Protocol Report 743.b

Protocol Report – A Conservation Audit of Archaeological Cave Resources in the Peak District and Yorkshire Dales

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CONTENTS

LIST OF TABLES .................................................................................................................. II

1 BACKGROUND .................................................................................................................. 1

1.1 INTRODUCTION ......................................................................................................... 1

1.2 SITE CLASS DESCRIPTION ......................................................................................... 1

1.2.1 Definition of a cave .............................................................................................. 1

1.2.2 Definition of an archaeological cave ................................................................. 1

1.2.3 Extent of an archaeological cave ......................................................................... 2

1.3 SITE INCLUSION CRITERIA ......................................................................................... 2

2 ARCHIVAL RESEARCH .................................................................................................... 4

2.1 CAVE REGISTRIES ..................................................................................................... 4

2.2 HISTORIC ENVIRONMENT RECORDS .................................................................... 4

2.2.1 National Monuments Record ............................................................................. 4

2.2.2 Local Authority and National Park Historic Environment Records ................. 4

2.3 MUSEUMS AND LOCAL ARCHAEOLOGICAL SOCIETIES ..................................... 4

2.4 OTHER DATA SOURCES .......................................................................................... 5

2.4.1 Archaeological monographs and specialist catalogues ..................................... 5

2.4.2 Radiocarbon dating ............................................................................................ 5

3 FIELD ASSESSMENT ....................................................................................................... 6

3.1 SCOPE AND NATURE OF FIELD ASSESSMENT ..................................................... 6

3.1.1 Purpose and extent of field assessment .............................................................. 6

3.1.2 Sampling procedures ......................................................................................... 6

3.2 FIELD RECORDING PROTOCOL ............................................................................ 7

3.2.1 Land ownership and management .................................................................... 7

3.2.2 Data acquisition and recording ........................................................................ 7

3.2.3 Field Data Collation and Archiving .................................................................. 8

3.3 DATA REPORTING AND ANALYSIS ..................................................................... 8

3.3.1 Catchment descriptions .................................................................................... 8

3.3.2 Univariate and bivariate analyses ...................................................................... 9

3.3.3 Predictive modelling ......................................................................................... 9

3.3.4 Analysis of finds data ....................................................................................... 9

4 GUIDELINES FOR MANAGEMENT ACTION ................................................................ 11

4.1 REMEDIAL ACTION ................................................................................................. 11

4.2 MONITORING .......................................................................................................... 11

4.3 EDUCATION AND OUT-REACH ........................................................................... 11

4.4 PROTECTION ............................................................................................................ 11

5 REFERENCES ................................................................................................................ 13

6 APPENDIX ..................................................................................................................... 14

6.1 PRINCIPAL AREAS OF ENGLAND WITH ARCHAEOLOGICAL CAVES ................ 14

6.1.1 South Devon .................................................................................................... 14

6.1.2 Mendip ............................................................................................................. 14

6.1.3 Gloucestershire/Forest of Dean ......................................................................... 14

6.1.4 Magnesian Limestone ...................................................................................... 14

6.1.5 Jurassic Limestone ............................................................................................ 14

6.1.6 Peak District .................................................................................................... 15

6.1.7 Yorkshire Dales and Northern Pennines ......................................................... 15

6.1.8 Morecambe Bay ............................................................................................... 15

7 APPENDIX BIBLIOGRAPHY ......................................................................................... 16
List of Tables

Table 3.1  Summary of data recorded during field survey ..................................................8
1 BACKGROUND

1.1 Introduction

This report sets out protocols for the assessment of the conservation status of archaeological caves in areas of karst limestone in Britain. The protocols cover the definition of archaeological caves as a class of field monument and they delineate procedures for conducting desk-based and field-based surveys of the archaeological cave resource. Some guidelines for management action based on analysis of the assessment results are also provided.

The protocols reported here were developed primarily from experience of conducting cave conservation audits in a variety of limestone terrains (Chamberlain and Ray, 1994; Davies et al., 2004; Holderness et al., 2005). The majority of archaeological caves in Britain are located in areas of hard limestone geology, but similar strategies to those reported here can be used for the assessment of caves in non-karst environments, for example when appraising former sea caves now elevated above the high water mark, or for evaluating slip-rift cave systems and rock shelter localities that are developed through differential erosion in bedded sedimentary rocks such as sandstones and gritstones.

