

# CHAPTER 13

## THE INTEGRATION OF DATA SOURCES

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*There is no possible archaeological heritage policy  
without the systematic control and inventorying of the resource*

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### I. INTRODUCTION

#### I.a. Data integration Within ARM

Archaeological Resource Management today can draw on more data than has ever been previously available for heritage management policies and research agendas. Information technology is well-suited to the requirement of systematic control and inventorying of the resource and has been widely adopted by heritage professionals to hold and analyse archaeological data. This data is not only being collected faster and more comprehensively, but a significant proportion is being acquired in digital form directly from fieldwork or research.

Archaeological resource managers are being challenged to:

- create modern inventories not only of sites, but also of a comprehensive set of relevant data relating to them, not all of which may be archaeological
- assemble the information in a way that allows it to be accessible and informative for the construction of heritage policy and research agendas, and
- to increase public awareness of the cultural heritage including the provision of direct on-line access to the inventory.

The large amount of data that is being gathered, and the pace at which it is being assembled is overwhelming if it is not organised in a rational and accessible way. It is also wasteful of resources if work is duplicated or undertaken in ignorance of previous relevant research or field data.

The most effective way of managing both the quantity of data and the scope of information, the accessibility and the wide spectrum of users and an integrated heritage policy is to operate an integrated data system.

### 1.b. Data integration within the National Monuments Record of Scotland (NMRS)

In order to describe how an integrated data system for inventurisation can operate, this paper draws mainly on the example of the National Monuments Record of Scotland where such a system is in place (Figure 13.1).

The NMRS grew from a number of different roots including the Inventories published by the Royal Commission on the Ancient and Historical Monument of Scotland (RCAHMS) from 1908 to 1994. Since 1994, the database of the NMRS, which is part of the RCAHMS, has been regarded as the Inventory, while publications are directed to more detailed analysis of the archaeology and historic buildings of Scotland. The records and responsibilities of the Archaeology Division of the Ordnance Survey (OS), the UK mapping agency, were transferred in the NMRS in 1983 and have heavily influenced both the structure of the inventory and the current methodology of the field survey undertaken by RCAHMS. The NMRS also maintains collections of primary archive material resulting both from RCAHMS field and aerial survey work and from items deposited in the national record. This includes not only archaeological material, but also a large and internationally important collection of architectural drawings, historical photography and aerial photography, both vertical cover and targeted obliques. (Further information about the work of the RCAHMS and the National Monuments Record of Scotland can be found at [www.rcahms.gov.uk](http://www.rcahms.gov.uk) which also includes access to Canmore, an interface to the NMRS database, designed to allow the public to browse NMRS data.)

The idea of integration is a strategy that has to be established and developed to cover all data. In the NMRS, the decision was taken early on to ensure that the indexes and catalogues to all the material held in the archives, however diverse, was integrated so that users could cross-search or easily navigate between different elements of the data (Murray, 1992). Today, compatibility of systems is no longer a real hurdle and compatibility of data and standards for data integration is the real debate.

Data integration can only function as a model that has the facility for the user to assemble data in useful and meaningful ways from a number of different entry points. Therefore there is no clear starting point from which to describe integrated systems in a linear fashion. There are, however, two main means of integrating archaeological data, one is by using unique identifiers that describe data elements or entities common to two data sets; the other is by using geo-spatial referencing. Used either separately or together, these integrating mechanisms ensure that data held in disparate forms is linked in a way that provides cross-data functionality.

## 2. GEO-SPATIAL REFERENCING

### 2.a. Maps and GIS as integrating mechanisms for data

One of the most frequently used means of integrating heritage data is to use the concept of place. Maps are cartographic expressions of geo-spatial referencing and have been used for many years to integrate data by physically plotting information from a number of sources onto paper maps, either as indicative points, boundaries of extent or drawn out depictions.

Maps can also, themselves, be a source of information about the historic landscape and how that relates to the landscape of today. In Scotland, the tradition of mapping is a long one, but the first accurate surveys start with General Sir William Roy. Thanks to his vision, archaeological sites have been an integral part of OS mapping in Britain from the early nineteenth century to the present day. In the early twentieth century, archaeologists were employed in the OS to improve the quality of the survey and this was supported by accurate location of sites at scales of 1:1,250; 1:2,500 or 1:10,000 as appropriate, by accurate surveys and hachured depictions that sensitively displayed the archaeology, and by controlled terminology. Information was collected for a much wider range of monuments than were ever published, and these are recorded on annotated maps and in a card index (Harley, 1975; Murray, 1999).

