Archeologia e Calcolatori
21, 2010, 339-356

STATISTICAL TOOLS IN LANDSCAPE ARCHAEOLOGY

1. Introduction

Recent evolution of the Romanian national policy regarding the protection of cultural heritage has increased the general interest in organizing information about archaeological sites and monuments in georeferenced databases. The main result of this systematization was aimed at monitoring the interaction between archaeological heritage and urban development. However, a better use of these data management systems through Archaeological Predictive Modeling could contribute both to the improvement of the heritage management activity and to an advance in scientific research. Our aim here is to discuss the intermediate process, which should ensure the transition from tables and lists of archaeological discoveries to meaningful connections and interactions, using Landscape Archaeology methods and statistical algorithms.

As GIS applications in archaeology were classified by Aldenderfer (1992) and Kvamme (1999), Archaeological Predictive Models (APMs) represent an important evolution of spatial integrated databases of archaeological records. Most of the development of these techniques has taken place in North American archaeology, where the spatial extent of some archaeological landscapes was difficult to survey in an inclusive and efficient manner. Recently, APMs were also applied in the national management of archaeological resources of some European countries, in particular the Netherlands (van Leusen, Kamermans 2005; Verhagen 2007; Kamermans, Van Leusen, Verhagen 2009), and Great Britain (Renfrew, Bahn 2004).

APM correlates the distribution and density of certain categories of archaeological sites discovered in a particular geographic region with the environmental conditions of their location and surroundings. Therefore, it predicts with a variable probability the location of analogous sites by identifying similar environmental conditions with those quantified for the discoveries already known. This kind of model is called inductive or correlative. There is another type of approach, the deductive model, which verifies a behavioral hypothesis on the existing data sets focusing on the same assumption that the sites' emplacement is connected with environmental features.

Our aim is to assess the evolution of archaeological data sets into APMs and to reconsider the real value of such attempts for Romanian heritage protection and for scientific purposes. We will consider as well certain aspects regarding the deductive/inductive nature of the APMs.

2. Environmental features

We will use as a case study the database of sites of a certain administrative region of Romania called Buzău, for which we actually contributed in the building and exploitation of the GIS. Even if the modern area of the Buzău County does not represent a prehistoric or ancient reality, being historically and culturally related to the neighboring counties of Braşov, Prahova, Covasna, Brăila and Vrancea, some arguments may support the scientific relevance of such an attempt, besides, of course, the administrative advantages in managing the regional heritage.

The region is characterized by the hydrographic basin of the river Buzău, which crosses over the entire county from its mountainous springs to its middle course in the plains (Fig. 1). Therefore, Buzău County is quite interesting for a Landscape Analysis since it contains all the known relief shapes, from the 1700 m high peaks of the Curved Carpathian Mountains, hilly terrains, to flooded marshes and large sandy river valleys, distributed in a balanced coverage of the area. At the same time, the registered archaeological remains belong to all prehistoric and historical epochs and represent both excavated sites and surface discoveries.

Buzău area has been used since prehistory as the main passage route between three important geographic and cultural areas: the Danube Valley to the S, the North Pontus steppes to the E, and Transylvanian Plateau to the N (Fig. 1). This important functionality ensured the cultural homogeneity of the archaeological discoveries in the region which showed a strong mixture of various neighboring influences.

Surface deposits of salt (Lopătari, Bisoca, Râmnicu Sărat, Bădila, Mânzăleşti, Brătileşti, Goideşti), mineral waters (Sărata Monteoru, Bozioru, Fisici, Balta Albă, Siriu, Nehoiu, Lopătari) and amber (Mlăjet, Sibiciu de Sus, Colţi, Bozioru, Ploştina, Terca) represented important local natural resources that influenced the land-use patterns and distribution of sites.

3. Patterns of archaeological sites' distribution

During the Neolithic era, the sub-Carpathian area received influences from many directions, mainly from the southern and north-eastern regions, establishing complex interactions with the intra-Carpathian area as well (Pandrea 1999; Frânculeasa 2007). This makes the identification of land-use patterns rather difficult, as they cannot easily be considered relevant in every situation. The majority of the discovered archaeological sites belonging to the Neolithic period were settlements located in the plain, along river valleys: Smeeni, Costeşti-Pietrosu, Sudiţi. Several sites were located in higher areas such as hilly plateaus: Aldeni, Bălăneşti, Fulga, Vadu Soreşti. During the Eneolithic era, the number of known sites increases. During the Eneolithic period, human communities inhabited the regions located S to Buzău River, sometimes in tell-settlements. Typical sites were identified at: Aldeni, Gherăseni, Sudiți, Nişcov, Gura Vitioarei, Sărata-Monteoru, Săpoca, Coțatcu (Andreescu *et al.* 2008), Pietroasa Mică (Sîrbu, Matei, Dupoi 2005), Câlțești (Constantin, Constantin 2008), Cotorca, Lipia, Poșta Câlnău (Frânculeasa 2008, 37, tav. 2).Their material culture was recognized as a different version of Gumelnitsa, called Stoicani-Aldeni, strongly influenced by the northern neighboring culture of Cucuteni.

During the Bronze Age the number of sites grew significantly, mainly associated with the Monteoru culture (Motzoi-Chicideanu 2003). The majority of settlements and necropolises were located on higher relief, on hilly terraces and plateaus: Năeni (Motzoi-Chicideanu, Sârbu 2003), Sărata-Monteoru (Zaharia 2000), Pietroasa Mică (Sîrbu, Matei, Dupoi 2005; Motzoi-Chicideanu 2000), Cârlomănești, Aldeni and even in mountain areas. Many settlements were fortified. The density of habitation on lower terraces suggests an extensive land use. During this period, the intensity of cultural and material changes seemed to have intensified. The richness of these finds was connected with the idea of exploitation of local salt resources. The eponym site of the culture, Sărata Monteoru (Zaharia 2000), was located in the vicinity of a mineral spring. The site was fortified and multi-leveled.

