

A GIS-based analysis of Later Prehistoric settlement patterns in Dolenjska, Slovenia

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23.1 Introduction

Archaeologists have long recognised the need to define boundaries and areas related to specific human behavioural patterns. Boundary research has taken place at a variety of geographical scales within archaeology. At a macro-level this has frequently involved the attempted definition of social, ethnic or cultural territories. At a micro-regional scale, archaeological interest has revolved around exploitative or economic territories associated with specific sites, whilst analysis at the intra-site level has frequently been concerned with the definition of specific activity areas. The ultimate value of some of the entities defined by archaeologists has frequently been questionable, and this has been reflected in past debate on the validity of archaeological evidence for boundaries in the light of ethnographic studies and appeals for archaeologists to view activity across the landscape as a continuum rather than to indulge in artificial, if convenient, partitions. Despite this debate, there can be little doubt that boundaries and their perception are important to human societies. Recent European history emphasises this dramatically. In recent years previously fixed boundaries have become fluid and permeable, and terrible human tragedies have resulted in some instances. Notwithstanding the many difficulties related to the definition of such entities, boundary definition remains an important archaeological problem and deserves serious discussion. This paper outlines several basic approaches to archaeological boundary definition using GIS and applies these techniques to the later Prehistoric settlement system in Dolenjska. It is perhaps appropriate that the database chosen for such applications should come from Dolenjska, as it is a region of Slovenia, one of Europe's newest states (Fig. 23.1).

23.2 The Dolenjska study area

The Dolenjska study area discussed within this paper is situated in the south of Slovenia and contains an area of c. 900 square kilometres. Topographically the area is mountainous but is cut by a series of major river valleys including those of the Krka, Temelnica and Mirna. The region is dominated by limestone which is responsible for a lack of surface water in the south-eastern part of the study area. However, flysch and dolomite also occur and quaternary deposits are found within the valleys.

The later prehistoric remains of the Dolenjska region have been the subject of archaeological and antiquarian study

for over 100 years (Gabrovec 1987, Gustin 1990). Much important work was carried out when the area was under the control of the Austro-Hungarian Empire. However, Dolenjska has been the subject of more intensive work over the last decade. During the latter period, archaeological teams led by Dr. Janez Dular of the Institute of Archaeology (Slovene Academy of Arts and Sciences), have carried out intensive judgmental survey for the purposes of site location. This survey, supported by extensive test-pitting, has provided one of the better data sets from the region. As a result of this work, the settlement sequence within the region has a relatively secure chronological base (Dular 1985).

Despite this, it should be acknowledged from the outset that there are particular problems associated with later prehistoric settlement data from this area. The nature of past work has resulted in a situation in which the archaeological record is dominated by the most visible settlement types — defended hilltop enclosures. Lowland settlement is a rarity within the record for this period. Despite this absence, recent work suggests that such settlement did exist and indicates that further detailed work will provide in-

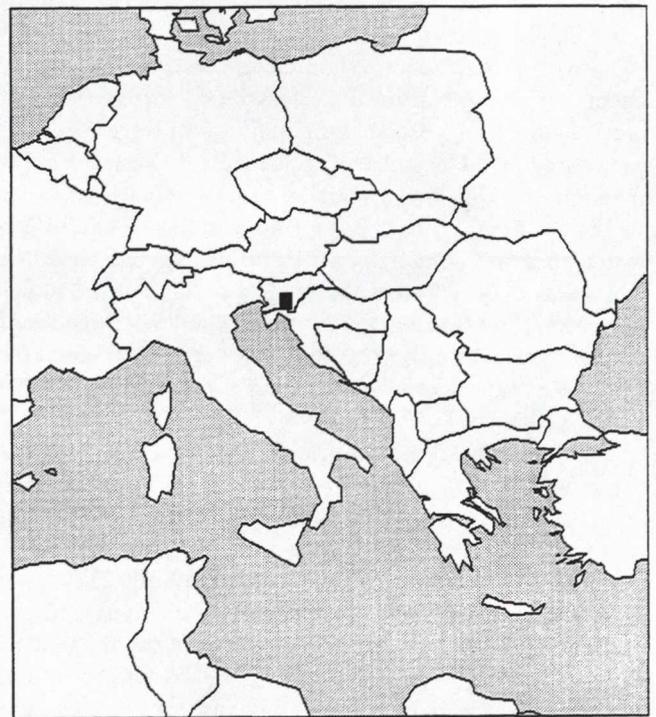


Figure 23.1: Location map of the Dolenjska region, Slovenia.

