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A GIS platform dedicated to the production of distribution models of archaeozoological remains

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ABSTRACT: The paper considers some of the problems related to the planning of a digital tool for processing faunal remains with the use of a GIS (Geographic Information System) solution. Archaeozoological data processing can be carried out on different levels: it can concern both the production of thematic maps or the elaboration of interpretative and predictive models, using statistical and mathematical tools.
The distinction between GIS platforms for excavation or animal bones analysis is based on differences in data processing methods. In fact the level of detail shifts from stratigraphical contexts to the set of bone fragments pertaining to the same context (or structure, or period, etc.); at the same time the underlying database (strictly dialoguing with the GIS platform) becomes our animal bones DBMS instead of the excavation DBMS.
Data frequency (and eventually other statistical) analyses are done on the DBMS and then imported within the GIS platform as points related to the zooarchaeological sample; using a GIS technique called geocoding, coordinates of the points are generically positioned inside the stratigraphical context they belong to.
Our aim is to display the bone deposit, by using stratigraphical and zooarchaeological keywords in order to understand how anthropic, animal and natural factors transformed the original animal population into a fossilized sample.
Experimenting with GIS technology on a large open area excavation like the Poggio Imperiale project (more than 1.5 hectares excavated, with a bone sample of 5.763 fragments), has allowed us to produce important information used in elaborating diachronical models of social and economic structures.

KEY WORDS: ARCHAEOZOOLOGY, TAPHONOMY, GEOGRAPHIC INFORMATION SYSTEM, FAUNAL REMAINS, MEDIEVAL ARCHAEOLOGY, COMPUTER APPLICATIONS IN ARCHAEOZOOLOGY, QUANTITATIVE METHODS

RESUMEN: Este trabajo aborda una serie de problemas relacionados con el diseño de una herramienta digital para el procesado de restos de fauna a través del uso del GIS (Geographic Information System).
El procesado de los datos arqueozoológicos puede ser llevado a cabo a diferentes niveles. Así, por ejemplo, tanto a nivel de la producción de mapas temáticos o de la elaboración de modelos predictivos e interpretativos a través del uso de herramientas matemáticas y estadísticas.
Las distinciones entre plataformas GIS para la excavación o el análisis de los restos animales se basan en diferentes métodos de procesado de la información. De hecho el nivel de detalle oscila desde los contextos estratigráficos a los conjuntos de fragmentos óseos que pertenecen a un mismo contexto, estructura o periodo. Al mismo tiempo la base de datos subyacente, la que dialoga estrictamente con la plataforma GIS, se convierte en el DBMS de nuestros restos animales en vez del DBMS de la excavación.
Los análisis de frecuencias de datos, y otros análisis estadísticos, se ejecutan en la DBMS y posteriormente se importan dentro de la plataforma GIS como puntos relacionados con la muestra zooarqueológica. Utilizando una técnica GIS denominada geocodificación las coordenadas de estos puntos son situadas genéricamente dentro del contexto estratigráfico al que pertenecen.
Nuestro objetivo es representar el depósito óseo utilizando palabras clave estratigráficas y zooarqueológicas a fin de comprender cómo los agentes naturales, antrópicos y animales transformaron la población animal original en una muestra fosilizada.
Experimentaciones llevadas a cabo con tecnología GIS en una gran excavación a cielo abierto como ha sido el proyecto Poggio Imperiale, con más de 1'5 hectáreas excavadas y una muestra ósea de 5.363 fragmentos, nos ha permitido generar importante información de utilidad en la elaboración de modelos diacrónicos de estructuras sociales y económicas.

PALABRAS CLAVE: ARQUEOZOOLOGÍA, TAFONOMÍA, SISTEMAS DE INFORMACIÓN GEOGRÁFICA, RESTOS FAUNÍSTICOS, ARQUEOLOGÍA MEDIEVAL, APLICACIONES INFORMÁTICAS EN ARQUEOZOOLOGÍA, MÉTODOS CUANTITATIVOS

INTRODUCTION: A NEW RECORDING SYSTEM FOR THE INTEGRATION OF ARCHAEOZOOLOGICAL DATA

For over 20 years, archaeozoologists have been complaining about a lack of integration between their discipline and archaeological research: collecting and studying animal bones should not be intended as a complementary activity within an excavation's strategy. Notwithstanding this, it still usually happens that osteological finds are handed over to specialists only when archaeological projects are in an advanced phase, or when the excavations are finished. Nowadays, an archaeological research project should provide an interdisciplinary approach from its very first step, and zooarchaeology should be among the considered disciplines. The absence of a comprehensive planning often generates gaps that are hardly recovered. If the specialist is extraneous to the questions derived from an excavation, the animal bones lack of an adequate contextualization; this usually causes a loss of information.

The creation of an integrated system for the management of archaeological data (Valenti, 1998; Francovich, 1999) at the LIAAM (Laboratory of Information Technology Applied to Medieval Archaeology), moves exactly from the need to narrow the distance between the main discipline and its subsidiary sciences. The system is structured on several GIS platforms [regarding GIS solutions for archaeological excavations see Valenti (2000) and Nardini (2000)] supported by appropriate databases (Fronza, 2000, 2001; Valenti, 2000; Valenti *et al.*, 2001).

Having access to an information system containing all data produced by a project allows the specialist to put the osteological finds within their context, avoiding all those slow and complex operations that often arise in the case of a poor collaboration on the field. In other words, it ensures a better quality of work and a significant reduction of retrieval/processing times and of errors in reading archaeological data.

In a GIS platform the researcher is able to practice a real time observation of the finds within their spatial and chronological collocation (Figures 1-6). The usefulness of such a tool is particularly clear in the case of open area and multilayered excavations, where the finds have different distribution modalities in the horizontal deposit. A good example comes from Tel Qiri, even though it is not strictly a GIS application; it regards an Iron Age settlement in Israel investigated by Simon Davis, where osteological and anatomical distribution of finds in five different ritual areas has shown a difference in cult practices. In the period between 12^{th}-8^{th} century B.C., the sacrifices concerned almost exclusively the right forequarters of goat/sheep, mainly lambs and kids (Davis, 1987).

Testing GIS platforms on the production of animal bone distribution models, aims at the creation of a useful tool in visualising information derived from synchronic analysis of bone deposits. This can be done by creating various data views by theme, based on different criteria.

Archaeozoologists can therefore interact with the platform by formulating questions and combining osteological and archaeological data in order to confirm, widen or deny the hypothesis made on the samples. In fact they are involved in the excavation questions even if they have not directly participated in the campaigns. This allows an easier approach to the interpretative grids of particular sites, as well as a deeper contribution of elements that integrate and complete the archaeological understanding of a settlement. For instance, it can point out specific functional or productive areas or the presence of social stratifications.

