The Geographic Information System of Pescara Valley and the Settlement Patterns in the II Millenium BC

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Abstract. Topic of the paper is the use of GIS for the analysis of settlement pattern development in ancient landscape study in order to propose new interpretations. In this study the work with GIS, accomplished according to precise phases, tests the possibility to apply spatial analysis to contexts known partially through archaeological data in order to suppose a total comprehension of settlement pattern, developing predictable reasons. Main result of this work has been the elaboration of new interpretations about settlement systems of Pescara Valley in the Bronze Age. This elaboration will direct the future survey to improve field work and data collection system.
Keywords: GIS, spatial analysis, settlement pattern, predictive archaeology

1. Introduction

The aim of this work is to show the opportunities offered by GIS to the analysis of ancient landscape.

Especially in contexts with poor archaeological data, spatial analysis, will propose new interpretations in order to suppose a total comprehension of settlement pattern, developing predictable settings.

For this kind of analysis I chose a territory, the Valley of Pescara, a middle-adriatic river in the Abruzzo (Italy), and a chronological period, the Bronze Age.
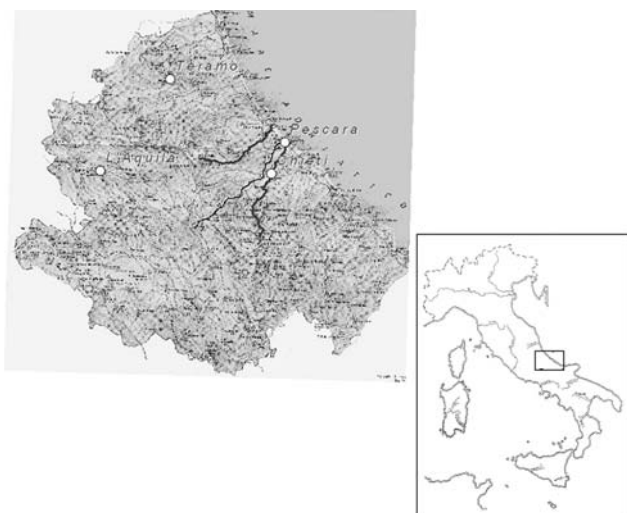

Fig. 1. Location of Pescara Valley in Abruzzo, Italy.

2. The GIS Project

The work with GIS was realized with Arcmap 8.2 according to following phases:

1. collection of all Bronze Age archaeological data in the Pescara Valley through bibliographic and archive research;
2. survey along the valley in order to check the main evidences;
3. recording of data in database and creation of site files;
4. collection of environmental data using different map of the valley:
   - the regional map at scale 1:500.000 to locate the Pescara valley;
   - the technical regional map at scale 1:25.000, to digitalize elevation contours and hydrography;
   - the geological map at scale 1:100.000, to study the environmental specifications of the valley.
   - The maps, not available already in a digital format, were scanned and georeferred with MSR software, using the UTM grid, with metric coordinates.
5. Digitalizing: this was a very important work in order to make analysis and to display and print thematic map. I digitalized:
   - mean rivers;
   - elevation contours every hundred meters;
   - coastline and Adriatic sea;
6. making of DEM from theme of elevation contours;
7. digitalizing of ancient mean roads: this theme shows the three sheep-tracks and the roman road that cross the valley in the ancient times.
   Their reconstruction was useful to understand specific settlement choices that are conditioned by proximity of roads in addition to morphologic, defence, and catchment factors;
8. positioning on the numerical cartography of archaeological sites and join between points and database;
9. query of database in order to make thematic and chronological maps;
10. spatial analysis:
    - The Thiessen polygons have the goal of evidencing the sphere of influence between contemporary villages (Renfrew and Bahn 1999:157–158). In this work the polygons were made with GIS for every phase map, after I selected the evidences which could be considered centres of polygons for typology and location. I chose to show in the map with red lines the geometric limits of polygons and with coloured polygons the natural limits,

especially rivers. Moreover, for all polygons I considered as northern limit the river Tavo and as southern limit the river Alento.

