitat's patterns and organisation;
3) Spatial analysis of the settlement patterns to locate the most dynamic areas in terms of intensity and durability of occupation.

In this paper, we will focus only on the two first stages, the spatial analysis of the settlement patterns being still in progress.

Quantitative Analysis of the Settlement Dynamics

The most basic analysis consists in calculating the percentage of settlements per century. This first level of reading enables to mark the main interruptions in the settlement evolution. A detailed study of the settlement's foundations and abandonments allows deeper characterisation by identifying the processes behind this evolution. Finally, the variations in the number of settlements must be weighted by taking into account the settlements surface, which gives a more accurate image of the intensity of human pressure *(Fig. 3)*.

In this way, each studied area can be compared to the others, following a common methodology[2].

To better understand these chronological dynamics, it is necessary to consider the forms of the settlement patterns. Indeed, the variations in the number of settlements through time have a different meaning according to the settlements function.

Analysis of the Settlement Hierarchy

From the perspective of an interregional comparison, it is essential for the settlements to be characterised by identical criteria, using a standardised and homogeneous descriptive grid. The descriptive grid used, derived from the Archaeomedes project (Favory et al. 1999; van der Leeuw / Favory / Fiches 2003), includes five variables, each one composed of several modalities. These variables have been established from surface survey data *(Fig. 4)*.

Correspondence analysis and agglomerative hierarchical clustering[3] were used to generate an automatic classification of the settlements by analysing the structure of the processed data. The results of the typology only concern the French study areas. Due to the type of investigation (selective survey), the profile of the Slovenian area was too particular leading to a bias in the first analysis. Indeed, almost all the Slovenian settlements defined a single class. The present analysis was carried out on 1251 settlements, i.e. 63% of the total settlements. In order to avoid bias, we removed all the settlements having no information for at least one of the variables.

Seven classes of settlements were defined from the agglomerative hierarchical clustering. A typological and hierarchical interpretation of the settlements

[2] Such a long-term approach always raises the question of the over-representation of Roman remains on surface survey compared to those of previous and later periods. Without underestimating this issue, it is important to note that our comparisons concern the trends of the settlements' evolution in the different studied areas rather than the raw numbers of settlements. Moreover, in several regions, other types of investigation (aerial survey, excavations) complete the data collected from surface survey and allow to better address Iron Age and Late Roman settlement patterns.

[3] Agglomerative hierarchical clustering (CAH) and factor analysis (AFC) algorithms used within the project stem from the correspondence analysis developed by the Franco-Lebanese Benzecri at the end of the 1960s (Benzecri 1992; http://www.micheloud.com/FXM/COR/e/index.htm). The dissimilarity coefficient used for hierarchical clustering is based on the Chi^2 distance and the aggregation uses Wards' method.