1.2 Site class description

1.2.1 Definition of a cave

For audit purposes a suitable definition of a cave is one in widespread use by speleologists, karst scientists and recreational cavers (despite its potential ambiguity: Klimchouk, 2004):

A cave is an enclosed but accessible natural void within a rock formation which has dimensions minimally sufficient to accommodate a person.

This broad definition of a cave encompasses several distinct categories of cave that reflect variations in the shape of the cave entrance and chamber. Caves typically have an entrance and up to five structural surfaces (roof, floor, walls on either side and a back/end wall). Rock shelters are caves of restricted depth which have a roof, a floor and a back wall but the side walls of a shelter are poorly defined or absent. Fissures are horizontal or vertical entry caves which lack a well-defined roof, while potholes are vertical entry caves with limited horizontal development of passageway. Sink holes or swallets and resurgence caves are hydraulically active caves which respectively receive and discharge surface watercourses. Dolines or shakeholes are locations on the limestone surface where widening of vertical fissures through dissolution or underground collapse gives rise to circumscribed local depressions in the soils covering the limestone bedrock.

Although all of the above-mentioned categories of cave have the potential to preserve archaeological remains, in practice some caves are judged to be ineligible for inclusion in archaeological assessments: inclusion criteria are specified below in section 1.3.

1.2.2 Definition of an archaeological cave

An archaeological cave is a cave (as defined in 1.2.1 above) that contains, or has been recorded as previously containing, archaeological evidence for past human activity. Such evidence includes archaeological artefacts, archaeological deposits (including charcoal) and deliberately deposited ancient human remains. The term
‘archaeological artefact’ is interpreted broadly to include, for example, pre-modern built structures and cave art and other deliberate modifications to cave structures. It is recognised that activities in caves dating to the modern era, such as industrial mining activity, modern graffiti, historical evidence of cave occupation, etc, do not constitute archaeological evidence per se in the strict sense of the term. Modern or historical evidence is therefore excluded from the site class definition, although such activities should be recorded during assessment as they may have significant implications for the conservation status of the cave site. Judgement may need to be exercised in specific cases where it is not clear whether a site fully meets the criteria for definition as an archaeological cave.

1.2.3 Extent of an archaeological cave

It is recognised that standard methods used for demarcating the extent of surface archaeological sites cannot be applied easily to sites whose extent is mainly hidden underground. Cave deposits include both consolidated and unconsolidated sediments and clastic deposits that have accumulated within a cave or at the entrance to a cave. As cave entrances are subject to erosion, some deposits that were previously contained within a cave can eventually end up outside the cave, as can spoil excavated from within the cave by human activities or by animal occupation. For this reason, external talus deposits adjacent to cave entrances are usually included within the scope of an audit, particularly where there is spatial continuity and visual proximity to deposits contained within the structure of the cave. For reasons of safety and practicality, archaeological assessments conducted by field survey do not normally extend beyond those chambers and passages of the cave that are accessible by walking, and the deeper and less accessible parts of the cave are usually excluded from the survey.

1.3 Site inclusion criteria

Cave sites selected for archaeological audit include the caves mentioned above in 1.2.1, but exclude the following types of location:

- hidden natural cave systems which have been intersected by ground works such as mines, tunnels and quarries: these sites should be excluded if the intersected caves have no identifiable natural entrance other than that created by recent human activity. In such cases the a priori likelihood of the existence of cave archaeological deposits is deemed to be low.
- unexcavated shakeholes and dolines which have not been proved to connect to an accessible cave system. While such sites may well have archaeological potential, it is difficult to characterise their potential by surface survey. In addition, only the larger shakeholes are recorded on Ordnance Survey topographical maps, and most shakeholes are not included in cave registries, so a comprehensive survey of this category of karst feature requires intensive surface landscape survey in order to identify sites prior to their assessment.
- sinks and resurgences which are accessible only to persons equipped with diving gear. Cave archaeological deposits are relatively uncommon in caves that carry active streamways, and considerations of access and safety preclude this category of cave from being included in surveys of archaeological caves.
- artificial caves and grottoes, except where these represent a modification of a pre-existing natural cave system. Most artificial caves are constructed in sandstone or soft limestones such as chalk, and they tend not to accumulate
sediments except through roof collapse or by deliberate back-filling. Nonetheless, in some regions of Britain such as Nottingham (Waltham, 1996) and Kinver, Staffordshire (Kempe, 1988) artificial caves constitute an important component of the historic environment record and it is recommended that separate guidelines are formulated specifically for the assessment of this class of site.

