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

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1 Introduction

Many caves contain important archaeological material and some caves exhibit remarkable preservational conditions, such that the artefacts and evidence for ancient environments preserved in cave deposits (and, less frequently, ancient modifications to cave structures) provide an invaluable resource for the study of past cultures. The very survival of such evidence within caves depends, however, on the integrity of the protected yet fragile environment provided by the subterranean depositional context. Cave conservation is well established as a central issue of concern for recreational cavers and professional speleologists alike, and threats to caves and their contents have been recognised and acted upon by earth scientists, conservation ecologists and biologists and regional and national caving organisations. In contrast to the speleological and nature conservation communities, British archaeologists have shown less awareness of the extent and significance of the cave archaeological resource, and there is a need to develop effective procedures for characterising the resource, to identify and understand threats to its integrity, and to formulate strategies that will help to conserve archaeological caves for future study. This report discusses the management of archaeological caves as a cultural resource in England, with insights from research recently undertaken on the caves of the Peak District and Yorkshire Dales.

A pilot audit of the conservation status of archaeological caves in the Peak District and Yorkshire Dales National Parks was carried out in 2004-2005. The audit was undertaken in response to the recognition by English Heritage of a deficit of knowledge that could inform management strategies for archaeological caves at the national and regional level (English Heritage, 2003a, 2003b). The project undertook a thorough review of the extent and nature of the archaeological caves in the study regions, explored the contrasting characteristics of archaeological versus non-archaeological caves, identified threats to the integrity of deposits in known archaeological caves, and delineated strategies for the non-intrusive evaluation of archaeological potential of newly discovered and unexcavated cave sites. The outcomes of the research conducted during the pilot audit are reported in a separate document (Holderness et al., 2005). The purpose of the present report is to discuss the issues arising from the pilot project relating to the protection and management of archaeological caves, and to propose recommendations for mitigation of adverse impacts, management action and further investigation of the resource.
2 Caves and their archaeology

2.1 The nature and distribution of the resource

Archaeological caves are a type of archaeological site that has been poorly understood compared to other entities in the historic environment record. The deficit of knowledge concerning archaeological caves arises for several reasons. Firstly, there is a general problem in recognising the archaeological importance of features of the natural landscape (Bradley, 2000). While the aesthetic and natural history values of individual caves can be assessed in a straightforward manner, using generally accepted criteria, the archaeological value of a cave site is difficult to characterise by inspection alone. This leads to the second reason for the lack of comprehensive and reliable archaeological knowledge concerning cave sites: relatively few caves have been investigated using modern field archaeological methods, and there are logistical difficulties and stratigraphic complexities that hinder the use of traditional methods of archaeological investigation inside caves. Therefore our knowledge of archaeological caves tends to be less complete and less reliable than is the case for equivalent archaeological sites at ‘open’ locations, and curatorial responses to archaeological discoveries in caves tend (with a few notable exceptions) to be reactive to the occurrence of new, unexpected and vulnerable finds, rather than being based on a prior, well-founded characterisation of the existing cave archaeological resource.

Caves (defined as accessible natural cavities within rock formations) are found in a variety of rock types and result from a range of different geomorphological processes. Most caves are initially formed by hydrological processes acting on slightly soluble minerals within the rock, giving rise to karst landforms characterised by solution caves, sink holes, lack of surface water courses and efficient underground drainage. Karst landforms are limited to a few geographical areas in England, mainly those where the soils are underlain by the massive limestones of the Devonian, Carboniferous and Permian periods. The Yorkshire Dales has the greatest extent of cave development in England and the Peak District has the largest unbroken extent of cavernous karst (Waltham et al. 1997). Caves are also formed by mechanical processes, such as the slip-rift fissuring which can affect well-bedded and jointed limestones and sandstones.

This type of cave is found in the Jurassic limestones of Portland, the Cotswolds and the Ryedale area of North Yorkshire (where the Windypits are well known as archaeologically important examples of vertical fissure caves). Sea caves constitute another category of cave that is formed by the erosion and dissolution of weaker beds within coastal exposures of rocks. Sea caves can develop in any type of rock, but they form in a high energy environment and their archaeological potential is generally low unless the coastline is tectonically uplifted or rebounds isostatically following deglaciation. This can result in sea caves being lifted above the current sea level, as is now the case in some western and northern parts of Britain, and this may help to preserve any archaeological deposits contained within the caves.

The discussion that follows focuses on the cave archaeological resource of the Carboniferous Limestone outcrops of the southern Pennines (corresponding approximately to the White Peak natural area and falling mainly within the Peak District National Park) and the central northern Pennines (covering the limestone landscape
contained within the Yorkshire Dales National Park). Carboniferous Limestone is also the rock type underlying the important caving region that includes the Mendip Hills, Gloucestershire and the Forest of Dean. Additional outcrops of this rock are found to the north and west of the YDNP along Teesdale, Weardale, the Vale of Eden and around the shores of Morecambe Bay. Caves occur at high average density in the Carboniferous Limestone, typically one to three surface accessible caves per square kilometre, and due to geological and hydrological controls on cave formation there is a high degree of spatial clustering in their geographical distribution.

### 2.2 Depositional environments within caves

Caves within the Carboniferous limestone vary in their potential to preserve archaeological deposits. Most caves have formed over long periods of geological time, typically hundreds of thousands or even millions of years, and many of the caves which are now exposed at or near the current ground surface are parts of relict cave systems that are no longer hydrologically active. Clastic sedimentary deposits accumulate in caves by a combination of alluvial and colluvial action, wall and roof breakdown and speleothem formation, but the flow of high-energy water through a cave is generally detrimental to the survival of clastic sediments, except where these have been cemented into place by speleothem deposits. The caves of the Yorkshire Dales appear, on average, to be more hydrologically active than those in the Peak District, and this may contribute to reduced rates of sediment accumulation and the apparent lower frequency of discoveries of archaeological caves in the Yorkshire Dales.

Away from entrance areas limestone cave environments are characterised by darkness, environmental stability, reduced biological and trophic inputs, low levels of energy and slightly alkaline ground water conditions – all of which can contribute to the exceptionally good preservation of bone and other sensitive archaeological materials over long periods of time. Diurnal and annual temperature variations are heavily damped by the low thermal conductivity of the surrounding rock, so that within a few metres of a closed cave entrance the temperature will be held constant at the regional mean annual temperature (which in upland areas of central and northern England is typically less than 10 degrees Celsius). Even unconsolidated sedimentary deposits are often protected from erosion in undisturbed caves, as the hydrologically active parts of cave system may be confined to passages well below the near-surface relict passages where cultural deposits and sediments tend to accumulate. Unconsolidated cave sediments, however, are particularly vulnerable to visitors, whether these be human or animal. The accumulated deposits can also extend outside the present physical dimensions of a cave and many caves have an external talus consisting of cave sediments interspersed with roof fall blocks derived from a former cave entrance roof. Therefore caves and their immediate vicinity often contain a higher density, and better quality, of archaeological deposits than the surrounding landscape.

### 2.3 The importance of caves as sites of activities in the past

Cave deposits often contain a palimpsest of different phases of past activity, and this is generally true of the Peak District and the Yorkshire Dales where most of the known archaeological caves are multi-period sites. The disparate archaeological remains found in British caves reflect the long time spans and wide variety of activities that characterise the successive use of caves by different groups of people. Previous studies of cave
usage in antiquity have categorised activities at cave sites as broadly falling into two categories: ritual, such as art, burial and votive deposition, and subsistence-related, for instance domestic occupation, storage, industrial activities and refuge. Such categorisations are partly based on historical and anthropological analogies, but it is often difficult to elucidate precise patterns of usage from the cultural evidence preserved at specific cave sites. Collations of radiocarbon dating evidence (Chamberlain, 1996) and analyses of finds associations (Holderness et al., 2005) indicate that there is strong patterning both in the chronological distribution of material and in the types of artefacts and other materials that have been deposited in the caves.

