Rock Art Pilot Project

Main report

A report on the results of a pilot project to investigate the current state of research, conservation, management and presentation of prehistoric rock art in England commissioned by English Heritage from

Archaeology Group, School of Conservation Sciences,
Bournemouth University
and the
Institute of Archaeology,
University College London

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ABBREVIATIONS

4WD	Four wheel drive vehicle
ADS	Archaeology Data Service
AIP	Archaeological Investigations Project
AML	Ancient Monuments Laboratory
AONB	Areas of Outstanding Natural Beauty
AURA	Australian Rock Art Research Association
BAS	Border Archaeological Society
CAD	Computer Aided Drawing
CBA	Council for British Archaeology
CD	Compact Disc
CRO	County Records Office (Local Authority based)
DEM	Digital Elevation Model
DETR	Department of the Environment Transport and the Regions
DoE	Department of the Environment
DoENI	Department of the Environment Northern Ireland
DOS	Disk Operating System
DTM	Digital Terrain Model
DVD	Digital Versatile Disk
DXF	Digital Exchange Format
EC	European Community
EDM	Electronic Distance Measure
EH	English Heritage
ES	Environmental Statement
ESA	Environmentally Sensitive Area
FMW	Field Monument Warden
GIS	Geographic Information Systems
GPS	Global Positioning System
HBMCE	Historic Buildings and Monuments Commission for England (English Heritage)
HELICS	Handbook for Enumerating Listing and Illustrating Cup-and-ring Stones
HMSO	Her Majesty's Stationery Office
HS	Historic Scotland
IAG	Ilkley Archaeology Group
IAM	Inspectorate of Ancient Monuments
IEA	Institute of Environmental Assessment
IFA	Institute of Field Archaeologists
IFRAO	International Federation of Rock Art Organisations
IT	Information Technology
LPA	Local Planning Authority
LUSS	Land Use Stock System
MAP2	Management of Archaeological Projects - Second edition (English Heritage 1991)
NAG	Northern Archaeological Group
NAR	National Archaeological Record
NCC	Northumberland County Council
NGO	Non-Governmental Organisation
NMR	National Monuments Record
NNR	National Nature Reserve
NOAA	National Oceanic and Atmospheric Administration
NP	National Park
OS	Ordnance Survey
PC	Personal Computer
PD	Project Design

PSAN	Proceedings of the Society of Antiquaries of Newcastle
PPG	Planning Policy Guidance (issued by the DoE)
RAD	Rock Art Database
RATS	Rock Art Tagging System
RCAHMS	Royal Commission on the Ancient and Historical Monuments of Scotland
RCHME	Royal Commission on the Historical Monuments of England (now part of English Heritage)
RSM	Record of Scheduled Monuments
SAM	Scheduled Ancient Monument
SI	Statutory Instrument
SLR	Single Lens Reflex camera
SM	Scheduled Monument
SMR	Sites and Monuments Record
SPA	Scottish Palaeoecological Archive
SSSI	Site of Special Scientific Interest
TS	Total Station (method of field survey using an electronic theodolite and data-logger)
UA	Unitary Authority
UK	United Kingdom
WDC	World Data Centre for Palaeoclimatology
WHS	World Heritage Site
WYAS	West Yorkshire Archaeology Service

GLOSSARY

Anthropomorphic: Suggestive of a human form.

Carving: Term widely used in the United Kingdom to mean "rock art" (s.v.).

Composite motif: A repeatedly occurring combination of motifs, for example cup and ring.

Coverage: A single digital map layer, which may display many different feature types, within a Geographic Information System.

Cupule: See cup mark.

Cup mark (also, cup): Small, artificial curvilinear depression in a rock surface.

Differential Correction: The process by which the intentional degradation of satellite signals introduced by the United States Department of Defence is corrected in GPS readings. This involves the comparison of data collected by a GPS base station with that collected by a roving GPS receiver so that the difference can be subtracted from the rover data.

Element: One component of a composite motif.

Engraving: Term widely used in the United Kingdom to mean "rock art" (s.v.).

Georeferencing: The process by which the features on a map are linked to a co-ordinate system such as the Ordnance Survey National Grid system (OSGB36).

Mobiliary art (French: art mobilier): Portable rock art.

Motif: A repeatedly occurring mark that has been artificially created on rock.

Panel: A spatially delimited rock surface with art on it.

Patina: A surface alteration of rock due to chemical, physical or biological action.

Penannular: An interrupted or incomplete circular motif.

Petroglyph: Term used for any artificially created mark that is cut, engraved, incised, etched, gouged, ground or pecked into the surface of rock. Some rock art combines the techniques of petroglyphs and pictographs.

Pictograph: Term used for any artificially created mark that is applied with paint, wax or other substance onto the surface of rock. Some rock art combines the techniques of petroglyphs and pictographs.

Raster format: A spatial model using a mesh or matrix of regular grid cells to which attribute values and spatial information are assigned.

Rock art: An artificially created mark that is cut, engraved, incised, etched, gouged, ground or pecked into, or applied with paint, wax or other substances onto, a rock surface.

Site: A place where archaeological remains such as rock art are found.

Superimposition: The occurrence of one motif over another.

Triangulated Irregular Network (TIN): A series of irregularly spaces points possessing x, y and z values, which are converted into adjoining triangular facets in order to represent a three dimensional surface.

Vector format: A spatial model which represents map features using one (in the case of points) or a series (in the case of lines or polygons) of linked co-ordinate pairs.

Zoomorphic: Suggestive of an animal form.

EXECUTIVE SUMMARY

- This report presents the results of the Rock Art Pilot Project (RAPP) commissioned by English Heritage from the Archaeology Group in the School of Conservation Sciences in Bournemouth University and the Institute of Archaeology in University College London. Proposals arising from the material set out here are presented in a separate volume.

- RAPP was carried out between March and December 1999. The work was overseen by a Steering Committee, established by English Heritage, with a membership drawn from heritage organisations in the UK, archaeological consultants, rock art specialists, and academics. The preliminary results and conclusions were presented to a seminar of invited experts and interested parties held in London on 29th November 1999. The results of discussions at the seminar have been incorporated in the final text of the reports, together with comments from members of the Steering Committee.

- The purpose of the Pilot Project was two-fold: a thorough critical review of the current state of rock art studies, data availability, and study methods; and the development of a Project Design / set of proposals for future work. Although RAPP was confined to England in terms of its data gathering and assessment, wider catchments were used in reviewing the application of scientific techniques and the interpretation of rock art in its broader archaeological context.

- The main data sources used during RAPP were published and internet literature, interviews and inquiries, data held in the National Monuments Record (NMR), local Sites and Monuments Records (SMRs), and records held by private individuals and rock art study groups. Experimental work was also carried out in two sample areas: around Weetwood Moor in Northumberland and on Rombald's Moor in West Yorkshire.

- Rock art is widely scattered across the British Isles, although there are a number of marked concentrations such as in West Yorkshire, Northumberland, and Galloway. These in part reflect the pattern of archaeological activity. Rock art has been recorded in Britain since the late 18th century, although it remains a relatively neglected aspect of the historic environment.

- In Britain rock art occurs as open-air panels, monument-based panels, and mobiliary panels. The range of motifs is fairly restricted compared with the repertoire documented in other areas of northern Europe. There is some regional variation in the range of motifs represented in different parts of the British Isles, but analysis of this is hampered by the absence of a consolidated corpus of British rock art sites. It is believed that most British rock art dates to the period between 4000 and 1500 BC.

- It is estimated that there are 1600 rock art panels in England. The most widely represented motif is the cup-mark. This motif is found all over the world in many different contexts, and is believed to be the oldest motif represented in the archaeological record.

- An assessment of the regional, national, and international importance of rock art in Britain reveals its value both as an academic resource and a very visible and publicly accessible component of the historic environment. Some rock art sites are protected as Scheduled Monuments; perhaps as many as one-third of known rock art sites lie within National Parks. Difficulties in precisely quantifying the extent of rock art in England were encountered during RAPP, mainly because of inconsistencies between recording systems and the definitional problems associated with the creation of records relating to this kind of archaeological material. Across England as a whole, the most comprehensive records are those held by private researchers.

- A rapid national survey of rock art and its distribution revealed that very little investigation has been carried out at or around rock art sites. Most of the excavations that were documented related to monument-based rock art where discovery of the panels was incidental to the aims of the work. There is very little environmental evidence relating to areas where rock art sites are frequent.

- The main threats posed to rock art sites are described and assessed, including the issues of chemical weathering, physical weathering, biological weathering, and human damage. Rates of loss vary between regions and cannot be quantified in national terms because of the poverty of the record. In the area of the Aire, Wharfe, Washburn and Nidd watersheds in West Yorkshire, 26 panels are known to have been destroyed during the second half of the 20th century. Quarrying and agricultural improvements are the main causes of recent losses.

- A wide range of survey methods for the plotting and georeferencing of panels was investigated and subject to field trials within the two sample transects. It is concluded that the most effective system involves combining survey grade GPS to provide survey stations followed by GPS, or (in wooded areas) total station plotting of individual panel outlines and the recording of reference points on panel surfaces.

- A range of contact and non-contact methods of recording motifs on panel surfaces were tested and evaluated. Each had strengths and weaknesses, and a critical factor was what the images produced were intended for. In creating a basic record of British rock art it was found that drawing and conventional photography provided high quality images at modest cost. At the other end of the spectrum laser scanning, although costly, provided an extremely high quality record of the panel surface in the form of a digital model of the micro-topography. The data generated by this method can be used to make replica surfaces as well as graphic images. For detailed long-term monitoring of panel surfaces, digital imaging through laser scanning provides the best available method of high-resolution recording.

- An experimental GIS-based record system was established to provide a means of storing and manipulating available records. By using multiple layers, the system can be sensitive to the various sources of data available. It is recognised that for the creation of a National Rock Art Index it will be necessary to collect a consistent set of information and that appropriate data standards will need to be developed and agreed.

- Detailed reviews of approaches to dating rock art and scientific methods for conserving rock art panels and providing protection from particular threats are presented, together with accompanying bibliographies.

- Current approaches to the presentation and display of rock art in Britain and abroad are reviewed. It was found that in England there is relatively little active management and presentation of rock art for public access.

- Appendices providing thematic bibliographies are provided on rock art interpretation, chronology and dating; conservation studies and resource management; European rock art studies; and world rock art studies.

- Overall, it can be concluded that there is an urgent need for further work on British rock art as it is under considerable threat and is a relatively understudied and undervalued component of the historic environment. There is no corpus of British rock art, although a number of regional studies are available. In the past the process of recording rock art has focused on the location of panels rather than the motifs represented; this balance needs to be redressed.

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1. INTRODUCTION AND BACKGROUND

1.1 Background

1.1.1 Prehistoric rock art has been recognised in the British Isles since the early days of antiquarian and archaeological inquiry and has since provided a useful, if often peripheral, element in understanding the exploitation of land and landscape by prehistoric communities. The few dedicated researchers, many of them amateur archaeologists, who study rock art will testify to the growing popularity of this subject given the number of private archives, conferences, seminars, courses and discussion groups that now exist. However, fundamental limitations to the study of rock art still remain. Rock art is well known, but not known well, and in Britain it is rarely referred to in detail.

1.1.2 The situation is, however, changing and over the last decade or so, researchers have tried to overcome these problems with new approaches, for example, by studying the landscape context of rock art. Alongside the serious attempts at recording made by amateurs and archaeological groups in areas where rock art is concentrated, this portion of the recorded resource is slowly being enhanced. A conservative estimate suggests that some 1600 panels exist in England. This is based on the calculations and projections of records retrieved or consulted using several sources (see Chapter 5). In this sense, the number is just an estimate and hides a complex series of definitions about what is regarded as rock art items by different archives and sources. In England, rock art is still not only poorly recorded but it also faces the same range of pressures as other monument classes found in the countryside. It is commonly believed to be under considerable pressure and at high risk of damage or destruction from normal land-use practice. The effect of one ploughing episode or localised quarrying is likely to cause the wholesale destruction of panels or individual motifs whereas similar activity may only cause peripheral damage to larger monument types. Exposed panels are at higher levels of risk from decay and wholesale destruction than other monuments because they are generally small, friable, and often obscured by low vegetation cover. Inevitably, motifs have been lost to natural decay and anthropogenic forces at various points in antiquity and in the recent past, and many of these have been lost without record. There is, therefore, a sense of urgency now to explore the archaeological character and vulnerability of this element of our prehistory, as the pressures facing archaeological resources in general continue, often unchecked. Field visits reveal just how vulnerable these motifs are in comparison to other elements of the archaeological record. Motifs have been reduced from clear, distinct shapes (complete with tool marks) to smooth surfaces where only the most ideal lighting conditions reveals their outline.

1.1.3 The relationship between discovery and survival is not clear. Many records are only available through private sources and are somewhat more difficult to investigate than those available more publicly through local authorities and national heritage agencies. Discovery and field investigation is difficult as the majority of motifs are found at low level or ground level, often obscured by vegetation cover. Indeed, the physical nature of many of the ground level outcrops visited suggest that there is either more of the panel to be revealed or further panels buried below accumulated layers of vegetation and soil. In this sense then, the potential for discovery of new panels (i.e. the extant unrecorded portion of all petroglyphs that were created in prehistory) remains strong.

1.1.4 The potential contribution of rock art studies to archaeology has been elaborated previously. In the recently published *Archaeology Division Research Agenda* document (English Heritage 1997), English Heritage recognised several gaps in our understanding of rock art and its contribution to a knowledge of the past. Listed study themes include the more precise identification of site locations; the placing of rock art sites into a geographical and inter-monument context; the assessment of this resource and its survival potential and the recommendation of further research strategies, especially for monument conservation and management (English Heritage 1997, 47).

1.1.5 There are many uncertainties surrounding the place of the United Kingdom's prehistoric rock art in archaeological studies. This report sets out the results of a pilot study into the prehistoric rock art of the United Kingdom, with special attention paid to England. The work was conducted by a joint research team from the School of Conservation Sciences, Bournemouth University, and the Institute of Archaeology, University College London.

1.2 A pilot project

1.2.1 In September 1998 English Heritage issued a Project Brief and invitation to tender for a Pilot Project entitled *The research, conservation, management and presentation of prehistoric rock art in the UK*. This followed a series of discussions with archaeological curators, individual researchers and other interested parties over the preceding two years. A proposal and project design compiled by a partnership of two organisations: the Archaeology Group, School of Conservation Sciences, Bournemouth University and the Institute of Archaeology, University College London, was accepted and pilot work was carried out between February and December 1999. The project, termed RAPP (Rock Art Pilot Project) was overseen by a steering committee and managed for English Heritage by Alex Gibson and Henry Owen-John. The project was formally launched on 4th June 1999 and attracted considerable media coverage (e.g. local and national television, radio and print news companies and see also APPENDIX A).

1.2.2 In presenting this report, the guidelines for the preparation and management of archaeological projects as set out in MAP2 (English Heritage 1991) have been followed with minor adaptations to suit the special needs of this work which is essentially of a research nature. This report represents the fourth element of the MAP2 scheme (English Heritage 1991, Figure 2), the first of which is a "review". It is anticipated that this will lead to the production of new proposals for a series of projects.

1.2.3 A process of public and professional consultation throughout the period of piloting work involved the distribution of a newsletter and holding a professional seminar on 29th November 1999.

1.2.4 In summary, piloting work has involved the desk-based investigation of the state of rock art studies in England in particular and the United Kingdom in general, within the context of rock art research in Europe and the rest of the world. Archaeological records relating to rock art sites from a variety of sources have been gathered, analysed and presented. Field-based recording and monitoring methodologies have been tested.

1.3 Definitions and parameters

1.3.1 There is currently no single, unified, and widely accepted terminology to describe many of the fundamental ideas in the study of rock art. Even the words 'rock' and 'art' are loaded with different meanings. A working definition of United Kingdom rock art was set out in the project design as:

> *Symbols, shapes, lines, or other images and designs cut, engraved, incised, etched, gouged, ground or pecked into the surface of stone boulders, slabs, or surfaces, whether forming part of the natural bedrock, earthfast or incorporated into a structure.*

In the light of research undertaken, a simpler and more generalised version of this is preferred and so rock art is now therefore taken to mean:

> *Any artificially created mark that is cut, engraved, incised, etched, gouged, ground or pecked into, or applied with paint, wax or other substances onto, a rock surface*

1.3.2 A glossary is given at the start of this report and the terms used here refer to these definitions unless otherwise specified. It is hoped that the glossary will develop over the review period, so that a commonly accepted set of definitions can be developed for use in the United Kingdom context.

1.3.3 In the Project Design three levels of definition appropriate to recording rock art were identified: **Site** as simply meaning a place where rock art occurs without prejudice to physical size or extent; **Panel** to refer to any spatially delimited rock surface with symbols or designs (there may be several panels within a site), and provides the main unit of record for the purposes of identification and analysis; and **Motif** to refer to a repeatedly occurring artificial mark within a panel e.g. spiral, cup and ring (an individual panel may comprise one or more motifs). The scheme draws on that originally developed by Ian Hewitt (Hewitt 1991) and has been followed throughout the pilot project and subsequent sections elaborate upon the terms.

A number of authorities have considered the classifications and categorisation of rock art panels and motifs, and these are discussed in detail below in Chapter 3. In the Project Design, the following three style-groups were recognised:

Passage-grave art epitomised by the Boyne Valley carvings in Ireland but with isolated pockets elsewhere such as at Pierowall, Westray, Orkney, and Calderstones, Liverpool. This form is characterised by spiral motifs, sometimes inter-linked to form extravagant designs.

Cup-and-ring motifs, a somewhat simplistic description of a rather more complex phenomenon which can include a variety of curvilinear grooves and variations upon a theme. In most cases spirals are absent and this may be regarded as one defining feature; clusters of cups are also common. They are sometimes described as *Galician* in style because they resemble examples from that area of the Iberian Peninsula. In broad terms, the principal concentrations are in Argyll, Galloway, Aberdeen, Tayside and the Ayr / Edinburgh / Glasgow triangle (Scotland); Cumbria, Durham, Northumberland, Yorkshire and Peak District (England); and southwest Ireland. Within this group some significant regional variations can be seen, for example ladder motifs in Yorkshire, keyhole designs in Scotland and sharp angular grooves in the Peak District. In some cases it is even possible to perceive characteristics which might be the work of the same individual (e.g. West Horton, Northumberland).

Miscellaneous forms, which include axes and daggers (e.g. Badbury, Dorset [Durden Collection, British Museum]); Stonehenge, Wiltshire; Kilmartin, Argyll), labyrinths (e.g. Rocky Valley, Cornwall; Hollywood, County Wicklow), anatomical (e.g. Pool Farm, Somerset [now in Bristol Museum]), lozenges (e.g. Cairnbaan, Argyll), and zoomorphic (e.g. Goatscrag, Northumberland). The southwest of England contains an assortment of these erratics in addition to cup-and-ring examples.

These provide a useful starting point but require some adjustment in the light of perspectives offered below in Chapter 3. The revised groups are:

British open-air rock art, where the motifs occur on rock outcrops, boulders of natural rock faces in Britain (see for example Figure 1.1);

British monument-based rock art, where the motifs occur on the faces of stones incorporated into the fabric or structure of a deliberately constructed monument. Some of these pieces may have been open-air rock art before being incorporated into a monument, others were created during monument building (see for example Figure 1.2);

British mobiliary rock art, where motifs occur on the surface of stones that have been re-located from their source and moved one or more times. These are essentially portable pieces of rock art. The date of their relocation is rarely known, but is not necessarily ancient (see for example Figure 1.3).

1.3.5 Prehistoric rock art in the United Kingdom is generally believed to be mainly of Neolithic and Bronze Age date. Ambiguity over origins exists because very few panels have been specifically and properly investigated through archaeological excavation and complementary field techniques. Conventional dating methods (both absolute and relative) are often inapplicable. There are however, a few notable exceptions which have helped to place the motifs within a more restricted time band, and these, along with examples more thoroughly investigated, are described in Chapter 7.

1.3.6 Specifically excluded from this study are any Palaeolithic mobiliary art and all later prehistoric, Roman and medieval rock art or decorated stonework such as grave-slabs, memorial stones, crosses and mobiliaries. Also excluded is any consideration of painted or drawn rock art, mainly on the basis that there are currently no authenticated examples in Britain. Furthermore, there are two other classes of object which could be considered within the term 'rock art', but for the purposes of this project they have been deliberately excluded. These are hill-figures cut into the downland of Southern England, and small pieces of shaped rock that are decorated or ornamented in various ways, for example carved stone balls and plaques.

1.3.7 The geographical limits of the Pilot Study can be seen at a number of levels. The primary focus and the area within which the data collection surveys were carried out is England and its associated offshore islands such as the Isle of Wight and Isles of Scilly. In the general discussion, however, account is taken of the situation covering the United Kingdom as a whole. On a still wider scale, the United Kingdom's material is set within a broader European and global context.

1.4 Document organisation and structure

1.4.1 This document is one of two report volumes produced as part of the pilot study, the second being Proposals for future directions. This report, represents the principal output from the Pilot Project, and is organised into three sections:

Main report: Text
Figures and tables
Appendices

Within the Project Brief, and carried over into the Project Design, was the suggestion that the Pilot Project would lead directly to the preparation of a Project Design for a "main project". During the course of carrying out the Pilot Project it became clear that a single monolithic main project would be impractical. Instead, it was decided that the documentation of the Pilot Project should focus on the range of options that could be followed, so as to inform the review stage and allow the closer formulation and prioritisation of further initiatives.

1.4.2 The body of this report is organised as nine chapters that broadly follow the key aims and objectives noted in the Project Brief.

1.5 Pilot project archive arrangements

1.5.1 A body of research information and associated material was compiled throughout the course of the piloting work and has been stored at Bournemouth University and UCL. It is available for consultation by appointment with either organisation and or a designated representative of English Heritage. The elements of the Project archive are:

- Rock art core data derived from SMRs, NMRC and private collections (e.g. RWB Morris for England only)

- Draft database and GIS framework (created using *Paradox* V7 and *Arcinfo* software programmes)
- Draft database documentation
- Field work data for two sample transects comprising database, GPS and TS files; digitised drawings and images;
- Digital version of the Project Design
- Rock art copy articles filed under core research themes
- Correspondence and administration files

2. ACADEMIC SCOPE, AIMS, AND OBJECTIVES

2.1 Pilot Project aims

2.1.1 For more than a decade now it has been recognised that prehistoric rock art represents a significant, and potentially highly important element of the archaeological record relating to the period broadly conceivable as the later Mesolithic through to the middle Bronze Age, 5000-1000 BC. Equally it has been recognised that the nature, extent, preservation, condition and potential of rock art is poor, and, in general, inadequate for the detailed planning of any national initiatives relating to the conservation, management, study and presentation of the material itself of the knowledge that it represents. In the language of the recently established trend for research frameworks (English Heritage 1997), there was no resource review, no adequate agenda and no future strategy. Although not explicitly stated as such, the overarching aim of the pilot project as set out in the initial Project Brief could therefore be interpreted as a movement towards a "universal framework", that would itself embrace the core notions of a "research framework" and a "management framework". This is reflected in the two general aims identified in the Project Brief as:

- To carry out and report a series of thorough reviews, tests, and experiments in order to establish the current state of rock art studies, data availability and quality, relevant study methods, and the intellectual, academic, practical and methodological basis for a wider study of rock art;
- To provide a draft Project Design and associated documentation for a larger programme of work, the Main Project, which would be United Kingdom based and which would aim to create a full record and analysis of British rock art.

As already indicated, the second of these two aims has been modified to lead to the development of a set of proposals that set the parameters of a universal research framework, rather than a specific main project.

2.1.2 In developing these aims a number of assumptions were made, notably that rock art should be seen as a sub-set of the archaeological resource and that as such it must be conceived as being finite and fragile. Like many elements of the archaeological resource it was recognised that it occurs as a discrete element broadly equivalent to a monument class (i.e. individual rock outcrops and boulders) as well as components of other monuments through intentional or non-intentional incorporation. Following the initial Project Brief, the Pilot Project was developed with six specific objectives. These were as follows:

A1 To underline the importance of British rock art in a European and wider context;

A2 To establish the quality of existing locational information, to recommend cost effective survey techniques, including community involvement which would enable the assembly of adequate baseline information on rock art in its cultural and topographical context, and to recommend how these data could be best stored and used. This aim included the appraisal of techniques of micro-recording of individual panels and macro information on archaeological context;

A3 To review existing scientific methods of assessing the condition of rock panels and decay trajectories and to recommend techniques for the future;

A4 To document the threats to the survival of rock art, to detail ways in which these threats may be averted and to identify those areas where the resource is most at risk;

A5 To assess existing ways of increasing public appreciation and understanding of rock art and to recommend how to improve the comparatively low level of perception which exists at present.

A6 To generate a Project Design for further work, if possible on a United Kingdom-wide basis.

A7 Potential funding sources need to be considered.

The degree to which these aims were successfully met is discussed in a separate volume which deals with proposals.

2.2 Aims to objectives

2.2.1 In developing the above aims into meaningful research targets and specific jobs, twenty objectives were identified. These are listed below under each of the research themes outlined above.

2.2.2 *A1 Importance:*

OB1 Provide a clear statement on the importance of prehistoric British rock art within the context of European landscape archaeology

OB2 Produce a concise report summarising the main conclusions of the Pilot Project, including all the areas covered by the above aims

OB3 Produce a well-structured project archive to support the conclusions of the report

2.2.3 *A2 Survey and record:*

OB4 Document and assess the extent and accuracy of existing records which provide locational information on prehistoric rock art in England

OB5 Document and define those groups of carvings in England where existing locational details are adequate for management purposes (e.g. 8 or 10 figure NGRs, mapping at 1:10,000 scale or larger, and where the location is likely to be understood by land managers)

OB6 Identify the principal geographical areas in England where there is inadequate locational information

OB7 Establish the most cost effective techniques of providing accurate locational records, and assess how local communities could best be involved in this process, in particular taking account of the combination of GPS and TS survey as used in the MPP

OB8 Document and identify those areas where adequate survey and palaeoenvironmental information exists to enable rock art to be set in a cultural, natural, environmental, and topographical context, and where the opposite is the case

OB9 Assess the importance of the cultural/environmental/topographical context to recommend and define appropriate levels of survey work for future research

OB10 Assess the extent of regionality and local distinctiveness and, where possible, to define provisional regional groups on the basis of style, location etc.

OB11 Recommend the most effective way of storing, curating and using existing data, and those which may be acquired in future

2.2.4 *A3 Condition:*

OB12 Document and assess the techniques currently used in the scientific research of rock art to develop understanding (e.g. dating), and to test how such work could best be advanced

OB13 Document and assess the techniques currently used to record the microtopography of rock art (e.g. carbon cloth rubbing) and to test those methods suitable for the establishment of a benchmark against which condition can subsequently be monitored

2.2.5 *A4 Preservation:*

OB14 Identify, with specific examples, the most significant threats to the survival of rock art; land-use (e.g. quarrying, agriculture, visitor erosion); weathering and chemical degradation; and neglect and lack of understanding

OB15 Identify (using data obtained form the previous objective) where rock art in England is most severely under threat, so that areas can be specifically targeted for action in any wider programme of work

OB16 Identify, list and describe the most effective means by which such threats can be overcome, and assess the practical difficulties in implementing such techniques

2.2.6 *A5 Presentation:*

OB17 Document and assess the various ways in which rock art is being presented on site and in museums, and to list other methods being used to increase public understanding and appreciation both within local communities and for visitors

OB18 Recommend the best methods of increasing public understanding and appreciation of the resource, without endangering its conservation

2.2.7 *A6 and 7 The future:*

OB19 Develop a Project Design for a wider programme of work, built around the aims set out above, as amended by the results of the Pilot Project

OB20 Identify potential sources of funding

2.3 Pilot Project programmes and data sources

2.3.1 It was seen as important from the outset that research undertaken throughout the Pilot Project was focused as much on understanding and articulating the problems and opportunities in a United Kingdom-wide study of rock art, as on providing complete coverage or major new insights. Indeed this scoping exercise has defined new, and refined existing, academic questions to be addressed in a wider programme of work. Desk-based research was therefore complimented by experimental fieldwork, project-specific IT development, project management studies (for example logistical planning, time and motion studies) and communication and feedback (through newsletters, media contact and publicity, seminars and advisory group meetings).

2.3.2 Specific work programmes and tasks-sets were designed in order to meet the objectives listed above. All relied upon receiving information, advice, and support from others, for example local authorities, equipment suppliers and those with local knowledge of rock art in specific regions. The key sources consulted during the piloting work were:

English Heritage Ancient Monuments Laboratory
English Heritage National Monuments Record (NMR)
English Heritage Record of Scheduled Monuments
HELICS archive
Ilkley Archaeology Group archives
Local authority Sites and Monuments Registers (See Chapter 5)

Northumberland County Council (SMR)
Royal Commission on the Ancient and Historical Monuments of Scotland (Morris archive)
Stan Beckensall archive
West Yorkshire County Council (SMR)

2.3.3 The work programmes devised to meet these objectives comprised the following:

2.3.4 Desk-based research:

Researchers based at Bournemouth and London, carried out a series of literature reviews based on material collated from university libraries, inter-library loans, and information taken from the internet. Copies of a selection of the articles explicitly referred to are available within the Project's archive. This has been drawn upon in chapters three to nine. A series of thematic bibliographies were also constructed from this work, and these appear as Appendices I-L. Appendix B lists those internet sites identified as containing useful information on rock art.

2.3.5 Sample areas and fieldwork trials:

2.3.5.1 Two sample transects were identified in the Project Design as being suitable for testing methods and procedures relevant to the pilot project periods of intensive field survey were carried out in Northumberland (14th to 24th May 1999) and West Yorkshire (26th July to 6th August 1999). The transects were selected on the basis of presence of known concentrations of rock art panels, accessibility, and potential for comparison of field recording with private archives. In these respects they are not necessarily representative of other areas in England where panels are poorly recorded and sparsely distributed, but they were well suited to the purposes of the field trials.

2.3.5.2 The first transect is located approximately 25km south of Berwick-upon-Tweed, Northumberland and lies on the southern edge of the Milfield basin. Fieldwork was scheduled over a ten-day period to evaluate individual recording techniques and equipment. A 3x2km study area was chosen and is centred on Weetwood Moor and Whitsunbank Hill, Berwick-upon-Tweed, Northumberland (Pathfinder map No. 476 Chatton and Ellingham. Sheet reference NU02 NW). Topographically the immediate ground undulates for several kilometres to the east and to the west after a kilometre or so dips steeply towards the river Till and onto the town of Wooler. Land-use in the area is a mixture of permanent grazing, cropped land and maturing conifer plantations. Many of the panels visited lie within the bounds of private land whilst the remainder are found on open, common moorland.

Study area southwest grid co-ordinate:	400000, 627000	Westsouthwest of Coldmartin Farm
Study area northeast grid co-ordinate:	403000, 629000	West of Bountree plantation

2.3.5.3 Once a base and temporary office had been established, preparatory research and data collection was undertaken, a scheme for fieldwork was drawn up and subsequently fieldwork was conducted. An initial tour of all panels in the transect revealed the scale of work to be undertaken, and tests were revised and a more realistic plan prepared. Work involved the use of SLR and digital photography, survey-grade GPS and total station recording systems and, conventional drawing techniques to compare the ways in which rock art panels could be recorded. Panels were found on a mixture of the three land-uses and it was noted how much the study area in general was used for recreational activities such as dog-walking, and cross country running.

2.3.5.4 The second transect, lying at the western edge of Rombald's Moor, between the towns of Keighley and Ilkley, West Yorkshire, marks the high point in the immediate area (360m OD). The ancient monuments and specifically the rock art panels on this and adjacent moors (Ilkley Moor to the north, Bingley and Hawksworth Moors to the east), are relatively well studied. They are found within the grouse and partridge moors of local estates, permanent pastures, private commercial plantations, and open moorland which characterise the wider countryside to the north of Bradford. Fieldwork was scheduled over a nine-day period to test new recording and representation techniques, to refine previously tested methods, and to trial general survey strategies which might be employed in the future. A 3x1km horizontally aligned study area was selected and is centred on Rivock Edge, the southwest area of Rombalds Moor, West Yorkshire (Explorer map No. 27 Lower Wharfedale and Washburn Valley).

Study area southwest grid co-ordinate:	407000, 444000	North of Marsh Farm
Study area northeast grid co-ordinate:	410000, 445000	at Brown Seaves (west of Ilkley road)

2.3.5.5 The aim of fieldwork in both areas was to field test the suitability of a number of methods for identifying and recording panel and related attributes in the field. In the case of work carried out in West Yorkshire, the field team was able to refine techniques learnt in Northumberland and so additionally, it was possible to start compiling a series of survey levels appropriate to different recording criteria / priorities. This second period was also used as a means of refining realistic field recording conditions for future work. Collectively then, work in the two areas had the following objectives:

- to compare the variation, if any, in records from a variety of sources (SMR, NMR and private archives) relating to individual rock panels in the area;
- to test and evaluate a variety of established and novel recording equipment and techniques, and;
- to record the practical arrangements for organising fieldwork (staffing, resources, access and permissions, time and motion studies, risk assessments, fieldwork limitations).

The reviews and test results from the fieldwork are presented in Sections 7.3, 7.4, 7.5, and the main techniques tested and equipment used are listed in Table 7.1.

2.3.6 Information technology

2.3.6.1 The use of Information Technology (IT) lies at the heart of any future work on United Kingdom rock art, especially in relation to assessment and making high quality information on the nature, extent and distribution of rock art available. Accordingly, several applications were examined during the Pilot Project in order to develop identification, recording, analysis, and presentation tools. IT is already a significant element of national rock art programmes in other European countries, especially in Sweden, Norway and Denmark (for example, see Jensen 1996). This work has had a major influence on thinking about similar problems in the United Kingdom. A relational database where thematic data on rock art panels is stored in separate tables linked by panel number was designed using Paradox 7 for Windows. This database comprises 18 tables and 39 look-up tables (see APPENDIX C) which streamlined new and existing data on rock art sites using controlled vocabulary. The database is capable of storing images and enables users to conduct sophisticated data queries. In the context of the Pilot Project field trials paper records were used, though data could in future work be directly input via a digital recording form.

2.3.6.2 Database records were imported into a Geographic Information System (GIS) using *Arcinfo* 7.2.1 software. The GIS allowed spatial attributes, qualitative data, and images to be linked for analytical and display purposes, including the investigation of distribution patterns via queries and proximity and overlay analysis, and accessing database records via a digital map. To facilitate the presentation and distribution analysis of rock art sites, digital landscape data was obtained for the sample transects, in vector (co-ordinate based) format from three data sources:

- Edina Borders map data displaying county boundaries and the coastline for England was sourced from an on-line catalogue and downloaded for use in *Arcinfo* coverages.

- Two 20x20km tiles of spot height data were purchased from EDX. This data, supplied as points recorded at 50m intervals, was first transformed into a surface, and then converted into contour lines in *Arcinfo*.

- Landline Plus data was purchased from Ordnance Survey in the form of four adjoining 1x1km tiles for use as a study area basemap in display. This data comprises lines depicting a 100m interval grid, field boundaries, water features, forested areas, roads, paths, archaeological features, buildings and colour-coded annotation.

These coverages were then overlaid with maps featuring rock art locations derived from existing data sources, panel positions, and panel and motif plans recorded during the Project's field trials. The analyses carried out for the Pilot Project are, because of their scale, indicative rather than comprehensive.

2.3.6.3 Existing rock art site data was available in digital form from some Sites and Monuments Record Offices, National Park Offices, and English Heritage's Monuments Protection Programme. Database extracts from these sources were supplied in various formats (*Oracle, Microsoft Access, Microsoft Excel*) and were reformatted for import into the Project database. In addition, rock art location co-ordinates from private sources, such as work published by Morris (1989) and paper records collated by Hewitt, were manually input into Microsoft Excel files for use in map display and analysis.

2.3.6.4 During the Project field trials, a range of equipment was used to create digital maps and images. A Total Station was used to experiment with detailed manual recording. These included recording panel positions, planning panel outlines, directly recording motif edges using a detail prism, and creating three dimensional models of the rock art panels. The plans recorded by the Total Station were edited using SDR Mapping and Design 6.5 software and incorporated into the GIS.

2.3.6.5 Three grades of Global Positioning Systems (GPS) were employed in recording spatial attributes. GPS receivers use a constellation of United States owned satellites to rapidly obtain location co-ordinates. For increased co-ordinate accuracy, differential correction must be conducted using base station data to compensate for the intentional accuracy degradation introduced by the U.S. Department of Defense. The System 500 survey grade GPS recently released by Leica, the Fastmap for GIS GPS from Survey Supplies, and a Garmin 12 hand-held unit were tested. Panel positions were recorded with all three models, and the outlines of the rock panels with the survey grade and Fastmap units. A single base station located in the centre of the Northumberland study area provided real time differential correction for the survey grade GPS data. The Fastmap unit relied on differential correction using a beacon data signal from a coastal station. The GPS data was edited in manufacturer-supplied data transfer software and used to generate a GIS map coverage.

2.3.6.6 Digital images recorded using a range of equipment were incorporated into the Project database to create an image archive, and 'hotlinked' to some of the panels in the GIS allowing access via digital maps. A ModelMaker Laser scanner was tested, in order to record the three dimensional surface of a number of panels in sub-millimetre resolution. Using a 3D animation software package, 3D StudioMax the lighting, view angle and z factor (height) was manipulated in order to create views of the petroglyphs in optimum conditions. Two Sony digital cameras, one with macro capability, were used to photograph both general panel and context views, as well as photographing motifs parallel to the panel surface. Standard black and white and colour photographs were digitised on a flat bed scanner. Using a digitising table, motif plans created using hand drawing methods (scale drawings, rubbings, tracings) were input into the Project database as images, and into GIS coverages as georeferenced plans.

2.3.6.7 These technologies enabled a diverse range of spatial, qualitative, and image data to be integrated into a unified system.

2.4 Professional seminar comments and public consultation

2.4.1 The Rock Art Pilot Project has provided a series of public consultations and briefings. In March 1999, a newsletter was circulated and comments requested. The formal launch of the Project on 4th June 1999 attracted considerable publicity and led to the further requests for comment and news. The final element was a professional seminar held on 29th November at UCL. This marked the end of the Pilot Project and the onset of discussions as to the most appropriate way forward and the shape and size of future programmes.

3. Rock art in England: the British and international perspective

3.1 Introduction

3.1.1 Viewed from a broad perspective, rock art is fairly widely scattered across the British Isles, although at a more detailed scale of analysis its occurrence is highly localised and clustered. Although RAPP is geographically confined to England, this chapter provides the general background by first looking at British rock art as a whole, and then by broadening the perspective still further to look at the European and world context for certain types of motif. Throughout, emphasis is placed on open-air sites although some attention is given to other situations in which rock art occurs.

3.1.2 This chapter is divided into three main sections. The first deals with the history of rock art studies in Britain. The second is concerned with the definition, character and interpretation of British rock art and the third with the wider international context of the most commonly occurring British motifs, cup-and-ring marks and cup marks.

3.2 A brief history of rock art studies in Britain

3.2.1 Interest in rock art has a long history within British antiquarian traditions. Colonel Montgomery made one of the earliest known drawings of British petroglyphs in 1785. It showed a cist cover from Coilsfield, Ayrshire, with a spiral and cup-and-ring marks. In the 1820s the site at Old Bewick, Northumberland, was found and published (Hadingham 1976, 136). In the following years more and more petroglyph sites were discovered in Scotland, Northumberland, and Cumbria. The pages of local and regional journals such as the Proceedings of the Society of Antiquaries of Newcastle upon Tyne and the Proceedings of the Society of Antiquaries of Scotland contain numerous notes of new discoveries and many high quality drawings. In 1852, W. Greenwell investigated and published the extensive rock art site at Roughting Linn, Northumberland. However, it was the publications by G. Tate (1865) and J. Y. Simpson (1867) with their detailed illustrations that made rock art known to a wider public. Tate published all available information on rock art sites in Northumberland in great detail, while Simpson provided a comprehensive overview of prehistoric rock art in Scotland and England (Simpson 1867). During the last quarter of the 19th and the first half of the 20th centuries a number of additional rock art sites were reported (Bruce 1869; Taylor 1883; Bailey 1888; Allen 1896; Lamb 1897; Thornley 1902; Christison 1904; Fergusson 1910; Garfitt 1924; Raistrick 1936; Cowling 1937; Young 1938; Miller 1949; Carmack 1949/50). These studies were mainly concerned with recording and describing petroglyphs, but many of them also featured speculation as to the meaning, function and origin of British rock art.

3.2.2 In the first half of the twentieth century a number of notable, and influential archaeologists became enthused by the rock art of Atlantic Europe, and began to give it a wider context. Notable among these was the A.H. Breuil whose presidential address in 1934 to what was then the Prehistoric Society of East Anglia, provided a landmark in the study of prehistoric rock art in the European perspective. He provided not only drawings of numerous individual stones and objects, but also the beginnings of categorisation systems that linked similar forms of motifs. He also recognised the fact that similar motifs occurred over wide areas and in many different contexts (Breuil, 1934). Some of Breuil's themes were later taken up by O.G.S. Crawford in 1957 in his book *The Eye Goddess* which provided an essentially diffusionist view of the development and chronology of Atlantic European styles. The same Atlantic theme was also followed up by H. Savory in a paper which connected British rock art with that of the Iberian peninsula (Savory

1973). Looking in other directions, eastwards and northwards, rock art provided an important strand of evidence in the synthetic discussions of the prehistory of eastern and central Europe by G. Childe (1957), in which amongst other things, he emphasised the pan-European use of the spiral motif from the Neolithic onwards. Graham Clark (1952) also made extensive use of rock art motifs in his study of *Prehistoric Europe: the economic basis*, but in this case he focused on the pictographic qualities of certain motifs to illustrate early practices such as hunting and the use of wheels.

3.2.3 Since the late 1950s, much of the work on rock art in Britain has been carried out by amateur archaeologists, notably Ronald Morris in Scotland and Stan Beckensall in northern England. Both authors have recorded rock art extensively in their areas of research and have tried to give it a broader setting. Beginning in the late 1960s, they published a series of books and articles containing information on the sites that they had recorded. However, since Morris' study of prehistoric rock art in Scotland was restricted to sites with motifs other than cup marks, his work could only take a partial view of rock art in Scotland (Morris 1977). Sites with cup marks as the only motifs comprise up to two thirds of all rock art sites in Scotland and are more widely distributed than sites with other motifs (Morris 1981). Beside the work of Morris and Beckensall a large number of additional sites have been published by a range of authorities (Lynch 1974; Trudgian 1976; Greeves 1981; Barnatt and Reeder 1982; Van Hoek 1982, 1991, 1992; Barclay *et al* 1983; Marshall and Morris 1983; Marshall 1985, 1986; Hartgroves 1987; Twohig 1988; Van Hoek and Smith 1988; Frodsham 1989; MacKie and Davis 1989; Stevenson 1993; Bettess 1995; Sherriff 1995). In Yorkshire, the members of the Ilkley Archaeology Group have recorded and published many sites, especially those at Rombald's Moor (Haigh *et al* 1987; Hedges *et al* 1986). In Scotland the Royal Commission on the Ancient and Historical Monuments of Scotland has published records of rock art sites in Argyll (RCAHMS 1988). These studies are mainly descriptive, but collectively record many hundreds of sites, and the pages of periodicals provided by county and local archaeological societies continue to bristle with notes about newly discovered panels or new motifs recognised on previously identified panels.

3.2.4 In addition to the descriptive material, rock art has also formed a key element in a range of broader studies that address wider and more general issues. One of the first of these can be traced in a series of papers by Alexander Thom (1968a, 1968b, 1988) who studied the geometry and metrology of British rock art. He claimed that what he terms a *Megalithic inch* (c. 2.07 cm) is the basic unit of measurement used in the spacing of cup marks and in the layout of cup-and-ring marks on the rock surfaces. This work was first supported, and then later negated, by A. Davis (1983, 1988), who used quantum analysis in the study of a group of petroglyphs in West Yorkshire. A fixed unit of measurement in the layout of motifs is no longer apparent if the number of sites studied is increased. Also, Thom's assumption that the curvilinear grooves of cup-and-ring marks were geometrical circles was shown to be incorrect (Davis 1988).

3.2.5 M. Walker (1977) suggested that territorial exploitation patterns can be deduced from rock art without necessitating an understanding of the meaning of the motifs displayed. In his study of rock art in Britain and in Galicia, northwestern Spain, Walker questioned why rock art is clustered in certain regions and seemingly absent in others. He showed that rock art sites in several areas were located on land intermediate in altitude between low-lying and mountain habitats. He also provided statistical correlations between the location of rock art sites and find-spots of other kinds of archaeological data. Palaeoecological reconstruction, rock art distribution and distributions of correlated artefact-types were used by Walker to predict trade routes, territorial exploitation patterns and socio-economic relations of prehistoric populations.

3.2.6 A rather different approach was taken by J. Steinbring and M. Lanteigne (1991) who focused on the positioning of motifs in relation to each other on the rock faces of Rombald's Moor, Yorkshire. They claimed that they could distinguish panels and that some groupings of petroglyphs on such panels were intentional, thus, for example, they claimed that the centre of the panels was often left empty. If patterning was indeed correctly identified, then their study may reveal interesting information about the use of motifs.

3.2.7 Since 1991 Richard Bradley has attempted to shift the emphasis of rock art studies away from imputed motif meanings to relationships between rock art and landscape. He studied the nature and visibility of motifs on the rock surfaces, as well as spatial relationships between rock art sites, monuments, settlements, and the natural topography. Based on the location of rock art sites in relation to ancient land-use patterns, Bradley claimed to be able to extract information on the socio-economic context in which rock art was created. Many of these sites are located on the fringes between upland and lowland areas or along possible access routes between lower and higher ground. Bradley suggested that petroglyph sites were situated so as to command views over the landscape or to line routes towards what he called important monument complexes. If accepted, such evidence shows that the sites could mark the movements through the landscape of at least seasonally mobile people who lead a pastoral, rather than an agricultural way of life (Bradley 1991, 1993, 1994, 1997).

3.2.8 C. Waddington (1998) in a study of the landscape context of rock art in the Milfield basin, Northumberland, has further expanded the relationships between rock art and landscape. Here he proposed a threefold temporal sequence for the development of open-air rock art in Britain, beginning in the early Neolithic. He claimed that the initial phase of petroglyph production could be linked to a "symbolic portrayal of the ideological beliefs which constituted the Neolithic (c. 4000-3200 BC) by mapping them on the landscape". This phase, according to the author, was characterised by a pastoral way of life, with petroglyphs marking destinations of localised transhumance movements. In a proposed second phase (c. 3200-2000 BC) which is characterised by increasing human control of nature, this symbolism "is reworked into 'man-made' megalithic constructions, which 'monumentalise' the landscape". A third proposed phase (c. 2000-1800 BC) sees the end of the tradition of petroglyph production in Britain, and the re-use of rocks with petroglyphs in burial contexts. Waddington claims that the various contextual associations of rock art in his area of study during the period from the early Neolithic to the early Bronze Age correspond to distinct episodes in land use. Fundamental changes in the exploitation of the landscape were connected with ideological and social changes, and consequently, with changes in the way the landscape was symbolically ordered (Waddington 1998).

3.2.9 The development of this second strand of rock art studies represents a shift from attempts to simply document the nature and distribution of sites towards attempts to understand the uses, purposes and symbolic contexts of rock art. However, it has focused attention on the quality of existing records of rock art sites, the extent to which the presently known distribution of sites is reliable, and whether the samples are large enough to allow meaningful conclusions about prehistoric behaviour to be made (e.g. Davies 1988, Sognnes 1994 on Steinbring and Lanteigne 1991)

3.2.10 A third strand of study which has been moving in parallel with the work just discussed is that relating to the rock art found on stones used in the construction of monuments and buildings, such as portal dolmens, passage graves, stone circles, standing stones, cists and burial cairns. Critical in these studies has been the recognition that rock art in these contexts is, in some cases, possibly the result of decorated stones being re-used or incorporated within later structures (e.g. Hewitt 1991). In other instances carvings were made on the stones during their erection and as an integral component of particular structures. Because of its frequent occurrence on the large stones used in so called megalithic monuments, this rock art is sometimes called "megalithic art" and has often been studied separately from rock art in other contexts (Twohig 1981).

3.2.11 Twohig (1981) provides a summary of the megalithic art of Western Europe, including a substantial corpus of drawings and illustrations. The largest increase in the corpus of such material in recent years has been linked to the investigations of major passage grave cemeteries in the Boyne valley of central Ireland, in particular Knowth and Newgrange (Eogan 1984, 1986, 1997; O'Kelly 1982; and see Herity 1974).

3.2.12 The excavation of rock art in England

3.2.12.1 To date, addressing archaeological questions about rock art through excavations appears to have been a rare occurrence in England. Where excavations have revealed rock art, this often consists of previously unknown panels, the discovery of which is incidental to the aims and objectives of the work. As a result, research questions such as the chronology of the motifs are seldom adequately addressed. Although not exhaustive, inquiries forming part of the Pilot Project lead to only a handful of recently excavated rock art sites, mainly monument-based panels. A number of these investigations deserve further comment.

3.2.12.2 Excavations of known rock art sites

- At Gardom's Edge, Derbyshire, three boulders featuring various motifs including multiple cup-and-ring marks and spirals were found during an early excavation of a large cairn (see Appendix B for internet reference). In 1996 the area surrounding the boulder featuring the most complex motifs was excavated in order to investigate whether activities which were contemporaneous with the rock art could be identified. The excavation revealed two stake holes, a polished shale ring, and some chert and flint flakes (see Appendix B).

- Several open-air panels (some visible prior to excavation) and small mobiliary stones were found within and around Fowberry cairn, near Weetwood Moor, Northumberland during an excavation investigating the relationship between the cairn and the outcrop panels (Beckensall 1999, 142-144). The only other artefactual evidence recovered was a flint scraper found in the deposit between the cairn and the outcrop rock.

- At Backstone Beck, Ilkley Moor, West Yorkshire, an open-air panel situated within an enclosure was investigated (Edwards and Bradley 1999). The aim was to investigate the relationship of three visible carved panels with artefact scatters. A fourth panel was found during the excavations. Two distributions of grooved ware and worked flint were found in close proximity to the boulders, as were areas of heat affected soil. Charcoal yielding a radiocarbon date of 2923-2613 Cal BC was found underneath one of the boulders in the enclosure, but in this case no rock art was visible (Edwards and Bradley 1999, 76).

- An excavation of a cist at Fulforth Farm, Witton Gilbert, near Durham is referenced in Beckensall (1999). The cist cover consisted of two stones featuring rock art. Excavation reports are forthcoming (Hammond *pers.comm.).*

3.2.12.3 Excavations featuring incidental rock art

- Numerous slate slabs with cup marks, and a variety of groove motifs were recovered during an excavation of Trugulland Burrow in Cornwall in 1955, as part of the Ministry of Works arable land improvement scheme (Ashbee 1958). Carved stones were found in the cairn-ring, the soil bank, the ditch infilling, and in unstratified contexts within the site. Ashbee (1958) compares one of the motif types, likened to an 'eyebrow', to those found in Boyne Valley sites in Ireland.