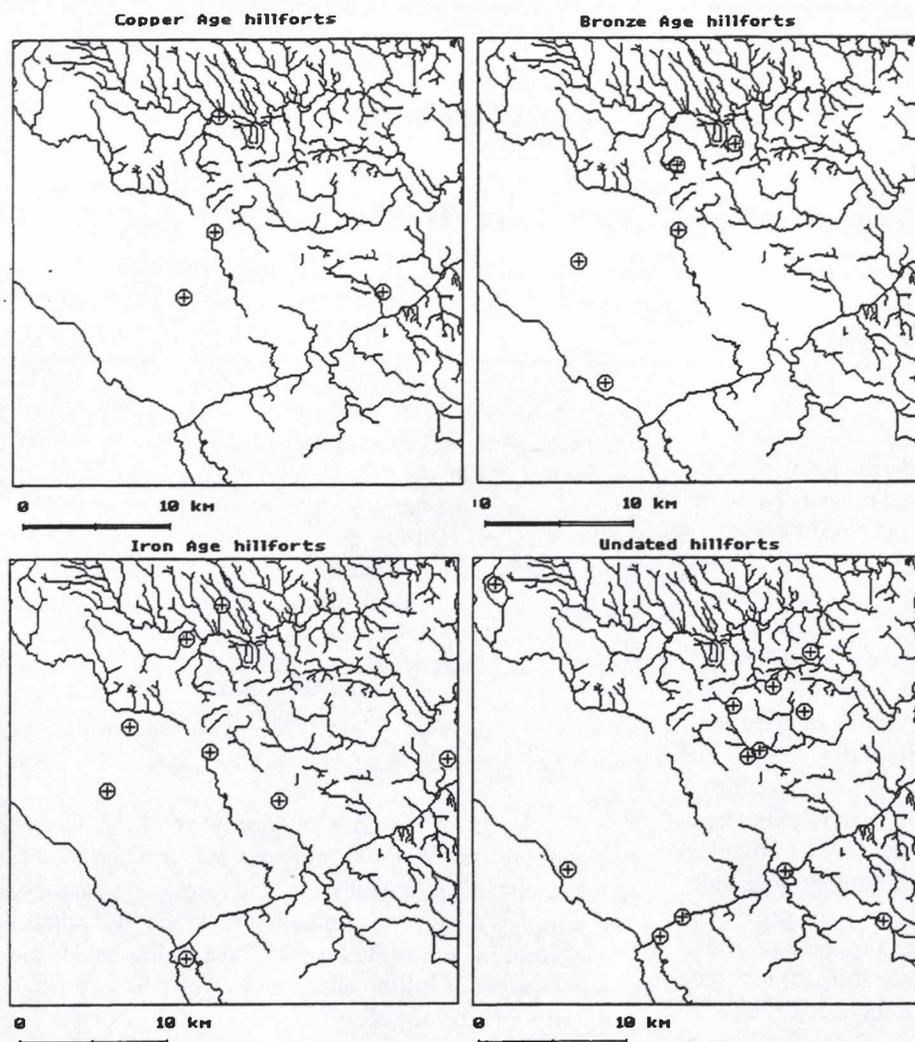


Figure 23.2: Hillfort sites in the Dolenjska region.

valuable information on this poorly represented level of settlement (Mason 1988).