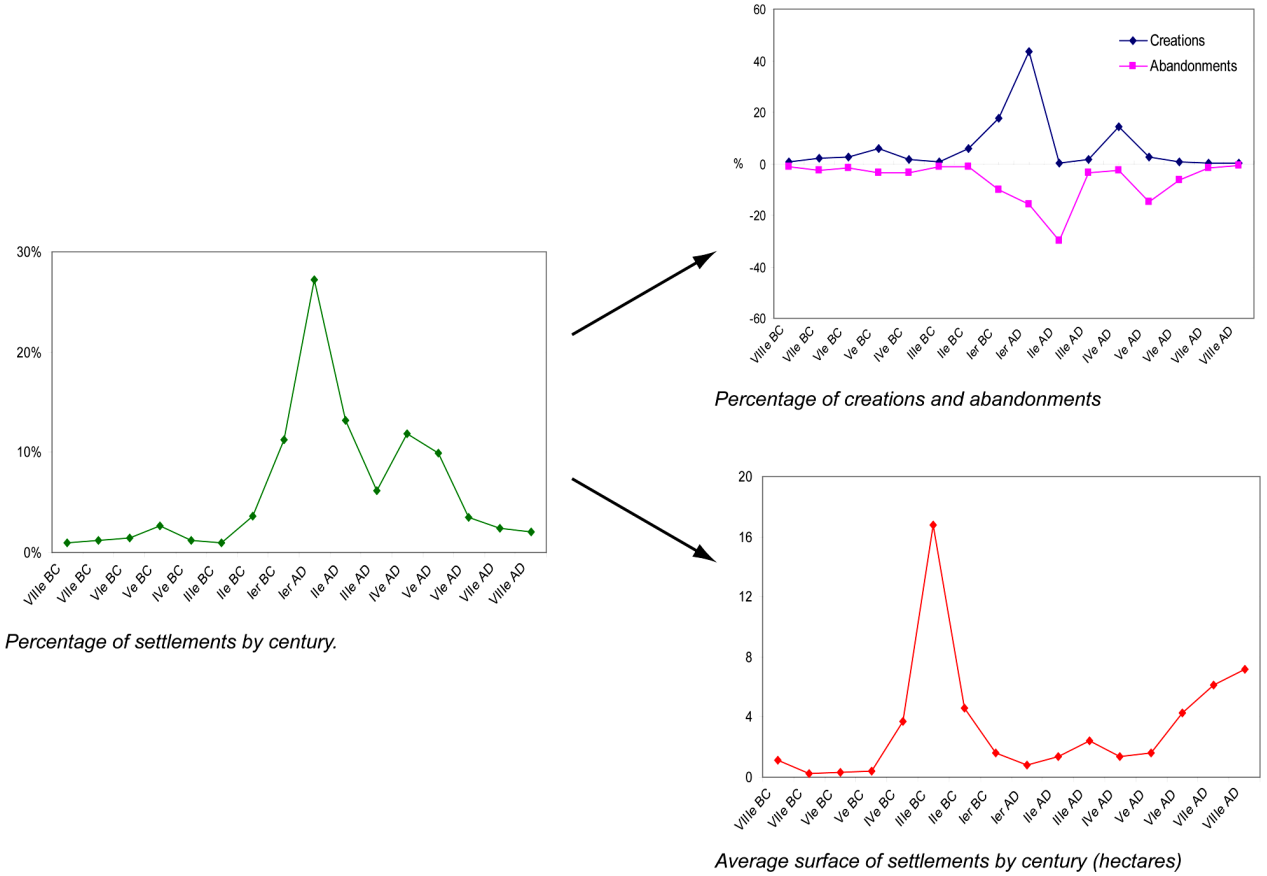


Fig. 3. Settlements' dynamics. Example of the Languedoc region (graph: E. Gauthier, L. Nuninger; data see footnote 1).

Surface (Sup)
- Below 0,1 hectare
- Between 0,1 and 0,3 hectare (excluded)
- Between 0,3 and 0,5 hectare (excluded)
- Between 0,5 and 1 hectare (excluded)
- Between 1 and 2 hectares (excluded)
- Between 2 and 5 hectares (excluded)
- Above 5 hectares

Length of the occupation (Occ)
- 1 - 3 centuries (imprecise datation)
- < 100 years
- 100 - 199 years
- 200 - 299 years
- 300 - 399 years
- 400 - 499 years
- 500 - 999 years
- 10 - 15 centuries
- > 15 centuries

Function (Fon)
- Agricultural function or without established function
- Indication of specialized craft activity (working of metal, pottery, glass, stone, etc.)
- Political and/or religious and/or symbolic function (fortification, worship place, mausoleum, minting workshop, public building)

Building materials (Mat)
- Absence or perishable materials
- Stone
- Tile and/or sawed plate
- Stone and tile and/or sawed plate
- + mortar and/or hydraulic concrete
- + hypocaust brick and/or tubuli and/or painted coat
- + decoration elements (mosaic, marble, sculpted element)

Former occupation (Ant)
- No former occupation
- Occupation between 0 and 99 years before the creation of the settlement
- 100 - 199 years before the creation of the settlement
- 200 - 499 years before the creation of the settlement
- > 500 years before the creation of the settlement

Fig. 4. Variables used for hierarchical typology.