Even if, during Neolithic era and the Bronze Age, the Buzău area was densely inhabited, beginning with the First Iron Age, the demography of this area registered a strong set-back. From the end of the Bronze Age (eastern chronology) until the 8^{th} century BC there were no funerary discoveries. Basarabi type discoveries (8^{th}-7^{th} century BC) were made at: Cârlomanesti, Berca, Pietrosu and Izvorul Dulce (Constantinescu 2008b; Matei 2009b). For the 6^{th}-5^{th} centuries BC more discoveries were noted, mostly graves, belonging to the Ferigile-Bârseşti Group: Năeni-Colarea, Năeni-Zănoaga, Valea Viei and Gherăseni. First Iron Age discoveries were made mainly along river valleys in small mountain hollows (Matei 2009b).

Settlements dated to the two centuries before the Roman conquest of Dacia (which happened in 106 AD) were discovered densely amassed in the high-hilly sector of the Buzău river valley, right before its descent and enlargement in the plains. In addition, several fortresses located in strategic positions guarded the communication route through the mountains towards Transylvania (Matei 2009a). Cârlomănești (Babeş *et al.* 2010) and Târcov (Trohani, Andreescu 1992; Matei 2008) are the most relevant sites for this period. Pietroasa Mică-Gruiu Dării was a sacred Dacian place enclosed with a limestone wall (Dupoi, Sîrbu 2001; Sîrbu, Matei, Dupoi 2005).

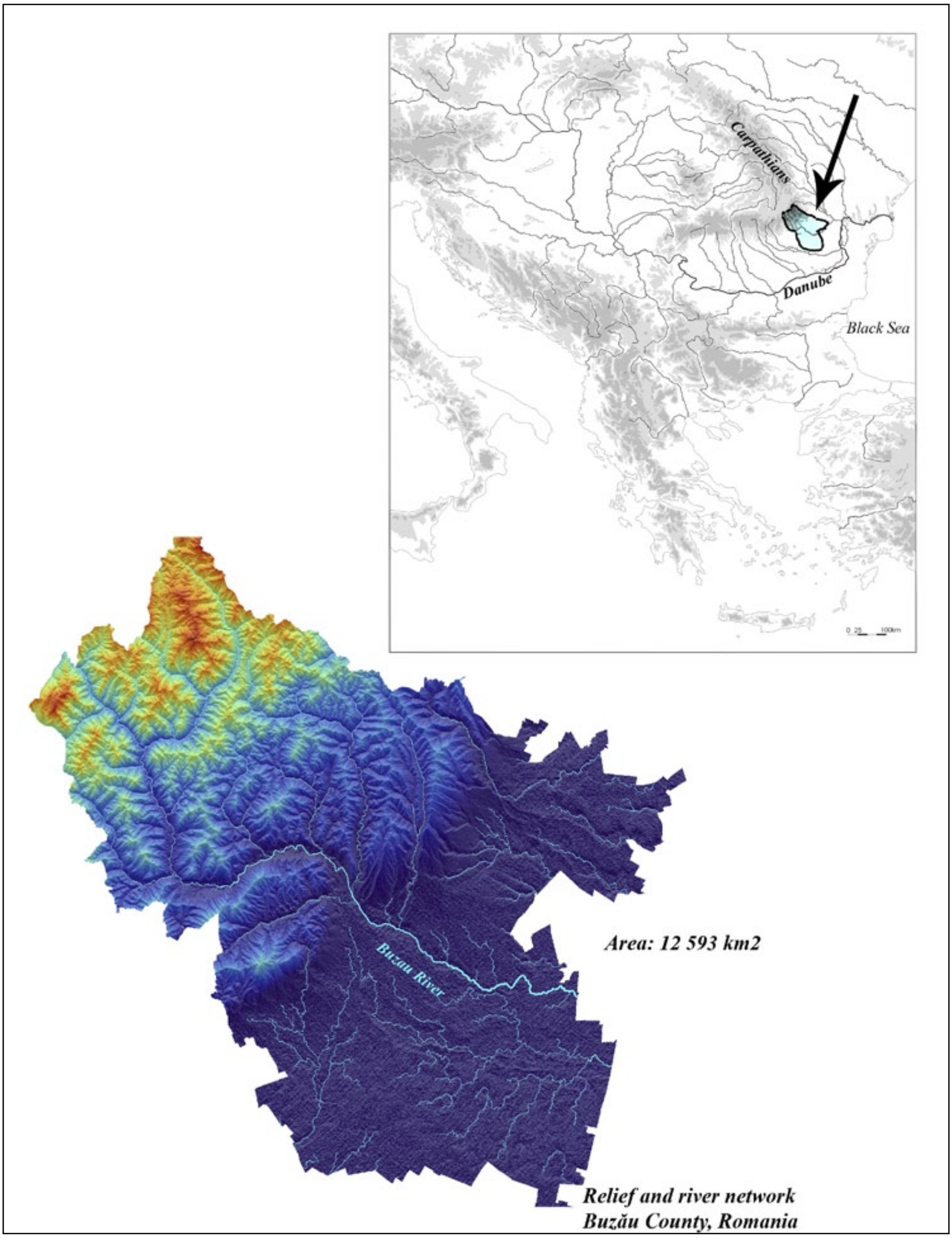
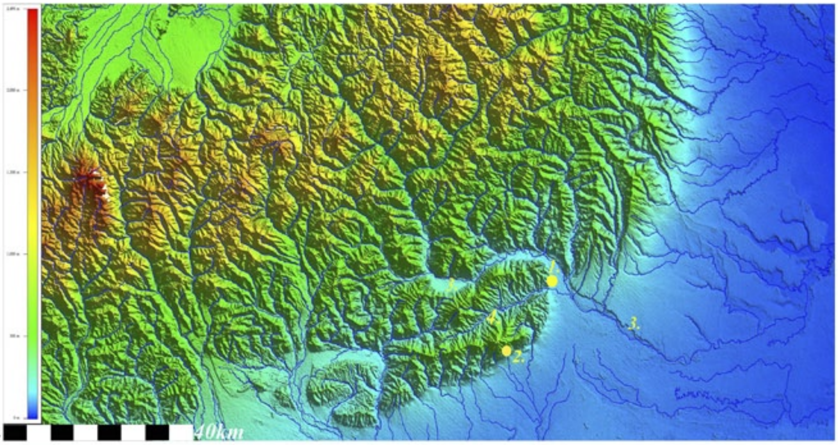


Fig. 1 – The relief and river network of the Buzău County. General emplacement of the discussed region in the Balkan Peninsula area.