- evidence for mining history contained within natural cave systems: the presence of such evidence should be noted when encountered, but it does not normally constitute part of the definition of an archaeological cave (see 1.2.2 above). Detailed guidelines already exist for recording the underground archaeology of mining sites (Roe, 2002).
2 ARCHIVAL RESEARCH

2.1 Cave Registries

Databases of caves (often called Cave Registries) exist for the principal recreational caving regions in Britain, and in some instances these registries are available as electronic or paper publications. For example, *Caves of the Peak District* (Gill and Beck, 1991) is a published, comprehensive survey of the caves of the Carboniferous Limestone outcrop of the southern Pennines, including the separate limestone inliers at Ashover and Crich as well as the southern part of the Magnesian Limestone outcrop. As cave registries are compiled for the purposes of recreational cavers they often exclude rock shelters and small caves of limited horizontal development. Furthermore, the published versions of the registries are only intermittently revised, and do not necessarily reflect the current state of knowledge of the cave resource. Nonetheless, the cave registries constitute fairly comprehensive records of the larger caves, and they often include formerly-known caves that have subsequently been lost to quarrying and minerals extraction. In some instances the cave registries mention archaeological discoveries in caves, and in some areas (e.g. Mendip) the registries include comprehensive bibliographies covering all published research on the region’s caves.

Information from cave registries can be supplemented by consultation of records kept by local recreational caving clubs and the extensive archives held at the BCRA cave studies library in Matlock, Derbyshire. This specialist library holds back-runs of many caving club journals as well as books with records of cave exploration.

2.2 Historic Environment Records

2.2.1 National Monuments Record

The records of archaeological caves in the National Monuments Record (NMR) are comprehensive and were systematically checked and revised in 1997 (Martyn Barber, personal communication). The NMR records are partially congruent with the records maintained by local authority and National Park archaeology services (see 2.2.2 below) but there are sufficient discrepancies between the national and locally-maintained records to merit independent searches of both sources of information.

2.2.2 Local Authority and National Park Historic Environment Records

Historic environment records (HERs) are maintained by local authority archaeology services and by the national park authorities. HERs are used primarily for the purposes of planning, development control and land management, although the public information and educational roles of these records are increasingly recognised and prioritised. A few HERs are already searchable on-line (e.g. the Somerset HER, which includes records of nearly 60 caves and rock shelters) and many other HERs have plans to facilitate on-line searches in the near future.

2.3 Museums and Local Archaeological Societies

Many finds and records from cave excavations are curated by national and local museums, and discoveries of archaeological remains in caves are sometimes published in the journals of local archaeological societies. The archives from early cave excavations were sometimes disseminated amongst many institutions – for example, material from the excavations in the caves at Creswell Crags in the
nineteenth century are distributed amongst more than 30 museums including several overseas.

2.4 Other Data Sources

2.4.1 Archaeological monographs and specialist catalogues

For many categories of prehistoric artefact there exist monographs or corpora that catalogue the provenance of all examples of the artefact under consideration, and these can be a useful source of data pertaining to archaeological finds in caves.

Some categories of archaeological information from caves have been subjected to systematic survey at the national or regional level. Examples include the gazetteers of prehistoric cave burials hosted on the CAPRA website (www.shef.ac.uk/~capra), and the records of Romano-British cave archaeology collated by Branigan and Dearne (1991).

2.4.2 Radiocarbon dating

Radiocarbon dates constitute an important category of archaeological information that is not systematically appended to historic environment records. The CBA radiocarbon database (Council for British Archaeology, 2000) contains over 9000 radiocarbon dates for Great Britain and Ireland, although it is only comprehensive for dates up to the year 1982. Additional date lists of radiocarbon determinations conducted by the Oxford Radiocarbon Accelerator Unit (available at http://www.rlaha.ox.ac.uk/O/index.php) provide the largest online sources for radiocarbon determinations (currently includes dates up to the year 2000), and additional date lists are available in the journals *Archaeometry* and *Radiocarbon*. 
3 FIELD ASSESSMENT

3.1 Scope and nature of field assessment

3.1.1 Purpose and extent of field assessment

Field assessment serves a dual purpose: field visits are essential for determining the conservation status of archaeological caves, and field survey is desirable in order to validate existing data on cave location and morphology as well as to provide additional topographic data that are not usually available from existing records.

