

4

The SRAP GIS project

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Introduction

The SRAP geographic information system (GIS) project began in 1998 as a data management system to organise, manage and present geo-referenced topographic and archaeological datasets. The purpose of the GIS project is to integrate different datasets into one computer-based system that can be used to show the spatial relationships between different geographic features and the distribution of archaeological material in the Lăceni-Măgura reach. As the SRAP has progressed generating more and different kinds of spatial data during each subsequent year of fieldwork so the GIS has been updated accordingly. Depending on the needs of the SRAP, the GIS articulates different combinations of spatial datasets to generate maps that show the relationships between Holocene land forms and changes in prehistoric land-use through time. This chapter provides a general outline of the GIS project and details of the different kinds of spatial data integrated.

Outline of GIS project

This chapter provides an outline of how the GIS project has been used to further the requirements of the SRAP; it is not intended as a general guide to the use of GIS in archaeology. For detailed discussions on the functionality of a GIS and the role of GIS in archaeology I refer the reader elsewhere (ESRI 1990; Wheatley 1993; Lock and Stančič 1995; Gillings and Goodrick 1996; Gillings *et al.* 1998).

From the outset of the SRAP in 1998 it was necessary to integrate different kinds of spatial data generated during fieldwork in a way that documented the progress of the SRAP and that could be used to aid future planning. Furthermore it was imperative that all fieldwork conducted and the data thus generated were spatially co-ordinated if an accurate representation of past human land use was to be produced. The SRAP GIS project was established for these reasons.

The SRAP GIS project aims to integrate archaeological datasets with a topographical map of the reach. The archaeological datasets include the following: the areas covered and cultural material encountered during fieldwalking; the areas covered and cultural material encountered during excavations; the distribution of geomorphological features in the reach; the location of samples taken for C14 determinations; the location of known prehistoric features in the reach; and the distribution of key topographic features including the drainage channels. All of these datasets are overlaid on a topographic base-map of the reach. By integrating these datasets in one computer-based system it is possible to generate maps of different kinds depending on the needs of the SRAP. The maps are used to show the progress of the SRAP, the distribution of prehistoric cultural material in the study area, the changes in human land use in the area through time and the development of Holocene landforms in the area. They also help in the planning of future fieldwork.

Based at Cardiff University in the School of History and Archaeology and with the assistance of Dr Paul Pan from Cardiff University's Maritime Studies Department, the GIS project was first established in 1998 using ArcInfo version 3.3 and ArcView version 3.1 software on a Windows 95 platform. The initial phase of the GIS involved digitising a copy of a Romanian 1:25,000 topographical map of the Lăceni-Măgura reach. This was achieved in the Maritime Studies building using a digitising tablet and ArcInfo. The digitised version of this map was imported into ArcView and thus provided the base-map for the GIS project. The digitised base-map covered a 10 x 10 km area centred on the Lăceni-Măgura reach of the Teleorman River. The co-ordinate system used for this original version of the GIS project was based on the site-grid established during the 1998 fieldwork season. The temporary benchmark with co-ordinates 5000, 5000 located on the surface near Teleor 001 provided the datum point of this grid system and of the GIS project.

Fieldwalking during the 1998 season was co-ordinated using the site-grid system and based on 100 x 100 m grids. A theme indicating the area covered during fieldwalking was created using ArcInfo and imported into ArcView. The cultural material encountered during fieldwalking was included in the attribute table for the fieldwalking theme. A separate theme was created for the five concentrations of Boian cultural material identified during the 1998 fieldwork season (Teleor 001, Teleor 008, Teleor 009, Teleor 010 and Teleor 011). The GIS project was used to generate maps showing the distribution of fifth millennium BC cultural material in the reach based on the results of the 1998

fieldwork season (for further details and the GIS maps of the 1998 fieldwork season see Mills 1999). The additional area covered and material encountered during fieldwalking in the 1999 season was added to the fieldwalking theme. During the 1999 fieldwork season the two concentrations of Teleor 012 and Cla 002 were discovered and added to the cultural material theme accordingly.

The small-scale excavations at Teleor 001, Teleor 008, Teleor 009 and Teleor 010 conducted during the 1998/9 fieldwork seasons were geo-referenced in the field using a Topcon 303 Total Station. The co-ordinate data detailing the spatial extent of all excavations was imported into the GIS project. A theme was created displaying the spatial extent of all excavations. The Total Station was also used to generate contour surveys of Teleor 008, Teleor 009 and Teleor 010. The data from these surveys was imported into the GIS and contour maps of each of the three concentrations were created as separate themes.