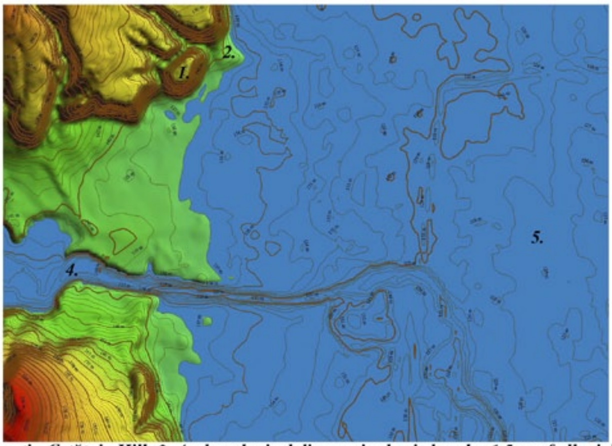
A.



B.

1. Buzău Valley; 2. Cârlomăneşti - Cetăţuia Hill; 3. Nişcov Valley

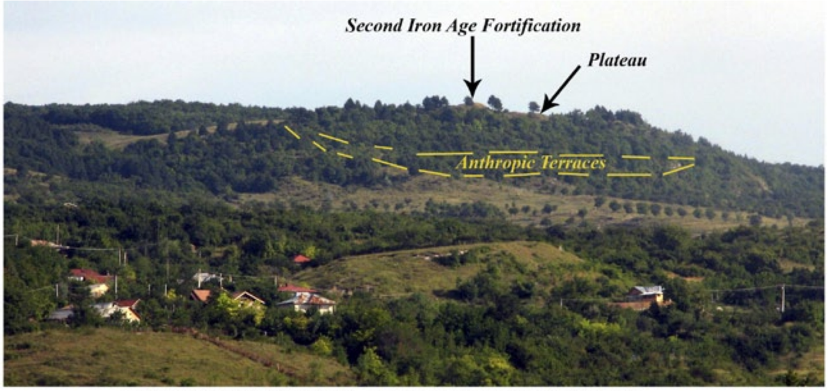
C.



1.Cârlomăneşti - Cetăţuia Hill; 2. Archaeological discoveries buried under 1,5 m of alluvial deposit; 3. Nişcov Valley; 4. Simulated flooding of Buzău River

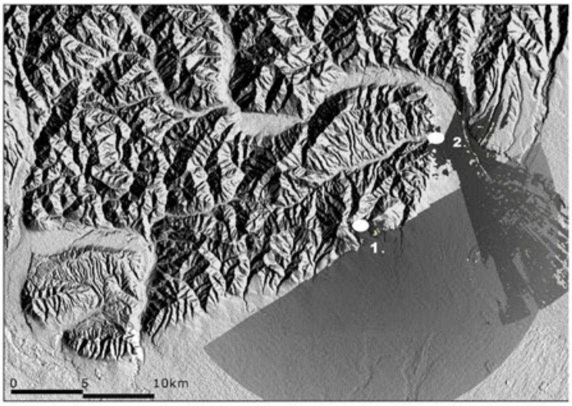
Fig. 2 – Archaeological site Cârlomăneşti-*Cetăţuia*, Buzău County.

A.



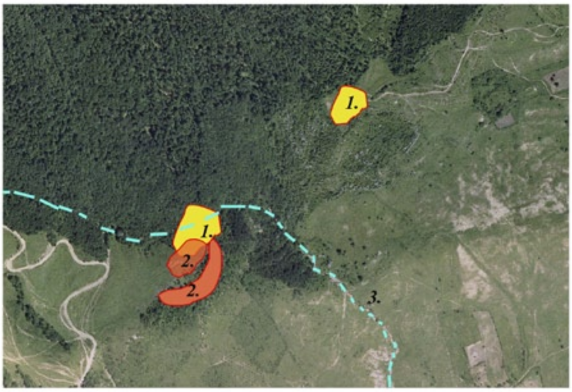
Pietroasa Mică - Gruiu Dării - view from the plain towards north

B.



Viewshed Analysis. 1. Pietroasa Mică - Gruiu Dării; 2. Cârlomăneşti

C.



Pietroasa Mică Gruiu Dării - aerial photo. 1. Neolithic settlement; 2. Bronze Age and Second Iron Age sites; 3. Dara River

Fig. 3 – Archaeological site Pietroasa Mică-*Gruiu Dării*, Buzău County.

Only a small number of sites were discovered in the plain which belonged to the period during which Dacia was a Roman province (2^{nd} -3^{rd} centuries AD). Even if the official Imperial border is believed to have passed a few dozen kilometers further to the E, on the axis of Boroşneu Mare (Székely 1975)-Drajna de Sus (Ştefan 1948), important Roman discoveries were made in the area of Pietroasele (Constantinescu 2008a), suggesting the existence of a fort, and a second inner line of defense, whose chronology is still under debate.

During the Post-Roman Age, habitation intensified as revealed by the large number of discovered sites, both settlements and necropolises. These were located along river valleys, either in the plains or in hilly regions. The high density of settlements and inhumation necropolises belonging to the Sântana de Mureş culture points to the presence of a Gothic authority center located in the area of Pietroasele. Pietroasele was the place of discovery of the famous hoard "Cloşca cu puii de aur", weighing over 18 kg of gold, dated to the beginning of the 5^{th} century AD (Odobescu 1976).

During Early Medieval times settlements were located in higher and more remote places on small tributaries of the Buzău River.