Of all the systematic archaeological recording that took place in the first 50-60 years of the twentieth century, the annotated maps and card index of the archaeology division of the OS, provided the most widespread model and most comprehensive data source for the establishment of archaeological resource management in Britain. With the emergence of information technologies, the card indexes of the local and national records were the first to be computerised and for a while became dislocated from the maps – essential to the inventory but still in paper form. Records frequently lost sight of the fact that the map itself provided the integration of the data.

GIS brought to the database the integrating potential that the maps provided for the card indexes, but in a much enhanced and powerful way. GIS provides a blank geo-spatial canvas on which historic and modern maps can be layered together with other data. The value of the map as information can therefore be paramount while its integrating function is taken over by the GIS technology. It is the only method of recording the continuum of the heritage resource with the complexity of the sources of information that contribute to the knowledge of the landscape from aerial survey to architect's design. It allows intelligence to be attached to the landscape and provides a means of dissecting the various elements to produce, not only an analysis of the heritage landscape, but potentially how this interacts with other layers such as the natural landscape and the present day social and demographic landscape.

### 2.b. Basic elements for geo-spatial integration of data

#### 2.b.1. Metadata

Technological presentation can, however, give spurious authenticity to the data. Metadata such as information about accuracy, method of capture, date of capture and reason for collection should also be available for any data set to ensure that the user can know both how comprehensive and how accurate the source data is, and provide vital information about the reliability of the re-use of the data for secondary analysis or heritage management purposes. Transparency concerning the level of reliability of the data is important because, as information becomes more widely available and transferable, it will be used for purposes for which it was never collected in the first place.

### 2.b.2. Scales

GIS allows any data layer to be viewed at any scale, although extreme disparity of scales can usually be switched off for ease of use. It is important to include information in the metadata about the scale of capture of any data set. Information will be most accurate at the scale at which it has been collected, so that aerial transcriptions that have been captured at 1:2,500 will be suitable for display and analysis with map data at 1:2,500 and survey data captured at the same scale. It is possible and reasonable in most instances to use data together that has been captured at different scales but disparity can be expected and must be taken into account. The integrity of the data set should be maintained and should not be adjusted to fit any discrepancies that appear on the screen.

### 2.b.3. Positional accuracy

GIS appears to confer absolute accuracy upon each and every data set, and surveying techniques are also providing accurate data through a variety of techniques from EDM to GPS. While it is possible to combine the results of these different techniques in GIS, it is highly likely that, the larger the scale, the more disparity there will appear between datasets. This occurs, not just because of the scale at which they have been surveyed, but because the reference points for the data are different, EDM for example using local reference points and GPS using satellite positioning. This is compounded when data derived from hand plotting from paper maps is included. These disparities do not invalidate the data. RCAHMS believes that the data sets should retain their internal integrity so that they are not adjusted to fit one another (including the OS mapping data) and it is important to record information about the method of survey and to be aware of positional accuracy when data is required for analysis or output (McKeague, 2001).

## 2.c. Examples of the RCAHMS experience in geo-spatial integration of data

The GIS is one of the integrating mechanisms at the heart of the NMRS. When combined with associated data in the GIS attribute tables and in the related database it provides the means for both the storage and manipulation of data and the operation of the necessary collection management functions of a national archive. Some of the sources may not, therefore be geo-referenced, but, in instances where data does not have a spatial reference at all, there is always a common denominator that can be used to relate it to other data within an integrated system using a unique identifier.

### 2.c.1. The First Edition Survey Project (FESP)

Using maps as a source of historical data with GIS as an integrating mechanism has been the basis of a project undertaken to record the medieval and later rural settlement in Scotland (Figure 13.2). The historical information on the early editions of the OS maps has been digitised into a separate GIS layer with relevant textual information being added to the NMRS database. All rural settlements shown as abandoned on the first edition OS map have been identified and classified with a short description. This work has generated a map layer in the GIS of 25,647 archaeological sites abandoned by the 1860's, of which 80% were previously unrecorded in NMRS. Pre- and post-improvement

farms, townships and their associated agricultural remains were poorly represented in the national database and, as a result of the project, it is now possible to offer guidelines for any policy of study, survey or preservation (Stevenson, 1996; RCAHMS *et alii*, 2002).