- The site of Flagstones near Dorchester, Dorset, revealed engravings on the sides of four pits that, combined with other unmarked pits, defined a segmented enclosure ditch dated to the 4th millennium cal. BC. On the lower parts of the chalk walls of each, various curvilinear designs had been engraved into the natural chalk. The largest (46 by 30.5 cm) and the smallest (11.2 by 21.2cm) of these were comprised of various inter-cutting curvilinear grooves, thought to have been made using an antler pick (Smith *et al* 1997). In the broadest sense, these fall within the scope of the Project's definition of rock art but the markings are certainly not representative of the majority of material reported here.

- During the excavation of a ring cairn (Barbrook II) in Derbyshire a cist capstone with an angular motif was revealed (Hart 1984). A charcoal sample associated with the capstone gave a radiocarbon date of 1500 bc ± 150 (Hart 1984, 57-8). However this stone has been reinterpreted more recently as having been broken into two sections, both of which were located in the cairn during a site visit (Hewitt 1991, 44). This suggests that the capstone may not have been in primary context within the cairn, in which case the sample cannot provide a date for the motifs themselves (Hewitt 1991, 44).

- Excavations of a number of the 30 barrows investigated by Croft Andrews during WWII in the face of airfield developments across the Cornish moorlands lead to the discovery and documentation of six cup-marked mobiliary stones (Christie 1985). The ditch and topsoil at Penhale Barrow, Nancekuke contained single fragments of, respectively, a shaped cup-marked stone and a 'holed and cupped' stone. Lousey Barrow, St Juliot contained a cupped pebble with two opposing hollows, possibly used as a hammer-stone, at the bottom of the surrounding ditch. Barrow 7 on Triligga Common contained four cup-marked stones, two being slate slabs, and two quartz. Barrow 2 featured a slate slab with multiple cup-marks, and single cup-marked stones were also found at the edge of the central cist, inside the mound's margin, associated with a burial, and inside the kerb.

- Three cup marked slate slabs were recovered in excavations of 'ritual hollow' and house features at Trethellan Farm, Newquay, Cornwall (Nowakowski 1991 153-55). These were all recovered from Bronze Age contexts, and ranged from occurring as paving stones (cup mark up), to simply forming part of deposits containing mixed materials.

- A palisaded ritual enclosure was revealed during an excavation of what had initially appeared to be a denuded round barrow in Cleveland (Vyner 1988). Twelve small cup and other marked stones were found in the later capping levels of the central feature and the palisade trenches. These levels are thought to date to the middle Bronze Age (Vyner 1988, 193).

3.3 Definitions, character and interpretations of British rock art

3.3.1 Terminology and definitions

3.3.1.1 The multiplicity of approaches that have developed within rock art studies, not least because of the highly localised or specialised nature of so much of the research, means that there is no agreed terminology for describing and analysing British rock art. A large number of different terms are widely employed, many of which have become loaded with meaning.

3.3.1.2 British rock art today is best known as *rock carvings* / *rock engravings* / *cup-and-ring marks* (the best known group of motifs lending its name to all of British rock art). A number of other terms are used less frequently, such as: *carved rocks, carved symbols, cup-and-ring art, cup and ring carvings, cup-and-ring engravings, cup-and-ring marked stones, cup-and-ring markings, cup-and-ring petroglyphs in the gallego-atlantic tradition, dot-and-circle marks, gallego-atlantic style, Galician style rock art, incised markings, inscriptions, North British style, petroglyphs, ring cuttings, rock markings, rock motifs, scribings, sculptured rocks* or *sculpturings*. Some of these terms are used by several authors, while others are confined to one author. Hewitt criticises terms such as *carving*, *engraving* or *incision* as making definite statements about the technique of manufacture, which in reality often seems to be pecking (Hewitt 1991, 17-18).

3.3.1.3 The term *cup-and-ring marks* is often used to describe British rock art in general. *Cup and ring marked stones,* as used in the Monuments Protection Programme, Single Monument Class Description (English Heritage 1990), include stones and boulders with cup and ring marks and also other motifs, but exclude representations of people or objects. Cup-and-ring marks and other motifs found on standing stones, stone circles and in burial contexts, such as cist covers are also excluded. A definition of British rock art that excludes petroglyphs found on cists and cairns is not useful, since it excludes exactly those rock art examples that occur in datable contexts. Also, the use of the term *cup-and-ring marks,* as a general term for British rock art is too simplistic. It does not take into account the large variety of motifs in British rock art and their local distinctiveness. In this study the terms *British rock art* and *petroglyphs* are used interchangeably. The term *British open-air rock art* is used when referring specifically to rock art on outcrops, or boulders, in contrast to rock art in a funerary or other monumental context.

3.3.1.4 In the light of research conducted during the Pilot Project a number of terms and definitions have been developed as vocabulary to assist discussion and analysis. Some of these are "cover-terms" used to embrace substantial bodies of material. While others are categories that can be applied when larger groups of data need to be split up. There is no suggestion that this terminology is anything other than a set of imposed thinking: certainly it cannot be regarded as having any meaning in terms of original construction or design of the material we now see in the archaeological record. At a general level, the term *rock art* is applied to the body of material that is of interest to the study and is defined here as:

> *"any artificially created mark that is cut, engraved, incised, etched, gouged, ground or pecked into, or applied with paint, wax or other substance onto, the surface of rock"*

The term *motif* is taken to mean:

> *"a repeatedly occurring mark that has been artificially created on rock"*.

In this study the term *composite motif* is used to describe a repeatedly occurring combination of motifs.

The term *panel* is taken to mean:

> *"a spatially delimited rock surface with motifs on it"*.

The term *site* is taken to mean:

> *"a place where archaeological remains such as rock art are found"*.

3.3.1.5 The term *panel* has currently been used in reference to rock surfaces as they occur today. However, in cases where multiple panels are known to have originally been part of a single panel (for example the Ros Castle panels known to have been separated during the 19th Century (Hewitt *pers.comm.*)) a means of cross-referencing will need to be developed.

3.3.1.6 The following terms were used by the Pilot Project during fieldwork trials to describe simple and complex motifs, the latter where elements such as cup, groove or other such combinations were present in what appeared to be a composite, as described above. The terms are based on Hewitt's (1991) classification and are provisional and not exhaustive. A simple way of describing the more complex motifs involved listing the individual elements of the motif working from an arbitrary centre point outward. Where there was no clear centre, terms were listed and the method by which they were identified was recorded on a field form. Singular and plural forms for each element were specified. The resultant terms allow for relatively easy visualisation of such complex shapes but where four or more elements are present the terminology becomes cumbersome. The key list includes the following terms: Anthropomorphs(s); Axe(s); Cross(es); Cup(s); Dagger(s); Foot / Feet; Grid(s); Groove(s); Hand(s); Hatching(s); Keyhole(s); Ladder(s); Linear(s); Lozenge(s); Occulus / Occuli; Ovoid(s) Pennanular(s); Rectilinear(s); Ring(s); Spiral(s); Triangle(s); Zigzag(s); Zoomorph(s)

3.3.1.7 All known British rock art is either cut, engraved, incised, etched, gouged, ground or pecked into rock surfaces and as such may be referred to as *petroglyphs*; the terms *British rock art* and *petroglyphs* are used interchangeably in this report.

3.3.1.8 As will be discussed in more detail below, there are three main situations in which prehistoric rock art occurs in Britain:

British open-air rock art:	where the motifs occur on rock outcrops, boulders or natural rock faces in Britain;
British monument-based rock art:	where the motifs occur on the faces of stones incorporated into the fabric or structure of a deliberately constructed monument. Some of these pieces may have been open-air rock art before being incorporated into a monument, while others were created during monument building;
British mobiliary rock art:	where motifs occur on the surface of stones that have been re-located from their source one or more times. These are essentially portable pieces of rock art. The date of their relocation is rarely known, but is not necessarily ancient.

3.3.1.9 These groups are not mutually exclusive, and indeed a given piece of rock art may, at different times in its life, belong to all three of these categories. The use of these terms is simply in defining the current situation and character of a piece of rock art.

3.3.1.10 The definition of a classification of motifs is far more difficult and subjective. A number of schemes have been developed, from Breuil (1934) onwards, and there is some further discussion and use of these in Chapter 5 where existing records of rock art in England are reviewed. It is beyond the scope of the present Pilot Project to provide a detailed consideration of motifs, and the following notes are intended only to assist in later discussion and, identify the scale of the problem that needs to be addressed in future work. In this, two points must be stressed. First, the overall repertoire of motifs is wide, but many are currently represented by few examples. Certainly, there are patterns in the distribution of motifs, possibly related to regionality and chronology, and these issues will be touched upon in later sections. Second, the range and representation of known motifs is probably a product of the kinds of survey and research undertaken to date. These need to be tested, but it is notable that those motifs that are most difficult to recognise are the most poorly represented. Accordingly, it must be emphasised that the following notes are based on current understandings of recorded rock art in Britain; how they relate to the original range of rock art produced in prehistory is not known. For convenience then, known British rock art can be divided into four main groups:

Cup marks:	These are the most frequent and most widely distributed motifs in British rock art. They are often described as circular hollows worked into the rock surface. According to the occasional measurements given in the literature cup marks are between 20mm and 400mm in width and depth, the larger cup marks over c. 15cm in width being termed *basins* (Morris 1977). Mostly, however, cup marks measure about 5 cm in width and 3 cm in depth. Cup marks occur on their own or in groups, arranged randomly or in patterns. Two conjoined cup marks are often termed *dumb-bell.* Cup marks are also components of other motifs, such as cup-and-ring marks or *rosettes,* circles of cup marks around a central cup mark. In a study by Steinbring and Lanteigne (1991) of a sample of rock art sites on Rombalds Moor, Yorkshire, it was found that 77.2% (1064) of all motifs are single cup marks, 7.3% are grooves and the remaining 15.5% are motifs composed of c. 36 different combinations of these two primary elements. Of the 15.5% or 214 motifs, most incorporate cup marks: 66 consist of a cup mark enclosed by one curvilinear groove, 32 of a cup mark connected to a linear groove and only three examples consist of a curvilinear groove or a number of those without a central cup mark (Steinbring and Lanteigne 1991, 19).

Grooves: These motifs consist of lines of varying shapes (curvilinear, oval, rectangular, linear, meandering). They occur on their own or they connect other motifs. Frequently, grooves of circular, rectangular, oval or triangular shape enclose a number of cup marks. Linear grooves leading from (or to) central cup marks, a common feature of British rock art, are sometimes termed *tails* or *lines* (Shee Twohig 1988). Frequently the terms *channel* or *duct* are used (e.g. Beckensall 1983, 26). Hewitt (1991) rejects the usage of these latter two terms, since they imply an association with liquids. He favours the more neutral term *groove*, which will also be used throughout this report.

Cup-and-ring marks: These are the most prominent composite motifs in British rock art. They consist of a central cup mark with one or more surrounding curvilinear grooves. Cup-and-ring marks occur in different sizes, and with varying layouts, differing, for example, in the number of curvilinear grooves surrounding the central cup mark. A central cup mark can be surrounded by up to nine curvilinear grooves. Also, one or more linear grooves may be connected to the central cup mark (*radial grooves*), and the curvilinear grooves may be discontinuous. Cup-and ring marks with different characteristics, such as varying numbers of curvilinear and/or linear grooves are often lumped together in British rock art research as variations on one motif. However, these variations could potentially all be distinctive motifs. In some instances *penannulars,* cup marks surrounded by one or more discontinuous curvilinear grooves, are set apart as different motifs from cup-and-ring marks. The discontinuous curvilinear grooves are frequently termed *gapped rings, penannular rings* or *penannular grooves* (Morris)*,* or *horseshoe shapes* (Beckensall). Often, however, such distinctions are not made. The re-examination of the set of assumptions connected with the definition of cup-and-ring marks must therefore be a major methodological question in a larger extended study. In this preliminary report the term *cup-and-ring marks* is used to denote composite motifs consisting of a central cup mark, surrounded by varying numbers of curvilinear grooves, which may be discontinuous, and with or without linear grooves connected to the central cup mark. In describing such motifs, the terms *ring* and *circle* are replaced with the term *curvilinear groove*, since the former terms imply an inappropriate accuracy of geometric forms.

Miscellaneous motifs: Rare motifs in British rock art include *spirals, rosettes, chevrons* or *U-shapes* (often multiple U-shaped grooves)*, ladders* (two parallel linear grooves connected by multiple short grooves)*, key-holes* (a wide short groove connected to a large cup mark) and *grids* (multiple crossing linear grooves). Van Hoek in a number of papers studied the distribution of *spirals* (Van Hoek 1993), '*rosettes'* (Van Hoek 1989/90) and *key-holes* (Van Hoek 1995), and suggested more detailed typologies. Motifs such as *crosses* (short linear crossing grooves)*, cross-rings* (curvilinear grooves with two internal radial crossing grooves)*, lozenges, comb-like motifs, tridents, feet, hand-prints, deer, ships* and *axe-heads* are extremely rare, sometimes occurring only at a single site each (Morris 1981, 171).

3.3.1.11 Hewitt (1991) includes cup marks and grooves of various shapes in a list of 30 different '*symbols'* in British rock art, which are regularly combined to form other motifs, such as cup-and-ring marks or rosettes. The use of the term *symbol* is avoided in this study, since it is inappropriate for the description of motif elements (i.e. it implies the presence of symbolism). Similarly, the terms *simple motifs* and *complex motifs* are not used here, despite their frequent use in the literature to describe motifs such as cup marks and grooves of varying shapes, and motifs which are combinations of these motifs, such as cup-and-ring marks, respectively. The use of these terms may give the erroneous impression that a composite motif may be equated with complexity in thought or practice.

3.3.2 Technique of Manufacture

3.3.2.1 Rock art in Britain is generally thought to have been made by pecking on the rock surface with a pointed tool (Beckensall 1996; Morris 1989, 48). Only rarely, on well preserved examples, is it possible to make out individual peck marks, such as at North Plantation, Weetwood Moor (Beckensall 1996, 139) or Ormaig, Argyll (see RCAHMS 1998). The grooves forming the motifs are often strongly abraded either because of intentional abrading (Morris 1989, 48; Beckensall and Laurie 1998, 19) or weathering (Beckensall 1996, 139; Beckensall and Laurie 1998, 19). It is thought most likely that stone, possibly flint or quartzite, was used as a pick (Morris 1989, 48), although metal and antler have also been suggested (Beckensall and Laurie 1998, 19). Three worn flint tools were found near the site of Torbhlaren, Argyll, but their association with the petroglyphs is not clear (Morris 1989, 48). A basalt chisel was also found in close association with panels at Doddington, Northumberland (Smith 1990). Both direct and indirect percussion has been suggested as impacting techniques used in manufacturing petroglyphs. While most early publications assume a direct impact of the tool on the rock surface, it has recently been suggested that a mallet might have been used to impact the tool (Beckensall 1996; Beckensall and Laurie 1998; Shee Twohig 1981, 116; Van Hoek 1997, 4). Scored lines are also known although their recognition is more difficult (cf. Radley *et al* 1999).

3.3.3 Location and situation

3.3.3.1 Most known British rock art sites are situated in northern Britain, often in upland regions or their fringes. However, there are some other sites in southern Britain, for example in Cornwall and Devon. It is possible that the original distribution pattern of rock art sites in Britain differed from the pattern seen today. In some areas the destruction of rock art sites because of quarrying, building activities or farming is believed to have had a larger impact than in others (Hewitt 1991; Bradley *et al* 1993). Also, rock art research is focused on areas where rock art is easily detected or where local enthusiasts are active. Other regions with reported rock art sites, such as Cornwall, Wales and Derbyshire, have not been investigated to the same extent as many areas in northern Britain. Beckensall and Laurie (1998) have shown that rock art may still be found in regions in which its occurrence was hitherto unknown, such as within the Yorkshire Dales National Park.

3.3.3.2 Open-air rock art in Britain is located on *outcrop rock,* on *slabs* and *boulders*. It is mostly placed on horizontal or nearly horizontal rock surfaces, i.e. on outcrop rock or on slabs. Often it can only be made out in the terrain from a short distance. However, there are notable exceptions. Petroglyphs are also placed on vertical stone slabs, such as standing stones. In many cases, it is not clear if the petroglyphs were added before or after the stones were erected. At Ballochmyle, Ayrshire, a recently discovered open-air site, the extensive petroglyphs are placed on a large vertical cliff face (Stevenson 1993).

3.3.3.3 Monument-based rock art is found on a wide range of structures including standing stones, pillars used in stone circles, the orthostats forming the chamber walls of passage graves, the kerbs of passage graves and other types of funerary monuments, (*cf.* Beckensall and Laurie 1998), cist covers, wall-stones, and walls in houses and related buildings. As already noted, these surfaces may have already been decorated as part of the process of building the structures themselves or incorporated into structures from earlier monuments, the breaking up of open-air rock art sites, or the use of mobiliary panels. The distribution of monument-based rock art is largely determined by the distribution of the kinds of monument on which it occurs. Those passage graves containing rock art are mainly around the Irish sea-basin and in the Northern Isles. In many cases the rock art in these situations occurs on vertical faces.

3.3.3.4 Mobiliary rock art is sometimes termed *portables* (Beckensall and Laurie 1998) or *mobiliary decorated stones* (Hewitt 1990-91), since they are of smaller size and can be moved. These rocks have been relocated from their source, e.g. broken off from outcrop rock or boulders, and sometimes they are incorporated into monuments of various kind, such as cists or cairns (Beckensall and Laurie 1998) where they can be considered monument-based rock art. These portables may have been moved at some time again from where they were originally manufactured and now turn up in all sorts of places including riverbanks, and stone walls. Hewitt (1990-91) subdivides *mobiliary examples* into

- decorated pebbles, cobbles and boulders (naturally formed stones with petroglyphs);
- decorated stones broken off from larger boulders or outcrops and;
- worked stones (motif-bearing stones whose form has been altered into shapes, such as triangles).

3.3.4 Regional variations in British rock art

3.3.4.1 An analysis of regional variation in British rock art ideally needs to be based on statistical data, which itself needs to be based on clearly defined categories. In the light of a lack of agreement concerning the description and definition of motifs in Britain, such a task is currently (more or less) impossible, although some more impressionistic comments can be made. A review of the distribution and variation in the records of rock art held by local SMRs is set out in Chapter 5 below.

3.3.4.2 It has been noted already that the common usage of the term *cup-and-ring marks* for the general description of rock art in Britain masks the existence of a considerable variation in British rock art, of regional variations in motifs, their frequency, their association and their placement.

3.3.4.3 Some motifs occur only in restricted areas, such as a *ladder* design around Ilkley (e.g. Beckensall 1986). Other motifs are found in some regions, but not in others. A *flanged-axe-head design* is only known from within c. 3km of Kilmartin in Argyll as well as at Stonehenge and Badbury Rings in Dorset. *Chevrons,* are found in Galloway, but not in Argyll, while depictions of *feet* are found in Argyll, but not in Galloway (Morris 1981, 166). '*Rosettes'* seem to be a rare motif. The site of Ormaig, Argyll (RCAHMS 1998) in Scotland yields examples of its occurrence. Although much British rock art is circular in shape, a range of square or rectangular forms are known from northern Britain, such as the rectangular grooves enclosing a number of cup marks at Dod Law, Northumberland (Beckensall 1986, 38).

3.3.4.4 Morris (1981) has attempted a description of regional variation in the types of motifs and their frequency in southern Scotland. He suggests that cup-and-ring marks with linear radial grooves connected to the interior of cup-and-ring marks seem to be more common in Galloway and eastern Scotland, than in the West. Cup-and-ring marks with continuous circular grooves also are said to be more common in the east of Scotland (Morris 1981, 167). The maximum number of curvilinear grooves in cup-and-ring marks and the frequency of cup-and-ring marks with multiple curvilinear grooves vary from region to region, and also within regions (Morris 1981, 12). Cup-and-ring marks in western Scotland are said to have a greater number of curvilinear grooves than those in eastern Scotland. Eastern Scotland has more sites with *spirals* than western Scotland (Morris 1981, 165). The greater the number of curvilinear grooves of a cup-and-ring motif, the less common this motif seems to be. In southern Scotland only six examples of cup-and-ring marks with nine curvilinear grooves are found (Morris 1981, 165). Panels with large numbers of petroglyphs, such as Achnabreck, Kilmartin, Argyll (Morris 1977), and Roughting Linn, Northumberland (Beckensall 1983), are a rare occurrence. Generally most sites contain only a limited number of petroglyphs. In southern Scotland, for example, more than 50% of all rock art sites with motifs other than cup marks have only a maximum of five motifs (Morris 1981).

3.3.4.5 In some regions of Scotland cup marks are the sole motif known, while other regions are characterised by a high proportion of sites with more composite motifs, such as cup-and-ring marks. Variations in the complexity of the motifs have also been recognised within and between other areas. From the Isle of Man, for example, mainly cup marks are known (Bates 1995), while the site of Dod Law in northern Northumberland has a larger number of composite motifs than the site at Millstone Burn close by. Altitude may play a part in this distribution pattern. In some regions of England cup marks only are reported as being placed on rocks on lower terrain, while other motifs tend to occur on higher ground in the same region (Bradley *et al* 1993). Rock surfaces with composite motifs in areas of Northumberland and Argyll are apparently visible from a greater distance than other panels. In some areas composite motifs are also are found on different kinds of rock surface, for example on outcrop rock, while cup marks are found on boulders (Bradley 1995).

3.3.4.6 Rock art sites tend to cluster in specific regions. From Galloway alone, for example, more petroglyphs are known than from the whole of eastern Scotland (Morris 1981, 165). In Northumberland and West Yorkshire, clusters of sites are found while in other areas no rock art has been found (Bradley 1996). The situation of rock art varies between regions. In Cumbria, for example, most petroglyphs are situated on monuments such as cairns, while rock art in Northumberland is mostly confined to open-air sites (Beckensall and Laurie 1998, 112). From the Cotswolds all known rock art is mobiliary (Marshall 1986). A range of regional characteristics and inter- and intra-regional variations in British rock art are highly probable. British rock art is not the homogenous phenomenon so often perceived. A full record of British rock art with a clearly defined terminology could help to achieve a clearer picture of variation and regularities in the rock art of the British Isles. Two developments are required in order to achieve this: first; a corpus of rock art panels with motifs fully recorded, and second; a broadly applicable categorisation of motifs, motif groupings and situational contexts for use in classification.

3.3.5 Dating

3.3.5.1 It is not known what temporal relationship the motifs on the panels had with each other, whether they were created in one episode, or if they accumulated over time. Since motifs in British rock art are rarely identified as superimposing each other, such accumulation processes are difficult to identify. Only two sites, one at Greenland (Auchentorlie), Dumbarton, and one at Wooler, Northumberland, could be identified confidently as multi-period sites. At both sites, a part of a rock art panel had been quarried in prehistoric times and new petroglyphs were made on the fresh rock surfaces (MacKie and Davis 1991; Bradley 1995). Differences in the degrees of erosion of motifs on a panel could potentially also indicate an accumulation of motifs over time. Thus, Stevenson (1993) suggests that the rock art at Ballochmyle, Ayrshire, was created over a long period of time, since various parts of the rock art panel differ both in motif range and in style (Stevenson 1993, 36). As open-air rock art in Britain has usually been assumed to belong to one style, any differences of style will only become apparent when the motifs range has been more clearly defined. Stylistic variations may then be able to provide a means for the relative dating of rock art in Britain (see section 7.7.3).

3.3.5.2 Absolute dates for British open-air rock art are hard to establish, since the petroglyphs usually do not occur in datable archaeological contexts. British rock art is dated mainly by its association with other archaeological monuments, which themselves are dated through associated material culture or radiometric determination. At the very beginning of British rock art research the petroglyphs were attributed to the Celts or to the Romans (Beckensall 1983, 19). However, the frequent incorporation of small slabs or boulders with petroglyphs into dated Bronze Age burial structures, such as cairns, cists or round barrows, suggested a Bronze Age date for British rock art. Rock art on boulders or slabs within such archaeological monuments have to be at least as old as the monument. Tate (1865), for example, linked Northumberland's rock art to the early Bronze Age on the basis of comparisons with burial structures in Argyll. Because of similarities between the petroglyphs found in funerary contexts and those found on outcrop rock and on boulders, open-air rock art also was attributed a Bronze Age date. A Bronze Age date for British rock art was consequently accepted by MacWhite (1946), Barnatt and Reader (1982, 33), Eogan (1986, 221), and Beckensall (1974, 8-9).

3.3.5.3 However, since some of the petroglyphs within burial structures were broken and also heavily weathered, the question arises whether petroglyphs were produced especially for the inclusion in such monuments, or if they were re-used once or even more often. It has been suggested that blocks with petroglyphs had been broken from rock outcrops or standing stones and, consequently, that they were earlier than the Bronze Age burial structures (Burgess 1990). Such re-use of older petroglyphs suggests an earlier, Neolithic date for at least some British rock art. According to Stevenson, the re-use of older decorated slabs or boulders in burial monuments could have been the practice in the Neolithic, since some of the burial structures belong firmly to the Neolithic period (Stevenson 1997, 95). Burgess (1990) argued strongly for an early Neolithic beginning of the British rock art tradition, which, according to him, ended before the early Bronze Age. Morris (1991) rejected a proposed Neolithic date and argued for an early Bronze Age date for British rock art, though adding that some rock art might be earlier or later. Already in 1981 Morris had argued for a long period of rock art production, starting in the Neolithic c. 3000 BC and lasting until possibly 100 AD (Morris 1981, 3). Beckensall and Frodsham argue that petroglyphs were indeed especially made for Bronze Age burial structures, judging from their very fresh appearance, such as at Knappers, near Glasgow. Both authors reject the common opinion that only re-used petroglyphs occur in Bronze Age monuments (Beckensall and Frodsham 1998, 67).

3.3.5.4 The fact that some cairns in Northumberland were built over rock art panels on outcrop rock, such as at Fowberry Moor, seemed to support a Neolithic date for British rock art. However, Beckensall and Frodsham (1998, 52) argue that the petroglyphs on the outcrop rock and the burial structure on top could have been contemporary. Since even the burial structures are not always securely datable, petroglyphs could have been made in either, the Neolithic or the Bronze Age (Hewitt 1991, 44; Beckensall and Frodsham 1998, 67). Rock art also can be found on standing stones and at stone circles. However, it is not clear if the petroglyphs were made before the stones were erected, in the process of erecting them or after. Since the temporal relationship of the petroglyphs to the standing stones is not clear, this evidence cannot be used for dating rock art. Similarities between the motifs occurring in British rock art and designs on dated archaeological material, such as pottery, can be established at this time. Some sherds of Neolithic grooved ware display designs comparable to motifs occurring in the passage tomb art of Britain and Ireland (Hewitt 1991, 39; Bradley 1994, 98). The designs on other kinds of objects such as stone plaques and stone balls are also similar. Overall, it must be recognised that the range of motifs seen in rock art is mainly a sub-set of the wider range of motifs found on contemporary material culture. How and why such sub-sets were created and the contexts and situations in which they were applied is a matter for further research.

3.3.5.5 The relationship of open-air rock art to the designs in the interior of passage tombs in Ireland and Britain is not clear. British open-air rock art and British and Irish passage tomb art are characterised by different but overlapping sets of motifs, the former having a more limited repertoire of motifs than the latter. In contrast to open-air rock art, passage tomb art contains many examples of joined groups of curvilinear grooves and arcs, lozenges, zig-zag grooves, serpentiform grooves and spiral designs. However, some of the motifs of open-air rock art, such as cup marks and cup marks with single curvilinear grooves, also occur in passage tomb art, while passage tomb motifs, such as spirals and chevrons occur in open-air rock art. It is tempting to date British open-air rock art on the basis of comparisons with passage tomb art. Similarities have been noted between the motif forms of northern England and the dated passage tombs in the Boyne valley, Ireland, and it is proposed that outcrop cup-and-ring marks in Ireland may predate those in passage tombs (Hewitt 1991, 35-36). However, Hewitt (1991, 36) also warns against the reliance solely on stylistic attributes as a means of establishing chronology. The currency of passage graves was probably also fairly short lived compared with that of rock art.

3.3.5.6 Frequently it has been suggested that British rock art had a long tradition, spanning the Bronze Age and the Neolithic, from the fourth to the second millennium BC (e.g. Beckensall 1986, 1998; Chappell 1999). It is possible that rock art traditions were still alive in some regions after they had ceased in others (Hadingham 1974, 63). Hadingham suggested that the practice of making rock art had died out by the beginning of the Bronze Age in western Scotland, but that it persisted in some eastern parts. He therefore suggests that the British rock art tradition might not have been a uniform phenomenon, but might have lasted for different lengths of time in different regions. Additionally, certain motifs may have been more widespread and more persistent than others. Cup marks, for example, seem to span a long period of time and can be found in certain Neolithic as well as Bronze Age contexts: passage graves and cists respectively (Hewitt 1991, 36). However, there are very few secure Neolithic or Bronze Age contexts for rock art in northern Britain. Unless absolute dating techniques can be applied to British petroglyphs, the problem of dating British rock art remains unresolved. Section 7.7 explores the potential of the methods commonly used in rock art studies.

3.3.6 Interpretations of the meanings of motifs in British rock art

3.3.6.1 Long ago, Simpson warned of the difficulties in interpreting British rock art motifs, stating that the meanings of petroglyphs were no longer accessible (Simpson 1864, 261). However, the appeal of exploring this aspect of British rock art has not prevented a range of different interpretations of the original meaning and function of motifs and groups of motifs especially of cup-and-ring marks. For Breuil (1934) many of the curvilinear designs were derived from human faces and from full human figures. Breuil interpreted designs, in which cup marks or cup-and-ring marks are inter-linked by grooves, as genealogical trees (Breuil 1934, 312-18).

3.3.6.2 In 1979 Morris listed 104 interpretations of the meaning and function of British petroglyphs, which he collected together from published and unpublished sources and which he rated according to their likelihood. Morris considered it most likely that the petroglyphs were linked to burial practices or to beliefs concerning ancestors and an afterlife, or that they were alignment markers. These interpretations are closely followed by those that see the petroglyphs as having an astronomical significance (predicting tides, lunar and solar eclipses and sowing dates, or depicting the night sky), as having a religious or magical significance, or as having been made by the earliest gold and copper prospectors. Some likelihood was attributed to the interpretation of cup-and-ring marks as representations of a Mother Goddess, of breasts or eyes, or as part of fertility cults or of circumcision ceremonies. Morris attributed little or no likelihood to interpretations of the petroglyphs as freemason's marks, marks of sexual prowess, sex symbols, phallic symbols, as representation of a sperm entering an egg, as quantity measures or connected to water divining. Morris considered a number of other interpretations of cup-and-ring marks equally unlikely. The petroglyphs were thought by some to be primitive calendars, a form of early writing, gaming boards, clocks, primitive lamps, mixing vessels, quantity measures, victory marks, pilgrimage marks, bonfire site markers, boundary markers, route markers, maps of the countryside, house plans or plans of megalithic structures, maps indicating hidden treasure or marking the location of wells, aids in seed production, tattoo designs, depictions of the sun, of mirrors with a handle, of worm casts or tree rings. Cup-and-ring marks have even been taken as messages from outer space. In some cases no meaning was attributed to the petroglyphs at all and they were thought to be idle doodles or acts of penance (Morris 1979, 16-28).

3.3.6.3 More recently Beckensall and Laurie (1998, 17) have suggested a shamanistic interpretation for some of the motifs. They claim that curvilinear concentric grooves and spirals could be interpreted as entoptic images. Dronfield (1995, 1996) has used a framework of altered stated of consciousness to place the rock art in Irish passage graves in context.

3.3.6.4 It has become clear from the above review how difficult any attempts to an interpretation of non-figurative prehistoric rock art are. Non-figurative designs have a quality of ambiguity. As such, they lend themselves to a wide range of interpretations (not least as there is no ethnographic evidence regarding their significance). One of the characteristics shared by the interpretations reviewed above is that they normally assume a uniform meaning and function for all British open-air rock art. However, this is not necessarily the case, since even at the time of their production the petroglyphs may have had different meanings for people belonging to different parts of the society, possibly depending on age, sex, kinship or grade of initiation (Layton 1992). Nor, should we assume that meaning has always remained static. So, for example, the re-use of rock art from open-air sites in burial structures might have changed their significance, as a new context was provided for the petroglyphs. On the basis of a number of Scottish examples Bradley concludes that petroglyphs, which initially were directed to a wider world on open-air rock art sites, were turned inwards into the burial structure and directed towards the deceased person in the Bronze Age (Bradley 1992, 176). While Burgess (1990) maintains that Neolithic petroglyphs were re-used in Bronze Age burial structures with no regard for their original significance, Beckensall and Frodsham (1998) argue that the decorated rocks were re-used because some significance was attributed to the petroglyphs.

3.3.6.5 It is evident that it is not possible to extract the range of meanings that the makers of British petroglyphs potentially attributed to them. Recently other approaches have been used to access the possible significance, as opposed to meaning, of British rock art. These include the study of the placement of petroglyphs on rock surfaces (Steinbring and Lanteigne 1991), the placement of petroglyphs in the landscape (Bradley 1991-1997), or the geometric properties of the motifs (Thom 1988). Some of these studies have added a new dimension to our knowledge of British rock art.

3.3.7 Rock art and folklore - recent uses of prehistoric petroglyphs in Britain

3.3.7.1 Open-air rock art has been part of the British landscape for a very long time. The evidence suggests that at some time in prehistory petroglyphs were vested with new significance, as indicated by the possible re-use in a funerary (but also other monumental) context of originally open-air rock art. It is also known that at least some prehistoric rock art sites continued to have meaning for local people until very recently. The majority of the few references on folklore connected with rock art sites were recorded in remote regions of Britain during the 19th and the first half of the 20th century (Cowling 1946).

3.3.7.2 Some rock art sites were the focus of customs promoting fertility. A now destroyed boulder at Tormain Hill, near Edinburgh, the 'Witch's Stone', had a line of 24 cup marks on its surface. The rock surface was highly polished due to the practice of people sliding down the stone. It is not known if a ritual was associated with this practice, but in another village, barren women used to slide down an unmarked rock if they wanted to conceive (Chappell 1999). Some rocks with petroglyphs have specific names, which could indicate their use in historic times. *Fertility stones*, for example, are known from various regions, such as the 'Fertility Stone' at Patley Bridge, North Yorkshire (Chappell 1999). Until recently cup marks played a role in fertility rites in the Western Isles. In the churchyard at Kilchoman, Islay, for example, several cup marks are situated on a slab which forms the base of an early Christian Cross. Until recently it was believed that a person who turned a pestle clockwise three times in one of the cup marks and put a coin into another of the cup marks, would be granted a wish connected with fertility - for example when asking for good crops or a child of specific gender. The money was collected periodically by a church officer and added to the church collection (Morris 1979, 18-19).

3.3.7.3 The incorporation of slabs with petroglyphs into Christian monuments, for example as cross bases, such as at Adel churchyard, Leeds, seem to have been no single incident (Chappell 1999). It is not known, however, if the petroglyphs in these cases were attributed some ancient power which could or had to be incorporated into new rites. Such powers could have been attributed to the 'Tree of Life Stone' in the Washburn valley in North Yorkshire. This remote rock with a number of inter-linked cup marks was until the mid 20th century the site "of many May Day religious services" (Cowling 1946). According to Mackenzie (1899-1900) in some regions of Scotland stones with hollows were attributed a sacred character. He also refers to the existence of so-called worship stones, stones with or without cup marks, in remote regions of Scotland. If these stones were broken up or removed, the wrath of spiritual beings would be unleashed.

3.3.7.4 Morris (1967/8, 55) was told by a number of farmers in different parts of Argyll that until about the 1930s a custom existed whereby farmers in this region were required to pour milk into specific cup marks on a certain day each spring. If this was not done, "the 'wee folk' (fairies) would see that the cows gave no milk that summer" (Morris 1967-8). Near Kenmore cup marks were often called "elf cups" (Mackenzie 1899-1900).

3.3.7.5 Beside their connection with ritual activities, petroglyphs were also used in profane circumstances. Morris witnessed the use of a cup-mark on the Faroe Isles for grinding the roots of the tormentil, a small yellow flower, in order to make dye (Morris 1979, 19). Along the coasts of Argyll and Tiree a number of large cup marks on boulders were used until the early years of this century by fishermen for grinding ground-bait, which was then thrown into the sea to attract fish (Morris 1967-8). These examples reflect recent functions and meanings that have been attributed to British petroglyphs. Most often, judging from the little evidence we have, they played a role in rituals, such as fertility rites.

3.3.8 The origin of the British rock art tradition

3.3.8.1 While many authors assume that the British rock art tradition developed in a British context, some authors have assumed that there was an outside stimulus acting on British rock art, either through the diffusion of ideas or the actual colonisation of the British Isles by new populations (MacWhite 1946; Morris 1977; Van Hoek 1982,1997). Since most petroglyph sites in his area of study were located within 5km of the sea, Morris (1977) suggested that petroglyphs in Scotland were first made by peoples who arrived on the British coast by sea, and who, in the Neolithic, were among the first inhabitants of Scotland following the last Ice Age. Van Hoek interpreted the petroglyph sites of Northumberland as marking the landing places and the migration routes used by colonising Bronze Age (Van Hoek 1982) or Neolithic (Van Hoek 1997) populations. He pointed to the location of petroglyph sites in upland areas, commanding extensive views, and along pathways, which were used in the settlement of the region. According to him British open-air rock art is a feature of uncertain times, characterised by travelling and exploring. The petroglyphs represent, according to the author (Van Hoek 1997, 16), a complex body of magical and socio-religious rituals of migrating peoples in the early Neolithic.

3.3.8.2 The origin of these migrating peoples is generally thought to be the European continent, specifically the southwestern parts of Europe, where motifs comparable to British cup-and-ring marks are said to exist. In his 1934 address to the Prehistoric Society of East Anglia, Henri Breuil attributed the choice of motifs in British and Irish rock art to continental influences (Breuil 1934). MacWhite (1946) compared British cup-and-ring marks with motifs found in Galicia, northwestern Spain. He introduced the term *Galician* to describe British and northwest Spanish open-air rock art. Both traditions are contemporary according to MacWhite, and date to the Bronze Age. British rock art, according to him, originated in Portugal and Spain. Shee Twohig also saw rock art along the Atlantic coast as a single tradition. She described *gallego-atlantic rock art*, a term coined by Sobrino Lorenzo-Ruza (1952), as

> *"...cupmarks and sets of concentric circles with a central cup. The circles are frequently gapped and may have a radial line carved through the gap. A ring of cupmarks may be carved between the circles. Serpentiformes, meandering lines, rosettes and cross-in-circles also occur in all the areas. Iberia has the greatest range of motifs and Ireland the most limited. Spirals occur in Iberia and Britain. Naturalistic carvings of animals, especially cervids, occur in Iberia and a possible example has been noted in Scotland. Daggers and axes occur in Iberia".* Shee Twohig (1981, 122)

Van Hoek (1997, 5) associates the distribution of these motifs along the Atlantic coast with marine travel and with northward migrations in the currents of the Gulf Stream. Hewitt (1991, 10) warns against diffusionist ideas on apparently common elements in rock art, which he suggests might be due to chance. These do not necessarily hint at common origins and common meanings (Hewitt 1991, 10).

3.3.8.3 The existence of motifs comparable to British cup-and-ring marks in other regions along the Atlantic coast of Europe has fuelled speculation about the origin of the British rock art tradition. Comparisons of British rock art with rock art in other areas of Europe, however, have been based on a single group of motifs. Motifs with a central cup mark and varying numbers of curvilinear (and possibly discontinuous) grooves, as well as with or without linear grooves connected to the central cup mark, were generally thought to belong to a common cup-and-ring mark tradition all over Europe. Differences in the contexts and associations in which the compared motifs occur in Britain and Europe have been disregarded. The next section of this report describes motifs in Europe and the world, whose design is comparable to British cup-and-ring marks, and discusses to what extent British rock art is part of a larger phenomenon, and to what extent it is unique.

3.4 Cup-and-ring marks in Europe and beyond

3.4.1 Cup-and-ring marks in context

3.4.1.1 A number of authors claim that cup-and-ring marks are a worldwide phenomenon (e.g. Mark and Newman 1995; Van Hoek 1997). However, usually very little evidence is presented on the distribution of comparable motifs beyond Europe and the USA. This section summarises some of the distributional data. It also examines the extent to which these motifs can be compared with British rock art, in providing information on their characteristics, their associations with other motifs, their frequency, location, date and interpretation. It describes, first, evidence from Europe, beginning with the Iberian Peninsula, then France, Scandinavia and finally Switzerland and the alpine region of Italy. Examples of motifs comparable to British cup-and-ring marks are given from the Canary Islands, from Africa, the Americas, Asia and Australia. Figure 3.1 to 3.45 inclusive represent a catalogue with depictions (photos and tracings) of some of the motifs mentioned in the text.

3.4.2 Cup-and-ring marks in Europe beyond the British Isles

3.4.2.1 Similarities have been claimed among the motifs found in rock art throughout Atlantic Europe, i.e. northern Portugal, northwestern Spain, western France, Ireland, Britain, and western Scandinavia. These similarities, notably in cup-and-ring marks, have often been seen as the result of close cultural contact. This section consequently focuses on the occurrence and interpretation of cup-and-ring motifs in the rock art of Europe and the validity of claims for close cultural contact based on shared rock art motifs.

3.4.2.2 The Iberian Peninsula

3.4.2.2.1 Rock art on the Iberian peninsula includes the Palaeolithic pictographs of the caves in northern Spain, the petroglyphs of the Coa valley in Portugal, the Levantine painted art in the east of Spain and the petroglyphs of the north-west Iberian peninsula. In the rock art of the northwestern Iberian Peninsula circular motifs are the most common motifs, followed by zoomorphs (see Figures 3.1, 3.2 and 3.3). The circular motifs consist mainly of cup marks surrounded by one or more curvilinear grooves, which are frequently discontinuous (*circulos concentricos con cazoletas*). Linear grooves connected to the central cup mark frequently cut through the curvilinear grooves (Figure 3.4). Occasionally linear grooves link circular motifs (Figure 3.5). In some areas single curvilinear grooves with a central cup mark are frequent (Figure 3.6), while curvilinear grooves without interior cup marks, or curvilinear grooves which enclose more than one cup mark, also occur. Rare motifs in the rock art of northwestern Iberia include *spirals*, *oculi* (pairs of small cup marks surrounded by oval or other shaped grooves), *labyrinths* (labyrinth-like grooves)*, crosses* (short deeply cut crossing linear grooves), depictions of humans and of weapons.

3.4.2.2.2 Circular motifs and zoomorphs, the latter usually resembling deer, are often placed close to each other on the same panels, frequently superimposing each other (Figure 3.3). Normally, zoomorphs seem to overlay cup-and-ring marks, but also, although more rarely, cup-and-ring marks may overlay zoomorphs. Pena Santos (1976) consequently suggested that such closely associated zoomorphs and circular motifs, which were made using the same technique, may have been produced at the same time and may have formed scenic compositions. Borgna (1973) in a study of the positioning of motifs suggested that the circular motifs were the earlier motifs and that the zoomorphs were later added in more marginal positions.

3.4.2.2.3 On the basis of comparisons with dated megalithic art the petroglyphs of the northwestern Iberian Peninsula have been attributed to the Bronze Age (Obermaier 1925; Sobrino Buhigas 1935, Sobrino Lorenzo-Ruza 1952) or the Iron Age (Santos Junior 1942). Lopez Cuevillas (1973 [1951]) proposed a middle Bronze Age date for circular motifs and a late Bronze Age date for zoomorphs. In 1968 Anati dated zoomorphs to the Epipalaeolithic and Neolithic and circular motifs to the middle and late Bronze Age, while Santos and Varela (1979) dated labyrinths and cup-and-ring marks to the late Bronze Age, and cup marks to the Iron Age. Burgess (1990) argued that depictions of early Bronze Age weapons adjacent to cup-and-ring marks indicate an earlier, Neolithic date for cup-and-ring marks. The lack of superimpositions with datable motifs makes an attribution of the cup-and-ring marks to any time period difficult.

3.4.2.2.4 The rock art motifs have been interpreted as maps (Obermaier 1925; Zuechner 1989) or as depictions of traps and trapped deer (Blanco Feijreiro and Patratcha Vazquez 1964) or as mathematical, astronomical or calendrical markers (Vazquez Varela 1983; Alonso Romero 1983). Such interpretative approaches have been widely abandoned in more recent research, which posits that access to the meaning of rock art without ethnographic information is not possible. A different approach was taken by Bradley, Criado Boado and Fabregas Valcarde (1994), who criticise the trend to study motifs separately from the rock surface and from their place in the landscape. The authors claim that Galician rock art occurs only in regions of extensive land use with a mobile pattern of exploitation and that the distribution of petroglyphs closely follows the routes that free-ranging animals take today. The authors argue that these paths also existed in prehistoric times.

3.4.2.2.5 Close connections between the rock art of Britain and Ireland and of the northwest Iberian Peninsula have been assumed on the basis of similarities in some motifs, such as cup-and-ring marks. The term *gallego-atlantic style* was introduced by Sobrino Lorenzo-Ruza (1952), who claimed that it spread out from Galicia along the Atlantic coast to Britain and Ireland and further. Although the rock art of north-western Spain and northern Portugal incorporates motifs that are indeed common in other regions of the Atlantic coast, such as cup-and-ring marks, other motifs are either specific to northwestern Spain and Portugal or, if they occur outside of the Iberian peninsula, they are found in different contexts, e.g. in passage tombs. Depictions of deer for example, which are regularly associated with cup-and-ring marks in Galicia, are absent in other regions of Atlantic Europe. Meandering grooves and curvilinear grooves with rays, on the other hand, in Britain only occur in passage tomb art, not in open-air contexts. A separation of motifs into two styles, as in Britain and Ireland (passage tomb art and open-air rock art) cannot be found in the Iberian Peninsula. On the basis that similar designs are contemporaneous, northwest Iberian rock art has been used to date British rock art and vice versa. Bradley *et al* (1994) suggest that the overlap of rock art styles in the Atlantic region of Europe could be a response to similar environmental conditions across this region, rather than a result of *one* rock art tradition.

3.4.2.3 France

3.4.2.3.1 Although western France is included within the geographic region of Atlantic Europe, there is currently little evidence for the occurrence of motifs similar to British cup-and-ring marks. Cup marks and cup marks with single curvilinear grooves have been reported from a chambered tomb (Table des Marchands, Morbihan). Additionally, a rock from a possible burial context from the same region also has cup marks, curvilinear grooves and a cup-and-ring mark (Kerphenir, Morbihan). No cup-and-ring marks have been found on outcrop rock (Shee Twohig 1981; Burgess 1990).

3.4.2.4 Scandinavia

3.4.2.4.1 Scandinavian rock art has traditionally been subdivided into a northern corpus, which is attributed to hunting peoples and is characterised by depictions of various animals, such as reindeer and elk, and a southern corpus which is characterised by depictions of humans and boats, by cup marks, and circular motifs (so called *ring figures*) (Figures 3.7 and 3.8), and is attributed to agricultural populations of the Bronze and Iron Ages (Hesjedal 1994). Within the south Scandinavian corpus, variations in the frequency of certain motifs occur between the rock art of the Scandinavian south-east (southern Sweden, south-eastern Norway and Denmark) and the south-west (south–west Norway and middle Norway), the latter having a more limited number of different motifs than the former. In southeastern Scandinavia depictions of boats and humans are more common, as well as *cross-rings* (curvilinear grooves enclosing radiating linear grooves, which often form a cross, Figure 3.9), while motifs such as *concentric ring figures* (concentric curvilinear grooves with or without a central cup mark), *frames* (rectangular grooves with a linear groove lengthways which is crossed by short grooves), *lattices* and *U-forms*, are more common in south-western Scandinavia (Figure 3.10). According to Fett and Fett (1979) Scandinavian archaeologists do not distinguish between curvilinear grooves with or without a central cup mark, which elsewhere is considered important.

3.4.2.4.2 Scandinavian researchers have frequently looked to other areas of Europe in search of the origins of Scandinavian rock art (Fett and Fett 1979, Burenhult 1980, Mandt 1983). Fett and Fett (1979) compare a number of motifs in western Norwegian rock art with motifs found on the Canary Islands, the Iberian Peninsula, in Brittany, Ireland, Wales, England and Scotland. They stress similarities between circular motifs, meandering grooves and spirals on open-air petroglyph sites on the Canary Islands and in western Norway. Equally, similarities in the choice of motifs in northwest Iberian rock art and in western Scandinavia are claimed. Cross-rings, circular motifs, labyrinths, and frames are common in both regions. Also, frame figures, U-forms and curvilinear grooves without a central cup mark which are found in the rock art of western Norway, can be found in Irish passage tomb art. However, it is apparent that they study motifs in isolation, paying attention neither to their association with other motifs nor to their context, such as open-air sites (Norway) or burial contexts (Ireland). Western Scandinavian open-air rock art and open-air rock art in Ireland and Britain, for example, show marked differences. Although cup-and-ring marks occur in both contexts, they are much more frequent in British rock art. Many Scandinavian circular motifs have either no central cup mark or have internal crossed linear grooves. Discontinuous curvilinear grooves, *keyholes* (broad grooves connected to a cup mark with or without surrounding curvilinear grooves) and grooves which interconnect other motifs, all of them characteristics of British rock art, are not found in Scandinavian rock art. As Malmer states:

> *"Cup-marks, concentric rings, spirals, labyrinths, and the rest are common goods decoratively, the presence of which in two different areas hardly provides definite evidence of a connection between them."* (Malmer 1979, 96/97).

3.4.2.5 The Alps – Switzerland and Italy

3.4.2.5.1 The occurrence of motifs resembling British cup-and-ring marks is, however, not confined to Atlantic Europe, but extends also to the alpine region of Italy and Switzerland. The rock art of the Alps is characterised by figurative motifs, such as anthropomorphic and zoomorphic motifs and depictions of houses and weapons. Circular motifs, such as cup-and-ring marks, are rare, such as at Sonico and Luine (Figures 3.11 and 3.12; Anati 1976), but on certain sites can be numerous, for example at Carschenna in the central Alps (Figures 3.13, 3.14 and 3.15; Zindel 1968). At Carschenna the surfaces of 10 limestone rocks show a large number of concentric curvilinear grooves with a central cup mark *(cerci concentrici con copella centrale)*, cup marks and spirals. The cup-and-ring marks have up to 9 concentric circular grooves. Cup marks are often connected by linear grooves. These circular motifs have been interpreted as topographic-territorial representations, i.e. maps, or as depictions of villages or lakes (Arca and Fossati, 1995).

3.4.2.5.2 Superimposed on the cup-and-ring marks are schematic horses and riding scenes. On the basis of stylistic comparisons with dated archaeological finds and superimpositions of motifs, Arca (1998) argues that horse-and-rider scenes date to the early Iron Age, and cup-and-ring marks pre-date them, while cup marks post-date them. Cup-and-ring marks in the Alps have been linked to both the megalithic art of Atlantic Europe, and the open-air rock art of Britain and Ireland (Anati 1976; Arca 1998), but differences are as apparent as the similarities. For example, few of the cup-and-ring marks in the Alps have discontinuous circular grooves, which are common in both British and northwest Iberian open-air rock art.