In the areas of central and northern England that are considered in the present study there needs to be a reassessment of the use of caves in the prehistoric and early historic periods, because earlier interpretations of the material culture from these sites may be inaccurate. For example, some of the archaeological cave sites along Attermire Scar, near Settle in the Yorkshire Dales National Park, have been described as places of habitation, an interpretation also favoured by Branigan and Dearne (1992) who classified most caves with Romano-British evidence as being used either for domestic or refuge purposes. These interpretations are based on the observation that some parts of the artefact assemblages from these caves also occur in domestic contexts on settlement sites, yet a cursory examination of the finds data suggests that the assemblages are more likely to result from ritual or votive activities, as previously noted by King (1974: 200). However, the notion that caves served as habitation sites in prehistoric and early historic times has exercised a strong influence on the interpretation of the archaeological evidence, and it is now a challenge to present an accurate narrative on the use of these caves in antiquity.

A high proportion of the archaeological caves in the study regions included finds of human remains: there was evidence for mortuary activity in about two-thirds of the archaeological caves in the Peak and over three-quarters of those in the Dales (31 and 27 burial caves have been found in the respective regions). Human remains in British caves are mainly associated with prehistoric mortuary activity, primarily dating to the Neolithic and Bronze Ages but also continuing up to the Romano-British period (Chamberlain, 1996). Although some finds of Palaeolithic and Mesolithic human remains have been reported from the caves of southern England, in the study regions of the Peak District and the Yorkshire Dales the earliest dated human remains are Neolithic (Chamberlain, 2001). Evidence for cave burials continues to accumulate through new discoveries, and within the study regions caves may have rivalled surface tombs and barrows for the purposes of disposing of the dead in prehistoric times.

The interpretation of caves as burial sites emphasises the physical similarities between caves and rock built tombs, but it may be that the landscape setting of the cave is more important than its physical appearance. In the Peak District, where the Neolithic burial mounds are often highly visible on the skyline, some of the cave burial sites also follow that pattern. Falcon Low and Sevenways Caves, both high above the Manifold Valley, Windy Knoll Cave above Winnats Pass, Fox Hole Cave on High Wheeldon, and Carsington Pasture Cave on the southern margin of the limestone plateau, are all burial caves that are located at prominent points on hill tops or ridge crests that overlook both local valleys and more distant horizons.
3 Auditing the resource

3.1 The extent of the cave archaeological resource

An indication of the extent of the cave archaeological resource in England is provided by the National Monuments Record (NMR), which in 2001 recorded 468 English cave sites as being of archaeological interest (English Heritage, 2003a). The caves listed on the NMR form a relatively small proportion (approximately 15%) of the total number of caves recorded in the English cave registries. The cave registries themselves are considered quite comprehensive listings of the larger caves, but they record relatively few caves of passage length less than 5m, and they include few rock shelter sites. During the cave audit surveys we detected and recorded many small caves and rock shelters that were not listed in the cave registries – these unnamed sites amounted to 56% of sites surveyed in the Peak District and 33% of sites surveyed in the Yorkshire Dales. Ground survey by archaeologists in other karst regions (e.g. Davies et al., 2004) have identified large numbers of small caves, fissures and rock shelters that have not been recorded in previous surveys by cavers, although the proportion of these that are likely to contain archaeological remains is not yet clear.

Previous estimates of the proportion of known caves with archaeological evidence are based on a limited number of intensive surveys of restricted regions. A survey of the Manifold valley in Staffordshire identified 19% of the caves as being archaeological (Trent and Peak Archaeological Trust, 1993), and a study of the caves of the Malham area in the Yorkshire Dales indicated that between 10% and 20% of the assessed caves had archaeological evidence (Donahue and Lovis, 2005). The results of the recent and much more extensive cave audit survey in central and northern England indicated that 25% of the Peak District caves in the survey and 16% of the Yorkshire Dales caves had records of archaeological finds, but these proportions may be biased upwards slightly by the decision to include all previously-identified archaeological caves in the survey (Holderness et al., 2005). Integrating the results of all of the systematic surveys in the study regions it is likely that between 10% and 20% of the known caves of northern and central England contain archaeological deposits, and the generally lower estimates for the caves of the Yorkshire Dales may partly reflect a lower intensity of archaeological effort in that limestone region. In relation to the latter point, it is interesting that from desk-based surveys of non-human vertebrate remains in the caves of the Yorkshire Dales, Murphy and Chamberlain (2002) concluded that only half of the caves with vertebrate remains had been reported in the scientific media. This perhaps provides a further indication of the under-reporting of finds from the caves of the Yorkshire Dales.

The predictive modelling exercise undertaken as part of the cave audit survey provides some indication of the possible extent of ‘hidden’ archaeological caves, i.e. caves currently classified as non-archaeological but which have attributes indicating a high probability that they contain archaeological deposits. In the Peak District only six of the non-archaeological caves had a probability of greater than 0.5 of being archaeological, whereas in the Yorkshire Dales more than 20 non-archaeological caves had probabilities greater than 0.5 of being archaeological. These data give further support to the notion that the Yorkshire Dales caves have been under-researched by archaeologists compared to the caves of the Peak District.
The archaeology of rock shelters is even less well characterised than is the case for caves. Rock shelters are of little interest to either speleologists or recreational cavers but rock shelters can form in a wide variety of rock types and they are therefore more widely distributed in terms of geographical area and substrate geology than are the solutional caves of the limestone regions. There have been no systematic studies of rock shelter sites, and yet like cave entrances they sometimes have important and vulnerable archaeological deposits. Rock shelters were recorded in the audit survey where they were encountered within the sections of catchments visited by the survey team. A total of 37 rock shelters were recorded in the limestone areas of the Peak District (4 with known archaeology) and 25 rock shelters were recorded in the limestone areas of the Yorkshire Dales (none with known archaeology).

3.2 The condition of the resource

Most of the caves in the Peaks and Dales were excavated before the 1960s (when current methods of stratigraphical and contextual excavation and scientific approaches to post-excavation analysis became the norm). The paucity of records and incomplete archives for the caves of the study regions hinders the evaluation of sites and their deposits, but this situation is common to cave archaeology throughout England and is not particular to the study regions. Early excavators have been described as leaving caves “completely cleared of their archaeological levels” (King, 1974: 183), but the audit survey revealed that this statement is a wild exaggeration – only about 5% of the archaeological caves in the study regions could be described as having absent or residual sediments. The majority of the archaeological caves (60% in the Peak and 64% in the Dales) have in situ deposits that are damaged or eroding, but sediments in this condition were also observed in many of the non-archaeological caves. From the data it is evident that archaeological excavation, recreational caving activities and natural agencies (such as animal activity – see below) all contribute to damage the sediments and their integrity in archaeological caves, but even taken together these agencies rarely result in the complete removal of archaeological deposits.