- Buffer is a zone of a specified distance around features. Buffers are useful for proximity analysis, for example, around particular landscape elements (rivers, roads, resources) to verify the distance between them and the sites (Forte 2002:183). With Buffering I draw respect zones of one kilometer around Pescara river, to show up regular location of sites.
- The viewshed identifies the areas on a surface that can be seen from one or more observation points. It allows to determine visibility on a surface from point across the entire surface (Forte 2002:100). When you calculate a viewshed you can set the offset of the observer above the surface. In this work this analysis was applied only to the settlements; the offset is 5 m for the observer.

The satisfactory final result of this elaboration whit GIS was the ability to make new interpretations about the settlement patterns of Pescara Valley in the Bronze Age.

3. The Bronze Age in the Pescara Valley

The sixty seven evidences of the Bronze Age in the valley belong to six classes of source, shown through different symbols: the "settlement", the "tomb", the "cave", the "stray find bronze", the "other" to mean the isolated archaeological find. This map is yet a first tool of analysis: it shows immediately the anomalies of researches, represented by zones with high concentration of sites and zones without evidences (Francovich 2001).

But in order to study the diachronic evolution of settlement in the valley, the sites were divided in four phase maps: Early Bronze Age (XXIII– half of XVII cen. BC), Middle Bronze Age (half XVII–XIV cen. BC), Recent Bronze Age (XIII–half XII cen. BC), Final Bronze Age (half XII–X cen. BC) (Cardarelli 1993: 368–370).

These maps, made by query of database, were starting points to apply spatial analysis and develop historic observations through comparison with phases.

3.1 Early Bronze Age

During the Early Bronze Age the settlement evolution shows, in the middle-Adriatic countries, some peculiar trends: the villages in the valley floor increase, because of growing dryness causing a thick occupation of damp zones. Also the villages along paths increase, evidence of a high interest in the exchanges (Guidi and Piperno 1993: 423, 438).

In the Pescara valley we know fifteen sites during this phase, four settlements, three caves and eight stray find bronzes.

We can observe that the sites are near the river but only in the upper valley; probably this situation is due to the covering of sites by recent river floods.

The caves are used like settlement places during the pasture or like sanctuaries with wall pictures.

About stray find bronzes, they are probably hiding-place of artisans. Because of low number of villages, the Thiessen polygons of these phases aren't much significant.

For their construction I didn't consider one village because it seemed to disappear yet at the beginning of Early Bronze Age; moreover I didn't consider the cave-settlement because it was occupied only for the pasture during summertime.

The buffer around Pescara river shows the proximity between the villages and the river, a settlement situation similar to other central regions of Italy.
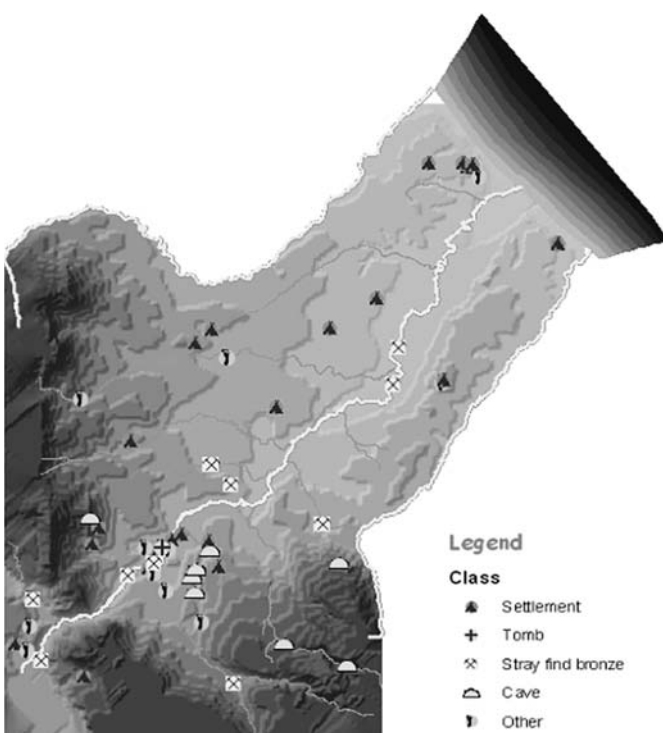