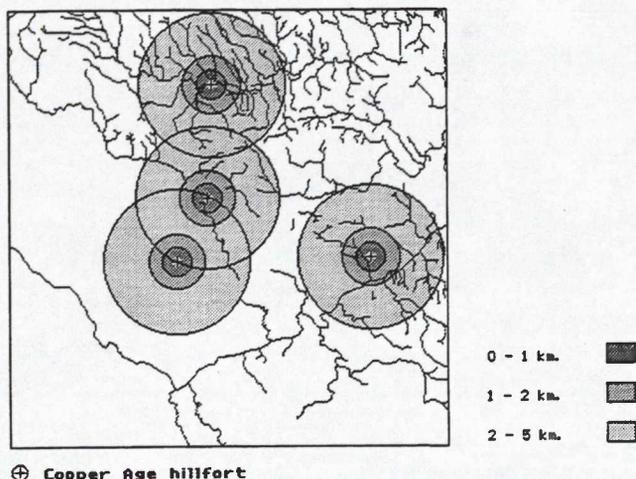
Any such deficiencies should not, however, prevent any attempt at analysis of the available data as the intensity of previous work suggests that the majority of large defended enclosures in the area have been located. Moreover, excavation on these sites indicates that some, at least, were settlement areas. The frequent association of enclosures with cemeteries containing elite burials also indicates that these sites may represent the upper echelons of the settlement hierarchy (Mason 1992). The relative completeness of the data set suggested that the settlement data for Dolenjska could reasonably be incorporated within a GIS-based settlement analysis.

All known later prehistoric hilltop sites were incorporated in the study. This included four sites dated to the Copper Age, five sites dated to the Bronze Age, eight sites of Iron Age date and a further twelve sites where dating evidence was either absent or equivocal (Fig. 23.2). The archaeological settlement data was analysed along with the available topographic and geological data using the IDRISI pc-based GIS system. The 900 square kilometres of the study area was held as an image database with a resolution of 100 x 100 metres.

23.3 Analysis of the Dolenjska database

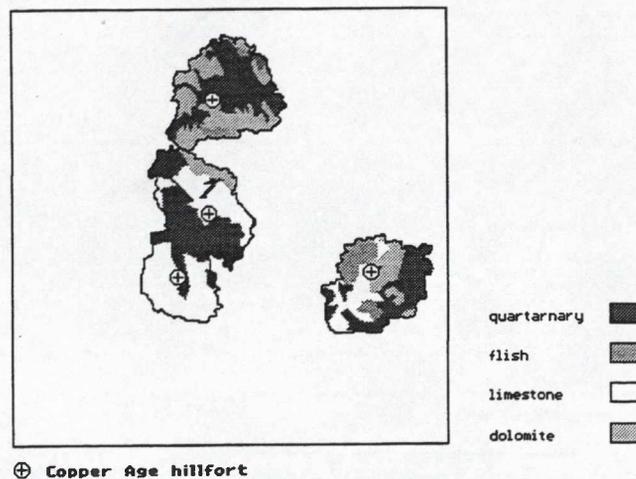
Several techniques have been applied to the study of the Dolenjska database. These have included Site Catchment Analysis (SCA), a technique originating with the work of the geographer, von Thunen (1875) and popularised amongst archaeologists by the Cambridge palaeo-economists during the 1960's (Higgs & Vita-Finzi 1972). The fundamentals of SCA and its variations, are well known to most archaeologists and need not be re-iterated here. However, the technique is important within the context of this paper in that it is easily and rapidly applied through standard GIS modules. A sample SCA analysis illustrating catchments at 1, 2, and 5 kilometres and based upon the four Copper Age hillforts in Dolenjska is illustrated in Fig. 23.3. This exercise exemplifies some of the problems inherent in classic SCA. The overlap of the territories indicates an over-estimate of the size of the site territories or, less probably, the existence of shared resource zones at the periphery of site territories.