Cave sites that have been excavated but where no archaeology was found are rarely reported, but for the purposes of predictive modelling the data from these “null” sites are as important as the evidence from caves with proven archaeological remains. During the field surveys several sites were located that showed clear signs of excavation, such as spoil heaps and uneven floor deposits, but no record could be found for the excavations, so it is not known whether these sites contained archaeological evidence or were in fact sterile.
4 Threats to archaeological caves

The fragility of the archaeological cave resource lends extra importance to the conservation and management of caves and their sediments. Threats to caves and their contents can be divided broadly into human activities and the actions of physical and biotic processes in the natural environment. The limestone areas in both National Parks appear to undergo similar kinds of threats, but each region needs to be assessed individually for although they have similar problems, the mitigation of the threats may require different strategies in each region.

4.1 People

Human visitors are potentially the most destructive threat to caves and their sediments, and adverse impacts due to individual activities within caves include trampling, disturbance and removal of sediments, metal detecting, collection of fossils and speleothems, vandalism, graffiti and littering. The digging for new passages and chambers, an important aspect of cave exploration, may threaten archaeological deposits as well as leading to changes in the air and water flow through cave systems that can influence the biotic equilibrium and conditions of preservation within cave deposits. Some cave entrances are also used by climbers and erosion to cave sediments and damage to cave walls attributable to rock climbing has been observed at several caves in the Peak District and the Yorkshire Dales. Archaeologists themselves, both professional and amateur, are also included here. Not only are archaeological excavations destructive, with the loss of information only offset when there is a clear advance in knowledge and understanding, but when vertical cut surfaces in sediments remain unprotected they are susceptible to erosion, and the evidence of excavation may attract the interest of visitors and may increase the likelihood of vandalism.

Most recreational cavers view caving as a challenging sport, and their primary motivation is to descend to the furthest and/or lowest point in a cave system and then return (Mycroft et al. 1997). A preference is often expressed for “through trips” that link separate cave entrances, adding to the interest and navigational challenge of the underground route. Many cavers have a desire to explore new caves, but the effort required to excavate in choked or sediment-filled passages without a guaranteed prospect of success deters all but the most dogged explorers and thus digging tends to be an intermittent and minority activity amongst cavers. The focus of interest for discovering new cave passages also tends to be in the deeper (and usually less archaeologically rich) areas of existing cave systems, rather than in cave entrances at the ground surface. Even at cave entrances cavers usually exhibit the principle of least effort, and they tend to dig only a sufficient depth of sediment to permit crawling access to the cave passage.

Cavers who utilise caves for leisure purposes are generally aware of the need to protect fragile speleothem formations. In the Peak District, caving clubs affiliated to the Derbyshire Caving Association take an active role in cave conservation including controlling access to vulnerable caves and taping off sensitive or non-access parts of caves. There is much less awareness amongst cavers of the importance and vulnerability of cave sediments, especially if no bones or artefacts are visible on the
sediment surface. Non-caving tourists to caves and karst landscapes often are completely unaware of the impact that they have on cave archaeological sites and more could be done to offer better education and advice to this category of visitor.

Visits to caves may increase as a result of the recent implementation of the provisions of the Countryside and Rights of Way Act 2000, which establishes rights of access on foot to designated areas of mountain, moorland, heath, downland and common land (CROW, 2000). Many caves are on land that is now accessible as a result of this act, and although the act only permits access for the purposes of “open-air recreation” it does not explicitly forbid caving or climbing at sites on access land. The CROW act does, however, forbid the use of metal detectors on access land and this is a useful provision in view of the fact that metal detectorists are believed to have been prospecting at some caves in the Yorkshire Dales National Park.

4.2 Extractive industries

Although limestone quarrying is perceived as an important threat to caves, many quarries within the National Parks are approaching the ends of their licences and there are few proposals for new quarries or extensions to existing ones. There have been attempts to re-activate old permissions for stone extraction that were granted but never used (Anon, 2001). A notorious example of this is provided by the Stanton gritstone quarries near Youlgreave, where a controversial proposal to re-open redundant sandstone quarries has been viewed as a test case that might encourage other quarry owners to try to reactivate old licences. While quarrying within the National Parks is not perceived as a substantial current problem, there may be pressure in the future from quarries which at present extend to just outside the National Park boundaries. The current limits of the limestone quarries around Buxton are adjacent to the National Park, and national economic pressures could mean that they might in the future gain permissions to extend into the Park.

Most limestone extraction for the minerals industry is carried out in the high-purity limestones, well above the water table and avoiding fissured or cavernous rock that carries sedimentary impurities (Harrison et al., 1985). The preferred locations for limestone extraction tend to avoid areas with many caves, but exploitation of roadstone from hard rock formations underlying the limestones can result in the loss of important cave sites. A recent extension to the Arcow Quarry (adjacent to the Ingleborough SSSI in the Yorkshire Dales National Park) provided an opportunity for archaeologists to examine caves and their sediments before these sites were destroyed. Earlier episodes of quarrying had destabilised the limestone pavement above the site and the quarry owners requested permission to reprofile the working face, a process that resulted in the removal of several caves that were known but had not been assessed for their archaeological potential. The cave archaeology audit survey identified eleven caves at the Arcow Wood site, several of the caves had visible sediments and all were considered to have moderate archaeological potential. Some of the Arcow Wood Caves were partially excavated before they were destroyed (Donahue and Evans, 2005).

4.3 Farming

Many farmers have had to diversify their land use practices to ensure economic survival within a highly competitive market, and this has resulted in some quite radical changes to a seemingly traditional pattern of upland farming in the limestone areas of the National
Parks. The repercussions of the Foot and Mouth epidemic - that affected many farmers within the National Parks in 2001 - are still being felt, and some of the farms have still not been restocked after the cull of animals took place.

Farms in the Yorkshire Dales tend to be small and family-run, although there are several landowners who hold large estates of tenanted land. Arable farming is limited and farms concentrate mainly on raising livestock. Traditionally mixtures of cattle and sheep have grazed the uplands during the summer months with the cattle being brought down to the pastures in the valley bottoms during the winter and the sheep being brought to the slopes of the valleys. In some areas the allotment system is still in operation with controls on the number of livestock grazed on pasture land, but this practice is now in decline.

There are two large holders of land in the Peak District National Park; the Chatsworth Estate, which also has extensive land holdings in the Yorkshire Dales, and the National Trust. The Chatsworth Estate maintains a hands-off relationship with their tenants with minimal interference in farming practice, whereas the National Trust takes a much more active role in their tenants’ activities. The valleys in the Peak District tend to be shallower and smaller than in the Yorkshire Dales and these differences are reflected in the farming practices. The average altitude of the Peak District is also lower, with the high gritstone areas around the limestone outcrop being used as rough grazing for sheep and, in some areas, for grouse rearing, while the more fertile limestone plateaux and valleys are used for mixed arable and livestock production. A greater percentage of land area in the Peak District is designated as SSSI and NNR, with consequent constraints on farming practices.

Farming practices have a relatively benign impact on caves, but there have been some intermittent problems in the Peak District with pollution of underground percolation and allogenic water supplies that have been linked to industrial and agricultural effluent disposal. The complexity of hydrological systems in karst limestone areas means that it is often difficult or impossible to trace polluted underground water to a specific surface source. There are also recognisable problems posed by cattle and sheep using cave entrances as shelters. Although some farmers have walled or fenced off cave entrances to prevent animals becoming endangered, the animals still congregate near the entrances and can cause trampling and erosional damage to talus deposits in front of the cave: these are often the areas of caves that have heightened archaeological value.