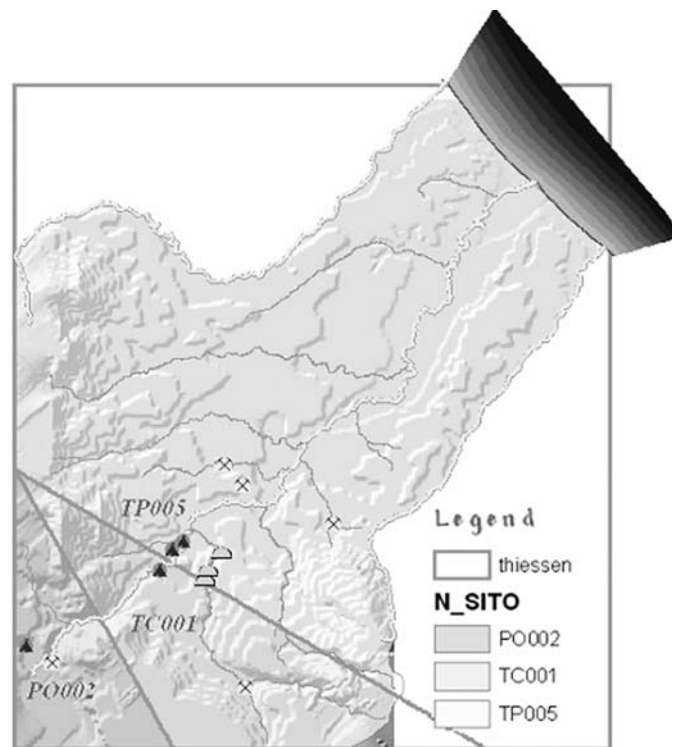**Fig. 2.** Thematic map of Pescara Valley during the Bronze Age.

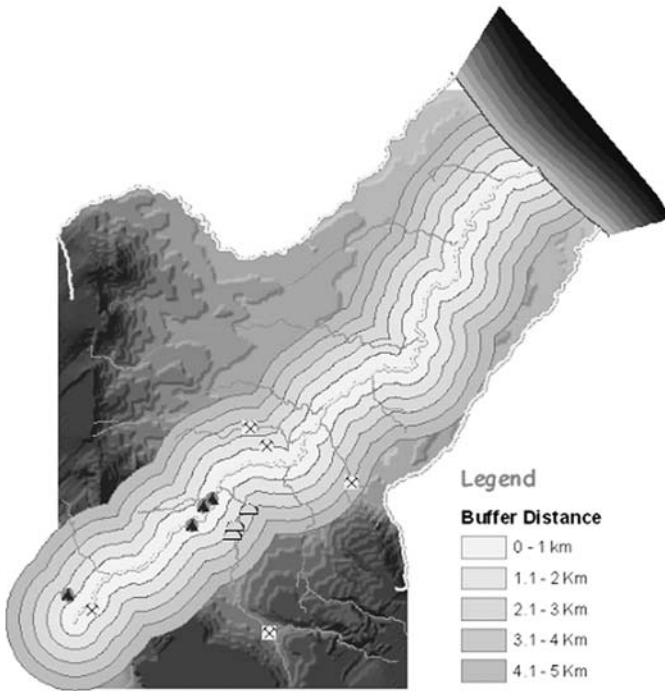**Fig. 3.** Thiessen Polygons of Early Bronze Age.

Fig. 4. Buffering around Pescara river.

The viewshed shows that the settlement PO002 belongs to the Pescara Valley only from a morphologic point of view; its visibility of the river is limited to the source but vast in the direction of the inland basin.