3.4.3 Cup and Ring marks beyond Europe

3.4.3.1 The Canary Islands

3.4.3.1.1 McMann (1980, 91) claims that the motifs at Fuente de la Zarza, La Palma, such as spirals, meanders and *concentric arcs* (multiple arc-shaped grooves), are similar to motifs in Irish passage-grave art, especially at Newgrange (Figure 3.16). However, the petroglyphs are found on vertical rock faces in the open and are not associated with megalithic structures, as they are in Ireland. McMann regards the petroglyphs of La Palma as a link between open-air rock art and passage tomb art since, despite having the motifs of passage-grave art, they are located on open-air sites. Willcox (1984) points to the close resemblance of motifs on the Canary Islands to motifs at various sites in Namibia, and sees the Canary Islands as an intermediate point on a route between north-western Europe and south-western Africa.

3.4.3.2 Africa

3.4.3.2.1 Rock art in Africa is best known for the anthropomorphic and zoomorphic pictographs and petroglyphs of the Sahara and southern Africa, but a wide range of circular motifs also occurs on the African continent. Curvilinear grooves with central cup marks, i.e. cup-and-ring marks, are found but rarely.

3.4.3.2.2 Morris and Milburn (1976, 143) report possible cup-and-ring marks on a horizontal rock outcrop in the western Air, Nigeria (Figure 3.17). The authors stress the uniqueness of these motifs in a Saharan context and compare them to Scottish cup-and-ring marks. In the Ogooue valley in Gabon, several sites with circular motifs are known (Oslisly 1993). Among a large number of single curvilinear grooves, chains of single curvilinear grooves, concentric curvilinear grooves and chains of concentric curvilinear grooves, which are frequently inter-linked by linear grooves (Figures 3.18 and 3.19), a few cup-and-ring marks are found (Figure 3.19). Triangular and rectangular motifs, depictions of animals, weapons and tools are also found in the Middle Ogouue region. Oslisly (1993) maintains that these petroglyphs date to the Iron Age, c. 2300-1400 BP, since they seem to have been pecked with an iron chisel through indirect percussion, judging from the great homogeneity and uniformity in the peck marks. At the site of Tchitundo-hulo, Angola, a number of concentric curvilinear grooves are interconnected by linear grooves (Figure 3.20; Ervedosa 1974). In oral traditions the motifs are interpreted as topographic landmarks for people arriving in this region, although the informant stated that the petroglyphs pre-dated the arrival of his people in this region (Gutierrez 1996, 90). Other circular motifs are reported from Loteteleit, Uganda (Figure 3.21; Morton 1967, Chaplin 1974, Willcox 1984, 79), northern Kenya (Figure 3.22; Soper 1968), Zambia (Chaplin 1958), South Africa (Figure 3.23; Pyper 1918) and from Namibia (Viereck 1959), where circular motifs have recently been interpreted as entoptics, experienced by shamans during trance (Wallis 1999). According to Maggs (1995) the curvilinear motifs in north-eastern South Africa were made by agriculturalist populations and represent their circular homesteads, cattle pens and villages, since these petroglyphs are all in the vicinity of stone-walled settlement sites of the late Iron Age (Figure 3.24). Malan (1957) saw Zulu boys peck representations of homesteads and kraals into flat stone surfaces for a game. Stones of varying size represented cattle and calves. The boys used stones in manufacturing the petroglyphs by direct percussion. Maggs advocates the use of the petroglyphs in the reconstruction of road layout and of details in the settlements, which are otherwise not recognised in the archaeological record.

3.4.3.3 Americas

3.4.3.3.1 Among a large range of rock art styles in North America, the *Pit-and-Groove* style was defined in 1958 by Baumhoff, Heizer and Elsasser to describe a petroglyph tradition of linear or curvilinear grooves and *pits* (cup marks). Cup marks and grooves often are interconnected, cup marks frequently are surrounded by curvilinear grooves. The Pit-and-Groove style is thought to be the earliest petroglyph style in western North America, dating between 7500 and 2500 BC (Schaafsma 1986), although similar motifs were made until recently, especially in California (Minor 1975). The *Woodland Pit-and-Groove* style of Tennessee, Kentucky, North Carolina, northern Alabama and northern Georgia includes cup-and-ring marks, cup marks and grooves of varying shape, such as meanders, *grids* (grooves crossing each other) and *herring bones* (herring bone-like arrangement of grooves), spirals and tracks (Grant 1983). Mark and Newman (1995) use the term *cup-and-ring petroglyphs* or, alternatively, *concentric-circle designs,* to describe concentric curvilinear grooves with a central cup mark. They refer to British cup-and-ring marks as "classic" cup-and-ring marks.

3.4.3.3.2 Concentric curvilinear grooves with central cup marks occur in a range of regions in North America, for example in California (Figures 3.25 to 3.31; Breck Parkman 1995; Mark and Newman 1995), Arizona (Figure 3.32; Alaska (Figure 3.33 Georgia (Figures 3.34 and 3.35; Perryman 1964) and Washington (Figure 3.36). As in Britain, the curvilinear grooves are often crossed by linear grooves. In contrast to the British examples, where only up to four linear grooves are connected to the central cup mark, in California higher numbers of diagonal linear grooves can be found. Although straight and meandering grooves are abundant, they do not seem to interconnect cup-and-ring marks, as in British rock art. Cup-and-ring marks with discontinuous grooves, common in Britain, have not been reported up to now (Morris 1998). Moreover, Californian cup-and-ring marks are associated with a number of motifs that are not found in British open-air rock art, such as zigzag grooves. Breck Parkman (1985) suggested that cup-and-ring marks in California could have been used by Native American shamans as ceremonial targets or as places of energy focus, while other interpretations regard the motifs as symbolising the sun, solstices, the equinox, the world or time.

3.4.3.3.3 Little evidence on the occurrence of cup-and-ring marks is available for the Middle American region and for South America. In Bolivia, they are reported from Piedra Marcada, Prov. Velasco (Figure 3.37), and from Serrania de San Simon, Prov. Itenez, where a boulder features a cup mark with two concentric grooves and four linear grooves extending downwards from the outermost curvilinear groove (Figure 3.38). Other motifs at the site include simple circular grooves and several cup marks enclosed by a large curvilinear groove (Riester 1981, 136/155).

3.4.3.4 Asia

3.4.3.4.1 Among the little evidence on cup-and-ring motifs from Asia are some petroglyphs from Lianyungang, Jiangsu, China (Chen 1987, 211). Some of the circular motifs at the site are cup marks surrounded by up to two curvilinear grooves (*cerci e circoli concentrici con un puntino nel mezzo).* Other motifs at the same site have linear grooves starting out from the outermost curvilinear groove (Figure 3.39). Chen offers an interpretation of these designs, taking them as solar symbols*,* maps or as representations of galactic nebulas. A slab with cup-and-ring marks was found in front of a small round barrow in Dohangri, Haman, near Pusan, South Korea. On the slab a number of cup-and-ring marks with up to seven concentric grooves are visible, as well as a great number of cup marks and linear grooves (Figurre 3.40). Kwang-Hyon (1997) suggests that the making of the cup marks and cup-and-ring marks was connected to prayers for the "Egg", which stood for the womb, the earth and the universe.

3.4.3.5 Australia

3.4.3.5.1 Maynard (1979) subdivided Australian rock art into three broad stylistic categories: the Panaramitee, the simple figurative and the complex figurative styles. The Panaramitee style, which incorporates a large range of circular designs, was defined as being a homogenous, pan-continental , essentially non-figurative petroglyph style, dating to the Pleistocene. Common motifs of the Panaramitee style are tracks, circular motifs, crescent shaped grooves, *dots* (cup marks), human footprints, radiating linear grooves and line mazes (Franklin 1991). Substantial intra-site and inter-site variations exist in the choice and frequency of motifs. A range of motifs are unique to one or two sites. Different variants of circular motifs occur at various sites in different frequencies, among them single or concentric curvilinear grooves surrounding a cup mark (Figures 3.41 - 3.43). Sometimes curvilinear grooves are pecked around natural pits (Figure 3.44; Flood 1997). The concept of the Panaramitee style has been challenged repeatedly, for example by Rosenfeld (1991). The critics stress that there is considerably less homogeneity in the Panaramitee style than thought earlier, also, its definition is too wide, including material that is very diverse. Furthermore, the petroglyphs are not all of Pleistocene Age, but have possibly been made until the recent past.

3.4.3.5.2 Although Maynard excluded rock paintings from the Panaramitee style, Rosenfeld (1991) points to strong similarities between the motif range of non-figurative rock paintings and the Panaramitee style petroglyphs. According to Rosenfeld, both paintings and petroglyphs could belong to the same tradition, since the choice of technology used for marking the rock is not based only on cultural preference, but also on factors of materials and environment. Depictions of sets of concentric circles joined by bands of parallel lines are found in rock painting (Figure 3.45) and also, though rarely, among Panaramitee petroglyphs. Studies among the Walpiri have shown that non-figurative rock art can be representational, based "on a sort of 'bird's-eye-view' of the world, where images are reduced to essential schema of their pattern on the ground" (Rosenfeld 1991; Munn 1973). The simplicity of form in these schemata allows for a multitude of meanings attributed to them, according to the social context of the creator/viewer. The meaning of these motifs can change over time. Similarities of motif forms therefore do not need to imply uniformity of cultural expression. Among the Walbiri, circles can specify a waterhole, fire, fruits, the base of a tree, a cave, and others (Flood 1997). Concentric circles represent, for example, a lake or the camping place of a totemic hero/heroine. Concentric circles with internal straight grooves or with rays can represent headdresses. Joint concentric circles may stand for the routes taken by legendary figures from one place to the other (Layton 1992). Finally, concentric circles are also drawn in sand in preparation for ceremonies (Flood 1997).

3.5 Cup marks, a worldwide phenomenon

3.5.1 Cup marks occur on all inhabited continents (Steinbring, Granzberg and Lanteigne 1995, 55; Tacon, Fullagar, Ouzman and Mulvaney 1997, 945). They are also referred to as *cupules, pits* or *dots*. Large cup marks are frequently termed *basins*. Cup marks are defined as artificial 'hemispherical' depressions in rock surfaces, which occur singly, in groups or as part of composite motifs (Bednarik 1996, 66; Parkman 1995, 1). Some authors term all hemispherical depressions cup marks, be they non-utilitarian or utilitarian (Bednarik 1996, 66), while others exclude utilitarian marks (Flood 1997, 145-146). The distinction between utilitarian marks and non-utilitarian marks is generally made on the basis of their size and their location on the rock surface. Large circular depressions on horizontal rock surfaces are often thought to have had a utilitarian function, for example as grinding hollows for food or ochre processing. Parkman (1995, 1) defines as *cupule* any round depression which is found on a vertical surface, while, if found on a horizontal surface, only those depressions are seen as cupules, that have a diameter of 10 cm or less and a depth of 4 cm or less. Some authors do not classify cup marks as rock art at all (Parkman 1995, 3-4; Rosenfeld 1992; Flood 1997). Rosenfeld (1992) and Flood (1997, 943) classify cup marks as *rock marks*, a group that also includes hand stencils, as well as incised and abraded grooves, all of which, according to the authors, were made under socially different circumstances. Frequently cup marks are regarded as a separate category from petroglyphs. Lee (1996, 169), for example, distinguishes between *petroglyphs* and *cupules*, while Anati (1976, 44) distinguishes between *rock engravings* and *cup marks*. In this report such a distinction is not made. Cup marks are regarded as petroglyphs since they are artificial marks that cut into the rock surface.

3.5.2 Studies on the frequency of cup marks have shown that they are often the most common motif found in a rock art region, such as in Bohuslan, Sweden (Bertilsson 1987, 52/70) and western Norway (Walderhaug 1995, 170), or the only motif occurring, such as in Estonia (Poikalainen 1995, 338). Despite their frequency and their wide distribution cup marks have rarely been studied in their own right. Often they have been deliberately omitted from research (Morris 1977, 1979, 1981, 1989). In regions where cup marks occur together with figurative rock art, preference in study and presentation is generally given to the latter, such as in the Alps or in Scandinavia.

3.5.3 The finds of cup marked rock surfaces in Palaeolithic contexts in Europe, India and Australia have established the antiquity of some cup marks (Bednarik 1996; Kumar 1996; Tacon, Fullagar, Ouzman and Mulvaney 1997). Cup marks seem to be the oldest surviving rock art in the world, possibly, because their depth makes them very long lasting and relatively erosion-resistant forms (Bednarik 1993, 139). The oldest known cup marks in Europe were placed on the underside of a rock slab covering a middle Palaeolithic grave in the cave of La Ferrassie, France (Peyrony 1934; Bednarik 1993, 138). Cup marks are also found in the later open-air rock art of northwestern Spain, Scandinavia and the Alps (Arca and Fossati 1995; Arca, Fossati, Marchi and Tognoni 1995, 87).

3.5.4 According to Bednarik (1996, 64), the oldest known rock art world-wide was found in central India, in Auditorium cave, Bhimbetka complex, where a large cup mark as well as a pecked meandering groove, both heavily weathered, were recognised on a buried boulder lying in an Acheulian deposit. An equally early age was proposed for the cup marks at Daraki-Chattan, a cave in the Chambal valley, and other sites (Bednarik *et al* 1991; Kumar 1996, 38; Sharma *et al* 1992). Cup marks in recent contexts are reported from the Himalayas and southern India (Bednarik 1993, 139). Cup mark sites also occur in the Middle East, in northern Russia and China (Tacon, Fullagar, Ouzman and Mulvaney 1997, 946). Recently cup marks were found in Japan (Chen 1996, 130).

3.5.5 In Australia most cup mark sites are situated along river systems in the north and north-west of the continent, where they seem to be the earliest rock art in the regional sequences, sometimes being superimposed by later figurative rock art (Walsh 1994; Tacon, Fullagar, Ouzman and Mulvaney 1997, 947). Early cup marks are often found in large numbers on the vertical walls of rock shelters, but also occur on horizontal surfaces, such as at Granilpi (Flood 1997, 148). Sometimes cup marks are buried under occupation layers, which can be subjected to absolute dating methods. At Jinmium the dates established via thermoluminescence for the layer where cup marks were found, 58000-75000 years ago remain to be confirmed (Tacon, Fullagar, Ouzman and Mulvaney 1997, 958). Cup marks were also made or retouched in recent contexts, for example as part of increase ceremonies (Flood 1997, 146-147; Tacon, Fullagar, Ouzman and Mulvaney 1997, 959). Cup marks have been recorded on a number of Pacific islands, such as the Solomon Islands, Easter Island and Papua New Guinea (Tacon, Fullagar, Ouzman and Mulvaney 1997, 946-947). At the site of Puuloa on Hawaii 30,000 cup marks have accumulated since the first settlement of the island 1500 years ago. For each newborn child a cup mark is made to hold the umbilical stump (Lee 1995, 171).

3.5.6 Cup marks are thought to be the oldest surviving motifs in the Americas (Schaafsma 1986, 215). The earliest known petroglyphs in South America are the cup marks from Cueva Epullán Grande, Argentina and from Toro Muerto, Bolivia (Bednarik 1996, 71). Other sites with cup marks are reported from Chile, Peru, Colombia and Mexico (Tacon, Fullagar, Ouzman and Mulvaney 1997, 946). The *pitted boulder tradition* and the *Pit-and-Groove* style in North America, both characterised by large numbers of cup marks, are early rock art traditions, the former possibly being over 9000 years old (Parkman 1992, 1995). Cup marks were, however, made by Native Americans as recently as the early historic period (Parkman 1995, 5). They are especially common in the American Northwest, with the largest known concentration occurring in California (Parkman 1995, 1). Ethnographic evidence links these cup mark sites with fertility rituals and weather control ("baby rocks" and "rain rocks"), with astronomical observations or powder manufacture. Other evidence suggests the use of cup mark sites as territorial markers, as designating burial ground, as commemorative stones ("jumping stones"), as power spots and in rituals that ensure good fishing (Parkman 1995, 8-9).

3.5.7 Cup marks are common on open-air rock art sites all over Africa. Frequently these cup marks are arranged in paired lines which form the gaming boards for the widespread *bao* game, played with seeds, pebbles or beads. However, the *bao* game cannot be made responsible for all cup mark occurrences, since cup marks often seem to be arranged randomly (Loumpet-Galitzine 1992; Odak 1992; Tacon, Fullagar, Ouzman and Mulvaney 1997, 946) or in circular patterns (Haselberger 1968). In Zimbabwe cup mark sites are frequently connected with rock gongs (Robinson, 1958, 76).

3.5.8 Cup marks are a simple form that is likely to have been developed independently in various regions (Steinbring and Lanteigne 1991, 24). Since they often appear to be the oldest surviving form of rock art, they are by some thought to be connected with the colonisation of an area (Tacon, Fullagar, Ouzman and Mulvaney 1997, 961). However, although cup marks are the oldest rock art known, even older traditions might have existed which have not survived.

3.5.9 The functions and meanings of cup marks, and the socio-economic circumstances of their production will have varied widely in time and place, as a worldwide phenomenon. They deserve further research, not least because of the light it might throw on the origins, development, use, and significance of the largest group of motifs that can be recognised in British rock art.

4. THE SIGNIFICANCE OF ROCK ART

4.1 The importance of British rock art

4.1.1 With the exception of two possible examples, the motifs in British prehistoric rock art are largely non-figurative. The repertoire of motifs consists mainly of cup marks and differently shaped grooves, and of a variety of combinations of these motifs, such as cup-and-ring marks or rosettes. Cup marks are the most wide spread and most frequent motif in British rock art. Although British rock art may be less appealing than figurative rock art, which seems to be easier to relate to, British rock art is nevertheless an important and fascinating part of the cultural heritage of the British Isles.

4.1.2 The variety of motifs in British rock art is generally underestimated, as is evident in the common use of the term *cup-and-ring marks* applied to British open-air rock art. Also, the lack of a clear definition of motifs and, consequently, the inconsistent use of a variety of terms in the description of motifs has limited the general applicability of previously conducted rock art research in Britain. Questions concerning the definition of motifs and the terminology used in their description need to be addressed in a future extended study of British rock art. Only then can statements about the range of regional variation in motif types and in their frequency be made.

4.1.3 In a worldwide perspective, Britain is one of the few regions with an almost exclusively non-figurative corpus of rock art. Cup marks, often neglected in British rock art research, are the oldest known and among the most widely distributed rock art motifs in the world. Motifs similar to cup-and-ring marks, the best known motifs in the rock art of Britain, can be found on all inhabited continents in a variety of layout, association, frequency and context. Britain seems to have the highest concentration of such motifs. While British cup-and-ring marks are part of a worldwide phenomenon, British rock art as a whole is unique. In comparison with cup-and-ring mark occurrences in other parts of the world, British motifs occur in a wide range of varying layouts, having continuous or discontinuous curvilinear grooves, one or more linear grooves connected to the central cup mark, one or more curvilinear grooves surrounding the central cup mark. In the variety of circular motifs with a central cup mark, British rock art only seems to be rivalled by North American rock art. Some of the other motifs in British rock art, such as a *ladder design* in Yorkshire, seem to be unique in rock art.

4.1.4 In comparison with other regions of the world relatively little attention has been paid to the study of rock art in Britain. For a long time it was left to rock art enthusiasts and amateur archaeologists to record sites and to make them known. Only recently has rock art research turned away from purely descriptive studies and speculations as to the meaning of the motifs. It has now been acknowledged in British rock art research that the meaning of rock art motifs to their makers may never be uncovered. These non-figurative motifs could have had a range of different meanings to different people, even within the same society. Over time the significance of the petroglyphs is likely to have changed, as is signified in their re-use in funerary contexts. The impossibility of a straightforward interpretation of British rock art, an approach often taken in the study of figurative rock art, has led to the development of new research methods. These recent approaches to the analysis of British rock art opened new avenues for British and international rock art research in accessing information on the socio-economic background of the rock art makers and on the role rock art might have played in these societies. A landscape approach to rock art analysis studies the placement of rock art in relationship to natural and cultural features in the landscape. It has shown that petroglyph sites are often situated on the interface between upland and lowland areas in regions suitable for transhumance or that they seem to line paths to important monuments. The rock art evidence, therefore, suggests an essentially mobile pattern of land use at the time the petroglyphs were made. These new approaches to the study of rock art in Britain rely less on extensive fieldwork and more on the use of previously recorded data and the application of general theory. It is therefore crucial that an accurate documentation of the rock art sites is created and that a clearly defined terminology, is provided.

4.1.5 Although the meaning and significance of the petroglyphs to their original makers are not known, we can nevertheless trace some more recent significance that was attributed to British rock art sites. In some regions of Britain rock art sites were until recently thought by local people to be connected with supernatural powers. Even today rock art is a focus for some people who believe that rock art sites emit special powers, as seen on internet sites describing psychedelic trips related to petroglyph sites. More generally, however, public interest in rock art today focuses on rock art as part of prehistoric landscapes, as part of Britain's heritage. Rock art in Britain, consequently, is valuable as an archaeological resource yielding information on our prehistoric past, but it also has a public dimension, having been attributed varying significance throughout the ages. The key features that underpin the importance of British rock art can be identified as follows:

- Open air rock art sites represent a widespread and relatively numerous class of prehistoric monument;
- The material remains are a long-lived phenomenon that link into other aspects of material culture;
- It is the earliest apparently abstract expression by cultures living in the British Isles;
- It appears as the earliest known physical representation of human and animal forms in the British Isles;
- The incidence of rock art in many different situations allows it to help connect together otherwise diverse components of the archaeological resource;
- British rock art is part of a European phenomenon which, although in some ways is distinctive, provides evidence for the investigation of links and connections with other regions;
- Some elements of British rock art, notably cup marks, connect to one of the most widespread and ancient styles of "art" in the world;
- The ancient authors of rock art in Britain made extensive use of natural rock surfaces and thus provide an archaeological link between the natural world and the human mind;
- Research has led to the identification of many motif types in the recorded rock art and others no doubt await recognition.

4.2 The existing designation of rock art in England

4.2.1 As with all other classes of field remains, rock art panels can fall within site and area based designations, and with such status they are afforded varying levels of legal status, protection and management. This section concentrates on the archaeological designation of rock art in England, but in passing it is pertinent to note other appropriate schemes. The project did not specifically research the relationships between rock art panels and non-archaeological designations and excepting those data received from SMRs no further data in fact was collected on this matter. There are, however, indirect benefits of such designations and schemes and these are mentioned by way of highlighting current resource management opportunities.

4.2.2 The archaeological designation of rock art panels in England falls under four categories:

• Internationally recognised sites	For example World Heritage Site status
• Nationally recognised sites	For example Scheduled Monument and Guardianship status
• Regionally / locally recognised sites	For example Archaeologically Sensitive Areas. (No information collected)
• Management Agreements	(No information was collated in the level of management agreements affecting rock art)

The term 'sites' is used here in a generic sense to describe discrete panels, panel complexes, record entities and archaeological items as expressed in the English Heritage Record of Scheduled Monuments (RSM).

4.2.3 International designation

4.2.3.1 The main recognised rock art panels in England which, by association are included on the World Heritage Site list are Stones 3; 4; 5; 23; 29; 53 and 57 at Stonehenge and thus within the Stonehenge and Avebury World Heritage Site, Wiltshire (Lawson and Walker 1995). In five of the seven uprights, axes, axeheads, and a small knife are visible under certain light conditions, the remaining two stone bearing a 'torso' (Crawford 1954, pl viib) and an irregular quadrilateral (Crawford 1954, pls v and vi). The motifs are relatively rare in England. Currently the stones are fenced off and access is only possible via permission at certain times. Prior to inscription, risks (such as visitors walking over the rock art) threatening the longevity of several of the fallen stones bearing carvings were recognised and recommendations made for them to be re-erected to prevent further damage (Lawson and Walker 1995, 345). It was also noted that monument-based rock art may appear within Hadrian's Wall World Heritage Site, but the Pilot Project was unaware of any records for this.

4.2.4 National designation

4.2.4.1 Guardianship represents one form of direct management that is brought to bear when the future survival of archaeological information is critical, but other means of securing proper management have failed. Such sites are usually made accessible to the public, and in the main were acquired many years ago. There are currently about 400 Guardianship sites in England, relating to a very small percentage of the overall resource.

4.2.4.2 An examination of the list of Guardianship monuments reveals that very few Guardianship sites contain rock art, and all of these seem to be monument-based rock art: Castlerigg stone Circle, Cumbria; Stonehenge, Wiltshire; Avebury, Wiltshire; Ballowall Barrow, Cornwall and Routing Linn, Northumberland. The direct effect on the survival of motifs as a result of this designation is not clear, but recent moves to transfer the management responsibility of Guardianship to a local level (for example to the National Trust, The National Park Authorities and to Unitary Authorities) indicates a more practical approach to site management.

4.2.4.3 Scheduled Monuments are those ancient monuments given protection under the *Ancient Monuments and Archaeological Areas Act 1979* by virtue of their "national importance". Protection in this way is provided through the control of works likely to affect a monument. About 14,000 ancient monuments in England are Scheduled, approximately 6% of all recorded monuments. Scheduling does not confer any right of public access to the site.

4.2.4.4 Two sources were used to gauge the extent of scheduling affecting rock art sites in England: the RSM and, data supplied by SMRs. The former was more reliable because of its statutory responsibility to maintain such a register. Using data supplied by the latter sources (in fact only three county SMRs: Northumberland, Cumbria and Cleveland) the number of panel level records relating to Scheduled items of rock art was calculated. It appears that 27% of recorded panels in these three counties (some 191 records from a sample of 700 for these three counties) are scheduled but this figure needs further explanation. There are 170 Scheduled panels for Northumberland alone. It was unclear whether panel level Scheduling was consistently being applied or in fact the spatial extent of individually Scheduled sites included more than one panel - an issue relating to records standardisation (and whether panels were lumped together into one record). No Scheduling information was available from the two remaining SMRs. This is, however, an incomplete picture and attention must be turned to the RSM for details of scheduled rock art for all England.

4.2.4.5 Prior to the Monuments Protection Programme (MPP), rock art sites were generally termed "rock carving". More recently, however, rock art sites have been classified as "rock carving" and more specifically "cup and ring marked stone" for the purposes of MPP. The definition of both excludes the less frequently recorded motifs such as the axes and daggers mentioned above, those carved panels that survive within other monument classes (cists etc.), and, in the case of the latter term, it includes "stones and boulders with other kinds of decoration" (English Heritage 1990, 5). The work is informed by a single monument class description that includes an overview of current knowledge and an assessment of the class according to characterisation criteria (English Heritage 1990, 7). The assessment resulted in the following statements on class characteristics:

- That the tradition of carving is long-lived, perhaps over thirty centuries;
- That examples are common and the range of forms is very high (seven variant groups being identified) and;
- That the class is relatively widely scattered but poorly understood.

4.2.4.6 The MPP class description suggests that an estimated minimum of 810 stones (a term used by MPP and roughly equating to panel) existed in England in 1990, but that this figure was unlikely to reflect the total number of carved stones as many would be overgrown, destroyed or simply missed by excavations. Figure 4.1 shows a distribution plot of the items, *rock carving* and *cup and ring marked stones* for entries in the RSM. The data was prepared by running raw grid references for both item classes (supplied by English Heritage Records Office) through a co-ordinate calculating tool, in order to create absolute references, converting grid letter to numbers and, adding a 5 and 0 (where applicable) to both the easting and northing in order to create the 12 figure references. The distribution appears to reflect the recorded resource for rock art in England (see sections 5.1, 5.2). MPP work for the class is not yet complete for England, but as has been demonstrated in West Yorkshire where the whole county's resource of panels has been assessed, the programme can significantly increase the number of recommendations for Scheduling, and more fundamentally, can improve the level and standardisation of documentation for these sites.

4.2.4.7 The effectiveness of Scheduling as a site management tool has been investigated by others (for example Darvill and Fulton 1998, Glass 1989, Saunders 1983) and it remains to be seen if Scheduling is effective as a means of protection for this class of monument. From observations made in the field (in Northumberland and West Yorkshire) it appears that Scheduling might improve awareness on the significance and vulnerability of certain rock art sites (and certainly the level of archaeological information). In practical terms, however, Scheduling has little effect regarding potentially damaging activities (such as cattle poaching, browsing animals, atmospheric pollution, and visitor damage).

4.2.5 Regionally / locally recognised sites and areas and management agreements

4.2.5.1 These designations, often simple lists identifying sites and areas of interest (because of their intrinsic natural or archaeological value) are made by local authorities, countryside agencies and other organisations, and it is often by association (such as the inclusion of rock art sites within National Park boundaries) that archaeological sites are included. Some of these are supported by protective legislation, guidance on best conservation practice whilst others have no legal basis and are simply a way of highlighting distinctive sites and areas. The designation of distinctive areas of countryside and natural assets such as wildlife habitats will often encompass rock art. A full exploration of the scope of these designations and schemes, for example Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), National Parks (NPs), Areas of Outstanding Natural Beauty (AONB), and Environmentally Sensitive Areas (ESAs) is given in the Monuments at Risk Survey of England (see Darvill and Fulton 1998, 205-215).

4.2.5.2 No information was collected during the Pilot Project on the coverage of these designations over recorded sites, except that contained within SMR records. Where blanks existed in the record it was not clear whether this confirmed a lack of designation or that the information simply was not present. Table 4.1 shows the level of countryside designation of rock art panels as recorded in SMRs. The totals are somewhat skewed by the presence of good information in the Northumberland SMR.

4.2.5.3 Given the general situation of the majority of panels (lying in the uplands around or above the 244m contour mark) it is likely that a high number will be covered within National Parks. This is certainly the case for panels in North Yorkshire (North York Moors National Park and York Dales National Park authorities). Whilst the designation of "National Park" does not provide for the specific protection of archaeological sites, several authorities have an archaeologist in post and their work has had a demonstrable, practical effect on monument management. The work of these officers has, and continues to be, a very useful vehicle for management agreements, interpretative schemes and general awareness of conservation issues. In Northumberland, for example archaeological sites including carved panels have been included within management agreements between the Park Authority and the landowner (Paul Frodhsam *pers. comm*). This has also lead to the development of site interpretation works. Archaeological resource management issues in National Parks has been explored elsewhere (for example see White and Iles 1991) as has the scale and nature of this designation on ancient monuments in general (see Darvill and Fulton 1998, 208-210). Of all 353 SMR records received some 103, or just under a third relate to panels which the North York Moors and York Dales National Parks. The project did not collect any further data on this designation.

5. THE NATURE AND EXTENT OF ROCK ART IN ENGLAND

5.1 Rock art and the archaeological record

5.1.1 Creating and developing the record

5.1.1.1 As with all components of the archaeological resource in England, there are a series of relationships between those items which have been recorded and those that have not; those that survive now and those that have been destroyed (for a full explanation see Darvill and Fulton, 1998, 13). In the case of rock art we simply do not know the total number of panels that were carved. Thus the relationship between the original population and that portion which has been recorded (the recorded resource) remains unclear. Indeed the situation changes regularly as panels are degraded and subsequently lost and others are rediscovered. Later chapters in this report will deal with the issue of survival and wholesale loss and, it is hoped, that the results of any larger programme of work will improve still further our understanding of these relationships, contributing to well-informed resource management. Before this, it is important to understand the nature of the record of rock art as it stands now, in late 1999. This chapter investigates the characteristics of the recorded resource that is English rock art, and its potential in contributing information to such a future programme. Throughout this and later sections, the term "recorded resource" relates to records held by local government, national heritage agencies, and a select few archaeologists and amateur groups / locals all of whom have and, continue to afford access to information on rock art. Although material from the first two can be said to be in the public domain, access to private archives is clearly more limited. Those private archives participating in the pilot work are described below. The term does not, for the time being, include other potential sources (largely private material held by landowners and further amateurs) where access cannot be guaranteed.

5.1.1.2 Unlike many elements of the archaeological record, rock art has until recently found itself relegated to the fringes of academic study. As a result, the discovery, recording and record enhancement work that has helped shape the records available for study today has been left to dedicated amateurs, curatorial staff where time permits, and a small number of academics. In this sense, the best available information is not necessarily the traditional sources such as Sites and Monuments Records or the National Monuments Record. Rather, significant portions of these are copies or enhanced copies of private material. Furthermore, there are numerous overlaps and gaps when looking at the record collectively. It appears that the process of record exchange between national and local sources and private archives has been haphazard and so, for example, all sources might have copies of some records and in places it is only the individual sources (such as private archives) that will contain unique records. Archives have developed in different ways, each with their own idiosyncrasies, and so in order to understand the record it was important initially to compile a consolidated record to understand the limits of information from each source. These records relate to the general term of 'site'. Later on in the chapter, the splitting of records to form standardised and comparable record units is discussed.

5.1.1.3 The earliest discoveries can be traced back to the work of antiquarians, but, although fieldworkers were active in the early decades of this century, it was not until the 1970s that the collective record started growing appreciably when amateur fieldwork took off. As illustrated in distribution plots (for example Figures 5.1, 5.2 and 5.3) record development has clearly had a regional bias with fieldworkers concentrating on specific areas at first, extending their coverage only later on. Morris started with Galloway and Argyll, Beckensall with the Northumberland and IAG around the Airedale valley, Ilkley and Keighley, West Yorkshire. Where it happens, the exchange of this information with SMRs and the NMR can be seen in those record fields dealing with recording events and in descriptive fields referencing the work of specific individuals and their numbering systems. This work continues today as new discoveries are made and existing information is occasionally checked on the ground.

5.1.1.4 Discovery of new panels continues today as fieldwork programmes are conducted, land-use changes or development reveals new panels and chance finds are made. In Scotland for example, over the three year period, 1996-98 reports for over 50 panels were made to the relevant authorities (Turner, 1996, 1997, 1998). However, these successes also highlight some of the continuing problems of identification and recording. Principal among these are natural features being misinterpreted as rock carvings, and previously recorded motifs being re-recorded, often duplicating the original record. In these Scottish cases it is not just the traditionally dense areas that yield new material. Over this period, reports were made for finds in Aberdeenshire, Angus, Argyll and Bute, Dumfries and Galloway, East Lothian, Inverclyde, Mid Lothian, North Ayrshire, Perth and Kinross, Shetland, South Ayrshire and Stirling. In England, reports continue to be passed to SMRs and are publicised separately (e.g. Beckensall 1999). In previously 'blank' areas finds have been made, for example in Somerset and Gloucestershire. Indeed, even during the brief field trials in Northumberland and West Yorkshire new panels were discovered during reconnaissance survey for specific known panels. The fact that this process is still occurring in relatively well surveyed areas suggests that our current record of rock art panels underestimates the quantity of this site type. Attention is now turned to the nature of these archives and the panels recorded within them.

5.1.2 Private archives

5.1.2.1 Chapter 3 summarised something of the development of interest in the subject by highlighting the main contributors of material and their works. Appendix K sets out key published texts and articles for each county, and from these, a number of points can be made. First, they largely reflect the work of dedicated amateurs and amateur groups and thus represent a range of different recording objectives, biases, and interpretative judgements. Familiarity with this material is clear in many of these archives, as individuals have compiled entries following extensive fieldwork and, over long periods of time. Secondly, there is a strong regional bias in recording, favouring the northern and northwestern areas of England (for example Cleveland, County Durham, Cumbria, Northumberland, and West Yorkshire). What is unclear, is whether this is a good representation of the original population or a function of recording work to date. This issue is unlikely to be resolved without further widespread prospection work that is based on well-structured sampling.

5.1.2.2 There are five key private archives relevant to the Pilot Project.

- **Stan Beckensall archive.** Held by Mr Beckensall in Hexham, Northumberland.

This archive covers an area from the Scottish Borders to the northern region covered by the Ilkley Archaeology Group, including County Durham, Cumbria, Northumberland, Swaledale and Wensleydale (Stan Beckensall *pers. comm.*). The archive contains numerous drawings (based on panel rubbings), photographic transparencies and notes written by Mr Beckensall. Publication of this material has taken place and these are listed in Appendix K.

- **Ian Hewitt archive (HELICS database - Handbook for Enumerating Listing and Illustrating Cup-and-ring Stones).** Held by Ian Hewitt at Bournemouth University

Hewitt's HELICS Database, compiled with the aid of I M Hewitt, covers a wide area including sites across eleven counties in England as well as Wales, the Channel Islands and the Scilly Isles (Hewitt 1991). In the case of certain counties, the HELICS database represents the only systematic record for rock art sites – this is true for Gloucestershire and Hampshire, and, along with Morris' archive, for Devon. With SMR records currently unavailable for Cornwall, the HELICS database is a valuable indication of the extent of the resource in this county. Hewitt has thus far avoided compiling records for counties where significant work has been conducted by other researchers or amateur archaeologists (Cleveland, Durham, Yorkshire) in favour of collating less well known records, and concentrating on an intensive investigation of sites in Northumberland, where wall-walking also formed part of the survey work (Hewitt *pers.comm.;* Hewitt 1991). Though Northumberland is particularly rich in rock art sites, the concentration of field work in this county has without doubt had an impact on the sheer number of sites identified here, compared to other areas. Hewitt (*pers.comm.*) has suggested that in terms of county coverage, Lancashire is the only outstanding county yet to be systematically checked and integrated into the database. The current record totals some 387 sites and 612 panels.

Records are arranged in individual panel units providing location and context details, descriptions and references. Due to software obsolescence this data now exists in paper form and would require manual input for use in a digital format. In fact a project to transfer these records to Microsoft Access tables will shortly commence. In addition to this database Hewitt has amassed a catalogue of newspaper cuttings, and a library of articles and books including very early, rare, and out of print publications. These are referenced in the bibliographic field in the HELICS database records and are cross-referenced to the site record forms. Unique site numbers prefixed with 'H' were assigned to individual panels and to sites featuring a concentration of panels. In the case of the latter, individual panels are identified by letters or numbers within the overarching site number. Fieldwork in Northumberland has resulted in a substantial archive of paper site record forms, almost entirely directed at the individual panel level. The most recent of these are yet to be input to a digital database. Unique location co-ordinates are available for almost three quarters of the sites, and are frequently duplicated for individual panels found within these sites (these were not included in analysis). Approximate locations were established in the field through traditional triangulation techniques using compass readings and 1:2500 OS maps (Hewitt *pers.comm.*). The number of sites and panels per county are indicated in Table 5.1.

- **Ilkley Archaeology Group.** Held by Dr Keith Boughey, Baildon, West Yorkshire on behalf of IAG.

Established by a local society, the Ilkley Archaeology Group (IAG) rock art database focuses on the Rombalds Moor area (Hedges 1986). Bibliographic data, location details, descriptions, photographic references and co-ordinates are organised in separate Microsoft Works files. This database is consistently organised at the individual panel level, including unique location co-ordinates. Location co-ordinates were established in the field through traditional triangulation techniques using compass readings and 1:2500 OS maps (Boughey *pers.comm.*) and are almost entirely 10 digit references, accurate to within 10 metres. As a result of the work by the IAG, maps of the area showing the location of panels were created – a feature which is not common in studies of rock art in other counties. Fieldwork by IAG members has included the creation of detailed plans for a significant number of the motifs visited. Here photographs were taken parallel to the rock surface with a metre grid square laid over the panels in sections. The photographs of the motifs were then projected onto a screen to the correct scale, 'traced' and reduced (Hedges 1986).

The archive currently published (Hedges 1986) relates to fieldwork seasons during the 1970s and contains details for 290 sites. More recent fieldwork in the same areas has revealed a large number of new sites, and the total is now approximately 640 sites. These sites were largely identified through the group's familiarity with the area and through word of mouth rather than controlled searches (Boughey *pers.comm.*). This factor, in addition to the tendency for low panels to become lost under heather and turf suggests that, though Rombald's Moor is one of the most well surveyed areas in the country, there are likely to be more panels awaiting discovery.

- **Ronald Morris archive.** This archive is held by RCAHMS, Edinburgh

An inventory of sites across thirteen English counties as well as those located in Scotland was published by Morris in 1989. All records are at the site (frequently multi-panel) level with the number of panels featured in each site indicated for the majority of records. The co-ordinates range from 6-10 digit accuracy, with the majority of sites featuring 8-10 digit co-ordinates (i.e. accurate to 10-100 metres). Information on the site name, panel type, motif type, minimum age and references is also collated. The number of sites and panels per county is illustrated in Table 5.1, and a distribution map at site level is shown in Figure 5.1. As these demonstrate, Morris' archive indicates the presence of high concentrations of rock art panels in Northumberland, North Yorkshire, and West Yorkshire, with lower concentrations in Cleveland, Cumbria, Derbeyshire and Durham.

Over 420 records are catalogued by information available in the original Ordnance Survey card format, along with notes, sketches and photographic transparencies.

- **Maartin van Hoek archive.** Held by Mr van Hoek.

This archive was not consulted during the Pilot Project.

5.1.3 Sites and Monuments Records (SMRs)

5.1.3.1 At the outset of the Pilot Project, local authority SMRs and the NMR were taken to be the primary source of recorded material, but, as has been shown, private archives clearly have an important role to play. All known SMRs in England (some 58 archives), and the NMR, were contacted at the outset and invited to participate in the Pilot Project by providing information in the form of a completed questionnaire, and copies of any digital records relating to carved panels or other monument classes incorporating rock art, for inclusion in the project's trial database. Additionally, seven National Parks were contacted and the response from these, along with all others contacted, is set out in Table 5.1.

5.1.3.2 The questionnaire was designed to investigate whether rock art appears in the SMR and, if so, what form it takes. Questions structured on the following sections were therefore asked:

- SMR Name; SMR Location; Date of form completion; Respondent's name; SMR System used.
- Presence and quantity of rock art records in the SMR; Presence and quantity of rock art information in non-rock art records (i.e. other monument classes); predominating monument classes (in the case of the latter).
- Indication and counts of archaeological periods represented (where possible using prehistoric sub-divisions)
- Comments and any other relevant information

APPENDIX D details the covering letter and questionnaire sent SMRs.

5.1.3.3 52 out of the 58 (90 %) SMRs contacted replied to the questionnaire. 15 SMRs (29% of the replies) sent completed forms confirming the presence of rock art in their records, 37 SMRs (71% of the replies) confirmed that no such information existed in their record (to their knowledge) and lastly, 5 SMRs (10% of the replies and all from National Park archaeologists) referred the project to a Unitary Authority. Where a false negative reply was given (for example in the case of Lancashire) anecdotal evidence for the existence of inscribed panels was known about but no record was found in the SMR. Lastly, 1 SMR was unable to complete the questionnaire for technical reasons (systems migration and record upgrading work). Table 5.2 lists those authorities responding to the questionnaire.

5.1.3.4 For those SMRs replying with information on rock art there were a total of 809 records counted, of which 655 relate to specific entries on rock art. The remainder, a maximum of 154, was for records of other monument classes that contain information on rock art. The county breakdown of these and the periods represented is set out in Table 5.3. Of the fifteen counties replying with information, this represents an average of 54 records per county. However, this figure and the component totals can only be used as a guide because the level of recording or *record mode* varies between SMRs. Where one archive lumps several carved panels together into one record, another may split these up into individual records and *vice versa.* It should be noted that these figures do not necessarily correlate with the numbers used below because the information relates to SMR *records* as opposed to "sites" or "panels", as more precisely defined elsewhere.

5.1.3.5 The SMR and National Park records represent the most extensive archive for English rock art in terms of the number of counties (fifteen) covered, though as detailed below this is not exhaustive. There is a considerable degree of variability between SMRs in terms of the manner in which rock art is recorded. Most of the SMR records received were derived from flat file databases where all information is contained in a single table or spreadsheet. The Northumberland SMR features a more developed relational database with thematic information separated into different tables. Some records operate on the panel level - notably the Cleveland SMR, though this may relate to the nature of the sites themselves, and the West Yorkshire SMR due to IAG survey work. The majority of SMR records however, feature internal variation in terms of record level, combining panel and multi-panel site approaches. Panel level records are most commonly present for isolated or distinctive panels, but this recording approach is not necessarily consistently applied. While certain information is generally found in every data set - such as SMR or NMR number, description, and eastings and northings - there is a great deal of variation between each of the data sources. Relevant information that is not recorded as standard practice across all of the data sets includes; bibliographic references, geology and soil type, site tenure, motif type, land-use, condition, finds repository (particularly important in the case of mobiliaries), number of panels within site (explicitly stated in a separate field only in North York Moors National Park), and excavation details.

5.1.3.6 On the basis of the digital and paper records supplied for five SMRs and National Parks a number of observations can be made. Rock art is recorded as a unique site class - most frequently cup-and-ring marked stone – particularly where panels are isolated, but also within other site classes, such as cairns and burial mounds. Often the latter will take the form of a simple reference to carved stones in the description field relating to the cairn or mound rendering the search process more complex. Between SMRs and within individual SMRs descriptions of motifs are highly variable. Where these do occur they are most usually general descriptions, and very occasionally give the number of individual motif types such as cup and grooves. Within the SMRs and NPs that were able to supply data, separate fields detailing the motif classes were rare. The North York Moors National Park record is a rare example featuring a field for decoration type containing classes of cup, ring and channel. Information on condition and land-use is also scarce in the SMR record – though general notes were made on the West Yorkshire hand written record forms, but these were not transferred into the digital form currently available (it should be noted that this is still under construction). Graphics of any sort seem to be limited to those counties where private researchers have been active, such as Northumberland and West Yorkshire.

5.1.3.7 SMR descriptions in counties with a lengthy history of field checking and data deposition by private researchers (notably Northumberland) operate as a cumulative record of observations made over decades, or even centuries. The descriptions must be seen, therefore, as artefacts in themselves, and reaching a standardised account of the panels requires interpretation. Location co-ordinates vary from 6 to 12 digits (accurate to 1km to 1m) but most commonly range between 8 to 10 (accurate to 100 to 10 metres). Most locations were established through field checking using OS maps, systematic surveys and the use of appropriate survey equipment are rarely mentioned in the records. Locations are commonly site-centred for multi-panel sites, though the description fields sometime offer more detailed co-ordinate information for individual panels. Height data is rarely available. In all cases the use of data for analyses of the nature of rock art has to be tempered by uncertainty over the consistency with which values were assigned. This is partly a product of the cumulative nature of the data acquisition and the variety of data sources (from word of mouth via local residents to systematic surveys) included. In many cases the majority of information is stored in the description field, where data tends to be less standardised and more difficult to query.

5.1.4 The National Monuments Record

5.1.4.1 The NMR was contacted and asked to provide digital data for all records with the following monument thesaurus terms: carved stone; carving; cup and ring marked stone; cup marked stone; rock carving; and, where motifs were present and recorded, passage grave. Unfortunately, it was not possible to extract this data within the time frame available for technical reasons (systems migration). However, a basic search of the NMR database was carried out and revealed over 800 entries (not necessarily records). Table 5.4 shows the geographic range of this material.

5.1.4.2 There are a number of points to bear in mind when looking at this data. It is displayed according to the 1974 counties, it does not necessarily relate specifically to prehistoric material and, there will be overlaps in the terms used for each entity (hence the difference between 800 quoted above and the total achieved by calculation). It does, however, give a rough estimate of the scale of information available from the national archive. Further editing and validation work using individual records would be required if this information was to be used in any larger programme.

5.1.4.3 Given the disparate nature of these records it is an important first step of any larger programme to validate, consolidate and, re-cast information from the various sources. Since digital data was only supplied by a select few SMRs what follows is a basic set of analyses characterising rock art in England as recorded in SMRs. Comparisons are made with data available from private sources.

5.2 The character of recorded rock art in England

5.2.1 A snapshot of the collective record for rock art in England

5.2.1.1 This section deals only with the analyses of data on rock art made available to the Project by SMRs (see Figure 5.4). In this sense the results are provisional and only when a full national dataset is compiled can the complete nature of the collective record for England be understood. NMR data was not available in digital format during the Pilot Project and time constraints prevented the hand entry of information from private archives. Digital data was received from Keith Boughey of the Ilkley Archaeology Group for parts of West Yorkshire but this was not incorporated into the database. These tentative analyses were therefore undertaken using digital data from Cleveland, Cumbria, North York Moors National Park, Northumberland and, Yorkshire Dales National Park. Analysis of the field trial data is discussed in Chapter 6. Interpretation of the SMR and National Park data has been conducted within the context of the issues raised above. For example, queries will reflect the nature of the recording approach used by the SMRs and National Parks, the quality of the data, and, hopefully the nature of rock art in England.

5.2.1.2 The Pilot Project recovered a total of 388 records from SMRs (Unitary Authorities and National Parks) of which 353 were supplied digitally and rest in paper format. Two further SMRs made estimates of the extent of rock art records, and so a further 350 records should be added to this number making an estimated total number of rock art records for England (as recorded in SMRs) of 738. The NMR yielded 1020 record items (not simply records but the figure can be used to gauge the level of information contained here). In this figure, there is an overlap for records held also by SMRs. The maximum number of rock art records in a single private archive are 630, but we cannot simply add the archive holding together as there is an element of overlap. Table 5.1 summarises this information for each county and each data source. Within the two sample transects we can look at the relationships between the size of the recorded resource as represented in different holdings. As Table 5.5 shows, the number of panels known from private archives is about double that recorded in SMRs. Assuming this is representative, and accounting for the proportions seen at the county level for these two counties, the projected number of rock art panels in England is likely to be about 1600. These figures are the first such attempt at a quantification of recorded rock art in England involving various sources and should be seen as provisional. They account for variations in the modes of record (motifs, panel, site etc.) as used by SMRs.

5.2.1.3 The scope of SMR records (and indeed the NMR and private archives) reflects four broad areas of recording. These are:

- Archaeological attributes (for example monument type, context, dating and descriptive information);

- Management attributes (for example location, land-use, designation, condition);
- Record event attributes (for example creation and record enhancement dates, references and compiler);
- Visual information (for example sketch plans and drawings).

Excepting the last category (mainly found in private archives and in particular well represented in the Hewitt archive), it is against these categories of information in the record that the following discussion is set out. The range of fields commonly found in SMRs encompasses the first three of these categories and typically (but not exclusively) includes:

Archaeological attributes: Site / panel / motif name; Monument type; Archaeological period; Archaeological context and; Basic description.

Management attributes: Reference number; Locational information (NGR, NGR qualifier, county / district / parish); Landowner comments an information; Legal status (archaeological and non-archaeological); Prevailing state;

Record event attributes: Record compilation and enhancement date; Compilers; Fieldwork and archaeological history; Further sources and; Field notes

The following sections describe the actual content and level of recording as found in SMRs and therefore, strengths and weaknesses. These data are also discussed in Chapters 4 and 6. The analyses hereafter are based on the digital records supplied to the project and include Cleveland (25 records); Cumbria (18 records); Northumberland (207 records); North York Moors (56 records); Yorkshire Dales (47 records) (the records here relate to those SMR entries standardised to panel level recording).

5.2.2 Rock art motifs

5.2.2.1 In order to investigate the frequency of the use of motif categories the records were queried for cup, cup-and-ring, groove, channel, and less common terms such as basins, spirals, penannular motifs, grids, ladders, lozenges and feet. Usually, this information was derived from the general description fields as no records had explicit fields for motif categories. Where possible the results were checked so that records that contained references to, for example, ring ditches or incense cups, were removed. The query is currently the only method of assessing the theory of regionality or local distinctiveness in English motif types against existing records, other than the general observations made in the literature (for example Morris 1989) and so until such a scheme is devised to accurately record recognised motifs, the results must remain provisional. Table 5.6 lists the range of motif types found in the sampled SMRs.