In karst landscapes dolines provide convenient dumping sites for rubbish, building debris, abandoned machinery and other unwanted materials – in instances where such sites serve as sinkholes in wet conditions this is likely to have adverse effects on local ground water quality. The infilling of such sites also reduces landscape diversity and closes off access routes for fauna into small crevices and fissures in the limestone. Dolines were not included in the cave audit survey, so the extent of the problem of infilling of these structures is not currently quantifiable, but some dolines have been found to contain material of archaeological importance which could be damaged by indiscriminate dumping of waste at these sites.

### 4.4 Other land uses

Strict planning controls constrain the extent of development within the National Parks, and potential impacts on caves would have to be assessed before any development took place in the limestone areas. Possible future large-scale uses of the limestone uplands...
include the construction of wind farms and forestry. Both of these developments would require the construction of access roads, and forestry plantations are usually accompanied by extensive surface drainage works that might be expected to cause changes to the underground drainage regime.

4.5 Animals and plants

Species of burrowing mammals such as rabbits and foxes tend to pose a slight threat to unconsolidated cave sediments, but it is badgers that pose the greatest threat from animals to any archaeological deposits within caves. The landscape of the Peak District is more attractive to badgers as it has many narrow, heavily wooded and secluded limestone gorges with suitable small cave entrances that are close to open pasture feeding grounds. Also the caves in the Peak District tend to be drier, providing many alternative denning sites for badgers, whereas in the Yorkshire Dales there are fewer caves that are dry enough to sustain badger setts year round.

Badger disturbance of cave sediments was noted at 19 (13%) of the caves surveyed in the Peak District. Only three of these disturbed caves were known to have contained archaeological remains, but nearly all of the others were recorded as having moderate or high archaeological potential on the basis of their in situ sediments. Badgers prefer smaller, sediment-filled caves for the construction of their setts, and in the Peak District nearly 50% of the smallest category of caves, i.e. those with cave entrances of less than 1m$^2$ area, showed active or recent disturbance of sediments by badgers, whereas badger disturbance was less frequently encountered at the larger caves. Badger activity also appeared to be clustered in particular catchments, with about 20% of caves in the Lathkill and Wye catchments showing badger activity but smaller proportions in the other catchments, perhaps reflecting the more wooded character of the Lathkill and Wye valleys.

In the Yorkshire Dales disturbance to sediments due to badger activity was noted at only nine cave sites, four of these being at the Arcow Wood caves and one instance at Kinsey Cave, which is a scheduled archaeological site. Although badgers cause visible disturbance to cave sediments, regular and careful monitoring of their spoil could be used to detect new instances of archaeological remains in caves, and appropriate mitigation could then be undertaken in selected cases, subject to the appropriate permission being obtained from DEFRA. Rabbits have also caused disturbance to sediments at Victoria Cave.

4.6 Management practices

The management of caves within the National Parks has generally been one of benign neglect, although an active management regime including regularly scheduled site visits has been introduced by the National Trust for the caves on its South Peak Estate (National Trust, 2000; Malley and Droy, n.d.). Caves tend to be located in less accessible areas of the limestone uplands of the National Parks: 57% of Peak District caves and 76% of Yorkshire Dales caves are located in land that is allocated to woodland or rough grazing (see Table 4.1). Caves also tend to be located on steeper slopes: 82% of Peak District caves and 95% of Yorkshire Dales caves are located on terrain with a general ground slope of greater than 30°. The differences between the National Parks in the proportions of caves that are located in the different land use categories broadly reflects the overall distribution of land use in the two regions, with a
greater proportion of woodland and pasture in the Peak District and a wider distribution of rough grazing in the Yorkshire Dales. Livestock movements in unenclosed areas of rough grazing are not controlled, and only in a few instances are caves fenced off from surrounding land, and trampling and erosion of cave sediments by livestock was observed at several cave entrances. In many cases the woodland adjacent to cave sites is unmanaged, and evidence was seen of tree root penetration of rock fissures and cave sediments. Tree fall at cave entrances can also be a significant cause of damage to cave roofs. Overall, the locations of caves in sparsely managed or unmanaged land units implies that when human or natural processes have an adverse impact on caves and their contents this may not be readily observed by land managers, and this reinforces the case for regular monitoring of cave sites.

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<th>Rough Grazing</th>
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<td><strong>Yorkshire Dales</strong></td>
<td>14%</td>
<td>62%</td>
<td>19%</td>
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Table 4.1: Land use in the vicinity of caves in the Peak District and Yorkshire Dales
5 Current conservation structures

5.1 Inclusion of caves on the Schedule of Monuments

Current strategies for curating the cave archaeological resource in England show a strong emphasis on the need to preserve the Palaeolithic component of the resource. In a commissioned report for English Heritage and CADW, Barton and Collcutt (1986) identified 72 cave sites in England as having produced Palaeolithic material, and although this led to a programme of scheduling of the most important Palaeolithic cave sites, very few caves with archaeological evidence solely from later periods have been scheduled (Dowkerbottom Cave, scheduled for its Romano-British finds, provides the only such example within the study regions). As mentioned above (2.3) there are some misconceptions about the nature of cave usage in the past, and it is possible that the Holocene use of caves has been perceived of as mundane and domestic, rather than as ritualistic as suggested by more recent studies of the evidence (e.g. Barnatt and Edmonds, 2002).

In the Peak District four cave sites have been scheduled, all on the basis of their Palaeolithic evidence: these are Dowel Cave, Elderbush Cave, Fox Hole Cave and Ossum’s Crag Cave. Two additional cave sites in the Peak District have benefited serendipitously from their inclusion within the protected zones of other scheduled monuments – these are Odin Cave (in the scheduled area of Odin Mine) and Hermit’s Cave (a gritstone cave, within the scheduled area of Cratcliff Rocks). Also in the Peak District many lead mining sites have been scheduled (Barnatt and Penny, 2004: Appendix H), and although it is not clear whether the scheduled areas include the underground mine workings, in several cases natural cave passages have been intercepted by the mined shafts and adits at these sites. In the Yorkshire Dales there are four scheduled cave sites: Dowkerbottom Cave, Kinsey Cave, Jubilee Cave and Victoria Cave.

The four scheduled caves in the Peak District have in situ sediments that are stable or only slightly eroding, whereas Kinsey Cave, Jubilee Cave and Victoria Cave show considerable amounts of sediment erosion, due primarily to visitor pressure. These three Yorkshire Dales scheduled caves are located close to public footpaths, are easily accessible, and are named on the Ordnance Survey maps with a distinctive gothic typeface indicating a site of antiquarian interest, whereas the scheduled caves in the Peak District are less accessible and are not identified by name on the maps, with the exception of Fox Hole Cave (which is a securely gated site from which casual visitors are excluded). These cases indicate how issues of visibility and accessibility interact strongly with the effectiveness of scheduling as a protective measure.

Scheduling as an isolated conservation measure is probably ineffective when applied to archaeological cave sites in the absence of an active management strategy. A scheduled monument is effectively protected against the impact of inappropriate development, but most caves are not threatened by the kinds of development that are regularly notified to planning authorities. We note, however, that an additional beneficial effect of scheduling is that the monument is thereby prioritised for monitoring of its condition, and an example of this is provided by Victoria Cave in the Yorkshire Dales.
where extensive archaeological survey and assessment work was undertaken in response to conservation concerns (Quartermaine, 1995). Similarly, at Creswell Crags in Derbyshire, the scheduling of caves with archaeological remains was instrumental in the creation of the Creswell Heritage Trust, which actively manages the Creswell Caves as an educational resource.