Classes distribution in the AFC

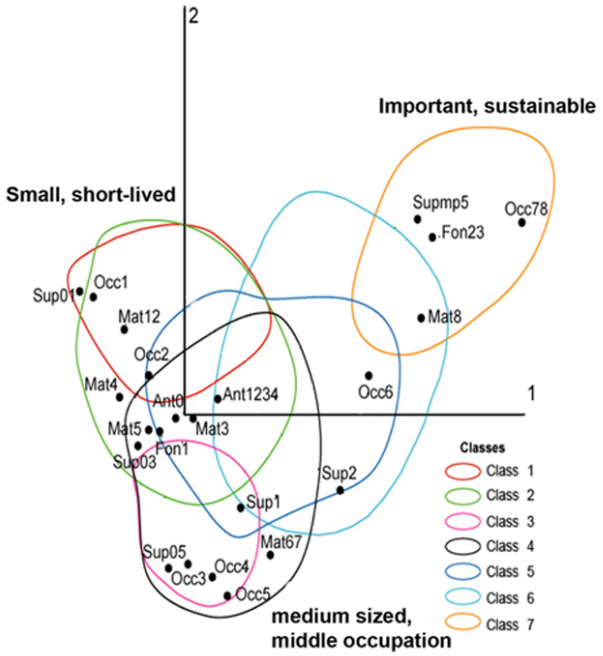


Fig. 5. Distribution of the classes in the factorial space (graph: C. Gandini, F. Bertoncello; data see footnote 1).

Interpretation of classification

Class	%	Description	Test of interpretation
1	23	settlements without specific function, very small (70 % < 0,1 ha) and modest architecture, without former occupation and short-lived (86 % < 1 century).	agricultural buildings or small dwellings (temporary ?)
2	16	settlements without specific function, small (72 % < 0,3 ha) and modest architecture, without former occupation (63 %) or re-occupying a site occupied in the 5 previous centuries, and short-lived (69 % between 1 and 2 centuries)	small dwellings (temporary ?) or small farms
3	10	large settlements (41 % > 2 ha), not very durable (74 % < 3 centuries), varied construction and function, without former occupation (69 %) or re-occupying a site occupied in the 5 previous centuries	Small clustered habitat
4	25	settlements without specific function, small or medium-sized (75 % between 0,1 and 1 ha) and modest architecture, not very lasting (43 % between 2 and 3 centuries) and without former occupation (80 %) or re-occupying a site occupied more than 5 centuries before	farms
5	11	settlements without specific function, medium-sized (55 % between 0,5 and 1 ha, 21 % between 1 and 2 ha), ordinary or comfortable construction (28 % with hypocaust brick and/or tubuli and/or painted coat), durable (43 % between 3 and 4 centuries, never < 2 centuries) and without former occupation (80 %) or re-occupying a site occupied more than 5 centuries before	farms or comfortable agricultural exploitation (*villa*) or small clustered habitats
6	8	settlements without specific function, medium to large size (76 % between 0,5 and 2 ha) and comfortable (26 % with decoration elements), very lasting (62 % > 5 centuries) and without former occupation	*villa* or clustered habitat
7	8	the most durable settlements (74 % > 5 centuries), largest (56 % > 2 ha), comfortable architecture (56 % with decoration elements), with a spécific function (especially political/religious or symbolic) for half of them	important *villa* or town

Small, short-lived

Important, sustainable

Fig. 6. Classes of settlements (table: F. Bertoncello, C. Gandini; data see footnote 1).

is proposed, based on the characteristics shown by each class *(Figs. 5, 6)*. By hierarchy, we mean the sorting of the settlements according to a degree of importance based on the level and the range of their forms and functions (Durand-Dastès et al. 1998). It is necessary to underline the relative value allotted to the concept of "hierarchical level". Indeed, there is no intention in this construction to estimate the social and legal status of a settlement. The aim of this classification is simply to provide a scale of reference to approach the spatial organisation of the settlements.