5.2.2.2 Two approaches were used to look at the potential regionality of motifs. First, queries based on county areas were conducted in order to investigate recording patterns within and across county sources, and to demonstrate whether any distribution patterns are identifiable at the county level. Secondly, the use of GIS digital maps allowed the distribution of the motifs themselves to be investigated and thus possible stylistic regions to be identified without the influence of county level recording. Of the five digital data sets available for analysis, four featured single fields offering some very general information as to the motif types featured at the site. These were usually 'Type' or 'Site Name' fields. The recording of motif type is performed at the panel or multi-panel level, rather than at the individual motif level. It should be noted that the fields were, with the exception of the North York Moors, not likely to have been designed to describe motif type variation. The North York Moors data set featured the most developed set of classes or types in a 'Decoration Type' field. The broad categories do not express the variability in motifs which is demonstrated in the description fields, which refer to other motif types such as spirals, penannular grooves, and grid patterns.

5.2.2.3 Another way of looking at the level of variation in motifs present in SMR data was to validate and re-cast information so that all records related to 'panels' and then to query the description fields in the source data for appropriate terms. Table 5.7 lists the results of this work. Most are derived from the scheme developed by Hewitt (1991) and others were added on the basis of familiarity with the terminology used in the descriptions. Note that some terms which initially appear to be adjectives, but which might be applied to motif types (such as rectilinear), were queried. This is due to the use of these terms as motif classes in the descriptions (e.g. linear motif or rectilinear pattern etc.). Circle is commonly used in place of ring, but is often found in the earlier descriptions and may have been replaced by the term ring.

5.2.2.4 A '+' Indicates that in many records the number of panels featuring this motif cannot be determined, and numbers therefore represent a minimum of 1 panel for each of these records. Because records may be duplicated between motif types, except in the case of cup and ring, county totals are not given.

5.2.2.5 The following motif types recognised by other authorities were not found in the SMR and NP descriptions: Axe, Cruciform, Dagger, Hand, Hatching / Hatch, Keyhole, Labyrinth, Ladder, Rhomboid, Zigzag, Zoomorphic. The widespread use of 'cup and ring' as a generic term, regardless of whether the panels actually possess both motif types renders the secure identification of cup and ring, and cup, and ring panels difficult. Cups commonly occur without rings, but rings seldom occur without cups. Some terms are possibly regional due to development by individual recorders, for instance 'penannular' is used by Hewitt and Beckensall (*pers.comm.*) and is only found in the Northumberland records of the HELICS system and where both rock art researchers are most active. West Yorkshire description fields were generally much shorter than those in the other counties, with less detailed information on the individual motifs. This has undoubtedly affected the numbers represented for this county.

5.2.2.6 The figures undoubtedly demonstrate the under-developed nature of the motif type recording scheme within the SMRs and NPs with the terms cup and ring being used to describe what is a much more internally variable resource. More detailed categories such as adjoining cups, penannular grooves, and lozenges are rarely identified, rendering the assessment of more subtle regional differences in motif types more difficult. As expected, the predominance of cup motifs over any other category and across all individual records is demonstrated.

5.2.2.7 Figure 5.5 displays the distribution of cup-and-ring marked panels, cup-marked panels, and ring marked panels as identified in the SMR digital data description fields. It must be stressed that motif classes are recorded only in general panel descriptions and are not likely to have been consistently applied by SMR data compilers, and as such, distribution patterns may reflect differences in recording approaches at the inter- and intra-SMR level. Some very basic trends are worth noting. First, panels featuring cups without rings, and those featuring cup-and-ring marks are both widespread, except in the case of Cumbria, where panels featuring only cups were not identified. In fact it is known from the HELICS archive that two such examples exist (Hewitt *pers.comm.*). Again, these sites would have to be ground checked to confirm whether this pattern relates to recording procedures or to actual patterns in the archaeological record. Secondly, within Northumberland the distribution of the three classes is markedly different (see Figure 5.6). Cup marked panels predominate over cup-and-ring marks in the southern areas, whilst the opposite is true in the north. Furthermore, in the northernmost concentrations of panels cup-and-ring marks tend to be more tightly clustered while cup marked stones commonly occur singly and are located on the periphery of the areas featuring concentrations of cup-and-ring marked panels. The only sites recorded as featuring only rings are isolated and extremely widely dispersed, with all four occurring within Northumberland's boundaries.

5.2.2.8 Although many of the SMR descriptions clearly state that panels feature certain motif types exclusively (for example, "cups without rings" is a common description) the problems of consistency and accuracy in SMR recording of motif classes render the interpretation of such distribution patterns redundant. The use of more detailed and accurate data sets where motif classes were clearly defined and consistently recorded in future analysis is imperative if current discussions on regional distinctiveness are to be refined.

5.2.2.9 A distribution map of panels featuring a range of less commonly occurring motif classes is shown in Figure 5.7. The sample sizes here, with some motif classes (such as 'star' and 'grid') featured in single panels only, prevent the development of current knowledge with regard to regional distinctiveness in terms of these rare motif types. However the location of spirals (in Cumbria and Northumberland) and grid motifs (in Northumberland exclusively) mirror trends recorded in Morris's (1989) inventory of rock art sites. The other classes shown (comb, horseshoe, rectangular patterns and stars) are not featured in Morris' categorisation system.

5.2.3 Panel types

5.2.3.1 The frequency of different situational types (boulders, outcrops and mobiliaries) is also of interest for two reasons. First, the different categories bring their own management and conservation issues. For example small mobiliaries are particularly at risk in terms of loss, relocation or theft, and really require a means of identification, such as a tagging system to address this problem. Boulders are more likely to be lost under vegetation than large outcrops, and both are vulnerable to stock damage (as discussed in Chapter 6). Secondly, the distribution of panel types, though clearly governed to a certain extent by geology and by transformation processes such as quarrying and wall building in the case of mobiliaries and boulders, demonstrates patterns which may also relate to regional differences in style or function. The identification of earthfast boulders and outcrops would also aid in future work on chronology. Current approaches to the problem emphasise the likelihood that mobiliaries located within other monument classes, such as cairns, burial mounds, and souterrains dating to the Bronze Age and the Iron Age are in secondary context, so that their distribution may not reflect their original placement within broader settlement patterns. Investigation into the original distribution of panels and their relationship to the landscape and other archaeological evidence therefore relies on outcrop and boulder data. Results for this query are presented in Table 5.8 and Figure 5.8.

5.2.3.2 There were no examples of SMR or NMR extracts in which panel type is recorded as a separate field. The description fields most commonly record rock art panels simply as 'stones', which is no doubt linked to the recording of petroglyphs under the classes of 'cup marked stone' and 'cup and ring marked stone', as recommended by English Heritage and RCHME (1992). However, outcrops and boulders are also commonly mentioned in the descriptions. Problems arise here, as it is not necessarily clear as to how these types were defined and recorded. As an illustration of the possible ambiguities in recording these types, at least 11 records feature descriptions, compiled on separate occasions, which refer to individual panels both as boulders and outcrops. These variations in terminology are no doubt related to inconsistencies in the descriptions of material in the published literature.

5.2.3.3 A query on the term "mobiliary", commonly used by rock art researchers in Britain, did not produce any results. Interestingly, the term "portable" is featured only in Northumberland. As mobiliary or portable stones are not limited to Northumberland, this may be seen as a regional recording term. However, it may also reflect that a large number of mobiliaries are found in Northumberland, though there is currently no way of demonstrating this potential distributional pattern more conclusively. As a general observation, the field team's experience certainly followed this pattern, with no mobiliaries seen in the West Yorkshire transect, but many encountered in the Northumberland study area. Again, it is highly likely that other factors (such as relocation to museums) could be influencing this observation, and further research is needed in order to make any more concrete statements regarding mobiliary distribution. References to caves and shelters featuring cup and ring markings are limited to Northumberland only.

5.2.3.4 Figure 5.8 shows the distribution of panels recorded as 'portable', 'boulders', and 'outcrops'. While the figure demonstrates the concentration of portable carved stones in Northumberland, and a predominance of outcrop rock in Northumberland and North Yorkshire, this patterning cannot be interpreted as a true reflection of the archaeological record until ground checking confirms whether these categories have been consistently recorded.

5.2.4 Tooling and manufacture

5.2.4.1 Variation in the techniques used to create the motifs is poorly documented and poorly understood for petroglyphs in England. Again this type of analysis may aid in discussions on regionality of style. In general only pecking, engraving, and incising are recorded in the SMR and National Park records; this is not recorded as standard practice or in a consistent manner. Though these cannot be used to discuss technique distribution patterns due to the poor quality of the data, results of the number of occurrences of technique types are displayed in Table 5.9.

5.2.4.2 Technique of manufacture is not recorded as a separate field by any of the counties or National Parks that were able to supply digital data. For this reason the description field was used in queries which aimed to survey the frequency at which techniques of different types, using keywords, are mentioned in general descriptions. While 'pecked' give a reasonably good indication of means of manufacture, all of the other values are too general to indicate a specific technique. The range of technique terms used in the project, and their definitions, is given in Chapter 3.

5.2.5 Dating

5.2.5.1 SMRs generally use the same terms to describe prehistoric divisions and sub-divisions, although some define these with slightly different date ranges. English Heritage has set out a standardised scheme for dating at this level (English Heritage 1997). Unless detailed investigation has taken place and a direct dating technique applied, then this level of dating represents nothing more that an impressionistic view of date as perceived by the record compiler, perhaps using some insights from the sources drawn upon. Table 5.10 sets out the categorisation of validated rock art panels into prehistoric sub-divisions without reference to subtle date range differences. A sample of 674 panels is used (representing those SMRs where dating information was forthcoming). The example dated to the early medieval period is in fact a panel lying within part of a larger, later site. This illustrates the problem where rock art is recorded as relating to another monument class, in that the date fields may not be sensitive to the range of material embraced by the entry as a whole. What the table shows is a level of information that is only suitable for the very broad date classification of rock art.

5.2.6 Context, geology and topography

5.2.6.1 Something can be said from information relating to the archaeological, topographical and geological context of recorded panels as found in SMRs. As with the above analyses, this data is somewhat limited in scope and may not be representative of all recorded panels. It does, however, show a number of broad traits. Information on the archaeological context of panels was available and this demonstrates the range of other monument types in which rock art survives. Table 5.11 shows those classes of monument, standardised by the *Thesaurus of Archaeological Site Types* (English Heritage and RCHME 1992) that rock art exists within. The figures represent the number of panel descriptions that mention these site types. Duplicate entries are therefore possible and so totals are not given for each source. The table illustrates that three site types: "burials"; "cairns" and; "mounds" are dominant (grouped together, 37% of all site type records represented) with "barrows", "camps", and "cists" also well represented (collectively, 34% of the total number of mentions). Cairns and burials therefore appear to dominate the associations with which rock art has been recorded.

5.2.6.2 In order to illustrate this resource, Figure 5.9 shows the location of rock art panels which are associate with specific site types (here forts, mounds, stone circles and standing stones are shown). According to the SMR descriptions, panels associated with forts are most common in Northumberland, and are absent in Cleveland. Mound associated panels are distributed throughout Northumberland and Cleveland, with a single occurrence in North Yorkshire. Stone circle associated panels are less common than the other categories and are widely dispersed but absent in North Yorkshire. Rock art panels associated with standing stones are most common in Northumberland, with small numbers also occurring in Cleveland and Cumbria. The collection of additional information, such as the age of the sites and the manner in which the rock art is incorporated (*in situ* outcrop versus quarried sections in secondary context), would enable researchers to investigate issues such as the possible reuse of rock art during the Bronze Age (see Hewitt 1991, Burgess 1990).

5.2.6.3 Panel geology was also analysed and although the Pilot Project was interested in the difference between panel geology and surrounding geology this was not made clear in the SMR data. A variety of description and geology fields were queried to produce the following tables. 700 panels were used in this analysis. Table 5.12 confirms that rock art predominantly lies on the sandstone geologies of England. Very small numbers of granite and a single case of an unknown 'volcanic' rock appear in the record. Several problems, however, arise with regard to the way in which geology is discussed in the description fields. Limestone and sandstone are not consistently applied, particularly in the cases where multiple descriptions have been accumulated over time for single records. 18 panels have been described both as sandstone and as limestone by different recorders in the Northumberland data set. Some of the sites in the Northumberland transect, which had all been recorded as sandstone during the Project field trials, were recorded as limestone in the SMR record (e.g. Panels 16-20). Ambiguous local names for rock types are also commonly used. For example, millstone grit or gritstone can be applied to either basaltic or very hard sandstone (Hewitt *pers. comm.*). The data for West Yorkshire, and some of the North Yorkshire sites was derived from descriptions originally taken from the NMR rather than the SMR. Though references to gritstone were common for the West Yorkshire records, the North Yorkshire NMR records contained just one reference to geology out of 65 records. Until further digital records are obtained from the NMR the reasons behind this pattern cannot be ascertained, but clearly regionality in recording approaches, and differences between SMR and NMR recording are important to consider.

5.2.6.4 Height OD was also considered, using SMR data. Relevant information was found in just under half of all records received, but, in fact, all the figures relate to panels on the North York Moors and in Northumberland only. All panels here lie between 35m and 361m OD, the majority (38.9 %) of which are located between the 250 and 300 m contours. It has been reported that rock art in England predominantly lies between the 250m and the 335m contour lines (English Heritage1990, 5) but this remains an estimated height range.

5.3 Strengths and weaknesses in the collective record for England

5.3.1 The Pilot Project was unable to source all records on rock as held by SMRs in England. This was either because records existed only in paper format (and time constraints prevented substantial hand entry of this information) or where digital information was involved, systems were either being migrated or data being validated and thus SMRs advised that data transfer was not possible at that stage. This was the case for three archives: West Yorkshire SMR, Cornwall SMR and the National Monuments Record. Even within the digital datasets available it is clear that there remains great variability in those records held by different authorities. All apparently hold archaeological, management and curatorial information of sorts, but place different emphases on the types of information stored. In this sense any detailed national round up and analyses of such information would require data to be independently checked and reformatted. Part of the problem is undoubtedly the fact that rock art sites do not conform to the more traditional kinds of monument classes and that the relevant information is difficult to compile using field structures better suited to other site types.

5.3.2 As the above discussions demonstrate achieving both an extensive record encompassing all known sites in England, and an intensive record with sufficient detail on individual panels within each major region entails the integration of private and government records. This would be a prerequisite to a nation-wide study and, once completed, a number of issues would have to be addressed. These are discussed below. Currently only a sub-set of data from the SMRs has been imported into the Project database. Other components of the database were used for project field trial results and future work. Each SMR extract varies according to the types and level of detail recorded. Where good quality data is consistently recorded within single SMR extracts additional processing would broaden the possibilities for analysis – for example, the West Yorkshire SMR (currently only supplying paper records) records general details on land use and panel condition. The fields imported into the Pilot Project database – SMR number, location, designation, and description offer a limited range of query opportunities, as detailed above.

5.3.3 Record completeness

5.3.3.1 Several of the records consulted simply contained blank fields. This was especially clear in the case of management information where fields such as land-use, condition, and designation were blank. In the case of the latter, it was not clear whether a blank referred to the lack of designation or the lack of data.

5.3.4 Currency

5.3.4.1 Records resulting from accumulated observations from a variety of sources, and those for sites that have not been field checked for a number of years could be brought up to date and standardised through field checking. In one extreme example of the effects of these problems, a North York Moors National Park record refers to an early excavation during which "almost 300 [carved] stones" were found. Although it is highly likely that excavation records were either poor or lost, and that the location of the stones is now unknown, the positive confirmation of the existence of these stones would triple panel numbers for the National Park. In addition, in some records the more recent observations suggested that all 'motifs' previously identified look to be the result of natural weathering. In these cases it would be useful to field check the sites for an informed decision to be made. In two of the five digital data sets, District information was not up to date.

5.3.5 Data Standards and Consistency (record splitting and lumping)

5.3.5.1 RAPP has adopted *Panel* as the standard unit of record for all rock art record entities within a structured system which is sensitive to the data itself. Thus it has been necessary to re-format existing records to suit the Project's database. A considerable amount of variability exists on both the inter-SMR level and the intra-SMR level. Most SMRs and National Parks have adopted one or several of these approaches.

5.3.5.2 The frequency with which it was impossible to determine the number of panels referred to in digital SMR records, due to ambiguity or the lack of reference to numbers, is encouragingly low (see Table 5.13). In some cases this was due to the discovery and subsequent removal of mobiliary stones during 19^{th} century excavations. In these instances even ground checking would not allow panel numbers to be ascertained. Admittedly, however, when comparing SMR panel numbers to private records a discrepancy (the latter usually featuring higher numbers) is the norm (see Table 5.1). In most cases the number of panels can be calculated from the descriptions, but it should be noted that this sometimes involves a minor degree of interpretation on behalf of the data processor since some description fields do not explicitly state the number of panels but give general comments. This is complicated where these comments are accumulated over time. In general, the observation referring to the largest number of panels was used as a guide. Obviously this introduces the problem of different definitions of panel. While the definition of panel employed in the Pilot Project directly corresponds to individual stones, boulders, or mobiliaries (all frequently used in the SMR records), it is possible that errors are introduced where records refer to open-air panels or outcrops. Defining panels in these situations can be more ambiguous due to fissures and turf cover. In these cases field checking would be necessary to ensure consistency. The Northumberland data set also included two cave sites and one cliff face. Similarly, these sites would require field checking and possibly the modification or extension of the panel definition process (for instance introducing a distance criterion similar to the 20m criterion used by Bradley *et al* (1993) to account for such situations).

5.3.5.3 The results of the panel verification process are summarised in Table 5.13. Records were split in each of the SMR and National Park datasets, though Cleveland's records increased by just one. The Northumberland SMR record was the only digital data that overlapped with panels surveyed during the RAPP field trails. During this fieldwork the recording of a given panel did not necessarily entail surveying all panels referred to in the relevant SMR record. Thus while the number of panels was increased by this short period of fieldwork, these SMR records may be split further as a result of future survey. Five panels that were entirely unknown within the context of the SMR record (most of which are referenced in the HELICS database) were also recorded during the field trials.

5.3.6 Accuracy and Extent

5.3.6.1 Where rock art is recorded in both the SMR and private archives, the latter usually indicate a higher number of sites, and give more detailed information on panel numbers. Obviously the manner in which records are created (splitting and lumping panels) will play an important role in this pattern but in general this probably reflects the failure of more recent records to be transferred to or researched by the SMR. When compared to private archives, four counties of the twenty-one that replied did not have records for the rock art known to exist within their boundaries. These are primarily counties featuring very small numbers of rock art panels, and frequently these have been relocated to museums. These characteristics explain, to some extent, why these panels are not present in the SMR records.

5.3.6.2 The issues of accuracy and consistency in terms of locational information are complex. Using the example of Northumberland – a relatively detailed and developed record – numerous challenges are presented. The separate national grid reference (NGR) table supplied in the SMR extract featured 287 co-ordinate sets while the standard SMR record table featured 207 records. 80 of these co-ordinate sets were duplicate grid references that often did not correlate to the number of panels, including cases with multiple co-ordinate sets for a single panel site. In addition it contained many NGRs also featured in the description fields, but which actually referred to other site types, such as cairns. Thus these had to be edited for them to be matched up to the RAPP panels. For the location data and GIS maps to reflect the number of panels, the editing process could not be avoided. A range of situations occurred:

- Some SMR sites were listed with multiple NGRs, sometimes quoting several (but not necessarily all) of the co-ordinate sets accumulated in multiple descriptions entered at different times. That is, each NGR was a reference to a single site that had been recorded by different people, each of whom reached a slightly different answer. In general the most recent was used in the project database but it is acknowledged that this was not always the most accurate (as tested by the field team).

- For some records several but not all of the NGRs for individual panels held in the description fields had been entered into the NGR table, and here the descriptions were checked for the missing NGRs.

- In some cases NGRs were available in the descriptions for several but not all panels. For those panels without assigned NGR the 'site centred' NGR was quoted. The problem arises here that site centred NGRs were not always available. As there was no way of choosing the most appropriate co-ordinate set to use the choice of an NGR to duplicate became random and this is recognised as a weakness in the Project database.

- In some multi-panel sites, panels had to be assigned NGRs copied from the single co-ordinate set given for the SMR record, but descriptions were checked for other available NGR. Again these act as a general site location.

- In some cases the description fields contained recent co-ordinates accurate to 1m for individual panels but these did not feature in the NGR table. This relates to the issue of currency discussed above.

- The NGR table thus features a range of data types – site level, panel level, and sometimes co-ordinate ranges. Furthermore some appear to be rounded versions of the description field NGR while others are given in full.

- Where several panels in a single site are individually given the same NGR in the description (possibly quite valid if they are abutting, and also valid for the accuracy level which is not often to 1m anyway) these are not featured in the NGR table (i.e. there are no duplicated NGRs to reflect panel numbers).

5.3.6.3 It was particularly important that the correct NGRs were assigned to those panels that had been surveyed during the RAPP trials. Because SMR records were simply copied to RAPP records for individual panels within a given SMR site, the data still refers to the whole site rather than individual panels. To improve upon this situation, especially in the case of the description field, the data would have to be split up where it only applies to specific panels. Data relevant to all panels could still be copied. In this way, it is only the RAPP number that is unique to the panel as the database now stands.

5.3.6.4 Returning to the locational data supplied by the SMRs, it appears there is much variation in the types and accuracy of locational information presented. Most refer to county, district, and parish names and in only one county, Cumbria, are absolute references used. For panels in the remaining SMRs, Table 5.14 shows the level of accuracy achieved (proportion by each county and then the total). It is encouraging to see that very few records relate to four figure references (the average is eight absolute figures) and that three of the five SMRs polled use twelve figure references. It was noted during fieldwork, however, that several references (although eight or twenty figure in length) were simply wrong when compared to map and compass work and average GPS positions. As mentioned above, the situation needs careful attention as where record validation involves splitting records, a copy of the grid reference is taken across to the new record. Fieldwork validation is therefore a necessary part of confirming the accuracy of grid reference information.

5.3.7 Dating

5.3.7.1 The means of determining the period assigned to the SMR records is not generally made explicit. Absolute dates are rarely referenced, and as already noted many of the assigned periods probably relate to the secondary context of the panels, commonly within Bronze Age cairns and other site types. The occurrence of Neolithic and multi period date categories is significantly less frequent than the Bronze Age category. Recent revisions to the dating question (Hewitt 1991, Burgess 1990b) may indicate that most SMR records may simply be assigning a Bronze Age date due to the traditional assumption that the petroglyphs can be dated through association with Bronze Age site types. This situation is also carried over into isolated carved boulders and outcrops that cannot be dated through association. Often in these cases, the general belief that petroglyphs are Bronze Age in date, due to the reason discussed above, is sufficient for periods to be assigned. Uncritical dating in this way serves to sustain preconceptions. The accidental inclusion of non-prehistoric rock art sites in the SMR extracts supplied to the Project was rare.

5.3.8 Variability in recording approaches: Case Study using Northumberland

5.3.8.1 By comparing the SMR, NMR and private records for Northumberland a number of observations can be made. One of the most notable distinctions between the different archives is a function of the issues of currency and recording consistency. The number of sites and or panels recorded in each data set decreases down the line from the HELICS record (268 sites, 448 panels), to the SMR (207 sites, 450 panels), Morris' inventory which includes Tyne-and-Wear (164 sites, 197+ panels), and the NMR (a maximum of 131 records). Familiarity with the records for Northumberland indicates that many of the more recently recorded sites surveyed by Hewitt are not present in the SMR record (despite the surprisingly similar number of panels). Comparison of the SMR and NMR records also reveals that the NMR duplicates all early SMR descriptions but not the more recent entries (generally from early to mid 1970s onwards). In other instances the more recent descriptions and comments in the SMR and NMR do not overlap. In all other respects the SMR and NMR records for Northumberland are very similar, particularly in terms of the types of information stored. Details on location (NGR), scheduling, site type and age, and descriptions are routinely recorded. In this case the HELICS database and recording system makes valuable contributions to the public records through panel level recording of motif plans, photographs, geology, altitude, and bibliographic references.

5.3.8.2 A degree of uncertainty arises when matching NMR and SMR sites, as the two resources do not always cross-reference their numbering systems. In these cases correlation relies on grid co-ordinates (which may frequently differ up to 10 metres or more between the two records) and descriptions. Where individual panels are isolated, feature distinctive motifs or other characteristics, correlation is often easily achieved. The benefit of the data processor being familiar with the panels, preferably through field checking, cannot be underestimated. Clearly where there are concentrations of panels within a small area problems may arise, and could only be solved through field checking.

5.3.9 Archive potential

5.3.9.1 The piloting work has established a provisional baseline data set for those local authorities in England that were able and willing to provide digital information. It is recognised that this baseline is incomplete and that any wider study of rock art would need to 'plug the gaps' accordingly, hand entering information where necessary and standardising the terminology / controlled vocabulary used. In some cases local copyright limitations prevent the further use of this information and so data exchange agreements would need to be entered into, in order for records to be available for use in further work.

5.3.9.2 More specifically, the potential for analysis of a more complete data set will be greatly improved if particular goals are achieved. First, the private archives of English rock art sites have been demonstrated to be of critical importance to attaining a complete record for the country. Secondly, locational data need to be improved so that, at least in areas where rock art is highly concentrated, panel location is accurate to within 10 metres (8 digit co-ordinates). Thirdly data on land-use, condition and risk need to be collected or digitised from existing sources. Fourthly, the recording of information such as motif type needs to be vastly improved before issues such as stylistic variation across space can be properly addressed.

5.3.9.3 As has been shown, there is much useful data contained within these archives, and once a composite record has been created and validated (assuming private archive material can be incorporated), this information represents a useful core record for further fieldwork. In general, terms, the breadth and resolution of information recorded for rock art sites in SMRs and the NMR has been shown to be a potential weakness as Section 5.2 illustrates. It is perhaps appropriate in developing a specific recording scheme for rock art that the best structural components of these records and private archives are adapted, and new recording prompts developed. One possible scheme for this is described in Chapter 7.

5.4 The palaeoenvironmental record

5.4.1 As an important means of enabling future research to contextualise *in situ* English petroglyphs in terms of their environmental setting, the availability of palaeoenvironmental data resources, particularly in database and GIS formats, was investigated. This research suggests that there is currently no single ideal data set freely available which presents a digital map coverage of sufficiently detailed palaeoenvironmental zones for archaeological periods complete with attribute data.

5.4.2 The Global Atlas of Palaeovegetation, available from Southampton University, includes a digital map for Europe at 5000BP, but the United Kingdom is assigned a single vegetation category (mixed conifer-broadleaf deciduous forest). However, a range of databases, georeferenced sites and general literature resources were identified.

5.4.3 The European Pollen Database, a relational Paradox database available free from the Internet, presents pollen core results for 75 sites across the United Kingdom (the majority of which lie in Scotland). Linking this digital information to the rock art database would be a relatively easy step to make. This would allow broad scale research into certain regions to take into account palynological evidence from the nearest core sites. Such a study would be particularly valuable in conjunction with view shed analysis for rock art sites. For example this could help in testing the idea of the panel visibility from a distance, and the character of certain landscape features visible from panels. In its current form the European Pollen Database consists of technical palynological information and coded data that would require further interpretation for use by non-specialists. The database is also housed in 45 separate tables that could be reformatted for easy reference. The National Oceanic and Atmospheric Administration in the United States provides an alternative means of searching the reports, included in the European Pollen Database and the International Tree Ring Data Bank, through the World Data Centre for Palaeoclimatology. Sites can be selected on the basis of age, name, country, co-ordinate location, elevation, and type. Results take the form of a list of sites with locations in Latitude, Longitude, author reference, and data type with linked files containing the raw data. Searches based on UK sites resulted in 46 site matches, but only one of which was older than 2500BP. Again this dataset would require further interpretation, before students of rock art could readily use it.

5.4.4 In order to increase the number of sites featuring palaeoenvironmental data within any future database, information could be drawn from the regional reviews which are currently under commission by English Heritage for northern England and the Midlands (*pers.comm.* James Wells). These reviews aim to collate the results of 'grey-literature' documents and published work linking palaeoenvironmental data to archaeological periods. This information is already available for southern England (Keeley 1987). Excavations carried out in the vicinity of rock art sites that included palaeoenvironmental sampling such as that on Rombald's Moor (Bannister 1985). This work could initially be pitched at a regional level so that areas featuring concentrations of rock art could be analysed. The English Heritage Environmental Archaeology Bibliography would be particularly useful in such an exercise. This database was established under the auspices of the Ancient Monuments Laboratory and is available online. The data is also available as a Paradox database, and this represents another useful archive that could be readily linked to the project database (Hall *pers. comm.*). Over 10,000 reports from 1950 onwards on environmental archaeology are included covering biological, pedological and geological work sourced from county journals, period archaeological journals, and major excavation report monograph series. Searches can be conducted using subject, period, site name, location, county, country (Scotland, Wales, Isles of Scilly, Northern Ireland and Eire, the Isle of Man, Channel Islands and England), bibliographic reference, report size, and grid reference. The results also detail the report numbers used in the Archaeobotanical Computer Database.

5.4.5 Pollen core evidence for Scotland has been formatted so that data can be downloaded from the Scottish Palaeoecological Archive Database and used to create digital map coverages of the sites. This demonstrates the potential utility of establishing a similar resource for England. Sites can be selected via a map by clicking on a point and selecting the size of the search area, by searching for specific site names, through parish, council, and region, grid reference and height searches, as well as site type queries. Data for up to 28 attributes including site name, locational details (including Parish and County, co-ordinates in Latitude Longitude and eastings and northings), site type, elevation, local vegetation, sample information, C14 dating information, site worker information, and publication information can also be downloaded with the site locations. Arc/Info format files are available at this site.

5.4.6 The increasing utility of Geographic Information Systems (GIS) approaches in palaeoenvironmental reconstruction in response to the inherently spatial nature of the data has been acknowledged (Coles *et al* 1998). GIS also provides an accessible means of identifying resources available in particular areas of interest, and highlights gaps in the data resource. The collation of site locations for excavations in England involving palaeoenvironmental analysis would aid in rapidly selecting and accessing relevant site reports. This data would be even more useful if actual results could be linked to the project database in a form accessible to non-specialists, as in the SPA Database. The potential utility of such a resource would be further enhanced if pertinent sites such as those in West Yorkshire mentioned above were included.

5.4.7 Overall, preliminary inquiries at a number of possible sources reveal very little environmental evidence that can be directly related to recorded rock art sites. This relates to the fact that locational data for rock art sites is not yet consistently available to feed into the search process. More importantly, the environmental data would no doubt be best captured using processed locational data at a more sophisticated level than simple sweep searching. The construction of viewsheds and catchments of various sorts would give coherence and structure to searches of palaeoenvironmental information as well as provide a basis for further sampling programmes.

6. THE CONDITION AND SURVIVAL OF PANELS AND MOTIFS

6.1 Risk and threats to the resource

6.1.1 Unlike much of the archaeological record in England, where deposition and subsequent burial has facilitated survival by buffering the impact of the elements, most rock art is located on natural rock outcrops and boulders and is thus exposed to all the erosive forces of nature. In fact, petroglyphs may be more intensely attacked by natural weathering processes, as the carved surface may function as a repository for moisture, soil and debris (Rosenfeld 1985). The exposed nature of rock art sites also puts them at greater risk to damage by humans, not only thoughtless yet intentional acts of vandalism, but also well-intentioned yet inappropriate documentation and preservation techniques. In fact, one could say that rock art is one of the most 'at risk' elements of the archaeological record, due to both its exposure to the elements and the relative lack of recorded information publicly available.

6.1.2 The state of preservation of an individual rock art panel depends upon a number of factors. The characteristics of the rock including both chemical composition and physical properties such as porosity and permeability, and the method by which the rock art was created will affect the survival of a rock art panel. A multitude of site attributes are also involved in the preservation of rock art panels including the degree to which the panel is exposed, the direction it faces, vegetation present, groundwater (levels and chemistry), soil chemistry, prevailing wind direction, rainfall (amount and pH), solar radiation and number of freeze/thaw cycles, to name a few.

6.1.3 Traditionally, deterioration and weathering forms have been divided into three categories: chemical, physical, and biological. Although this division is maintained here as a matter of convention, it is perhaps not the most ideal classification. Water, for example, does not fit neatly into any single category, as it plays a significant role in each. Furthermore, this classification system is generally used to present the negative aspects of the forces affecting sites. Under certain conditions, some weathering processes may in fact be protective in the long term. For example, the formation of weathering products such as patina layers, including desert varnish (Rosenfeld 1985 and Dorn *et al.* 1988) and silcrete or silica skins (Taavitsainen and Kinnunen 1979, Rosenfeld 1985, Wainwright 1985 and Watchman 1990), may be protective, and some are useful for other purposes such as in direct dating techniques. Additionally, current lichen research has begun to demonstrate that not all species are as damaging as once thought, and some in fact may be protective. The weathering and deterioration of rock art panels is a complicated equation involving both chemistry and physics, and is site specific. Although many of the deterioration processes that attack rock art sites have been identified and studied, each site has its own unique combination of features, thereby making it almost impossible to generalise about rates of deterioration.

6.1.4 Chemical Weathering

6.1.4.1 Chemical weathering refers to the alteration of rock minerals by chemical reactions (Trudgill 1983). Virtually all chemical weathering activity involves water either directly as in hydrolysis reactions, or indirectly as a solvent and/or transport mechanism (Ollier 1969). Water may derive from a variety of sources including groundwater, rain, snow, condensation, dew, frost, fog, mist, atmospheric humidity, sea-spray, floods and run-off (Goudie and Viles 1997). Water properties, such as pH and Eh and soluble and insoluble material content, will vary by source and the means by which it reaches the rock (Rosenfeld 1985). All minerals are at least slightly soluble in water, and dissolution rates vary by mineral and depend upon pH, temperature and grain size (Walderhaug and Walderhaug 1998). When minerals dissolve, they may be leached away to leave a weakened and more porous rock matrix (Rosenfeld 1985). In sites where precipitation exceeds evaporation, solution movement and mineral leaching is almost continuous (Ollier 1969). Alternatively, if evaporation predominates, the chemical species dissolved may form new minerals such as salts (see section 6.1.5.3), causing physical damage within or on the surface of the rock (Ollier 1969, Rosenfeld 1985 and Thorn 1993). Rainwater typically has a pH of approximately 5, and is therefore sufficiently acidic to affect mineral dissolution rates (Amoroso and Fassina 1983; Michelsen 1992; Walderhaug and Walderhaug 1998; Yates *et al* 1998a).

6.1.4.2 Pollutants causing chemical deterioration include 'carbon dioxide, nitrogen oxides, ammonia, hydrogen fluoride, hydrogen chloride, hydrogen sulphide, ozone, particulate matter and sulphur oxides' (Amoroso and Fassina 1983). Pollutants can occur in gaseous, liquid or solid forms, and reach the rock surface as dry or wet deposition (Amoroso and Fassina 1983 and Yates et al 1998a). Such chemicals can be transported and deposited in rain, aerosols and even snow, resulting in acidic solutions. These substances may be of natural origins, such as atmospheric carbon dioxide and volcanic gases, or from man-made fossil fuel emissions and industrial air pollution (Amoroso and Fassina 1983).

6.1.5 Physical weathering

6.1.5.1 Physical weathering refers to the physical disruption or breakdown of rock caused by various mechanical forces originating either internally or attacking externally (Ollier 1969). Physical deterioration may slowly occur on a molecular level or catastrophically affect an entire rock outcrop, as in the case of earthquakes, landslides, ice jams, volcanic activity, lightning, fires and other natural disasters (Autio 1981; Rosenfeld 1985; Bahn 1998). Much physical weathering commonly results from climatic conditions such as moisture, temperature and wind (Michelsen 1992). Perhaps the most obvious means of physical damage is the general surface erosion often caused by water runoff and windborne sand and dust (Lambert 1989; Yates *et al* 1998a). However, it is thought that the method by which stone is quarried or the surface of a stone is dressed may predispose a stone to certain forms of physical deterioration (Schaffer 1932; Amoroso and Fassina 1983). Repeated cycles of wetting and drying are particularly destructive (Swartz 1997a) as such conditions directly influence a number of physically damaging processes. Moisture and temperature are obvious factors in this process, but the drying effect of wind is another significant element (Yates *et al* 1998a).

6.1.5.2 Expansion due to water absorption by stone used as building materials has been subject to study for quite some time (Schaffer 1932). Direct application of this information to the field of rock art may not be possible, as such tests were inevitably done with cut blocks of stone with fresh faces that would respond to water much differently than weathered stone, however similar effects would certainly occur. More recently, however, the study of expansive or swelling clay minerals is particularly relevant to the weathering of rock art. Although much research is still inconclusive, it has been suggested that several clay minerals expand to such a degree upon water absorption that they may generate forces strong enough to disrupt adjacent stone material (Trudgill 1983; Walderhaug and Walderhaug 1998).

6.1.5.3 Salt damage is another physical deterioration process regulated by both moisture and temperature. Salt forming elements may be derived from the weathering products of the stone itself (Thorn 1996), or from various external sources such as seawater, aerosols, groundwater, soil, desert dust, de-icing products, fertilisers, air pollution, unsuitable cleaning materials, inappropriate building materials, micro-organisms and animal waste (Price 1996 and Yates et al. 1998a). Although the mechanism is somewhat unclear, it is generally accepted that damage results from phase transitions, such as the crystallisation of salt crystals or changes between hydration states, which are directly related to the environmental conditions of temperature and relative humidity. Salt solubility generally increases with increasing temperature, and is influenced by the presence of other salts (Price and Brimblecombe 1994). Depending upon the evaporation rate, salts may be deposited either on the surface as an efflorescence or below the surface as a subflorescence. Subflorescences often form beneath weathered surface layers and the more porous stone, and pose a severe threat to surface skins (Rosenfeld 1985).

6.1.5.4 Physical damage to rock art has also resulted from frost activity (Coles 1992, Michelsen 1992, Bednarik 1995a, Bednarik 1996 and Walderhaug and Walderhaug 1998). Although many still consider the increase in volume associated with water freezing and forming ice crystals to be the source of frost damage, it has been demonstrated that liquids that do not expand as well, cause damage upon freezing (Honeyborne and Harris 1958). Other damage causing mechanisms have been proposed including regelation (Schmid 1958, cited in Bednarik 1996) and rock fatigue as a result of air compression in pores (Tricart 1969, cited in Bednarik 1996). Although, the damage causing mechanism is somewhat unclear, frost damage seems to be regulated by the rock structure and porosity (Amoroso and Fassina 1983, Bednarik 1996 and Walderhaug and Walderhaug 1998) and the number of freeze/thaw episodes and not the intensity of the freezing (Trudgill 1983).

6.1.5.5 Thermal expansion, the expansion of materials resulting from heat absorption, may cause physical deterioration by generating stresses between individual grains or between surface layers and the stone substrate (Schaffer 1932). Sudden temperature changes, such as those associated with lightning or forest fires, are particularly damaging, however very high surface temperatures, up to 80C in very arid climates, may result simply from the normal environmental conditions of ambient air temperatures and sun exposure (Rosenfeld 1985).

6.1.6 Biological weathering

6.1.6.1 Rock surfaces are affected by various living organisms such as bacteria, fungi, algae, lichen, mosses, higher plants and animals, all of which are capable of causing either physical damage, chemical damage or both. Many organisms cause physical damage by growing into the rock surface and disrupting it, and cause chemical damage directly by the production of acids and indirectly by retaining water on the rock surface. Factors affecting the growth of organisms and subsequent decay of rock surfaces include rock properties such as pH and texture, orientation and location of the panel, the nature of the petroglyphs, air quality, availability of water and light, and temperature (Yates *et al* 1998a). Seven broad biological agents have been identified as:

- **Bacteria:** Although the presence of bacteria or bacterial decay may not be readily visible, a number of studies have demonstrated that bacteria are generally abundant on all rock surfaces and many cause damage by oxidising stone minerals directly or by producing various acids (Schaffer 1932). Bacteria can be divided into two groups, autotrophic and heterotrophic bacteria, depending on their means of obtaining nutrition. Autotrophic bacteria utilise reduced sulphur and nitrogen compounds and produce sulphuric and nitric acids (Yates et al. 1998a). This group includes sulphur bacteria, nitrogen bacteria and iron bacteria (Rosenfeld 1985 and Yates et al. 1998a). Heterotropic bacteria utilise organic carbon compounds and produce various organic acids that can dissolve minerals such as granite, orthoclase and biotite (Rosenfeld 1985).

- **Fungi:** Fungi require moisture and small amounts of organic matter to survive and usually grow where the pH is below 7.0 (Yates *et al* 1998a). Fungi do not directly attack rock minerals, however, they do produce more corrosive acids than bacteria, including citric and oxalic acid which is strong enough to dissolve siliceous minerals (Rosenfeld 1985; Yates *et al* 1998a). Fungi can also stain rock surfaces (Yates *et al* 1998a).

- **Algae:** Algae require moisture, light and small amounts of inorganic nitrogen nutrients to survive. Some species have adapted to survive at very low light levels (Rosenfeld 1985) and some species only survive under alkaline conditions (Yates *et al* 1998a). Algae regularly found on rock surfaces fall into one of three groups: blue-green algae, green algae and diatoms (Yates *et al* 1998a). Algae can form dense black layers on rock surfaces, thereby obscuring any rock art present. Although algae are known to produce a variety of acids, it has been difficult to separate their effects from that of other cohabiting organisms. However, algae enhance other weathering processes by retaining water on the rock surface, and facilitating bacterial and moss colonisation and cause red, brown or black surface staining (Rosenfeld 1985; Yates *et al* 1998a).

- **Lichens:** Lichens consist of both fungi and algae living in a symbiotic relationship. Lichens can grow on very bare rock surfaces, require little moisture to survive but are very sensitive to pollution and air quality. Lichen are classified as one of three types, fruticose, foliose and crustose, based upon their vegetative form (Yates *et al* 1998a). The ability of lichens to damage the rocks they inhabit has been the subject of much debate. Chemical damage is attributed to lichens as they retain water on the rock surface, and produce various secretions including oxalic acid, carbon dioxide and complexing agents (Jones and Wilson 1985; Walderhaug and Walderhaug 1998). Physical damage may be caused by rhizine growth physically disrupting the rock matrix (Rosenfeld 1985), and the expansion and contraction of the thallus with changing conditions (Jones and Wilson 1985) - hence the common reference to lichens as one of the major factors in soil production (Yates *et al* 1998a). Lichens are often hailed as a primary threat to rock art, however recent research suggests that the effect of lichens depends upon the composition of the rock substrate, the climate, type of lichen and other environmental factors. In fact, some suggest that lichen secretions may stabilise rock art surfaces chemically and physically (Tratebas and Chapman 1996; Walderhaug and Walderhaug 1998).

- **Mosses and Liverworts:** Mosses and liverworts require a moist environment and therefore are often found on surfaces where dirt and soil has accumulated. Both mosses and liverworts attach to porous rock with rhizoids, thereby indirectly damaging rock surfaces by retaining water which in turn gives rise to frost damage and providing nutrients and moisture for other micro-organisms (Yates *et al* 1998a).

- **Higher Plants:** The effects of root growth can cause serious physical and chemical damage to some porous stones (Michelsen 1992; Demas *et al* 1996; Walderhaug and Walderhaug 1998). Trees can penetrate and fracture porous stone causing severe structural damage. Roots increase carbon dioxide levels in soil, create channels that increase air and water circulation, and associated micro-organisms produce various acids and complexing agents (Michelsen 1992 and Walderhaug and Walderhaug 1998). Leaf litter or forest debris retains moisture and creates acidic conditions (Michelsen 1992), however such cover may serve to protect rock art by insulating the panel from climatic extremes, surface erosion and the activities of animals and humans (Morris 1981; Beckensall 1983; Bahn 1998; Beckensall and Laurie 1998).

- **Animals:** Termites, bees, wasps, swallows and other organisms that build mud nests have caused considerable damage to rock art sites (Rosenfeld 1985). Although the nests are often easily removed, damage has resulted when nests were bonded to the panel or the panel surface was not stable (Rosenfeld 1985). Bird droppings may cause additional chemical damage and provide nitrate, phosphate and organic nutrients that may facilitate the colonisation by bacteria and fungi (Yates *et al* 1998a). Bat guano has a similar effect (Rosenfeld 1985). Large animals can damage rock art by rubbing against panels (Lambert 1989, Watchman et al. 1995 and Yates et al. 1998a), trampling panels (Yates et al. 1998a), and stirring up dust that can adhere to the rock surface (Lambert 1989). Additional deterioration may occur from excreta accumulation, which may leach organic compounds, including urea, into groundwater and could potentially result in salt damage (Lambert 1989 and Rosenfeld 1998a).

6.1.7 Human damage, inappropriate recording, conservation and treatments

6.1.7.1 Perhaps the most serious threat to the survival of rock art is human activity (Gale and Jacobs 1987b; Bednarik 1990a; Coles 1992; Bednarik 1995a; Bednarik 1996; Dean 1997; Bahn 1998). Land use patterns and modern forces such as mechanised agricultural practices, urbanisation, environmental degradation and armed conflict (Stanley-Price and Sullivan 1995) threaten the archaeological record in obvious direct ways, but the more subtle effects of changes in air quality, groundwater levels and vegetation may not be so apparent.

6.1.7.2 An unfortunate side effect of the growing interest in rock art has been an increase in damage caused by tourists, vandals and even those attempting to document or preserve rock art. The most obvious forms of damage are aesthetic or physical in nature, however damage to the scientific potential or integrity of a rock art site is a matter of growing concern. As the knowledge of and access to rock art sites increases, so does the risk of damage, particularly at sites not managed for public presentation. The effects of tourism on rock art sites have been a topic of increased study in the recent past (Gale and Jacobs 1987b; Bednarik 1990b). Often visitors do not realise the effect they have on a site, and that their actions can result in serious damage. Cave sites particularly suffer from changes in temperature and humidity caused by tourism which can affect the microflora and fauna present (Rosenfeld 1985; Gale and Jacobs 1987b). Both foot traffic and vehicular traffic on nearby roads produce dust (Gale and Jacobs 1987b; Bednarik 1990a; Ward 1993; Watchman *et al* 1995; Ageeva and Rebrikova 1996; Bahn 1998; Loendorf *et al* 1998) that may chemically bond to the panel surface (Gale and Jacobs 1987b; Ward 1993; Watchman *et al* 1995). Rock art panels situated on outcrops may suffer from vibrations caused by vehicular traffic on nearby roads (Bednarik 1995a; Bednarik 1996; Ageeva and Rebrikova 1996).

6.1.7.3 Repeated touching of rock art panels results in staining, soiling and deterioration (Gale and Jacobs 1987b; Dean 1997; Bahn 1998; Loendorf et al. 1998). Walking on panels can cause serious damage (Rosenfeld 1985; Gale and Jacobs 1987b; Coles 1992; Bahn and Hygen 1996; Bahn 1998; Loendorf *et al* 1998), but even walking around rock art sites can alter the landscape patterns (Ageeva and Rebrikova 1996), vegetation (Gale and Jacobs 1987b) and may affect drainage (Loendorf et al. 1998). Autio (1981), Coles (1992), Kivikäs (1995) and Lauhakangas (1998) have found evidence of fire damage on numerous rock art sites. Visitors attempting to enhance the visibility of rock art have been known to abrade or scrape surfaces (Gale and Jacobs 1987b; Bahn 1998), colour in carvings (Gale and Jacobs 1987b), and apply various substances over the surface such as beer and cola (Bahn 1998) and kerosene (Bednarik 1995a).

6.1.7.4 Even more destructive acts of intentional damage and vandalism threaten rock art resources. Graffiti, both painted and carved, is perhaps the most common form of vandalism and has been the subject of much concern for several years (Rosenfeld 1985; Gale and Jacobs 1987b; Coles 1992; Østmo 1992; Bednarik 1995a; Bednarik 1996; Sale and Padgett 1996; Ageeva and Rebrikova 1996; Dean 1997; Loendorf *et al* 1998). Damage caused by gunshot has also been documented at several sites (Trotter and McCullogh 1981; Kivikäs 1995; Dean 1997; Bahn 1998; Loendorf *et al* 1998). Additionally, the illegal removal, theft and 'souveniring' of rock art are increasing problems (Gale and Jacobs 1987a; Gale and Jacobs 1987b; Dean 1997; Bahn 1998; Loendorf *et al* 1998).

6.1.7.5 An increased awareness of rock art sites without an understanding of their cultural or scientific significance threatens the survival of rock art resources. Attempts to merely cordon off or isolate panels are often ineffective, visually intrusive, offensive to local communities, and contrary to the nature of rock art sites. Furthermore, fencing close to panels can also lead to concentrated visitor erosion of surrounding soil, effectively severing the panels from their archaeological context. Education and site management policies and activities may be the means to most effectively stimulate an enlightened attitude toward rock art and prevent most of the damage currently associated with the effects of visitors to sites.

6.1.7.6 Damage caused by rock art recorders is a controversial issue. References to 'professional vandals' (Bednarik 1990b) and damage caused by recording techniques, conservation treatment methods and site management practices permeate the literature, although few formal studies have been published about the effects of rock art research and management activities on rock art panels. Many methods used to document rock art are now known to cause damage, including tracing, rubbing, abrading, casting with plaster, latex, rubber or papier-mâché, and application of aluminium powder, chalk, charcoal, crayon, dye, flour, ink, paint, pencil, kerosene, motor oil, marine varnish and even water (Bednarik 1990b; Bednarik 1995a; Bednarik 1996; Bahn *et al* 1995; Dean 1997; Loendorf *et al* 1998). All of these methods can result in structural and/or aesthetic damage, but recent trends in research are also addressing the detrimental effects that these activities may have on future scientific research, particularly some dating techniques (Bednarik 1990b; Bahn *et al* 1995; Tratebas and Chapman 1996; Dean 1997; Loendorf *et al* 1998).

6.1.7.7 The effects of chalking, rubbing and casting rock art have been mentioned in several recent articles. Chalk has often been applied to petroglyphs to enhance their visibility as it was commonly regarded as a harmless material that would easily wash off. However, chalk is surprisingly durable and damaging. Evidence of past chalking has been found on a number of sites (Booth Childers 1994; Kivikäs 1995), and in some environments chalk can mineralise and bond to the surface to the degree that its removal would further damage the rock art (Gale and Jacobs 1987b; Dean 1997; Loendorf *et al* 1998). Furthermore, the application of chalk on rock art panels chemically contaminates surface layers and may render them unsuitable for dating techniques (Bednarik 1990b; Loendorf *et al* 1998). Moulding and casting techniques involving the use of wet, adhesive materials often cause surface erosion and staining (Bednarik 1990b; Bahn *et al* 1995; Bednarik 1995a; Bednarik 1996; Ageeva and Rebrikova 1996; Dean 1997; Loendorf *et al* 1998). Recent studies have shown that the application of casting materials also contaminates surface layers thus preventing future use of dating techniques (Loendorf *et al* 1998). Similarly, techniques for creating rubbings of rock art panels are physically damaging. Residues may be left on the rock surface, and this practice alters surface layer chemistry and their ability to be dated accurately (Bednarik 1990b; Bahn *et al* 1995; Bednarik 1995a; Bednarik 1996; Dean 1997; Swartz 1997; Loendorf *et al* 1998).