4. Archaeological data sources

The data which we considered were partly processed in one of the few implementations of the Governmental Project EGISPAT (Electronic GIS Heritage), promoted by the Romanian Ministry of Culture, Cults and National Heritage (http://www.inmi.ro/egispat.html). An interactive map of archaeological sites, based on GIS principles, was meant to be useful to the Regional Heritage Authorities for managing and protecting the monuments, but also to the general public – through a web interface – for knowing the local potential. The database of archaeological records included the official regional list of protected sites and monuments (LMI 2004). Apart from systematic excavations, the majority of information originated from occasional and old surveys, not properly documented, preserved in the memory of different researchers (M. Constantinescu, G. Trohani, S. Matei). Little information was actually verified and updated in the field.

However, APM was not an aim of this project, as none of the GIS type landscape analyses (site catchment, viewsheds, least cost analysis, etc.). An important aspect of the EGISPAT project was to deliver the Regional Heritage Authorities maps with sites, also containing the protected areas calculated at various distances (buffers) around the known surface of the sites. In these protected areas, even if the archaeological finds were not documented, any intervention which may affect the terrain would require expert archaeological control.

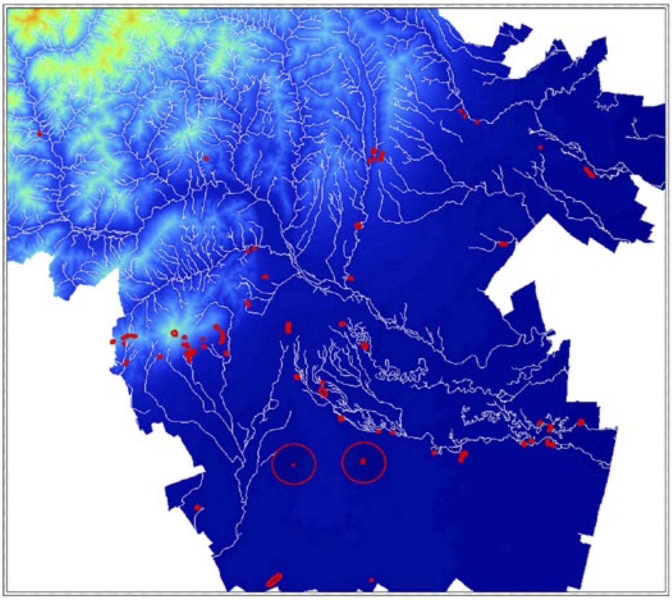
At the same time, part of the information was collected in the context of a scientific research project, ISTVB, funded by the Romanian Ministry of Education and Research (2007-2010) and supervised by the National Centre for Program Management (CNMP), dealing with the study of the Buzău River Valley as a communication passage from the southern plain towards the inner Carpathian areas, over the ages (http://istvb.net4u.ro/en_index.html). Within this project, mapping of sites and understanding their relation with the natural environment represented the major aspects of the research. Limited systematic surveys were made, in conjunction with systematic excavations of a few key-sites. Predictive models were desirable in the context of this scientific research project, in order to allow the formulation of statements regarding the ancient routes used by people in the past in this region.

5. Predictive models of site location. The case of the Post-Roman Age sites

A sequence of predictive models was created as a first step in the process of integrating field-research data sets with theoretical assumptions regarding the correlation between past human communities and their surrounding environment. In the initial stage of developing this predictive model we took into consideration only three simple environmental variables – mean elevation of sites, spatial continuity within the site surface (roughness), distance to the nearest permanent water course – and two archaeological variables – chronology of site, type of space use (habitation or funerary).

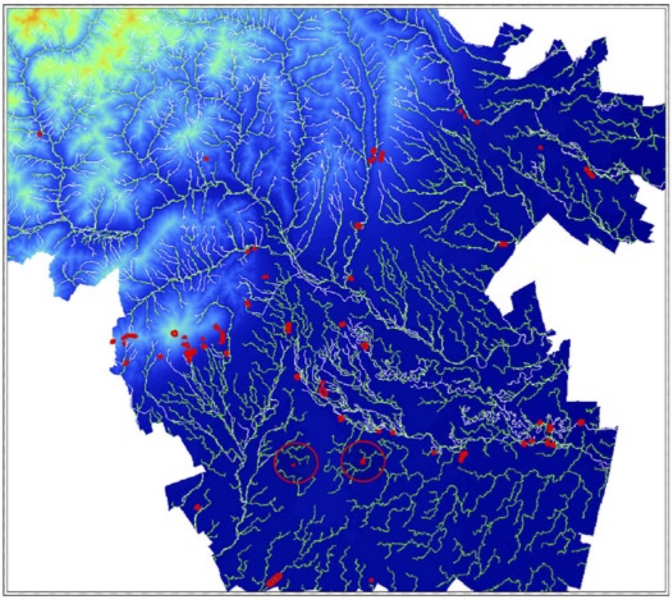
In the development of our model we followed three steps: 1) data collecting and hypotheses development; 2) development of initial models; 3) testing. As the project is still in progress, for the moment we are just presenting the preliminary results obtained for a single chronological framework: the case of Post-Roman Age sites (3^{rd}-4^{th} centuries AD).

The majority of sites belonging to this period were discovered in close proximity to permanent rivers, along their valleys (Fig. 4, A). When mapped, only a small number of cases from the large group of Post-Roman Age sites appeared to be located quite distant from permanent water courses. A calculation of the channel network in the plain revealed however that these apparently unusual locations were determined by the existence of smaller, temporary water valleys (Fig. 4, B). The normal distribution curves of mean elevation calculated for settlements from different periods indicate differences in the height of the occupied hill (Fig. 6). A general normal distribution curve of the elevations calculated for the entire Digital Elevation Model of the region is represented for a better understanding of the human habitation choices (Fig. 6). Differences may be observed as well, in the comparative analysis of normal distribution curves calculated for the spatial continuity within sites



A.

Post-Roman Age sites in relation to river network



B.

Post-Roman Age sites in relation to water channel network

Fig. 4 – Detail of the Buzău County map showing the distribution of the Post-Roman Age sites. Hydrological Analysis.

