I.2.2

The archaeological/cultural datasets and the research methodology

DEALING WITH THE ARCHAEOLOGICAL RECORD

The archaeological information available for the region of Boeotia comes from bibliographical records and archaeological reports, mainly concerning topographic research, excavations and rescue excavations carried out in the region, as well as intensive artefact surface survey results (for details see chapter II.2).

The starting point for the collection was Fossey's book (Fossey 1988), currently the richest source of information as far as extensive research on ancient settlements in Boeotia is concerned. It offers an excellent survey of the material published by the mid 1980s.

Following Fossey's general structure, data are gathered according to *chorai* (fig.1). This implies an approach to the areas of influence of the ancient *poleis* (as they appear in the Classical period) as a focus for analysing the settlement system. Due to the marked territorial character of the ancient Greek *polis* (see Snodgrass 1987/9 among others), and the 'village territory' character of the settlement in the majority of Greek regions and in the majority of historical periods (Kirsten 1956 and Bintliff 1994), for 1200 years of history the model of interaction between the city and its territory can be considered as effective and as having had a relatively strong influence on the natural settlement pattern. Therefore, there is a methodological reason for gathering information and structuring the research according to *chorai*, enhancing peculiarities and detecting similarities. This also facilitates the analysis of the lower rank sites mainly directly related to the *polis*. Furthermore, there are differences in intensity and quality of research in the various *chorai* affecting the available data and the knowledge of landscape and settlement history.

Generally speaking, according to the kind of archaeological evidence being dealt with here and its distribution in space, a suitable methodology for data recording is required. A system has been implemented to deal critically with the different levels of complexity of both the information and the archaeological evidence available from the bibliography (in a broader, regional perspective) and from more recent systematic artefact surface surveys, which intensively cover the landscape in search of all traces of human activity in smaller defined areas. The system should also be able to deal with a large chronological span (over 7000 years, from the Neolithic to the Late Roman period) as well as with multi-period sites.

The archaeological information encountered, which was recorded and collected by previous scholars in different periods and within different research frameworks, is characterised by a high level of inhomogeneity and by inner biases which are a challenge to uncover. Compared to environmental layers, whose spatial resolution as well as quality of data can differ, but which are usually characterised by stronger linearity and consistency (see chapter I.2.1), it is much more difficult to give to archaeologically-meaningful entities as well as social variables a coherent spatial form or a consistent structure. In particular, the archaeological record is marked by a high degree of non linearity.

Despite this, as if the problem did not exist, many of the current archaeological GIS projects often contribute to an indiscriminate production of maps simply corresponding to a database containing a discrete representation of archaeological data, often acritical, due either to a lack of prior theory or hypotheses about the problems the archaeologists want to resolve or especially to a lack of detailed monitoring of the available record. Thus, including the largest quantity of data and data layers into a map seems to be the main goal, without always paying adequate attention to the alphanumeric information attached[1].

Archaeologists used to mechanically define social activity areas from evidence and/or artefact concentrations discovered on the ground, but I would suggest that in order to carry out meaningful analyses, the archaeological information and evidence would need to be evaluated in terms of what they really represent before associating evidence into landscape-meaningful social entities. Within GIS systems, the archaeological entities often do not carry with them information about their quality, precision, or even at the very least about how the information was collected and recorded. In other words, good metadata[2] information is lacking in many archaeological GIS projects, and this is sometimes due to a general disregard of this kind of information, or sometimes, as is often pointed out, it is due to the balance between quality and cost in terms of time, since any metadata collection operation is time consuming.

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[1] We should be aware, though, as Gillings and Wheatley point out (2002: 16-17), that we "*are rarely interested only in where things are*"; on the other hand, we "*often have a wealth of information about the archaeological entities under study, and we should be able to deal with it in a suitable and coherent manner, according to our research aims*".

[2] On the concept of metadata see chapter I.1.1, and Gillings and Wheatley 2002: 86.

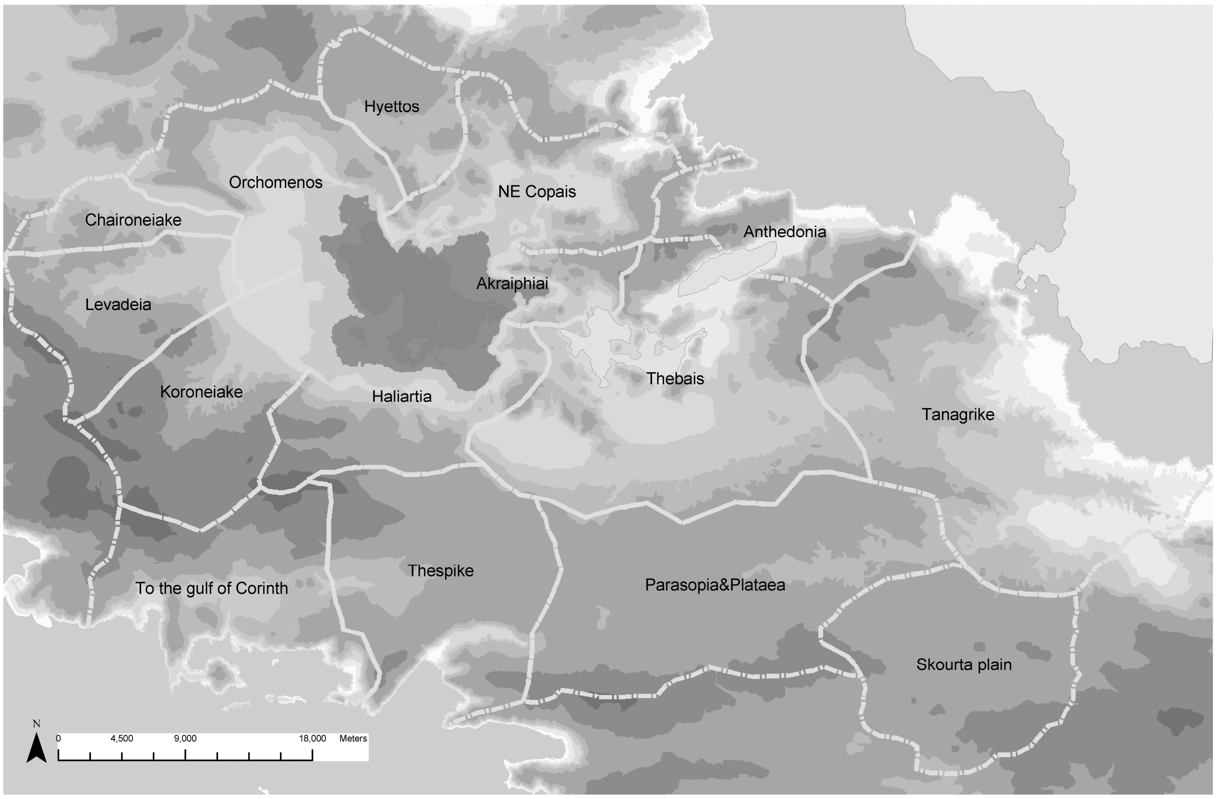

Fig.1. *Ancient Boeotia and the chorai (ancient polis territories)*

Thus, it is important to find a way to deal meaningfully with the uncertainty, fuzziness and inconsistency central to the archaeological record. Using GIS would enable researchers to move "*beyond the dots on the map*" (as in the title of Bintliff 2000b), monitoring the available archaeological record and its quality, as a starting point towards the performance of high quality spatial and landscape analyses aiming at a full understanding of the archaeological and social landscape. Consequently, the process should therefore begin at the phase of data collection and recording.

THE DATABASE STRUCTURE

Deconstructing information and reassessing known data

In order to deal with, and in an attempt to integrate, those inhomogeneous, non linear datasets, we would deconstruct the available archaeological record, through a process of strong source-critique, and reconstruct it in terms of meaningful units of social activities in the landscape, extracting the meaning from each individual component to best assess the huge quantity and variety of archaeological information available, taking into account the non-linearity and incoherence of the data set.

In the bibliographical record, the archaeological evidence is described, either in a general or in a more detailed form, clustered in different ways, but mainly according to geographical location and/or proximity to the main settlement in Greco-Roman antiquity. In archaeological reports the evidence is mentioned with an indication of its location, which is usually in strict relation to the modern settlement network. In this book, these general indications of location, and therefore groups of information, will be called *sites*, as they are in the majority of bibliographical records. Therefore, within the system, units of archaeological evidence, as noted in the field and reported in the bibliography, are collected according to '*sites*', as mentioned in the bibliographical record, which usually correspond to general modern indications of location (or traditional names). Following that, in the framework of a constructive critique, a process of deconstruction of the known archaeological information is carried out. This, therefore, also becomes a deconstruction of the notion of *site*, as conceived – in the majority of cases acritically – over years of archaeological research. Thus, a process of deconstruction of the archaeological information into the minimal '*units of archaeological evidence*' recognisable at this scale is carried out through a 'positive' critique. Afterwards, the known data managed this way are reassessed into a more coherent information structure, the system allowing for the formation of '*components*', i.e. 'archaeologically relevant spatial aggregates'[3], archaeological components of the landscape, which can then be used for further analysis (see scheme in fig.2).

In this way, information from the bibliography is deconstructed and the known data reassessed into a more coherent information structure, and special attention is

[3] According to Dunnell's definition (1992; see below in the text).