6.1.7.8 Unintentional damage has been the result of some methods and treatments intended to preserve rock art. Most conservation treatments for rock art sites have been for the purpose of stabilising surfaces and areas of loss. Rocks are not as durable as they may appear, and great care must be taken on all rock art panels as severe damage may occur even from surface washing. Additionally, the introduction of foreign chemical species may affect the chemistry of the stone and make it unsuitable for future scientific research (Thorn 1993). A variety of materials have been used to attempt to fill cracks in rock art panels. Although use of cementacious materials to fill cracks was quite common in the past, it has been deemed an inappropriate material as its physical properties are quite different from natural stone. It often fails to adhere to natural stone, and it may introduce salts and other foreign chemicals to the rock (Finn and Hall 1996; Walderhaug and Walderhaug 1998). Since realising the unsuitability of cement for conservation purposes, experiments with several other materials have been carried out, and some suggest potential success.

6.1.7.9 Surface coatings are often applied to consolidate unstable surfaces. Such coatings can be problematic if their properties are not consistent with those of the stone. Thermosetting resins, for example may have different thermal expansion characteristics and will respond differently from the stone substrate to changes in temperature (Andersson 1986). Furthermore, if they block the pore structure and do not allow for air and moisture exchange, severe damage can result from the mechanical forces generated by the accumulation of materials behind impermeable surface treatments (Rosenfeld 1985; Michelsen 1992). The removal of various destructive elements such as algae, lichen and graffiti can lead to further deterioration by exposing fresh rock surfaces (Loendorf *et al* 1998). Lichen removal can be particularly destructive if their rhizoids are actually holding a friable surface in place (Tratebas and Chapman

1996). Furthermore, the use of powerful chemicals and biocides can cause further damage (Tratebas and Chapman 1996; Loendorf *et al* 1998). Only specialists should undertake graffiti removal, as extensive damage can result from overly intensive scrubbing or the use of air abrasive units (Trotter and McCullogh 1981; Bahn *et al* 1995; Ford 1996; Dean 1997; Loendorf *et al* 1998).

6.1.7.10 The use of iron products at rock art sites presents a variety of problems. Iron bars have been used to give structural support to rock art sites, however the development of corrosion products resulted in staining and cracking (Andersson 1986). Iron fences and grates installed to protect rock art sites from vandalism have similarly damaged sites (Finn and Hall 1996; Walderhaug and Walderhaug 1998).

6.1.7.11 Site presentation practices intending to enhance the visibility of rock art but which cause damage to the panel surface should not be continued. Scratching (Bahn 1998) or painting (Coles 1992; Mandt 1992; Michelsen 1992) surfaces to make petroglyphs more visible is advocated at some sites with the justification that if the site managers do not do it, the visitors will. However, these practices are not only damaging, but they also impose the subjective view of the modern day interpreter and may not accurately reflect the original rock art at all (Bahn *et al* 1995; Walderhaug and Walderhaug 1998). Alternate means of public presentation and education should be explored to eliminate such activities from practice.

6.1.7.12 Some rock art has been removed from its natural setting and transported to museums. Often overly aggressive methods of extraction were employed, including the use of dynamite, which may cause severe physical damage (Autio 1981; Gale and Jacobs 1987b; Dean 1997; Bahn 1998). Today removal is considered only if a site is threatened with destruction. Furthermore, as urban environments are still affected by increased amounts of air pollutants (Butlin *et al* 1992), the relocation of rock art panels into such an environment must be given careful consideration and adequate facilities must be available.

6.1.7.13 Any research activity on or around rock art panels may affect the site in unforeseen ways. Damage to rock art panels has resulted from changes in drainage patterns caused by archaeological excavations (Bolle 1996). The effects of protective structures built for rock art sites have also been subject to much debate and ongoing research and development (Bahn *et al* 1995; Bahn and Hygen 1996; Bullen 1996; Ford 1997; Bahn *et al* 1997; Wainwright *et al* 1997; Bahn 1998).

6.1.7.14 Although one cannot condemn past activities executed in good faith for the purpose of preserving sites using what were considered the best methods of the time, one must learn from the observed consequences and lessons only the passage of time can teach us about such practices. The use of any contact recording method that may result in physical and/or chemical damage or that introduces foreign chemicals that may compromise future scientific research should be avoided (Bednarik 1990b; Thorn 1993; Tratebas and Chapman 1996; Dean 1997; Loendorf *et al* 1998). To further this aim, the International Federation of Rock Art Organisations (IFRAO) rejects all recording methods involving the application of pigment (Bahn *et al* 1995), and Bednarik (1990b) suggests that all rock art publications and conferences should reject submissions containing physically enhanced images of rock art panels. Similar considerations must be made regarding the consequences of conservation treatments and site presentation practices when making treatment decisions.

6.2 Amelioration and conservation

6.2.1 Conservation of rock art is an extremely complicated subject, as the causes of rock art deterioration are complex and not always well understood, and the problems encountered are often vast physically, technically and/or financially (Schwartzbaum 1985). Characteristics of the panel itself, the natural environment and the human impact upon a site make each site unique and will influence the conservation decisions made to preserve the site. The determination of the causes of deterioration and a detailed recording of the site must precede any conservation treatment (Rosenfeld 1985). Intensive examination and environmental monitoring should be carried out to best understand the forces at work on the site before any treatment is proposed. All treatments should be reversible to the greatest extent possible and any form of direct intervention with the rock art itself should be kept to a minimum. Systematic monitoring should also follow any treatment, to monitor the success and understand the long-term effects of any specific conservation method (Bednarik 1995a; Bednarik 1996; Bahn 1998).

6.2.2 Condition recording

6.2.2.1 Condition surveys are an essential part of the field of conservation. Although a general statement about the condition of a site may be included in typical recording procedures, a much more intensive survey must be made before any conservation treatment is undertaken, and is the subject of this section. Producing a condition survey not only creates a record of the state of a panel at a given time, but it also allows for better observation and subsequent understanding of the elements involved in the deterioration of a panel. A comprehensive condition survey should include precise recording of both general features and the condition of the art itself and the surrounding rock, and a detailed examination of all environmental factors affecting the site. Long term monitoring of environmental factors with analytical instruments is usually necessary in order to be able to determine the factors causing deterioration (Thorn and Dean 1996). A variety of diagnostic tests may also be required. Detailed information on type and intensity of damage as well as its distribution in both written and image forms is important for the planning and execution of conservation and management measures (Fitzner *et al* 1992).

6.2.2.2 Definitions and descriptions of deterioration forms should accompany any visual recording method. There have been several attempts to develop a comprehensive terminology and classification system (Fitzner *et al* 1992; Fitzner *et al* 1995; Franke and Schumann 1998). Although none of these systems have yet to be universally endorsed, each offers useful considerations and can form the basis of a site specific or project based terminology. Photographs and drawings produced when recording a site are very useful when undertaking a conservation survey. Historic photographs or images produced prior to the condition survey are useful for comparing the state of preservation over time. Also both enlarged photographs and detailed drawings of rock art panels can be used as base images upon which to record the surface condition features. Mapping weathering forms is a useful technique to provide detailed information regarding the type, extent and distribution of weathering and deterioration forms (Fitzner *et al* 1992; Fitzner *et al* 1995). The different agents of weathering and deterioration can be classified and recorded either with different coloured pens, different symbols, or on separate transparent sheets fixed over the original base image (Stanley-Price 1991; Fitzner *et al* 1992; Fitzner *et al* 1995; Sale and Padgett 1996). If conservation treatments are subsequently executed, any direct intervention on the panel should similarly be noted (Thorn 1993; Sale and Padgett 1996). Such images can also be digitised or directly created in CAD computer applications.

6.2.2.3 A detailed examination of the site's geology, geomorphology, biology, hydrology, climate and microclimate is part of a condition survey. This examination may include tests for rock hardness, composition, porosity and capillarity (Mamillan 1991), and analysis of visible salt efflorescences, the character and quality of the surface, ground and rain water (Thorn and Dean 1996). Air temperature, air humidity, rock surface temperature, surface pH, wind speed and direction, exposure to sun or shade, and moisture distribution can be measured (Rosenfeld 1985; Coles 1992; Fitzner and Heinrichs 1994; Thorn and Dean 1996), and the annual rainfall and number of frost days can be determined (Yates *et al* 1998). The survey should also look for evidence of drainage patterns, determine the nature of lichen and other flora growth, and evaluate visitor and animal impact (Thorn and Dean 1996).

6.2.2.4 Most of the environmental conditions requiring examination for an intensive condition survey can be tested and monitored on site. During individual site visits, a variety of data can be collected with some basic equipment. Ambient temperature and relative humidity readings can be made with several types of commercially available equipment. Immediate surface temperature can be measured using an infrared thermometer (Rosenfeld 1985; Fitzner and Heinrichs 1994). The presence of moisture can be taken with conductivity meters, such as a Protimeter (Thorn and Dean 1996). Wind-speed can be measured with anemometers. A compass and inclinometer are necessary to determine the relationship between a panel and the sun (Thorn 1996; Thorn and Dean 1996). Data loggers attached to a variety of equipment can monitor both ambient and surface temperatures and relative humidities over time. If possible, such equipment should be installed for at least 12 months in order to gain an understanding of the full climatic variations (Thorn and Dean 1996). Other useful environmental information can be obtained from meteorological and climatic monitoring agencies.

6.2.2.5 The physical properties of a rock can be determined through a variety of laboratory and on site tests. Laboratory petrographic analyses on samples of stone taken from inconspicuous areas of a site are essential for understanding stone composition and properties. Porosity, permeability, pore size and density can be determined with additional laboratory tests (Mamillan 1991). Other tests on site can provide supplemental information as well. Water absorption can be measured in situ using a permeability box or the pipe method (Mamillan 1991). Surface hardness can be measured by two techniques, however both are potentially destructive and therefore only appropriate for use on areas of stone not containing rock art. The Schmidt rebound hammer measures surface hardness and compression strength however methods for executing and interpreting this test are not standardised (Poole and Farmer 1980, McCarroll 1987, Campbell 1991, Mamillan 1991, Bertilson 1992 and Nappi and Côte 1997). Surface hardness also can be determined by measuring the scratch width created after coating the stone surface with lampblack and dragging along a specially designed small carriage on two wheels equipped with a hardened steel point and a 3kg load (Mamillan 1991). The tensile strength can also be measured using a pull-out test in the field and other mechanical strength tests can be carried out in the laboratory (Mamillan 1991).

6.2.2.6 Although changes in condition and deterioration over time can be evaluated qualitatively by comparing photographic images and other record documents, a variety of methods are available to quantitatively monitor change both on the surface of materials and internally for assessment purposes. Most of these techniques allow for deterioration monitoring by repeating the test over time. Both laser scanning and photogrammetry produce digital data sets providing three-dimensional co-ordinates over the surface measured, thereby facilitating surface deterioration study by recording the panel again and subtracting the data sets. Other tests monitor structural change or stresses during a single session (see below). Erosion pins can be used to monitor surface loss over a period of time. Metal rods driven into rocks act as reference points to which changes in the rock surface height can be measured (Trudgill 1983).

6.2.2.7 Similarly, a micro-erosion meter can be used to monitor stone surface loss over time. This is a slightly more advanced version of erosion pins and involves the attachment of three metal reference studs permanently inserted into the rock. A micrometer, an engineer’s dial gauge attached to a probe, is placed upon the metal studs and the distance to the stone surface is measured (Trudgill 1983). Readings can be repeated at regular intervals to monitor deterioration (Trudgill 1983; Lambert 1989). Strain gauges can be used to measure the width of cracks and to monitor their development over time (Mamillan 1991). Two systems are available: vibrating wire strain gauges and bead strain gauges. Both systems require being attached to the rock surface. A stylus technique has been used to monitor the surface roughness of stone (Jaynes and Cooke 1987 cited in Price 1996). Surface irregularities are recorded with a stylus drawn across the surface. Stylus movement is recorded by an electrical signal relayed to a transducer. As most modern stylus systems have a diamond tip, the stylus may scratch the rock surface. Pulse velocity technology, using both ultrasonic and sonic pulses, has been utilised extensively to determine the interior condition of stone material (Esbert 1989; Cardu *et al* 1991; Montoto *et al* 1991; Valdeón *et al* 1992; Montoto *et al* 1994; Simon *et al* 1994; Nappi and Côte 1997). By transmitting pulses through stone to several receivers, an internal two- or three- dimensional image or tomograph is produced (Montoto *et al* 1994). These images reflect differences in density, which is correlated to variations in petrophysical qualities and mechanical properties (Montoto *et al* 1994). Additionally, attempts have been made to find a correlation between pulse velocity and compressive strength (Nappi and Côte 1997). Ground probing radar (GPR) can be used to investigate interior features of materials (Finzi *et al* 1992; Nappi and Côte 1997). By transmitting radar pulses through a material and sensors, electromagnetic properties such as permittivity or conductivity can be determined and correlated to physical characteristics such as density, layers, cracks, voids and other possible inclusions (Finzi *et al* 1992; Nappi and Côte 1997). Two- and three-dimensional images illustrating internal material properties can also be obtained with this method (Nappi and Côte 1997).

6.2.2.8 Infrared thermography can be used to detect heat flow (Nappi and Côte 1997) and moisture movement in materials (Gayo *et al* 1992) using instruments sensitive to both infrared radiation and temperature. This method also allows for relationships to be established between certain environmental conditions and material properties (Gayo *et al* 1992). Another technique using electromagnetic waves to measure moisture content operates by constantly emitting a sine wave at a given frequency (rather than a pulse) and calculating the absorptivity and the inner moisture level based upon the amplitude of the received wave (Nappi and Côte 1997).

6.2.2.9 Computerised X-ray tomography (CT) has been used to record the internal structure of stone and the changes that occur during weathering (Jacobs and De Cleene 1996). Rotating an X-ray tube and detectors around an object produces data for CT-scanners to generate cross-sectional images of a material (Jacobs and De Cleene 1996). X-ray tomography allows for viewing changes in bulk density and monitoring deterioration by quantifying change with statistical analysis (Jacobs and De Cleene 1996), however this method cannot be used in situ. Research is also ongoing regarding the use of neutron capture and prompt gamma analysis, which can also provide internal moisture mapping information (Nappi and Côte 1997).

6.2.2.10 Stress and in situ microdeformations in materials can be monitored with a variety of different techniques referred to as holographic interferometry or contouring (Paoletti and Schirripa 1991), line profilometry (Aires-Barros *et al* 1994), structured lighting (Bertani *et al* 1997), moiré method (Nappi and Côte 1997) and electronic speckle pattern interferometry (ESPI) (Meinlschmidt *et al* 1991). All of these techniques operate in a similar fashion: light is projected as evenly spaced lines or in a grid pattern, or a laser light is projected onto a material and viewed by a CCD camera attached to a computer. Any stresses, deformations or other physical changes in the material will result in a change in the lighting pattern and can be calculated to varying degrees of accuracy depending upon the method. Holographic interferometry is sensitive to changes as small as approximately 5 micrometers (Paoletti and Schirripa 1991). Line profilometry has been used on a microscopic level (Aires-Barros *et al* 1994). The method using laser light, ESPI is capable of detecting changes in form as small as approximately 0.5 micrometers, and this technique has been applied to observe the growth of salt efflorescences (Meinlschmidt *et al* 1991). These methods are suitable for monitoring change in material so long as the equipment can stay in place, and are therefore not appropriate for all sites.

6.3 The condition and survival of rock art in 1999

6.3.1 Background

6.3.1.1 Within the scope of the Pilot Project it was not possible to examine the impact of the long-term erosive processes discussed above; the objectives of the project focus on the identification of the issues and the means of recognising such impacts. Chapter 8 deals with deals with monitoring and its implementation. During the Pilot Project it was, however, possible to look in very broad terms at the condition and survival of whole panels and, to a lesser extent, individual motifs. This was a point-in-time set of observations of the kind utilised in the MARS Project. In doing this, the information contained within SMR files was used, and direct observations were made of the panels examined in the sample transects.

6.3.1.2 The data analyses that follow, use a low number of field observations recorded by the project in the two study transects. The purpose here is to first, provide 'live examples' for the chapter's discussions and secondly, to demonstrate the sorts of management / condition attributes that could be recorded. In this way the data is not statistically representative of the situations affecting all recorded rock art panels in England.

6.3.1.3 It was also felt that the digital data supplied to the project was on balance, not suitable in representing the overall condition and survival of rock art in England on the whole. Specific information on attributes such as land-use condition, survival and risk was largely missing and in those examples where it was recorded (often in a non-specific general comments field) it was not in a standardised form in terms of terminology and classifications.

6.3.2 Impacts on rock art panels

6.3.2.1 In addition to the harmful combined effects of time and the elements, land-use practices pose the greatest immediate risk to rock art sites in the areas studied. Dr. Keith Boughey is aware of the loss or destruction of 26 out of 637 known cup-and-ring marked panels in the Aire, Wharfe, Washburn and Nidd watersheds alone (*pers. comm.*). No single enemy to rock art can be identified, as Boughey describes:

> *'The reasons for the loss and/or destruction of sites...includes bridge destruction for the construction of a new by-pass, the construction of a modern working quarry, the construction of a cemetery, incorporation into a later burial cairn, aforestation, reconstruction of a field wall, buried under concrete (allegedly when a farmer was burying a dead sheep!), demolition of nearby houses, relandscaping of a disused railway line, construction of a reservoir, extension of a golf course, mining activities, reconstruction of a footpath, removal of a gatepost, and finally destruction by enemy bombing action during World War II'* (K. Boughey *pers. comm.*).

Several of these events have occurred within recent years, but a common factor is a general ignorance of the existence of panels in the first place. Therefore it cannot be stressed enough that thorough and accurate documentation and communication of this knowledge may be the only means of preserving rock art sites from both gradual deterioration and the very real threat of unintentional destruction.

6.3.2.2 During the field trials a number of general observations were made about average condition of the panels in the transects, and the relationship between the survival of the resource and land-use. These are discussed in the following sections. Table 6.1 indicates the spatial nature of impacts over panels for a small selection of panels visited in the Northumberland and West Yorkshire study transects.

6.3.2.3 **Northumberland**

6.3.2.3.1 In Northumberland the sandstone geology appeared to be less dense, and more friable and homogeneous than the millstone grit geology of West Yorkshire. The significance of this general observation in terms of conservation concerns became evident during detailed recording, when it was noted that minute stone grains were removed easily simply by gently touching the panel surfaces. This confirms the point made in earlier sections about damage through recording. The effect of weathering processes, and the impact of stock, is undoubtedly influenced by the geology of the panels. In Northumberland evidence of quarrying was widespread with numerous pits dug into outcrops in the vicinity of the panels. Many of these were to obtain stone for the construction of dry-stone walls or agricultural facilities. The existence of broken decorated slabs in the local walls (Figure 6.1 A and B) confirms that rock art has been destroyed by this process in the past. Quarry marks were visible on four out of the twenty panels recorded. In addition, quarry workers initials were frequently observed and had sometimes caused direct damage to motifs (for example see Figure 7.15). Grazing sheep and cattle are clearly impacting the panels in this transect, a situation which is worsened by the natural tendency for the animals to congregate on raised outcrops and use the rocks as scratching posts. 13 out of the 20 panels recorded were exposed to grazing livestock.

6.3.2.3.2 The effects of other land-uses were also noted in Northumberland. The ploughing of fields had resulted in significant damage to at least three panels out of twenty recorded in the study area. The complexity of land-use issues and conservation was clear here, as the damage had resulted from the activities of contract workers rather than the land owner or manager. The possible effects of conifer plantations on the panels studied were not readily apparent, but could include increased conservation concerns due to felling of trees, the action of tree roots (particularly in the case of outcrops), and the effects of acidic pine needles on the surface of the panels. The national stock of public woodland in England is especially noticeable in the uplands and marginal areas of countryside, where large tracts of countryside were planted with coniferous species after world war one. Many of these plantations are now mature and in managing these woods, Forest Enterprise (the commercial wing of the Forestry Commission) adheres to a set procedures which includes the consideration and, where appropriate, conservation of archaeological monuments. Nevertheless, tree growth and the cycle of management works (preparation, planting, thinning, brashing, felling and re-stocking) involved in managing plantations (both coniferous and deciduous, and especially commercial woods) represents a significant threat to low lying panels. In general, biological growths and what a non-specialist field team could only describe as general surface weathering, were the primary damage or weathering types observed in the Northumberland transect. The effects of these processes were notable when attempting to categorise motif types, for example distinguishing between a highly eroded or obscured ring and a penannular groove is extremely difficult. Further research into the effects and management of these processes is important. Many of the panels located in the heather moorland often became overgrown and lost and would require excavation of turf for positive identification. A high number of mobiliaries are located *in situ* in Northumberland and there is currently no strategy for protecting these panels against movement or theft. Typical examples include stones in the fabric of cairns, or used in the kerbs around cairns. Such stones are small and can easily be carried away. Many of the mobiliaries are now in museums and new discoveries are still being deposited on a regular basis: two mobiliaries were deposited with Berwick Museum during the field trial, by Stan Beckensall and local residents. This process needs to be carefully documented so that record currency is maintained, and to facilitate both analysis and management. It is also likely that mobiliaries will disappear from view only to re-appear and be treated as a new find. This could be partly controlled by marking or tagging pieces in some way.

6.3.2.4 West Yorkshire

6.3.2.4.1 In the West Yorkshire transect some different situations were encountered. In some cases lack of knowledge of the existence of rock art panels by landowners and land users was resulting in damage. One panel (8022) was located in the centre of a regularly used farm track adjacent to sheep pens and the farmer had apparently not been made aware of its existence. The visible panels in grazing areas were frequently high off the ground so that erosion caused by livestock appeared to be less serious here compared to the Northumberland transect. Three out of the fourteen panels investigates were exposed to grazing stock. Again, however, many of the panels could not be located due to the growth of grass and heather. Quarrying evidence was again widespread, and lichen and general weathering were the most widely evident problems. Eleven out of the fourteen panels recorded had lichen species colonising the rock surface and all panels showed signs of general weathering. Quarry workers' initials were also seen, but instances of overlap with prehistoric motifs were less common than in the Northumberland transect. The panels located on grouse moors were being used as platforms for quartz-based grit deposits supplied by gamekeepers for the grouse. This substance appeared to be having a significant effect on the panel surfaces. The areas beneath the grit were light in colour and it was more difficult to interpret subtle depressions in the surface. It was not clear whether the surfaces had simply been bleached or protected from darkening through air pollution and microbiological growth, or whether chemical surface erosion was occurring. The impacts of forestry, particularly during planting when furrowing machinery is brought in, and during felling of trees requires further research, and is certainly a major issue for the panels in the West Yorkshire transect. In many cases, the trees around the panels had been felled. Though this may be beneficial in terms of avoiding root disturbance to panels by living trees the potential for damage to be caused at the time of felling is likely to be high.

6.3.2.4.2 Two sets of relocated panels were also visited during the field trial in West Yorkshire. The first, SMR number 308, had been cut and removed from Rombald's Moor and placed in a public display area on Bow St, Keighley. The details of the original location and context of the stone are not available in the SMR record, and are likely to be difficult to recover, particularly as the land manager was not involved in the relocation (Gaister *pers. comm.*). The interpretation of the petroglyph consists of a metal panel with text relating to ritual and fertility. The second group, the Panorama Stones, was relocated in the nineteenth century from Ilkley Moor to a display area, once privately owned, in Ilkley (Boughey *pers.comm.*). Each of these panels had been damaged during their relocation, when the panels were cut from bedrock stone in segments (sometimes damaging the motif areas) and concreted into their new location. More recently green paint had been deposited, presumably by vandals, on some of the panel surfaces. A metal railing surrounds the panels and a small interpretation board has been erected. The poor condition of these panels is cause for concern, particularly as the high number of 'ladder' motifs featured is unusually distinctive, and is highly significant in terms of stylistic analysis. The potential for damage to panels in public areas, largely due to lack of education regarding the significance of the motifs, was observed on Ilkley Moor. The large rock outcrop and high viewpoint attracts significant numbers of visitors to the area. Both painted and carved graffiti was very common on the outcrops (though fortunately these did not feature prehistoric petroglyphs) both as vandalism and what appeared to be activities relating to 'new age religion'. Four of the larger more prominent outcrops had significant paint and graffiti marks on them. Though prehistoric motifs had not been affected this did highlight the potential vulnerability of panels in areas frequented by the public, and the need to provide the public with information on the importance and fragility of this aspect of England's cultural heritage.

6.3.2.4.3 The Millstone Grit sandstone in the West Yorkshire transect appeared to feature much larger grains and inclusions, and a less friable surface than the Northumberland sandstone. Grains appeared to be more solidly concreted so that they were less commonly removed through people touching the panel surfaces. The visibility of individual peck marks (e.g. in Panel 8013) seemed to be more noticable here than in Northumberland. This factor may relate to the differences in geology as described. Variability in the visibility of motifs at the intra-panel level was also noted, for example in Panel 8013. In this panel some of the cups were very clearly defined with sharp edges and highly visible peck marks, while others were more subtle, with more eroded edges and surfaces. These differences might be explained through variability in stone condition or differences in the age of the individual cup marks. Similar differences between panels located on south facing slopes in the transect, and those on north facing slopes were also observed. Those on the steep south-southwest facing slope of Rivock Edge facing a major valley system generally seemed to be more highly eroded. Presumably, the weather patterns through the valley would have increased the impact of wind, and driving rain on the stone. This idea is also supported by the frequency of black staining thought to relate to air pollution on these panels. This staining is often more serious in panels with more eroded, and therefore more porous and vulnerable surfaces. The number of known mobiliaries for West Yorkshire is significantly lower than in Northumberland, and none were seen in the field. It is not currently known whether this is a reflection of the recording approach used in the area by the IAG and SMR, the survival of this panel type, or whether this reflects a true pattern in the archaeological record.

7. SURVEY, RECORDING AND STUDY METHODS

7.1 Introduction

7.1.1 A major element of the Pilot Project was to establish which survey and recording techniques best suit rock art in England and where transferable, the United Kingdom. When a wider programme of survey and recording is undertaken it is important that the methods used are applicable and practicable. It appears that combining a range of complimentary techniques is the best means of creating a complete record. For the purposes of the Pilot Project a number of carved panels in different situations within the study transects in Northumberland and West Yorkshire were selected for recording. Chapter 2 sets out background information for the transects, and the fieldwork strategies applied.

7.1.2 There are three aspects to the surveying and recording of British rock art reflecting three different scales of analysis. At the broadest level there is the matter of identification. This can be broken down into two elements: the identification of panels that have already been recorded in some way, and which need to be relocated in the field and thereafter subject to further study; and the identification of hither to unknown panels. Within the scope of the Pilot Project the former was the focus. The second level involves the georeferencing and mapping of individual panels. The third level involves the detailed recording of motifs found on each individual panel. This again has two dimensions: techniques involving no surface contact and those involving surface contact. The final part of this chapter is structured to reflect these three levels and their sub-division.

7.1.3 What follows is essentially a series of discussions on techniques used to record rock art panels. This includes technical appraisals of equipment tested, a display of results produced, direct comparisons between several techniques used on the same panels, and notes on the suitability and application of these techniques in a wider survey and recording programme. The range of techniques explored is not exhaustive, and the results described only represent the views of the Pilot Project team members. It is noted that some of the techniques tested here can also be used in a monitoring capacity. Where this occurs the techniques are discussed further in Chapter 8, which deals with conservation monitoring issues.

7.1.4 The aim of the fieldwork programme was to concentrate on evaluating a range of techniques, rather than to create the most complete record for each panel, or to survey all panels within the study areas. Within the Northumberland transect (6 square km) techniques were evaluated on 20 out of 65 panels and in West Yorkshire (a 3 square km transect) 14 out of 33 panels were recorded. As a result of the time required for the field team to become familiarised with the panels, to evaluate recording strategies, and deal with the problem of motif visibility (through poor lighting or the survival of the motif), initial plans to survey a greater number of panels had to be revised. In addition to motif recording, attention was also given to the recording of key physical attributes of rock art panels such as surface condition, geology, visibility, and vegetation cover.

7.1.5 Later sections deal with database construction to store, analyse and manipulate, and make accessible the data built up as part of these studies. A following section deals with dating rock art through scientific and archaeological means. The chapter ends with a review of the relative merits of different recording systems.

7.2 Identification and general fieldwork issues

7.2.1 Foremost among the difficulties in identifying previously recorded panels on the ground, is the lack of a consolidated core record with accurate locational details. This creates difficulties in identifying specific rock art panels, particularly where there are a number of panels within a small area. Furthermore, panels are often at ground level and obscured by low level vegetation which makes identification problematic. Without a core record detailing motif level information, many of the more subtle motifs can easily be missed (as was the case in several panels deliberately visited 'blind' by the field team, and later checked against the HELICS records). This was compounded by the fact that many SMR descriptions of the panels amalgamate observations made over several visits under different conditions; a single visit by one individual is unlikely to reveal as much as return visits. The benefit of having the landowner, or a local expert, with a field team at the time of visiting panels was immediately obvious. As an aid to the identification process all recorded panels were plotted on a 1:10,000 scale map prior to the field visit and a series of preparatory tasks carried out before attempting conducting the fieldwork proper:

- Correlation and consolidation of records from SMR, NMR and private archives
- Familiarisation with recorded information and map plotting
- Field reconnaissance of the area with the landowner / monument warden / local archaeologist
- Risk assessment
- Logistical planning

7.2.2 During the surveys the motifs and panels were superficially cleared of leaf litter, but turf was generally not disturbed (except for the case of 8002, which was covered with pine needles and forest debris). This decision related both to time constraints (considering that the outcrop panels were likely to be parts of very large rock formations) and to the fact that the effects of removing turf on the condition of the panel surface has not been adequately researched. Permission was sought before any such work was carried out. In the case of one panel complex, the landowner had deliberately encouraged the build up of leaf litter so as to cover up the more vulnerable panels within a copse of beech trees. Where panels were found it was anticipated that nearby outcrops which were largely covered with turf might reasonably reveal additional unrecorded motifs. This was in fact the case in several instances during fieldwork by private researchers in Northumberland (I Hewitt and S Beckensall *pers.comm.*).

7.3 Recording panel context and structure

7.3.1 Background

7.3.1.1 At the broadest scale, the detail of motif and panel designs needs to be accurately georeferenced so that individual panels can be related to one another and to other attributes of the landscape in which they lie. The key elements of this level of survey must be to first georeference the panels to provide accurate location, and second to situate the detailed panel records in the context of the rocks on which they occur.

7.3.2 Total station recording

7.3.2.1 The purpose of carrying out technical survey work on, over and around inscribed panels using a total station was fourfold:

- To demonstrate the function of total station surveying in rock art fieldwork;
- To provide co-ordinate data and plot files for inclusion in the Project's GIS;
- To compare the results, accuracy, time and costs involved in carrying out the same work using survey grade GPS equipment;
- To compare the results of the panel and motif based recording with that derived from the scaled drawings.

The Total Station used was a Sokkia SET 4C Electronic Distance Metre (EDM) with a Sokkia SDR 31 Datalogger. Survey stations and control points were recorded close to discrete panel groups and key landmarks and these were subsequently recorded using a Global Positioning System so that the total station survey points could then be used to transform the data into the Ordnance Survey National Grid co-ordinate system (OSGB36). In the case of one control point in the Northumberland transect, Whitsunbank Hill Triangulation Point, Ordnance Survey provided OSGB36 co-ordinate data.

7.3.2.2 A code library was developed for the purpose of coding different point types in the field, and it also helped to speed up the post-fieldwork data processing and creation of survey plots. The codes are transferable between the GPS and the Total Station data loggers (see Appendix G). Four levels of recording the rock art panels were tested:

- First, a single point in the centre of the panel (which would correspond to the location data stored in the SMR and private archive records) was recorded, and the horizontal extent of the panel was recorded as an outline.

- Secondly, the vegetation, quarry, and rock outcrop edges (the latter sometimes differing from the panel edge) were also recorded. The recording of these features allows the growth of vegetation and any reductions to the rock panel to be monitored over time. During this survey work, the Total Station (TS) was used to record the datum points included in the scale plan drawings so that the digitised versions of the motif plans could be georeferenced and incorporated into the Project's GIS facility as a digital map. Examples of the results are displayed in Figures 7.1 and 7.2. Figure 7.2 shows a comparison of results achieved for the panel outline using different recording methods: Totals Station; GPS; and representative scaled planning. All three overlays were georeferenced using two datum points.

- Thirdly, a mini prism that is designed for use without the prism pole was used to experiment with the recording of individual motifs. Points were recorded along the edges of the motifs, in some cases up to every 10mm (for example for small cup marks). As demonstrated by the examples in Figure 7.2, the results of this approach to motif recording produce a highly accurate plan of the designs. However, it is difficult to represent the subtleties of motif form using this recording method. It was noted that this approach was most useful in large panels where relatively simple motif types (particularly cup marks, which are more easily depicted using this technique) were widely dispersed across the surface. This allows the exact location of the individual motifs to be more accurately recorded than is the case in plan drawings. However, where more complex motifs are juxtaposed, this approach is less successful.

- Lastly, the total station was used to create surface models or Digital Elevation Models (DEMs) of a sample of panels. With the aid of a mini prism the total station was employed to collect a multitude of points across the surfaces of two panels in the West Yorkshire transect. The points were generally recorded at 10cm intervals except where panel features required a higher degree of detail, such as at dramatic changes in elevation and around fissures. This technique represented a means of experimenting with the visual depiction of the panels in three dimensions, and as a possible approach to depicting panels featuring a high level of relief, such as the pyramid shaped boulder panel 8012. Results are displayed in Figure 7.4.

7.3.2.3 Lansdscape survey work was not undertaken using the Total Station because of time constraints. Given the scale of the problem, it was already known that the Global Positioning System (GPS) instrument would pick up points approximately ten times faster than this conventional method. Furthermore, digital contour data had been previously been purchased for the project and although this was at a contour interval of 50m it seemed sufficient to show up the major topographical variation within the study area.

7.3.3 Global positioning system recording

7.3.3.1 Three different grades of Global Positioning Systems (GPS) which use a constellation of satellites to obtain location co-ordinates via a receiver, were tested during the Project fieldwork. This allowed the field team to explore the possible applications of a range of GPS systems varying in accuracy and cost. The equipment included a survey grade System 500 GPS supplied by Leica Geosystems (UK) Ltd, Milton Keynes, the Fastmap GPS with limited GIS capability from Survey Supplies of York, and a Garmin hand held unit from Dr Roger Doonan (Bournemouth University). These units were capable of achieving accuracy levels of sub-centimetre, sub-metre, and, through averaging, sub 10 metres respectively. Prices ranged from £200 per day hire for the survey grade GPS, £200 per week for the Fastmap, to £116 to purchase the Garmin.

7.3.3.2 In order to make best use of the equipment in the limited time available the GPS was used in the following work:

- To test the viability of GPS as a means of survey data collection for rock art fieldwork;
- To create comparable data sets to those collected using the Total Station;
- To accurately locate all panels recorded during the trial period and compare this data with locational data provide by other sources.

7.3.3.3 Panel positions were recorded with all three units for comparison, and the outlines of the rock panels were recorded using the survey grade and Fastmap GPS. The panel level surveying conducted with the Total Station, where panel outlines, datum points, different edge types, and survey stations and control points were recorded, was replicated using the survey grade GPS to enable the two methods to be compared.

7.3.3.4 Leica System 500 GPS

7.3.3.4.1 The Leica System 500 GPS comprises two sets of the same equipment (a base station and a roving receiver). Each consists of the following:

- Satellite antenna;
- Tripod or similar mounting (in the case of the roving receiver this could be either be a backpack mounted pole for kinematic /wide area survey work or a detail pole for high accuracy, intensive data collection);
- Data logger;
- Real-time correction transmitter and receiver;
- Independent power-supply.

A single base station receiver located in the centre of the Northumberland study area provided real time differential correction for the System 500 GPS survey, compensating for the intentional accuracy degradation introduced by the United States Department of Defence. The base station collects readings to calculate its own position (the triangulation point of signals received by at least four satellites) during the same period that data is collected by the roving receiver. An in-built radio transmitter then broadcasts a corrected position to the roving receiver, so that the roving data logger is able to show accurate positioning using the OSGB36 grid system (the National Grid). On average the equipment's data logger was showing a position quality for each point to within 1 or 2cm on the earth's surface. The limiting factor to this sort of data collection is that the equipment's antennae must have line of sight to the satellites and so dense woodland can only be surveyed using offsets. Despite this, the entire Northumberland study area (2.5km^2), which featured small conifer and broadleaf plantations, was successfully surveyed using a single base station.

7.3.3.4.2 In addition to the panel recording described above, a terrain model was also created as a result of picking up topographical points over an area surrounding one specific panel (Panel 2). The area was approximately 50m by 50m and some 1400 points were collected on a parallel series of tracks walked by one of the field staff (the detail pole was removed prior to this and the antenna attached to a simple pack back for ease of use).

7.3.3.4.3 In terms of speed and accuracy the survey grade GPS was highly successful, even in recording a large panel within a conifer plantation (see Figure 7.5 for a simple example of the panel outline survey). However, the number of satellites tracked by the receiver in the dense plantations at Rivock edge in West Yorkshire, and beneath the large beech trees in North Plantation in Northumberland, was not sufficient for accurate reading to be established. Equipment launched by Trimble and Survey Supplies in the form of a GPS which can be used in conjunction with a reflectorless theodolite, may aid in overcoming such obstacles. The majority of the panels visited in the transects were, however, situated in open moorland and the survey grade GPS provided a rapid means of recording at sub-centimetre accuracy. Because the entire study area could be surveyed using a single base station this dramatically reduced the time taken in similar surveys using the Total Station where additional survey stations had to be established and checked. Figure 7.3 shows a comparison of results achieved for a panel outline using different recording methods: Totals Station; GPS; and representative scaled planning. All three overlays were georeferenced using two datum points.

7.3.3.4.4 In summary, the survey grade GPS is exceptionally useful at locating individual panels on the ground as well as dramatically speeding up the process of survey data collection (compared to a conventional total station). It should, however, be seen as complimentary to the total station and certainly in woodland areas the Total Station is likely to be more reliable.

7.3.3.5 Fastmap GPS

7.3.3.5.1 The Fastmap GPS was used to collect position points and panel outlines for comparison with the Total Station and Survey Grade GPS data. The Fastmap unit, relied on differential correction using beacon data from a station at Flamborough Head on the northeast Lincolnshire coast, and arranging access to this data was included in the hire of the equipment.

7.3.3.5.2 The results of the Fastmap survey were not found to be sufficiently accurate to be used to transform the Total Station data into OSGB36 co-ordinates. With accuracy levels sub-metre at best, the motif datum points were sometimes skewed in relation to the panel outline when viewed on screen in the field. The graphical output was useful for viewing larger landscape features, boundary walls and general panel outlines, but was not as useful in creating a detailed or representative panel outline due to the accuracy level. Because the panel outlines produced would not necessarily give a good indication of exact dimensions and shape, this unit is best suited to recording at the panel position level.

7.3.3.6 Garmin 12 Personal Navigator GPS

7.3.3.6.1 A position point was established for each panel using a hand-held Garmin 12 Personal Navigator GPS. This unit does not allow for real time differential correction and can only be corrected using base station data from an external supplier (accuracy readings of +/-15m were being recorded). The data collected during the field trials was not post-processed and thus the intentional signal degradation introduced by the US Department of Defence has not been removed. During recording the unit displays an accuracy figure in metres and multiple points can be averaged to achieve a more accurate result. Panel position points were obtained in this manner for up to 30 minutes per panel, to an accuracy of between 4-10 metres (this averaging technique was thought to be better than taking a series of single readings over time). In the case of widely spaced moorland panels such a technique would be a useful aid in site relocation using the navigation function in conjunction with a motif plan or identity disk which would confirm that the correct panel had been relocated. This model is very reasonably priced and user friendly and might be useful in large-scale site monitoring and inspection work, or reconnaissance survey. However, its application in accurately recording location is clearly limited.

7.3.4 Conclusions

7.3.4.1 Each of these three GPS receiver sets has different limitations, accuracy levels and optimum applications. The high-end Leica equipment is best suited for high-accuracy recording and thus requires a higher degree of user input to process data than the lower grade Fastmap equipment. The Leica equipment is also more successful in poor survey conditions (such as poor satellite visibility and light woodland canopy cover). The Fastmap equipment is best suited for wide area recording such as picking up individual points and edge features such as boundaries. This is less accurate but far simpler to use and data collection is displayed as a developing map, in real-time. Lastly, the hand-held Garmin receiver is easily operated, and its pocket size makes it ideal for simple position-point data collection. All three systems are capable of working in the field with OSGB36 (the National Grid co-ordinate system) and so can display real time map co-ordinates. All three can be used to navigate with, although the hand-held Garmin unit is far easier to handle and a point position can be fixed within a couple of minutes. This receiver is, however, far less accurate (at best claimed to be within 15m) and this will not improve unless the selective availability (the American Department of Defence's satellite signal degrading programme) is removed. Selective Availability (SA) affects all three systems but both the Leica and Fastmap receivers get around the problem by using a second receiver to counteract the random errors. In the case of the Leica equipment this comes in the form of a second reference receiver used and in the case of the Fastmap a second satellite signal is picked up by a network of receivers around the coastline of Britain and broadcast to the data collection receiver.

7.4 Recording panel content

7.4.1 Background

7.4.1.1 Although rock art has been recorded in some parts of the world for over a century (Schaafsma 1985, Wainwright 1985, Wainwright 1990, Sognnes 1992, Hyder 1996, Milstreu 1996 and Sognnes 1996) attempts to standardise terminology and methods are relatively recent. Some broad terms to distinguish between types of rock art seem fairly standard. For instance, pictograph is used to refer to images created by using pigment only or 'rock art rendered on the rock surface without disrupting it' (Wainwright 1985) and petroglyph is applied to images 'carved, cut, engraved, pecked, ground, or abraded, rubbed, drilled, with secondary smoothing' (Swartz 1981). However, conformity amongst specialists in terminology does not extend much further. Throughout the literature individual units of rock art panels are referred to as designs, elements, figures, glyphs, images, motifs, pictures and signs. Definitions that distinguish between such basic terms as 'recording' and 'documenting' have yet to be agreed upon (Schaafsma 1985 and Swartz 1993). Such terms will be treated as synonymously.

7.4.1.2 As a result of the recent expansion of rock art research internationally, much discussion has taken place regarding the standardisation of methods and the establishment of minimum standards for recording (Swartz 1981, Clegg 1991, Walt and Brayer 1994, Gunn 1996 and Loendorf *et al* 1998). An interesting feature of each of these articles, however, is acknowledgement that in practice such a task is rarely possible. Many variables apply to every field visit including the purpose of the research, the uniqueness of each site, the experience and skill of the recorder, the field conditions encountered, and the resources of time, equipment, materials and funding (Clegg 1991). Additionally, no single recording method provides a complete and purely objective record, as all fall victim to the subjectivity of the recorder, the effects of the environmental conditions, and the limitations of the materials or equipment used or of the site itself. Therefore, a combination of several different recording methods supplemented with comprehensive field notes is required to thoroughly document a rock art site (Wainwright 1990, Moore 1991, Ogleby 1996 and Kolber 1997). Although individual project objectives are manifold, the purpose of recording rock art has been successfully summarised by Wainwright (1990) as being 'to meet the requirements of archaeological and anthropological scholarship and interpretation, and to serve as a tool for conservation and cultural resource management.'

7.4.1.3 An additional consideration in recording rock is that if the form of recordings and field notes is to outlive the actual panels, such documents must be stored under proper archival conditions and be accessible for future research. In addition to the required publication of research results, the actual records must be well organised, clearly labelled and deposited in a proper storage and retrieval facility in order to be useful to other researchers (Gunn 1996; Loendorf *et al* 1998). With recent and ongoing developments in computer technology, the possibilities for databases and other resources facilitating the exchange of rock art knowledge and data will quickly become more accessible and hopefully provide a more stable means for preservation (Swartz 1991; Walt *et al* 1997). However, caution must be advised here as well, as equipment and programmes quickly become obsolete and records can be lost if they are not regularly upgraded into new formats.

7.4.1.4 A number of recording techniques are reviewed below, including those tested during two periods of field work, the first in Northumberland during May 1999 and the second in West Yorkshire during July and August 1999. A total of 19 techniques were tested and a scheme has been developed for those found to be successful, in order to streamline their use in the field. The techniques described here include photographic methods, drawing techniques, other non-contact and contact recording methods, technical surveying, as well as laboratory analysis. Several were adapted directly from standard archaeological site survey and planning techniques. Table 7.1 lists all techniques evaluated.

7.4.1.5 Successful rock art documentation consists of two elements: non-image documentation comprising maps and field notes containing information regarding the location, description and any observations of the site; and image documentation of the actual motifs and panels. Several recording techniques may be required to cover the complete range of features associated with a rock art panel from its situation in the landscape to unique details present in a single glyph. In this report differentiation is made between those methods and techniques for recording images and those for monitoring and quantitatively determining the state of the panel under different conditions and over the course of time, although some methods may be suitable for both purposes. Recording techniques are generally considered to be of two kinds: those that require direct contact with the stone surface and those that do not. However, this division is not always as clear as it may sound. Some contact may occur when using so-called non-contact methods, for example when making measurements of motifs for drawings, but, overall, non-contact methods do not involve the application of materials that could cause chemical or physical damage. For the sake of site preservation, non-contact methods are recommended whenever possible, and contact methods only used on stable panels if absolutely necessary. In fact, some consider all contact methods inappropriate with some exception given only to sites about to be destroyed (Wainwright 1985).

7.4.1.6 The visual clarity or visibility of rock art depends upon the conditions under which the panel is observed, therefore sites should be visited several times and some recording methods should be repeated under various conditions in order to obtain the most complete record possible. Furthermore, it has been demonstrated that different people will produce very different results using similar recording methods on the same panel (Moore 1991; Brayer *et al* 1999). Swartz (1997a) addresses both of these issues by suggesting the formation of recording teams (to include a recorder and a checker), and that two teams should visit each site separately to record the same features observed under varying weather conditions and throughout daily and possibly seasonal cycles. Although such repetition may not be possible for all field research, the suggestion to have records cross-checked by different people while in the field and under different conditions is indeed very valid.

7.4.1.7 Once the basic record information and access permission has been received and the panel located on the ground, a variety of recording techniques can be applied. With the exception of laser scanning each of the motif recording techniques tested rely on lighting in order to reveal subtle depressions in the rock surface (see below for a discussion on rubbing methods in regard to this issue). As a result, the techniques involve a degree of subjectivity on behalf of the field recorder as to where points are recorded using technical surveying methods, where measurements are taken during drawing techniques, and the interpretation of photographs and rubbings. Highly weathered motifs and subtle tool marks are more readily identified under low and direct sun at dusk or dawn. For this reason, use of artificial light sources (not tested within the Pilot Project) during field recording could aid in eliminating recording bias and avoiding the time consuming task of multiple panel visits. The use of distilled water gently sprayed onto the panel surface almost always enhanced the visibility of the motifs.

7.4.2 Non-contact methods

7.4.2.1 Optical methods

7.4.2.1.1 Photography is one of the most common methods of recording rock art due to the versatility offered by various formats, film types, filters and processing methods available. In its simplest form, photography is a non-contact and inexpensive procedure, requires some specialised training and processing and is fairly accurate. Although a certain amount of subjectivity on the recorder's part may be apparent, the main limitations of photography are those of the equipment itself and the effects of the environment, both of which can be controlled or mitigated to a certain degree. The most widely used photographic format in rock art recording today is the 35mm single lens reflex camera using black and white print and colour slide film. Black and white prints have long been favoured for their archival properties (Wainwright 1985 and Walt and Brayer 1994), however colour slide film has developed considerably in recent years and is now of comparable quality (Loendorf *et al* 1998). Although some colour fading is inevitable over time, if proper colour scales such as the IFRAO Standard Scale are included in the photo, new methods of colour re-constitution have virtually eliminated this concern (Bednarik 1991a; 1994; Bednarik and Seshadri 1995).

7.4.2.1.2 As lighting can be the single most important factor affecting photography (Hyder 1996), and petroglyph visibility responds dramatically to lighting, it is advisable to photograph panels at different times of day and seasons for the benefit of different lighting angles and light diffusion (Wainwright 1990). Additionally, by using different filters and experimenting with various lighting sources, the effects of environmental conditions can be minimised or enhanced as required. For accurate lighting, the ambient colour temperature should be measured and the appropriate filters used (Wainwright 1985 and Loendorf *et al* 1998). Polarising filters can be used to eliminate surface glare (Sanger and Meighan 1990, Walt and Brayer 1994 and Loendorf et al. 1998) and cross-polarised electronic flash provides an added effect of colour saturation (Wainwright 1990). Either electronic flash (Wainwright 1985, Sanger and Meighan 1990, Wainwright 1990 and Loendorf *et al* 1998) or collapsible reflectors (Sanger and Meighan 1990, Walt and Brayer 1994 and Loendorf et *al* 1998) can be used to control illumination and to create or eliminate shadows.

7.4.2.1.3 Various effects can also be created with different film types. Infrared film has been used to enhance petroglyphs photographed in direct sunlight if the carved surface is lighter than the surrounding patina (Walt and Brayer 1994). Infrared film and filtered ultraviolet and infrared light can be particularly useful to differentiate between carvings of different ages when superimposed or to visually separate rock art from living organisms which fluoresce under these conditions (Loendorf et al. 1998).

7.4.2.1.4 Digital photography has also become a preferred method for recording rock art sites over the past decade. Digital cameras are now available with a variety of lens attachments and can be manipulated with various software packages for image processing and storage (Ogleby 1996). An additional advantage of digital photography is that results obtained can be checked instantaneously on site. However, currently only very high quality digital cameras produce images comparable to those of traditional photographic methods using slow film.

7.4.2.1.5 A number of image rendering techniques have developed based upon the further elaboration of photographic images. Tracing photographic prints onto transfer paper provides good panel and motif plans (Prøhl and Milstreu 1996), and Kivikäs (1995) has taken this method one step further by enhancing such images with watercolours. Slide images may be projected to any scale and tracings made of the panel and any motifs (Smits no date, Wainwright 1990, Moore 1991 and Kolber 1997). James Henry Breasted of the University of Chicago developed an elaborate method using photographic prints as a background image to make inked plans of panels and motifs by comparing the photograph with the actual panel, and then manually adding or deleting any details to the print (MacLean 1996, Oriental Institute University of Chicago 1998). This is useful because the photographic process renders three-dimensions into two-dimensions mechanically which avoids any unnecessary subjectivity, the image can be enlarged or reduced to any scale required, and the photographic image can be bleached away if desired. A digital version of this method has been proposed (Walt and Brayer 1994 and Walt *et al* 1997) whereby a digital photograph is taken, printed lightly and then compared with the panel making note of any additional details.

7.4.2.1.6 A direct consequence of the great variability in photographic methods is the even greater variability in the quality and detail of photographs. When possible, large format cameras are preferred over small format cameras for greater resolution, however they are much more difficult to manoeuvre and often require specialised, more costly processing (Wainwright 1990). On site photography should be methodical and the procedure should be described in the field notes for future reference. To maximise the output of each photographic session, multiple should be taken at different settings of each subject exposures (i.e. bracketing).