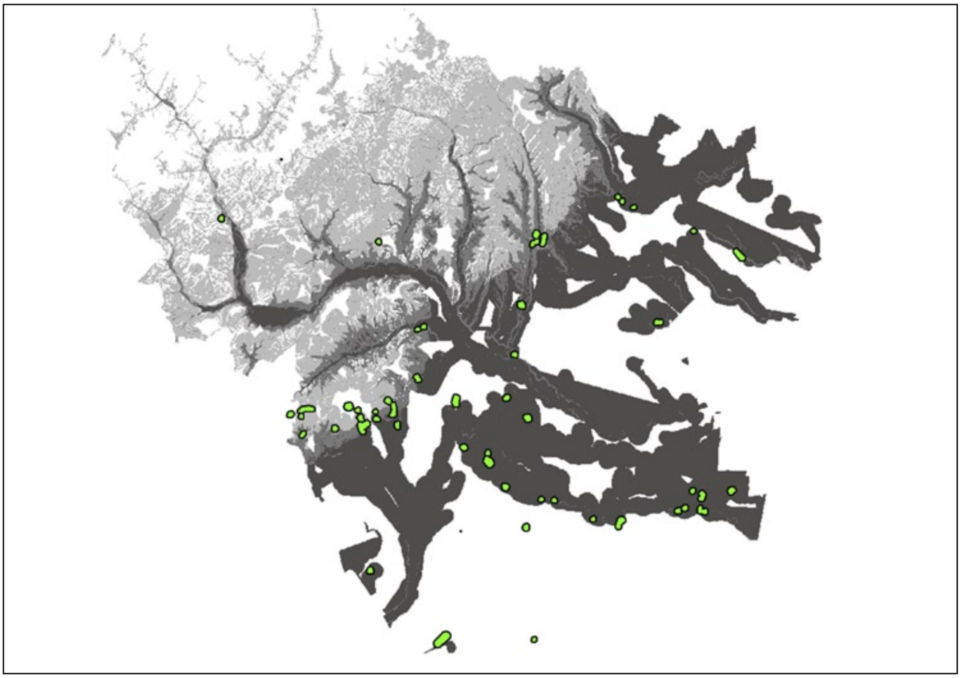


Fig. 5 – Archaeological Predictive Model of the Buzău County for the Post-Roman Age sites.

surface. A roughness index of the site surfaces was assessed statistically, using a range of variograms and curvature analyses. The noticed differences between these analyses are rather small, if judged as individual elements, but a combination of several variables could determine a clearer pattern of land-use (the multiplication result of several probabilities will always be smaller than any of the individual probabilities).

The Digital Elevation Model was reclassified in three orders according to the initial model proposed after the observation of the data sets. A similar reclassification and correlated representation of roughness index was performed. The reclassified grids were afterwards reunited through Boolean procedures in a single grid with four classes. Afterwards, we kept in the resulted modeled representation the intersection between this new grid and the river valleys' buffer calculated at 1000 m (Fig. 5).

The probability for the existence in the region of sites dated to the 3rd to 5th centuries AD is greater in the given region as the map color is darker. The proposed model corresponds to 95% of the registered sites in our database (eighty sites fit the pattern and four of them do not, each one explainable in a certain context).

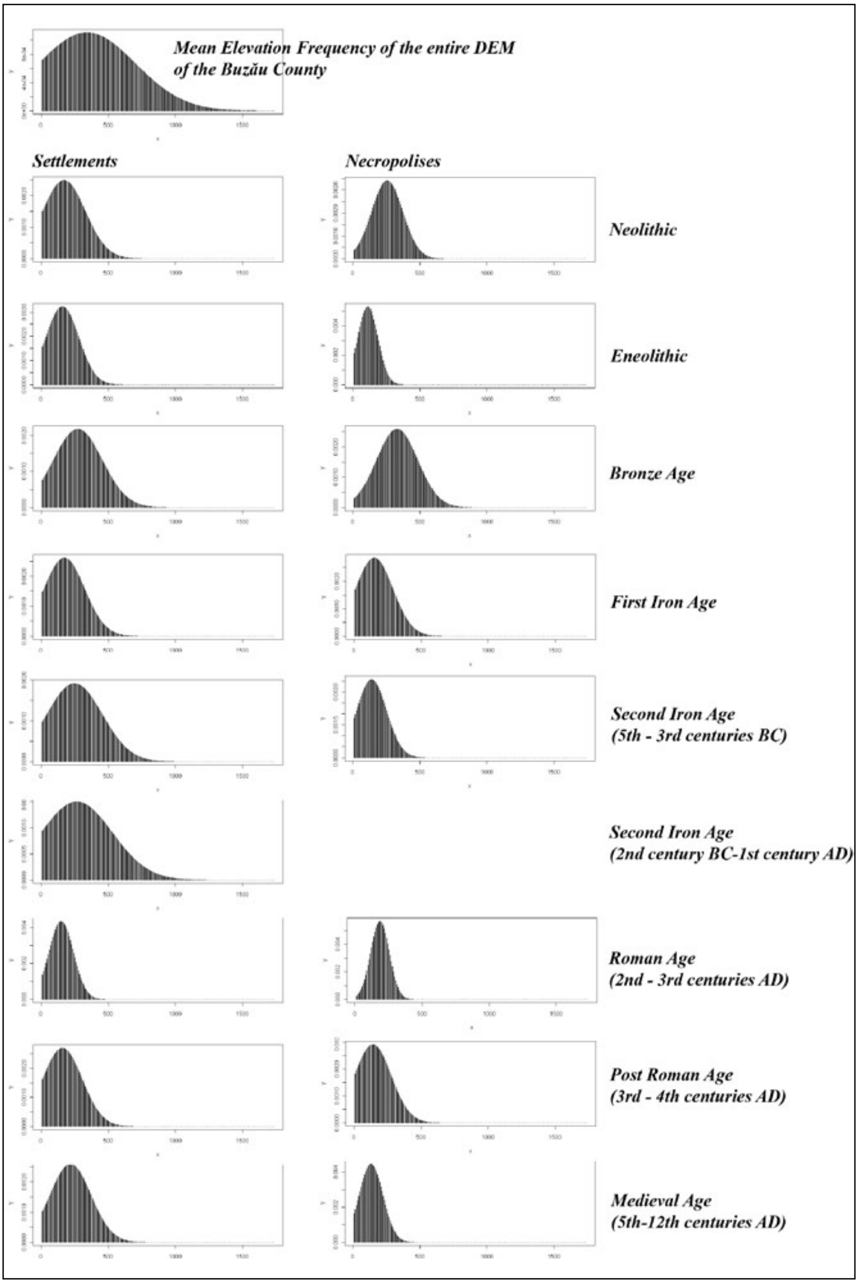


Fig. 6 – The normal distribution curves of mean elevation calculated for sites in the Buzău County dated in different periods.