The original GIS project was used to generate maps showing the extent of fieldwork conducted during the 1998/9 fieldwork seasons and the distribution of fifth millennium BC cultural material encountered. These maps were an integral component of the SRAP papers presented at the annual national archaeology conference in Romania in November 1999.

While the original GIS project was successful in its ability to organise, manage and present spatial data generated during fieldwork there were limitations based on the quality of the base-map used. As stated above the base-map in the GIS was generated from a copy of a Romanian 1:25,000 map. This copy was of low-quality, limited in extent and had no information about the original co-ordinate system used to generate the map. As the SRAP progressed it became clear that it was necessary to obtain better quality maps of Teleorman County if the project was to expand beyond the Lăceni-Măgura reach. Furthermore to produce a more versatile and accurate GIS it was necessary to change the GIS co-ordinate system from one based on the very localised site survey to one based on an established international system.

In 2000 the SRAP was able to obtain a digitised map covering a large area of Teleorman County based on the UTM zone 35 co-ordinate system. The map was acquired through *Geo Strategies*, an information technology company based in Sibiu, Transylvania. The map is a digitised version of the Russian 1971 1:50,000 map of Teleorman County.

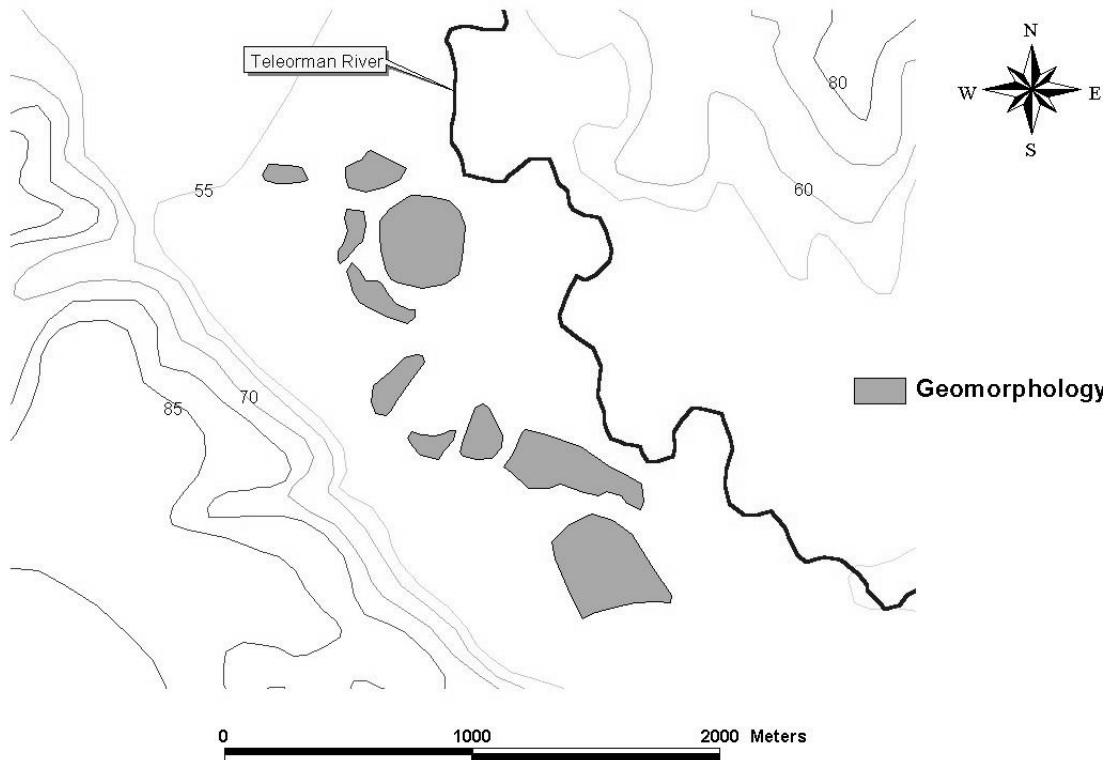


Figure 4.1. Elevation and hydrology themes around the Lăceni-Măgura region.

Already digitised in a '.bil' file format the map was imported directly into ArcView providing the base-map for a new SRAP GIS project. This base-map is comparable with a standard topographic map such as those produced by the Ordnance Survey and provides details of elevation, hydrology, communications (roads, railways) and settlements. In the GIS the base-map appears as an image-theme. Being an image-theme all the information is contained in the same layer; it is not possible to separate and display individual datasets such as elevation contours or hydrology. Using the base-map as the data source separate themes for elevation contours, hydrology, communications and modern settlements are being created within ArcView by digitising the relevant information for each. As the base map covers a large area of Teleorman County this is a lengthy process and will take some time to complete. Fig. 4.1 shows the themes created to date for the elevation contours and hydrology covering the area of the Lăceni-Măgura reach.