Photographs should be taken as parallel to the rock surface as possible for the best geometric accuracy. Wide-angle lenses should be avoided as they cause considerable geometric distortions. A tripod and cable release should be used for best results. Photographs should include a colour scale, metric scale, orientation marker (up or North arrow), surface perpendicular, panel number, glyph number, film roll designation, date, time and photographer's name or initials (Sanger and Meighan 1990, Walt and Brayer 1994 and Loendorf et al. 1998). A photo log book should include: site number, location, type of film, ASA, camera details, lens details, film roll and exposure number, exposure details (exposure time and f stop), subject, date, time, light conditions and direction, camera direction or subject direction and space for any other relevant comments (Walt and Brayer 1994 and Loendorf *et al* 1998).

7.4.2.1.7 Single Lens Reflex (SLR) photography

7.4.2.1.7.1 For the Pilot Project, three SLR Pentax 35mm P30T cameras were used simultaneously so that under optimum natural lighting conditions colour slide, black and white and normal colour print images could be taken. A standard IFRAO photographic scale was used as well as a 0.5m graded scale and these both proved extremely useful (especially where images are digitised and subsequently re-sized). The field team observed that in low light conditions where shadows were most beneficial, it was more effective to take photographs at an oblique horizontal angle facing the sun (contrary to conventional techniques). Several panels were visited more than once to test how different light levels affect the appearance of carvings and it was agreed that the use of artificial light at a low azimuth would enhance the effect of shadows and thus the visibility of motifs. Lighting proved to be one of the most influential factors in recording rock art during daylight hours. Although artificial lighting was not used during the pilot study fieldwork it has been shown elsewhere (for example in recording rock art in Argyllshire) to enhance greatly subtle features (see RCAHMS 1999, 7 and 53). Photographs of the general panel context, and of weathering patterns and other damage were also taken (see Figures 7.6 and 7.7). A photographic register was kept for appropriate photographic information to be logged, and an identification board was used to cross-reference this to the films.

7.4.2.1.7.2 Once processed, several of the images (all film formats) were scanned, so that they could be stored as image files in the Project database. Alongside the digital camera images and digitised drawings, these images can be called up alongside text-based records held in the database. The digitisation of these conventional images was achieved using an A4 flatbed scanner. Kodak UK offers a further service that creates a CD of conventional images at high resolutions. SLR photography is an integral component in creating a basic field record for rock art and enhanced lighting would improve the chances of successfully capturing images whilst minimising fieldwork times.

7.4.2.1.8 Digital photography and the application of digital images in interactive panoramic displays

7.4.2.1.8.1 Two digital cameras were tested during fieldwork, to capture images of motifs and panels (comparable to those taken with an SLR), to demonstrate the advantages of viewing photographic images in the field and also to capture panoramic images to create an interactive digital landscape for end users of the Project database. The equipment used for capturing motif and panel images were two Sony Digital Stills Cameras (MVC-SD81), one featuring a macro facility for high resolution close-ups, and an Olympus C-400 digital camera mounted on a tripod for the landscape and panoramic work. For general examples of digital photography as tested by the Project see Figures 7.8 and 7.9). In all three applications the benefits of immediate image processing were clear. Images can be reviewed, deleted or appended in the field and in the case of the Sony cameras, actually pre-viewed before being stored. This is particularly useful as the images can be checked to ensure that the motifs identified on the panel are visible in the digital photograph. The preview screen on the model used was small (approximately 5cm by 4cm) and displayed the images in a low resolution which reduced the success of field checking the images. Although the resolution of images captured was generally poor compared to conventional photographs, and would not be suitable for presentation and publication, the quality of the digital version was deemed to be sufficient for field work, database archiving, and web publishing. Motifs and panels were clearly visible, but in most cases only the addition of a macro lense would allow surface detail and texture to be captured. In the case of the Sony camera, the output resolution is 1028x768 pixels and when images are reduced by 30% or more there is a noticeable improvement in the visual result. Both cameras supported file formats that were compatible with a variety of image-processing programmes and media storage was either through a memory chip or 3.5" diskette.

7.4.2.1.8.2 In order to record motifs, panels and their immediate and medium distance setting, a series of 360 degree panoramas were taken using the Olympus digital camera. All component frames were taken form the same fixed point. Once processed using *Spin Panorama* software which 'stitches together' a series of twenty overlapping images, the result is an apparently seamless view of the micro and macro landscape of a motif and panel, within which the viewer can navigate horizontally and vertically at will. The viewing software includes a zoom function and allows the linking of further files (either spot images of other panels or other panoramas and viewsheds) so that the original landscape can be 'explored' further. The processing and viewing software does not, however, have analytical functions. The benefit of this form of imaging is clear where future on-site access and interpretation is not possible.

7.4.2.1.8.3 Digital cameras and digital imaging clearly has a role to play in rock art fieldwork. It is unlikely to replace SLR photography as in the near future image resolution is still limited. It should therefore be seen as only a complimentary method of image capture. However, the benefits of rapid processing in the field render this technique worthwhile. The creation of an interactive digital panorama on and around panels is perhaps novel to rock art studies but it gives access to sites and their settings for those unable to visit the panels in-situ. This lends yet another dimension to the visual record for rock art.

7.4.2.1.9 Close-Range Photogrammetry

7.4.2.1.9.1 Photogrammetry is a non-contact 3-dimensional documentation method known for its application in aerial photography and architectural recording. A stereoimage can be created from a stereoscopic pair of photos, that is two photos taken at approximately the same distance from an object but from slightly different positions. If photographing a large object, enough photo pairs must be taken to allow adequate overlap of all areas in order to create a complete surface model. To ease modelling and minimise distortion, photos should be taken as parallel to the panel surface as possible and shadows or water deposits should be avoided, as they may interfere with depth calculation functions. Additionally, a scale must be included in the photos for calibration. Ideally, a pair of precision scale bars, accurately marked and measured to sub-millimetre accuracy, should be arranged to make a right angle and frame the edges of the panel of interest. The more accurate the scale bars and the more scales present in the photos, the more accurate the 3-dimensional model will be. By modelling the positions of two photographic images in various software packages using image-matching techniques, spatial data can be generated and processed into stereomodels, orthoimages and 3-dimensional models. The photographs provide an archive of the visual condition of an object at a particular moment in time.

7.4.2.1.9.2 A pair of Rolleiflex 6006 semi-metric twin lens reflex cameras fixed to a metal bar mounted on a tripod with a boom bracket was used for the field trials. The cameras were each fitted with a reseau plate (a flat ground glass plate marked with precision cut crosses in the corners) and calibrated. The purpose of camera calibration is to model the characteristics of the camera lens. All lenses introduce some distortion to a photograph; the better the lens, the less the distortion. The engraved crosses on the reseau plate are known fixed points, which can be seen and measured on each image. The camera calibration reveals the exact centre of the lens and the lens distortion radiating from the centre in relation to the reseau points. From these measured reseau points, the photogrammetric software will compute and account for lens distortion. In the case of the Rollei cameras used, the lens distortion reached a maximum of 100µm at 18mm from the centre. Ilford Plus FP4 ISO 125 medium format monochrome film was used since its greater tonal range compared with colour film aids the automated image-matching routines for data processing. A right-angled scale bar was positioned close to the panels in all photographs so points could be measured from it during the photogrammetric process. Following the fieldwork, the film was processed by hand, to avoid the risk of film deformation from stretching or heat. The negatives were scanned at a resolution of 1 pixel = 20 µm using a photogrammetric scanner with very high geometric accuracy. The PHODIS Digital Photogrammetric Workstation (from Zeiss) was used for data processing in order to produce the stereomodel and Digital Elevation Model (DEM). Erdas Imagine software (from Erdas) was used to view the 3-dimensional terrain models. Photogrammetric processing was conducted by Leoni Blank, using equipment from the Department of Geomatic Engineering, University College London.

7.4.2.1.9.3 Three panels were recorded for photogrammetric processing: panels 8022, 8008 and 8000. These panels were chosen because they are accessible, because their scale was compatible with the equipment used, and because they were the same panels recorded by laser scanning and the results of the two methods could then be compared. Additionally, panel 8022 was chosen because of its 'at risk' status and it was considered a priority to obtain as comprehensive a record of this site as possible. Panel 8022 was the first to be modelled photogrammetrically. Since the entire panel could fit in a single frame, the stereomodel was easy to produce, as it consisted of only one pair of photographs. The accuracy of the model produced was calculated to be slightly better than 0.3mm in plan, and 0.8mm in height (Blank *pers. comm.*). The DEM was produced with a 0.5mm post interval, which gave a dense coverage for the surface model (see Figure 7.10).

7.4.2.1.9.4 The results obtained for this panel demonstrate what can be achieved with elementary equipment and less than ideal conditions. At the time of the field trials, advanced photogrammetric equipment and trained personnel were not available. Therefore, the very basic system described above was used. Possible sources of error affecting the accuracy of the model produced for this particular panel include uneven lighting, slightly overexposed photographic images, minor camera malfunctions and the lack of appropriate scale bars or ground target points for inclusion in the photos. Establishing ground control points to facilitate accurate photogrammetric scaling was not possible during the field trials. All panels chosen to test this method happened to be partially buried, and project policy dictated that partially buried rock art panels would not be excavated for the purposes of the field trials and nothing could be put into the ground that would potentially affect any associated archaeological materials. Many of these circumstances are commonly encountered in field survey situations. Therefore, the results obtained are representative of what could readily be produced by non-(photogrammetric) specialists using basic equipment on a protected site and relying predominantly on automated data processing. Given these circumstances, the results are considered very good (compared to SLR photography), although even better results could be obtained with superior equipment, such as Zeiss UMK or Wild P31 cameras which have lenses with negligible distortion, the use of a precision scale bar, and improved light conditions.

7.4.2.1.9.5 One objective of the field trials was to compare the results from photogrammetry and laser scanning. Only cursory remarks can be made, however, as the laser scanning equipment used was quite advanced compared to the fairly simple photogrammetric method employed. It was discovered that automated data processing software applications available for photogrammetry were not as capable of accurately rendering an entire panel as laser scanning packages. Automated photogrammetric data processing accurately provided 3-dimensional data for approximately 80% of panel 8022. The remaining 20% required manual adjustment and were therefore subjective in nature, although an experienced photogrammetrist would be able to measure points with a very high order of accuracy. The uncorrected digital terrain model was examined with a surface overlay and was found to be dramatically different from that of laser scanning. The photogrammetric image of Panel 8022 had a very rough top surface and smooth edges, due to misplaced data points. The exact opposite effect was observed in the field and was illustrated clearly in the laser scanning images. Although this could be corrected manually, such human intervention would be somewhat subjective in nature and time-consuming.

7.4.2.1.9.6 Photogrammetric photography can be undertaken with many different cameras and formats ranging, from basic 35mm single-lens reflex cameras to digital cameras to glass negative large-format metric cameras specially designed for this purpose. It should be noted, however, that the quality of the equipment affects the accuracy of the results obtained in the subsequent 3-dimensional modelling process. Standard use 35mm single lens reflex camera images are subject to considerable distortion (hundreds of microns), especially around the edges, as opposed to metric cameras (typically less than 5 microns). If an SLR is to be used, two things can be done to mathematically account for distortion. Either the camera can be taken to a photogrammetric specialist for calibration and adjustment to a fixed focal length before taking any photos, or it is possible to use a 'self-calibrating' bundle adjustment software package to compute the camera settings during photogrammetric processing. The second method would require a calibration target (an object with marked points of known co-ordinates) to be placed in the photo.

7.4.2.1.9.7 Like laser scanning (see below), photogrammetry is a non-contact method for 3-dimensional modelling with numerous output formats including options for replication. Deterioration monitoring is possible with the data generated. Photogrammetric photography can be undertaken with almost any camera, making it a very flexible technique appropriate even for very remote or difficult to access sites. However, smaller format cameras suitable for such research will have lower resolution and greater distortion levels than larger format metric cameras. Therefore the same problem encountered with laser scanning is again an issue: greater accuracy is at the cost of easy access and lower cost. Additionally, data processing is very time-consuming and can require substantial subjective intervention. Assessment of photogrammetric and laser scanning data obtained on this project is ongoing. However, further comparative testing is suggested in order to determine the capabilities and limitations of both methods more fully.

7.4.2.1.10 Photographic aids

7.4.2.1.10.1 A variety of materials and techniques have been developed to aid in the photography of petroglyphs. A few of these methods are still considered appropriate in certain situations, however, those involving the application of materials that could potentially alter the surface have generally become unacceptable. To improve contrast and colour saturation, rock art is often dampened with de-ionised water. This technique may be appropriate for sites regularly exposed to water including most British open-air rock art. However, it has been suggested that similar results can be obtained with the use of polarised filters and cross-polarised electronic flash photography (Wainwright 1990).

7.4.2.1.10.2 A number of techniques involving chalk, paint, crayon, suspensions and other pigments have been used over the years to enhance petroglyph visibility. The application of such materials is now strongly discouraged as they may cause permanent discoloration, physical and chemical damage and prevent the use of some absolute dating techniques. Chalk has been one of the most frequently used materials to outline or fill in petroglyphs due to the erroneous belief that it is a harmless material that will readily wash off with water even if left in place. In fact, chalk is surprisingly durable and may damage stone both physically and chemically (Gale and Jacobs 1987b; Booth Childers 1994; Walt and Brayer 1994; Kivikäs 1995; Bahn and Fossati 1996; Dean 1997; Beckensall and Laurie 1998; Loendorf *et al* 1998). Paint and crayon are even less likely to weather away naturally and may bond to rock surfaces becoming almost impossible to remove without causing further damage (Dean 1997). Solutions of polysaccharin, chalk and quartz suspended in water and painted on petroglyphs leave behind a white residue upon drying enhancing contrast for photography (Prøhl and Milstreu 1996). Although these suspensions are presented as 'harmless', this is probably not the case. Polysaccharin could attract various organisms as a food source that could then damage the stone surface. Ground quartz particles could abrade the surface and if small enough, could infiltrate the pore structure of the stone and cause a number of problems if obstructing air and water exchange. Objections to the use of chalk make all of these suspensions seem less than ideal and they probably should be avoided. One additional drawback of any method involving a recorder identifying and selecting features to outline or fill in is its ultimately subjective nature (Sognnes 1992; Bednarik 1995; Beckensall and Laurie 1998).

7.4.2.1.10.3 Anati (1978) describes the 'neutral method', an intensive method of black and white pigment application to enhance petroglyph visibility. After cleaning the surface, a dilute pigment contrasting to that of the original stone colour is brushed or sprayed over the entire surface. When dry, the paint is then partially removed with a wet sponge. Then, the upper surfaces are stamped with a colour opposite to that of the first paint layer. The benefit of this method is that all relief should be distinguished in a relatively objective fashion. However, the possible chemical and physical consequences resulting from the application of

successive paint layers and constant contact with the stone surface required to render this effect could cause extreme damage and are not encouraged.

7.4.2.1.11Laser Scanning

7.4.2.1.11.1Currently, laser scanning is one of the most accurate non-contact methods for recording 3-dimensional surfaces and provides a variety of data presentation options for documentation and exhibition purposes. Laser scanning operates by projecting a low-energy red laser stripe onto the surface of an object that is viewed off-axis by a video camera. Data is then relayed to a personal computer to calculate surface dimensions using the mathematical principles of triangulation, thereby eliminating the need for any physical contact. Depending upon the scanning system used and the speed at which the scan is made, such spatial measurements can be highly accurate, from 1mm to 0.1mm, and some scanners have the additional capacity to record colour, thus making an even more detailed record. Once the data has been gathered, it can be processed using various software packages, such as 3D StudioMax or Lightwave. These applications allow different surface patterns and colours to be overlaid, the manipulation of lighting effects of different intensities and angles, and data enhancement to exaggerate relief. Output for this method includes various computer-generated images and the possibility of machine milling scaled replicas.

7.4.2.1.11.2 The laser scanning system used during the field trials consisted of a ModelMaker H laser scanner mounted on an 8-foot Faro Silver arm. This system is capable of 3-dimensional spatial recording up to an accuracy of 0.1 mm without colour recording. Additional on-site equipment included a personal computer, 240-volt generator, small light-blocking shelter and light meter (lux). Data processing was done using 3D StudioMax software. The Conservation Centre of the National Museums and Galleries on Merseyside provided all laser scanning equipment, and Dr. Stephen Fowles of the Conservation Centre operated the scanner in the field and subsequently processed the data.

7.4.2.1.11.3 Panels 8022, 8008 and 8000 on Rombold's Moor were recorded by laser scanning. These three panels were chosen because they were relatively easy to access with the equipment required, and each was documented with photogrammetry, thus allowing for the comparison of the two methods. Panel 8022 was chosen for the first field attempt because it was the most accessible panel and was considered at risk as it is partially exposed, unprotected and located in a sheep pen and directly in the way of a farm track (see Figure 7.11A). Figure 7.11B shows a picture of the laser beam running tracking across the surface of the boulder. Moreover, in addition to several pronounced cups there were many areas of unclear relief, and it was hoped that computer imaging would aid in viewing these areas to assess whether they were the result of natural weathering or part of the motif system. After initial confirmation of relatively successful results for this panel, the two larger panels 8008 (1.5m x 0.55m) and 8000 (1.3m x 0.58m) were attempted. Figure 7.11C shows the rendered surface results for all three panels (panel 8000 on the left, panel 8008 in the middle, and panel 8022 on the right). These panels increased the technological challenges associated with the use of this method *in situ*, as the scale of these panels approached the limits of the range of both the laser scanner and the data file size. Scanning the object in increments that are later patched together during the data processing stage solves this problem. Usually this procedure is aided by the application of datum points to the scanned object. However, this was considered inappropriate for this project and the decision was made to attempt to combine the scanned sections without attaching datum points to the surface.

7.4.2.1.11.4 Laser scanning proved to be a successful method for recording petroglyphs *in situ*. This was the first known application of laser recording technology on British rock art. After reducing the ambient light to a suitable level (see below), obtaining complete, high-resolution scans of panels was a relatively fast procedure. Data processing was mostly automated, and no problems were encountered when patching the separate data files together for the larger panel images in spite of the fact that datum points were not attached to the stone surface. While experimenting with the 3-dimensional models, it became apparent that computer-based light manipulation functions offer greater illumination control than any field-based methods available. Features were observed on the computer-generated images produced for each of the three panels that were not readily apparent on site. Motifs were more visible in all three panels, and it was even possible to identify wear patterns on Panel 8022 - the topmost area was smooth and striated whereas the edges were rough and pitted (see Figure 7.11A, surface rendering). A number of three dimensional images, contour maps, short animation clips and a scale foam plastic replica were produced to illustrate the range of output possibilities available with this method. Figures 7.12, 7.13 and 7.14 show examples of interpolated contour surfaces where the contour interval is 2mm.

7.4.2.1.11.5 Many different laser scanning systems are now on the market, each with their own capabilities and limitations. In general, accuracy is gained at the expense of mobility and affordability. The ModelMaker laser scanner used in the field trials was expensive (£50,000), required an electricity source, and although considered 'portable' was difficult to transport as it is heavy and the laser calibration is delicate. Other more portable and inexpensive systems are available such as the Polhemus FastSCAN. However accuracy is compromised for such qualities as this system is only capable of providing accurate results to approximately 1mm. The single most limiting factor in the field is ambient light, which interferes with the laser reflection, thereby producing gaps in the data. Therefore, a shelter was required to block as much ambient light as possible (2000 lux or less for best results). Other factors such as the large scale of the panels, the coarse crystal structure, and the dark surface were suspected to be obstacles upon initial examination, but ultimately were found not to be problematic. Data processing is largely automated and consists mostly of computer time.

7.4.2.1.11.6 In addition to the various image-rendering options offered by laser scanning systems, analytical functions are possible as well. Surface loss can be quantified with terrain modelling functions available in IDRISI or other similar GIS software packages. It is also possible to monitor surface deterioration by re-scanning a panel and subtracting the data sets to give the difference in surface levels over time. The use of fixed datum points on the panel would make data set comparison easier, but it is possible to get relatively accurate results without such reference points.

7.4.2.1.11.7 An accurate laser scanner capable of recording colour could be the most objective and effective means of fully recording a rock art panel currently available, providing both quantitative and qualitative data. Digital data recordings of surface dimensions and colour could be used for a number of monitoring purposes. Additionally, the various imaging and replication options available make laser scanning the single most output productive and versatile method of recording of those tested in the field trials. Since this method is 3-dimensional, quick and requires no direct surface contact, laser scanning is perfectly suited for recording petroglyphs and further application of this method should be considered.

7.4.2.1.11.8 Laser scanning is time consuming in terms of getting the equipment on-site (portable in a van or Land Rover) and setting up and calibrating the machine. However producing individual panel scans was relatively quick - two small panels approximately 1m by 0.7m in size, were scanned within a working day. In cases where large panels are being scanned, a slightly different system to that used during the field trial can be employed. Hand held laser scanners using magnetic trackers are capable of attaining accuracy to 1mm, and can be used in conjunction with a laptop for increased portability (Dr S. Fowles *pers.comm.*).

7.4.2.2 Drawing techniques

7.4.2.2.1 Drawing is one of the most common methods used to document rock art. Drawing is predominantly a non-contact, inexpensive method for producing rock art images. However, it is also very subjective, potentially fraught with distortion when attempting to render a 3-dimensional surface into 2-dimensions, and the results obtained ultimately depend upon the abilities of the recorder (Loendorf *et al* 1998; Brayer *et al* 1999). It may be necessary to make several drawings of various scales ranging from the glyph level to overall site drawings in order to convey the full effect of a panel complex (Sanger and Meighan 1990; Walt and Brayer 1994; Loendorf *et al* 1998). Drawings are of three levels, the field sketch, the measured or ruled drawing and the grid drawing, each becoming successively more time consuming, but consequently more accurate (Walt and Brayer 1994; Loendorf *et al* 1998).

7.4.2.2.2 Sketches are created quickly and with minimal spatial referencing aside from taking advantage of relative reference points forming part of the panel as mentioned in Moore's (1991) description of the 'sighting' or 'grid visualisation' method, a technique slightly more advanced than freehand sketching. As sketches require no direct measurements of the stone surface, they are the least obtrusive method of drawing, but they are also the most inaccurate. Brayer *et al* (1999) have conducted preliminary studies to quantify the inaccuracy resulting from freehand sketching and their studies to date indicate that the subsequent distortion is significant. Shetches are however a useful preliminary exercise to other recording methods since they encourage careful observation of the motifs and rock surface.

7.4.2.2.3 Measured or ruled drawings involve the use of flexible rulers or tape measures used as reference points and to measure distances and drawings are often made on graph paper. Loendorf *et al* (1998) suggests the use of two rulers to establish an X and Y-axis for referencing. This method is more time-consuming than sketching, but the results are more accurate. As some direct surface measurements may be desirable, care must be taken to maintain this method as non-contact, especially on unstable surfaces. Grid drawings involve the use of string grids with spacing scaled appropriately to the panel and graph paper for drawing. The grid can be attached to nearby stable, uncarved stone using non-residue-leaving tape (Sanger and Meighan 1990; Kolber 1997; Loendorf *et al* 1998). Such drawings are the most time consuming but are also the most accurate due to the number of reference points available. Additional care must be taken to minimise contact between the panel and the grid used with this method.

7.4.2.2.4 Regardless of what level of drawing is undertaken, an attempt should be made to maintain consistent use of lines and patterns throughout. A key defining all notation should be included along with other information such as: glyph number, panel number, site number, site name, orientation marker (up or north arrow), datum points, date, time, weather conditions, scale and recorder's name (Swartz 1981; Sanger and Meighan 1990; Walt and Brayer 1994; Loendorf *et al* 1998). Additional notes can be written on drawings when elements are unclear or in places where natural forms have been incorporated into the panel to aid in later interpretation (Gunn 1996; Loendorf *et al* 1998). Also, all drawings should be checked by more than one person and under various weather conditions to ensure the rendering of the most complete drawing possible. When finished, the images may be inked or digitised for a more permanent record.

7.4.2.2.5 Representative scale plans of panels and motifs

7.4.2.2.5.1 Though scale plans are regularly used in standard archaeological survey and excavation to record a wide range of archaeological remains, the use of this technique in rock art recording differs in a significant way. This is due to the need to record both the three-dimensional surface of the rock panel, and the two dimensional motif design. Unlike standard practices which produce horizontal plans or vertical profiles, the latter must be recorded parallel to the rock surface so as not to introduce distortion. In this way the process has more in common with, for example, recording decoration on ceramic vessels. Clearly in cases where the panels are flat or a single plane has been carved this issue is less significant. Where panels were decorated on a 45 degree plane recording parallel to the panel surface is imperative. For panels created in the round it is necessary to produce a development of the surface. This technique was primarily used to record the motifs while the extent of the panel itself was recorded in more detail using the Total Station and Global Positioning Systems described above.

7.4.2.2.5.2 Baselines were set out across the longest axis of the panel and datum points to be recorded with Total Station and Global Positioning System survey equipment were established (see above). This allowed the plans to be linked (or georeferenced) to and rectified using real world co-ordinates, and overlaid on technical survey plans. Archaeological, geological, microtopographical and vegetation features were recorded using a set of conventions either developed specifically or taken from site based planning conventions. In most cases the motif edges were recorded and the depressions were shaded. Motif depths were recorded separately on the attribute recording forms. Unlike other agencies that use 1:25 as the standard scale for recording panels, the field test here recorded motifs at 1:10 or 1:20 so as to maximise detail. It proved useful to have a 1x1m planning frame available for this, although for the smaller panels a 0.5x0.5m frame would have been more suitable. Again, a light spray of water was useful in highlighting the relief of several motifs. The digitising process and storage of the plans in the database and GIS is discussed in Section 7.6. An example of the plan drawings and digitised version is shown for panel 9 in Figure 7.15. Figure 7.3 shows a comparison of results achieved for the panel outline using different recording methods: Totals Station; GPS; and representative scaled planning. All three overlays were georeferenced using two datum points.

7.4.2.2.5.3 This technique was usually more time consuming (with large and complex panels taking up to 2 hours to record) than the other recording methods. The measurement-taking process, because of the small scale at which the recorder is working inevitably introduces errors. Furthermore, the individual drawing style of the recorder, and their subjective interpretation of the motifs, is reflected in the result. The correlation of the plan drawings and the panel outlines produced in the technical surveys suggest that this method could be improved by increasing the number of datum points used. This would allow the drawn plans to be more accurately rectified to fit the technical survey results, as well as being displayed as two dimensional 'stretched' images of the motif designs. The optimum number and placement of datum points differs between individual panels. In general, panels featuring one surface plane can be recorded using datum points along the edges of the panel, whilst panels where the surface is undulating or stepped need to be recorded using temporary datums across the entire surface. In these cases the centre of cup marks were found to provide adequate and stable datum points, and this avoided potentially causing damage to the surface through attaching a temporary reference object.

7.4.2.2.5.4 Scaled motif plans were found to be a useful means of representing the motifs, particularly in comparison to photographic techniques that are more reliant on lighting conditions to display all of the designs occurring across the panel surfaces. On both an aesthetic level and in terms of accurately representing the forms of the motif designs, this method is more successful than those produced using the Total Station, rubbings, or tracings. Where the panels are small and feature relatively simple motifs this technique can be used by an experienced recorder to rapidly survey a large number of panels in careful detail. This was the case for the five small boulders and mobiliaries recorded in one of the cairn's apparently recorded by Canon Greenwell, in the Northumberland transect – Panels 4-8. This is a very low cost approach which could be quickly and easily taught to a range of individuals, from field archaeologists to members of the local community who may wish to participate in rock art recording.

7.4.2.2.5.5 The conventions used in recording motifs in the Kilmartin Glen, Argyllshire by RCAHMS could be developed for wider application. These appear to be representative drawings enhanced using photographs to register common points and to record geological features such as fissures and natural depressions (for example see RCAHMS 1999, 37 and 58).

7.4.3 Contact methods

7.4.3.1 Tracing

7.4.3.1.1 Although tracing is a contact method, some researchers still support its use for recording particularly faint images, and recording individual peck marks (Anati 1978; Loendorf *et al* 1998; Twohig 1988). Tracing has many pitfalls, however. Subjective decisions made by the recorder determine what elements are included or excluded in a tracing (Simpson 1993) and the quality of the tracing is dependent upon that of the recorder. Tracing is time consuming and cannot provide an accurate rendering of very uneven surfaces. The recorder must also guard against movement of the sheets during recording as it can result in inaccuracies. Changing weather conditions or light manipulation with reflectors or artificial light sources may be required to obtain a complete image. Care must be taken not to damage the rock art surface by applying too much pressure when tracing and to choose stable, non-carved surfaces if the application of tape or Blu-Tak to hold tracing materials in place is necessary

(Walt and Brayer 1994; Kolber 1997; Loendorf *et al* 1998). A final archival consideration: plastic sheeting expands and contracts with temperature thus distorting the recovered image (Kolber 1997).

7.4.3.1.2 A number of scale tracings were taken of individual motifs and one whole panel using clear polypropylene (30 microns thickness and 508mm width) and water proof marker pens. Figure 7.16 shows the digitised version of a tracing taken off panel 8008, compared to the results of an epigraphic survey (see section 7.4.4.1), Total Station survey (see section 7.3.2) and representative scaled planning (see section 7.4.2.2.5). The advantage of this technique is that a 1:1 scale plan is achieved, and the recorder is working in close contact with the panel surface, allowing fine details to be observed and recorded in the drawing. However, the characteristics of the panels in the study transects reduced the effectiveness of this technique. The panels in the study areas were frequently undulating and three dimensional, with motifs sometimes situated so as to take advantages of natural features in the rock. Furthermore, many of the motifs were akin to base relief surfaces, sometimes featuring very deep and wide grooves and basins with internal detailing. These factors meant that it was difficult to produce an accurate result by laying plastic sheets over these undulating surfaces.

7.4.3.1.3 Within the study areas motifs that featured internal details such as additional cups or multiple levels of internal relief were encountered. Where attempts were made to describe features within the individual motif grooves or basins this resulted in errors of scale, as the final product ended up being larger than the original. The large inclusions characteristic of the West Yorkshire geology also influenced the final drawing because these minor natural anomalies tended to be exaggerated in the tracing. Though this technique was not considered successful in the field trials, it is clearly highly valuable in recording petroglyphs on smooth flat panels, particularly where motifs are produced by incising or engraving methods, rather than by remodelling larger areas of the panel surface.

7.4.3.2 Carbon and Wax Rubbing techniques

7.4.3.2.1 Though rubbings have recently been criticised as possibly causing damage to rock art panel surfaces these techniques are still widely employed both in England and Sweden. The carbon rubbing approach, which is thought to be less abrasive than other methods, was tested on two panels in West Yorkshire (see Figure 7.17). This involved laying one or more adjoining sheets of paper (60 micron detail paper, 762mm width) over the panels, and rubbing the surface with a soft sponge wrapped in carbon paper. In this way a 'negative' of the motifs is captured as the carbon pigment describes the areas of raised surface across the panel. Wax rubbing using artists' crayon was also briefly tested on one panel. In both cases a number of problems were noted. First, though the benefits of this approach should be that the motifs are described through the objective action of applying a pigment (as in brass and coin rubbings) the process in fact involves an element of subjectivity. The clarity of the resulting image produced must be interpreted by visual comparison with the actual panel after the rubbing is produced or enhanced during the process by 'feeling' the edges of the motifs. Furthermore, the problem of scale error described for tracing also occurs here – that it, attempts to describe the internal features of the large groove motifs meant that the end product was larger than the original.

7.4.3.3 Damp Cotton Method

7.4.3.3.1 Dampened cotton cloth can be used as a photographic aid to record petroglyphs. By stretching damp, woven, unbleached cotton cloth over petroglyph panels, the cloth will lie on the uppermost relief with air filling the low relief. The effect created renders the carvings light in colour while the upper surface appears as a darkened background, thus removing any distracting surface coloration or shadows. The resulting image can then be photographed. (Selisaar, 1991). The only materials needed for this technique are de-ionised water, a spray bottle, a camera, and unbleached woven cotton fabric of different weights and weaves.

7.4.3.3.2 The damp cotton method was tested on panels 8000 and 8008 (see Figure 7.18). These two panels were chosen as they are both well documented with photographs, rubbings, tracings, measured plans and photographic plans that could then be compared to the results of the damp cotton method. Panel 8000 was chosen because the motifs were very difficult to perceive due to the surface coloration. Mixed results were obtained with this method. Two different weights and weaves of cotton cloth were used. A medium-weight cotton fabric seemed to give the best results.

7.4.3.3.3 The use of damp cotton on petroglyphs is not appropriate for all sites. It is most suitable for relatively flat, horizontal panels. As this is a contact method, it should only be applied to panels with stable surfaces. Since water is required for this method, it should be attempted only on panels normally exposed to water. The resulting images produced during the field trials were not very consistent, and are dependent upon the degree of stretching and wetting of the cotton over the panel. Moreover, there is no way to distinguish between natural and artificial markings with this technique. A final limitation is that only the high relief is evident and any detail below the uppermost level is absent.

7.4.3.4 Foil Impression

7.4.3.4.1 Kitchen foil can be used as a photographic aid and an alternative to chemical release agents used for moulding. By gently pressing household kitchen aluminium foil with fingertips, or cotton wool into a petroglyph, a more consistently coloured surface is created, free of deposits, discoloration, shadows and plant growth (lichens, moss and algae). It can be photographed with a polarising lens. Additionally, by using a fixative, plaster or other casting material, a negative cast of the petroglyph can be created without applying a moulding substance directly on the stone surface (Simpson, 1993). The only materials required for this photographic technique are kitchen foil, cotton wool and a camera with a polarising lens.

7.4.3.4.2 Panel 8000 was chosen to test this method because the motifs were difficult to see with an unaided eye due to general rounding and obscuring of the motif and surface discoloration. Unsatisfactory results were obtained with this method for this panel. The motif was too deep and mainly composed of cup motifs, which the foil could not conform to without tearing. A number of attempts were made with two different weights of foil, but none gave worthwhile results. There was no attempt to make a cast of the petroglyphs, as the foil could not form a permeable layer necessary for use with casting materials. This method was quickly abandoned as all other panels posed similar problems.

7.4.3.4.3 As with all contact methods, foil impressions should only be attempted on panels with very stable surfaces. Also, this method does not seem very effective on deep relief or circular motifs, as the foil tends to tear. The use of this method is limited by the foil strength. Although not particularly useful for this site specifically, the foil impression technique did seem potentially suitable for more shallow, linear relief. Additionally, this method may provide a safer means of casting than traditional mould making as the foil would create an impermeable layer to any applied casting materials. Therefore, this method is suggested as one worthy of consideration for use at sites where the degree of relief is slight.

7.4.3.5 Moulding and casting

7.4.3.5.1 Until relatively recently, moulding and casting were the only methods available to produce a 3-dimensional model of petroglyphs (see section 7.4.2.1.11). In recent years this method has been condemned as the deleterious effects of moulding and casting have become apparent and non-contact technology has developed that can provide similar results. Improper materials have caused staining and discoloration, deposition of residual material and removal of the stone surface (Wainwright 1990; Simpson 1993; Bednarik 1995a; Bednarik 1996). Furthermore, moulding and casting materials may chemically contaminate rock surface layers making them unsuitable for some dating techniques (Bahn and Fossati 1996; Tratebas and Chapman 1996; Dean 1997). Depending upon the materials used, moulding can be expensive and time-consuming (Simpson 1993; Walt and Brayer 1994). Moreover, many moulding materials are not very stable or suitable as archival records as they deteriorate and may shrink up to 10% (Walster 1996a). However, initial reports on the use of thermoplastics for casting petroglyphs sound promising for use on appropriately stable surfaces (Seglie *et al* 1991).

7.4.3.5.2 Traditional moulding and casting techniques were not employed during the field trials, as they were considered inappropriate. However, the possibility of producing replicas through non-contact methods was investigated, and a replica was made using laser scanned digital data in an electronic milling process (at the Merseyside National Museums and Galleries Conservation Centre). A foam plastic scale model was produced with good results, and future replicas using this technique should be considered. An additional benefit is that replicas can be made in any material, synthetic or natural (including stone), and to any scale.

7.4.4 Combined and other methods

7.4.4.1 Photographic Print Traced Plan (Epigraphic Survey)

7.4.4.1.1 Originally developed to record ancient Egyptian wall reliefs and inscriptions in situ by James Breasted of University of Chicago's Oriental Institute, a modified version of epigraphic survey recording was used in the field trial as a non-contact method to create a motif plan. Black and white photos were taken of the panels, using a measured scale bar, and processed into 8x10 inch prints with a heavy, lustre finish. The prints were then taken back into the field and the panel outline and motifs were drawn onto the prints while referring to the panel in situ. After all elements were identified and marked in permanent ink, the scale bar included in the photo was also inked. The prints were then taken back to the laboratory and the photographic image bleached away to leave an inked panel plan with scale.

7.4.4.1.2 For the field trial, 35mm black and white photos were taken of the panels with a 20 or 30cm measured scale bar divided into 10cm intervals. Where possible, images were captured parallel to the rock surface. 8x10 inch prints were made and a 0.25mm Rotring rapidoliner was used to ink the panel outline, motifs and scale. The inked images were scanned into Adobe Photoshop to preserve a copy before bleaching. The photographic image was then bleached away using a solution of 1 part potassium ferricyanide, 1 part sodium thiosulphate to approximately 15 parts water, leaving behind the inked plan.

7.4.4.1.3 Two panels that were very different from each other were chosen to test this method, thus presenting a wide range of variables to test in the trial. Both panels were well documented with photos, rubbings and plan drawings, thereby providing a means to evaluate the results. Panel 8008 was chosen because it is relatively flat and small, fairly devoid of plant matter, rather darkly coloured, and uniform in coloration. Additionally, we had photos of this panel in raking light, which accentuated the motif, and these were a helpful reference. Panel 8013 was chosen because it was much larger, spread over a high boulder on two levels, rather lightly coloured, and had a variable surface colour and texture due to the diversity of plant life present (including several different kinds of lichen, moss and algae). It was hoped that black and white photography would make the surface colour and texture more uniform and the motif system easier to identify.

7.4.4.1.4 Tracing a photographic print was a quick and effective means to produce a panel plan. This method was less time-consuming than making a measured drawing or tracing. The end result was also easy to scan into computer imaging software that would then allow the image to be enlarged or reduced to any scale required.

7.4.4.1.5 For the best results, a number of factors must be taken into consideration. Although any format camera can be used, a medium format camera gives better resolution. Ideally, the entire panel should fit into a single frame, therefore the accessibility of the site is important. This method is most suitable for panels that are relatively flat but may be useful for transforming more 3-dimensional panels into 2-dimensions with less subjectivity and distortion than through other more manual approaches (i.e. sketching, rubbing, etc.). The print paper must be of high quality, and the emulsion needs to be of an appropriate consistency to be drawn on and be bleached. If possible, a pencilled version of the plan should be done on the print first, possibly over the course of a few visits to the site under different lighting conditions. Someone very familiar with the panel should undertake the final inked version. Overall, this is a very inexpensive and quick method of producing a plan, in spite of the need for multiple visits and photo processing which may be impossible for short field surveys. Figure 7.19 shows the photographic print and ink-marked motif outlines (above) for panel 8008, and the bleached result (below).

7.5 Recording panel attributes

7.5.1 Introduction

7.5.1.1 The methods and procedures described so far relate to the form and layout of motifs on a panel. All represent some kind of depiction of what is observed or defined as being present. In recording rock art, however, there are other attributes of a panel that are important to know alongside the pictorial images. The following section discusses additional, largely descriptive or quantitative, data gathering exercises.

7.5.1.2 A field form for recording panel and motif attributes (measurements, observations and judgements) was created and it was foreseen that the database fields and controlled vocabulary lists might need to be modified in the light of this. For this reason, and because the field trials covered only a small number of panels, paper record forms, rather than digital input forms on laptop computer, were employed and data was later manually input into the database. To facilitate this process laminated prompt and lookup table cards were used in the field. This process would be significantly more efficient if data input forms on laptop computers or notepad computers were used in future surveys. APPENDIX E lists the prompts for recording panel context, panel and motif attributes in the field. Where motif plans were not made before the data input forms were completed the production of a non-digital sketch was required in order to assign motif numbers. These sketches are then stored in the database until a more accurate plan is produced.

7.5.2 Rebound Hammer

7.5.2.1 The Schmidt Rebound Hammer is a testing device used to assess stone strength and stability. The instrument is very simple, consisting of a spring-loaded metal plunger encased in a metal cylinder. When pressed against a hard surface, the plunger is released and its rebound is measured on a scale on the side of the case. This rebound value (R-value), which is dependent upon the angle of the hammer to the material when tested, can be used to determine the compressive strength and dispersion values of the material. An E.O. Schmidt Rebound Hammer N-13 was used in the field trials.

7.5.2.2 Since the rebound hammer is a forceful contact testing method, and all panels appeared to be of the same material and in a state similar to the rest of the outcrop, it was decided to test this method on nearby uncarved stone rather than risk damaging a rock art panel. The area of stone tested was part of the Rivock Edge outcrop just North of panels 8000, 8008, 8005, 8006, and 8007.

7.5.2.3 For the field trials, the different faces and different strata of a stone in the Rivock Edge outcrop were tested. A series of 20 measurements were taken from an area roughly 10cm in diameter per test area and the upper 10 values were averaged as suggested by the International Society for Rock Mechanics (1978). (Note: the destructive nature of this test was witnessed in the form of a white powder resulting from crushed quartz crystals each time the hammer was used).

The following results were obtained with an uncalibrated hammer:

Southwest face, top strata:	a= 0, avg.	R-value=37.3
Southwest face, bottom strata:	a= 0, avg.	R-value=34.5
Northwest face, top strata:	a= 0, avg.	R-value=33.1
North face, top strata:	a= 0, avg.	R-value=31.3
Top face:	a=-90, avg.	R-value=36.5

7.5.2.4 Since the materials required to calibrate the hammer for the field trials were not available, it was not possible to calculate absolute compressive strength and dispersion data. However, these values were deemed unnecessary for the purposes of the field trials, as the R-values themselves are useful relative measurements of stone stability. The above data demonstrates that some variation in strength exists between the different faces and strata of the stone tested. Uneven weathering may have caused some instability as the two most exposed faces, the top and the North face, have the lowest values. The variation in R-values between the top strata and bottom strata of the Southwest face could be attributed to differences in stone composition, but values also may be affected (lowered) if material is being crushed upon impact as was particularly the case in the lower strata.

7.5.2.5 The practicality of this method is limited by the fact that the testing procedure has not been standardised (Poole and Farmer 1980). Additionally, several sources of instrument error have been identified and although they can be minimised with systematic monitoring and calibration, it has been shown that no two hammers function identically (McCarroll 1987). Thus any readings can only be considered as relative values unless instrument error has been accounted for and the R-values obtained are mathematically calculated into a 'perfect' hammer reading using a calibration equation (McCarroll 1987). A final consideration regarding this technique: the rebound hammer is potentially very damaging, therefore its use on actual rock art panels may not be appropriate.

7.5.3 Geological identification

7.5.3.1 No stone samples were taken from rock art panels themselves; rather samples were taken from uncarved areas of the Rivock Edge outcrop of which the panels were part. No samples were taken from the Northumberland transect. It was known that the predominant geological formation in the area of the field trial in West Yorkshire is a sandstone commonly known as Millstone Grit (Kendall and Wroot 1924). A fresh surface exhibits an orange-coloured coarse-grained structure with many inclusions, but a weathered surface appears almost granitic as it weathers down to a dull grey surface skin composed of firmly cemented rounded quartz grains (see Figure 7.20A and B). Petrographic analysis undertaken by Arthur Beer of University College London confirmed that the stone was conglomerate Millstone Grit derived from Torridonean origins and of Namurian age (Middle to Upper Carboniferous). The samples were described as: of typical arkosic material, composed of angular quartz grains, microcline and perthitic potassium and sodium feldspar and were of igneous or metamorphic derivation evidenced by the liquid inclusions contained within the quartz crystals (Beer *pers. comm.*). Very small amounts of zircon, apatite and magnetite also were identified within the stone, and a large degree of iron oxide cementing was observed as well (Beer *pers. comm.*).

7.5.3.2 At a more detailed level, the application of recording prompts (such as grain size and shape, strata type and more besides) used in geological sciences alongside petrological analysis might aid in the identification of subtle geological differences within broader stone types. It may even be possible to source stone in cases where mobiliaries are thought to come from a particular area.

7.5.4 Soil sampling

7.5.4.1 Soil samples were taken to test for potential damage caused by salt ions. Three samples were taken, each from a different environmental location: near panel 8008 on the upper moorland, near panel 8020 in the lower moorland and near panel 8013 in the conifer tree farm. Ten millilitres of de-ionised water was added to 4.0 grams of each sample which where then tested for nitrate, sulphate and chloride ions using the Merckoquant 10020 Nitrate Test, 1.10019 Solfat-Test and 10 043 Chlor-Test respectively. For the sulphate tests, pH was adjusted with the addition of sodium acetate as per instructions. All pH measurements were taken using a Corning pHmeter model 7. Table 7.2 lists the results.

7.5.4.2 Samples were also taken of 'grit' put out by gamekeepers to maintain the grouse populations in West Yorkshire. Since the moorland was heavily vegetated, for the grouse to find the 'grit' it had to be placed in an open area which was usually a large stone surface and, more often than not, was one bearing motifs. A visible lightening in colour was observed on stone surfaces upon which 'grit' had been placed (see Figure 7.21). The lightening could be due to small particles of 'grit' dust filling spaces between the surface crystals, or the 'grit' layer could prevent sunlight penetration, thus killing any algae or other micro-organisms previously darkening the surface. However, it was not readily apparent while in the field why this colour change was taking place. Samples were taken for analysis. 'Grit' was identified as predominantly igneous quartz with traces of potassium and sodium feldspar, biotite and white mica also present (Beer *pers. comm.*).

7.5.4.3 The use of 'grit' on rock art panels is considered harmful both physically and chemically. Physical damage can result from abrasion to the stone surface, and very small particles could disrupt the pore structure, thus interfering with water and air exchange. An additional concern is that 'grit' is intended to attract birds to congregate on the panel surface, which could result in both physical and chemical damage. Another threat is that of salt damage. Given the acidic conditions on site, potassium feldspar could break down to release potassium ions which could then react with sulphate ions in the soil to form the salts arcanite (K_2SO_4) or its hydrate $K_2SO_4{\cdot}H_2O$. Biotite could also break down to release ions that could form magnesium sulphate and its associated hydrated salt forms including kieserite ($MgSO_4{\cdot}H_2O$), hexahydrite ($MgSO_4{\cdot}6H_2O$), epsomite ($MgSO_4{\cdot}7H_2O$) and dodecahydrate ($MgSO_4{\cdot}12H_2O$) (Thorn 1996). Although the mechanism is not completely understood, it is generally accepted that salt damage occurs when phase transitions take place, such as the crystallisation of a salt from solution or changes between hydrated forms, which are dependent upon the environmental conditions of temperature and relative humidity. As both potassium and magnesium sulphate salts exist in more than one form, they could be particularly hazardous under the extremely changeable conditions of Ilkley Moor (daytime temperature variations of 16-28C and relative humidity fluctuations of 38-75% were recorded throughout the week of field trials). Further chemical testing and environmental monitoring would be necessary to accurately predict the threat posed by the elements listed above, but repeated applications of 'grit' to rocks containing petroglyphs obviously would increase the risk of this potential hazard and should be discouraged.

7.5.5 Lichen identification

7.5.5.1 Lichen samples were collected and Dr. Allan Hall at the University of York and Dr. William Purvis of the Natural History Museum made preliminary identifications. Five different lichen species were discovered during the field session, possibly: Ochrolechia androgyna, Caladonia squarrosa, Lecanora muralis, Rhizocarpon geographicum and Parmelia omphalodes. Lichens produce oxalic acid, and are well documented in the literature for damaging rock art panels. However some species may not be damaging and, in fact, may protect the stone surfaces over which they grow (Booth Childers 1994; Purvis *pers. comm.*). Research on this topic is ongoing, and it is suggested that further study be undertaken regarding lichen varieties present in England and their potential affect to rock art.

7.5.6 Condition recording

7.5.6.1 Damage/Weathering Forms Mapping is a visual method of documenting the location and relative intensity of different damage and weathering forms on a rock art panel by marking the various deterioration forms present on a photograph, sketch, measured plan, or digital image of the panel. By documenting all of the observed agents of deterioration, such as those noted on the damage/weathering forms survey. This method of documentation can be used to monitor deterioration. Depending upon the variety and extent of deterioration, all forms may be documented on one plan or on several overlaid layers. The complete map can be digitised to aid in storage, information retrieval and comparison with future observations.

7.5.6.2 For the field trials, measured plans were used as the background panel image. The damage/weathering forms documented were those listed on the damage/weathering forms survey. Clear sheets of cellophane were used to overlay different layers. Each damage/weathering form was illustrated with a different colour permanent ink pen and/or pattern. The panels used in the field trial were Panel 8000 and 8013. These two panels were chosen because measured plans had been made of both and because each exhibited very different damage/weathering forms. Figure 7.22 displays the results of condition recording for Panel 8000 with vegetation (above) and weathering forms (below) shown separately.

7.5.6.3 This method was attempted during the field trials by using measured plans as a template and overlaying clear cellophane sheets to record the damage/weathering forms present with great success. Due to the variety of forms present on Panel 8013, four layers were necessary (one for each of the four broad categories of damage/weathering). Different colours and patterns were used for each of the individual forms on each layer and those forms demonstrating a range in intensity were illustrated as such (for example the microbiological colonisation on Panel 8013).

7.5.6.4 As the quality of the information documented by such maps is a direct result of the scale of the map and the amount of detail provided, mapping weathering forms can be very time consuming. A further consideration is that the results obtained with this method rely upon the recorder's ability to identify the deterioration agents at work and present them in a meaningful fashion.

7.5.6.5 The creation of damage/weathering forms maps may be unsuitable for panels that do not display obvious evidence of damage/weathering forms as it is a very time-consuming process. However, such maps may be the only means of spatially documenting information that otherwise might be less obvious on photos or simply noted in writing. Therefore, although time-consuming, this method is suggested for use on significant panels showing signs of active deterioration, panels with particularly complex systems of deterioration and/or panels demonstrating unique agents of deterioration. Furthermore, such documentation is suggested before any proposed conservation treatments are administered.

7.5.6.6 A descriptive assessment of the kinds of damage and weathering forms that have affected an individual rock art panel and the extent to which they have affected the panel can be an important piece of documentation. Although often very subjective and dependent upon the experience of the observer, such documentation can be an invaluable resource regarding the state of preservation/deterioration of the panel, especially when linked with photos or weathering form maps. No ready-made methods of damage documentation were available which seemed appropriate for English rock art sites. For the purpose of the field trials and for inclusion in the UKRAD database, a Damage/Weathering Forms Survey list was created based upon the available literature (Massa *et al.* 1991; Fitzner *et al* 1992 and 1995; Fitzner and Heinrichs 1994) and the personal experience of the field members.

7.5.6.7 No special equipment or materials are necessary for this method of documentation except a copy of the survey form. Damage/Weathering Forms surveys were completed for panels 8013 and 8008 in association with weathering forms maps. A survey was also completed for panel 8002 to complement the photographic record of its clearing from forest debris for recording.