6. Reflexive assessments

An important element which enhances the relevance of predictive models is the reflexive refinement of data, hypotheses, interrogations, applied algorithms and interpretation.

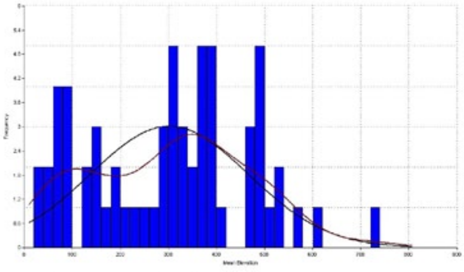
Predictive models may be improved by addition of supplementary environmental variables, which could constrain the variation of general values. For the case of Post-Roman Age settlement, previously described, the water resource analysis should be completed with more data types. Water table conditions are of great importance for choosing settlement emplacement, in the terms of water supplies. Other relevant data should refer to the paleochannel network. Flooded areas may benefit from the use of APMs, if we try to obtain information regarding the scale of flooding through systematic core sampling or integration of old maps depicting lands before modern river regularization. The changing nature of the landscape should not be seen as a menace to the APM consistency, but rather as an interesting field to which APM may bring important aid. In our case, the integration into the APMs of the results of viewsheds, least cost analyses, hypotheses about circulation routes helped us in giving additional socio-cultural meaning to the environmental parameters.

Another option of improving the APMs results is to better analyze the selected variables. In many cases, a simple normal distribution curve does not depict by itself the entire analyzed behavior, as this often bears multiple influences. For example, a simple kernel density estimation algorithm applied to mean elevation values of the sites emphasizes the multimodal nature of data sets (Fig. 7). At first view the differences are slightly noticeable, but every attempt for automatic classifications should be checked through confidence tests.

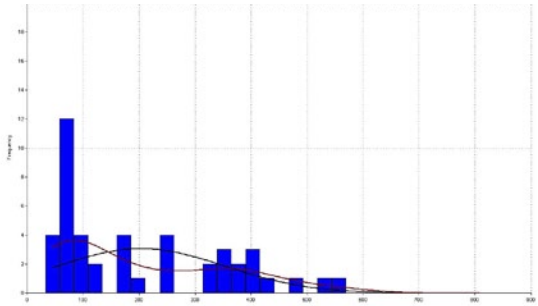
7. Understanding the real nature of data sets

The comprehension of the real nature of the archaeological data sets represents in our opinion the most delicate operation performed during the development of predictive models. In order to illustrate this issue, three case studies placed within the Buzău County will be taken further into consideration. They represent the result of the ISTVB project.

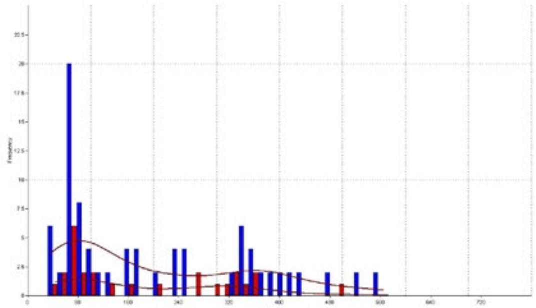
The archaeological potential of the mountainous lands of Buzău County is almost unknown and hard to cross-over due to the historical development of the region. Until the 18th century one of the main circulation routes from Transylvania towards the S passed through the region on ridge routes, but the shift of the circulation towards the river valleys, which were arranged and built as proper roads, changed significantly our perspective about the



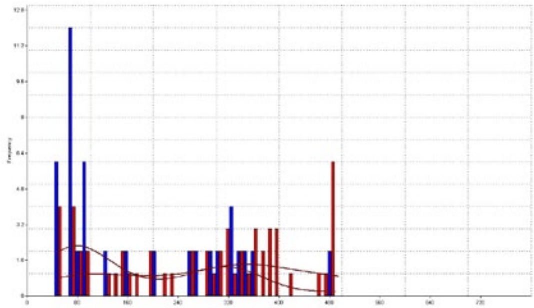
Bronze Age Settlements



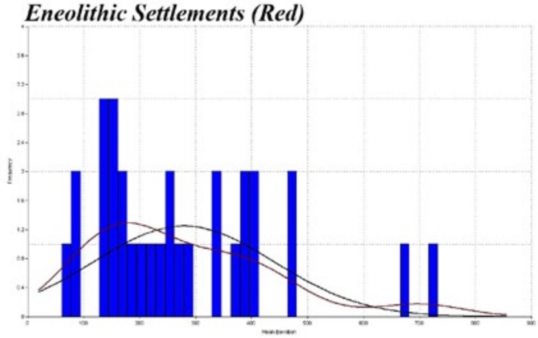
Neolithic Settlements



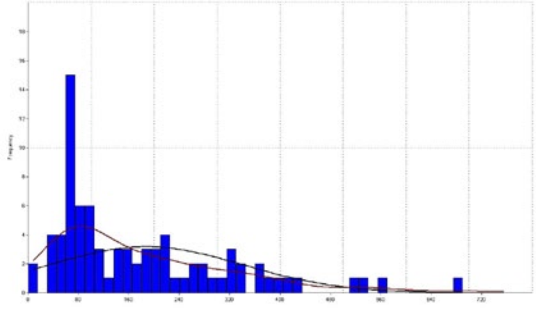
Neolithic Settlements (Blue) and Eneolithic Settlements (Red)



Eneolithic Settlements (Blue) and Bronze Age Settlements (Red)



Second Iron Age Settlements (2nd century BC - 1st century AD)



Post Roman Age Settlements

Fig. 7 – Histograms showing the frequency of mean elevation values for different categories of archaeological sites. Normal distribution curves. Kernel Density Estimation curves.

landscape. Little archaeological information has been available for the high elevated areas, as this region has been difficult to survey.