3.2 Middle Bronze Age

We know sixteen sites in the Pescara Valley during this phase. There's an increase of villages up to eight evidences, and a more homogeneous distribution with sites also in the middle and lower valley.
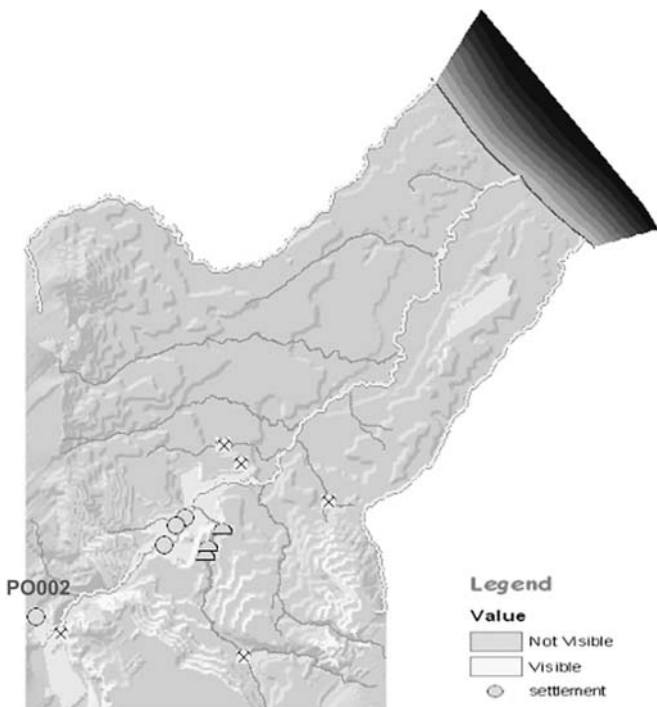
From the view point of settlement choices, the population is arranged according to two principal models (Guidi and Piperno 1993: 452):
1. all damp zones continue to be intensely occupied;
2. villages located on hills or river terraces, as centres of wide territories, start; many of these have around moats or palings as defensive system, sign of the increasing conflict between single settlements.

The selection of settlement location based on defensive cares, proximity to breeding grounds and to communication roads, begins in this phase (Guidi and Piperno 1993: 426).

Thiessen Polygons appear still too big, especially in the upper valley, but they have a regular distribution around the Pescara in the middle and lower valley, thus leading to see the river as the natural limit between polygons.

Buffer underlines this regularity: the villages are placed along the river between two and four Km.

The viewshed shows that the location of PE001 is much strategic for the control on the Adriatic coast and on the lower valley.

CE001 has a very good visibility around itself, while TP005 and TC001 have a little visibility; probably their location is due to the communication roads.

3.3 Late Bronze Age

There are 21 evidences in the Late Bronze Age.

The valley is occupied in all its extension, according to a pattern that provides for a few centres, located to regular distances, in the middle of similar territories, in order to create a check system and a regular occupation of the valley.

Actually we have twelve villages located six on the right bank of the river and six on the left, at regular distances as if there were two formations facing each others.
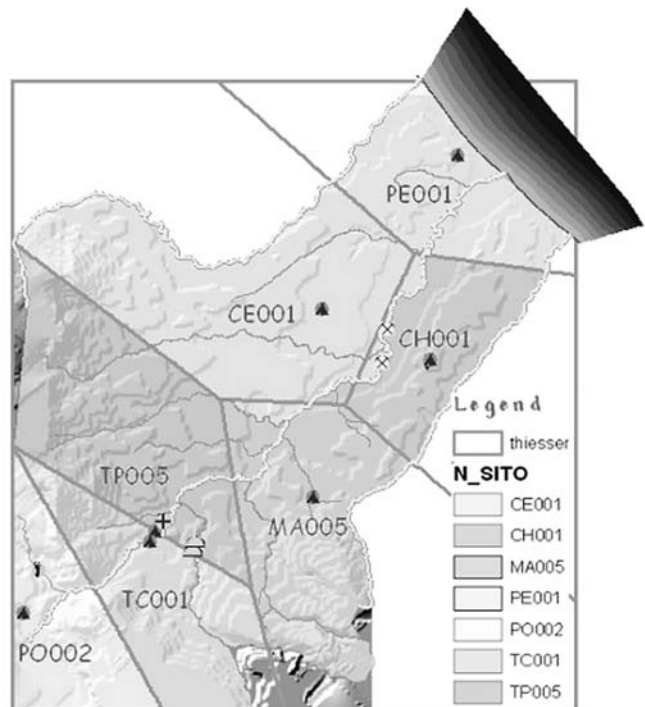

Fig. 5. Viewshed of settlements during the Early Bronze Age.