7.5.6.8 The final version of the Damage/Weathering Forms survey created for the field trials and the UKRAD database is a checklist. Influenced by Fitzner's methodology (Fitzner *et al* 1992; 1995; Fitzner and Heinrichs 1994), all damage/weathering forms are placed into 1 of 4 broad categories including: detachment/loss of material, discoloration/soiling, deposits/addition of material, and deformation/displacement. Each entry under these four headings must be observed and its magnitude noted with regard to the following relative scale: no visible effect, minor effect, partial effect, heavy effect, and total loss of pictorial information. (See APPENDIX C.2.11 for details).

7.5.6.9 The main limitation of the survey is that although the forms of deterioration are fairly objective and well defined, the extent of damage is not quantifiable and is therefore subject to the individual recorder's assessment. Additionally, although every effort was made to create a list as comprehensive as possible, other sources of deterioration may be observed at other sites, therefore this list may require future additions and refinements. Furthermore, although this may not be a definitive list of the damage/weathering forms affecting all rock art sites in England, that is not its main purpose. The survey is meant to function as an aid to field archaeologists, to guide them in the observation and documentation of the most commonly occurring damage and weathering forms - not to serve as a replacement for the services of a conservator who could identify and diagnose more site-specific and complex problems.

7.5.6.10 Overall, the survey form seems to be appropriate for the purpose and level of detail required at this point in the study of rock art in England. Independently, it provides a detailed assessment of the state of deterioration/preservation at a moment in time. Associated with a photographic record or maps of damage/weathering forms, it becomes considerably more useful and can be referred to for condition monitoring. Moreover, the use of such a standardised form will aid in evaluating the state of rock art throughout England as a whole.

7.6 Data handling and recording rock art in the United Kingdom

7.6.1 A key element of the project brief was to develop in outline form a system suitable for recording and handling British rock art. This section deals with the process of creating such a recording system, comprising a database, GIS, and linked image and survey files. The section explores the advantages and limitations of such a system, but first a review of systems already in place in other countries is presented.

7.6.2 Existing rock art databases

7.6.2.1 A number of databases documenting rock art sites around the world have provided models for the development of the project database. While some of these systems are primarily image catalogues or text based databases others have incorporated the two approaches.

- The HELIOS Database

This was established at the Tanum Museum of Rock Carvings in Sweden in 1994, following the launch of a systematic recording project six years earlier (Jensen 1996). Using Paradox for Windows the database was designed to contain both textual data and digital images derived from rubbings and photographs. Fields cover details on location, weathering, environmental factors, estimated period, motif categories and general descriptions. A number of predefined queries have also been established compiling site lists based on period or motif category.

- RAD (Rock Art Database)

Following work in the early 1990s on the Central Alps Rock Art Archive, a DOS format database RAD was created by the Orme dell'Uomo (Footsteps of Man) organisation to document the rock art of Valcamonica, Italy. Information pertaining to the individual rock panels includes location, access, environment, geology, rock surface, archaeological context, popular traditions, bibliography, and tracings recorded. Individual figures are described in terms of stylistic categories and motif type, with information on technique and superimposition also given. Values are generally numeric or Boolean based (yes / no), and queries can be conducted at the rock panel and region level. There are plans to transfer the data into a format capable of incorporating graphics. The group has also established a web site as an 'Iconographic Database' featuring links to pages displaying specific motif classes.

- The International Rock Art Database Project

This is a collaboration between the University of Queensland, Australia and the University of New Mexico, USA with support from the Australian Rock Art Research Association (AURA). The project aims to incorporate text, photography, video, audio scripts and possibly a GIS to permit the study of rock art sites in north Queensland and Northern Territory, Australia and the American Southwest combining existing data with new data collection (Walt 1994, Walt *et al* 1994, Walt *et al* 1997). Using a relational Microsoft Access database, information is arranged by site, site section, panel complex, panel and glyph, with information on conservation, ethnography and archaeological context also integrated.

- Bibliographic Rock Art Studies Database

The literature included in this database covers rock art across the globe with an emphasis on North American sites. The database, supplied with PC-File software, can be searched by keyword and output formats can be customised. This database has been purchased for incorporation in the RAPP database.

In addition to the local authority SMRs and the NMR, there are at least two existing private databases in England which cover rock art sites exclusively.

- Ilkley Archaeology Group rock art database

Established by a local society, the database focuses on the Rombalds Moor area (Hedges 1986). Bibliographic data, location details, descriptions, and co-ordinates are organised in separate Microsoft Works files.

- HELICS database

Hewitt's HELICS Database covers a much wider area including sites across England and Wales, as well as the Channel Islands and the Scilly Isles (Hewitt 1991). Records are arranged in individual panel units providing location and context details, and descriptions and references. Due to software obsolescence this data now exists in a paper form, however, the job of transferring this into a standard database is in progress.

7.6.3 RAPP Database

7.6.3.1 Background and basis

7.6.3.1.1 The existing rock art databases described above provided ideas on the range and types of information which are beginning to be recorded as standard practice for petroglyph sites across the world. They also highlight the need for a recording system to integrate text, graphics and georeferencing, if a holistic approach to rock art interpretation is to be achieved. The RAPP database was designed with the potential for use in a much larger programme across the United Kingdom. Paradox for Windows was selected to create a relational database of 18 data tables and 38 lookup tables. APPENDIX E lists the provisional database table structure and look-up tables. This system offered several advantages. The project team involved in the database design and data input were already familiar with the software and had access to useful utilities designed for previous projects, such as the co-ordinate conversion tool for transforming national grid letters into their numeric equivalents.

7.6.3.1.2 Paradox features all of the basic functions that were required for validating data entry, storing graphics, building complex queries to search the data-set, and creating reports and user interfaces. Data can also be exported in a range of formats (for example ASCII, Quattro Pro, dBASE, Lotus and Excel) which would facilitate use of the data in digital mapping packages and the exchange of digital information with SMRs and other interested organisations / users.

7.6.3.1.3 The database was designed so as to include a wide range of fields offering information on the nature of the panels and motifs, location and measurement, situation and land use, palaeoenvironment, condition and weathering, view shed data, digitised graphics (drawings, photographs, plots, maps and footage), existing records, and site visit information. In this way the data can be utilised for analysis and interpretation as well as acting simply as a record archive.

7.6.3.2 Data Standards and Validity Checks

7.6.3.2.1 The purpose of the database design is twofold – to act as a dynamic archive capable of integrating new data as it arises, and to include the standard fields used in SMR and NMR records for rock art so that this resource is available. SMR data was imported to three tables detailing basic SMR records, the existing location information, and site designation. As a relational database the 18 tables, each containing information along a particular theme (such as location or conservation), are linked through the key field of RAPP number, a unique record numbering system. Appendix F lists the allocation of these numbers for all counties in England. The unique numbering system directly relates to the Project's primary record unit, the "panel". Where single panels may require multiple values – for instance, a single panel may be designated as both a Scheduled Ancient Monument and a National Park site – the fields are located in separate tables so as to avoid data redundancy. Wherever possible field names have been kept simple, and a detailed explanatory document accompanies the database. In order to ensure consistency across the data set and avoid input errors, 38 lookup tables were designed. These tables allow anyone entering new records to rapidly check the predefined range of values and terms for a given field and to make a selection from these lists.

7.6.3.2.2 This validity check streamlines the values held in the database and prevents spelling errors or inappropriate data from reducing the effectiveness of a query. The system is also sufficiently flexible to allow new values to be added if the need arises.

7.6.3.2.3 Once best practice procedures had been established, the details of the data processing were documented for each county extract as recommended in data recording standards manuals (RCHME 1998a; Gillings and Wise 1998; Brown *et al* 1999). Records were deleted only where sites clearly did not pertain to rock art as defined for the purposes of the project and all deleted records were maintained in a separate file to avoid errors. As the enhancement of SMR records using project data was achieved through links between separate tables within the database, any confusion over the origin of the data was avoided. The process of matching new project records (created from fieldwork) with existing SMR records involved the comparison of co-ordinate data with 1:10,000 maps of the Northumberland transect and checking descriptions. Within this sample we did not encounter significant problems during this concordance process as panels tended to be recorded in groups under a single SMR number, or singly where the panels were isolated or featured particularly complex motifs. In the case of a larger sample however, reading and checking descriptions would render the procedure fairly time consuming. Where SMR and NMR numbers are not cross-referenced internally this process would also be required when digital NMR data becomes available. As new record entry is ultimately envisaged as taking place in the field, compilation information is entered in the 'Visit' table.

7.6.3.2.4 Location data is recorded using Ordnance Survey National Grid Reference 100km square, Ordnance Survey National Grid Reference Easting, Ordnance Survey National Grid Reference Northing and height above Ordnance Datum. Where accurate (in this case sub centimetre) GPS data was recorded Latitude and Longitude was also recorded so that sites can be included in a GIS extending beyond the United Kingdom, should the opportunity arise. Once SMR co-ordinates had been imported they were systematically checked to ensure that zeros at the beginning of co-ordinates had not been dropped automatically during reformatting in the intermediate software (Excel). A policy on location currency was developed so that District, County, and Parish relate to current boundaries (1999). This affected some records where former boundaries had been redefined as part of Unitary Authority changes.

7.6.3.2.5 As recommended by the RCHME (1998a) a primary reference number (RAPP number) was selected as the unique identifier for each panel. In an attempt to aid users of the database the RAPP numbers were pre-assigned to each county in groups of 1000, hence Northumberland is assigned 1-999 (see APPENDIX F). In this way the RAPP number will act as a general indication of location. The total number of panels estimated for West Yorkshire according to Ilkley Archaeology surveys is 600 (Boughey *pers.comm.*). Should this number come to surpass the thousand pre-assigned RAPP numbers the next available set of 1000 can simply be allocated.

7.6.3.3 Data entry: SMR, National Park and Project field data entry

7.6.3.3.1 The data imported and entered into the Project database included digital records supplied by the SMRs and National Parks (see Table 5.1), and the data collected during field work in Northumberland and West Yorkshire. As the Project adopted *Panel* as the standard unit of record, and most SMRs and National Parks have combined the *Panel* and *Site* approaches, it was necessary to re-format existing records to suit the Project's database. This reformatting entailed three stages of processing.

7.6.3.3.2 First, the number of panels indicated in the records was established either by checking descriptions or, in the case of the North York Moors National Park data set through a field specifically designed to indicate the number of panels referred to in the description. While the definition of panel employed in the project directly corresponds to individual stones, boulders, or mobiliaries, it is possible that errors are introduced where records refer to outcrops, since defining panels in these situations can be more ambiguous due to fissures and turf cover. In these cases field checking would be necessary to ensure consistency. The Northumberland data set included 2 cave sites and one cliff face. Similarly, these sites would require field checking and possibly the modification or extension of the panel definition process (for instance introducing a distance criterion) to account for such situations. Where descriptions referred to multiple panels the records were split into the required number of records and assigned unique RAPP numbers. In some cases the number of panels was not specified in the descriptions and the records remained unchanged – this included cases where very uncertain numbers were volunteered (such as the most extreme example of a cairn site containing "nearly 300" carved stones in the North York Moors National Park). In the case of the Cleveland data set, due to limitations in searching description fields in their database, the SMR also supplied records for burial mounds so that any referring to rock art could be included in the project. From 114 records, 17 cup-and-ring records were identified by the SMR search and 8 were identified from the burial mound descriptions during processing. One duplicate record (acknowledged in the SMR description) and a record referring to masonry marks were removed from the Northumberland extract during record validation. It should be noted that the SMR descriptions were simply copied to the new panel level records – thus RAPP panel numbers were not specifically allocated to individual stones identified within the descriptions as this would have entailed further data processing which fell beyond the scope of the pilot project. The results of the panel verification process are summarised in Table 5.13.

7.6.3.3.3 The second processing stage involved reformatting the existing data fields to correspond with those of the project database. While certain fields were found in every data set - such as SMR or NMR number, description, and eastings and northings - there was also a great deal of variation between each of the data sources. Where data was not deemed relevant to the current project database the fields were not imported. Where additional relevant data did not correspond to the SMR fields in the project database this was merged with the description field and imported. The Pilot Project archive contains notes (in digital and paper format) of this work. Due to the large size of the description fields in the Northumberland record (to the extent that the whole record could not be edited in Excel but had to be processed in sections) additional fields could not be merged with the description field within the time scale of the Pilot Project. Finally, the location co-ordinates for the panels were converted from grid letter format to full numeric form for import into the Arc/Info GIS. This is discussed below.

7.6.3.3.4 As the field trials covered a small number of panels and the recording methods were still under development, paper record forms were employed and data was manually input into the database. A data input form can be designed using Paradox so that during future survey data could be directly entered into the database. Where motif plans were not made before the data input forms were completed, the production of a non-digital sketch was required in order to assign motif numbers. These sketches are stored in the database until a more accurate plan is produced.

7.6.3.4 The database as an analytical tool

7.6.3.4.1 As demonstrated by the results of analyses in chapters 4, 5 and 6, the Project database can be used as a standalone system to construct queries in order to answer a variety of questions on the collective record. These queries, which can include up to 24 related tables, are stored for future use and maintain dynamic links to the database tables so that database updates are reflected in the answers. The analyses conducted to date have generally been used to generate panel numbers per county featuring specific attributes and rely on the 'count' facility in Paradox to summarise record numbers.

7.6.3.4.2 The current database has seen values entered as text where possible rather than as coded values in numeric form (e.g. sandstone = 1, granite = 2) in order to maintain accessibility for users. There may be instances, however, where coded values make GIS analysis more efficient and allow users to employ the arithmetic operators in database queries. For example, in the case of motif classification, where a single panel may feature multiple complex combinations of motif elements, processing time would be reduced, and the construction of queries would be simplified. The compatibility of field structure between databases and Arc/Info is discussed further below.

7.6.3.4.3 The Paradox database attribute fields and query results were imported into Arc/Info as ASCII text files. This allowed spatial attributes and data for map presentations to be analysed and displayed, leaving non-spatial attributes and longer text values and descriptions to be queried using the Paradox utilities. Whilst this was suited to the scale and objectives of the Pilot Project, a larger study would benefit from a fully integrated database management system and GIS. As discussed below, this can be achieved via the Database Integrator module in Arc/Info. As this module is compatible with Microsoft Access, MS SQL, Sybase, Ingres, & Informix any future work would benefit from the use of one of these software options. A recent Archaeological Data Service survey (Condron *et al* 1999) has documented MS Access is one of the most widely used database management systems in UK archaeology. Along with its data management functions, these advantages would render the program a strong candidate for future use. The opportunities for analysis of a complete dataset with larger numbers of panels recorded under the system used in the Project field trials are discussed below.

7.6.4 Geographic Information System

7.6.4.1 A Geographic Information System (GIS) has been defined as:

> *"An organised collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyse, and display all forms of geographically referenced information"* (ESRI 1997).

However, it is the ability to manipulate and analyse geographic data that sets these systems apart from related technologies. An important distinction to make is that between the use of a GIS to create map displays which, in themselves, may aid in making archaeological observations and interpretations, and the use of a GIS as a tool for spatial analysis. Spatial analysis differs from the creation of coverages exhibiting features which may be coded in relation to a given non-spatial attribute which is usually derived from a text based database (for instance, geology type or motif class). GIS analysis usually involves the comparison of two or more map layers so that relationships between the spatial distribution of landscape features can be investigated – queries which make full use of the capabilities of a GIS and which cannot be answered simply using a relational database. Of course these analyses can also integrate non-spatial attributes in order to investigate more complex patterns – for example the identification of conservation concerns could be conducted through the comparison of panel location and a digital map showing land-use (both spatial attributes) and the non-spatial attribute of panel condition.

7.6.4.2 While simple 'point and click querying' can be used to quickly answer straight forward questions and would provide a user-friendly means for members of the public or rock art researchers to access data records, more sophisticated analysis can be conducted using two approaches. Proximity analysis allows the user to investigate the distribution of panels in relation to other landscape features through creating buffers of a set distance around the features. In overlay analysis areas can be identified where two or more landscape features or attributes in different coverages overlap through overlaying or joining the separate digital maps. This process can simply be a visual operation, or a spatial join allowing the areas identified to be dealt with as a unique coverage. These utilities can be used to aid in making management decisions and answering research questions. The spatial information held in a GIS represents a potential analytical tool for investigating the factors affecting rock art distribution via numerous variables. Layers may contain themes such as the distribution of other site types contemporaneous with the rock art, zones derived from palaeoenvironmental data, and landscape variables like elevation, location of water features, and soil types. Distinctive patterns in rock art distribution may aid in answering certain questions regarding the role of the sites.

7.6.5 Rock art, landscape and GIS

7.6.5.1 Current landscape approaches to British petroglyph sites, without the aid of GIS software, point to the potential offered by applying this technology to wider areas or multiple regions. Bradley (1991) has suggested that petroglyph sites in Kilmartin and Northumberland tend to be situated both in the vicinity of monuments such as henges and stone circles, and in the intermediate zone between lowland and highland. Later work involved the development of a survey approach that documents both carved and non-carved stone surfaces across the landscape as a means of demonstrating that rock art distribution relies on factors other than simple geology (Bradley 1993). Further work in Galloway (Bradley *et al* 1993) and Galicia, Spain (Bradley *et al* 1994, 1995) has explored the relationships between rock art distribution and the surrounding views, and the possible connections between rock art location and pathways through the landscape. Different motif types were found to be associated with particular landscape features (Bradley et al 1995). These ideas are developed further in Bradley's 1997 publication where multiple context-dependent meanings are explored. These include interpretations of some complex rock art panels in marginal locations as both boundary markers intended for view by people entering the area, and as sites used by specific groups within the local community. The notion of rock art panels as signposts communicating social information to groups passing through is also explored. Waddington (1996, 1998) has compared rock art distribution with probable land-use derived from soil type and palaeoenvironmental data. He argues that rock art concentrations in Northumberland are located in what he terms 'inscribed grazing areas', defined by watercourses. The rock art is interpreted as focal areas or places for the destination of a transhumance cycle.

7.6.5.2 The establishment of a GIS approach to rock art would facilitate the development of such analyses. With increasingly accurate and extensive spatial data becoming available for rock art panels in England via this Project, a GIS has the potential to provide a dynamic and useful resource management tool enabling large data sets from diverse sources operating at a range of scales to be integrated and managed. Similar approaches have already been developed for general archaeological records by some SMRs and by the NMR (Fernie 1998; RCHME 1998b). Though GIS is a relatively recent addition to the rock art researcher's tool-kit GIS technology has already been applied to sites in Scotland, and America (Gaffney *et al* 1996; Hartley and Vawser 1997; 1998). Gaffney *et al* (1996) employed a GIS to test some of the ideas proposed by Bradley (1991). Here elevation data is used to investigate the view sheds - the areas of land visible from particular sites - for rock art sites as well as other monuments. The work documents the preference of intermediary elevation zones for rock art distribution, and suggests that rock art may have functioned in a unique way in the landscape as view shed results differ significantly from that of the other site types. Work by Hartley and Vawser (1996, 1998) in western North America uses GIS to compare the distribution of food storage sites, their view sheds, and rock art location to investigate the communication of resource ownership. Cumulative cost surfaces were constructed using slope data as a measure of accessibility and the distribution of rock art of varying complexity was documented. Rock art featuring a high information content was found to correlate to positions where the art is visible from surrounding canyons. These complex panels were also demonstrated to be located along paths of easy access to food storage sites.

7.6.6 Development of the Project GIS

7.6.6.1 Arc/Info, a software package produced by ESRI was selected for the construction of the project GIS. The benefits of using this program included the fact that the software was already available at Bournemouth University, its compatibility with ArcView, the software used to display the results of the photogrammetry trials at the University College London, and some project team familiarity with the program. ARC/INFO also possesses a number of advantageous functions. The more recent UNIX and NT releases are capable of processing both cell-based (raster) and co-ordinate based (vector) data, making a wider range of digital map products available for use. Arc/Info is also capable of conducting relatively sophisticated analysis as well as digital cartography, and features a Database Integrator module which allows external databases in a range of software options to be linked to spatial data held in Arc/Info. This program is also widely used by archaeologists around the world.

7.6.6.2 The project GIS is comprised of various map layers or 'coverages'. Three of these provide landscape information on elevation, authority boundaries, and general context (water features, roads, buildings, and forested areas). Other coverages result from the Project's survey trials in Northumberland and West Yorkshire. These include GPS and Total Station surveys of panel positions, panel outlines, motif plans, and surface models. A number of motif plans recorded using other methods are also included (see below). Lastly, image files derived from a range of recording techniques are linked to the panel position points allowing users to access these via the digital maps. Figure 7.23 shows a schematic representation of the system adopted by the Pilot Project. Information on the individual coverages has been documented in order to indicate the data capture method used, any processing conducted, control points used, data type (point, line, polygon), projection system and co-ordinate system, as recommended in Gillings and Wise (1998). A digital text file for this is held in the Project archive.

7.6.6.3 Digital data downloaded and purchased

7.6.6.3.1 A range of commercial digital data products were purchased or downloaded in order to demonstrate some of the display and analytical capabilities of the project GIS. Digital boundary maps are available free via the Edina Borders web-site for research use. Maps of the Unitary Authorities for England were downloaded directly as ARC/INFO coverages (just one of a range of available formats). Two 20x20km tiles of contour data were also obtained from EDX. This data is supplied as points recorded at 50m intervals. The co-ordinates require modification in Microsoft access or a similar package (when supplied the northings feature a surplus zero). The points are then transformed into a 'TIN' (triangulated irregular network) in Arc/Info in order to create what is technically a 2.5 dimensional surface rather than a full three-dimensional surface due to the process of draping (Burrough and McDonnell 1998). Essentially the program creates a continuous surface of triangular facets from the point data which can then be displayed as a mesh or rendered surface. This data is significantly more cost efficient than purchasing a similar product from the Ordnance Survey, and is supplied at a finer resolution than the elevation model data available free from internet sources (as discussed below, the Global One dataset is based on spot heights every kilometre). The subtlety in the distribution patterns for rock art, which may relate closely to local topography, also renders the importance of detailed elevation data highly important. This surface can then be converted into contour lines, which can be displayed at any chosen interval. As a matter of good practice, however, contours were maintained at 50m intervals for analysis purposes, as analysis should ideally be conducted at a scale no greater than the original data source so as to avoid introducing a false sense of accuracy.

7.6.6.3.2 Landline Plus data in the form of four adjoining 1x1km tiles was purchased from Ordnance Survey for use as a basemap in display and to assess the potential for use of this data in analysis. This data is comprised of lines depicting a 100m interval grid, field boundaries, water features, forested areas, roads, paths, archaeological features, buildings and colour coded annotation. In several instances the RAPP survey data overlapped with line features or annotation indicating cup and ring marked rocks. For small study areas such as those used in the Project field trials, the coding or selection of landscape features for use in separate coverages so that analysis could be applied was an acceptable approach. However, over much larger areas it would be more satisfactory and cost-efficient to manually digitise coverages from existing paper maps (allowing for copyright restrictions), or to purchase other digital data products. The availability of additional digital map data is discussed below.

7.6.6.4 Digital maps from SMR and National Park data

7.6.6.4.1 The co-ordinate data supplied by the SMRs and National Park required some processing in order to standardise their format for input into the GIS (see Figure 5.4). This was achieved using a Paradox calculation utility that had been developed on behalf of the Ordnance Survey. The locational accuracy of the co-ordinates ranged from 100m (6 digit co-ordinates) to 10m (10 digit co-ordinates) and two instances in the Northumberland record to 1m (12 digit co-ordinates). The Paradox transformation utility also involves the addition of zeros to the eastings and northings resulting in standardisation of all co-ordinates to 12 digits. This situation is problematic as the resulting GIS analysis is based on inconsistent data and an averaging error is introduced whereby the zeros added draw the panel locations towards the southwest corner of their national grid square. To improve this situation a minimum accuracy standard of 10m could be established as part of a wider programme through GPS and Total Station survey within concentrated areas of rock art where distribution analysis would be most productive. The processed co-ordinates are stored in a field specifically for co-ordinate sets used in the GIS maps so that location can be updated in the digital coverages. As a means of comparing two government based data sets, the co-ordinates from the Monuments Protection Program (MPP) established by English Heritage were imported into a GIS coverage (see Figure 4.1).

7.6.6.5 Private Data Sources

7.6.6.5.1 Research into existing private sources of rock art data including an inventory published by Morris (1989), the Ilkley Archaeology Group (IAG) database, and the HELICS database developed by Ian Hewitt (1991) at Bournemouth University, suggested that these provide the most detailed record of rock art sites in certain counties. For this reason the co-ordinates from these three data sets were input into the GIS (see Figures 5.1, 5.3 and 5.2 respectively). Morris' inventory was manually input into an Excel spreadsheet and imported as ASCII text data into ARC/Info. The co-ordinates ranged from 4 to 8 digit accuracy and the same standardisation applied to the SMR data in order for the ARC/INFO coverage to be compatible with the other data sets (GPS, Total Station, Edina, EDX). The same process was applied to the HELICS database (now in paper form) and the site record forms compiled by Hewitt. It should be noted here that Hewitt has recorded a great deal more panels than are indicated by the resulting GIS coverage as panels lacking co-ordinates and panels grouped together under a single co-ordinate set were not included. The co-ordinates supplied by the IAG were readily accessible in a single Microsoft Works database file. This was converted to ASCII format for input to the GIS.

7.6.6.6 RAPP coverages – Global Positioning Systems

7.6.6.6.1 Digital map coverages were derived from the data collected by Global Positioning System (GPS) and Total Station during the field trials in Northumberland and West Yorkshire. The data collected in the Northumberland transect using the Leica GPS Series 500 was edited in SkiPro software supplied with the unit (see Leica's 1999 manual for further details). This software includes a co-ordinate system utility enabling users to transform data into different projection systems. During fieldwork the co-ordinate display was set to local grid which displays the national grid (OSGB36) co-ordinates allowing easy comparison with Ordnance Survey maps and existing co-ordinate data. In the context of the database, where latitude / longitude co-ordinates as well as national grid were required the GPS points were output in both formats.

7.6.6.6.2 At the time of the project field trial the GPS and SkiPro software did not feature any computer aided drawing (CAD) capability for displaying lines and polygons it displays only points (this became available in mid-late 1999). An associated package, Liscad, is, however, available. The codes assigned to surveyed features were originally developed for use during Total Station survey and were stored in SDR Mapping software as a 'library' file (see APPENDIX G). In addition to identifying the features (for example as 'vegetation edge') the codes also direct SDR as to how to depict the recorded points – for instance as gently curving dashed lines (see Figure 7.1). In order to exploit this tool the GPS data was coded in the same way and imported into SDR. This allowed the GPS points collected to be transformed into lines, polygons, and point features. The GPS files were exported in ASCII comma delimited (CSV) format, with specifications as detailed in the SDR data input files. The files were then processed and a DXF (digital exchange format) export file created for import into ARC/INFO.

7.6.6.6.3 The rock art panels are represented in the GIS at three levels of detail. First, the panel position point indicates the centre of the panel and is compatible with existing location data sets that exist exclusively as single co-ordinate sets per panel or panel complex. Secondly, a polygon feature depicts the horizontal extent of each panel enabling information such as panel area to be efficiently calculated. Third, as a means of monitoring condition and damage over extended periods of time a number of coded edge types are also displayed. These include quarry edges, vegetation edge, panel edge (delineating the extent of the carved surface), rock edge (delineating the extent of the outcrop or boulder where this differs from panel edge) and fissures. In this way it will be possible to overlay the edge type data collected over an extended period in order to investigate the extent of vegetation growth, the widening of fissures and development of cracks, and possible reductions in the size of the panel due to natural or anthropogenic causes.

7.6.6.6.4 As discussed above, the Fastmap GIS grade GPS, which was capable of establishing locations to within a metre, was not deemed sufficiently accurate for producing panel outlines. The shapes produced in the graphic output are useful as a rough display of panel size, but the jagged angular edges bear little resemblance to the original panel shape. It was also evident from the relative location of the motif datum points in that a higher accuracy standard would be required for recording these survey datums. For these reasons, only the panel position data collected using this unit was input into the GIS in order to compare panel location with data from SMR and Ilkley Archaeology Group surveys. Following the use of the SDE data transfer software supplied with the GPS to export the collected data (we experimented with ASCII and DXF formats) the co-ordinates were imported into Arc/Info. The co-ordinates collected using the hand-held Garmin 12 GPS were also imported as panel position points for comparison with the Fastmap GPS data for panels in the West Yorkshire transect. This unit did not feature a download capability (although software and cabling is available), and data was therefore manually input into the project database.

7.6.6.6.5 GPS surface modelling trials were also conducted in Northumberland using the survey grade GPS (lower grade GPS are generally incapable of attaining sufficient height accuracy for this type of work). Points were recorded approximately every 200mm across the panel surface. These were converted into TIN structures using Arc/Info and displayed as rendered surfaces. The extent of interpolation required in order to produce a surface from the number of points recorded appeared to be too great when the results were viewed. Even where the panel surface was generally flat, as in the case of panel 2, points recorded in small depressions resulted in large surface errors. In addition some points recorded accidentally whilst moving between surface points required removal. As described below, the results were improved during the second field trial using the Total Station where points were recorded every 100mm. Points across a 50m by 50m area surrounding panel 2, were also recorded using the survey grade GPS. This survey approach would be useful for display and inter-panel analysis within a clustered group of panels located on a distinctive area of local relief.

7.6.6.7 RAPP coverages – Total Station Data

7.6.6.7.1 This data was edited in SDR Mapping software in order to establish coding to display different control point types and different panel edge types (vegetation edge, rock edge, panel edge, quarry edge). A rock art library of these codes was established. The linework was then edited and GPS co-ordinates for the control points were used to transform the data from arbitrary survey units into national grid co-ordinates. This data was then exported in DXF format for import into ARC/INFO.

7.6.6.7.2 In conjunction with the Total Station, a mini prism was used to collect x, y, and z co-ordinate points across the surface of panels. These points were imported into Arc/Info from SDR in ASCII format and transformed into a quasi three-dimensional surface known as a 'triangulated irregular network' (TIN). The edges of the cup and cup-penannular motifs on panel 8012 were also recorded in detail using the total station. This motif plan was draped over the TIN surface allowing the motifs to be viewed in the context of these almost vertical panel surfaces in a single view (see Figure 7.4). This approach, though time consuming in the field, avoids the need to record separate profile plans of each face of the panel (in this case there were four) to show the motifs and a fifth plan to show the horizontal extent of the panel. A second panel (8013) featuring motifs on two step-like levels and some unusually deep cup motifs was also recorded in this manner, this time with extra attention paid to a sample of the cups. This allowed the scale motif plan produced using a baseline to be compared with the surface model.

7.6.6.7.3 The results for both panels display the problems of creating an interpolated surface – that is, where points were not recorded the program must estimate the nature of the surface from the data available. The rendered surface available in Arc/Info also creates an image that resembles a cloth laid over an object, which is not ideal. However, this approach has enabled these highly three dimensional panels to be conveyed in a single image. Further research into alternative display options using other software would undoubtedly improve the aesthetic problems mentioned. In addition, the experience and knowledge gained from conducting this test in terms of the placement of points across the panel surface would also improve interpolation problems in future work.

7.6.6.8 Incorporating laser scanning results

7.6.6.8.1 The data output from the scanning laser trial is valuable as a means of displaying panels in three dimensions as database images or linked to panel position point in the GIS coverages. Furthermore, the raw data can be used to create contour surfaces that provide a means of accurately recording motifs. With contours set at 2 and 5mm, subjectivity in defining the edge of the carved area is greatly reduced compared to all other motif planning techniques. The images of the laser scanning results can be linked to the panel locations as an attribute that for display through clicking on the digital map features. In future work the contour surfaces could be georeferenced for direct inclusion in a GIS coverage.

7.6.6.9 Incorporating photogrammetry results

7.6.6.9.1 As detailed above, the photogrammetry images recorded for three panels in West Yorkshire were transformed into digital elevation models (DEM) using Erdas Imagine software. The resulting files can be readily imported into the Project GIS for display. Again the results can be linked as an image to panel positions on the digital maps and to the database records through including the images in the graphics field. In future work, the accurate recording of datum points could be used to georeference the results to real-world co-ordinates so that the DEMS could be incorporated into a digital map coverage.

7.6.6.10 Incorporating digitised motif plans

7.6.6.10.1A number of recording techniques resulted in motif and conservation plans which require digitising (transformation into digital format) in order to be stored as images in the project database linked to the GIS, or as georeferenced plans which could be overlaid onto the panel outlines in the GIS maps. This was achieved either using a digitising table or by scanning images on a flat bed scanner.

7.6.6.11 Incorporating scale drawings and conservation plans

7.6.6.11.1Drawings produced in the field at 1:10 and 1:20 scale were digitised using Corel Visual CADD 2.0.1 software and a digitising table. Some digitised plans were input into the database and GIS as images, and other were imported into GIS coverage as georeferenced maps. Some panels were best reproduced as if viewed parallel to the panel surface rather than in true plan view so that motifs were not distorted. In these cases register points were given arbitrary co-ordinates rather than real world co-ordinates. Motifs were digitised as polygon features to allow them to be in-filled. Due to the level of detail required to reproduce these plans in digital form vertices were recorded up to every 2mm. These files were then imported in DXF format into ARC/INFO. An approach allowing viewing of rectified images of motifs draped over a 3D model of the panel (much like a digital elevation model or DEM) was tested on panels 9 and 8013. The motif drawings were digitised using the motif datum points surveyed using GPS and total station to register the plan to Ordnance Survey co-ordinates. This allowed the drawing to be transformed into a true plan. The motif coverage was then draped over the model of the panel surface created from a TIN coverage.

7.6.6.11.2Similarly, the results of three conservation plans were also digitised. The complexity and subtlety of these plans where minute details and changes in algae density can be depicted fairly easily using a hand drawing technique, renders the digitising process highly time consuming. A preferable means of capturing this data in digital form would be through a flat bed scanner. This would ideally be achieved on a large scanner (not currently available at Bournemouth University) as the plans were up to A0size.

7.6.6.12 Incorporating epigraphic survey

7.6.6.12.1Motif plans resulting from epigraphic survey were also scanned and digitised. The creation of georeferenced plans for use as GIS coveraged relied on the visibility of motif datum points that had been surveyed using GPS and Total Station in the photographs. The inclusion of scale bars in the photographs also allowed the images to be rectified to account for any error introduced by the camera lense not being directly parallel with the panel surface.

7.6.6.13 Incorporating photographic images

7.6.6.13.1Black and white, colour and digital photographs were stored as JPEG or TIF format files in the project database graphics fields. These files can be 'hotlinked' to features in the digital maps in the GIS allowing them to be viewed by clicking on a feature.

7.6.6.14 Incorporating non-spatial attribute data

7.6.6.14.1The non-spatial attribute data can be used in analysis in three ways in the Pilot Project system. The data can be queried within the Paradox database as a standalone system for non-spatial queries, the results of queries can be imported into ARC/INFO to create map displays, and the raw attributes can be imported into ARC/INFO to be queried within the GIS. Since the ARC/INFO 7.2.1 database capabilities do not extend to some of the functions required for the Project, the use of a separate database management system is maintained as being the preferable approach. Lookup tables exist within ARC/INFO but are used only to code existing values rather than to enter and control new values. ARC/INFO can only create a 'quasi' relational database where up to ten tables can be temporarily related during a query (Paradox can relate up to 24 in a permanent data model). Options for querying text data in ARC/INFO are more limited than in Paradox, and logical expressions involving numbers and coding (text values reduced to 1-2 digit numbers) are preferable in terms of processing and the operators available. ARC/INFO also supports a maximum for 320 characters within a field, while many of the description memos held in the Paradox database are significantly longer. For these reasons it seemed logical to import only data relevant to a spatial query, in some cases queried within Paradox, into ARC/INFO rather than importing the entire database. Though importing Paradox results into ARC/INFO was suitable for the scale of the current project, the use of ARC/INFO's Database Integrator module, which links to an external relational database (compatible with Microsoft Access, dBASE, Oracle, MS SQL, Sybase, Ingres, & Informix), would be advantageous for a larger scale future project. The Database Integrator allows the user to employ the power and search capabilities of a relational database management system and to conduct queries in the 'native' language of the database as well as within ARC/INFO. This provides the choice of applying queries that are not concerned with spatial distribution within the external database only.

7.6.7 GIS analysis and future directions

7.6.7.1 Elevation analysis

7.6.7.1.1 As a means of illustrating the nature of and potential for future GIS an example using EDX derived contour data for the West Yorkshire study area is discussed here. The IAG site locations provided the most comprehensive subsample of all of the sources, featuring a high number of panels and relatively good locational data with all co-ordinates accurate to at least 10m. As discussed in section 7.6.6.3.1, the contours were set at 50m intervals in order to match the resolution of the original spot heights. The results are also displayed in Figure 7.24 (combination graph) and Figure 7.25 (contour plot). For simplicity, the data is also set out in table form (Figure 7.3). While the influence of other landscape attributes such as geology cannot be accounted for in this example, a number of trends can be observed in terms of the height ranges favoured for rock art location. First, the 250-300m elevation band is notably favoured over the other ranges. More detailed spot height data would be required in order to investigate whether distribution in the 50-250m elevation range is linked to local relief which may not be described in the EDX data used here. Secondly, absolute elevation does not seem to be important in the distribution of rock art panels, as the number of panels in the 350-400m band drops of markedly, and no panels were located within the 500-500m band.

7.6.7.1.2 These general observations support current discussions on the interaction between rock art distribution and the surrounding landscape. The fact that panel numbers drop off distinctively within the upper elevation range may suggest that the view available closer to the edges of steep slopes (often at a lower elevation than the crest of a hill) was a selection criterion. The importance of landscape features such as pathways through lowland valleys and entrances to fertile basins has been discussed by Bradley *et al* (1993, 1994, 1995). As displayed in Figure 7.25, there is a high concentration of panels at the edge of a major valley running on a diagonal NW to SE. However, other valleys in the figure do not feature such a concentration of sites. Additional landscape attribute coverages, such as those displaying water bodies and geology would aid in understanding the range of possible factors also influencing rock art distribution.

7.6.7.2 Viewshed Analysis

7.6.7.2.1 The combination of elevation data and site location can be used to investigate the views available from rock art panels using the viewshed utility in GIS software. This process allows the user to specify the height above ground at which the views are observed and the distance band of interest (here the entire 20x20km elevation data set was used). Figures 7.27 A to G illustrates the areas of land visible from rock art panels in the Northumberland transect. Where multiple panels were concentrated within a 5 metre area a single panel from the group was arbitrarily selected for this analysis. The elevation data was derived from 50m spot heights, and so analysis using more than one panel in a 5m concentration would imply a false level of precision in the resulting viewshed. Figure 7.26A shows the topographical position for selected all panels, colour coded according to elevation. Figures 7.27 B-G inclusive show viewsheds for each panel individually. Though larger sample sizes are needed in order to establish tends in the view directions and extent associated with panels, it is interesting to note that the panel with unusually limited views available, panel 9, is distinctive because of its commanding view of nearby lochs. The application of this analytical tool to a larger data set would aid in developing current discussions on view shed as a factor in rock art distribution.

7.6.7.3 The potential for applying GIS analysis to a more complete dataset includes investigating some of the landscape oriented theories currently in favour for petroglyphs in the United Kingdom (see above). These theories have arisen in response to observations in the field and have, excepting the study by Gaffney *et al* (1996), been developed using small samples of rock art sites using basic maps and statistical analyses. The combination of a large data set for the whole of England or the British Isles (which could then be analysed for regionality), and digital map data for specific landscape features and attributes would enable these ideas to be tested. Possible future directions include GIS analysis comparing site location to geology, soil type, elevation, investigating view shed, proximity to water, and proximity to prehistoric sites / site types, to investigate possible patterning in distribution.

7.6.7.4 The combination of these spatial analyses with data on non-spatial attributes would allow more complex patterns to be investigated. Theories on motif type distribution and the regional nature of style in British rock art could be tested using a more sophisticated record of motif categories than the current record allows. This would free the study of patterns in local distinctiveness from the county by county approach which is currently used (Morris 1989), and would allow the actual distribution of types to dictate the definition of stylistic regions. The investigation of other research questions such as the relationship between site location and proximity to water features, and the nature of panel location compared to other contemporaneous archaeological features could also be conducted. GIS analysis can also be seen as an aid to site management. A full-scale study into the relationship between panel distribution, land-use, access, and panel condition would be a valuable means of assessing whether poor panel condition or particular damage types are associated with particular types of land-use and access. This would also provide a method for identifying all sites located within land use areas deemed to be high risk as a result of the previous analysis.

7.6.7.5 The purchase of a number of digital maps would facilitate future research and resource management applications. Where certain landscape features are not readily available in the form of digital maps or they are not deemed sufficiently detailed, copyright permission would need to be sought to allow this data to be digitised for selected study areas (for further details see Gillings and Wise 1998). For instance, maps created during the British Geological Survey would provide highly detailed information on geological distribution. Digital map data displaying land-use, elevation, geology, soil type, water features and general landscape context (similar to, but more specialised than that provided in the Landline Plus data) would provide a solid basis for research, management and display. Digital maps of England, Scotland, Wales and Ireland can be downloaded free via the internet or purchased from a range of sources.

7.6.8 The database in the public and management domains

7.6.8.1 A number of issues must be addressed with regard to the potential for a rock art database to become accessible to the public as an educational and recreational tool, and for the database to be utilised as a management tool by national and local government and NGOs. The medium by which the database could be made available is still a matter for discussion. On-line and CD-ROM / DVD versions are just two practicable options. Ensuring that both the security of the data and the security of the actual sites are maintained could be achieved in a number of ways. First, where data is available for use by multiple members of the general public simultaneously network level security options such as establishing a password system and allowing users to access but not modify ('read only') the data would be valuable. Secondly, the potential for local archaeological societies, amateur archaeologists and students of archaeology to contribute valuable data to the recording system could be managed through simple security measures. A range of user permissions can be set from those allowing 'read only' access, to the updating of existing records and the entry of new records. Permission to delete records should be centralised and held only by staff working on the Project, in order to avoid accidental loss of records. Thirdly, the manner in which government organisations would make use of the data needs to be addressed. As these organisations maintain their own recording systems and databases, the Project database might act as a secondary resource for these groups, where cross referencing could be used to check and update their own records for rock art. This potential direction would be especially valuable for those SMRs which are currently unaware of the rock art sites in their areas, and would facilitate the promotion of the importance of rock art both within the profession of archaeology, and the public domain.

7.6.8.2 In each of these potential scenarios for the use of a rock art database, update procedures would need to be maintained and centralised. Paradox offers a straightforward means of rapidly updating individual tables, which would allow this process to be conducted at regular intervals. Backup procedures to guard against data loss or accidental modifications to data would also be best administered through a central system.

7.7 Dating

7.7.1 Dating issues

7.7.1.1 Rock art dating methods fall into one of two categories: direct and indirect dating methods. Direct dating methods attempt to date a physical feature or development of the rock art panel itself, whereas indirect dating methods attempt to link other material to the creation of rock art, such as associated archaeological finds. No single technique is considered to be entirely accurate or reliable. Often two or more methods are employed to obtain the best idea of the date of a petroglyph panel.

7.7.2 Direct dating methods

7.7.2.1 Direct dating methods applied to petroglyphs include:

- 36Cl method
- AMS radiocarbon dating
- cation-ratio dating of rock varnish

- microerosion dating and
- lichenometry (Dorn *et al* 1988, Lanteigne 1991 and Bednarik 1993).

7.7.2.2 All of these methods are subject to interpretation, as none account for variations in weathering patterns, either over time or over a single surface, and they can only provide maximum or minimum dates. As these methods undergo further testing, development and reconsideration, it is suggested that they are considered as experimental for the time being.

- **Chlorine 36 dating.** The Chlorine-36 concentration of a rock surface can be used to determine how long the surface has been exposed and therefore available for engraving. Dates provided by this method are considered as the maximum age of any rock art present.

  Chlorine-36 originates from cosmic nuclides 'produced by reactions of cosmic-ray particles with elements in the atmosphere or rock' (Cerling and Craig 1994 cited in Phillips *et al* 1997). These nuclides are absorbed by the rock through time, and the clock is reset if thick slabs of one to two metres are removed exposing a fresh surface (Phillips *et al* 1997). The usefulness of this method depends upon local geologic processes. This method provides a maximum date for petroglyphs by determining when the rock was exposed, however the carving could be from a much later time.

- **AMS radiocarbon dating.** AMS (accelerator mass spectrometry) dating operates under the same premise as radiocarbon dating but requires only minute samples of material. Its application to rock art was initially restricted to pictograph pigments (Chaffee 1993, Nelson 1993, Watchman 1993, Watchman and Cole 1993 and Loy 1994), however recent research has produced dates from microscopic samples of organic material such as algae, fungi, bacteria, diatoms, charcoal, calcium oxalate minerals and plant fragments encapsulated in surface layers (Watchman and Lessard 1993, Watchman 1996 and Dorn 1997).

  The age of a petroglyph can be estimated by dating samples from surface layers directly over the petroglyph to calculate a date before and the lower accretion layers from the side of the carving to calculate a date after which the petroglyph was made (Watchman 1996). Early attempts at obtaining suitable samples with laser extraction were not very successful (Watchman and Lessard 1993) and a tungsten-carbide needle seems to be preferred for removing samples (Dorn 1997). This method relies upon a number of assumptions regarding the deposition, encapsulation and stability of the surface layers, and the method and quality of sample preparation (see Watchman 1995, Watchman 1996 and Dorn 1997). Not all environments are conducive to the use of this method. Warm deserts, cold deserts, alongside tropical rivers and mid-latitude humid temperate environments produce the conditions under which silica skin formation will most likely be of the quality necessary for this method (Dorn 1997). Unfortunately, sample contamination from both internal and external sources is fairly common and difficult to predict, therefore if possible, several samples should be measured from each panel (Watchman 1999).

- **Cation-ration dating.** Minimum dates for petroglyphs with desert varnish layers, as often found in arid environments, can be calculated with the cation-ratio dating method (Dorn et al. 1988). As some cations are more prone to weathering induced leaching than others, a ratio can be established between the more mobile cations, such as calcium, potassium and sodium, and the less mobile cations, such as titanium and zirconium (Dorn *et al* 1988). A calibration curve is developed by comparing this ratio, often (K+Ca)/Ti, with the known age of the rock substrate determined by K-Ar dating, conventional or AMS radiocarbon dating or other methods (Dorn *et al* 1998).

  Although some initial tests claimed that dates obtained with cation-ratio methods are consistent with those produced using AMS methods (Loendorf 1991), this method has been the subject of much debate. The reliability of this method is affected by the inability to account for any gap in desert varnish formation directly after petroglyph manufacture or for any variations in weathering rates (Dorn *et al* 1988 and Lanteigne 1991). Additionally, the accuracy of the calibration curve relies upon the accuracy of the date provided for the rock substrate (Lanteigne 1991 and Bahn 1998).

- **Microerosion dating.** Microerosion dating relies upon the observation of the progressive rounding of edges in minerals referred to as 'wanes' (Bednarik 1992). This method is based upon the assumption that erosional processes gradually round edges both macroscopically and microscopically (Bednarik 1992 and Bednarik 1993). As weathering occurs at different rates at different sites, a calibration curve is developed for each site based upon the weathering of minerals in areas of datable disturbance such as glacial striae or recent graffiti (Bednarik 1993). The less soluble minerals such as 'granite, rhyolite, quartz, porphyry, granodiorite, rhyodacite, plagiophyre, quartz diorite, dacite, andesite, diorite, granophyre' are used (Bednarik 1992 and Bednarik 1993), as their weathering is thought to be more consistent, and as an additional precaution, more than one mineral is calibrated (Bednarik 1993). This method requires minimal equipment, does not necessitate sample removal, and can it is claimed can easily be undertaken by someone with a general knowledge of geology and some training in the philosophy and necessary observational skills required (Bednarik 1992 and Bednarik 1993). However, this method also has many limitations. Microerosion dating cannot be used for petroglyphs that have been buried, inundated, covered with plant life or otherwise unexposed to weathering agents for any length of time since their creation or on panels that have been covered with an accretionary deposit such as a patina layer (Bednarik 1993). Additionally, this method is unable to account for changes in weathering patterns or intensity (Bednarik 1992). Calibration curves developed for horizontal panels will not be appropriate for use on vertical panels, as their weathering patterns are different (Arca and Fossati 1996).

- **Lichenometry.** Lichen growth has been used as a minimum dating method, assuming that lichens could begin to grow after the petroglyph surface was exposed, and that lichens grow at a consistent rate. This method is currently under reconsideration as it has been shown that lichen growth is not a direct function of time, and in fact depends upon lichen species, properties of the rock substrate, water availability and other environmental conditions (Broadbent 1990 and Booth Childers 1994).

7.7.2.3 Of the direct dating methods available for use on petroglyphs, the cation-ratio method cannot be applied to English rock art due to environmental constraints. All other methods may be suitable for testing on English rock art sites depending upon the environment, individual panel condition and the expertise available. However, it should be remembered that these methods are not fully reliable or accurate, therefore until these methods are further developed any results obtained should not be considered definitive.

7.7.3 Indirect dating methods

- **Stylistic dating.** Stylistic dating methods are based on the thought that style is particular to a specific place and time. Style is therefore often used as a chronological marker (Rosenfeld and Smith 1997, 407). Superimpositions of motifs of varying styles are frequently used to provide relative temporal sequences in rock art (Chippindale and Tacon 1993). However, although the order in which the motifs were made can often be established on the basis of superimpositions, it is sometimes difficult to use these as a dating method. Styles may have persisted longer in some areas than in others, or motifs may have been superimposed on others because of other reasons than time (Thackeray 1983, 21).

  Chronological sequences in rock art were frequently suggested on the basis of stylistic change, often from perceived "primitive" to "sophisticated" and finally "degenerate" forms (Thackeray 1983, 21). Recently, the value of stylistic dating methods has been questioned. Contrasting dates have been determined by stylistic and absolute dating methods for the Coa valley petroglyphs in Portugal (Bednarik 1995; Zilhao 1995), while paintings attributed to one and the same style in the cave of Altamira, Spain, were directly dated to a period of several thousand years (Davidson 1996). Stylistic dating methods have also been criticised for not considering context sufficiently, since several styles may have co-existed and been used for different purposes and functions (Ucko and Rosenfeld 1967; Ucko 1977, 9).

Some authors have attempted to date rock art on the basis of similarities in rock art styles with graphic depictions on archaeological artefacts, such as pottery (Oslisly 1993), belt plaques (Pause 1997), or bowls and spoons (Carlson 1993).

- **Spatial arrangement of the motifs.** In some instances the spatial arrangement of the motifs on the panels is thought to indicate differences in their age. In these cases it is assumed that the centre of a panel is used first, and that subsequent figures are added to the sides, above and below the central motifs (Welch 1993, 14).

- **Content of the motifs.** Rock art has often been dated on the basis of the content of the motifs. Depictions of extinct animals, domesticated animals or of dated material culture items, for example, help to establish a *terminus ante quem* or a *terminus post quem* for the manufacture of these motifs (Thackeray 1983, 22).

- **Technique of manufacture.** Relative dating of rock art has also been based on the technique of manufacture. Oslisly (1993), for example, dates the petroglyphs of the Middle Ogooue river in Gabon to the Iron Age, since he assumes that the motifs were made with iron tools.