5.2 Inclusion of caves within SSSIs and NNRs

There is a high level of general awareness of the value and fragility of karst landscapes, both amongst international organisations such as the International Union for the Conservation of Nature and Natural Resources (Watson et al., 1997) and national bodies such as the UK’s Joint Nature Conservation Committee, English Nature and The National Trust. Many caves within the Peak District and Yorkshire Dales National Parks fall within specially protected areas such as Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (NNRs), or within other non-statutory conservation areas such as Local Nature Reserves (LNRs) and Regionally Important Geological and Gemorphological Sites (RIGS). The Countryside and Rights of Way Act 2000 has provided English Nature with additional powers to ensure that SSSIs are managed effectively and to take action in the event that features and habitats of SSSIs are damaged or destroyed. In some cases SSSIs are included within NNRs, which ensures a more intensive management regime for the natural resource, because all NNRs are owned either by English Nature or by approved bodies such as Wildlife Trusts.

Extensive areas of the karst landscape of the Peak District and the Yorkshire Dales are included within NNRs. The Derbyshire Dales NNR comprises an area of 335 hectares that includes five separate valleys in the central part of the limestone region. More extensive landscapes are included within the NNRs of the Yorkshire Dales, where over 1000 hectares of limestone pavements around Ingleborough and about 150 hectares of karst landscape around Malham Tarn are protected. Although the presence of archaeological remains is not a material consideration in the establishment of SSSIs and NNRs, the level of protection and monitoring afforded to caves by their inclusion within these conservation areas is significant and provides an added impetus to establishing effective liaison between archaeological curators and nature conservation organisations.

5.3 Cave conservation and management plans

The Nature Conservancy Council (a predecessor organisation to English Nature) recognised the vulnerability and irreplaceable nature of the structural elements and deposits of cave systems (Nature Conservancy Council, 1991). The NCC and subsequently English Nature also appreciated the value of working closely with land owners and representatives of caving organisations in the formulation of cave conservation plans (Price and Wright, 1990; Glasser and Barber, 1995). A typical conservation and management plan (e.g. Mycroft et al., 1997) includes a description of the topography, geology, biology, hydrology and history of exploration of the cave system; identification of the external and internal threats to the caves and their deposits; site-specific guidelines for permissible access and activities within the caves; proposals for management structures and mechanisms for consultation with interest groups; and recommendations for further research.

The formulation of a cave conservation and management plan is a complex and labour-intensive exercise that calls upon the expertise of a diverse range of specialists and
interest groups, but the resulting document can serve as an invaluable tool in guiding conservation and research into important cave sites. In the region controlled by the Derbyshire Caving Association progress on the production of cave conservation and management plans has been slow because of constraints on individuals’ time and the limited amount of funding available to support these initiatives.
6 Recommendations for mitigation and management

The work of conservation agencies with interests and responsibilities for the protection of caves and karst landscapes has shown that effective cave conservation requires active management based on a well founded understanding of the problems arising from natural and human impacts on caves, and a realistic approach to the implementation of management strategies including mitigation measures. The development of a co-operative approach involving heritage managers, scientific interest groups and recreational caving organisations is becoming increasingly important in cave conservation at the regional level. An example of this kind of approach is the Derbyshire Caving Association Underground Conservation Forum, which hosts regular liaison meetings between cavers, mines historians, speleologists and regional historic and natural environment resource managers.

The strategies outlined below for addressing some of the threats to caves are premised on the understanding that archaeological caves and rock shelters form integral parts of a dynamic landscape, and the impact on one component of the landscape is likely to affect other components to a greater or lesser extent. In the past some cave management guidelines have sometimes concentrated on a single aspect of the cave environment (for example, the conservation of a protected cave-dwelling species) but we advocate a total catchment management approach which considers all of the natural, archaeological and amenity values that contribute to the importance of the cave environment.

There are several published sets of guidelines for the protection and management of caves and karst environments (e.g. Watson et al., 1997), including guidelines that are specific to archaeological and palaeontological caves (Griffiths and Ramsey, 2005: see also Appendix 2). Such guidelines provide a basis for formulating national and regional cave conservation management strategies that are applicable within England or Britain as a whole.

6.1 Scheduling

- Scheduling is the inclusion of a site on the Schedule of Ancient Monuments, which provides statutory protection against damage from land use activities. Scheduling is an appropriate mechanism for protecting nationally important archaeological sites where other means of protection (e.g. by regulating developments through the planning process) are considered to be less effective.

- Previous exercises in scheduling cave sites have concentrated on the Palaeolithic resource, but it is recommended that sites with archaeological evidence from later periods of prehistory and from the historical era should also be considered for this form of protection.

- To facilitate this a generic monument class of “archaeological cave” may be required in place of the existing monument thesaurus entries for cave sites, cave settlements, cave burials etc., and this can be derived from the definitions and inclusion criteria developed during the cave audit survey (Holderness et al., 2005).

- The effectiveness of scheduling as a mechanism for protecting archaeological caves needs to be evaluated more thoroughly, and it is important to implement monitoring
programmes to ensure that the condition of any scheduled cave is checked at regular intervals.

- The extent of the scheduled area around a cave site needs to be ascertained with some care, and a review should be made of this parameter at existing scheduled cave sites. Important archaeological deposits (including secondary deposits from earlier excavations) may extend for some distance outside the present day cave entrance, and in some instances it is likely that adjacent caves have similar sequences of archaeological material and should therefore be considered as components of a single archaeological site for conservation purposes.

6.2 Planning control

- Planning authorities should be alerted to the potential for the discovery of new caves, and wherever possible they should insist on prior archaeological assessment of cave sites as part of the planning process before caves are damaged or destroyed. This is best achieved by increasing awareness amongst curators of the potential for new sites to be discovered during quarrying and other civil engineering works.

- Quarrying for minerals and aggregates may expose unknown caves in limestone areas, but the existence and significance of small sediment-filled caves may not always be detected or recognised prior to the determination of proposals for new quarrying activities. A mechanism is required for providing a rapid archaeological response to instances where new archaeological caves are uncovered in the course of limestone quarrying, either through additional conditions imposed when permission for extraction is granted, or through the provision of funds from other sources.

- Currently there is no requirement for excavations at non-scheduled cave sites to be notified to archaeologists working for local government planning departments. Both academic researchers and local archaeological societies who are planning to undertake archaeological investigations at a cave site should be encouraged to discuss their research designs with the relevant local government or National Park archaeology service, and these archaeology services are the most appropriate organisations to coordinate archaeological research on caves within their areas.

6.3 Education and outreach

There is an important role for education and wider dissemination of information in the advancement of cave conservation. We have identified four separate but inter-related groups who would benefit from the formulation of an education policy on archaeological caves.

- There is only limited information available to the general public on the archaeological significance of caves, and the National Parks and regional museums might do more to promote their archaeological cave heritage. The simplest way of educating the general public is through information boards located at or near appropriate sites, and through the distribution of information leaflets at central locations in the National Parks, for example at tourist information centres. This information could be supplemented through the provision of guided walks with suitably qualified archaeologists to explain the historical context and landscape setting of particular
groups of caves. Public lectures about archaeological caves would provide a further opportunity to disseminate knowledge and communicate good management practice.

- Opportunities should be pursued to engage the interest of farmers and landowners who have caves with archaeological potential located on their properties. Many farmers are under pressure to diversify the economic uses of their land holdings and it is possible that some proposed land use changes may have an adverse impact on caves. Some farmers do not welcome what they perceive to be interference from outside agencies, but land holders should be encouraged to enter into negotiations with other stakeholders about ways in which the caves on their property should be managed. An appropriate lead has been provided by The National Trust, which has established excellent working relationships with its tenant farmers, several of whom act as voluntary wardens for sites of conservation interest located on their property.