The analysis of the classes reveals a rather clear hierarchy of the settlements. The classes are well sorted from the smallest and short-lived settlements group to the biggest ones, with more comfortable and sustainable occupations. Likewise, the classification respects the general hierarchy of the habitat even if the same class can integrate settlements of different shapes.

84% of the settlements belong to the first five classes, which correspond to small or medium-sized settlements (< 2 ha) characterised by ordinary architecture and short to medium occupation (< 4 centuries). The largest, most durable and comfortable settlements (classes 6, 7) only represent 16% of the corpus. The big *villas* and towns of class 7 probably play a large part in structuring the settlement pattern thanks to their specific functions and very strong capacity to last.

The analysis of class distribution in every region and the representation of the regions in each class *(Fig. 7)* suggest different forms of organisation. In Languedoc, 77% of the settlements are small and short-lived (classes 1 and 2). They are also well represented in the Verdon (35%), although the majority (51%) of the settlements in this area is in class 4 (farms). On the opposite, modest settlements represent less than 6% in Burgundy. The other areas show a more balanced distribution of the various types of settlements. This approach suggests different types of settlement patterns, some areas being organised by a few major habitats surrounded by many small settlements, whereas the hierarchy of settlements seems more gradual in other regions. Spatial analysis will enable to better understand these differences by analysing the spatial links between settlements according to their hierarchical level (Bertoncello et al. in press).

Conclusion

At the end of two years of work, this workgroup was able to define and apply a common methodology in order to compare the dynamics of the settlement patterns at the interregional scale. Data homogenization and quantitative analysis of the settlements evolution are completed. The hierarchical typology gives a first insight of the diversity of the settlements' forms and patterns.

For the last year of the project, we will focus on the spatial analysis in order to compare the form, the intensity and stability of the occupation in various areas. The aim is to replace the settlements in their chronological and spatial dimension in order to identify zones of long-term continuity and zones of more unstable occupation. The interregional comparisons will then be the basis for an interpretation of the different time-space evolutions.

Finally, we would like to underline the relevance and richness of the collective approach carried out within this team which allows, for the first time, on the same methodological basis, to develop a comparison of settlements patterns and dynamics between Southern and Central Gaul over the long term.

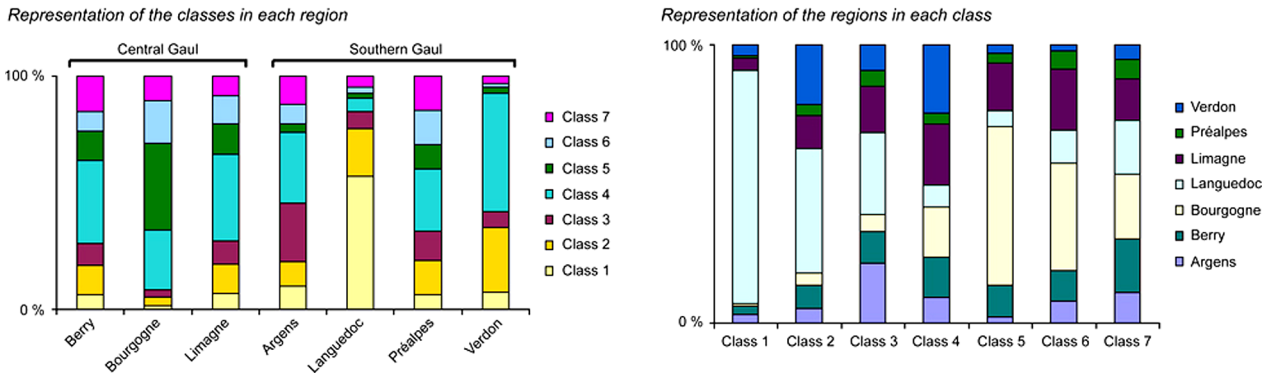


Fig. 7. Organisation of the habitat (graph: C. Gandini; data see footnote 1).

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