Boundary definition through the technique of Thiessen Polygon Analysis (TPA) is also a technique which has been frequently used by archaeologists (Hodder & Orton 1976). The technique is also commonly available on many GIS systems as a standard module. Fig. 23.4 illustrates the ap-



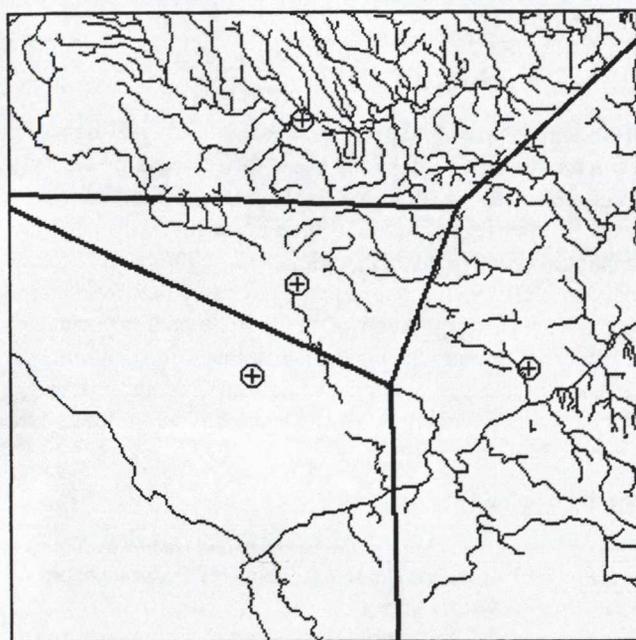
⊕ Copper Age hillfort

Figure 23.3: Site catchments for sites of Copper Age date.



⊕ Copper Age hillfort

Figure 23.5: Geological types within hypothetical territories of Copper Age sites.



⊕ Copper Age hillfort

Figure 23.4: Thiessen polygons for sites of Copper Age date.

plication of such a module using, once again, the example of the Dolenjska Copper Age sites. The data set illustrates edge effects, a phenomenon frequently associated with this technique and resulting, on this occasion, from the use of an inadequate site sample.

Although SCA and TPA have been applied successfully within archaeology, it should be emphasised that they represent ideal models. Consequently, their abstraction and, in the case of SCA, the economic functionalism of the model has resulted in a decline of their use by archaeologists.

GIS, however, has contributed to the rehabilitation of SCA in a modified form through the use of Cost Surface Analysis (CSA) (Gaffney & Stancic 1991). This technique involves the use of friction surfaces to define how difficult it is to move across a landscape. This information can then be used to define a GIS data layer which represents the cumulative cost of moving across a surface — usually

derived from a digital terrain model — from a fixed point in all directions. This data can then be calibrated according to experimental or other values to represent movement expressed in terms of time or energy costs.

In practical terms CSA analyses are comparable to earlier attempts to provide site catchments based on “time contours” derived from ethnographic studies of hunter-gatherers or simple farming societies (Bintliff 1977). Prior to the development of GIS, the difficulty of implementing such techniques, except in the simplest of manners, had largely led to the demise of such practices. In contrast, the ease with which GIS is able to carry out such procedures is now allowing the rapid calculation of calibrated catchments based upon theoretical and actual behavioural data.

Details relating to the derived hypothetical exploitative territory can then be tested against other archaeological data including associated site distributions or palaeo-environmental data.

23.4 Results of the analysis

Within the Dolenjska study, site territories were derived from friction surfaces calculated on the basis of slope. Territories were limited to areas calculated to lie within 1.5 hours walk from the site. This assumption arose from the probability that the hillfort occupants were sedentary farming communities (Bintliff 1977). Initially, cost surface catchments were calculated for the Copper Age sites and these areas were used as binary masks in order to quantify the environmental data within the territories. The results from this process suggested that the sites were positioned to control extensive areas of fertile alluvial plains (Fig. 23.5).

The complementarity of the territories produced by the cost surface analysis suggested that this technique was more applicable to the Dolenjska data than traditional SCA or TPA. It was therefore interesting to impose the distribution of later Bronze Age sites onto these hypothetical Copper Age territories. This indicated that, with the exception of the Sveta Ana hillfort which was occupied throughout later Prehistory (Tecco-Hvala 1990), all the Bronze Age