Digital data management also allows to use the same recording system for all information collected on the field or produced at the laboratories. This ensures a perceivable improvement in work methodologies and the real possibility of generating distributive charts. This way, retrieval and data management times are substantially reduced. This stops archaeozoological research from being an accessory discipline, as it becomes a part of a complete "archaeological container".

"AREAL" OR "PUNCTUAL" GIS PLATFORM? DIFFERENCES IN DOCUMENTATION AND ANALYSIS

The attempt to extend the GIS solution to the spatial reading of finds (pottery, metal, osteological finds, glass) aims at the characterisation of variables that ensure more detail in calibrating the historical models produced by archaeological research. In the case of animal bones, the possibility of a spatial visualisation of osteological deposits can supply useful information. Different spatial distri-

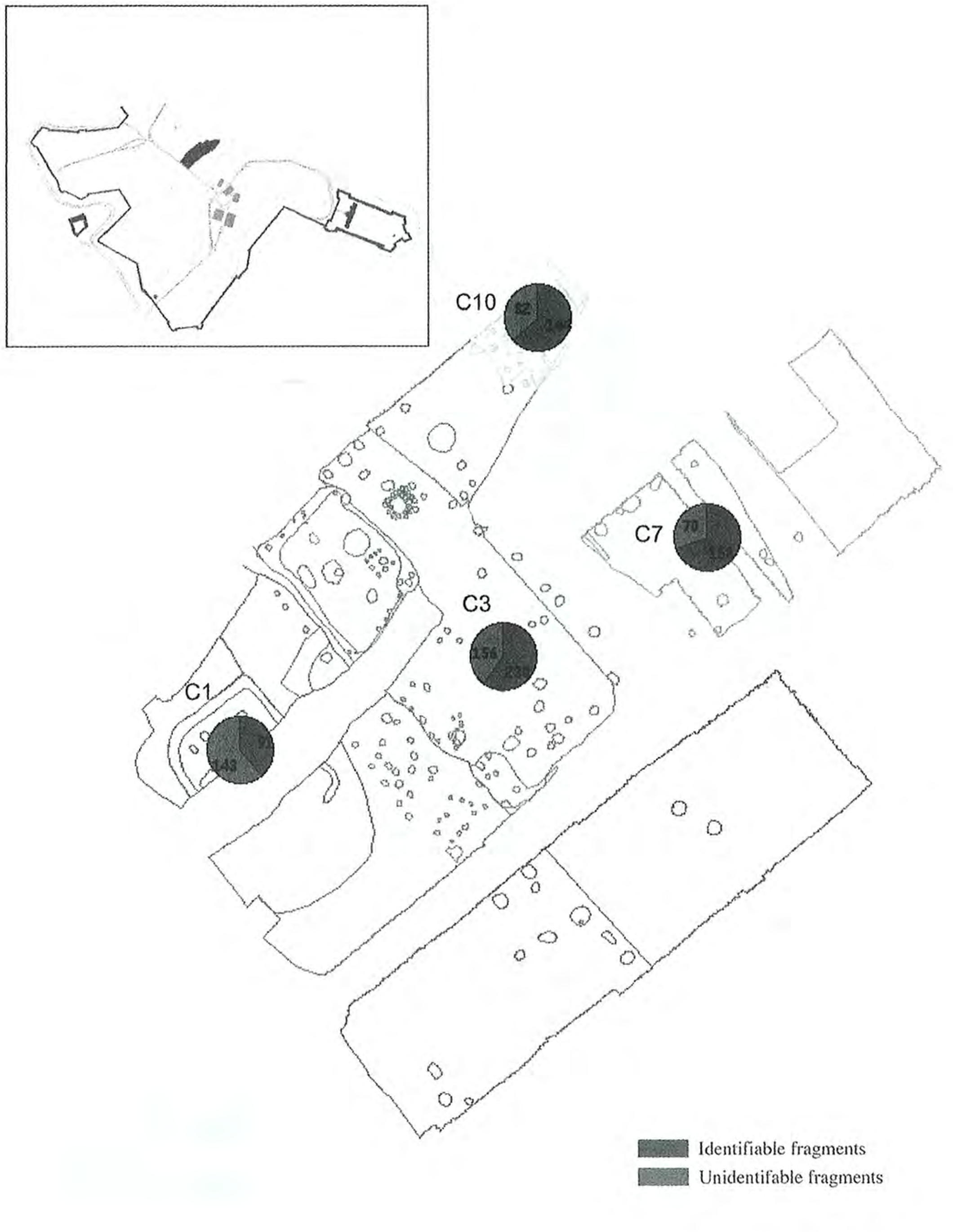

FIGURE 1
Poggio Imperiale in Poggibonsi (Siena, Italy), GIS platform. PERIOD X (second half 9th – beginning of 10th century): pie chart view of identifiable and unidentifiable fragments for each structure.