### 2.c.2. Historic Landuse Assessment

Landscape characterisation is now accepted as a method of analysing the landscape made possible by the use of GIS technology. The Historic Landuse Assessment Project at RCAHMS combines data from a number of different sources to identify the origins of the component parts of the historic landscape and the elements of earlier, relict landscapes surviving within it (Figure 13.3). Using aerial photographs, land cover data compiled by the Macaulay Land Use Research Institute, Ordnance Survey maps (both current and nineteenth century editions), and previously recorded areas of archaeological landscape, a mosaic is produced in which each piece (at least one hectare in extent) has a Current Landscape type and may also contain one or more Relict Landscape Types. The end product is a series of inter-related GIS layers with related attribute tables. Interrogations can be made of how much of the historic landscape of any one period is still extant or to provide a broad overview of the historic landscape and an analysis of the forces of change that have acted upon it. Such analysis is extremely valuable in demonstrating the dynamic nature of the landscape and the pressures on surviving historic elements (Dyson-Bruce *et alii*, 1999; RCAHMS *et alii*, 2000; 2001).

This data is geo-spatially referenced in the GIS and therefore it can be used in combination with other more detailed data relating to the historic environment, such as that resulting from the FESP project or with aerial photographic data.

## 2.d. Data sources

### 2.d.1. Aerial photographs

Aerial photographs are a fundamental source of archaeological information, particularly cropmark photography which reveals information on sites that are otherwise unknown. The photographs can be listed and described in a database and this has been the method used by most inventories. Some unrelated databases have been devised to analyse the content and form of cropmarks in great detail in England (Edis *et alii*, 1989; Stoertz, 1997). Effective as these methods can be, it is important to be able to see the photograph to both verify and understand the information that has been extracted. Using digital techniques, transcriptions of aerial photographs can be made (Brown, 1999) and the image can also be rectified to true position (Figures 13.4, 13.5 and 13.6). RCAHMS undertakes an annual programme of aerial survey, capturing between 2,000 and 5,000 air photographs each year. The results are selected for transcription at an accuracy of 1:2,500, and about 10% of all known cropmark sites have now been rectified and loaded into the GIS. No analysis of the form of the cropmarks has been undertaken systematically in Scotland, but could be carried out using GIS analytical tools.

NMRS contains a collection of 1.5 million vertical air photographs dating from 1940's to 1990's. These are not systematically digitised at present, but are referenced by sortie plots tracing the path of the aircraft as photographs are taken. The sorties plots have

been digitised from hand plotted traces and are linked to a separate database describing information about the flight (date, time of flight, etc.). These are used for the management of the collection, but can also be used in the GIS with GPS captured data from RCAHMS survey flights. So air photography can be discovered in three ways using the GIS; through a flight sortie index, through rectifications of the images, or through transcriptions of the cropmarks interpreted by an archaeologist, all of which can be set against a map background or combined with other data of choice.

#### 2.d.2. Field Survey Data

Non-intrusive survey of upstanding monuments and buildings has been the work of the RCAHMS since 1908 (Stevenson, 2000; Halliday, 2001; for full list of publications see [www.rcahms.gov.uk](http://www.rcahms.gov.uk)). Surveys can be very detailed drawings of carved stones at large scale such as 1:20, accurate plans and elevations of buildings with interpretations of the building phases, plane table surveys producing hachured plans of archaeological features at 1:200 or 1:500 and archaeological or industrial landscapes captured at mapping scales of 1:1,250, 1:2,500. These latter surveys are created at the same scale as the OS maps and use the maps as reference points. Surveys carried out at mapping scales are migrated routinely into the GIS (Figures 13.7 and 13.8). All survey data can now be captured digitally in the field and processed in house using digital drawing and reproduction software. Larger scale surveys of archaeological features are scanned and related geo-spatially into position, utilising mapping detail captured at the time of survey, and even the most detailed drawing can be incorporated into the GIS as an image related to a point.

From a data management point of view, the GIS becomes the active catalogue to the data. Working interactively with the database, the detailed surveys, whether aerial photograph transcription or survey data, no longer have to be indexed as entries in the archive catalogue because they exist within the structure of the integrated system.

Similar digital survey techniques are now common to archaeological work and are used on excavations, geophysical surveys and contour surveys among others. All organisations that curate archaeological archives and maintain inventories are now facing the problem of how to look after and access this data. Archival storage of digital data is an issue in itself, but there is also the question of how such information can be deposited with and integrated into inventories. A trial carried out by RCAHMS has migrated some data into GIS layers. A contour survey of the cursus at the Cleaven Dyke in Perthshire (Figure 13.9), was carried out by C. Burgess and G. Barclay, recorded in penmap and processed in DXF (Barclay *et alii*, 1998). The information was deposited with NMRS, migrated into the NMRS integrated GIS and can now be viewed and easily accessed. More importantly, it can be associated with other data such as aerial photography transcriptions that, in this example, reveal the full extent of the monument.