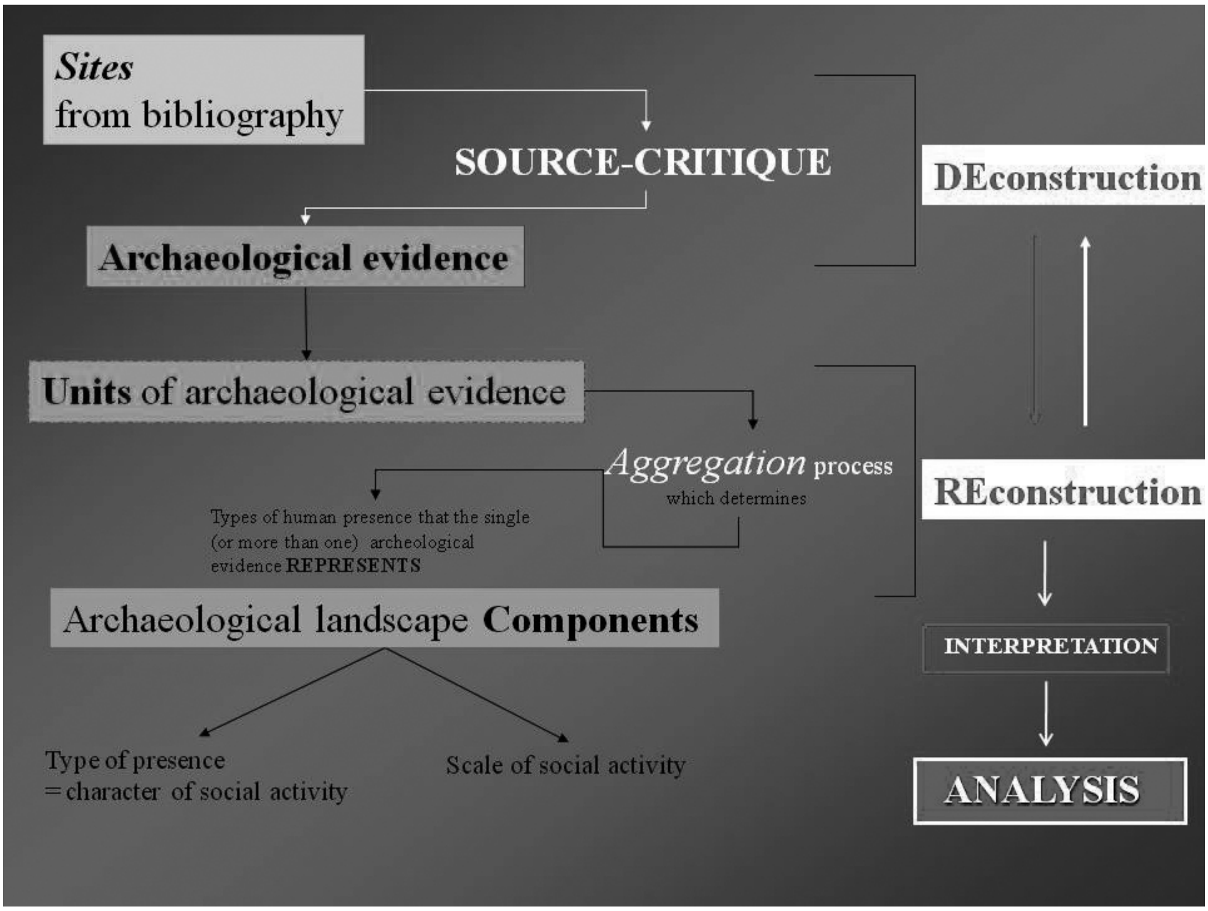

Fig.2. *Model of deconstruction and reassessing of the archaeological record*

paid to recording the type of source of each piece of information collected, in an attempt to carry out a coherent and structured source critique (see below). After the DEconstruction and REconstruction process, we would be able to better separate the '*sites*' (activity foci) in terms of the level of human activities they may represent, and in this way deal with the critical issue of *representativeness* and of valuing the information in terms of what it represents.

Unlike the traditional aggregations into sites, which, since the archaeological record is a non-renewable resource, may lead to the loss of information and biased destruction of the archaeological record[4], our *components* are always renewable, updatable and rethinkable. The system allows us to re-compose the units into different meaningful entries, either once new variables are involved and our knowledge increases, or when different individuals deal with the interpretation of the same archaeological evidence. With credit due to the digital archives and opportunities for the updating of GIS systems, we can always modify and recreate constructed aggregations (as long as it is remembered that they are a construction), and the units of social associations can always be deconstructed (and destructured) again into the individual features (units of archaeological evidence), which can be, if needed, aggregated again in a different way.

By reinterpreting traditional sites, I try to deal with the archaeological evidence without feeling frustrated by the notion of site. On one hand, the siteless approach is critically applied while dealing with the archaeological evidence; recognising, collecting, recording and describing the single minimal units of archaeological evidence, known from the visit in the field, as part of an "*extensive and fluid social landscape*" (Bruck – Goodman 1999b: 11). Contrastively, by means of a critical examination of the archaeological information, the methodology allows for the aggregation of units of archaeological evidence into units of social associations (called '*components*'), which have a coherent archaeological meaning and can be made available for further analyses of the social landscape, in which topographical and natural features, animals and humans each play a role in the creation of cultural meaning (Bruck – Goodman 1999b: 11).

Through the deconstructing-reconstructing procedure illustrated above, we could get to the definition of '*site*' as a cluster formed by the composition of more social units (*components*) and their mutual relationship, keeping in mind that the aggregation process is, of course, entirely interpretative. Misinterpretations arise when archaeologists, talking about and employing 'sites' and archaeological aggregations, forget that they are simply

[4] Dunnell (1992: 36) states how the notion site not only biases our understanding of the human past, but it is also rapidly leading to biased destruction of the record, forever impairing our understanding of the human past.

archaeologists' constructions, a constructed reality, and consider the sites as archaeologically relevant, empirical units that exist independently of the archaeologists.

Conversely, in the process of our research, we would need 'objects' (although they will always be the partial - imprecise real) on the basis of which to carry out analyses, and make our analyses comparable with other projects or research works whose focus is the *site* (even though not always constructed in a critical way). As Dunnell writes (1992: 33): "*We require a series of units, not just a single unit, of association within which counts and patterns are archaeologically meaningful*". The construction of archaeologically relevant and interpretable aggregates is, therefore, required to some extent. As Dunnell continues (1992: 34), "*this view proceeds building up to, rather than dividing, spatial aggregates of interpretive significance*".

According to this 'constructed components' approach, the 'sites' cease to be considered as empirical (archaeologically relevant) units that exist independently from the archaeologists, but become, in the form of archaeological *components* of the landscape, the basic unit of the archaeological interpretation (or 'inferential association'). On the other hand, the *units of archaeological evidence* can be seen as the basic units of archaeological knowledge recording.

With reference to Dunnell's critical approach, whilst our units of archaeological evidence are existing features – empirical units which can be seen, discovered, described – our constructed components will not be existing empirical units which can be discovered and described (in that way, we would make the same mistake of some archaeologists with their sites – see, for instance, Dunnell's disagreement (1992: 29) with Goodyear *et al.* 1979: 39), but constructed features, whose critical interpretation can lead to the extraction of some archaeological meaning. For instance, as many years of research on off-site archaeology have shown, it cannot be ignored that only by linking total landscape sherd scatters and their chronology could one perform possible aggregations into sites and clarify other phenomena, such as a sherd on a site possibly belonging off-site from another era. Evidence comprising only one or a few sherds, therefore, could be interpreted either as constituting a unit of an archaeological component of the landscape, or as evidence of off-site landscape use (see below – SOURCE CRITIQUE, ATTRIBUTE FUZZINESS).

A relational database was implemented (in a Microsoft Access 2004 environment) in order to record the archaeological information available, and it was then included in the GIS system, realised in an ArcGIS 8.1 environment.

The final development of the reassessment of known data is at the mapping and spatial level, when environmental, geoarchaeological, geographical, and topographical landscape data help us in the interpretation of the components.

Phase I. *Deconstructing*: the Units of Archaeological Evidence.

A *unit of archaeological evidence* is anything that derives, through various processes, from past human behaviour and/or activities, either at the level of simple human presence or at different levels of activity focus, and it is characterised by a location; a result itself of human behaviour and human agency. It is, in Dunnell's words, "*a unit within which association is observational rather then inferential*" (1992: 33) [5].

The notion of a unit of archaeological evidence employed here is close to the definition of '*site*' given by Hole and Heizer (1973: 86), and followed by modern textbooks: "*Site is any place, large or small, where there are to be found traces of ancient occupation or activity. The usual clue is the presence of artefacts*". For us, though, the presence of artefacts does not immediately define a site, as they might, for instance, be related to off-site material. The units of archaeological evidence are therefore recorded first, and interpreted at a later stage (see below).

In the present study, in practice, a unit of archaeological evidence is a certain artefact (or a group of similar, homogeneous artefacts – see below) that exists today or could be seen by archaeologists or other scholars in a certain location. Any ancient feature that one may encounter constitutes archaeological evidence; it is what has remained to us from the past. Therefore, the recording of known archaeological evidence can be characterised as an observational and descriptive process (rather than inferential) [6].

Within the database, each unit of archaeological evidence is recorded as a record in the table [Arch_Evidence]. The system allows one to choose among different types of archaeological evidence, and therefore to enter different properties for each unit of archaeological evidence: type, location, chronology, detailed chronology, excavated yes/no, information on excavation, known by means of intensive survey only yes/no, 1st mention of the unit of archaeological evidence, type of presence.

Evidence type: the field registers the type of archaeological evidence, among a given list of possible types of evidence. The values included in the list, and recalled from the [Arch_Evidence_type] look-up (reference) table have been updated according to requirements during data entry for the present work – see table 1[7].

Location: the field records a detailed location as reported in the bibliographical record.

Chronology: the field records the period to which the evidence can be attributed, among a given list of

[5] See Dunnell 1992 for a definition of artefact: "*anything that displays any attribute, including location, as a consequence of human agency*" – cfr. Spaulding 1960: 438; Dunnell 1971: 117.

[6] "*It is impossible to undertake archaeological analysis without grouping the data and so categories must be assigned. However, it would be naive to assume that the process of categorization can be undertaken in an entirely objective manner*" (Bruck – Goodman 1999b: 6)

[7] The question mark available for the record of each entry refers to the chronology assigned to the evidence rather than to the attribution of type.

agricultural production	Evidence that concerns agricultural production (e.g. grinding stones, beehives).
architectural fragments/building material	Architectural fragments (such as fragments of a frieze, columns, or building decoration) or building materials (building stones, bricks, or carved or squared blocks).
artefact concentration	Mainly pottery (but could also be lithic) from INT survey or from certain presence of human activity noticed by EXT survey. Not only quantitative but also qualitative.
scattered sherds/material	Surface sherds from EXT survey, mainly when density is unknown or cannot be quantified.
surface walls	Remains of walls or foundations visible on the surface.
isolated finds	Movable artefacts found on the surface but not associated (or immediately associable) with a context: e.g. a coin, a terracotta figurine.
epigraphical evidence	Inscriptional evidence.
excavated structures/layers	Unidentified excavated structures. If they can be identified then they become the corresponding Evidence type and the box Excavated yes/no will be ticked.
cemetery	Burial evidence, comprising more than one tomb or burial evidence.
isolated tomb/tumulus	Burial evidence, comprising only one tomb or a tumulus feature.
bath	Isolated bath buildings, visible on the surface or discovered during excavations.
boundary stone	*Horos*, inscribed boundary stones.
fortification	Remains of fortifications.
infrastructure	Infrastructure features, such as signs of a road, a bridge, an aqueduct, or a water channel.
mining	Signs of a special activity (mining).
quarry	Signs of a special activity (quarry).
reused	Architectural fragments/building material or inscriptions reused in later structures.
unknown	

Table 1. *Type of Archaeological Evidence.*

chronological periods. The values are recalled from the look-up (reference) table [Chronology] – see table 2.
Detailed chronology: the field records a more specific chronology than that recorded in the *Chronology* field, according to the most common divisions, as known from the bibliographical record (e.g. Early Hellenistic, 4th century BC).
Excavated yes/no: whether the evidence was discovered by excavation or not.
Information on excavation: information on the excavations which revealed or provided more detailed evidence.
INT only yes/no: whether the evidence is known from intensive field-by-field survey only, and not previously noticed by surveyors of the topographical tradition or during extensive survey work.

1st mention: the source which first reported the existence of the unit of archaeological evidence. This field is important for the source critique process, as will be clarified later (see below).
Type of presence: the field records the type of presence represented by the individual archaeological evidence itself – as much as our knowledge permits us – without considering any possible association with other units of archaeological evidence. The possible values are: 'human presence'; '? human presence'; 'activity focus'; '? activity focus' (see below and table 3). The question mark in front of the entry represents either an uncertain attribution of the evidence to a period, or an uncertainty inherent in the archaeological information.
Notes: the field allows the input of a discursive brief description of the evidence, with mention of the main bibliographical references.