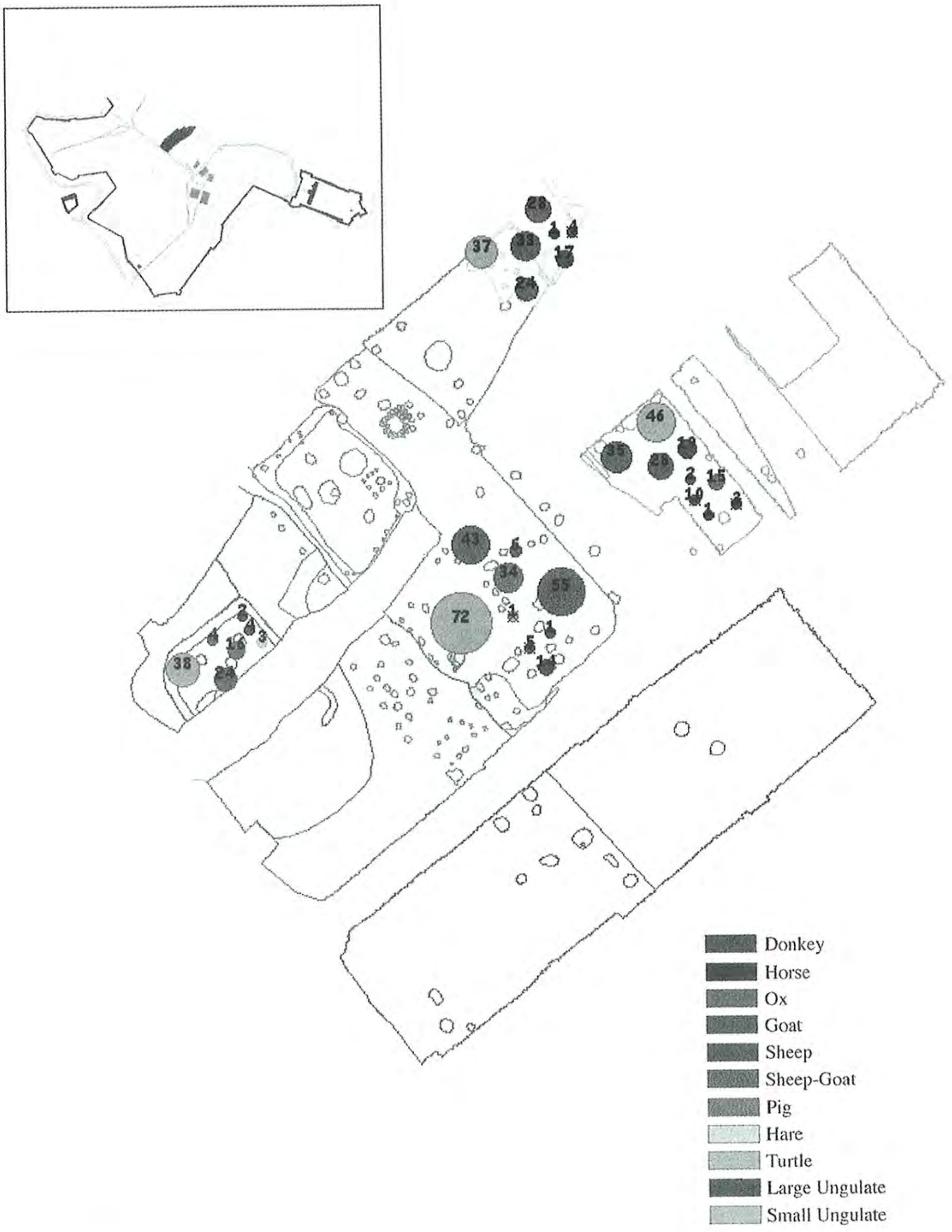

FIGURE 2

Poggio Imperiale in Poggibonsi (Siena, Italy), GIS platform. PERIOD X (second half 9th – beginning of 10th century): proportional view of fragment per species for each structure.

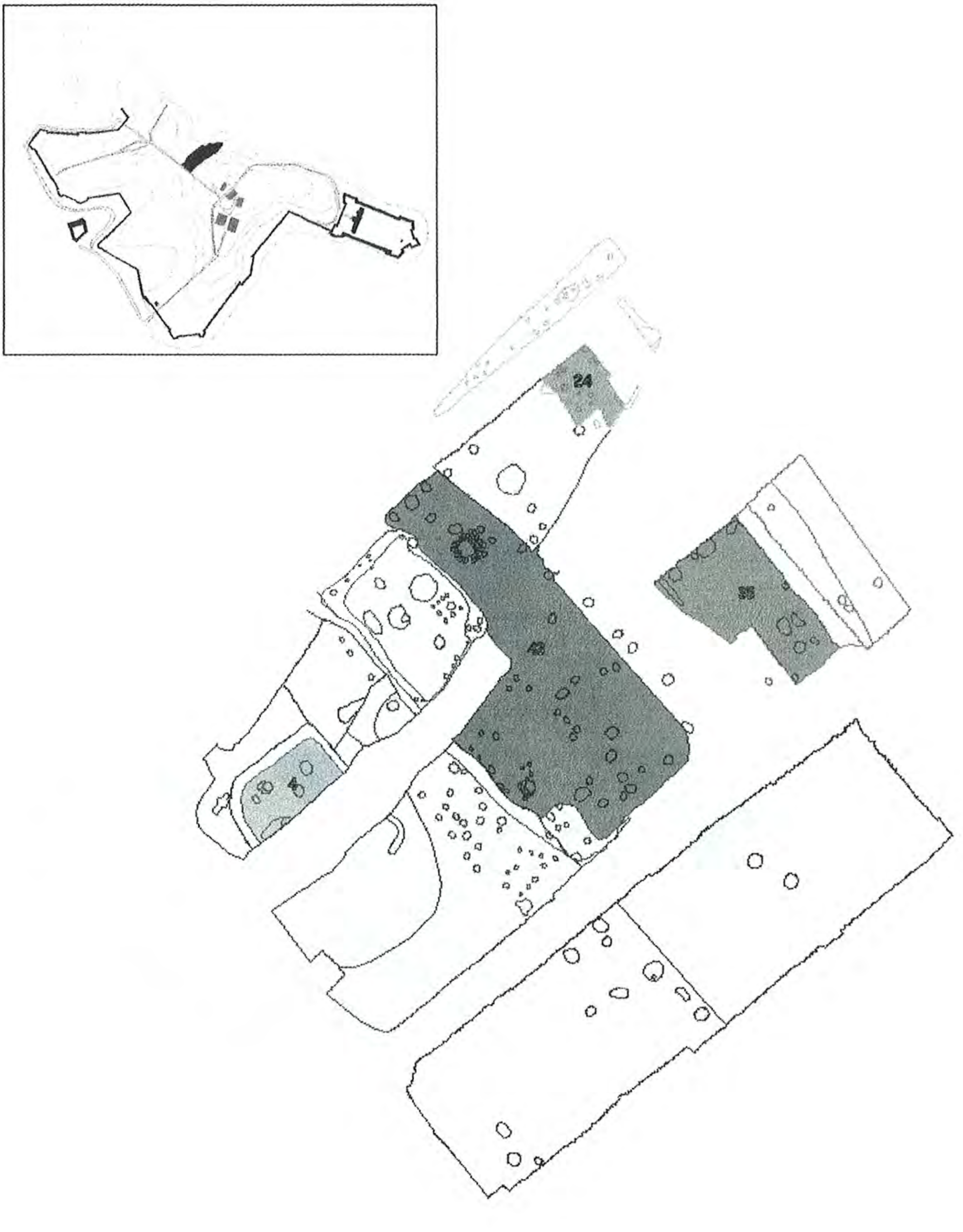

FIGURE 3
Poggio Imperiale in Poggibonsi (Siena, Italy), GIS platform. PERIOD X (second half 9th – beginning of 10th century): colour gradient view of ox fragments for each structure.