### 3. INTEGRATION OF RELATED DATA USING UNIQUE IDENTIFIERS

#### 3.a. The role of point data

Built using Oracle software, the NMRS database is the other mechanism at the heart of the integrated system and, like the GIS, can be infinitely expanded to accommodate

data of a wide variety of types. This is where the unique identifier becomes the key integrating factor. In common with many other systems, the database preceded the GIS and therefore was developed to operate independently from the GIS, but has now become part of an integrated system where the GIS plays an equal role.

One of the GIS layers consists of point data relating to the main NMRS database. The point data is a layer of unique identifiers (NUMLINKS) that has been derived from the geo-references, in this case National Grid References held in the database. These have been captured over many years from paper maps, both in house and in the field at scales of 1:10,000 to 1:1,250. The accuracy and consistency of the data is high having been undertaken by cartographically trained staff, but the positional accuracy when placed in a GIS is often insufficiently detailed. Some sites could only be located to 10m accuracy, while others are at 100m or less. This information can therefore only be indicative of the location of a site, but, when placed alongside survey data captured using GPS systems, flags attention that further data exists.

The point data, however, by virtue of its geo-spatial coincidence with other data in the GIS, serves to link all these layers to the information held in the database. Area searches in the GIS whether defined by boundaries such as administrative areas e.g. Parish or County, or by a user defined area, can retrieve information held in a number of GIS layers and, providing that the points layer is included, the information held in the data base (Figure 13.10). It would be preferable to hold this NMRS points layer as defined entities of points lines and areas, and to make a more direct relationship between the layer that is linked to the Oracle database and the other layers in the GIS, as well as improve the cross-referencing between key GIS data sets; however, it is a functional arrangement and a pragmatic and rapid solution for relating existing databases to GIS systems.

Point data is not only confined to legacy information. It is not always possible or cost effective to produce detailed depictions for every data capture programme. An example of this is the conversion of the RCAHMS catalogue of architectural drawings and photographs. This paper catalogue is arranged topographically, but there is no formal address, merely a description of the location of the building to which the material relates. The conversion of this catalogue to digital form includes plotting the location of the buildings on screen in the GIS using the OS seed point for each building and feeding the information back to the database. This produces a much more accurate location in relation to the map on the screen than can be achieved by feeding grid references into the database and then transferring them to the GIS. It would not be cost effective to digitise every building outline, especially as the outlines are already present on digital mapping, which can be used in conjunction with the data. Once located, the information that is recorded in the inventory for each building may be minimal (eg. name, location,) or can include extensive information that is structured in a number of tables, all of which are linked by unique identifiers.

For example, spatial referencing and display of data has brought immediate insights into the cataloguing of architectural drawings in another RCAHMS project. The Scottish Architects Papers Preservation Project was conceived following an assessment of all architects' practices in Scotland (Bailey, 2000) Funded by the HLF, the project is cataloguing 150,000 drawings. The project was conceived as a collections based project, but because the collections catalogue is part of the NMRS integrated system, it was agreed that

it was essential to include a component in the project to record the geographical location of the architectural works that were the subject of the architect's drawings. Architectural designs for buildings that were never built can also be included in the catalogue even though there may be no location because they can be catalogued in the collections table without being related to the site location table. Each architectural collection is also related to a collection essay giving an overview of the architect, their practice and the collection of material and is also associated with a table that provides a short biography of individuals such as artists and craftsmen associated with the work (Figure 13.11).

This provides a flexible approach to the data both for data capture as each table of information can be built together or independently, and for the user by locating each building represented in the collection, while the GIS related to the database can be used to visualise the work of an architectural practice.

Because this distribution is created from detailed data held in the GIS, the user can zoom in to discover the exact location of each individual building represented, and from there request all the information recorded in the system for that building from the architectural practice drawing to a relevant aerial photograph.

### 3.b. Relationships between data

This entity relationship, based on unique identifiers, provides the links that operate within the data tables held in the NMRS database. The information tables are a) directly related by holding fields in common e.g. the building/site table and the text table hold the field NUMLINK in common which is a numerical unique identifier or b) indirectly related by means of a link table e.g. between the building/site table and the collections table, that concords two separate identifiers (Figure 13.12). This has the advantage that not every entry must be linked (e.g. building designs that were never built and consequently have no location, and it can be used as a means of linking external databases, e.g. data tables relating to scheduled monuments and listed buildings which are held and maintained by Historic Scotland and linked by means of a landline link. Similar relationships can now operate over the Internet.