Period_ID	**Periods**	**From**	**To**
N	Neolithic	6800 BC	3300 BC
EH	Early Helladic	3300 BC	2100 BC
MH	Middle Helladic	2100 BC	1550 BC
LH	Late Helladic	1550 BC	1100 BC
SubM	Submycenaean	1100 BC	1050 BC
Preh	Prehistoric		
PG	Protogeometric	1050 BC	900 BC
G	Geometric	900 BC	700 BC
A	Archaic	700 BC	480 BC
C	Classical	480 BC	323 BC
H	Hellenistic	323 BC	31 BC
R	Roman	31 BC	330 AD
LR	Late Roman	330 AD	600 AD
gr-rom	Greco-Roman		
unknown			

Table 2. *Chronology*[8]

As seen above, the descriptive recording process of known data is accompanied by critical thoughts on the source(s) from which the information has been taken, and on the actual value of the evidence being recorded (see below also). Afterwards, yet within the framework of the archaeological evidence level, a further step can be taken which leads to the stage of the interpretation of the entries. The '*Type of Presence*' field, associated with each individual Archaeological Evidence entry, assigns to the evidence a general character which is the result of an interpretative process. The unit of archaeological evidence represents by itself a certain or possible human presence or activity focus. The known evidence is examined, weighted, and assigned a character (i.e. a scale of human presence that a certain piece of evidence might represent if considered on its own) among the values listed in table 3. This will give a general impression of

[8] The chronological chart is based on general periodisation (Perlés 2001, Dickinson 1994, Alcock 1993). Absolute dates are only indicative.

the area under study, which would show the overall distribution of human presence and human activities across time, at different levels of complexity.

human presence	From the evidence we cannot infer more than a human presence (e.g. 1 or 2 sherds).
? human presence	Either the chronology of the human presence is uncertain, or the evidence is comprised of isolated finds, characterised by a high level of mobility.
activity focus	Certain activity focus, whatever degree or level.
? activity focus	Either the chronology of the activity focus is uncertain, or we cannot distinguish, on the basis of the evidence itself, between a human presence and an activity focus level.

Table 3. *Type of presence.*

Phase II. *Reassessing*: Components and Activity Loci.

According to the approach discussed above, the aim was to develop a method of constructing units of archaeologically meaningful, inferential associations (*components* of the archaeological landscape) from smaller-scale observational units (*units of archaeological evidence*) – Fig.2. In the artificial formation of *components* (aggregation process), different units of archaeological evidence that can be spatially and logically related to each other are linked together. These would form a *component* of a certain type. The process is not characterised by a high level of automation, since it must be carried out critically and it must be revised many times, keeping in mind that the historical relatedness of the component's constituent elements (units of archaeological evidence) is highly variable and not always directly correlated with spatial proximity, and that "*objects found in spatial proximity may have* [...] *entirely unrelated histories that preclude a simple equation between spatial proximity and systemic relevance*" (Dunnell 1992:29).

Dewar (1986), discussing New England settlement, argues that 'sites' (concentrations of artefacts) should be distinguished from 'components' (artefacts from the same period) and from 'occupations' (artefacts from the same use). Our *components* were constructed taking into account, as we saw above, Dewar's components (archaeological evidence from the same period) and occupations (archaeological evidence from the same type). This is as far as the vertical dimension is concerned. As for the horizontal integrity, which for a site Dewar takes as a given, we used mainly a proximity criterion, but always keeping in mind what we stated above: two things/objects close to each other (in spatial proximity) are not necessarily assignable to the same component and may have entirely unrelated histories. Therefore, we also tried to establish historical connections between deposition events (even though this is much more difficult when dealing with extensively and not systematically collected data).

In practice, the units of archaeological evidence are all listed in the database form: 'aggregations'. They can be virtually picked up and located into a 'component in process'[9].

A preliminary filter was created in order to select only the records of the [Arch_Evidence] table to which were assigned the same 'Chronology' value. This, together with other filters that one may apply (by 'Site', for example, or by 'Location' data on the form), helps the process of aggregation. Otherwise, the process is as much as possible independent from either any preconceived aggregation process or site identification.

In the process of aggregation, the mapping of each unit of archaeological evidence is very important. Some of the units are very mobile and can only be assigned with caution to a component (e.g. epigraphical evidence, coins, isolated finds, reused pieces, or architectural fragments)[10]. Some other units of archaeological evidence simply belong off-site (see above), and they are not assigned to any specific archaeological component either.

Once a component is formed and the corresponding record created, the system allows the user to enter different properties for each component (chronology, detailed chronology, component type, excavated yes/no, known from intensive survey only yes/no, component status, details, other notes), including the research framework within which the discovery occurred.

Component ID: the ID code of each component, constituted by the code of the *chora* it belongs to spatially and a progressive number assigned by the system.

Component counter: a unique progressive number assigned by the system to each component.

Chora ID: the ID code of the *chora* within which the component is spatially included.

Toponym: usually the field records the traditional name, as known from the bibliography. When this is not available, the actual toponym of the geographical/topographical feature as appearing on maps (1:50,000 or 1:5,000) is recorded. In this way we can group the components according to the logic of association which would have been used in traditional studies to define a 'site', and we can recall a component with a text meaningful name referring to location, without necessarily referring solely to numeric codes, which are often confusing. Queries on the basis of this field would help in individuating the continuity of occupation of a certain place. In this way, the toponym represents an *activity locus* (place of concentrated evidence), much closer to the traditional concept of 'site'. In each *chora* chapter, these *activity loci* are indicated by a number on

[9] In the aggregation process different units of archaeological evidence that are logically or spatially related to each other and which correspond to the same component type are linked together. The network of spatial relationships would link social units, and would have a social meaning. We could analyse the social space on the basis of the different levels of human activities we can detect in it and their mutual relationships (spatial and logical/cultural) - see below in text (GIS and social landscape).

[10] Reused elements, as well as infrastructure evidence or inscriptional evidence, are not always associated with a archaeological component. Some of them remain simply units of archaeological evidence recorded.

the archaeological map, and listed with their related *components* in the table linked to the map.
Type: the field registers the type of the component, from among a given list of possible types. The values included in the list, and recalled from the [Component_type] look-up (reference) table, have been continuously updated during data entry for the present work – see table 4. The question mark before an entry refers to the period of occupation rather than to the attribution of type[11].
Details: details on location.
Position: the field gives an indication of the accuracy of position on the map. A list of choices is given, recalled from the [Position_type] look-up (reference) table: precise (GPS positioning, exact coordinates), located on map (when the component has been positioned on the 1:50,000 map, and therefore the position carries the accuracy level of the map), imprecise (when the exact location of the component is not known with precision), unknown (see table 5 and *Spatial fuzziness*, below in the text).
Chronology: the field records the chronological period to which the component can be attributed, among a given list of chronological periods. The values are recalled from the [Chronology] look-up (reference) table – see table 2.
Detailed chronology: the field records a more specific chronology than that recorded in the *Chronology* field, according to the most common divisions, as known from the bibliographical record (e.g. Early Hellenistic, 4thC BC).
Discovery: the research framework within which the discovery occurred. A list of choices is given, recalled from the [Discovery_type] look-up (reference) table (see table 1), illustrated and discussed in chapter II.2. It constitutes the key field for the source critique process (see below).
Excavated yes/no: whether the evidence was discovered by excavation or not.
INT only yes/no: whether the evidence is known from intensive field-by-field survey only, and not previously noticed by surveyors of the topographical tradition or during extensive survey work.
Other notes: some remarks on the component that cannot be inserted in a structured way in the other fields. During the aggregation process this field is required for noting down thoughts and remarks.
Status: in the field can be noted, when available, information on the 'status' the component has within a certain component type. For instance, for settlement components the 'status' could be a *protopolis*, a *polis*, a village, a hamlet, etc.; for burial sites the 'status' could be a cemetery, a small rural burial site, etc.; while for cult places the 'status' could be a sanctuary, a small cult place, a simple cult installation (altar), etc.

settlement[12]
burial place
cult place
rural site/activity
fort
infrastructure[13]
special activity[14]
activity focus
human presence
? settlement
? burial place
? cult place
? rural site/activity
? fort
? Infrastructure
? special activity
? activity focus
? human presence

Table 4. *Type of Archaeological Landscape Component*

Position Type	**Position Type Description**
precise	GPS positioning or exact coordinates
certain	located on 1:50,000 or 1:5,000 map
approximate	imprecise possible location: a possible area is known, but without enough precision
imprecise	known existence but unknown location (ex: epigraphical evidence - probable provenance from the area of a museum object - unknown original findspot)

Table 5. *Type of position.*

Constructed as such, a *component*, unlike the sites in the bibliographical record, is no longer a place distinguished by artefacts (or a grouping of more places in spatial proximity and distinguished by the presence of artefacts), but it is comprised by the artefacts themselves and their spatial relationship. In a way, this approach takes its inspiration from the definition of site expressed by Binford (1964:431): 'The site is a spatial cluster of cultural features or items, or both. The formal characteristics of a site are defined by its formal content and the spatial and associational structure of the population's cultural items and features present'. Such a notion of site can be accepted though only as long as it is borne in mind that the spatial component is a feature that the archaeologists are constructing, and it does not –and cannot - exist independently of them, as discussed above (see Dunnell 1992).
We should now ask ourselves: what role should such a *component* play in our archaeological landscape research? The issue is discussed later in the section *GIS AND THE SOCIAL LANDSCAPE*. Here, I should remark that it was decided to use the term 'components' (rather than

[11] The question mark before the component type value is related to an uncertainty concerning the chronological attribution. In cases where I could not be sure about an interpretation of a component type (component character), I usually recorded the component as a simple 'activity focus', noting the possible character in the field Status (and mentioning the hypothesis in the Notes field and in the text).

[12] The meaning of the 'Settlement' component type is dependent on the chronological period considered. In the Greco-Roman period, it can mean a nucleated site (of either urban or rural vocation), while in the Prehistoric period, it can mean a habitation site (in both cases at different levels, specified in the '*status*' field, if known).
[13] a road, a bridge, an aqueduct, a water channel, etc.
[14] a working area, a production activity, a quarry, a pottery workshop, a limekiln, etc.

'sites') in order to make clear their relation to a wider context, as inferred activity foci of a particular kind in a particular period, as archaeological components of the landscape, as well as their being constitutive parts of more complex activity loci, the latter being much closer to the traditional concept of site, as seen earlier (*Toponym*). As we have seen above, I use the components as a "*merely synthetic construct created by the archaeologists to deal with varying spatial distributions of artefactual remains*" (Goodyear et al. 1979: 39, as definition of 'site').

Discovery_Type	**Discovery_Type Description**
Ext. topographical surveys	Site-oriented extensive research.
Int. topographical surveys	Site-oriented intensive research not involving artefact surface survey.
Int. and sys. topographical surveys	Research that covers the landscape looking for sites but without counting surface potsherds systematically.
Int. and sys. artefact surface survey	Intensive and systematic artefact surface surveys' reports and/or preliminary data.
Historical geography	Mainly research focused on the search for *poleis*, town and village settlements and cult places.
Rescue excavation	Archaeological reports are the main source of information on rescue excavations, as well as some conference proceedings.
Personal or group interest	Personal or group research interest: site-oriented / period-oriented extensive research; problem-oriented research; systematic excavation.
Travellers	Early travellers of the 18th and 19th (and beginning of 20th) C. (e.g. Leake, Gell, Ulrichs, etc.)
Other	Mainly cases in which evidence for certain periods is discovered by archaeologists interested in different periods or particular site types while investigation is in process.
accidental	Accidental discovery, mainly from field ploughing or tomb robbing/illegal excavations.