Old maps of the area (mainly Austrian and Hungarian), used as background layers in APM, offered significant information: depiction of lost trails and strategic passing points. Moreover, these documents represent the immense scale of landscape change, which happened in the last half a century, caused by river regularization, drainage of marshes and building of concrete roads. Therefore, the APM was improved by adding supplementary environmental variables deduced from the analysis of old maps, bringing at the same time a clearer social meaning to landscape use patterns. APM helped us in reevaluating the importance of mountainous landscapes for the past people, not as a barrier but as a connecting bridge between spaces and cultures.

The Second Iron Age site of Cârlomanesti is located on a hilly plateau elevated 20 m above the surrounding lowlands, component of the large Buzău river (Fig. 2). Systematic excavations, undertaken over 20 years (Babeş 1975, 1977; Babeş *et al.* 2010), revealed the existence of a multi-leveled site, dated to the Bronze and Iron Age, on top of a hill, on the flat plateau. The particular nature of the discoveries from the Second Iron Age led to a scientific controversy regarding the character of the site. Recent interdisciplinary research changed the scale of the analysis from the site scaled information to integrated regional information. They showed that the archaeological discoveries found on top of the plateau represented only a part (the acropolis) of a larger site. Human presence was attested on the steep slopes of the massif as well, in the form of different ancient land modeling activities and fortification structures. Moreover, contemporaneous discoveries were made in the lowlands located at the foothill of the site, buried under a substantial layer of alluvial deposit, brought by historical flooding of the river Buzău.

Simulations of major flooding of the area suggested the scale of the landscape change in the region of the site (Fig. 2, C.). In this case, we pointed out the following aspects: the irrelevancy of slope and elevation variables and the difficulty in deciding where to draw the limits of this site in order to quantify it in a GIS application in relation with the surrounding landscape. Practically, this site overlaps a contact area between different types of relief shapes with opposing environmental features.

Another case, which may raise problems in a regular predictive model, is called Pietroasa Mică-Gruiu Dării, a multi-leveled site, with remains from the Eneolithic, Bronze and Iron Ages (Fig. 3) (Dupoi, Sîrbu 2001; Sîrbu, Matei, Dupoi 2005). The major feature of this context – the continuity of using the same space over the ages – emphasized the need to identify patterns of human land-use. Nevertheless, the manner in which space was occupied, used, transformed and seen was distinct for each particular epoch. In shaping these models, the real dimensions of the sites (the same site in different epochs) and the depths between which each archaeological deposit had formed were important variables. The archaeological and stratigraphic information were gathered in systematic excavations of the upper-plateau and systematic and long lasting surveys of the surrounding region combined with small control trenches of the stratigraphy and geophysical prospecting. Additional landscape analyses completed the models with the cultural-social component (Ştefan, Duțescu 2005).

Nowadays, the site appears to be located on a high oval shaped plateau, on top of a limestone hill, elevated 500 m above the plains placed immediately beneath it. A river valley (Dara) surrounds the massif on two sides. However, as excavations indicated, during the Eneolithic period, the outline of the landscape was quite different in comparison with the modern configuration of the terrain. People lived only in the northern part of the rocky hill, at the base of what was then a slope, close to the river valley. They settled on both banks of the river, overlapping only partially the nowadays recognized site surface. During the Bronze Age, the level differences between the margins of this slope were filled up with archaeological layers. The plateau and surrounding terraces were created through human effort for defensive and military purposes. During the Late Iron Age the visibility of the site (Fig. 3, B) recommended it for the imposing location of a sacred place. The leveling of older layers was performed in order to obtain the aspect of the flat surface of the terrain. Last, but not least, a modern limestone quarry destroyed almost a quarter of the plateau, dramatically changing the terms of the real site dimensions and forms of land use.

In this case, the modern landscape will never represent, for example, the real relation with the environment of the Eneolithic community. Moreover, each community seemed to have had different reasons for which it selected the same particular location: the proximity to water resources for the Eneolithic communities, defense and strategic reasons during Bronze Age and imposing visibility as a sacred place for the Late Iron Age people. The spatial complexity of this site is given by its evolution in time. Multi-leveled sites are the best examples to sustain the variability of human choices in the matter of environment and landscape and, in this particular case, we point out as well the issue of prehistoric large scale built-landscape.

8. Conclusions

Our attempt to develop predictive models is only in the preliminary stage, as we are still in the process of testing both the input and output data. It is probably more the case of "indicative maps" than real predictive maps. Nevertheless, we believe that several features regarding possible relevance and limitations of APMs for Romanian archaeology may already be emphasized.

It should be noted that these are the results of scientific research activities and are not directly connected with the heritage management. In our case, predictive models together with field surveys, geophysical prospection and other landscape analyses (slope, site catchment, least cost, viewsheds) helped us in assessing the past communities relation with the natural environment, giving us the occasion to test hypotheses about land use and to understand what are the most suited environmental variables to test hypotheses. In this way, we gained important support in developing recording data strategies.

A young rescue archaeology movement, as is the case in Romania, needs to establish its own assessment strategies and APMs should not be ignored. Even if, as it was showed before, APMs suffer from major limitations, we wish to highlight the important ability of spatial statistics to impose directions for field surveys strategies. In addition, predictive models may change the scale of archaeological analyses leading to a micro-regional integration of data, thus changing the perception about the nature of sites. However, APMs should not replace field survey. At the same time, in order to obtain consistent models one should take into consideration the need to develop particular models for particular regions. This means that experts may select environmental variables suited for the particular geographical and archaeological context.

In the end, let us summarize what in our perspective may represent ways of improving APMs: the use of more variables, the understanding of the analytical nature of data sets and of the real nature of archaeological data sets.

Dan Ştefan
Bucharest University
Digital Domain Ltd.

Valeriu Sîrbu
Museum of Brăila
Institute of Archaeology "Vasile Pârvan"

REFERENCES

Aldenderfer M.S. 1992, *The role of Geographic Information Systems in quantitative anthropology*, in H.D.G. Maschner, M.S. Aldenderfer (eds.), *The Anthropology of Human Behavior through Geographic Information and Analysis*, New York, Oxford University Press.