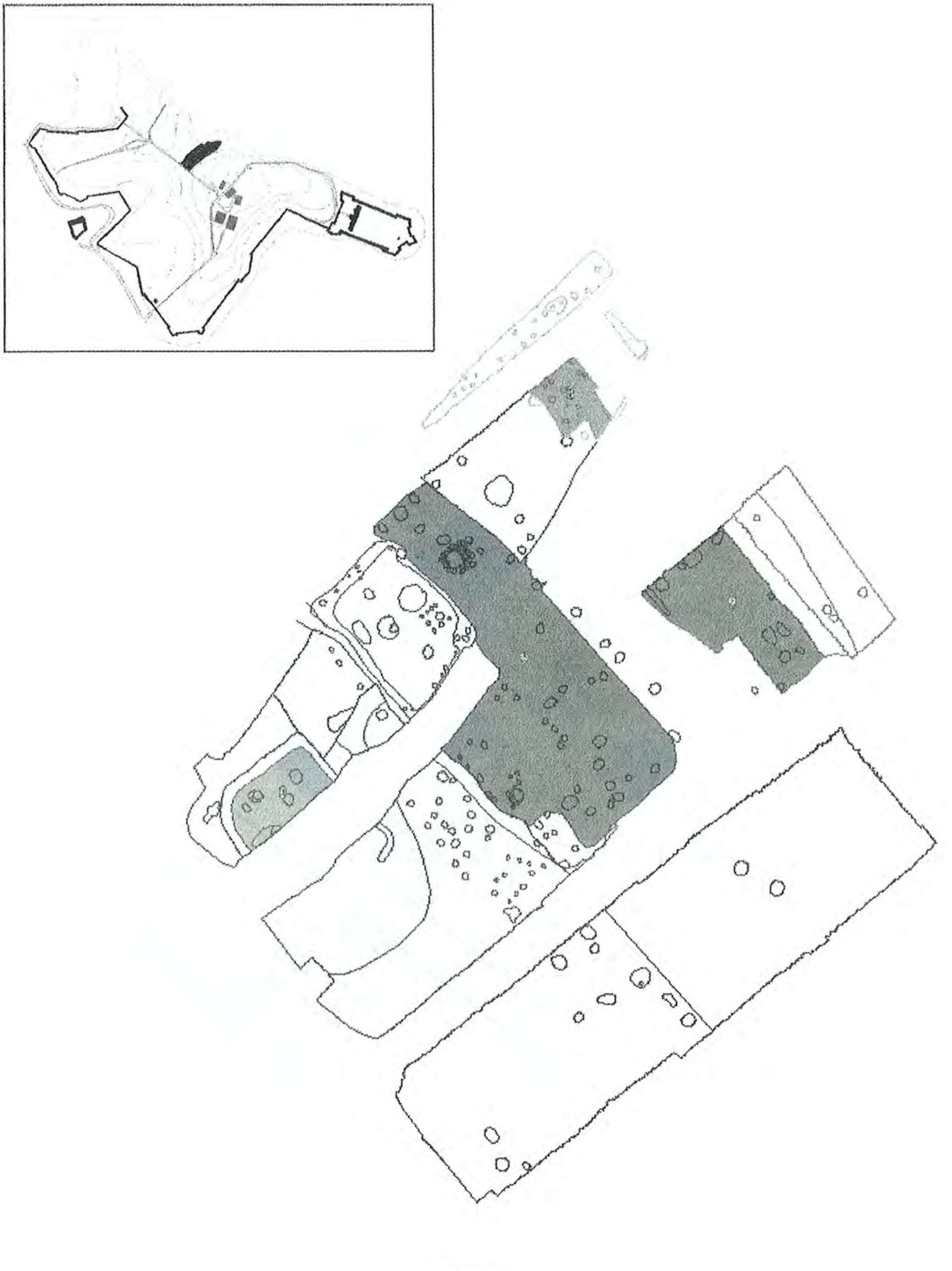

FIGURE 4

Poggio Imperiale in Poggibonsi (Siena, Italy), GIS platform. PERIOD X (second half 9th – beginning of 10th century): colour gradient view of ox fragments for each structure, limited to the 24-36 months age range.