Table 6. *Type of discovery.*

Relationships

The database set up for this work is relational, in order to better fit the needs of the GIS system, built itself on a relational basis.

In a relational database a *relation* is a table which assigns a series of attributes (stored in *fields*) to each object of a particular class/group. Each recorded object with attributes assigned to it forms a *record*. For each record we can assign a value for N variables (the fields). The number of attributes assigned to an object in a table is called the *information degree* of the table. We have seen above, for instance, the attributes which have been assigned to each archaeological evidence unit and to each component.

Within the database we can have as many relations/tables as we want (in our case, [Arch_Evidence] and [Components] constitute the main tables, along with look-up/reference tables mentioned earlier). Each of them is linked to other relations by means of *relationships* of different kinds (1:1; 1:N; N:M), in order to deal with the data to maintain a 'referential integrity' of the data themselves (for instance, we are not allowed to add information containing an object into a table if there is no record concerning the same object in a table associated to the one we are working on) and to easily carry out cross queries.

The picture in fig.3 shows the relationships which link the main relations/tables within the database.

The table [Chorai] is linked to the table [Sites] with a 1:N (one to many) relationship: each site is contained spatially in a *chora*.

The table [Sites] is linked to the table [Arch_Evidence] with a 1:N relationship: the units of archaeological evidence are the logical results of the 'deconstructing' process of the archaeological record available and usually recorded by site in the bibliographical record.

The table [Components] is linked to the table [Arch_Evidence] with a N:M (many to many) relationship: in the reassessing process, each unit of archaeological evidence is assigned to one (in the majority of cases) or more components (see above in text). The table [Components&Arch_Evidence] is a connecting table which helps manage the N:M relationship between the two tables [Arch_Evidence] and [Components]. A component is formed by many (more than one) units of archaeological evidence, and the same unit of archaeological evidence can belong to more than one component (e.g. some surface walls can belong to a necropolis as well as to the associated settlement, at least as long as we cannot be sure to which component they actually belong). In the case of uncertainty of attribution, a question mark is ticked next to the attribution of the unit of archaeological evidence to the component.

The core of the whole archive is the [Arch_Evidence] table, which stores all the units of archaeological evidence itself. At the first stage of the process, these units are assigned to sites (according to bibliographical records or other sources); they then, metaphorically speaking, 'move' to the components. Ultimately, there will be four different archives stored in tables: the archive of 'bibliographical' sites; the archive of all the deconstructed units of archaeological evidence; the archive of the reconstructed components; and the archive of the wider activity loci, resulting from a clustering of the components. The four archives are linked to each other, but can also be read and queried independently.

Structured in this way, the system allows us to structure our information at more levels, each related to the others, simplifying the complexity and attributing metadata information in each stage of the process. In other words, it allows reasoning on collecting, recording, managing, analysing and presenting our archaeological spatial data

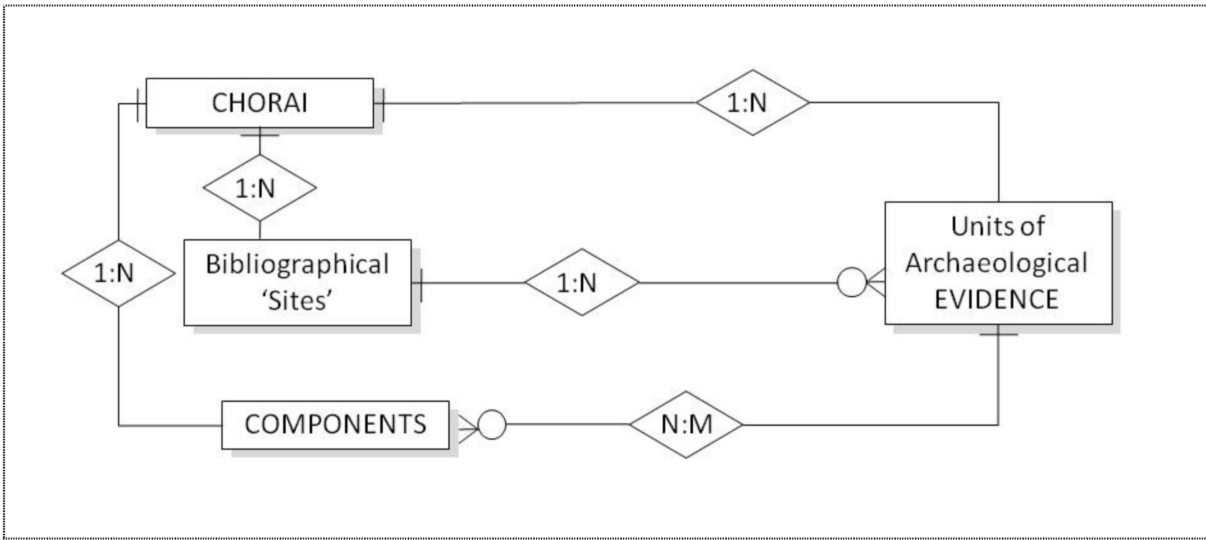

Fig.3. *The structure of the database with the logical relationships that link the main tables within it.*

from the textual/alphanumeric level, before entering into the mapping stage (see below).

SOURCE CRITIQUE

The deconstructing and reassessing processes therefore play an important role in building up the archaeological database for the Boeotia region. Behind these processes is a strong application of the so-called 'source critique' or 'info critique' (the '*Quellenkritik*' of the German tradition), which helps in the definition of metadata attached to the data within the system, and allows one to deal, to a certain extent, with the fuzziness inherent in the available archaeological data. Sometimes the fuzziness is expressed in the source (through indications of probability and uncertainty), but more often it remains implicit and must be detected through a critical examination of the information.

Within the database, fields are available to record and highlight the fuzziness at different levels: spatial, temporal and attribute (information content).

Temporal fuzziness: periodisation and chronological attribution

Diachronic studies are "*comparisons of settlement area structures in the same territory in various periods [..] as, among other things, they may bring a sophistication of our descriptive systems and profoundly influence the generation of archaeological structures and their interpretation*" (Neustupny 1994: 254, evoking diachronic studies). In order to proceed to diachronic analysis, a detailed chronology would be needed, while in the majority of cases it is not easily available in the archaeological record, and chronological attribution to the components remains at the level of larger temporal categories (Prehistoric or Greco-Roman, for instance).
Furthermore, issues of periodisation can heavily bias the archaeological record, as is known from previous reports and studies. Van Leusen, in his PhD thesis (2002), discusses these issues, showing how the chronological attributes of source observations come in a huge variety of terms and classifications, many of which need historical interpretation and may vary considerably from study to study. Moreover, chronological attribution to a site is often assigned on the basis of pottery types, creating typo-chronologies which "*tend to diverge as the distance between the observations increases, and a single period term may have different chronological significance depending on where an observation is made*" (Van Leusen 2002: 13.13). In addition, some periods can only be recognised if diagnostic forms or decorations are present, and the absence of those pieces may lead to an incorrect exclusion of the site from the record of that period; probably present but represented only by coarse ware (Attolini-Cambi et al. 1991; Alcock 1993).
Therefore, as Van Leusen states, "*interpreting the dating evidence presented by a source is often extremely difficult, and so various metadata fields are needed to record the nature and amount of uncertainty associated with any period assignment*" (Van Leusen 2002: 13.13). Sometimes old-fashioned terminology has to be adjusted to modern usage and temporal fuzziness is indicated by the source with expressions such as a generic 'Hellenic' or 'Greco-Roman' or other attributions, not always well determined. The identification of the source reliability is therefore also necessary for the determination of chronology.
In the present work, the attempt to deal with temporal fuzziness is represented by a field in the database assessing the validity of the chronological information, and by the application, for the chronological attribution too, of the same criteria of source critique applied to the content of the archaeological information.

Spatial fuzziness: location and positioning

The accuracy of spatial attribution to a piece of archaeological evidence or a component is strictly linked to the scale of the map on which the sites are positioned, or to the accuracy of the instrument used (e.g. GPS). In our case, the majority of sites have been positioned, according to indications given in the bibliographical record, on the 1:50,000 topographical GYS map[15], and therefore the position carries the accuracy of the map. In the Raster format, resolution of the base grid is 30x30m, and this also gives the precision of the spatial attribution to the dot representing each component.

Within a regional compilation, all source observations have locations which are known with a greater or lesser precision and accuracy. Most of the archaeological-topographical work does not pay attention to *where* something was found, but only to *what* was found[16]. Sometimes, fuzziness in location is indicated by the source in an often informal and inconsistent manner, through the use of qualifications such as 'nearby', 'in the vicinity', 'not far from', etc. Within the GIS, even relatively small errors in position can have significant consequences at the stage of spatial analysis of the data, as pointed out by, among others, Van Leusen[17], who also gives some examples and recommends "*[including] assessments of the precision and accuracy of such measurements wherever possible*" (Van Leusen 2002: 13.7).

In the present work, the attempt to deal with spatial fuzziness is represented in the database by a field (*Position*), which records an indication of the accuracy of position on the map (see above). At the stage of analysis, the presence of many components of uncertain position along with the low position accuracy due to the scale of the base maps, would bias the dataset too much for certain analyses. Nevertheless, when possible, I attempt some spatial analyses including only the features positioned with certainty (see chapter II.4).

Spatial fuzziness also concerns the extension of an activity focus, which is almost never specified in the source available, except for data from artefact surface survey, for which we have the extension of the surface evidence by phase, if not the actual original dimension of the component at a certain time. Therefore, it would be wrong to assign a more or less hypothesised (as never correctly documented) dimension to the component examined. In this work, when some indication is given for extension, it is documented in the Note field, and helps in the interpretation and assignment of a character to the component (*type* and *status* fields).

Attribute (information content) fuzziness

Source critique should always be applied in archaeological research. In Alcock's words, "*data must be examined to ensure that the patterns detected are not simply an artefact of the state of our archaeological knowledge – or ignorance*" (Alcock 1993: 49). Information cannot be taken for granted and not all information can be considered equal (with the same degree of quality or referring to the same level of occupation in the past). Fuzziness is inherent in the archaeological record (like non-linearity and incoherence), even if not explicitly expressed by the source, usually with the use of informal expressions such as '*probably* a site', or similar. Therefore, one should collect and work with metadata in order to extract meaningful entities from the archaeological record available.

As noted above, in the present work an attempt to deal with content fuzziness has been conducted throughout the whole process of archaeological data recording and structuring, by means of deconstructing and reassessing procedures. Within the database, for each unit of archaeological evidence, a field *1st mention* is available to record the first time the evidence is mentioned in the archaeological record, and the *Type of presence* field records a general attribution for each unit of archaeological evidence as representing a certain or possible human presence or activity focus (see above). At the component level, the *Discovery* field is available, in which information is recorded on the research tradition in which the information was first collected. Querying the database on the basis of this field would allow the discovery and investigation of biases in the archaeological map (see chapter II.2).