### 3.c. Alphanumeric and image data

The information contained within the database includes:

- i) text describing the sites
- ii) collections.—which provides a catalogue in summary and in detail of all the drawings and photographs and manuscript material held both in the NMRS collections and sometimes references to material held in other collections. Linked to this are associated tables providing information on accession, copyright, conservation treatment for each item, associated people e.g. archaeologists or architects, and collections essays relating to a group of items. A programme of digitising images from the collection is underway and each scanned image is separately catalogued in this section of the database. Once this is in place the integrated system will allow the images to be selected through any of the enquiry points

- e.g., by people, copyright, collection, date, location or by area using the GIS as a starting point
- iii) bibliography.—which provides a catalogue in summary and in detail of all bibliographical references related to the entries in the descriptions held in the database and a catalogue of books held in the NMRS library. These can be similarly used to retrieve information across the whole spectrum of the integrated database if required
  - iv) maritime data.—which extends the database to sites offshore, both wrecks and underwater sites that are located and those that are recorded as ships lost at sea. The structure of this database has to be different to include data that is not recorded for land-based sites, such as latitude and longitude, but by including a unique identifier can be integrated
  - v) a table recording events is planned for the NMRS. The structure of events, monuments and archive is one that is now well established in local inventories in the UK and provides a means of recording a chronological dimension to the data in addition to spatial and a history of the events that have taken place such as excavation, survey, change of use or date of construction and demolition. There will also be a link built to reference finds and their location in museums and an index relating to specialist reports and data sources is planned.

### 3.d. Site entities

The NMRS uses data entities, including unitary monuments that are a legacy of the former database system, to enable the attachment of data for data-management purposes, but the system has to be flexible enough to put the whole landscape back together as well as being able to dissect and analyse it. Therefore site and data entities are not rigidly defined, but adapted to suit each particular data set and to aid retrieval. Data entities can therefore relate to an item of archive e.g. a photograph, or to a unitary monument, or to an individual element in the monument e.g. a hut-circle within a prehistoric settlement. These can easily be reassembled through the database using the relationship of the unique identifiers and through the GIS by using spatial relationships. The definition of area of the archaeological site or building is therefore determined by ease of retrieval through the system rather than by any archaeological definition of entity.

### 3.e. External integration

Entities such as legal boundaries for monument protection and listed buildings only define the area that is protected, and these can be integrated using point references or by drawn areas. The use of the integrated system, means that these legal boundaries can be viewed combined with other data so that it becomes more obvious that they only represent a small portion of the total historic landscape. The links with legal areas in Scotland were built initially using related unique identifiers in the database and these are still in operation although areas of scheduled monuments are now incorporated as a layer in the GIS. The link operates over a landline to Historic Scotland through a concordance table:

TABLE 13.1. NMRS Links table.

Site name	NUMLINK	Scheduled Monument no.	Listed Building no.
Elgin Cathedral	244	90142	5073 173
Elgin Cathedral Bishop's Palace	246	90141	5073 173
Elgin Cathedral Chapter House	247	90142	5073 173
Elgin Cathedral Meikle Cross	252	90142	5073 173
Elgin Cathedral Pictish Symbol Stone	253	90142	5073 173
Dirleton Castle	259	90096	
Skara Brae	207	90276	

These are one to many relationships so that a single entity recorded by Historic Scotland as a Scheduled Monument may be represented in the NMRS record as a number of separate entities. The relationship works effectively when queried from either end.

Linking heritage data to non-specialist data sets is now feasible using the Internet and can be achieved based on the principle of unique identifiers. Land and property registers are now being digitised and heritage data will be one of the sets of spatial data that will be available through services such as Scotlis ([www.scotlis.com/](http://www.scotlis.com/)) and Nlis ([www.nlis.org.uk/](http://www.nlis.org.uk/)).

### 3.e. Ordnance Survey Pilot Project

There is also the exciting possibility of links to data held in the national databases through the new OS digital mapping – Mastermap, due to be implemented towards the end of 2001. A pilot project, initiated in Scotland, is being undertaken with Ordnance Survey by the three national records in Scotland, England and Wales. The project associates data from the NMR databases, using the unique identifier with the layers in the OS Mastermap through the OS unique identifier (TOID – Topographic Identifier). Users will have the facility when using the OS map data, not only to be able to search the "Heritage theme", but to have links built into the digital map that lead directly through to the data held in the three NMR databases. This provides an exciting means of dissemination and is being used by OS as a pilot for associating data from a number of different sources. It is also likely that this will include a layer of ortho-rectified air photography and indexes to "historic" photography held in locations such as NMRS.