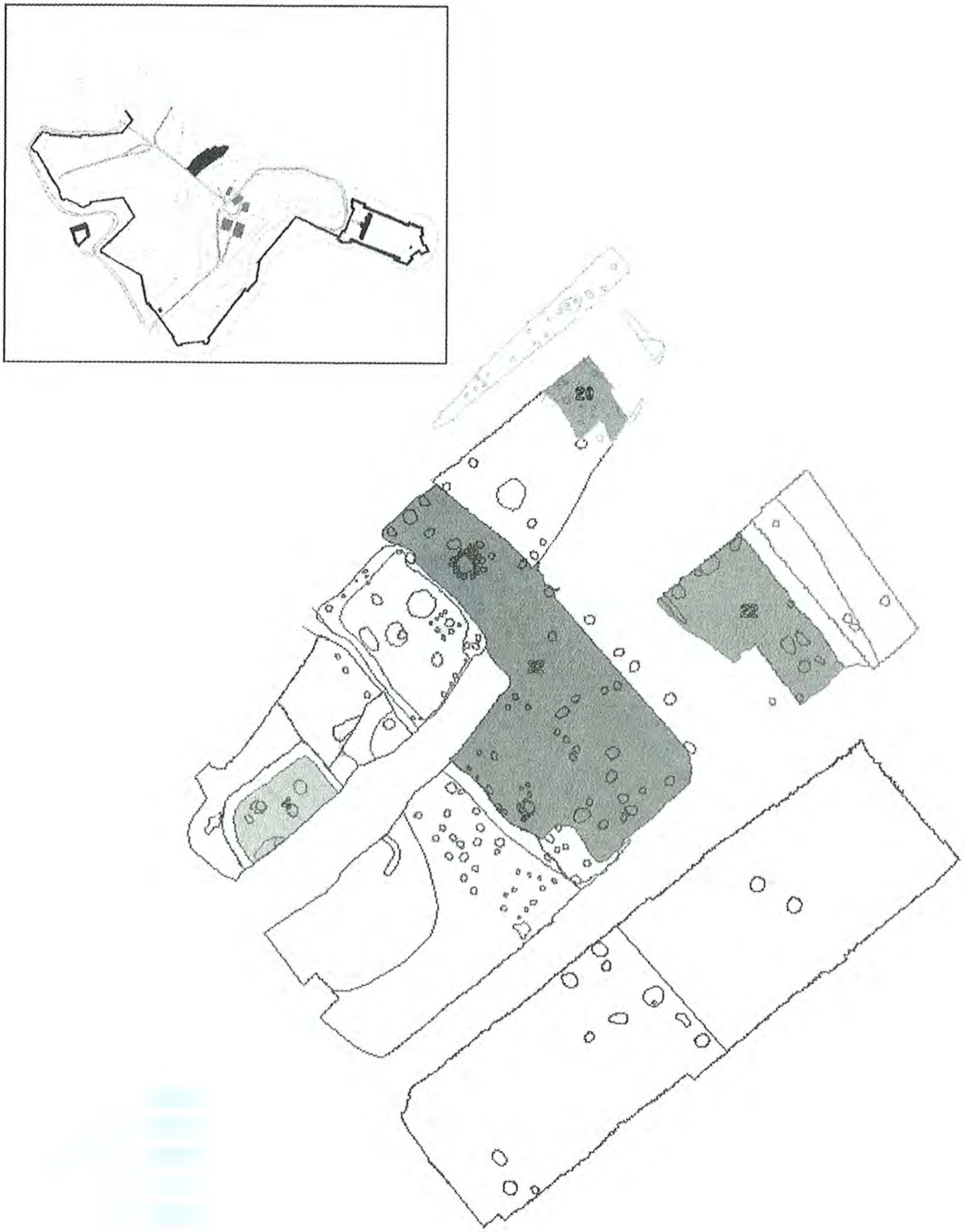

FIGURE 5

Poggio Imperiale in Poggibonsi (Siena, Italy), GIS platform. PERIOD X (second half 9th – beginning of 10th century): colour gradient view of ox fragments for each structure, limited to the generic adult age range.

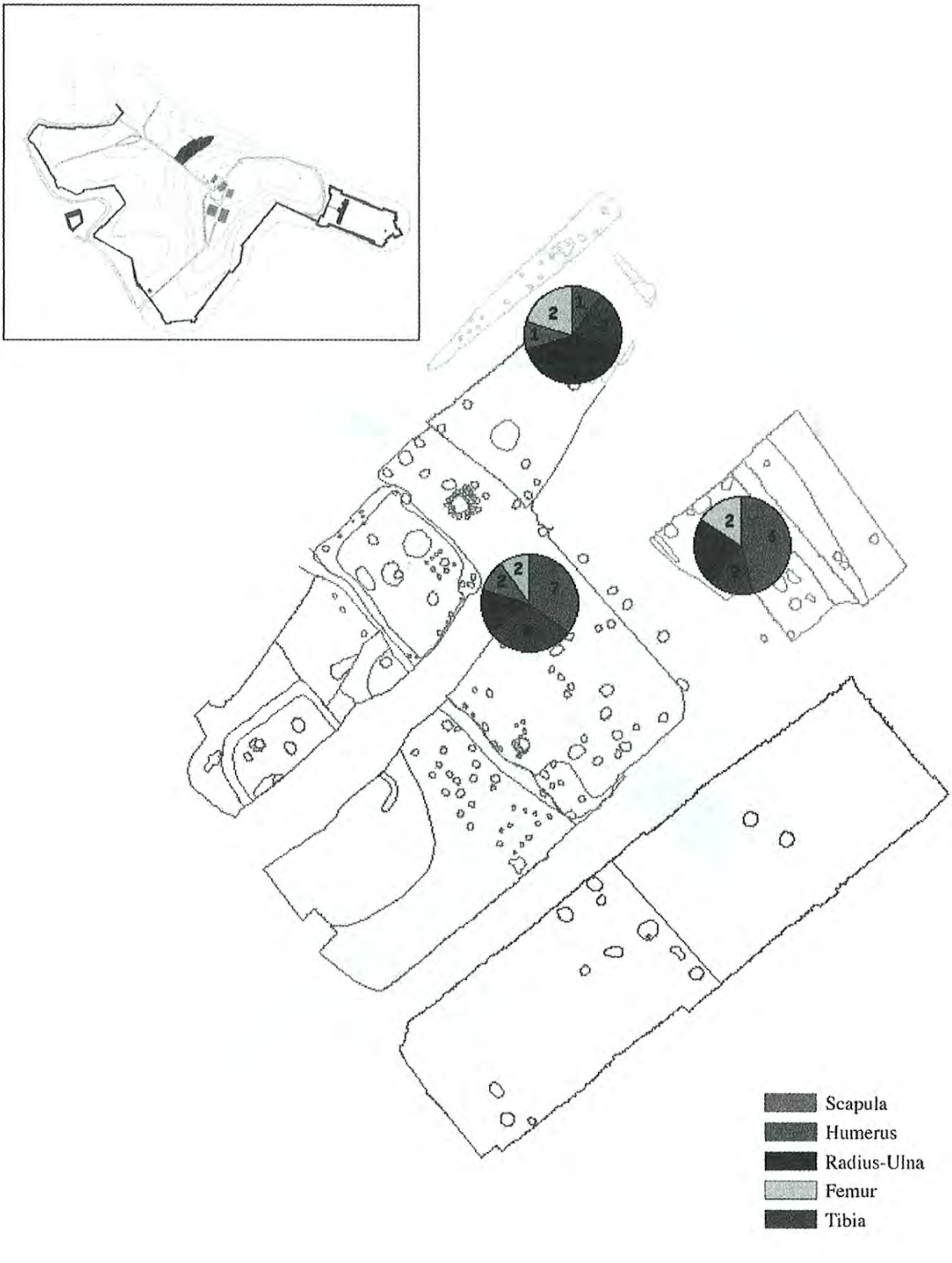

FIGURE 6

Poggio Imperiale in Poggibonsi (Siena, Italy), GIS platform. PERIOD X (second half 9th – beginning of 10th century): pie chart view referred to diagnostic zones of ox fragments for each structure.

butions are used to understand diet customs, economic activities, cult practices and social organisation.

In other words it is a redefinition and application of the Schlepp effect, which adds new variables to those previously considered for pre- and protohistorical contexts. Historic age brings new important factors for interpreting anomalies in concentrations of species recovered in different areas of a settlement. Namely, a higher complexity in economic systems, an articulated social structure in human communities and a development of means and routes of communication.

Only when the DBMS Scavo Archeologico (archaeological excavation) and the GIS platform have been fully integrated – allowing to translate data into information – statistical analysis on bone deposits can be put forth. This has been the case of the Poggio Imperiale excavation. Once the system planning and data entry phases have been completed, the GIS platform has been used to produce information, based on an "intelligent" use of digital tools.

This means our GIS solution uses the DBMS Reperti Osteologici Animali (animal bone DBMS; see the paper by Boscato, Fronza and Salvadori in this volume) to obtain frequency analysis, and the GIS platform to visualise the results in space. Both are necessary, since the single bone fragment is not recorded as an autonomous graphic object within the GIS platform, but can be represented through an integration of the alphanumerical (DBMS) and geographical (GIS) databases.