Assessment of small contiguous land units can be conducted by standard archaeological walk-over survey methods, but in larger regions of karst landscape this is normally beyond the scope of available resourcing, and a sampling approach is needed (see 3.1.2 below). In regions with large numbers of recorded caves it is neither realistic nor desirable to visit every known cave site. Within areas of karst landscape the density of caves tends to be high compared to other categories of field monument, for example an a real density of about 3 caves/km$^2$ is found across the limestone region of the Yorkshire Dales. Caves also tend to be spatially clustered due to physiographic and hydrological constraints on cave formation, and this factor needs to be considered when designing and resourcing field surveys.

In most areas of Britain there are comprehensive records of the larger caves (see 2.1 above) and the cave databases established through archival research provide a suitable framework for devising an appropriate sampling strategy. The pilot assessment conducted in the Peak District and Yorkshire Dales (Holderness et al., 2005) has confirmed that in these regions of Carboniferous Limestone approximately 15% to 25% of surveyed caves have produced archaeological evidence. This figure is comparable to the results of the survey of the Creswell Crags Limestone Heritage Area (Davies et al, 2004). It is reasonable to extrapolate this figure to other caving regions within Britain, and our default expectation is that in any given region about one in every five caves may prove to be an archaeological cave.

3.1.2 Sampling procedures

The sampling approach adopted in the pilot studies combined elements of stratified and clustered sampling (Orton, 2000). The advantages of stratified sampling are that it achieves an even spread of sites between the designated areas or strata, which in the case of the pilot study areas consisted either of hydrologically defined catchments or of geographically delimited areas of limestone outcrop. The clustered sampling approach was adopted in the pilot study to ensure that the sample of caves in the surveys included both archaeological and non-archaeological caves that were located in similar topographical locations. It was important for the development of accurate predictive models (see 3.3.3 below) that survey data were obtained for as many archaeological caves as possible, and this precluded a purely random sampling approach. Cluster sampling also provides logistical benefits, which in the case of the more remote landscape areas are an important factor in reducing time spent on travel between cave locations. Thus it was decided in the pilot study to focus the sampling frame on the distribution of known archaeological caves, while ensuring that the survey also visited a sample of caves in every defined catchment or terrain within the pilot study areas.

In the pilot study the karst regions were split into catchments following the structure adopted by the cave registries: in the Peak District the catchments were defined by the principal river systems (Gill and Beck 1991) whereas in the Yorkshire Dales
catchments were defined according to the geographical distribution of cavernous limestones (Brook et al., 1988, 1991, 1994). Within each catchment a sample of caves was drawn by selecting valley segments that included as many as possible of the archaeological caves identified from the desk-based phase of the survey. While visiting the known archaeological caves, all other known caves in the defined valley segment were also visited, along with any other unidentified caves that were detected while traversing the study area. In effect, the survey employed a 'case-control' sampling strategy, with every archaeological cave matched to a selection of neighbouring non-archaeological caves from within the same catchment.

The statistical implications of sampling strategies are complex, especially in the case of cluster sampling in which spatial data points cannot be considered to be independent (Orton 2000). Spatial correlation was ignored in the analysis of the pilot study data sets, but more sophisticated statistical data processing approaches can be adopted if required. We believe that the combined stratified/clustered sampling approach that evolved during the pilot study is an efficient and effective procedure for acquiring field survey data for cave conservation audits.

3.2 Field recording protocol

3.2.1 Land ownership and management

After selecting potential survey areas research permissions must be obtained from landowners, tenants and property managers. Where the survey areas are subject to conservation management it is also necessary to liaise with relevant organisations (e.g. National Park Authorities, English Nature, the National Trust and local Wildlife Trusts). During the pilot study there were few problems with gaining permission to enter land holdings, and in the few instances where permission was refused suitable alternative survey areas were substituted in order that the catchments were sampled adequately. However, within the National Parks the principal landowners are perhaps accustomed to and amenable towards field research with conservation objectives, and it is therefore possible that access arrangements outside the National Parks might present more difficulties to the organisation of field surveys.