As the co-ordinate systems differ between the original and the new GIS projects the transfer of themes from the former to the latter required the conversion of all co-ordinate data.

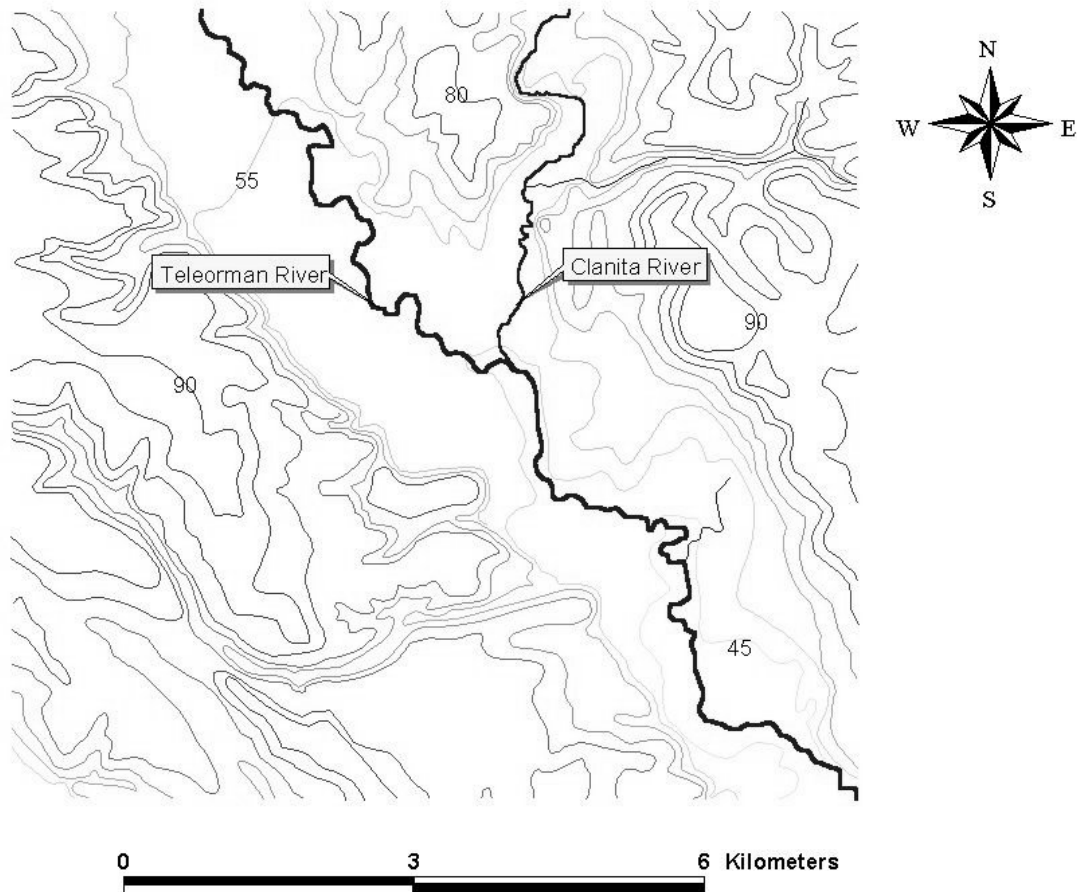


Figure 4.2. Theme showing former gravel bars.

To achieve this it was necessary to establish the UTM zone 35 co-ordinates of the datum point of the original site grid-system. A Garmin 12XL handheld Global Positioning System (GPS) was used in the field for this purpose. Following the co-ordinate conversion the theme of the concentrations of Boian cultural material and that of the 1998/9 excavations were imported into the new GIS project.

All spatial data collected during the 2000 fieldwork season using the handheld GPS and the Topcon 303 Total Station was based on the UTM zone 35 co-ordinate system and were suitable for direct importation into the new GIS project. The themes created based on the 2000 fieldwork season are discussed in the next section.