In fact, data related to the osteological sample are imported within the GIS platform as punctual objects directly derived from the frequency analysis put forth on the alphanumerical database. The choice of using a punctual shape is related to the fact that finds lack real spatial coordinates within the GIS. The corresponding X and the Y values are conventionally placed within the space occupied by the stratigraphical unit they come from (the modalities of digital data processing are described later in this paper).

The situation created by the use of a computer reproduces reality. On large open area excavations the spatial placement of finds within their context is hardly ever recorded. Georeferencing finds after the end of an excavation or dismissing a method if it is not based on graphic objects that represent the real fragment, are both equally misguided approaches. Archaeologists collect finds from earth moved by excavation practices that upset the original horizontal deposit.

This doesn't influence the fact that in some cases the position of finds within stratigraphical contexts can be an extremely important element in the understanding of a deposit. If a similar situations occurs, finds will be drawn and georeferenced through overlays of plans. It will then be possible to digitalise the finds within the GIS, just as it happens with the stones of a wall or the bones of a skeleton.

Therefore, the method we adopted for Poggio Imperiale does not derive from intrinsic limits connected to the excavation records or the digital management, but has to be considered as a conscious operative choice. Moreover, this type of sample analysis is based on frequencies instead of single drawn and georeferenced finds. In other words we could call it an "areal" rather than a "punctual" solution. It aims to be a recording procedure related to typological classification of finds, trying to override an examination of the single bone in order to offer a global understanding of the population. Such an approach produces thematic models that explain the formation dynamics, which do not rely on punctual reference at a single fragment detail level.

On the other hand, "punctual" analysis is more appropriate in the case of prehistoric contexts or particular situations (burials or heavy find concentrations). In these cases excavation times become longer since each single find is preliminarily catalogued and drawn on the context's overlay. The fragment can be identified with an inventory number and directly recorded within the database on the field. The data can then be completed during the exhaustive laboratory analysis. Such a strategy produces valid information for taphonomical investigation and for an understanding of natural processes that determined the deposition of osteological finds.

This type of solution has been experimented on the excavation at Siena's Duomo, conducted by Siena University's Medieval Archaeology Area (Causarano *et al.*, 2003). The discovery of three dog burials dating to Roman Imperial times, forced us to produce detailed plans of every single anatomical element in the context (Figure 7), assigning inventory numbers to identify the finds on the drawings as well as on the bags that contained them. This way, it has been possible to integrate alphanumerical and graphical databases.

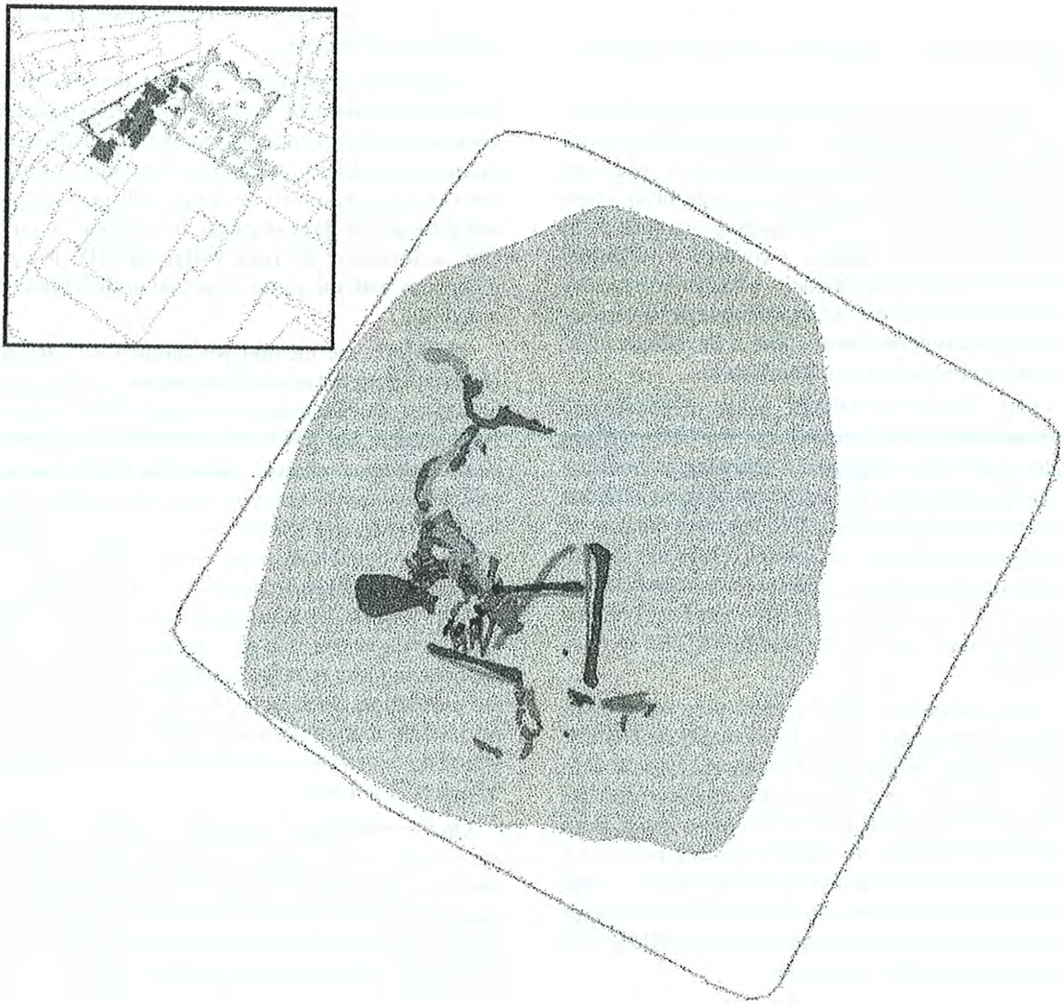

FIGURE 7
Cathedral of Siena (Italy), GIS platform. Graphical plan of dogs deposition where different colours represent the anatomical elements.

Another example of "punctual" analysis has been conducted on the excavation of Nortarchirico (Basilicata, Italy), a site dating to the early-mid Pleistocene (Tagliacozzo *et al.*, 1999). In this case the archaeozoological intervention regarded finds located in the fill of a dried-out paleo-river bed and aimed at understanding the processes that determined the deposit's formation. A graphic reproduction of the evidence has been carried out. The result is a georeferenced map containing every single bone fragment within a grid, based on taxonomical and anatomical identification, orientation, length indexes and degrees of surface alteration. The spatial reading that followed has been focused on a frequency analysis based on the paleo-surface's excavation grid and different combinations of classification attributes.