The multi-step procedure of data recording illustrated above, along with the recording of metadata, can be of some help in the source critique process, and allows the critical exploration of the available dataset.

Generally speaking, the critical issue is the question of *representativeness*. An effort should be made to assess the value of the information and to separate the 'sites' in terms of the level of human activities they may represent. One sherd from the Neolithic period might represent a Neolithic site (especially if found among Greco-Roman sherds, whose abundance creates a heavy background – Bintliff 1999; Bintliff et al. 2002), while in the case of Classical material scattered everywhere in the modern countryside, two Classical sherds in a certain location would not automatically mean a site[18]. Archaeologists dealing with settlement histories should pay attention to the critical issue of multiperiod sites, and especially to the level of complexity characterising the 'site' in the different periods of actual occupation recognised in a certain location. That is what the topographical tradition lacks; often recognising as real and, at the same level, the presence of some periods at a site mainly known for a significant occupation in other periods.

[15] GYS stands for Geographiki Ypiresia Stratou: the Hellenic Army Geographical Service.

[16] Fossey 1988: 20 writes: "*For the most part the important consideration is* what *is found, not* where". He remarks, correctly, that only if the entire surface area of all sites was covered in detail could the distribution of artefacts be possibly shown to have any significance. In this way, he himself stated the limit of extensive research, at least as far as location accuracy its concerned.

[17] Harris and Lock (1992:118-120) provide an early discussion of spatial error and fuzziness in the context of the representation of archaeological records in a GIS (Van Leusen 2002: 13.12).

[18] "*It seems likely that the prehistoric equivalent of a small historic farmstead with hundreds of sherds collectable today on the surface will be represented by a handful –maybe as little as 2-3 prehistoric sherds in a surface collection*" (Bintliff 2000b: 5) – see also Bintliff 1999.

Some evidence is less trustworthy than others with regards to representativeness. Some possible sites are represented by movable artefacts: for instance, inscriptions are very mobile, and the same could be said for coins. Sometimes only older finds are known from museum records as reported from an area (usually indicated by the modern toponym of the village, but with no clue to the precise location within the municipality – *koinotita*- boundaries). Moreover, in some cases we only know that 'something' was found at a location, without knowing the scale of human activity this 'something' may actually represent. Topographical tradition indistinctively makes up 'sites' as easily from a couple of sherds as from an actual artefact concentration, and considers that these sites could mean the same in terms of landscape. At the analysis stage, it would be wrong to mix together places so different in terms of nature of information, with the risk of comparing a settlement with a small farm, for example, as if they were identical in terms of landscape. This tends to be the problem with landscape studies of the topographical tradition (see below – THE MAPPING PROCESS WITHIN GIS).

How can one weight the data collected according to the most probable human presence which can be seen beyond each single dot? Obviously, it is impossible to do this quantitatively and on a general scale, but it is possible by considering, for each single dot on the map, what kind of archaeological evidence lies behind it. Were just a few sherds found there, or a concentration of artefacts? Who found the evidence? Did they find the site while looking for something else (e.g. human presence for other periods, in which they were much more interested)? What one can try to do is to consider each single dot in turn, and try to understand what the dot means in terms of human presence, and what is behind the material evidence representing it (Bintliff 2000b). This works at the level of data recording, and it should be performed during data processing in which a character is assigned to the human presence whose material remains were found at a certain place. Afterwards, at the level of interpretation, dots are analysed in terms of landscape, after the mapping process (see below).

Extensive/topographical surveys mainly revisit sites already known and larger centres and cult places, as stated by Fossey himself in his 1988 book, and give us an idea of what is present, but not of what is missing, in the landscape. On the other hand, intensive field-by-field surface fieldwalking ('intensive' meaning quantified observations and controlled / monitored artefact collections) give us reliable information also on the absence of presence, and on the character and significance of the actual archaeological presence. Furthermore, intensive and systematic surveys give a focus on the countryside and the rural segment of the landscape, for which we have insufficient information both from historical sources, epigraphical documents, and from extensive/topographical surveys.

In dealing with intensive field-by-field artefact surface survey, we can deconstruct the information until we obtain the smallest unit of archaeological evidence, since we have control of the information in the field. Conversely, in dealing with extensive/topographical survey data, we do not have control of the field record (if one never existed), and therefore we cannot always deconstruct information down to the smallest unit of archaeological evidence. Sometimes the smallest unit is what our source of information report as smallest. For example, often our sources report: "here is a LR site as I saw a few LR sherds". So we know at least that the smallest unit is 'a few sherds'. We will never know, though, how many sherds were actually there on the surface, and how large an area was explored. Thus, we are lacking the detailed *quantitative* information, but we do have, at least, the *qualitative* information, which can help. In other cases, though, a particular place is simply reported as 'Early Bronze Age site' without any information on the significance of archaeological evidence that was seen there. Nevertheless, we could infer the quality of the information from the background (theoretical and knowledge) and interest of the particular archaeologist who visited that place and gave us this (even general) information. We can always estimate, in some way, the qualitative information when dealing with extensive/topographical data, by applying to them a source critique process.

As noted above, a single unit of archaeological evidence can be part of more than one component. This is the case, for instance, of units with unknown chronology, e.g. a fortification dated to the Greco-Roman period may belong to the Classical settlement, to the Hellenistic settlement, to the Roman settlement and, probably, to the Archaic settlement[19]. The same is true also for a scatter of blocks and architectural fragments, without any given chronology.

During the aggregation (i.e. component formation) process, it is important to know what is behind each single activity mapped in order to assign a character, such as status, hierarchy, properties, etc., to the activity itself. Knowing its relationship with other units of archaeological evidence also helps. For instance, if there is a tomb and some inscriptional evidence, the single tomb could represent a cemetery, etc.

As S.E. Alcock has suggested in her book (1993), we should be able to establish the relative reliability of currently available survey results (source critique). We should ask ourselves if what we have is a genuine pattern representative of behaviour in the past, or whether it is rather a function of the relative 'visibility' of certain periods, and of our taxonomic schemes. For instance, for the Late Hellenistic – Early Roman period, only fine wares are well known and chronologically subdivided, and surveys examined by Alcock seem to have based the dating of sites on fine wares alone. This brings into question the visibility of all relevant sites, as the research is biased by the assumption that residents of all rural sites would have had equal access to all pottery types, and this was not the case. On the other hand, we cannot identify sites on the basis of imports alone either (Alcock 1993;

[19] We may get more precise information once a chronological study of the city wall is available.

Attolini-Cambi et al. 1991; Millet 1991), and the 'dissemination' time of specific types of high-quality ceramics must be considered as well[20]. I should point out though, that at least in the case of Boeotian cities, access to specific pots is unlikely to affect the picture, as nearly all the pottery was made within each *polis*. Rather, it is knowledge of the local wares and the sampling strategies for collecting the material during field survey which might affect the reliability of the pattern.

Once the data are plotted on a map (see below – THE MAPPING PROCESS WITHIN GIS), we may find that some areas have low amounts of data. We should ask ourselves whether the picture represents a reasonable paucity of sites, or whether areas may appear empty for topographical/geographical reasons, to geotaphonomic processes, or simply to lack of information. On the other hand, we can have a large amount of information about certain areas due to the interest of particular archaeologists (see chapter II.2 for further discussion on Boeotia) or to easier accessibility. Only a critical examination of the quality of data can help to weight an archaeological picture of the landscape having (very) good data in some areas and (very) poor in some others.

An acritical plotting of the known sites would result in maps full of dots which are, for the reasons illustrated above, often incomparable. Thus, any statistics derived from them would be totally inappropriate. Research projects carried out in the topographical tradition often run this risk. One can consider, for instance, Fossey's gazetteer and settlement history (1988) for Boeotia, and McInerney's (1999) work on Phokis (the region bordering Boeotia to the N); both very good studies with regards to the amount of information collected and discussed, but certainly lacking a critical approach. I will discuss Fossey's work in chapter II.2 and *passim* elsewhere in the present work, while I will comment briefly here on McInerney's work on Phokis.

In his book *The Folds of Parnassos* (1999) McInerney provides a good depiction of the historical landscape of Phokis, with a useful geographical description at the beginning, but in building up the archaeological map he lists and plots Phokian ancient sites on a map, without weighting them in terms of the archaeological information which lies behind them (chapter *Settlement and society*, pp.88ff). In analysing his data, he gives an interpretation of the peculiar increase in settlement in the Classical period, which in his opinion did not occur gradually in Phokis (unlike Boeotia, he says, according to data from the Durham-Cambridge Thespiae survey), but happened quite abruptly after the Persian Wars. McInerney compares data (densities and numbers) from intensive surveys with the data available to him, which come from extensive/topographical surveys. He does it, though, without a qualitative critique, and in this way falls into an acritical interpretation: the apparent lack of settlement in the Archaic period, which McInerney explains not by a process of depopulation but by a different way of settling (perishable dwellings, leather and wood tools, pastoralism mixed with intensive agriculture, leading to a lot of very small farmsteads in the landscape), could also be explained simply by the fact that sites cannot be found so easily because of the huge quantity of material coming from later periods (Classical and Hellenistic especially, with the peak of activity in the 4th C) which 'hides' material from other periods from the eyes of extensive surveyors[21]. Only a systematic and intensive survey could provide a proper answer to this question, and this brings to light the risk of comparing data sets so diverse and differently collected. The risk becomes even greater if this is done in numeric terms. It should be stressed here once again the lack of evaluation of archaeological evidence, emphasising how scholars still write books and assume settlement trends only on the basis of extensive survey, without applying any critical approach.

The general picture of ancient Boeotia that we can obtain from the site recognition carried out by means of archaeological, historical and extensive collection of data, has so far proved to be 'naturally' biased by a sort of city-centred or historical place-oriented or archaeologists' interests-oriented approach. This has resulted in a lack of information concerning lower rank settlement, such as small villages and farms, and the full range of occupation phases of well known sites.

On the other hand, intensive surveys provide information mainly concerning other levels of life in the past – small sites, rural areas, non elite elements – and allows a more detailed understanding of diachronic processes, for both rural and urban areas[22].

Therefore, the general picture has to be somehow calibrated on the basis of this extra information. Since intensive surveys will hardly cover the whole area (so far ca. 360 sq.km. has been intensively surveyed), 'intensive

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[20] Other issues could be: the effects of variations in the supply rate of ceramics; probable increased use of alternatives to pottery, such as glass and precious metals (this would have caused an exaggeration of the early imperial decline in site numbers); relationship of surface and subsurface remains; ability of survey to detect all strata of society.

[21] Material of less apparent periods will only be found through the careful examination of field-by-field surveyors, and with the correction and sampling techniques typical of their methods.

[22] Even within the framework of intensive surveys, we could only ever produce a near-precise picture of the ancient situation, since not all available kinds of investigation can be applied. Such an attempt has been made in England, for a small area, at Shapwick (Somerset), within the framework of a research project which is pioneering in many respects. There, across the whole territory of a parish of 1.284 hectares, a wide range of investigation methods and techniques have been applied: extensive survey, intensive survey, historical documentation, toponymic research, excavations, shovel-pit sampling, pollen and soil analysis, archaeological prospection (geophysics, aerial photography and remote sensing). Although we will never produce such highly-detailed information for an extended area (a *chora* or the whole of Boeotia), we will always be able to integrate information. As with the creation of a Digital Terrain Model from known individual spot heights (points with associated height values), we can, from the 'punctual data' given by surveys at different levels and research results, interpolate the surface of the development of the whole Boeotia province.

windows' represent only several small landscapes, as the picture (fig1 in chapter II.2) shows. Therefore, we cannot consider only the windows. What is true and proved for one area can be totally inappropriate for another.