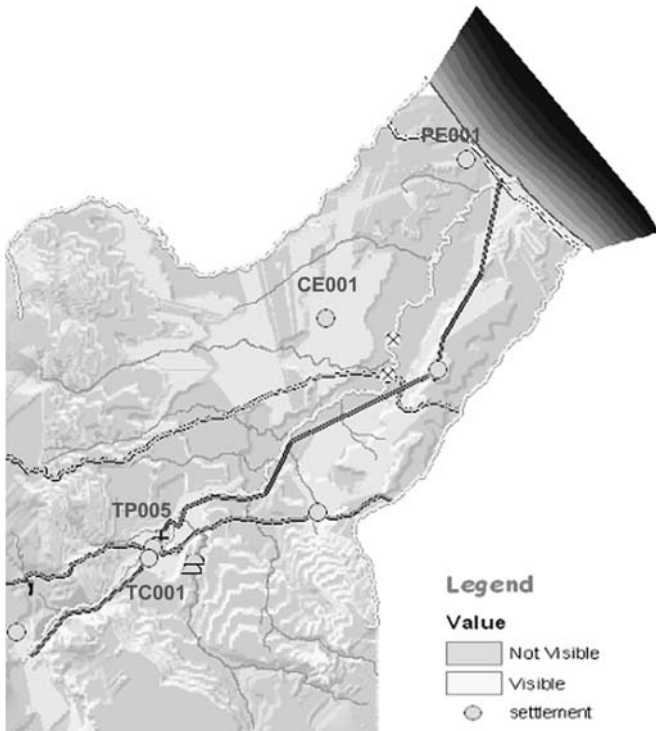**Fig. 6.** Thiessen Polygons of Middle Bronze Age.

Fig. 7. Viewshed of settlements during the Middle Bronze Age.

The impression of a "regular and organized occupation" of the valley is strengthened by Thiessen polygons, that appear more realistic, and increase the view of two lines.

The buffer around Pescara shows all the sites located between 3 and 4,5 Km from the river. The exceptions are CT002 and LA001 located near a torrent.

This occupation offers two possible interpretations:

1. there is a confederation coincident with the valley; the villages are placed around the river to ratify the control;
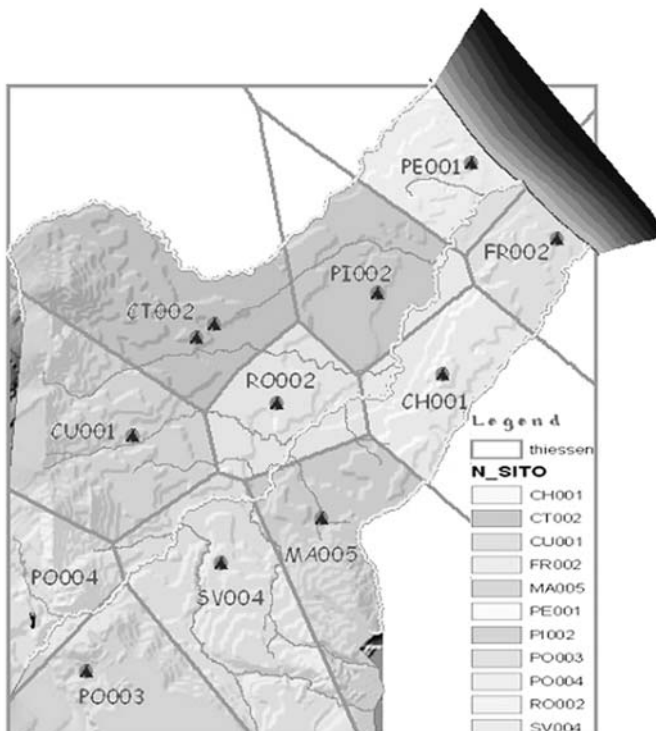