Andreescu R. *et al.* 2008, *Raport preliminar privind cercetările arheologice efectuate în tell-ul neo-eneolitic de La Coţatcu, com. Podgoria, Campania 2008*, «Mousaios», 13, 41-50.

Babeş M. 1975, *Problèmes de la chronologie de la culture géto-dace à la lumière des fouilles de Cârlomăneşti*, «Dacia», 19, 125-139.

Babeş M. 1977, *Statuetele geto-dace de la Cârlomăneşti (Jud. Buzău)*, «SCIVA», 28, 3, 319-352.

Babeş M. *et al.* 2010, *Cârlomăneşti, com. Verneşti, jud. Buzău, Punct Cetăţuia*, Cronica Cercetărilor Arheologice din România, Campania 2009.

Constantin M., Constantin C.P. 2008, *Rezultatele cercetărilor de suprafaţă de la Câlţeşti, com. Pietroasele, jud. Buzău*, «Mousaios», 13, 59-74.

Constantinescu E.M. 2008a, *Şantierul arheologic Pietroasele. Campania 2008*, «Mousaios», 13, 137-162.

Constantinescu E.M. 2008b, *Tombe d'incinération découverte à Izvoru-Dulce-Merei, Dép. Buzău*, «Mousaios», 13, 103-106.

Dupoi V.I., Sîrbu V. 2001, *Incinta dacică fortificată de la Pietroasele - "Gruiu Dării" (I)*, Buzău, Alpha.

Frânculeasa A. 2007, *Repere cronologice privind cultura cu ceramică liniară a sud de Carpaţi*, «Mousaios», 12, 27-56.

Frânculeasa A. 2008, *Epoca eneolitică în nordul Munteniei,* «Mousaios», 13, 7-39.

Kamermans H., Van Leusen M., Verhagen P. (eds.) 2009, *Archaeological Prediction and Risk Management. Alternatives to Current Practice*, Leiden, Leiden University Press.

Kvamme K.L. 1999, *Recent directions and developments in Geographical Information Systems*, «Journal of Archaeological Research», 7, 2, 153-201.

Matei S. 2008, *Târcov-Piatra cu lilieci, jud. Buzău,* Cronica Cercetărilor Arheologice din România, Campania 2007, 308-309.

Matei S. 2009a, *Dacii din Curbura externă a Carpaţilor*, in V. Crişan, V. Sîrbu (eds.), *Dacii din Curbura Carpaţilor. Catalog de expoziţie 2009*, Sfântu Gheorghe, Angustia, 18-21.

Matei S. 2009b, *Habitation structures and funerary discoveries in the area of Buzău County, in the 8th-3rd centuries BC*, in V. Sîrbu (ed.), *The Necropolises and the Environment. Proceedings of the 11th International Colloquium of Funerary Archaeology (Buzău 2009),* Buzău-Brăila.

Motzoi-Chicideanu I. 2000, *Observations concerning the Bronze Age cemetery of Pietroasa Mica*, «Romanian Journal of Archaeology», 1 (http://apar.archaeology.ro/rja.htm).

Motzoi-Chicideanu I. 2003, *Câteva observaţii asupra culturii Monteoru* [*Some regards concerning the Monteoru culture*], «Ea-Online» (http://www.archaeology.ro/imc_mont.htm; http://www.archaeology.ro/imc_mont_eng.htm).

Motzoi-Chicideanu I., Sârbu D. 2003, *Năeni-Zănoaga,* Cronica Cercetărilor Arheologice din România, Campania 2004.

Odobescu A. 1976, *Tezaurul de la Pietroasele*, in M. Babeş (ed.), *Opere IV*, Bucureşti, Editura Academiei.

Pandrea S. 1999, *Observaţii referitoare la evoluţia culturii Boian în nord-estul Câmpiei Române*, «Istros», 9, 13-46.

Renfrew C., Bahn P. 2004, *Archaeology: Theories, Methods and Practice*, London (4th ed.), Thames & Hudson.

Sîrbu V., Matei S., Dupoi V.I. 2005, *Incinta dacică fortificată Pietroasa Mică-Gruiu Dării (II)*, Buzău, Alpha.

Székely Z. 1975, *Noi descoperiri din epoca romană din sud-estul Transilvaniei*, «SCIVA», 26,3, 343-351.

Ştefan D., Duţescu M. 2005, *Abordări teoretice şi cercetări interdisciplinare*, in Sîrbu, Matei, Dupoi 2005, 119-138.

Ştefan G. 1948, *Le camp romain de Drajna-De-Sus, Departement de Prahova*, «Dacia», 11-12, 114-144.

Trohani G., Andreescu R. 1992, *Cercetările arheologice din punctul "Piatra cu Lilieci", satul Târcov, com. Pârscov, jud. Buzău*, «Cercetări Arheologice», 9, 46-51.

van Leusen M., Kamermans H. (eds.) 2005, *Predictive Modelling for Archaeological Heritage Management: A Research Agenda*, Nederlandse Archeologische Rapporten 29, Amersfoort, ROB.

Verhagen P. 2007, *Case Studies in Archaeological Predictive Modelling*, Leiden, Leiden University Press.

Zaharia E. 2000, *Monteoru*, in C. Preda (ed.), *Enciclopedia Arheologiei şi Istoriei Vechi a României,* Bucureşti, Editura Enciclopedică, 102-104.

ABSTRACT

Archaeological Predictive Models (APMs) represent an important evolution of spatial integrated databases of archaeological records. Before the development and the analysis of a predictive model, numerous other steps are required in order to integrate the raw data sets into functional archaeological systems. Our aim is to assess the evolution of archaeological data sets into APMs and to reconsider the real value of such attempts for the Romanian Heritage Protection or for scientific purposes. We will consider, as well, certain aspects regarding the deductive/inductive nature of the APMs. In our perspective, there are a few ways APMs could be improved: the use of more variables, as well as the understanding both of the analytical nature of data sets and of the real nature of archaeological data sets.