## 4. AND FINALLY, PUBLIC ACCESS

The challenge for modern inventories is to capture and present data in a way that can be made compatible with other data sets to make strategic planning easier for the implementation of policy decisions and research agendas, and to be presented in a user-

friendly way for public use, both in terms of ease of use and accessibility of language in terminology and description. This challenge is being met through on line access to datasets including CANMORE, the interface to the NMRS. The next major development will be the release of a GIS web interface –CANMAP– that will complement the online database and complete the use of GIS as integrating technology for public access through CANMORE.

## 5. REFERENCES

- Bailey, R.M. (2001): "A holistic approach to collections – The Scottish Architects' Papers Preservation Project". In *Proceedings of the Tenth Congress of the International Confederation of Architectural Museums (Rio de Janeiro, May 2002)*, 34-7. Edinburgh.
- Barclay, G.J. & Maxwell, G.S. (1998): *The Cleaven Dyke and Littleour: Monuments in the Neolithic of Tayside*. Society of Antiquaries of Scotland, Monograph n° 13. Edinburgh.
- Brown, M.M. (1999): "Aerial photography and the development of the archaeological landscape in Scotland". *Actes Du Colloque International d'Archaeologie Aeriene*, 231-243. Lille.
- Dyson-Bruce, L.; Dixon, P.; Hingley, R. & Stevenson, J.B. (1999): *Historic Landuse Assessment (HLA): Development and Potential of a Technique for Assessing Historic Landuse Patterns, Report of the Pilot Project 1996-8*, RCAHMS and Historic Scotland.
- Edis, J.; Macleod, D. & Bewley, R. (1989): "An archaeologist's guide to classification of cropmarks and soilmarks". *Antiquity*, 63, 112-26.
- Halliday, S.P. (2001): "Archaeological Project Selection". In *RCAHMS Monuments on Record Annual Review 2000-2001*, 55-58. Edinburgh.
- Harley, J.B. (1975): *Ordnance Survey Maps. A Descriptive Manual*, 145-158. Southampton.
- Mckeague, P. (2001): "Where we are. Understanding data and positional accuracy issues at RCAHMS". Paper presented to GIS e-conference  
<http://www.jiscmail.ac.uk/cgi-bin/wa.exe?A2=ind0110&L=fish&O=D&F=&S=&P=8190>  
<http://www.jiscmail.ac.uk/cgi-bin/wa.exe?A2=ind0110&L=fish&O=D&F=&S=&P=8348>
- Murray, D.M. (1992): "Towards Harmony. A View of the Scottish Archaeological Database". In Larsen, C.U. (Ed.): *Sites and Monuments, National Archaeological Records*, 209-219. Copenhagen.
- Murray, D.M. (1999): "Ordnance Survey and the Depiction of Antiquities on maps; past, present and future". In *Archaeology in the Age of the Internet – CAA9*, BAR 5750.
- RCAHMS (2001): *Well shelterd & watered' Menstrie Glen, A Farming Landscape Near Stirling*. Edinburgh.
- RCAHMS and Historic Scotland (2000): *The Historic Landscape of Loch Lomond and the Trossachs*. Edinburgh.
- RCAHMS and Historic Scotland (2001): *The Historic Landscape of the Cairngorms*. Edinburgh.
- RCAHMS and Historic Scotland (2002): *A survey of Abandoned Rural Settlement Depicted on the First Edition Ordnance Survey 6-Inch Maps*. Edinburgh.
- Stevenson, J.B. (1996): "The First Edition Survey Project". In *RCAHMS Monuments on Record Annual Review 1995-6*, 35-37. Edinburgh.
- Stevenson, J.B. (2000): "Rozpoznawanie dziedzictwa archeologicznego Szkocji: prace Krolewskiej Komisji ds. Starożytnych i Historycznych Zabytkow Szkocji (Royal Commission on the Ancient and His-

torical Monuments of Scotland)". In Brzezinski, W. (Ed.): *Metody Badan wykopaliskowych*, 123-143. Warsaw.

Stoertz, C. (1997): *Ancient Landscapes of the Yorkshire Wolds*, 11-20. RCHME.

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