- Many cavers already have an appreciation of and active interest in cave conservation, and the memberships of caving clubs are increasingly aware of the importance of archaeological deposits in caves. The main recommendation made here is to draw up guides to best practice in cave exploration, and to disseminate the information by leaflet, through meetings with representatives of caving clubs, and through publication in caving journals. By emphasising to cavers that archaeologists do not wish to simply exclude all access to caves, it may be possible to stimulate cooperation between recreational cavers and curators of the historic environment. Griffiths and Ramsey (2005) have advised that suitably qualified personnel should be available to episodically monitor the progress in excavations at archaeologically sensitive cave sites, and this is a measure that could be implemented in England. In the Peak District the Derbyshire Caving Association’s Underground Conservation Forum provides a channel of communication between representatives of caving organisations and local and academic archaeologists with interests in cave archaeology and mining history.

- There are currently few active research excavations in English caves, but looking to the future certain cave sites may attract the interests of both academic archaeologists and local archaeological societies. Currently it is the case that most of the archaeological investigations carried out in English caves are conducted by academic archaeologists, but there has been little effort to coordinate these activities, and there is a clear role for local archaeology curators in establishing a research framework for the caves within their geographical area of responsibility.

- Regional museums have often served as a passive repository for artefacts and archival material from cave excavations, but these institutions have been less active in the interpretation of cave archaeology for the general public. Within the study regions, only Buxton Museum and the Craven Museum at Skipton have display areas dedicated to the public exposition of cave archaeology. As part of the initial stages of the cave audit survey, many museums were contacted and arrangements were made to visit some of the principal archives of cave material, but not all of the museums were aware of the extent of their collections from caves, and some were unwilling or unable to consult their records due to ongoing refurbishment of museum facilities. More research needs to be undertaken on museums’ holdings of archaeological and palaeontological assemblages from caves in order to provide a more secure basis for formulating conservation measures for archaeological caves.
6.4 Physical protection

A range of protection or mitigation measures can be taken in instances where actual or pending damage to caves and their sediments has been identified as a major concern. All protection measures need to be implemented on a cave by cave basis, and with the agreement and support of other interested parties.

- Stabilization of eroding sediments, e.g. by supporting exposed baulks or by coverage with appropriate inert materials. At several of the archaeological caves visited during the audit survey it was observed that previous archaeological or palaeontological excavations had left unsupported exposures of sediments as “witness” sections, but these are liable to erosion and collapse and are vulnerable to burrowing animals. In some instances these standing sections may require remedial work to achieve long-term stabilization.

- Construction of walkways that protect the sediments from further trampling and erosion. This is an appropriate alternative solution in situations where it is important to maintain the facility for viewing the sediment exposures, either for educational or for monitoring purposes. Examples of both metal and wooden walkway constructions can be seen at the Creswell Crags caves in Derbyshire.

- Restriction or closure of access to sites by the installation of gates and grilles or by walling off cave entrances. This is often a more difficult or expensive solution, but one that may in certain circumstances be mandated by the importance of the material contained within the cave. Determined visitors will sometimes damage or destroy such obstructions in order to gain access, and it may then be appropriate to provide a difficult access route that will discourage most visitors while allowing access to the more determined person – this strategy has been adopted at some archaeological caves including Albert Cave and Rawthey Cave.

- Excavation of deposits. This option may be preferred at cave sites where continuing threats will eventually lead to significant loss of archaeological information. It may be appropriate, for example, at sites where deposits are being disturbed by burrowing animals that cannot be excluded in the long term, or at sites where only small amounts of eroding sediments remain in situ. Excavation is viewed generally as a last resort: it is expensive, it does not necessarily mitigate the problem (e.g. burrowing animals may return to dig in the newly excavated areas thus causing further damage), and it creates new vertical surfaces that are liable to erosion and collapse if the trenches are inadequately back-filled after the excavation.

6.5 Monitoring

Some caves can be seen to change very little over long periods of time, but sudden and dramatic changes do occasionally occur, as witnessed recently by entrance roof collapses at Windy Knoll Cave in the Peak District and at Dow Cave in the Yorkshire Dales. At the time of the cave audit survey in October 2004 the condition of Windy knoll Cave was recorded as stable, but in March 2005 a 2 metre section of the roof above the entrance suddenly collapsed. A similar collapse occurred at the entrance to Dow Cave in the Yorkshire Dales, some time after it was visited by the survey team in 2004 (Ryall and Speight, 2005). Another example of a change in deposit condition is provided by the recent discovery of human and faunal remains on the surface of sediments in Kinsey Cave. This finding has prompted renewed archaeological and
palaeontological interest in the cave, but during the cave audit survey in July 2005 no bone was visible on the surface at this site.

- Regular monitoring of the condition of archaeological caves is a useful measure to help identify new threats as they may arise. The National Parks could train staff to check on the condition of archaeological caves during field visits organised on a rotation scheme to ensure that each of the caves receives a visit at least once a year. An example of this type of monitoring scheme is operated by the National Trust as part of their management regime for the South Peak Estate. The National Trust’s monitoring programme includes regular visits to caves on their properties, organised at different times of the year according to the changing levels of threats from human activities, wildlife, and livestock. Monitoring visits could also be undertaken under the auspices of the Monuments At Risk programme.

- The “Adopt a Cave” Scheme promoted by the popular caving magazine ‘Descent’ has been successful in reducing levels of rubbish, graffiti and other hazards to cave structures. This scheme already covers several archaeological caves that are regularly accessed by cavers, and could easily be extended to additional archaeological caves perhaps by involving local archaeological societies and natural history groups as well as local cavers. Some financial support might be required, and occasional assistance from archaeologists might be needed, but this is viewed as an effective way both to enhance the protection of the caves and to promote a dialogue between cavers and archaeologists.

- At a broader regional scale the monitoring of caves and karst regions should take into account the full range of factors that may impact on preservation conditions in caves. Changes in water levels, pollutants in the ground water and increases in biological activity may all play a part in elevating the levels of threat to caves and their sediments. Changes in land use (especially changes in farming practices and land management) are to a certain extent inevitable, and a cross-agency group should discuss actions that will help to mitigate any damage that may occur.

7 Recommendations for further research

- The effectiveness of scheduling as a protective measure for archaeological caves requires further evaluation. The review of scheduling needs to be done nationally, as the sample of scheduled cave sites in the study regions is rather small and may not be representative of all of the caves on the national schedule. Appropriate measures of effectiveness of scheduling include an assessment of any changes in monument condition following its inclusion on the schedule, and a comparison with other indirect conservation measures such as inclusion of caves within SSSIs or NNRs. Also it may be appropriate to define a broader monument class of “archaeological cave” that subsumes the current narrow definition of “Palaeolithic cave”.

- Consideration should be given to the design of schemes for monitoring the condition of archaeological caves, and of the effectiveness of such schemes for providing early warning of newly developing threats to caves and their archaeological deposits. Cave monitoring schemes are currently in operation in the East Midlands on parts of the National Trust’s South Peak Estate and at the managed archaeological cave site of Creswell Crags in Derbyshire. Other formal or informal cave monitoring schemes
may be operative in other parts of Britain, and it would be useful to pool the knowledge and experience obtained from the various schemes and devise guidelines for best practice.