Spatial datasets integrated in SRAP GIS project

The accuracy of GPS data was significantly improved by the removal of Selective Availability (intentional signal scrambling of satellite data by the US government) shortly prior to commencing the 2000 fieldwork season. This

meant that the handheld GPS could be used to fix the co-ordinates of features of archaeological interest in the reach with an accuracy of 2-3 m on the ground. In most instances this accuracy was sufficient for the purposes of the SRAP. With this improvement in accuracy and the greater speed with which the handheld GPS can generate co-ordinate data (in comparison to the Total Station) it was possible to survey more features than in previous fieldwork seasons. The handheld GPS was used to survey the following: geomorphological features and the location of C14 samples (see Howard and Macklin this volume); the location and spatial extent of fifth millennium BC tells (Măgura, Vitănești, Lăceni I and Gorgan); Iron Age burial mounds; the drainage channels; and the course of the Teleorman River.

Based on the handheld GPS data a separate theme was created in the GIS for each of these datasets. Of particular interest to the SRAP were the geomorphological features indicating the location and spatial extent of former gravel bars in the reach. These former gravel bars are associated with the concentrations of Boian cultural material. Based on the geomorphological data generated using the handheld GPS a theme was created displaying the former gravel bars. Fig. 4.2 shows the theme for the former gravel bars. Fig. 4.3 shows the themes of the Boian concentrations and the former gravel bars combined (note the spatial correlation).

During the 2000 fieldwork season spatial data was also generated in the field using the Total Station. This data include the following: the location and extent of small-scale excavations including the depths of all contexts at Teleor 001, Teleor 008, Teleor 011 and Cla 002; the excavations at Tell Vitănești, the contour surveys at Teleor 011 and Tell Vitănești; and three transects across the western edge of the reach produced as part of the geomorphological survey. The process of importing and converting this data into themes within the GIS project is ongoing. Fig. 4.4 shows the theme of the small-scale excavations at Teleor 008.

Maps showing the spatial relationships between fifth millennium BC cultural material and geomorphological and hydrological features in the reach based on graphics generated using the GIS project were an integral component of the SRAP paper presented at the recent alluvial archaeology conference held at Leeds (Bailey *et al.* in press).

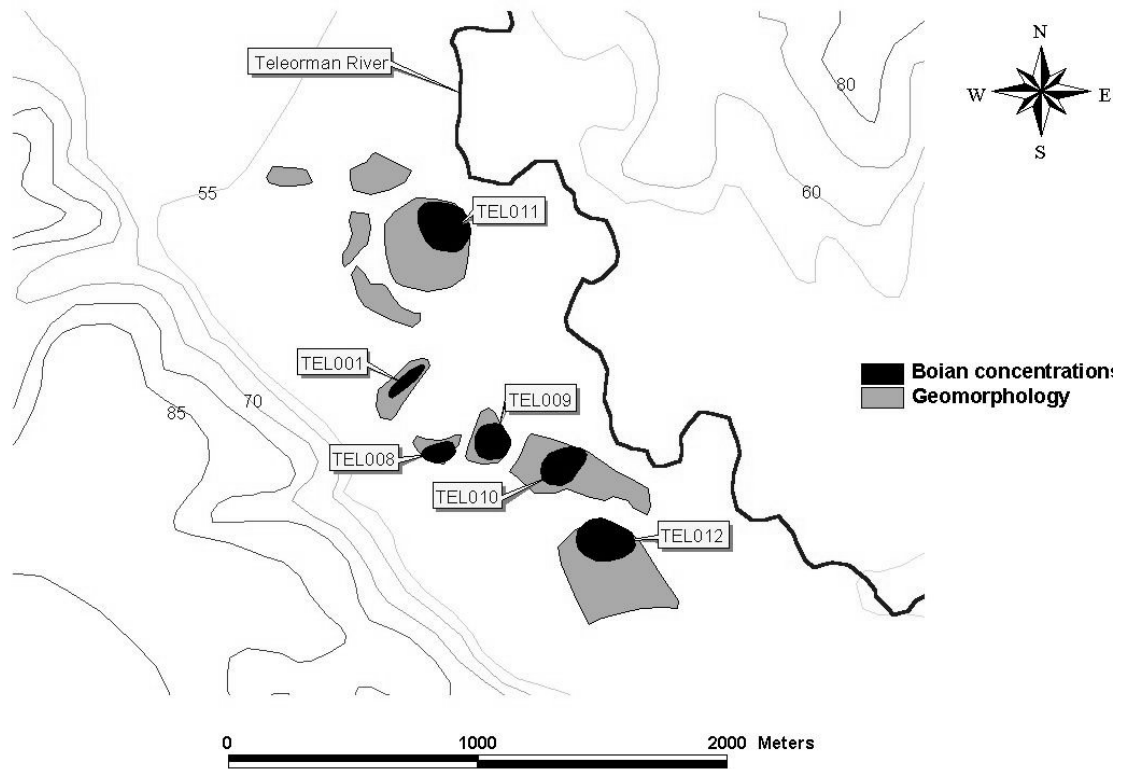


Figure 4.3. Theme showing the Boian concentrations and former gravel bars.