Since the deposit is made of sediments derived from water activities the results returned taphonomical indications. In other words:

a. A preferential orientation of finds suggests the direction of flow;
b. The presence or absence of specific anatomical elements indicates their degree of transportability;
c. The preservation of the bone surface is related to the alterations caused by water.

The thematic maps published in the volume represent the fragment's position and the different taxonomical classes that have been recognised (elephant, fallow deer, ox). On the other hand, the frequency analysis is represented through a coloured grid where different excavation squares assume variable chromatic themes on the basis of the observed values. It is not clear whether the analyses derive from a digital application (no reference is made in the publication). However, similar information could easily be treated within a GIS platform like that developed for the Poggio Imperiale project.

The excavations at Isernia la Pineta (Anconetani *et al.*, 1996) propose a different experience. In this case the researchers implemented a specific digital application to manage animal bones. It is a database supported by a graphic application representing the paleo-surfaces (a doubt remains about the use of CAD rather than GIS). The authors claim that this solution allows graphical representation of finds on a generic digital platform as points or real figures. These are defined through a set of coordinates stored within a database and shapes also taken from a database containing standard objects of stylised osteological segments codified in a geometric lexicon. The spatial analysis on the dataset should return useful information on fragmentation typologies in order to understand anthropic bone crushing techniques.

All these cases prove that a digital management solution has to be calibrated to fit the specific needs of an excavation: it would not make sense to establish aprioristic criteria to judge the validity of a developed tool.

Obviously, if the excavation objectives require a punctual registration of finds within the stratigraphical sequence (as in the examples we have discussed above), the exact position will be taken on the field and then recorded on a digital system through real coordinates. In the case of contexts where the material is better monitored through frequency and distribution analysis (without relevance of the exact location), the method adopted at Poggio Imperiale perfectly fits complex research needs.

Moreover, the application of distributive models on a GIS platform is by no means influenced by the recording systems. Our solution can easily be adapted to both methodologies. The only difference lies in the data entry phase. In the case of punctual recordings, the finds have to be digitalised following the overlays, just as it happens with the single georeferenced stratigraphical units. Quantitative analysis is made directly on the GIS or through the use of an external database. Our DBMS Reperti osteologici animali (animal bones DBMS) has a module on the single find's location, allowing the recording of X, Y and Z coordinates. These fields allow to preserve the real coordinates of the find's deposition in order to visualise it as a generic georeferenced point by simply exporting them to the GIS platform. Therefore, if particular excavation contexts require an exact recording of bone positions it will be sufficient to record the coordinates on the field and enter them into the database. This way, we obtain an authentic reproduction of the deposit within the GIS platform, except for the exact shape of the find.

THE GIS PLATFORM AS A DEVELOPMENT TOOL FOR FINDS DISTRIBUTION MODELS

To implement distributive models of finds we used a software extension of MacMap (the GIS application we chose for the excavation of Poggio Imperiale in Poggibonsi). In fact, the "Localisation" feature allows punctual representation of the alphanumerical information contained in a tab-separated text. Coordinates of each point are taken from the centroid of the object used as "localizer". This method has been tested on animal bones and will be soon applied to other types of finds (pottery, glass and metal). In our case the localizer has been the stratigraphical unit, so that the point is located exactly in the middle of the relative SU shape.

The generated symbol takes all relevant data from the alphanumerical database, storing it in previously created fields of the GIS's internal table. A tab-separated text file concatenating the SU number, the excavated structure, the animal species and the number of fragments is automatically represented as a point located at the centre of the stratigraphical unit. For instance, the text row "366/C3/ox/3" would be located at the centre of SU 366, and the internal fields would have the following values: structure=C3, species=ox, number of fragments=3.

This data import operation can be carried out at any time and can refer to all the frequency criteria needed in the analysis of a specific population. The adaptable nature of the GIS base means the creation of tab-separated text files is unlimited, needing only the fields to be defined within the internal table. This flexibility allows to test different options related to the detail level of the import process. It is possible to import all the records from the database by establishing a "point to single record" correspondence, or the results of a frequency analysis by setting up a "point to single frequency value" correspondence.

There is no need to adopt a specific data model; the addition of one or more point types to the normal excavation architecture complies with the requirements of the analysis. Data is directly stored within the GIS base, and deleted after being read in order to avoid the platform becoming uselessly overloaded.

Until now, two point types have been added to the excavation base, representing different distributive analysis. The first stores frequency values related to species found in the single stratigraphical units (or, equally, in the single excavated structures), while the second refers to the distribution of anatomical elements of a species within each excavated structure. Distribution by species, regardless of the adopted stratigraphical parameters (SU, excavated structure, phase, etc.), is usually the first evaluation of an osteological sample. The second type allows a more in depth analysis of anatomical elements referred to the taxonomical category they belong to.

The need to keep separated types for different evaluations does not depend of the GIS platform but lies in the correct organisation of the acquired knowledge. Fields for the SU number, the excavated structure and the species are common to both types. The first one is completed by a single field containing the number of fragments, while the second has a number of coupled fields that contain the single anatomical parts with the relative frequency value.

After data import has been completed, several thematic maps (called views) are created by taking advantage of MacMap's visualisation features. These range from simple coloured points, to pie charts or dimensional icons (objects changing their size on the basis of the percentage value they represent).

Global distribution maps can also be produced, showing the areas of maximum concentration through concentric circles with different chromatic values based on the evaluation's results. Another effective visualisation is obtained by a colour gradation of single stratigraphical contexts (SU) in proportion to the percentage values of a find's presence.

The goal of this operation is to produce distributive maps of frequency analysis which was previously processed using the DBMS Reperti osteologici animali (animal bones DBMS). The results are presented on excavation plans, produced according to specific needs (as period or phase plans, plans of excavated structures, etc.). It is therefore possible to translate the effects of our investigations into an easy-to-grasp representation system and to achieve a real integration of archaeological and zooarchaeological data sources.

FREQUENCY ANALYSIS PARAMETERS

More than once in this paper we underlined the choice to graphically represent processed information on a georeferenced platform. Frequency analysis are based on specific stratigraphical and archaeozoological criteria, and performed on the animal bones DBMS (see Boscato, Fronza, Salvadori in this volume). The role of the GIS platform consists therefore in visualising and spatially localising the outcomes of the database.

The dispersal of bones is, as we know, a sum of anthropic, animal and natural factors. It is the result of a long process, which transforms the original living population into fossilised samples. Studying the spatial distribution of finds recovered on excavations means trying to understand the way in which these factors influenced the deposit.