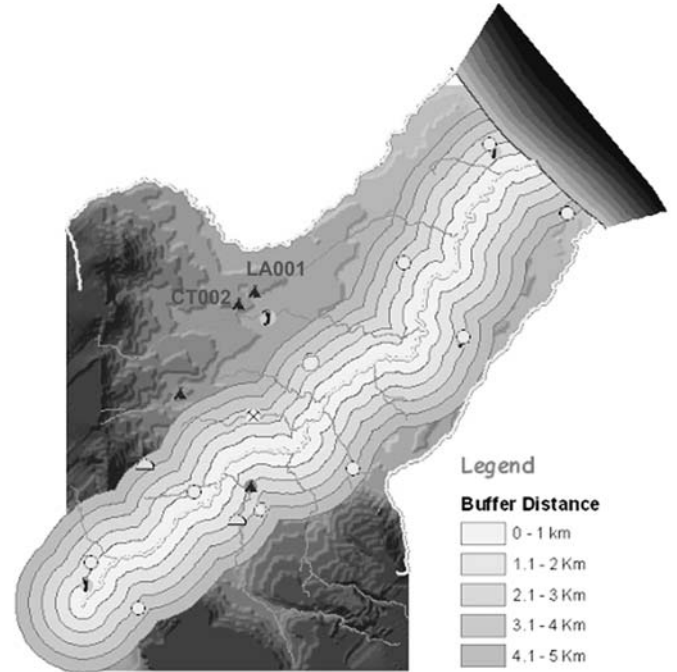**Fig. 8.** Thiessen Polygons of Late Bronze Age.

Fig. 9. Buffering around Pescara river.

2. there are two confederations located on the opposite banks of the river, controlling and exploiting them.

The second interpretation could be confirmed by viewshed analysis. Probably, if the sites were members of the same confederation, the river should be visible from each of them in order to have a total control on it.

On the contrary the Pescara is almost never visible, but there is often visibility between the opposite sites, as if the opposite village had been hostile.

To confirm this hypothesis there are some historic elements: in the Late Iron Age the Pecara river represented the border line between tribes of Vestini and Marrucini (Plinio il Vecchio, III: 106, 100–111).

3.4 Final Bronze Age

We can observe in this phase a further increase of sites, which arrive to 28 with 15 evidences of villages. Anyway, the distribution doesn't change; we observe rather an expansion of evidences already known in the Recent Bronze Age, with two exceptions: the ending of PI002 and the reappearance of TP005.

The polygons appear quite regular in the lower and upper valley, with some anomalies in the middle.

CH001 is a very important site in historic phases (D'Ercole 1995); it probably controlled a territory more extended than the one of other sites since the Late Bronze Age; but it is also possible there is an opposite site not known at the moment.

Of course, between CT002 and MA005 there must be a site, probably the same RO001 inserted in the map of Late Bronze Age.

Finally we can observe that also in this map the geometric limits of polygons correspond quite well to the course of the river. With the buffer around the sheep-track Centurelle-Montesecco we can observe that many sporadic axes in bronze have been found along the communication paths.

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With this territorial, social and political organization based on mean centres and different classes, whose antecedents are deeply rooted in the Early Bronze Age, the Pescara Valley advances towards the first millennium BC.
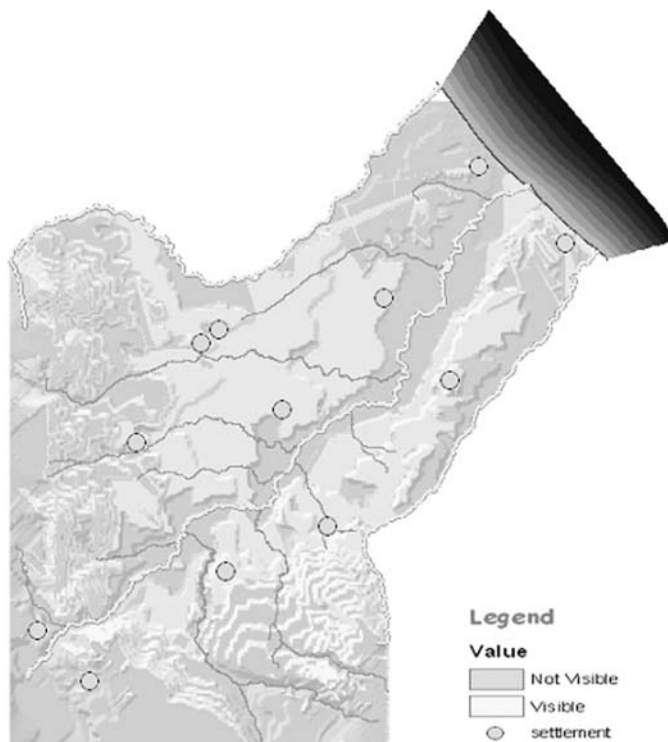