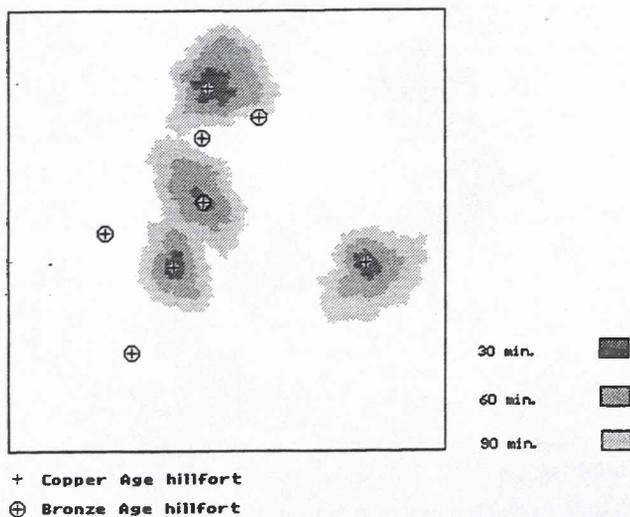


Figure 23.6: Bronze Age sites superimposed upon Copper Age site territories.

sites were new foundations. These new sites were all situated outside, or at the edge of the Copper Age site territories (Fig. 23.6).

The analytical procedure was repeated. The territories for all known Bronze Age sites were calculated and the positions of Iron Age sites were then imposed upon the image. A similar pattern was revealed. With the exception of one site which was situated adjacent to a Bronze Age site, all the Iron Age sites lay beyond the territorial boundaries of the earlier hillforts (Fig. 23.7). Analysis of territories associated with both the Bronze and Iron Age sites indicates that these settlements were also linked with control or access to fertile alluvial land.

23.5 Discussion

These analyses prompt a number of observations. The tendency of later sites to be located beyond the edges of territories of earlier sites appears to be a deliberate act. This suggests that the sites in question must have co-existed for some period of time. If this was the case, the test-pitting strategy adopted to date these sites did not locate this evidence and this may indicate a problem with the excavation sample. The continued preference for an association with alluvial soils indicates that we may be witnessing a gradual infilling of the landscape, although more detailed chronological data is necessary to confirm this trend. Given the clear relationship between dated hillforts and alluvial soils, a final observation should be made relating to the existence of extensive areas of alluvial soils in areas which are not currently associated with dated hillforts. In respect of this we should note that there are a considerable number of undated enclosures within the study area. Visual inspection suggests that these sites conform to the model and may account for these unoccupied areas. The only exceptions to this pattern are sites which appear to have acted as refuges or religious centres in the late Roman period e.g. Ajdovski Gradec (Knific 1987).

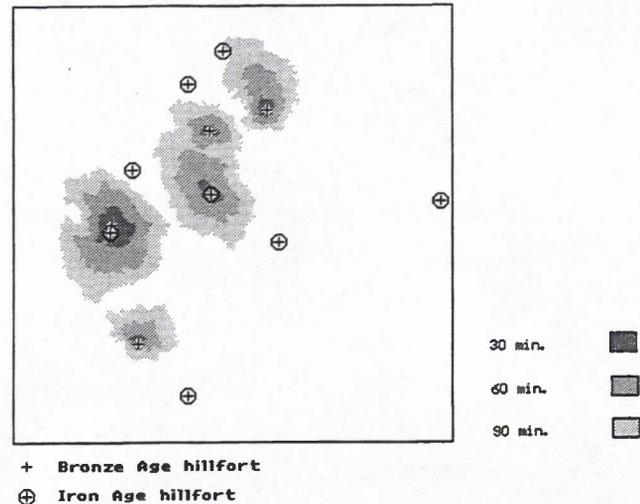


Figure 23.7: Iron Age sites superimposed upon Bronze Age site territories.

23.6 Conclusion

The analysis presented here indicates the merits associated with the use of GIS generated cost surface catchments, especially relative to several earlier, alternative techniques. However, it also illustrates that such sophisticated techniques cannot, ultimately, overcome deficiencies in the archaeological data. The analysis of settlement data will always demand chronological information of the highest quality. Although advanced computer analyses may isolate trends and indicate avenues of research, without accurate and adequate databases, such results inevitably await the testimony and testing of the spade.

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