3.2.2 Data acquisition and recording

Categories of data recorded during field visits to cave sites are summarised in Table 3.1. During the pilot study it was established that the location of nearly all cave entrances could be established to sufficient precision using handheld GPS (the precision required is that which allows the surveyor to return to and identify the site unambiguously on a future visit, without having to rely on external topographic clues: photographs of cave entrances serve as an additional identifier that facilitates accurate relocation of the site). The altitude data available from handheld GPS are much less accurate than horizontal coordinates, but more accurate altitude data can be obtained, if required, from digital terrain models if the horizontal coordinates are known.

Cave setting, cave structure and deposit status are recorded using a combination of text description, sketch survey and photography, while bedrock geology can usually be established from available British Geological Survey solid geology maps. In the pilot study the condition of the cave deposits was recorded in three categories:

1 = sediments either absent or present in minimal or residual quantities.
2 = in situ sediments in a damaged or eroding condition.
3 = in situ sediments present in a stable or accruing condition.
A more sophisticated categorisation of cave sediments could be achieved by incorporating measurements of sediment morphology.

<table>
<thead>
<tr>
<th>Information</th>
<th>Attributes</th>
<th>Data Capture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cave location</td>
<td>National Grid coordinates and altitude</td>
<td>Handheld GPS and visual correlation with large-scale Ordnance Survey maps</td>
</tr>
<tr>
<td>Cave setting</td>
<td>Nature of physical access, land usage, landscape setting, visual grouping with other nearby caves</td>
<td>Text description; digital photography towards and away from cave entrance</td>
</tr>
<tr>
<td>Cave geomorphology</td>
<td>Cave type, length, depth, entrance orientation, entrance and chamber dimensions, light zone extent, ground slope at entrance, bedrock geology</td>
<td>Text description; compass, clinometer and tape measurements; planning and profiling at 1:50 scale</td>
</tr>
<tr>
<td>Cave deposits</td>
<td>Internal deposits, external deposits, structural modifications of the cave or its setting, loose surface finds</td>
<td>Scaled digital photographs, description of sediments and any visible markings and surface finds</td>
</tr>
<tr>
<td>Conservation status</td>
<td>Condition, stability and preservation of deposits, evidence of recent human and animal activity, current management regime</td>
<td>Text description; digital photography</td>
</tr>
</tbody>
</table>

Table 3.1 Summary of data recorded during field survey

3.2.3 Field Data Collation and Archiving

In the pilot study the field data were recorded manually onto paper proforma data sheets for subsequent entry into a database compiled in Microsoft Access. Database entries were then linked by a unique cave record number to the archive of photographs and to large-scale maps on which the survey areas and cave locations were recorded. Alternative recording procedures in future field surveys could make use of portable recording technology such as handheld computers, and the data archive could be structured in a manner that is compatible with Geographical Information Systems.

3.3 Data reporting and analysis

3.3.1 Catchment descriptions

Catchment descriptions convey a general impression of the character of the landscape and the condition of the cave resource within a specific catchment area. The descriptions can be compiled after the completion of the fieldwork survey and they are intended to provide a summary of the general topography of the catchment, past and present land use, vegetation cover, the nature of access to the caves, the number of caves visited within the catchment and a summary of important conservation issues affecting the caves.
3.3.2 Univariate and bivariate analyses

In the pilot study preliminary explorations of patterns in the data were conducted using univariate and bivariate statistical analysis (Holderness et al., 2005). These analyses examined the variation between regions and catchments in the proportions of caves with identified archaeological finds, the relationship of archaeological caves with topographical and landform variables including altitude, aspect, size of cave, ground slopes, presence and status of cave deposits and proximity to water. Some interesting and statistically significant correlations were detected between the presence of cave archaeology and topographic/ morphological attributes, and it will be useful to determine whether these correlations can be found in other caving regions.

The distribution of deposit condition was also determined for archaeological and non-archaeological caves in the study areas. The majority of archaeological caves were found to have sediments in damaged or eroded condition, with a smaller number having stable or accruing deposits and very few archaeological caves having no or minimal sediments. This pattern probably reflects the fact that caves with little or no sediment are unlikely to produce archaeological finds, while many archaeological discoveries are the result of controlled or uncontrolled excavations which inevitably result in erosion and damage to sedimentary deposits. We expect this pattern to be able to be generalised to all caving regions in Britain.