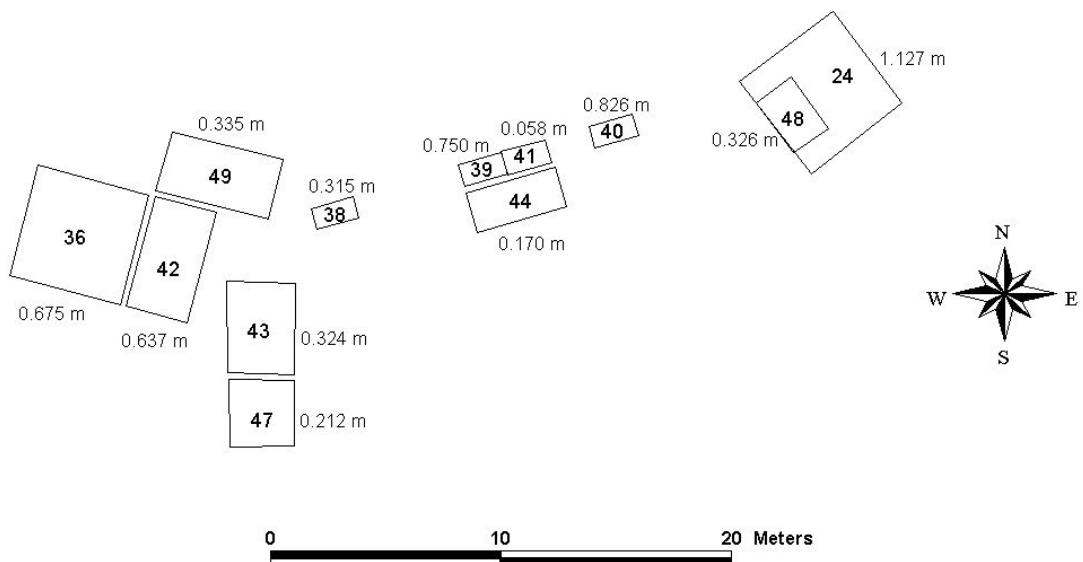


Figure 4.4. Theme showing the plan of sondages at Teleor 008.

Conclusions

The management and presentation capabilities of the GIS project have proven to be of considerable value for the SRAP. Organising and managing the large quantities of spatial data generated during the 1998-2000 fieldwork seasons has been significantly improved through integration within the GIS project. The ability to integrate different spatial datasets within the same computer-based application is of great benefit for apprehending and reproducing the many relationships between them. The presentational capabilities of the GIS project have enabled a range of maps to be produced displaying different combinations of spatial data depending on the needs of the SRAP. The maps generated by the GIS showing the progress of the SRAP and the spatial relationships between different datasets in the reach have appeared in publications and as visual aids in papers presented at conferences. The GIS project has therefore provided an important contribution to the SRAP as an aid to managing spatial datasets, interpreting the relationships between datasets and for disseminating information.

Future work

As with any database management system the SRAP GIS project requires continued maintenance if it is to be of value. To ensure that the GIS project is able to meet the requirements of the SRAP from one year to the next it is imperative that it is updated annually with all spatial data generated during each consecutive fieldwork season. Given the quantity of spatial data generated during each fieldwork season this can be a lengthy process. However, as outlined above, the benefits of integration within the GIS far outweigh the initial time expenditure during data input. The GIS project would benefit by increasing the number of dedicated person hours for updating and maintenance. It is hoped that as the SRAP continues and expands increased funding will be directed towards this recommendation.

To enable greater flexibility the process of converting the base-map image theme into separate themes for contours, hydrology, communications and modern settlements should continue. Following the 1999 and 2000 fieldwork seasons there remains a large amount of data (spatial extent and depths of contexts) from the small-scale excavations to be input. Once integrated within the GIS, three-dimensional representations can be generated (using ArcView 3D analyst extension) showing both the horizontal and vertical relationships between contexts. This will aid the interpretation of stratigraphic sequences. Integrating data on the distribution of cultural material and micromorphological, palynological and zoological samples would further enhance this utility. To

provide a more representative coverage of the relationship between the geomorphological record and prehistoric land-use it is recommended that the GPS based survey is expanded to include additional reaches of the Teleorman River and the data integrated within the GIS project.

Endnote

More information about Geo Strategies and their product range can be found on their web site at the following address:

<http://www.geo-strategies.com>

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