The deconstruction of the traditional definitions of the 'site' illustrated above is due mainly to the development of intensive surveys, which were able to locate up to a hundred times as many sites per square km as earlier work at a less intensive level (Alcock et al 1994; Bintliff 2000a[23]).
The only way to compare intensive with extensive survey data seems to be the application of info- and source-critique to the information. This could be done, for instance, by reducing the evidence to the smallest unit. For example, artefact concentration would be the smallest unit of evidence in the case of artefact surface survey, which, with due caution, could somehow be compared with evidence reported from extensive survey, at least to partially overcome the qualitative gap, without disregarding, though, the quantitative gap, which cannot be overcome. This is why the comparison of values between the two levels is always dangerous (see discussion in Van Leusen 2002: chapters 4 and 13), and when producing maps presenting both intensively and extensively collected data, one should always mark the areas actually covered by intensive surveys (intensive windows). Although direct integration of the two data sets cannot be automatic, one should not become frustrated (Bintliff 2000a: 137), but should find a way to discuss the increasing developments in knowledge that intensive and systematic survey can bring, as well as taking into account older information, no longer visible on the surface but noted during extensive/topographical survey. (In the present work, this was carried out within the framework of the discussion of each single component – see *chorai* chapters).

We should keep in mind that even data collected by intensive and systematic artefact surface surveys should be processed with a strong 'critique'. The issue of visibility can greatly affect the representativeness of data. Geomorphological, pedological and taphonomical processes, as well as surface visibility (influenced by vegetation, agricultural use and other factors) and period visibility (discussed above), influence the recovery of archaeological sites (Barker-Symonds 1984: 287-288; Bintliff-Snodgrass 1985; Barker 1995: 49-50; Terrenato-Ammerman 1996; Terrenato 2000; Wells 2001; see Terrenato 2004: 38-42 for a review of the issue). Also, problematic is the case of multi-period sites, where the off-site background (heavier in certain periods) may bias the period site maps if not dealt with properly (see Gallant 1986; Bintliff 1999 and Bintliff-Howard-Snodgrass 2007). This can be overcome by comparing on-site data collected with off-site data in their immediate surroundings (see Bintliff and Howard 1999 for the methodology in use, for instance, in the framework of the Boeotia project, and some examples in the chapter II.3.14 and appendix I.14-TANAGRA SURVEY). This moves beyond the purpose of the present work, however, and in some analyses we chose to include only those sites that were clearly datable (including only their main period of occupation), in order to avoid the risk of using data which could be dramatically changed following the in-depth examination of their composition. In the present work, I have inserted into the survey sites database only the surely dated artefact concentrations, mostly from preliminary reports (never fully and systematically published or currently being published). These are presented in each catalogue of sites related to the *chorai* in which they are included. Survey sites can be inserted into the database as 'artefact concentration' at the archaeological evidence level, and as settlement (hamlet, village) or rural site (according to the interpretation given) at the component level.

THE MAPPING PROCESS WITHIN GIS

Landscape archaeology deals with the interpretation and reconstruction of human behaviour over space, through time[24], based on appropriate spatial units of analysis (see chapter I.1.2). Therefore, the final development of the proposed reassessment of known data is at the mapping and spatial level within GIS. In order to understand the development of the procedure, we should keep in mind the basic distinction, within a GIS system, between alphanumeric-textual and graphic-spatial archives, logically linked in order to perform selection and cross queries (see Wheatley and Gillings 2002: 12 and 60).
All textual information entered into the relational database has therefore been linked to the corresponding features mapped, and their spatial information, in order to create a system able to manage, process and analyse spatial and temporal complexity. The result is that behind each feature on the map, or on the screen, different degrees of information concerning it are stored. We should not forget that the mapping process accompanies each stage of the data recording and interpretation, and operates not only at the alphanumeric database level; but also acts as a critical reviser, especially in the aggregation (component formation) process.

As illustrated above, we have assigned each single feature (unit of archaeological evidence) to a different class/type, specified by the diverse character of the features. Classes represent the different types of archaeological evidence involved in the system. For instance, if the possible presence of an ancient occupation is known through epigraphical evidence only, this will be recorded simply as epigraphical evidence (and not as a site, for example). The same would be true for the case of a few scattered sherds noted at a certain place. They will remain as such,

[23] For Boeotia, Bintliff mentions a density of 1 site x 26 sq. km (extensive/topographical survey) compared to a density of ¾ sites (or more) x 1 sq. km (intensive artefact surface survey) – Bintliff 2000a.

[24] 'How' and 'why' human behaviour over space changes, the dynamics… (Van Leusen 2002: 5.12). "*Space, time and function can be thought of as different axes along which the available data can be differentiated*" (Van Leusen 2002: 5.13)

scattered sherds, as long as we cannot find another indication of activity on that spot. If we do find other indications, then the presence of scattered sherds becomes evidence of sure and certain activity. Furthermore, if the scattered material can be associated with more distinctive evidence, this would enable us to assign a character to it. For example, if such scatters are associated with graves or with funerary stelae, then they would become a cemetery, while if we can associate them with walls, remains of buildings, fortification walls, then they could be assigned the character of a settlement. Low density scatters may represent small-scale or short term occupation sites, or even burials.
In this way we can monitor the quality, the suitability and the value of our data in qualitative terms (if not strictly quantitative) and proceed to a systematic 'info-critique' (see above).
Within the GIS system, which associates spatial with textual information, and through the aforementioned method of data collection and structuring, we are attempting to move beyond the dots on the map. In fact, in practice, the result is a graphical representation of the study area (a map) characterised by the presence of graphically diverse features, each one corresponding to different units of archaeological evidence at different levels of complexity. In this way, paper sketches or maps of the individual sites are also digitised and inserted into the system, when available. The digitised vector features corresponding to units of archaeological evidence are linked to the corresponding alphanumeric record in the database.

According to the same approach followed in the layout of the alphanumeric database, the first stage of recording of the archaeological evidence is followed by the mapping of the constructed components. Therefore, applying an interpretative filter, dots may become useful and helpful for visualisation and display purposes. The resulting map will be a map with dots. However, we should not forget that 'our' dots are not just floating points, but they remain within the system, and the information content, critically revised (see above) and stored in the [Components] table, remains attached to them.
Within GIS one could easily run the risk of returning to the traditional archaeological topographical tradition that approached landscape as an 'empty space' within which some points of particular interest, 'sites', are situated. This would be partially avoided if the dots are the result of a multi-step process of info-critique carried out on the archaeological information available, as illustrated above. On the other hand, we should keep in mind that we are dealing with data collected mainly through extensive topographical research and marked by a high degree of non-linearity. Therefore, the data do not have the character of intensive survey results which, if carried out in increasingly more sampling areas of the wider region, would fill in (with recorded presence and absence) the 'empty spaces', and would give us a better idea of the landscape trajectories.

Querying the database on the basis of the metadata fields (illustrated above in the discussion of temporal, spatial and content fuzziness) would allow the discovery and investigation of biases in the archaeological map (see chapter II.2), as would, for instance, investigation at the map level of the degree of correlation between the modern road network and the number/density of known units of archaeological evidence or components. The proximity to the modern road network can constitute a strong bias factor affecting the recovery of archaeological sites. In this work, a GIS analysis is carried out to define distance ranges from modern roads, in order to appreciate the possible increasing in presence of archaeological sites in the proximity of roads, due to easier accessibility or, in few cases, to road building or maintaining[25]. The results of the analysis are presented and commented in each *chora* chapter, taking into account the possibility of a real correlation between presence of sites and modern roads. The latter often trace the past road network by which some types of sites were located, or run along foothills and valleys, crossing areas where sites are much more likely to occur.
GIS can therefore be useful in visually representing biases in archaeological research or discovery of sites (density maps; geostatistical analysis to represent density of discoveries; relationships between hilltop sites and discovery, between modern road and discoveries, etc.) as well as helping in the evaluation of the cultural variable.

To sum up, our dots therefore represent the result of a multi-step process of info-critique carried out on the archaeological information available, as illustrated above. The importance of such a methodology can be seen more clearly if we critically consider some gazetteers and landscape studies that do not seem to carry out enough source critique, as well as some (recent) research projects carried out on the settlement history of Mainland Greece (McInerney 1999, examined above, and Fossey 1988, examined in chapter II.2). The aim is to produce, through the critical reanalysis of the quality of the available information, a map having a level of confidence in itself, exploring the less and more reliable possibilities. Most important is that we know the level of confidence that can be assigned to a map.

GIS AND THE SOCIAL LANDSCAPE

Social activities were, and are, performed in the landscape. In any single location, different social activities would have occurred through time, as well as different associations between them. Therefore, we would obtain archaeological evidence at different levels of complexity (Neustupny 1994: 248). For instance, some isolated finds may represent low level social activity areas, but could also represent a medium level social activity area on which taphonomic agents and post-depositional processes have buried or moved away some of the associated material culture. On the other hand, a few sherds from a certain period may represent activity at

[25] A similar analysis was carried out by Rajala et al. 1999, who interpreted the correlation between site locations and distance to Roman roads as indicating discovery biases.

higher level if noted among a large concentration of later material. Very mobile items, such as inscriptions for instance, can hardly have a meaning in themselves, unless they are found in association with other material. By looking at the spatial and cultural relationships occurring between social units we could try to detect associations between lower or higher levels of archaeological evidence, which could constitute meaningful entities in terms of activity areas at different degrees of complexity.

During the systematic analysis of the archaeological record to produce aggregations into culturally/socially meaningful entities (i.e. components), a chronology value is attributed to each component. In other words, each of the diverse components represents different choices taken over the landscape in different periods. This is why the database is constructed to have a single period of occupation assigned to each component; each component representing a single 'choice' over the landscape in each different period[26], while it has to be understood as a historically constituted entity[27].

GIS archaeologists usually display environmental layers as representing potential taskscapes, and then analyse their dots or polygons, representing archaeological features, on top of the resulting layer. This is often done as if the dots (or polygons) represent the full picture of occupation of the landscape. Yet, as stated earlier, it would be wrong to perform the analysis without assessing limits and being conscious of the research biases. On the other hand, I think that systematic analysis could be carried out meaningfully both at the 'single component' level, in the direction of an '*archaeology of place*'[28]. Since, due to our limited archaeological knowledge, we do not have the complete picture, we should examine each single unit of social activity. Once deconstructed and reconstructed, the archaeological record according to components, we would examine each single component/activity focus (GIS dot or polygon) *on the map*, trying to understand its meaning in terms of landscape and in terms of 'social use' of the landscape in the past, within the macro-region and sub-region (see Regional Approach chapter).