3.3.3 Predictive modelling

Predictive modelling is a statistical tool that can be employed to identify combinations of environmental variables that together are correlated with (and hence predictive of) the occurrence of archaeological sites (Warren, 1990). A preliminary study using survey data from the caves of the Manifold Valley in Staffordshire had shown that topographical variables together with measurements of cave entrance characteristics could distinguish between archaeological and non-archaeological caves (Chamberlain, 2003). This finding was corroborated with the much larger datasets obtained during the pilot study in the Peak District and the Yorkshire Dales (Holderness et al., 2005), but the predictive models showed some differences between the two study areas and it is unlikely that a ‘universal’ predictive model could be developed that is effective for all karst regions.

In the pilot study discriminant function analysis was used to achieve an 80% correct classification of the caves in the survey database, and the discriminant function served to identify unexcavated caves which had a high probability of containing archaeological remains. Many of these sites of high archaeological potential were previously unrecorded (i.e. they were not included in the local cave registries) and were first identified as cave sites during the course of the pilot study. The testing of the efficacy of predictive modelling through test excavation at selected cave sites of high and low archaeological potential is a priority for future fieldwork exercises.

3.3.4 Analysis of finds data

In the pilot study the archaeological finds made during previous surveys and excavations in the caves of the study regions were recorded in the caves database as presence/absence data. The finds were listed under the categories of Flint, Other Lithics, Prehistoric Pottery, Historic Pottery, Glass, Human Bone, Faunal Remains, Worked Bone, Bronze/Copper Artefacts, Iron Artefacts, Coins, Other Metal Artefacts, and Charcoal. Using a multivariate data reduction technique (Principal Components Analysis, or PCA), we were able to establish patterns of co-occurrence between particular types of finds. In particular, separate clustering of finds of prehistoric and
of historic type were identified, with human remains showing a clear correlation with prehistoric finds. The analysis of finds data therefore has the potential to reveal information about changing patterns of cave usage through time.
4 GUIDELINES FOR MANAGEMENT ACTION

The results of a cave conservation audit survey can be used to inform strategies for the management of the cave archaeological resource at the local or regional level. The assessment of the extent of the cave resource provides an indication of the scale of effort required in managing the resource, while the identification of the degree of threat to archaeological deposits and the sensitivity of particular sites (i.e. the vulnerability to specific threats) can help in the formulation of cave conservation plans. The survey of known archaeological caves provides a mechanism to identify any immediate threats to archaeological deposits that require remedial action, as well as more long-term problems that may require monitoring or the formulation of a public education programme. Field surveys also provide baseline condition reports that can be compared to the results of future monitoring visits.

4.1 Remedial Action

Site-specific actions may be recommended, including the removal of accumulations of litter, cleaning of graffiti from cave surfaces, the stabilisation and protection of cave sediments, and (usually as a last resort) the exclusion of visitors by gating or other means of blocking entrances and passages. Any cleaning, stabilisation and protection work will require assessment prior to undertaking the work, and restriction placed on access will require consultation with wildlife conservation agencies and with representatives of the recreational caving community.

4.2 Monitoring

Regular, long-term monitoring may be recommended, especially for sites with rare or particularly vulnerable deposits, or in areas which receive large numbers of visitors, or at sites where there has been a history of damage or disturbance of archaeological deposits. Monitoring can be undertaken as part of a wider archaeological monuments protection programme, but it is important that the staff involved are aware of the particular conditions and circumstances affecting archaeological deposits in caves. The frequency of monitoring visits should be linked to the perceived level of threat of damage, but a baseline level of monitoring of one visit every 4 or 5 years for the least threatened sites is appropriate, increasing to yearly or more frequent visits to particularly vulnerable caves.

4.3 Education and out-reach

Educational and out-reach programmes can be effective mechanisms for informing the public about the archaeological and palaeontological importance of caves and in appraising land owners and visitors to caves of the kinds of activities that may result in damage to archaeological structures and deposits. Information dissemination is most effective when targeted towards landowners and tenants, public bodies and participants in out-door recreational activities. Short information guides can be created that highlight the nature of archaeological deposits in caves, as well as indicating the processes and activities that can damage these deposits, and that include recommendations for good management practice as well as contact information for reporting damage or to obtain advice.