- The nature of the archaeological cave resource and the history of its research is quite variable across the different karst regions, and there are considerable gaps in existing knowledge as well as academic questions that need to be addressed through field research. The formulation of regional cave research strategies would provide appropriate structures for coordinating future studies of archaeological caves. Some informal coordination of research activity already takes place through regional liaison groups such as the Yorkshire Dales Archaeology Group, the Peak District Archaeological Advisory Group and the DCA Underground Conservation Forum. There is therefore a need for more detailed cave research strategies that are tailored to the particular research and management issues that arise in each caving region.

- Further cave conservation audits are needed to provide a baseline for future research and management in the principal caving regions of England (i.e. in Mendip/Gloucestershire/Forest of Dean, Northwest England and the North Pennines) as well as in the other karst limestone areas (the northern part of the Magnesian Limestone outcrop, the Jurassic Limestones of North Yorkshire and Dorset, and the South Devon limestone outcrop). These audits should include both fieldwork and further archival research, especially in those regions which have been less intensively studied by archaeologists.

- Discussions between Dr Randolph Donahue and employees of the U.S. National Parks Service have led to the conclusion that a consultation exercise should be conducted with organisations in other countries to determine how protection and management of archaeological caves is carried out in other parts of the world.
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Appendix 1

Guidelines for Cave and Karst Protection (from Watson et al, 1997)

1. Effective planning for karst regions demands a full appreciation of all their economic, scientific and human values, within the local cultural and political context.

2. The integrity of any karst system depends upon an interactive relationship between land, water and air. Any interference with this relationship is likely to have undesirable impacts, and should be subjected to thorough environmental assessment.

3. Land managers should identify the total catchment area of any karst lands, and be sensitive to the potential impact of any activities within the catchment, even if not located on the karst itself.

4. Destructive actions in karst, such as quarrying or dam construction, should be located so as to minimise conflict with other resource or intrinsic values.

5. Pollution of groundwater poses special problems in karst and should always be minimised and monitored. This monitoring should be event-based rather than at merely regular intervals, as it is during storms and floods that most pollutants are transported through the karst system.

6. All other human uses of karst areas should be planned to minimise undesirable impacts, and monitored in order to provide information for future decision-making.

7. While recognising the non-renewable nature of many karst features, particularly within caves, good management demands that damaged features be restored as far as is practicable.

8. The development of caves for tourism purposes demands careful planning, including consideration of sustainability. Where appropriate, restoration of damaged caves should be undertaken, rather than opening new caves for tourism.

9. Governments should ensure that a representative selection of karst sites is declared as protected areas under legislation which provides secure tenure and active management.

10. Priority in protection should be given to areas or sites having high natural, social or cultural value; possessing a wide range of values within the one site; which have suffered minimal environmental degradation; and/or of a type not already represented in the protected areas system of their country.

11. Where possible, a protected area should include the total catchment area of the karst.

12. Where such coverage is not possible, environmental controls or total catchment management agreements under planning, water management or other legislation should be used to safeguard the quantity and quality of water inputs to the karst system.
13. Public authorities should identify karst areas not included within protected areas and
give consideration to safeguarding the values of these areas by such means as
planning controls, programs of public education, heritage agreements or
covenants.

14. Management agencies should seek to develop their expertise and capacity for karst
management.

15. Managers of karst areas and specific cave sites should recognise that these
landsapes are complex three-dimensional integrated natural systems comprised
of rock, water, soil, vegetation and atmosphere elements.

16. Management in karst and caves should aim to maintain natural flows and cycles of
air and water through the landscape in balance with prevailing climatic and biotic
regimes.

17. Managers should recognise that in karst, surface actions may be sooner or later
translated into impacts directly underground or further downstream.

18. Pre-eminent amongst karst processes is the cascade of carbon dioxide from low
levels in the external atmosphere through greatly enhanced levels in the soil
atmosphere to reduced levels in cave passages. Elevated soil carbon dioxide
levels depend on plant root respiration, microbial activity and a healthy soil
invertebrate fauna. This cascade must be maintained for the effective operation of
karst solution processes.

19. The mechanism by which this is achieved is the interchange of air and water
between surface and underground environments. Hence the management of
quality and quantity of both air and water is the cornerstone of effective management
at regional, local and site specific scales. Development on the surface must take
into account the infiltration pathways of water.

20. Catchment boundaries commonly extend beyond the limits of the rock units in which
the karst has formed. The whole karst drainage network should be defined using
planned water tracing experiments and cave mapping. It should be recognized that
the boundary of these extended catchments can fluctuate dramatically according to
weather conditions, and that relict cave passages can be reactivated following
heavy rain.

21. More than in any other landscape, a total catchment management regime must be
adopted in karst areas. Activities undertaken at specific sites may have wider
ramifications in the catchment due to the ease of transfer of materials in karst.

22. Soil management must aim to minimise erosive loss and alteration of soil properties
such as aeration, aggregate stability, organic matter content and a healthy soil
biota.

23. A stable natural vegetation cover should be maintained as this is pivotal to the
prevention of erosion and maintenance of critical soil properties.

24. Establishment and maintenance of karst protected areas can contribute to the
protection of both the quality and quantity of groundwater resources for human
use. Catchment protection is necessary both on the karst and on contributing non-
karst areas. Activities within caves may have detrimental effects on regional
groundwater quality.
25. Management should aim to maintain the natural transfer rates and quality of fluids, including gases, through the integrated network of cracks, fissures and caves in the karst. The nature of materials introduced must be carefully considered to avoid adverse impacts on air and water quality.

26. The extraction of rocks, soil, vegetation and water will clearly interrupt the processes that produce and maintain karst, and therefore such uses must be carefully planned and executed to minimise environmental impact. Even the apparently minor activity of removing limestone pavement or other karren for ornamental decoration of gardens or buildings has a drastic impact and should be subject to the same controls as any major extractive industry.

27. Imposed fire regimes on karst should, as far as is practicable, mimic those occurring naturally.

28. While it is desirable that people should be able to visit and appreciate karst features such as caves, the significance and vulnerability of many such features means that great care must be taken to minimise damage, particularly when cumulative over time. Management planning should recognise this fact and management controls should seek to match the visitor population to the nature of the resource.

29. International, regional and national organisations concerned with aspects of karst protection and management should recognise the importance of international cooperation and do what they can to disseminate and share expertise.

30. The documentation of cave and karst protection/management policies should be encouraged, and such policies made widely available to other management authorities.

31. Data bases should be prepared listing cave and karst areas included within protected areas, but also identifying major unprotected areas which deserve recognition. Karst values of existing and potential World Heritage sites should be similarly recorded.
Appendix 2

Best Management Practices for Palaeontological and Archaeological Cave Resources (Griffiths and Ramsey, 2005)

General:
A management authority can authorize the study of palaeontological/archaeological resources in caves as part of overall cave inventory and evaluation activities, subject to the following best management practices:

1. Where applicable, the palaeontological/archaeological research activities in caves, including access, orientation for field personnel, reconnaissance visits, sampling, photo documentation and geo-referencing activities, research and excavation activities, removal and processing of sediments, removal, handling and curation of specimens, and dissemination of results should be planned in conjunction with the management authority(s).

2. Research activities in caves should be compatible with the management authority's cave and/or karst inventory objectives and priorities.

3. Research activities (including reconnaissance visits) in caves, should be undertaken by the minimum number of qualified personnel required, and should include persons with speleological knowledge and experience matching the technical difficulty and sensitivity of the cave.

4. Alterations of caves, cave sediments and other objects during research activities or inventory must be consistent with requirements of the B.C. Heritage Conservation Act, where applicable.