The use of a GIS platform as an analysis tool can be extremely useful in understanding these issues. All aspects derived from find cataloguing are directly involved. Frequency analysis, obtained through the combination of fields within the animal bones DBMS and data produced by archaeological investigations, are directly viewed on the GIS. In fact, all quantitative data can be potentially transferred to the platform and provide evidence that allows significant improvements in the dynamic interpretation of a deposit.

In the case of Poggio Imperiale, the development of a GIS solution which also focuses on zoological finds is aimed at understanding the settlement's social-economic models. This is why we used the database to obtain a concentration of species present in the excavated structures belonging to the same phase, subsequently visualised on the GIS platform (Figures 1-6). The presence or absence of some species within the buildings is taken as evidence of differentiated meat consumption, and hence of social stratifications. The same methodological rule is applied to the distribution of anatomical elements belonging to the same taxonomical class: a higher or lower presence of particular elements, again within different structures, could suggest a qualitative distinction of the inhabitant's diet. Moreover, the distribution of finds allows to obtain information on the activities carried out in the buildings. A high number of discarded bones (such as extremities or cranial, costal and vertebral remains) in comparison to long bones could suggest slaughtering activities. On the other hand, if their number should be very small we could point to a mainly residential function.

Age of death of the animal population is another parameter that can yield interesting evidence of social differences. Structures that preserve homogeneous samples in terms of age can be interpreted on the basis of meat quality, which will obviously be higher in the case of young animals.

The examples we have seen clearly show how the platform's potential for visualisation allows a real-time exhaustive comparison between synchronic samples, processed by the researcher through the use of the DBMS, on the basis of stratigraphical and zoological criteria.

While the DBMS has been planned to store zooarchaeological data independently of a site's specific issues, the GIS solution has been focused on the Poggio Imperiale excavation, where the deposit's nature and the archaeological interpretative grids have allowed an almost perfect data integration. This means that the GIS platforms applied to archaeozoological analysis have to be calibrated to fit different research needs directly related to the deposits' state of preservation.

THE CAROLINGIAN VILLAGE OF POGGIO IMPERIALE: A CASE STUDY

We present a limited example of the results obtained by data treatment applied to the Carolingian phase of the Poggio Imperiale excavation.

The settlement of this period has returned a fairly large osteological sample (1072 bone fragments). It is a village of wooden huts arranged around a longhouse (called Capanna/Hut 3). In this case we have considered the four structures (huts 1, 7 and 10, Figure 1) that lay closest to the main building. Analysis of the osteological deposit has therefore been aimed at a comparison between the samples belonging to the floor contexts of the four structures, in order to isolate anomalies that could derive from economical, social and diet factors.

The stratigraphical parameter we adopted has been the single excavated structure, that is, all the stratigraphical units belonging to the same hut. The zooarchaeological criteria was based on five different research issues:

The first quantitative operation regarded a general evaluation of deposits within the four structures (identified and unidentified fragments), choosing the pie chart visualisation method on the GIS platform (Figure 1);

Secondly we explored the distribution of species, using a dimensional visualisation where the size of graphical elements representing the species is proportional to the frequency value (Figure 2);

The third operation involved each single species, by calculating its numerical consistence within each structure (Figure 3; visualisation method has been, this time, a colour gradient);

The bone fragments have finally been compared by estimated age of death, grouped in four classes: 6-12 months, 12-24 months, 24-36 months and generic adult. The output has been based again on a colour gradient. This operation has shown a clear prevalence of anatomical elements within the Capanna/Hut 3, especially in the case of the age groups 24-36 months (Figure 4) and generic adult (Figure 5). The difference with the other structures is extremely relevant.

A last comparison has been based on the distribution of ox fragments by anatomical elements, considering only the long bones. The results have been visualized by means of a pie chart (Figure 6). They show an absence of bones in Capanna/hut 1 where only a few fragments pertaining to the extremities have been found, a high incidence of radio-ulna in hut 10 and a predominance of humerus and tibia in hut 3.

The evidence of a hierarchical character of the settlement, already stated on a topographical basis (the central and articulated longhouse surrounded by smaller huts), seems clearly confirmed by archaeozoological data.

The model that we can derive from the finds distribution, with a particular reference to ox remains, is based on an diet hierarchy. The consumption of higher quality bovine meat (anatomical parts and age of death) can be seen as a distinctive element related to the inhabitants of the long house Capanna/Hut 3.

CONCLUSIONS AND NEW RESEARCH PERSPECTIVES

The results obtained at Poggio Imperiale make it clear that the structuring of a GIS solution depends especially on the research objectives, on the knowledge of the software features and, subsequently, on the development of a suitable tool. The creation of an open management system cannot be done without a clear solution planning based on a single project evaluation.

The characterisation of the two processing methods ("punctual" and "areal"), which represent the main recording techniques adopted on excavations and are directly connected with the research strategies, has been an important step in this direction.

Potentialities related to similar analyses can also involve the taphonomical aspects that determine a sample's deposition. It is possible to distinguish four research fields aimed at the production of social-economic models of past societies, especially in terms of anthropic activities.

A. Economical model (visualisation of distributive plans based on a settlement's chronological phases)

- distribution of species
- distribution of anatomical elements referred to the same taxa
- distribution of ages for each species
- find concentrations

B. Social distinctions (visualisation of concentrations in each structure)

- distribution of species
- distribution of anatomical elements referred to the same taxa
- distribution of ages for each species
- fragmentation typology, referred or not to the species

C. Activities related to the structure's function (visualisation of concentrations in each structure)

- distribution of anatomical elements referred or not to the same taxa
- fragmentation typology, referred or not to the species and the anatomical element

D. Specialisation of internal areas or rooms of a structure (visualisation of concentrations in excavation squares)

- find concentrations
- distribution of anatomical elements

These four subjects can be developed, following different research interests, through a combination of archaeological and zoological parameters. Such a procedure is rarely applied, but turns out to be quite effective in the creation of historical models.

This paper is not intended as a criticism towards the traditional methods of zooarchaeological investigation. In the last years quantitative and statistical analysis have played an important role in the understanding of a faunal population. The real enhancement is related to the potential of graphic visualisation and automatic processing, which drastically reduce data treatment times and result in the sample's spatial distribution being easier to grasp. Until now, archaeozoological research has expressed itself mainly through tables and charts representing frequency values based on the detail level of the laboratory analysis conducted on the sample. Undoubtedly, the readability of similar outputs is quite complex, as references to the stratigraphical context are often unclear.

To conclude, managing frequency distributions on a GIS platform means gaining immediacy in data fruition which is reflected in a better understanding of an osteological sample and of the factors that determined its fossilisation. Following in this direction will lead, we hope, towards an better integration between archaeological and archaeozoological research, as has often been sought in the past twenty years.

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