Each single 'DOT' could provide information on the social use of the landscape if examined in isolation over a set of landscape data, such as raster environmental datasets for the recognition of suitable activity landscapes (land potential, communication routes, relationships with other components/activity foci, probable activity areas, etc.). Therefore, as a preliminary step to dividing the landscape into 'task-areas' (such as agricultural production, settlement/habitation, industrial activity; associating activities and landscape zones according to environmental and cultural factors), which could be represented by GIS polygons (or groups of pixels) associated with a specific function, we would analyse each single dot in terms of environmental landscape and of social use of the landscape, and then in relation with other activity foci in an attempt to consider the relationship between people, place and landscape[29].

The aim of the research is to give each archaeological inferential component (the meaning of a dot in terms of human activity) a meaningful interpretive context. On one hand is the analytical and critical deconstruction of the archaeological record (of *what is* known in the landscape) described above; on the other hand is the consideration of bits of landscape as wholes[30], considering the absence of presence and presence of absence (Van Leusen 2002) of remains of social activities, and detecting taskscapes in terms of connection between activities, objects and people (for the concept of *taskscape* see Ingold 1993 and 2000 and chapter I.1.2 for discussion).

By examining the relationship between landscape and activities (what/who influences what/whom; what/who informs what/whom; how they interrelate), we can derive the potential significance of the material from the landscape characteristics and, conversely, we can derive the potential significance of the landscape and landscape features from the social and spatial characteristics of the material culture.

According to an 'activity areas' dynamic approach, based on a meaningful interaction between the 'Community Area' and the taskscape theory (see chapter I.1.2), we can try to assess the shifting of use of landscape, in terms of the different social choices taken over an area of the landscape in different periods…[31]. According to a 'settlement dynamic' approach, we can analyse the shifting of the main settlement, the shifting of satellite settlement location, the disappearance of settlement, and similar aspects regarding the main residential cores within a micro-region, according to the revised settlement chamber approach as illustrated in chapter I.1.2[32].

Within this framework, the *chora* constitutes a micro-region/sub-region included in the wider region of Boeotia. Within a *chora* several 'community areas' can be active, one of which usually gravitates around the

[26] Choices over the landscape can be seen as acts of agency. For the concept of 'agency' see M. Johnson 1999: 189, and Tilley and Shanks 1992: 122-6, as well as Dobres - Robb 2000, and Wheatley 2000: 123-31. See also Van Hove 2003: 201-207, Llobera 1996, and Corsin Jiménez 2003: 137-153.

[27] **"**[…] *understanding places, including settlements, as historically constituted entities. The act of settling may involve reference to the previous use of that place*" (Bruck – Goodman 1999b: 14).

[28] For a discussion on the distinction between the concept of space and place see, among others, Tuan 1977: 12; Thomas 1996: 31, as well as Tilley 1994: 14ff, and Knapp and Ashmore 1999: 20f.

[29] Settlement studies go beyond site-centred approaches to consider relationships between people, place and landscape (Bruck - Goodman 1999b: 12).

[30] As opposed to the individual archaeological evidence and its typology etc.

[31] Proximity to resources; landscape use; land suitability according to production type for the period; relation with other landscape elements and other components; activity areas within the settlement chamber; taskscapes.

[32] With the 'settlement dynamic approach' I refer both to the community area theory (Neustupny 1991 and 1994; and Kuna 1991), as well as to the dynamic settlement system approach (Dewar 1986 and 1992). See also chapter I.1.2 for details.

main settlement centre, the *polis*. Within each *chora* micro-landscapes can therefore be defined, marked by a distinctive landscape 'character', a concept which constitutes a bridge between landscape and region / micro-region (see chapter I.1.2). There is a level of landscape characters that can be examined in the long-term perspective, i.e. the level which belongs to the interaction between environment and human activities, which, in other words, belongs to the taskscape. This is what is of interest in the present research, aiming to identify settlement hierarchies (the size and distribution of community areas, the relationship between central places and their satellites, etc.) and to explain them in economic and social terms, to describe the inner structure of the community areas (settlement patterns on a local, community level) including the relations between habitation, production, burial and ritual areas, to identify the main general as well as culturally specific factors (environmental, economic, social, symbolic etc) in past site-locational preferences, to evaluate the reliability and explanatory power of individual datasets collected by different research methods. Following the trend given by the settlement chambers approach (revisited through the community area theory and the taskscape approach - see chapter I.1.2), one can obtain more detailed and larger clues on the social use of the landscape by looking at the location in the landscape of the units of social evidence, at the settlement and activities pattern, at the association between activities and landscape zones, and especially by looking, in the long term, into the movements and shifting of areas of use (activity areas) within a settlement chamber. The shifting of the major settlement, or the gradual transformation and modification of settlement structures through time, for instance, as well as (and especially) the shifting of activity areas in space through time, are all objects of the research.

Following the above statements, it is clear that the archaeological record to be used for archaeological landscape analysis, and for assessing the social use of the landscape, must be revisited in a 'GIS-based' (GIS-designed, GIS-informed) way in order to become suitable for more meaningful analyses. Therefore, in the interpretation of archaeological landscape data, the use of GIS becomes a GIS approach to landscape studies, which informs and drives data collection and management up to *or* down to the analytical level.

APPLICATION OF COST-DISTANCE ANALYSIS

Traditionally, site catchment analysis is aimed at individuating territories exploited by a settlement. Its first application in archaeology was the work of Vita-Finzi and Higgs (1970: 1-37)[33]. The basic principle of the method is the acceptance of the relationship between the fruitful exploitation of a source by a population, and the amount of energy consumed by that population in order to exploit it. The limit of a site catchment area (i.e. the distance from the site exploiting it) differs according to the type of settlement or the period considered. For the Greek landscape, Bintliff (1977: 112) suggests two hours' travel time for a site related to animal husbandry, and one hour travel time for an agricultural community, while later he (Bintliff 1997c and 1999c) goes into more depth by recognising a dynamic development of territory size, and concludes (following Flannery 1976) that "*the 5-kilometre farming radius may operate in certain settlement scenarios, such as pioneer farming 'infill' situations, but not others, with mature 'filled' farming landscapes stabilizing into 2.5-kilometre radius catchments*" (Bintliff 1999c). Accordingly, the average cross cultural distance between villages is 4-5km (Bintliff 1999c).

In order to individuate and graphically present site catchment areas, different methods have been developed, especially within geographical studies. Allocation analysis, otherwise known as 'tessellation' of space, is based on the concept of division of space on the basis of the geometric properties of a set of points. It is based mainly on Euclidean distance and gravity based rules, and considers the space as 'flat'. The most common application of the method in geography and archaeology is the so-called Thiessen/Voronoi polygons[34], a developed version of which is the X-tent model[35] (Hodder and Orton 1976; Wheatley and Gillings 2002: 149-151). Within a GIS environment, the application of algorithms allows identification of which cells belong to which source based on closest proximity (in a straight line). An output raster is produced that records the identity of the closest source cell for each cell. Each cell in an allocation raster receives the value of the source cell to which it will be allocated. The allocation analysis in itself is based on measurements of Euclidean (straight line) distances, but it can also be performed on the basis of a cost weighted distance, which considers the space as topographically variate (rather than 'flat') as well as taking into consideration the cost (in time or energy) of moving over the terrain within space (see below). By offering tools for calculating cost- (time- or energy-) distance, GIS can help to overcome an excessive and risky abstraction of space.

The series of GIS techniques that are based on the capacity to assign a cost value to each cell of a raster dataset/matrix and then to calculate the cumulative cost on the map (Van Leusen 2002: 6.1) is given the name *Cost-surface analysis*. The concept of cost-surface is the expression of energy or time cost of moving over the

[33] The concept is based on the idea that the further an area is from a site, the lower the probability of that site's inhabitants exploiting that area.

[34] Thiessen/Voronoi polygons (a sort of tessellation) are based on a simple nearest-neighbour method for partitioning a featureless space, equivalent to a gravity model operating in 'flatland', and result in a complete tessellation of space (Van Leusen 2002 : 6.4).

[35] The X-tent model (used by Renfrew and Level 1979, and Grant 1986 among others) refers to the influence of the size (or rank) of a centre onto its territory. It is assumed that the degree of influence of a centre is proportional to a function of its dimension, which would diminish gradually as the distance increases (see also Van Leusen 2002: chapter 6).

terrain. In order to calculate this, not only the Euclidean distance between the locations is taken into account, but also other variables, among which primarily the terrain slope (Wheatley and Gillings 2002: 151; 159-162) [36]. The possibilities offered by this technique have led to some confusion as to the best way of calculating costs, as illustrated extensively by Van Leusen (2002: 6.5)[37]. Some of these methods consider terrain slope as the key factor for the speed of the moving on the terrain. For the analysis carried out within the framework of the present study while exploring site catchments, boundaries between communities and settlement chambers, I calculated the accessibility of settlements on the basis of slope, according to a formula provided by Gorenflo and Gale 1990 (and re-proposed by Tobler 1993[38]). The relationship between terrain slope, velocity/speed and cost value is represented by the formula:

$$V = 6 \exp \{-3.5 * \text{abs} (S + 0.05)\}$$

where V is the walking speed in km/h, S the terrain slope in degrees, and 'exp' is the base for natural logarithms. This function is symmetrical but slightly offset from a slope of zero so the estimated velocity will be greatest when walking down a slight incline (Van Leusen 2002: 6.6). For each degree of slope[39] is assigned the time (min/km, approximated value) that a man employs to walk it, taking into account his speed. The result is a time-cost surface with values from 12 to 395, representing the effort to move from one cell to the other (expressed in min/km).

From the cost-surface one can derive the *cost-weighted distance*, i.e. the Euclidean distance corrected by the cost surface values (from one or multiple features). The distance obtained in this way can be considered temporal rather than geometric (expressed in time –minutes- rather than in metres), and constitutes a continuous raster map, of which any number of values may be used to provide 'cut-off points' or boundaries to the catchment or territory (Van Leusen 2002: 6.4-5). If the cost-distance is allowed to run until all available space has been used, the result is a tessellation of space similar to Thiessen/Voronoi polygons[40].

The cost-surface analysis can be used to determine the potential catchment area of a site, by defining a buffer area around the settlement site based on a specific distance radius, taking into account the topography.

On the other hand, the continuous surface of topographically corrected distance values, which results from the analysis, can be explored in terms of movement in the landscape and of relative distances between settlement sites. In this way, settlement chambers can be appreciated, although they result from more qualitative issues than do site catchments. Therefore, the continuous surface resulting from cost-surface analysis constitutes the basis for the settlement chamber analysis carried out for each *chora*, and helps to better evaluate the impact of physical constraints on the creation of settlement areas, the spatial inter-relationships among settlement sites, as well as the degree of movement over the landscape of settlement foci (see *chorai* chapters and chapter II.4).

In the cost-surface analysis carried out within the framework of the present study and aiming at exploring site catchments, boundaries between communities and settlement chambers, the partially reconstructed ancient roads (mainly physical routes as they are mapped in this work - see fig.5) have not been added as a correcting factor of the analysis. The analysis would be too strongly biased by the incompleteness of the dataset, as a detailed and systematic study of the ancient road network would be needed. This can be demonstrated by a GIS distance analysis from reconstructed and potential routes performed on the archaeological components. The fact that 82% of the archaeological components listed and mapped in this work are further than a distance of 100m from the partially known and supposed physical routes network, would testify for how many routes and ancient paths used in the past we miss in the constructed dataset. Such a study is not available nor could have been done within the framework of this work as it would go beyond its scope. Furthermore, what is explored by means of cost-surface analysis in the present work is the relationship between the settlement and its territory for its economic use mainly, rather than the communication network between communities nor the chosen and preferred paths followed by main routes.