4.4 Protection

Protection of archaeological caves can also be enhanced through ensuring that comprehensive records of caves are maintained by the relevant local authority or National Park Historic Environment Record, and through effective liaison with other
conservation agencies such as English Nature. Many archaeological caves already receive some level of protection by virtue of their being included within the boundaries of Sites of Special Scientific Interest, National Nature Reserves or other designated high-value landscape units, and in these instances the conservation interests of archaeology and natural history converge. Protection can also be enhanced through the listing of a site on the schedule of monuments, but in many cases scheduling as an isolated conservation measure is probably ineffective when applied to an archaeological cave in the absence of an active management strategy.
5 REFERENCES


6 Appendix

6.1 Principal Areas of England with Archaeological Caves

6.1.1 South Devon
There are over 200 known caves in the Devonian Limestones, which outcrop in South Devon mainly in the Plymouth and Torquay area (Oldham et al, 1972). Several of the Devon caves are of national importance due to their preservation of Pleistocene faunas (Sutcliffe, 1974). The archaeological and palaeontological caves of the area between Plymouth and Yealmpton have been catalogued by Chamberlain and Ray (1994), and Roberts (1996) has reported on archaeological discoveries in the Torbryan caves.

6.1.2 Mendip
The Mendip Hills form a region of Carboniferous limestone containing approximately 1200 known sites of speleological interest. The region benefits from an accurate and up-to-date cave registry that covers the counties of Somerset, Wiltshire and the City of Bristol (Irwin, 1997). The Mendip region has been subject to intensive archaeological and palaeontological research and has a good record of finds publication.

6.1.3 Gloucestershire/Forest of Dean
This region includes approximately 100 sites of speleological interest, distributed at a high density within a restricted geographical area. There is little exposure of caves away from the river valleys, and many caves are hydrologically active. There has been intensive archaeological study of a small number of caves along the Wye valley (Barton et al., 1997), but little archaeological work has been conducted at cave sites elsewhere in the area.

6.1.4 Magnesian Limestone
The Magnesian Limestone, which is of Permian geological age, forms a narrow north-south oriented outcrop that runs from near Nottingham in the south to the North Sea coast near Tynemouth in the north. Most cave development is associated with west-east river valleys that bisect the linear outcrop (e.g. at Creswell Crags, the Don gorge, the Nidd at Knaresborough and the Wear Valley). The Creswell Heritage Area has been intensively surveyed for archaeological caves (Davies et al., 2004) but there is scope to extend the survey both northwards and southwards along the Magnesian Limestone outcrop. There are at least 10 known archaeological caves located north of the limits of the Creswell Heritage Area, but most of the Magnesian Limestone outcrop has not been systematically surveyed for caves and apart from the Creswell area the region has received negligible archaeological attention.

6.1.5 Jurassic Limestone
The Jurassic Limestone consists of an extensive band of limestones extending from the south coast in Dorset to the northeast coast in North Yorkshire. The main process of cave development in the Jurassic Limestone is by slip-rift fissuring along coastal cliffs and along hillsides adjacent to steep valleys, usually due to cambering of the limestone above underlying clay beds. Occasional solutional caves are also formed, as at Kirkdale Cavern in Yorkshire. The main concentrations of caves are on the Isle of Portland in Dorset (Ford and Hooper, 1964) and on the North Yorkshire
Moors where 78 sites of speleological interest have been recorded (Gibbs and Stewart, 2003; Leach, 2005).

6.1.6 **Peak District**

178 caves in the Carboniferous Limestone outcrop of the southern Pennines were included in the audit survey (Holderness et al., 2005), nearly all of these being sites that fall within the boundaries of the Peak District National Park. Additional caves are situated outside the boundaries of the Park.

6.1.7 **Yorkshire Dales and Northern Pennines**

221 caves located within the National Park were included in the audit surveys reported by Holderness et al. (2005), but there are a large number of caves in the area to the north and west of the YDNP which were excluded from the survey area. Many of these are hydrologically active caves that may not be suitable for including in an archaeological audit survey.

6.1.8 **Morecambe Bay**

Over 100 caves have been identified in the Morecambe Bay area (Holland, 1967; Brook et al., 1994) and a substantial number of these are known to have produced archaeological finds.
7 Appendix Bibliography