Orientation for Field Personnel:

5. Before any reconnaissance, scientific sampling, or other research activities in caves are commenced, all field personnel should receive from qualified persons a comprehensive orientation or training session. Topics to be addressed in this session should include cave safety issues, potential underground hazards, caving codes of conduct, and a thorough introduction to cave and karst conservation issues and concerns.

Geo-referencing and Photo-documentation of Palaeontological/Archaeological Resources in Caves:

6. Cave resources of palaeontological/archaeological interest should be mapped and photo-documented prior to any handling, repositioning, testing, sampling, or collecting of specimens.

7. A map of the cave showing the locations and photos of the cave resources of palaeontological/archaeological interest should be submitted to the management authority as soon as possible after the field visit.

8. Photos and maps of cave resources of palaeontological/archaeological interest should be generated both before and after any research activity.
The following additional requirements should be met if research sampling or subsurface sampling of palaeontological/archaeological material in caves is proposed:

**Surface Sampling in Caves:**

9. Sampling of palaeontological/archaeological material in caves should be initially restricted to the removal of a minimum number of representative specimens required for diagnostic and/or dating purposes, from the surface of the bedrock or cave sediments only. When Heritage Conservation Act permits are required, sampling is to be consistent with the methodology outlined in the application for permit. No other sampling is permitted.

10. Protocols for handling specimens such that maximum scientific value is retained must be established in advance.

11. Casual cave reconnaissance visits are not normally to be combined with collection of palaeontological/archaeological materials. The collection of any such material is a separate, planned, and authorized activity, which should only be carried out with the consent of the management authority and a Heritage Conservation Act permit when required.

**Research and Excavation Proposal:**

12. Upon determining that additional testing, sampling, or excavation of palaeontological/archaeological resources in caves is warranted, the proponent should prepare a detailed research and excavation proposal, and submit the proposal to the management authority. The proposal should include an analysis of potential impacts on other cave resources.

13. The impact analysis should be broad enough to include possible future research activities or expanded excavations within the cave.

14. The impact analysis should address the permanent curation of specimens removed from the cave, or how specimens are to be returned to the cave.

15. No permit for research activities involving subsurface sampling or excavation in caves should be issued until the cave has been inventoried and evaluated by qualified persons. At minimum, the inventory should address the sensitivity of the cave, or portions of the cave, to impacts that might result from proposed research activities, identify and document any unique or outstanding values, and identify any hazards to researchers. In the case of sensitive caves with one or more significant values, monitoring of research activities by qualified persons may be recommended.

16. The management authority should review the research and excavation proposal, consulting externally with other interested parties, if required.

**Research and Excavation Plan:**

17. The management authority will select the preferred alternative, and a final research and excavation plan should be prepared in conjunction with the proponent. The final plan should outline the research and excavation activities, and the anticipated effects of the activities on all cave resources associated with the cave site as well as monitoring activities.

18. The proposed research activities should be limited to specific cave passages or areas, so that other parts of the cave are maintained unaltered.
19. A reclamation plan, if appropriate, should be developed for the proposed excavation prior to approval. A reclamation bond should be established where appropriate.

20. Where applicable, the approved final research and excavation plan, including the reclamation plan and collections repository should be integral to any application for a Heritage Conservation Act permit.

Requirements for Digging/Excavation Activities in Caves:

21. No digging or excavations in caves should occur until after a) the material in item 9 is dated and analyzed, and/or until it is demonstrated that the cave site warrants further sampling.

22. If the cave, or portions of the cave are deemed to be sensitive by qualified persons, photo documentation of the sensitive areas or features should be carried out prior to the commencement of research activities.

23. Maximum environmental proxy indicator information should be derived from the sedimentary matrices where possible, when processing cave sediments for palaeontological/archaeological material.

24. Wherever possible, a certain predetermined percentage of a given cave sediment deposit slated for excavation should be left intact for future research.

Effectiveness Evaluation:

25. After research activities in caves are completed, a second round of photo-documentation and comparison with baseline conditions (photo-monitoring) may be required to determine the effectiveness of the impact reduction strategies.

Archaeological or Cultural Materials:

26. If suspected archaeological or cultural materials are identified during an approved palaeontological excavation in a cave, the excavation in that area of the cave must be suspended, and the management authority and Archaeological Planning and Assessment, SRM consulted. It is likely that further excavation at that specific location can only be resumed after a Heritage Conservation Act permit has been obtained.

27. Palaeontological excavations in caves should be conducted in such a manner that the provenience and contextual attributes can be assigned to specimens identified as cultural during sorting and analysis.

Cave Management Plans:

28. From the impact analysis in item 11, the management authority should develop an individual cave management plan or prescription for the cave site being considered for research and excavation.

29. The cave management plan objectives related to research activities in caves should be consistent with the plan approved in item 16, and with other potential future research activities.

Dissemination of Results

30. Researchers should avoid disclosing or making reference to specific geographic locations when discussing or disseminating the results of their activities in sensitive caves.
31. Researchers involved in palaeontological/archaeological work in caves should adhere to both caving codes of conduct and professional codes of ethics, which should include the recognition of research precedence at cave sites and giving accurate and complete credit/acknowledgement where it is due.

Appendix 3

Recreational Activities at National Trust Properties. Guiding Principles and Good Practice (extract from National Trust, 2000)

Caving and Potholing

Natural caves are a particularly fragile environment and have been seriously damaged in recent decades, from both recreation and other land uses. Physical damage to formations is very serious and usually irreversible. There is a correlation between the amount of access to a cave and levels of damage. It is important that caves on National Trust land are regularly monitored taking all land uses and interests into account.

Guiding principles

1. The National Trust welcomes caving and potholing at selected sites, subject to area, regional or national strategies as appropriate.
2. Cave conservation on National Trust land should be regularly monitored and reviewed.

Good practice

- Promote the National Caving Association (NCA) Cave Conservation Policy.
- Prepare a strategy for each main caving area with the appropriate regional caving association, NCA, local clubs and other landowners.
- Establish close liaison with local clubs and cave conservation officers for regional associations.
- Liaise with guidebook committees and/or editors.
- Encourage clubs to participate in cave conservation plans.
- Grille or gate cave and mine entrances (allowing for bat access).
- Zone more resilient sites for group and training centre use.
- Tape routes and tape off delicate formations.
- Stipulate leadership qualification (ie NCA Cave Instructors Certificate) as condition of access.
- Digging and use of explosives should be for authorised research and rescue purposes only
- Prohibit use of carbide lamps.
- Use internal locked gates to prevent access to susceptible parts of cave systems.
• Limit access by novices (eg a maximum of 2 in a group of 7) as they generally cause more damage than experienced cavers.

**Legislation, codes and agreements**

Whether or not a formal access agreement is in place, all cavers are required to observe the law in so far as it touches upon aspects of caving activity, such as digging, the use of explosives or acts likely to pollute water. In addition it is an offence under the Wildlife and Countryside Act (1981) to wilfully disturb bats or badgers, both of which may inhabit some caves. Destroying birds, nests or eggs, or damaging limestone pavements can also lead to criminal proceedings.

It is the law protecting bats which is probably most likely to be infringed by cavers. It is illegal knowingly to disturb, injure or kill bats. It is also illegal to seal the access to any cave or disused mine known to house bats. Gates or mine shaft covers fitted to the entrance of such sites must contain gaps large enough to allow the passage of bats.

Cavers and mine explorers visiting known bat sites are urged by the NCA to observe its Cave Conservation Policy and respect any restrictions imposed to minimise disturbance, particularly during the winter hibernation period.