[36] Compared to other kinds of analysis, such as Thiessen/Voronoi polygons or circular catchment analysis, performed in a 'flat' space on the basis of Euclidean distance and gravity based rules, cost surface analysis allows the simple 'flat' geographical space to be supplanted by a set of complex cost surfaces incorporating many relevant properties of the terrain, taking into account the expenditure of time or energy (Van Leusen 2002: 6.1).

[37] For instance, travel cost surfaces can be isotropic (the same in all directions) or anisotropic. Because of the effect of both slope and terrain, the cost of traversing a particular location may differ depending on which direction it is being crossed in (Van Leusen 2002: 6.5). However, most authors agree that travel cost has both an isotropic and an anisotropic component; the former exemplified by costs relating to the type of terrain and ground characteristics (soil, vegetation, and wetness), the latter by costs relating to slope and streams.

[38] See Tobler Waldo, www.geodyssey.com/papers/tobler93.html (last visit April 2008). The formula has been employed for instance by Verhagen et al. (1999), who calculated the accessibility of settlements in the Vera Basin, Spain.

[39] Slope classified up to 45 degrees because above it the terrain can be considered unwalkable. The highest value in our Boeotia dataset is 85.28 degrees. In the slope model therefore slope values fluctuate between 0 and 85.28 degrees.

[40] This process is called 'allocation' in the ESRI ArcGIS Spatial Analyst extension. Performing allocation via the Straight Line Distance function allows one to find the cells that are to be allocated to which source based on closest proximity, in a straight line (=Thiessen/Voronoi polygons), whilst performing allocation via the Cost Weighted Distance function takes into consideration the cost of travelling over the land rather than the straight line distance.

CULTURAL-ANTHROPIC GIS LAYERS

In addition to the archaeological evidence and components, from the Neolithic to the Late Roman period, other GIS layers included into the system refer to cultural-anthropic landscape features. These are listed and described below.

Layer **COMPONENTS** [points]: the layer includes the components recorded in the archaeological database of ancient Boeotia built up within the framework of the present work, mapped according to information given in the bibliographical sources and built up according to the methodology stated above in this chapter.

Layer **CHORAI** [polygons]: the borders of ancient *chorai*, into which ancient Boeotia can be divided, represent approximately the limits of the *poleis* territories in the 4th century BC (at the time described by the *Hell. Oxy.)*. They mainly follow geographically marked lines, building up topographical units, and sometimes they are known with higher precision due to some archaeological features discovered (e.g. a sanctuary situated at the border, as stated in ancient texts, or inscribed boundary markers– *horoi*). At other times it is much harder to identify the actual border line, and in those cases a 'guessed' line has been drawn as working hypothesis (fig1).

Layer **ROADS** [polylines]: the layer is constituted by the vectorisation of the main (i.e. paved) modern road network. Some roads, such as coastal or mountain roads, or the road running along the E side of Paralimni lake, are totally new (most of them are not even marked on the 1:50,000 Geological maps, and some are marked only on the most recent version of the 1:50,000 GYS topographical map). As basis for the vectorisation of roads I have used the 1:50,000 GYS topographical map drawn in the 1980s, which should have been the road network available to earlier researchers in the Boeotian landscape (Fossey, Lauffer, compilers of Prehistoric gazetteers, etc). The main purposes of this work are: i) to add a feature layer in order to make the maps much more comprehensible to users (to show the positions of sites in relation to modern landscape features, together with modern villages); ii) to create a layer on the basis of which to map possible biases in archaeological discovery according to the proximity of roads[41]; iii) to identify, when of interest, changes in communication patterns between past and present, and to compare with the physical routes much more used in past communication. Some mountain passes, for instance, disappeared (e.g. the pass through Helicon village or through Koukoura/Agia Anna), some others take different ways[42].

Layer **ROUTES** [polylines]: physical ancient routes known or hypothesised, on the basis either of archaeological evidence or of ancient sources or modern travellers' reports[43]. Archaeological remains of ancient routes are recorded as units of archaeological evidence (AE) in the [Arch_Evidence] table of the archaeological database.

Layer **CHORIA** (modern villages) [points]: based on the 1:200,000 *nomos* map, recorded in the 1960s and updated in 1983 by the Hellenic Statistical Service - ESIE. The main villages and 2nd rank hamlets (*synoikismoi*) are included, constituting the *demoi* giving their name to the corresponding territories (see *Koinotites* layer).

Layer **KOINOTITES** (modern village boundaries/administrative divisions) [polygons]: digitised from the 1:200,000 *nomos* map, recorded in the 1960s and updated in 1983, with attached information from the Hellenic Statistical Service (ESIE) concerning 1981 (population, number of hamlets, etc.)

Layer **FRANKISH TOWERS** [points]: based on Lock's 1896 map; the result of Lock's study on the remains of Frankish towers in Boeotia. In addition, the two main Frankish centres (castles of Thebes and Levadeia) have also been added, as well as some towers noted within the framework of the Boeotia Survey Project (Chaironeia and Tanagra/Ag.Thomas)[44].

Layer **OTTOMAN VILLAGES** [points]: based on research carried out by J.L. Bintliff and M. Kiel (Bintliff–Kiel in preparation) who positioned known and potential sites employing as reference old maps, including the *Carte de la Grèce* (1852), and travellers' accounts, as well as recent place names[45].

41 The analysis does not really work for rescue excavation – most recent roads are not mapped, though recent rescue excavation work is discussed in the *chorai* chapters – nor for intensive systematic surveys which walk each field no matter the proximity to the easiest path, but for extensive survey work visiting the most accessible places.

42 As far as roads not really belonging to the network but simply leading to churches/monasteries, I included that to Moni Panagias (by the Apollo Ptoion sanctuary), but omitted those to Proph.Ilias monastery above Vathy/Aulis –East end of Thebes sheet, W end of Chalkis- and to Moni Sagmatas (both not marked on the Geological maps, probably older than the topographical GYS).

43 The main studies on routes in Boeotia are Burn 1949 (plan 42) and Pritchett 1985: 138-165 (*Routes over Helicon from Thespies towards Levadeia*), mainly on the Helicon area and central and W Boeotia. On routes in Boeotia see also Gomme 1911/12. Useful for the layer creation were also accidental discoveries of traces of ancient routes (mainly from rescue excavations) and Philippson's (1951) remarks on the physical passes. Sowerwein maps and time calculation, based on the 19th century postal times (given personally by the author to J.L. Bintliff and kindly passed onto me) were also helpful.

44 The layer is probably incomplete because, since Lock's work, no other systematic study has been published on Frankish settlement in the region.

45 See Farinetti – Sbonias 2004 for an example of the potential of GIS analysis in the study of Ottoman archive data from Boeotia, studied by M. Kiel (Bintliff-Kiel in preparation).

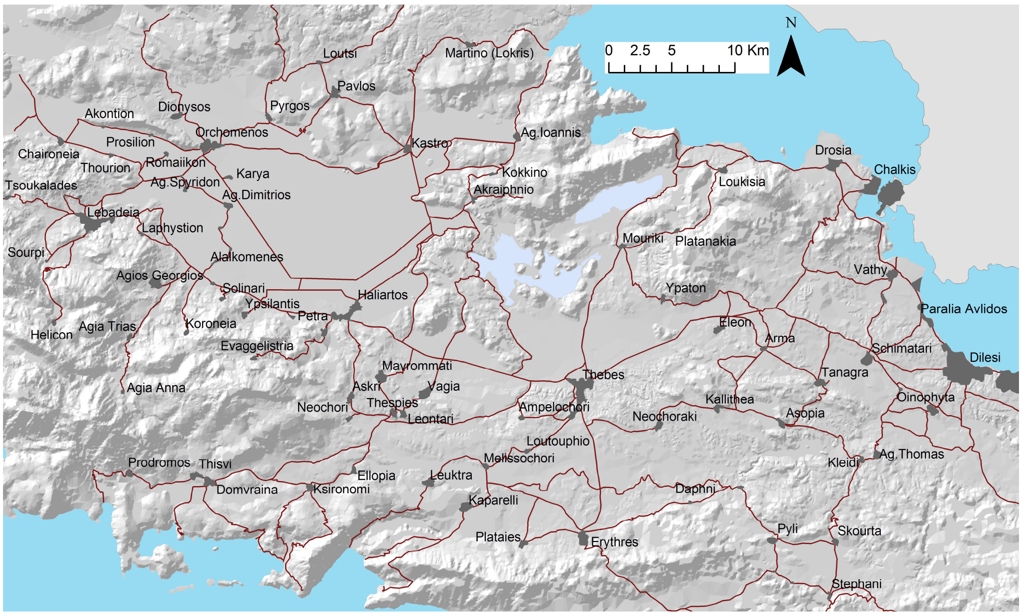

Fig.4. *Modern settlement (choria) and roads in Boeotia*

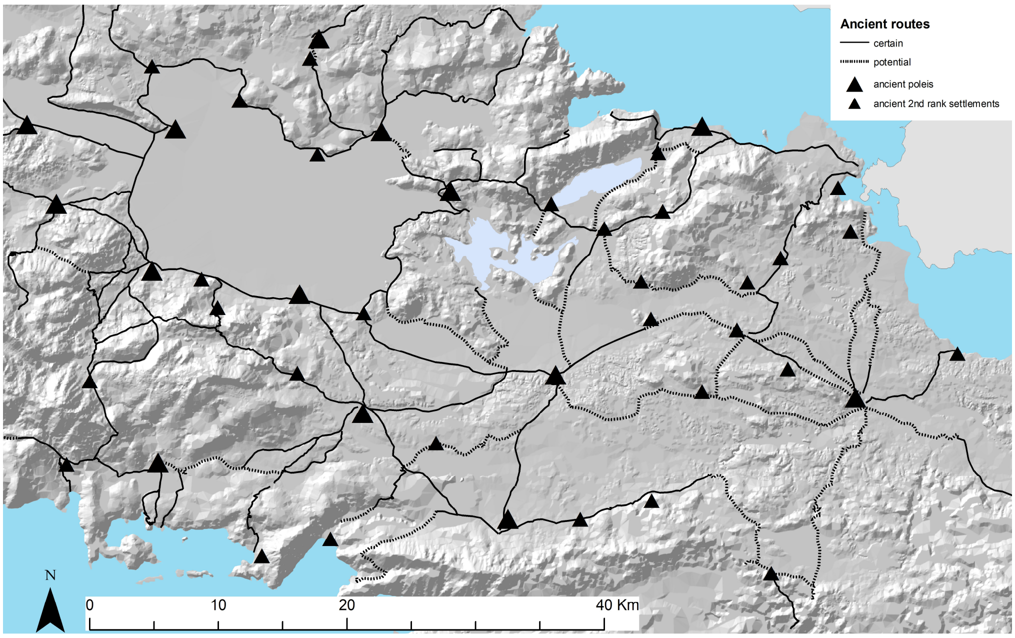

Fig.5. *Physical routes of ancient Boeotia. The archaeologically testified or most certain routes are represented with a continuous line, while dashed lines represent the potential routes.*