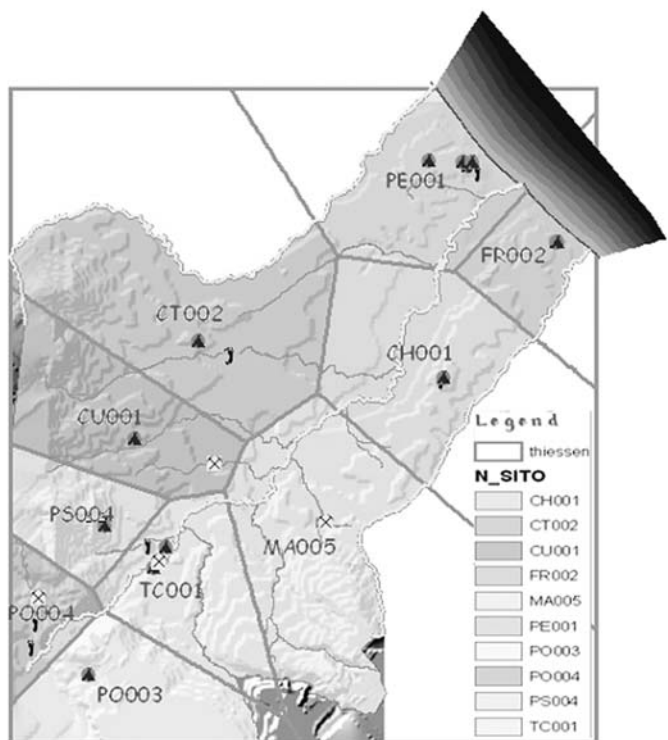**Fig. 10.** Viewshed of settlements during the Late Bronze Age.
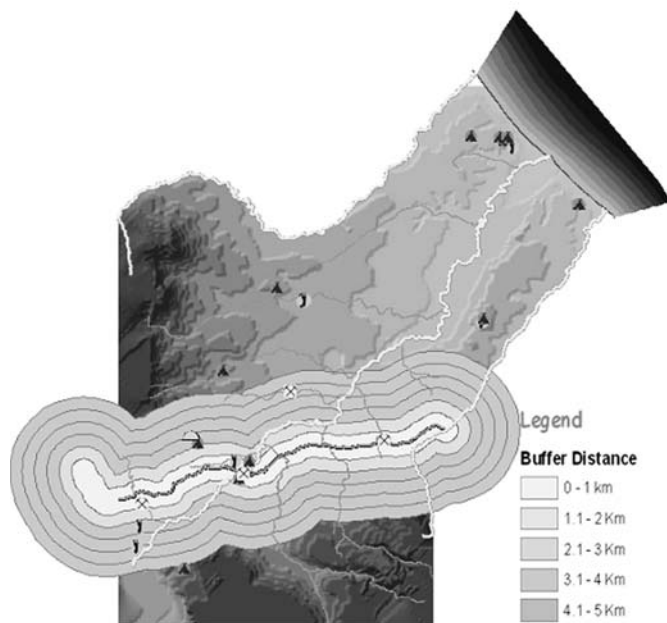

Fig. 11. Thiessen Polygons of Final Bronze Age.

Fig. 12. Buffer around sheep-track Centurelle-Montesecco.

Acknowledgements

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