- **Differences in weathering and patination.** Differences in the degree of weathering or the degree of patination of motifs are frequently assumed to indicate differences in age (Welch 1993, 13). However, physical and chemical changes in the condition of rock art depend on a variety of factors which may lead to different degrees of weathering in contemporary motifs even at the same sites (Thackeray 1983, 22). Such factors are differences in the condition of the rock surface or in the lifespan of different paints.

- **Archaeological associations.** In some instances the age of rock art is estimated on the basis of artefacts found at rock art sites. However, since these finds are often not directly associated with the rock art, such conclusions remain hypothetic. Sometimes pieces of flaked off rock art were found in datable archaeological strata, which provide a minimum date for the rock art. Equally, rock art can be found on rock surfaces that are buried by archaeological strata, which provide a minimum age for the motifs (Thackeray 1983, 22).

7.7.3.1 Indirect dating of British rock art

7.7.3.1.1 The dating of British rock art to the Neolithic and the Bronze Age is based on indirect dating techniques, i.e. on archaeological associations. Most indirect dating techniques are not applicable in the context of British rock art. In-depth studies of stylistic change, for example, have not been undertaken yet, nor are there sufficient superimpositions in British rock art to establish a relative chronological sequence. Differences in weathering could be based on the protection of panels under turf or on their exposure to the weather, rather than on temporal differences in their manufacture. More reliable dates than those achieved by indirect dating of British rock art can only be achieved through the employment of direct (absolute) dating techniques.

7.8 Conclusions

7.8.1 One objective of this project was to examine past and current international trends in rock art recording and documentation methods, to assess which techniques are appropriate for English rock art sites and to confirm their suitability through field tests. All of these tasks were completed, and several techniques not previously used to record English rock art were found to be very successful. Although some methods, such as the use of foil or damp cotton as photographic aids, were found to be of limited use on this particular kind of rock art, they should not be discredited immediately and may prove useful at certain sites. The development of the weathering/damage forms survey and mapping system was a great stride toward standardising rock art documentation, as a simple yet effective method of conveying condition information, with further applications if future conservation treatments are considered. Perhaps most noteworthy was the opportunity to compare and contrast the field results of two different 3-dimensional recording methods, namely photogrammetry and laser scanning, particularly as there are no published accounts of the on-site use of laser scanning and it proved to be a great success.

7.8.2 The first obvious conclusion from the field-testing was that many of the techniques were complimentary and that certain combinations of these would achieve a different level of record, for example basic, intermediate or advanced. The benefit of this is simply the breadth of information gathered, but the selection of the appropriate methods is easily complicated by field conditions (for example dense undergrowth, lack of line of site to satellites in the case of GPS applications, poor lighting conditions or the poor survival of the motifs themselves). A further variable to consider is the resolution of results that is required. Outputs can range from the micro to the macro level such as microtopographical data for individual motifs and panels to wide area landscape analysis and, variations between and so taken all together these factors will influence what techniques are actually used. Table 7.4 shows a summary of these techniques and factors affecting their application in recording rock art.

7.8.3 In one sense it is the sheer range of techniques available to rock art fieldworkers that makes decisions over applying the most appropriate one(s) more difficult. A guide in this could be the prior assessment of panels using selection criteria and various sorts are already in place for other monument types (for example RCHME 1999; Mercer 1985). Indeed criteria used by the Monuments Protection Programme in selecting appropriate sites for inclusion in the Record of Scheduled Monuments of national importance have been applied to rock and this might be a useful guide in further fieldwork. It would seem sensible to develop a series of recording methodologies (employing different combinations of the techniques described above), as a way of defining the level of survey and record possible, and the selection criteria by which individual panels can be assigned to these levels by adapting the current criteria to suit recording objectives. Other factors that will have to be weighed up include the aim and scale of the study and the financial, time and skill resources available to carry it through.

8. MONITORING AND CONSERVATION

8.1 Introduction

8.1.1 Rock art is always changing, not only in its appearance but also in its overall condition and its relationship to the surrounding environment. The conservation of rock art is not new: Australian Aborigines installed beeswax driplines, and during wet seasons spinifex grass was piled above the rock faces to prevent rain flow over the painted surfaces (Bahn 1998). Current trends in conservation seem to hark back to these early practices. Direct intervention is seen as a last resort, and preventive conservation is always preferred (Bednarik 1995a and Bednarik 1996). This may include altering the environmental conditions surrounding a site, controlling access to a site and generally maintaining a site to prevent the need for future massive intervention. The preservation of rock art does not end at the panel level, however, and the immediate environment and general view area should also be treated sympathetically.

8.1.2 Any conservation treatments executed should be reversible to the greatest extent possible and their success monitored (Bednarik 1995a; Bednarik 1996). Any direct intervention should be kept to a minimum, and it should alter the art as little as possible, particularly with regard to its future scientific value (Tratebas and Chapman 1996).

8.2 Conservation and management policies

8.2.1 Responsible conservation measures are only carried out after an intensive condition survey is completed and the causes of deterioration are identified. All treatments should be reversible to the greatest degree possible, involve only the minimum amount of intervention required, must be fully documented, their results monitored, and any noteworthy results both positive and negative should be reported to the scientific community for future reference.

8.2.2 The conservation of a rock art site consists of not only preserving the image and immediate environment but also to maintaining the scientific integrity of the site. This is no small task since we often do not know what the consequences of our actions will be or what will be required of our sites by science in the future. However, much has been learned in recent decades about treatments executed directly on panels and the effects of activity around them, and we must build intelligently upon this foundation.

8.2.3 Visitor practices once allowed but now known to be destructive such as the painting, chalking or otherwise enhancing rock art visibility or the rubbing or tracing of rock art panels must be stopped. Admittedly, it is difficult to isolate sites from visitors that were once fully accessible and even more difficult to change behaviour, but more controlled access to sites and better educational policies about their importance and fragility may be the only way to physically preserve them.

8.2.4 Site management is a fundamental aspect of both conservation and presentation. Without a site management plan, no conservation treatment can be fully successful – graffiti will reappear, trees will regenerate, driplines will fall off. Whether a site is actively managed by people present on site, is barricaded off with fences or is made less accessible by creative landscaping is a decision to be made after considering the needs of both the conservation and the presentation of the site. This is discussed further in chapter 9 below.

8.2.5 Most rock art in England is on sandstone as it is easy to carve, but therefore also prone to deterioration (Beckensall 1974). Very little has been done to systematically record rock art in a way that is useful in conservation studies or to monitor change in England. Fortunately, a few interested individuals have produced records of sites, some as early as the mid-19th century (Beckensall 1974 and Beckensall 1983). Traditionally, rock art has been recorded with paintings, photography, drawings, tracings and rubbings (Barnatt and Reeder 1982, van Hoek 1982, Beckensall 1983, Hewitt 1991, Bradley 1997, Beckensall and Laurie 1998 and Donnan 1999). The accuracy and completeness of these records vary, as they are generally not consistent in format or quality. Additionally, the record tends to be biased as those panels considered the most 'interesting' are most often recorded.

8.2.6 Only recently has rock art recording started to employ new methods such as making a mould of a panel for the purpose of producing a replica and subsequently burying the original panel for preservation purposes (Walster 1996a and Walster 1996b) and some use of digital image processing (Donnan 1999). Although some well-intentioned individuals have attempted to clean panels, such attempts usually result in increased deterioration (Walster 1996a). The only information available about the rock art deterioration is on a case by case basis relying upon observations by local rock art enthusiasts and qualitative assessments based upon the comparison of photographic images when possible. Although many references were found that referred to panels that were buried, little information regarding the burial procedure is given, leaving one to assume that the panels were simply covered with local soil (Beckensall 1974; Barnatt and Reeder 1982; van Hoek 1982; Beckensall 1983; Beckensall and Laurie 1998). Some panels have been moved to museums for protection. Aside from the burial of the Gardom's Edge panel (Walster 1996a; Walster 1996b), no references were found regarding professional conservation treatments or monitoring rock art deterioration in situ for panels in England.

8.3 Site management treatments

8.3.1 Managing and maintaining a site in certain ways can solve several preservation problems. Simply keeping panels clean of abrasive debris or soil can eliminate physical damage and a number of biological hazards (Walderhaug and Walderhaug 1998). However, thoughtful consideration must be given to any site management strategies and their effect upon the surrounding landscape and any associated archaeological remains (Walderhaug and Walderhaug 1998). The following management treatments are identified for British rock art sites on the basis of earlier discussions of cause of decay and erosion.

8.3.2 Water control

8.3.2.1 The effect of water activity on a rock art panel is an important conservation consideration. Water access, due to exposure to rain and snow, drainage patterns, ground water and condensation, can result in substantial damage. Some of these problems are relatively easy to solve, others however, offer no practicable answer.

8.3.2.2 The flow of water over rock surfaces often can be controlled by installing gutters, artificial driplines and other diversions above the rock art (Rosenfeld 1985; Wainwright 1985; Lambert 1989; Bednarik 1990a; Clarke *et al* 1991; Michelsen 1992; Bednarik 1995a; Bednarik 1996; Watchman *et al* 1995; Ageeva and Rebrikova 1996; Loendorf *et al* 1998). The material used to construct driplines should be unobtrusive, easily reversible, have adequate bonding ability, high thermal stability and high resistance to moisture and UV light (Clarke 1979 cited in Rosenfeld 1985). The most commonly used material currently seems to be clear silicone resins applied with a pressure gun (Rosenfeld 1985; Bednarik 1995a; Bednarik 1996). However, silicone can be difficult to remove, it is not very durable and driplines can be visually obtrusive (Lambert 1989).

8.3.2.3 It is important to monitor installed water diversions as any defects can result in an increased water flow over a small area of the surface. Additionally, the effect of diverted water to adjacent rock surfaces must be taken into consideration (Gillespie 1983 cited in Rosenfeld 1985). Furthermore, the development of damaging salt minerals, specifically weddellite and whewellite, has been observed along installed driplines possibly due to preferential microorganism growth in the moist environment (Watchman *et al* 1995).

8.3.2.4 The total effect of dripline installation must be considered, for example, rainwater may serve to wash pollutants away, which may prevent more damage than it causes. However, the installation of artificial driplines can prevent the formation of silica skins by changing the microenvironment of the rock surface. Silica skins assist in maintaining the stability of rock surfaces and therefore their formation should not be prevented (Watchman 1990 and Ward 1993).

8.3.2.5 In cases where driplines are not sufficient, small roof structures or protective enclosures may warrant consideration (Coles 1992; Bednarik 1995a; Bednarik 1996; Walderhaug and Walderhaug 1998). Small roofs of non-metallic material have been built above rock art panels situated on vertical rock surfaces for protection from deterioration caused by rain and sun. However, these constructions can be costly, maintenance can be problematic, they can be visually obtrusive, and their effect to the microclimate of the site can be damaging (Clarke *et al* 1991).

8.3.2.6 Drainage patterns may be created and changed in many ways. Tourist traffic can change drainage patterns (Loendorf *et al* 1998). Incomplete archaeological excavations at the base of a rock art panel drastically changed the drainage pattern at an Argentinian site and caused water to pool below the panel subsequently causing considerable damage (Bolle 1996). A treatment proposal was made consisting of dripline installation, creation of drainage ditches, backfilling to return the floor level to its pre-excavation level, installation of a geo-textile and vegetation control (Bolle 1996). Vegetation management is one of the least intrusive and most common means of controlling drainage patterns (Rosenfeld 1985; Bolle 1996; Walderhaug and Walderhaug 1998; Loendorf *et al* 1998).

8.3.2.7 There is no general solution to control ground water. Drilling drainage channels may be possible in some situations to isolate a site from the hydrological system of the bedrock. However, this is costly and involves massive engineering works and is therefore not practicable for most sites. Additionally, the results obtained with drainage channels is not always predictable, as effects of physical properties such as porosity and capillarity need to be considered for all elements involved, including the stone, mortar and drainage pipes (Rosenfeld 1985).

8.3.2.8 Condensation on rock art panels is controlled by temperature and humidity fluctuations and may vary topographically over a surface (Rosenfeld 1985). Again, vegetation can be used to influence ventilation and isolation and alter the microclimate around the panel, however, unless the side-effects of such actions are considered, damage may result as increased ventilation will affect evaporation which may lead to salt damage (Rosenfeld 1985).

8.3.3 Vegetation control

8.3.3.1 Properly planned or maintained vegetation can protect rock art sites from a variety of hazards. As illustrated in the previous section, vegetation is instrumental in the control of water access and temperature fluctuations to a site. However, the removal of trees and bushes can be essential for preservation as well (Lambert 1989, Mandt 1992 and Michelsen 1992). Shade created by larger plants can create environments that will encourage the growth of mosses, fungi and various microorganisms. Trees also need to be monitored to prevent root penetration (Michelsen 1992; Demas *et al* 1996; Walderhaug and Walderhaug 1998), and the creation of fire hazards. Unpleasant varieties of plants can be cultivated to prevent human access to sites, such as poison ivy and oak or stinging nettles (Loendorf *et al* 1998).

8.3.4 Burial

8.3.4.1 Rock art sites can be protected from weathering agents and vandalism by burial (Coles 1992; Walster 1996a; Walster 1996b; Walderhaug and Walderhaug 1998). The burial of archaeological sites is an active field of study and a few important sites such as the Laetoli hominid trackway in Tanzania have been buried (Demas *et al* 1996). Intensive documentation and a detailed condition survey must precede site burial. Also, the stone characteristics and the ground conditions, particularly water content and pH, must be considered to ensure further damage will not occur to the stone (Walderhaug and Walderhaug 1998). Current basic burial practices consist of lining archaeological surfaces with permeable geotextiles that allow moisture and air transfer but prevent encroachment by vegetation. A layer of washed sand is then added followed by soil from the site. Some sites have also been capped with a damp-proof membrane, a cap layer of concrete and other materials depending upon the conditions desired (Goodburn-Brown and Hughes 1996), and others have incorporated low-toxicity biobarriers to prevent root growth and a top layer of rocks for further site protection (Demas *et al* 1996).

8.3.4.2 Buried sites require maintenance and monitoring. Any threatening plants need to be removed periodically. Monitoring the burial conditions is possible by constructing a nearby test pit constructed in the same fashion as the site burial to simulate the conditions (Coles 1992 and Demas *et al* 1996).

8.4 Panel treatments

8.4.1 After completing and intensive condition survey and identifying all destructive agents at work on a panel and the actual risk they propose, some interventive conservation treatments may be deemed appropriate. In addition to following the philosophies of minimal intervention and reversibility, any treatments carried out on a panel should first be tested on an uncarved area of rock to ensure no unexpected damage occurs (Wainwright 1985; Sale and Padgett 1996; Tratebas and Chapman 1996). All materials used must be documented and the location of their application recorded and monitored (Bednarik 1995a and Bednarik 1996).

8.4.2 Graffiti removal

8.4.2.1 Graffiti treatment, either removal or reintegration, is one of the most common conservation activities carried out at rock art sites both for aesthetic reasons (Rosenfeld 1985; Ford 1996; Sale *et al* 1996, Padgett 1996) and because existing graffiti has a tendency to encourage further graffiti (Rosenfeld 1985; Gale and Jacobs 1987a; Gale and Jacobs 1987b; Bednarik 1995a; Bednarik 1996; Ford 1996; Franklin 1996). However, in some cases specific examples of graffiti may be of historical significance (Gale and Jacobs 1987b; Franklin 1996; Dean 1997) or can provide weathering information if of known age (Bahn 1995; Franklin 1996; Bahn 1998), and the appropriateness of their alteration can only be determined after careful consideration. Furthermore, graffiti treatments are most effective if an overall site management policy is in place to further discourage such acts of vandalism (Bednarik 1995a and Bednarik 1996). In fact this has not been noted as a significant problem in the United Kingdom.

8.4.2.2 Graffiti treatments vary depending upon whether the graffiti was made by applying a material to the surface of a rock or if the surface was cut and material removed by carving or scraping. Additionally, the properties of the graffiti will change over time. It may not be possible or feasible to remove graffiti so re-integration, or altering its appearance to hide it from the casual visitor, may be a temporary solution. Chemical and mechanical treatments are available for both types of graffiti, however due to developments in dating technology reliant upon uncontaminated surface layers, physical treatments are usually preferred.

8.4.2.3 The chemical removal of applied materials has been much modified in recent years. Extremely harsh and caustic chemicals are no longer approved, although the use of water, some commercial solvents and paint strippers, detergents, poultices and gels is fairly common (Rosenfeld 1985, Wainwright 1985, Thorn 1991, Thorn 1993, Sale and Padgett 1996 and Loendorf *et al* 1998). Such chemical treatments are considered appropriate as long as the full effect of the materials used is considered and tested, the least aggressive approach is attempted first with the intensity of treatment gradually increasing until successful, and a minimum amount of chemicals are applied and only to restricted areas where required (Thorn 1993. Loendorf *et al* 1998). One disadvantage to chemical removal is that staining may result as not all reactions between the graffiti materials and conservation materials may be predicted even in preliminary testing (Bednarik 1995a and Bednarik 1996). Physical treatments must be undertaken carefully so as not to damage the underlying surface materials. Mechanical removal methods include the use of various brushes with non-metallic bristles, scalpels, dental tools, erasers, putty rubbers and Groom Stick (Rosenfeld 1985; Thorn 1991; Thorn 1993; Ageeva and Rebrikova 1996; Sale and Padgett 1996; Loendorf *et al* 1998). As a last resort, small-scale air abrasive treatments have been used successfully to remove graffiti from rock art panels (Wainwright 1985; Ford 1996; Sale and Padgett 1996; Ford 1997).

8.4.2.4 Graffiti produced by carving and scratching cannot be removed. However, it is often possible to reintegrate such graffiti into the background by removing traces of freshly crushed rock material with gentle brushing or using an eraser (Rosenfeld 1985 and Loendorf *et al* 1998), or toning the incisions with local dust, acrylic, watercolour or mineral pigments, (Thorn 1993; Sale and Padgett 1996; Loendorf *et al* 1998). Filling incised graffiti has been subject to debate (Rosenfeld 1985, Thorn 1993, Sale and Padgett 1996 and Loendorf *et al* 1998), however currently it is generally deemed unnecessary and ineffective as it soon fails (Loendorf *et al* 1998). Some attempts have been made to hide incised graffiti by precipitating artificial desert varnish on the fresh surfaces (Elvidge and Moore 1980), however this method has received criticism as the long term results were not satisfactory (Bock and Bock 1990 as cited in Bednarik 1995a and Bednarik 1996).

8.4.3 Lichen removal

8.4.3.1 Approaches to lichen removal have changed considerably in the recent past. Rosenfeld (1985) claimed all lichens should be removed using rather harsh methods such as wire brushes and biocides. Today, some lichens are thought to be protective and removal is undertaken with much less rigor (Tratebas and Chapman 1996 and Loendorf *et al* 1998). Whether to remove lichens or not will depend upon the lichen species and the state and composition of the rock substrate (Tratebas and Chapman 1996).

8.4.3.2 Use of commercial fungicides to eliminate lichens and other biological agents is falling out of favour as such materials are ecologically harmful, they may cause staining, and their effects on the chemistry of surface layers and subsequent dating methods is not clear (Bednarik 1995a; Bednarik 1996; Walderhaug and Walderhaug 1998; Loendorf *et al* 1998). Generally, most lichen removal undertaken currently is either manual removal, excluding brushing (Bednarik 1995a; Bednarik 1996; Swartz 1997; Walderhaug and Walderhaug 1998), or by using dilute chemical solutions to promote dehydration (Loendorf *et al* 1998).

8.4.4 Salt removal

8.4.4.1 Salt removal treatments can only be successful if the sources of the salts are eliminated. As the sources of salts are manifold, this is not often possible. However, unless salt sources are removed, any treatment such as brushing away visible salt efflorescences and wet poulticing (Rosenfeld 1985; Lambert 1989; Clarke *et al* 1991) will only be superficial and temporary. If the environmental conditions of temperature and relative humidity surrounding a site can be controlled to a great degree, damage can be minimised if the conditions are maintained at relatively constant levels appropriate for the specific salt system present (Price and Brimblecombe 1994).

8.4.5 Crack filling and re-attachment

8.4.5.1 Filling cracks and reattaching pieces of rock art panels was often done with cementatious material, however due to its many negative properties, experiments with several other substances have been undertaken. Polyester and acrylic resins have been used to both fill cracks and reattach pieces (Rosenfeld 1985 and Wainwright 1985), however these materials regularly fail. Tetraethoxysilane (ethyl silicate or tetra ethyl orthosilicate) has become the recent favourite applied as an adhesive or mixed with washed sand or microballoons to form a grout (Bednarik 1995a; Bednarik 1996; Finn and Hall 1996). However, the long-term survival of this product is still unknown. Both fill materials and adhesives must have thermal and hygric properties similar to the rock to which they are applied. Air and moisture exchange must be possible, therefore impermeable materials are inappropriate and adhesives should be applied in spots along the edge, not applied as a layer (Finn and Hall 1996).

8.4.6 Consolidation

8.4.6.1 A variety of substances have been used to attempt to consolidate unstable and friable surfaces. Similar problems encountered with crack filling and reattaching pieces apply to surface consolidants: consolidants cannot be impermeable layers and must have properties similar to those of the substrate. Many materials have been tested and most have failed in this endeavour or their long-term survival is unknown. Barium hydroxide, silanes, organic polymers, epoxies, acrylics and limes on limestones have all been tested but none have proven to be exceptionally successful for stone surfaces in an uncontrolled environment (Price 1996). Application of artificial desert varnish also has been suggested (Bednarik 1995a and Bednarik 1996), however this method is often seen as a last resort.

8.5 Monitoring methods

8.5.1 A key element for the future conservation of rock art in the United Kingdom will be the effective monitoring of rock art sites. General patterns can be determined from sample data rather than total coverage, although the selection of a representative sample of sites will be critical here, and will in part depend upon having available a fairly comprehensive database of all examples. In the first instance, however, such a sample could be stratified by a taking a geographically dispersed selection first so that monitoring can commence, with a second wave of monitored sites introduced later, as a better understanding of the resource as a whole, and appropriate sample size, is developed.

8.5.2 There would be two scales to monitoring: short term changes and the speed and impact of, for example, fluctuating levels of tourism and agricultural land-use policies, long term changes in condition are also important (50-100 + years) and this will relate to the cumulative effects of chemical and physical erosion. In both cases the monitored stones would need to be fully 'bench marked' with a detailed survey and recording. The laser scanning used in the Pilot Project appears to be the best available approach at present. Repeat surveys at defined intervals will allow the nature and extent of changes to be determined. In setting up a monitoring site it may be necessary to insert control points into the stones so that the measurement of key variables such as position / depth measurements can be accurately made. Monitoring stones might include the areas regularly visited by visitors as well as those in isolated positions. Some control over relevant eternal factors such as rainfall, temperature ranges, number of frost days and so on will also be needed.

9. THE PUBLIC PRESENTATION OF ROCK ART

9.1 Introduction

9.1.1 Since rock art has been acknowledged as an important part of cultural heritage and since rock art sites all over the world are visited by ever higher numbers of visitors, the need for an active management of rock art sites has become recognised. The danger of the destruction of sites through uncontrolled visitor access and a variety of other factors, such as weathering, quarrying, mining or building development, prompted the development of a number of management strategies for rock art sites, which provide for their conservation and public presentation. The rise of public interest in rock art often endangers the preservation of rock art at these sites (see chapter 6). Since in Britain we aim at raising public awareness about this part of the country's heritage and at furthering public access to the rock art sites, presentation and preservation measures must be implemented at rock art sites before these come under threat from increased visitor numbers. Generally, it is important that any measures planned for the public presentation of rock art sites take into account conservation and preservation concerns. Indeed, the decisions if and how a rock art site is made accessible for the public and what presentation measures are applied, must be formed within the context of a wider conservation strategy for the site (see chapter 8).

9.1.2 Of the two closely linked components of the management of rock art, conservation and presentation, this chapter deals with the presentation of rock art *in-situ* at sites and *ex-situ* in museums. The extent of public interest in rock art as well as the standard of management and public presentation of rock art sites in England and Scotland are briefly evaluated and a variation of presentation strategies adopted in other countries is discussed. Although management strategies always have to be site specific, it is considered valuable here to draw on experiences made in other regions of the world. In this way mistakes made in the management of rock art sites in other countries shall be avoided and successful approaches adopted. The chapters generally concentrate on the management of open-air petroglyph sites, which are most relevant for the British situation. Presentation approaches specifically adapted to pictograph sites or to cave sites are mentioned, but not discussed in depth. A number of detailed case studies provide in-depth information on measures taken at specific sites. Additionally, the display of rock art in British museums is discussed. Finally, recommendations are given as to how public awareness of rock art and public access to rock art sites can be increased in Britain.

9.1.3 Only little published data is available on public attitudes to rock art and on the public presentation of rock art sites in England. Therefore, most information in this chapter derives from telephone interviews and written communication with Mr. Stan Beckensall, Dr. Keith Boughey and Dr. Simon Woodward. Other information is derived from the World Wide Web.

9.2 The in-situ presentation of rock art in Britain

9.2.1 Rock art and the Public

9.2.1.1 Public interest in British rock art exists in those areas with a great number of rock art sites, such as western Scotland, Yorkshire or Northumberland. This interest in rock art is mirrored in the activities of a number of individuals and of local archaeology and history societies, who have recorded and published a large number of rock art sites and have so contributed substantially to our knowledge of British rock art. They have published a number of rock art guidebooks intended for the general public, or, more recently, put information on rock art on the World

Wide Web. Additionally, they inform interested members of the public about British petroglyphs in giving talks or in conducting walks to rock art sites (K. Boughey and S. Beckensall 1999, *pers.comm.*). Local concern about the preservation and presentation of rock art in England is mirrored in local newspaper articles, where members of the public appeal for the implementation of protection measures for rock art sites (K. Boughey 1999, *pers. comm.*). More rarely, rock art is made a topic in television documentaries, such as in BBC's 'Essential Guide to Rocks' (Beckensall 1999, 9).

9.2.1.2 Given the clearly existing (regional) public interest in petroglyphs and the importance of rock art as part of Britain's cultural heritage, it is important that information on rock art and access to sites should be provided on a larger scale, and on a more professional basis than is presently achieved. Examples of the current standard of the public presentation of rock art in England come from Northumberland (Roughting Linn and Lordenshaws) and Yorkshire (Swastika Stone and Panorama Stones). The presentation measures taken at some Scottish sites in the Kilmartin Glen area are outlined here to contrast with the situation in England.

9.2.2 Northumberland

9.2.2.1 Of Northumberland's rich rock art heritage the sites of Roughting Linn and Lordenshawes are among the most widely known. Roughting Linn, the largest rock art site in England, is enclosed by a wooden fence. Visitors can access the site via a gate, while animals are kept out. Beside the panel a notice board was set up c. 30-40 years ago. The brief information provided on the board is long out of date. No depiction of the petroglyphs is given on the board, making it difficult for the visitors to identify the faintly visible motifs on the rock surface. In an attempt to enhance their visibility, the motifs at the site were painted with glossy brown paint by a member of the public c. 10-15 years ago. The paint had flaked off the petroglyphs a few years after the incident. The site itself is not managed: trees are allowed to grow out of cracks in the panels and the access to the site is not marked, giving visitors a hard time finding the petroglyphs. The presentation and preservation measures taken at Roughting Linn are clearly inadequate.

9.2.2.2 The petroglyph site of Lordenshaws is located close to a well-visited hillfort. It receives some publicity, being included in a leaflet "Lordenshaws – an historic landscape" issued by the Northumberland National Park authorities. An internet site on Lordenshaws, maintained by the Northumberland County Council, also includes brief information on the petroglyph site. No guidelines on visitor behaviour are given. Beside the occasional 19th century initials, a new 'cup-and-ring mark' was hammered into the rock with a metal tool on top of prehistoric petroglyphs. Beneath the design the words "rock map" were engraved. Also, since the site is not enclosed, visitors walk on the rock and possibly across the petroglyphs, adding to the erosion of the rock surface. Some other sites are endangered by uncontrolled animal access, such as at Chatton Park Hill, where cattle walk over the petroglyphs (Beckensall 1999, *pers. comm.*)

9.2.3 Yorkshire

9.2.3.1 The Yorkshire region represents another major concentration of rock art in England. About 640 petroglyph sites have been identified. Some of the motifs are unique to this area, such as a 'ladder' design. Despite the fact that most of the sites are scheduled monuments, none of them is managed. Neither conservation nor presentation measures have been undertaken. Although a number of rock art sites in the region are easily accessible for visitors, next to none is equipped with any explanatory signs or panels. Only one out of 640 rock art sites is marked for the public, the "Swastika Stone" on Woodhouse Crag. The rock with a rare *swastika* motif was enclosed with metal railings in the late 19th century, preventing direct access to the rock surface. These railings, now heavily eroded, were set up to keep visitors away from the dangerous cliff face, where the petroglyph panel is situated. A brass panel was bolted on the rock directly beside the petroglyph in the late 19th or early 20th century. Its outdated legend informs the visitor about the assumed age and interpretation of the petroglyph. Parallels to Swedish and Mycenean *swastika* motifs are drawn and a Bronze Age date proposed.

9.2.3.2 The only other marked petroglyphs in the region, although no longer *in-situ,* are the Panorama Stones, once one of the finest examples of rock art in the area. The petroglyph panels were originally situated on the upland area of Ilkley Moor, on Panorama Ridge, overlooking the valley. In the 1890s, however, when a reservoir was built at the site, the Panorama Stones were moved to Ilkley. During transport one of the 3 panels was broken. The two pieces were cemented together again and put in an enclosure opposite the Church of St. Margaret's in Ilkley. One of the panels is set in concrete. The late 19th century metal railings around the rock art panel are still in place, as is an outdated metal information panel beside the petroglyphs. Today the petroglyphs are badly weathered and covered with lichen. The site also is a target for vandalism: graffiti was added and paint was splashed across the panel.

9.2.3.3 Although a large number of rock art sites are found in the Ilkley area, the public is ill informed about this archaeological heritage. The tourism industry focuses on the natural beauty of the area, on its Roman and Victorian past, but not on its prehistoric past. In leaflets and tourism brochures, the existence of rock art is only occasionally mentioned. The museums in the area only provide scant or no information on rock art (K. Boughey 1999, written and *pers. comm.*).

9.2.4 Scotland – The Kilmartin area

9.2.4.1 The situation is somewhat better in Scotland. In Argyll rock art sites are part of the presentation of archaeological landscapes. Road signs lead visitors to a number of different archaeological monuments, among them rock art sites. In the Kilmartin area a selection of sites is presented to the public, the most important being Achnabreck, the largest rock art site in Britain. 332 individual motifs are located on three separate panels. Surveys conducted between 1970 and 1990 have shown a marked deterioration in their preservation (Yates *et al* 1998, 10). Solutions for this problem included the improvement of visitor management and the diversion of runoff water. Additionally the returfing of large areas of the petroglyph panels was suggested, leaving only a few small areas uncovered for viewing. This suggestion was not realised because of the popularity of the site with visitors (Yates *et al* 1998, 10).

9.2.4.2 The petroglyph panels of the Kilmartin area are now enclosed by metal fences (railings) of about 1m height. At Achnabreck visitors can view the petroglyphs from a slightly raised wooden walkway to the south of the main panel. At other sites visitors are allowed to enter some of the enclosures via stiles leading across the fences. Since the vegetation within the enclosures is kept short, the petroglyph panels can be fully seen and the sites make a maintained impression. Information on the petroglyphs is provided on panels, which include explanations on the sites and depictions of the petroglyphs (Beckensall 1999, *pers. comm.*). Furthermore, the petroglyph sites of the Kilmartin area are promoted via the internet, by Historic Scotland and are mentioned in tourist maps of the area.

9.2.5 Remarks

9.2.5.1 Generally, there is no *in-situ* presentation of rock art in England. No active management strategies on the conservation and presentation of rock art sites are undertaken. The sites are not maintained and their condition is not monitored. Visitors have to make an effort to find the unmarked sites. No in depth on-site information is provided, apart from a few dated metal panels. No guidelines for visitor conduct at the sites are given. Site management agreements guaranteeing access to rock art on private land only rarely exist.

9.2.5.2 Looking across the border to Kilmartin, a rather different situation is apparent. Here an integrated approach to interpretation, visitor management and tourist development has been created. Many of the sites are maintained and monitored. They are enclosed and equipped with information panels. The rock art sites are presented as part of a larger archaeological landscape. Further information is supplied in museum displays and on the internet. The Scottish approach to the presentation of rock art sites can be taken as an example for future approaches in England. However, since the Scottish method of rock art presentation is only one possible approach, the following sections provide approaches to the public presentation of rock art all over the world, starting with the management of visitor access to rock art sites.

9.3 On-site access and site management for presentation: A global perspective

9.3.1 Site selection: The management of public access to rock art sites

9.3.1.1 The public presentation of rock art sites generally aims at providing access to the sites, at informing the visitors, but also at protecting rock art from the negative side effects of site visitation, such as vandalism (see chapter 6). The presentation measures chosen at rock art sites must reduce these side effects as widely as possible. The first step in limiting negative visitor impact on sites is the control of visitor access.

9.3.1.2 Trends in the management of visitor access include the selective presentation of sites, the restriction of access as well as the diversion of visitors to other, less pressured rock art sites. Frequently, rock art sites are part of a larger presentation scheme of whole archaeological landscapes, such as at Kilmartin, Scotland or of wider regions of historic and natural significance, such as at Alta, Norway.

9.3.1.3 Decisions concerning the extent of control of visitor access to rock art sites, and the kind and extent of development of the sites, have to be based on factors such as the condition of the site, its importance in a local, national and international context, on visitor numbers and ease of access. In countries where rock art sites are still part of the living culture of indigenous populations, such as in Australia, public access to the sites needs to be negotiated. The significance attributed to rock art sites by state authorities or by the academic community, for example, as part of the collective heritage which needs to be studied, conserved in its present form and made accessible to the public, may deeply conflict with the use of such sites by indigenous communities (Meehan 1995, 311-314; Fourmile 1995; Morris and Hamm 1995; see also chapter on the repainting of rock art in Australia). If consent by the indigenous communities is given to make rock art sites accessible, these communities should be heavily involved in the presentation and management of these sites. The involvement of local communities and landowners should be a concern in the management of sites everywhere, since it could help to ensure the preservation and successful presentation of rock art (see section 9.7).

9.3.1.4 The control of visitor access to rock art sites is often based on the selection of a few sites for development as 'tourist sites' and of the reduction of visitor numbers to other sites, which remain undeveloped. This practice is widely followed in the presentation of rock art sites in many regions of the world, for example, at the World Heritage site in Alta, Norway. The first category of sites at Alta is comprised of those that are heavily publicised and receive a large number of visitors. They are equipped with visitor facilities and visitor guidance systems, such as wooden walkways, to prevent people from walking on the rock surface, interpretive panels, guided tours, etc. The second category includes sites which are not specifically publicised, but which are generally accessible to the public. No visitor facilities are provided, only few people visit the sites. The third category of sites is not made public in any way. Their locations are kept secret, and no signs are put up. Locational information on these sites is only made available for research purposes (Helskog 1988, 1992).

9.3.1.5 Another example of the selective presentation of rock art sites is the presentation of the petroglyphs of the Coa valley. Only a few sites are made accessible to the public. These can only be visited in small groups of up to 8 individuals. In this way many petroglyph sites in the area are not visited at all and so are protected from visitor impact of any kind. Also, the number of visitors at a site at any time is manageable, crowding is avoided and visitor impact reduced (Zilhao 1998; see also section 9.4.3).

9.3.1.6 Diversifying visitor attractions in the region can reduce visitor impact at rock art sites. The high visitor numbers at the passage tomb sites of the Boyne valley in Ireland, for example, was substantially decreased, when other attractions became available. A visitor centre was built at a distance from the main passage tomb sites of New Grange and Knowth, organised minibus circuits and an advance booking system for coaches were established and an alternative site at Lough Crew, c. 30 km away, opened to the public. Though the overall visitor numbers to the area rose because of the new attractions, the high visitor numbers at New Grange could be cut by c. 25% (Stanley-Price 1999).

9.3.1.7 In order to completely prevent uncontrolled visitor access to rock art sites, the restriction of locational information on these sites often is the best protective measure. At Carnarvon Gorge, Queensland, Australia, for example, three rock art sites without any presentation measures were threatened by the impact of high numbers of visitors. Consequently, two of these sites were chosen for development: boardwalks were set up and brochures with site information provided. Visitation of the third site, however, was successfully discouraged. The access tracks were camouflaged and all references to the site were deleted from maps and written material (Walsh, 1983, 11-12; Lambert, 1989, 35). However, this approach is not always successful. In Gosford, New South Wales, Australia, an attempt was made to divert visitors from the undeveloped Feast Group petroglyph site to a newly developed site nearby. The track to the Feast Group site was partly obscured and allowed to overgrow. Signs directed visitors to the developed site at Bulgandry. But, since a high proportion of the visitors were local and had a good knowledge of the terrain, the Feast Group site continued to be visited. The visitors cleared the tracks to the site and some vandalism occurred at the site (Lambert 1989, 35).

9.3.1.8 A second method of restricting public access to rock art sites is used in the management of some Palaeolithic caves in southern France. In the case of Lascaux the fragile Palaeolithic paintings were endangered by the masses of visitors. Fluctuations in the humidity inside the caves caused the accelerated growth of algae and christals on the images, the *maladie verte* and *maladie blanche*. While Lascaux had to be completely closed, daily visitor numbers to other rock art sites have been successively cut. Other attractions, such as the replica of parts of the Lascaux cave (Lascaux II) or the Museum of Prehistory at Les Eyzies, have been heavily promoted in order to divert visitors from the fragile rock art sites. Newly discovered caves with Palaeolithic rock art, such as the Grotte Chauvet and the Grotte Cosquer will not be opened for the public at all (Brunet and Vidal 1984, 1987; Brunet and Vouve 1996; Delluc and Delluc 1984; Saint Victor 1987; Vidal, Vouve and Brunet 1991; Vouve 1987).

9.3.1.9 The access of the public to rock art sites needs to be controlled in order to protect these sites from the negative side effects of visitor impact. A selective public presentation of rock art sites allows some sites to be developed for public visitation, while other sites remain undeveloped and unvisited. The developed sites will necessarily have to bear the effects of the presentation measures employed and of actual visitation. Visitor guidance systems and other presentation and protection measures will alter the character of these sites to a certain extent (see section 9.3.3). The extent to which controlled visitation has any negative impact on the rock art depends on the effectiveness and appropriateness of the measures employed. Although the reduction of visitor numbers to rock art sites can be an appropriate tool in reducing negative human impact on some sites, high visitor numbers can also help to protect rock art. A study in Australia has shown that continuous visitor presence can actually limit damage to the sites, since acts of vandalism usually occur when no one else is around. Increased visitation can therefore have a positive side effect in reducing acts of vandalism by self-regulation (Gale and Jacobs, 1983, 40; Lambert, 1989, 35).

9.3.2 Site development: Combining site presentation and preservation

9.3.2.1 Any management plan for rock art sites must take into account both preservation and presentation needs. Often both conservation and presentation measures can be combined. Visitor guidance systems, such as walkways, on the one hand protect rock art in keeping visitors away from direct physical contact with the art, while on the other hand they can provide better viewing possibilities for the public. Presentation and protection measures, however, often alter the character of a site more or less substantially. Therefore, measures that greatly alter the integrity of a site should only be implemented if absolutely necessary. Site development for public access should follow the principle of least possible physical intervention, as laid out, for example, in the Burra Charter (Marquis-Kyle and Walker 1996, Article 3). Presentation measures implemented at rock art sites need to include information on the site. Visitor education, therefore, forms an important part of the public presentation of rock art sites. Both, site-specific and general information on rock art should to be provided, as well as information on conservation issues and visitor conduct.

9.3.2.2 A selection of site development measures is presented in the following section. Beside a range of visitor guidance systems and visitor education measures, problems such as the highlighting of rock art for better visibility or the question of how to deal with graffiti at rock art sites are addressed. Whatever actions are taken in the development of rock art sites for public access, these measures have to be maintained, the information provided should be up-to-date and the condition of the sites needs to be monitored. Sites that look neglected are prone to be targeted by vandals.

9.3.3 Keeping to the path: Visitor guidance systems

9.3.3.1 In order to keep visitors from damaging rock art by touching it or by walking on the panels, means of guiding visitors across sites have to be installed. According to site conditions, a variety of guidance systems can be used. The most important guidance systems are listed here, taking into account their advantages and disadvantages.

9.3.3.2 Guidance fencing and low barriers

9.3.3.2.1 The existence of clearly laid out paths is often not enough to keep visitors from straying aside and touching the art. Low wooden fences and chain or rope barriers in front of rock art panels, although easily climbed, provide a psychological barrier that is rarely crossed. Guidance fencing and low barriers therefore are an effective and cheap way of guiding visitors through sites and of positively influencing visitor behaviour. Without such low barriers, visitors might assume that there are no behavioural standards to be observed at the sites. Vandalism occurs considerably more often when no barriers are in place (Gale 1984, Gale and Jacobs 1987b).

9.3.3.3 Enclosures

9.3.3.3.1 Enclosures often are low and pose no physical deterrent for entering the enclosed space. However, as guidance barriers, these low enclosures function as a psychological barrier to approaching closer to the rock art panel. Such low enclosures do not alter the character of the site as much as other guidance systems. At the Ring Mountain petroglyph site, California, USA, for example, a large boulder was surrounded with a low wooden rail barrier which suggested to the public an appropriate viewing distance, without destroying the integrity of the site (Leigh Marymor 1998).

9.3.3.3.2 Such low enclosures are no option for sites that are located on pastures. Such sites should generally be protected by high and strong enclosures in order to prevent animals from reaching the rock art sites. However, since high and strong fencing spoils the character of the sites, it could be preferable to relocate the animals to other pastures or to fence off a wider area, not just the immediate rock art site. Sites located in fields should also be visibly fenced off, since recently commissioned ploughing of fields in Britain has resulted in considerable damage to rock art panels (I. Hewitt, *pers. comm.*). Before setting up fencing posts it should be made sure that no archaeological deposits around the rock art sites are destroyed.

9.3.3.4 Protective Grills/Mesh Screens

9.3.3.4.1 An approach often chosen for the protection of rock art sites, such as rock shelters and caves, is the installation of protective metal grills, or alternatively of mesh screens. Samples of such "jailed" rock art are found all over the world (e.g. Ritter 1991, 15; Brunet and Vouve 1996, 208-210). Person-proof steel grills have been erected frequently in Australia at significant sites under visitor threat. These sites mostly had already been vandalised by graffiti. Generally the grills consist of galvanised steel mesh fixed to a galvanised pipe frame which is fixed to the cave or shelter entrance. Usually these grills are equipped with a gate to allow access by custodians or researchers, while visitors are prevented from entering, unless accompanied by a custodian. The screens/grills prevent further graffiti in the enclosed area. However, other acts of vandalism have occurred. At least one site has been shot at through the screen (Bull Cave, Campbelltown, New South Wales, Australia). Attempts to enhance the images for photography by spilling liquid over them have also been reported from sites with protective grills.

9.3.3.4.2 Still, a rather high degree of protection from vandalism, such as applying graffiti or chipping off paint can be achieved through the use of grills or screens. However, the grills destroy the integrity of the site. Grills and screens should be removed if other, alternative and less intrusive protection measures are available, such as the construction of walkways, which also keep visitors at a safe distance from the rock art panels. Often grills can be removed with little impact on the site, if their installation and positioning was carefully planned before (Finn and Hall 1995). In some cases damage to floor deposits have been reported from Australia (Lambert 1989, 40).

9.3.3.5 Protective plexiglass panels

9.3.3.5.1 A further method of keeping visitors at a distance from the rock surfaces is the placing of transparent plastic panels over the motifs, such as at Font-de-Gaume, France, where the depiction of a bison is covered in this way (Brunet and Vouve 1996, 208). In the late 1970s it was planned to cover the whole surface of the rocks at Nadro, Italy, with sheets of plexiglass, in order to preserve the petroglyphs permanently. The plexiglass sheets would have kept water, the main source of weathering, off the petroglyphs. This plan was, however, not realised, because of a lack of funds. Details of the method of covering rock surfaces with plexiglass are not published, therefore an evaluation of its usefulness cannot be given (Cittadini 1982).

9.3.3.6 Walkways

9.3.3.6.1 The installation of walkways (boardwalks, catwalks) on rock art sites is an established means of making rock art sites accessible to large numbers of visitors with the least possible negative impact to the sites (Gale and Jacobs 1987a and b; Lambert 1989, 41). Walkways guide visitors through the site and keep them at a safe distance from the art. At Alta, Norway, a slightly raised walkway prevents the erosion of the fragile vegetation cover in this arctic region. The walkway also keeps visitors from stepping on the rock surfaces. Viewing platforms with benches, erected at spectacular spots, invite visitors to rest and to appreciate the scenery (see section 9.4.2). At Naquane, Valcamonica, Italy, walkways bridge over the rock surfaces and allow the visitors a better view of the art. Walkways have also been constructed at smaller sites, such as at a private farm at Tandjiesberg, South Africa. The raised wooden boardwalk with its handrails keeps visitors at a safe distance from the fragile paintings (Loubser 1995). The benefit of walkways for the visitor generally is an unobstructed view of the rock art panels.

9.3.3.6.2 Each walkway design has to be suitable for the specific site. The design of the walkways should be as little intrusive as possible at the sites. If possible, the construction material should be typical for the region, a suggestion also brought forward in the Burra Charter (Marquis-Kyle and Walker 1996, Article 8). Experiences with walkway construction have been made in several regions of the world during the last 25 years or so, for example at the petroglyph sites at Alta (Norway) and at Valcamonica (Italy), or on the pictograph sites at Piaui (Brazil) or at Cueva de El Raton (Baja California, Mexico). However, since most material on the construction and consequent use of walkways is published on Australian sites, it is hoped that a selection of examples from this continent will allow some general statements on structural, aesthetic and safety aspects of walkway design and construction. Some of the experiences made at petroglyph sites and at one site with pictographs are described in the following section. A list of guidelines concerning the design and construction of walkways is given at the end of this section.

- **Mootwingee, Broken Hill, New South Wales:** Completed in 1978, this was the first walkway constructed on an Australian rock art site. Since this was the first attempt, a number of mistakes were made from the planning stage onwards. The design of the walkway was drawn up mainly by the New South Wales Public Works Department, which then put more emphasis on public safety than on aesthetic considerations. The material used in the construction of the walkway was prefabricated metal, which did not blend well with the natural setting of the site. Also, the siting of the walkway did not allow visitors to view or photograph the entire petroglyph site but just a sample of it. Since originally all visitors were meant to arrive at the site as part of a guided tour, no sign-posting or interpretive material was provided. These signs were later added and self-guided walks offered. The design of the walkway with its handrails succeeded, however, in keeping visitors off the site (Lambert 1989, 42; Dragovich 1993, 1995).

- **Carnarvon Gorge Central Queensland:** Carvarvon Gorge is a large rock shelter with extensive areas of pictographs and petroglyphs. A walkway was constructed in order to keep visitors away from the rock surfaces and to reduce the amount of dust in the shelter. At this site experiments were carried out during the planning stage, in order to determine the most suitable walkway positioning for photographic purposes. Tests were also carried out at the proposed height of the walkway, ensuring that the distance to overhanging rock surfaces was sufficient so that visitors could not touch the art. At most spectacular points resting places with seating facilities were planned. These resting-places provided views of significant art panels, but did not interfere with normal pedestrian traffic. The position of the walkway was also evaluated by geologists, who identified possible areas of risk from overhanging ceiling areas. The final layout of the walkway therefore took account of visitor needs, of site protection needs and of public safety (Walsh 1983, 5-7).

- **Bulgandry, Gosford, New South Wales:** This petroglyph site was developed to cater for the increasing public interest in rock art in the Sydney region. The site was chosen for its location near a road and because of the relatively good visibility of the petroglyphs. Additionally the development of the site intended to redirect visitors to Bulgandry from an undeveloped site close by. At Bulgandry a low-level walkway was constructed. It was designed to be built with local timber (ironbark), which was left to weather for several months to leach out any resins which might have stained the rock surface. In addition to the construction of the walkway a site leaflet was made available and interpretive signs were set up at the site. However, about one third of the visitors were leaving the walkway and walking over the site. It was then recommended to additionally construct a low barrier to prevent trespassing (Gale and Jacobs 1987; Lambert 1989, 44).

9.3.3.7 Guidelines for the construction of walkways

9.3.3.7.1 On the basis of the Australian experiences a number of general guidelines have been suggested by Lambert (1989, 44-45), which should be observed in the planning and construction of walkways:

- If possible, the motifs should be seen clearly from the walkway and should be able to be photographed. Good visibility of the rock art prevents visitors from leaving the walkway in order to get a better view;
- The walkway must have a sufficient setback from the rock surfaces, in order to prevent visitors from touching the images;
- A barrier defining and limiting the area where visitors are permitted to go should be included in the design of the structure;

- Visitor safety concerns have to be taken into account (e.g. slippery wooden walkways);
- The materials used in the construction of the walkway should complement the aesthetics of the site. Local natural materials are usually most appealing;
- The construction work itself needs to be supervised by experienced staff with knowledge on the fragility of rock art;
- Finally, the practicality of the structure should be evaluated after a certain time, and modifications of the design envisaged, if the structure does not fulfil its purpose.

9.3.3.7.2 Walkway designs should take into account the provision of easy access to visitors in wheelchairs and buggies, with ramps as alternatives to steps, and appropriate gradients and width.

9.3.3.8 Visitor Books

9.3.3.8.1 Visitor books are a non-interventive and low-cost way of visitor management at rock art sites in Australia. Provided at rock art sites, they can have a positive effect on the site in minimising vandalism, "since they convey a sense of managerial care, even if the site is unattended" (Dragovich 1995, 103). Experiences in Australia have shown that visitor books redirect vandalism from the sites to their pages. Dragovich (1995, 103) refers to visitor books as "psychological tool in reducing careless behaviour at heritage sites". Additionally visitor books serve as a source of information for both the visitors and the site manager. Visitors are given the opportunity to communicate their needs and wishes to the site manager. Sullivan (1984, 52-53) has drawn up detailed guidelines for the design and the maintenance of visitor books in an Australian context.

9.3.4 Making rock art visible: Cleaning, painting and highlighting of petroglyphs for better visibility

9.3.4.1 A problem in the presentation of petroglyphs is commonly their poor visibility under normal conditions. Visitors often are not able to make out the designs on the rock surfaces because of little difference in the colour of the grooves and of the surrounding rock surface. Also, rock art panels may be overgrown with moss or lichen. Attempts by visitors or tour guides to make the rock art more visible have led to vandalism, such as scratching, chalking or painting of the petroglyphs. In an effort to avoid such actions by visitors, various methods for raising the visibility of the rock art have been introduced by site managers, such as the painting of petroglyphs, the repeated cleaning of the rock surface and the highlighting of petroglyphs. These methods have been heavily criticised for their potentially destructive effects on the petroglyphs and the rock surface. A method, which makes direct contact with the rock surface unnecessary, is day or night viewing with side-light (raking light) (see section 9.3.4.5.1).

9.3.4.2 Cleaning the rocks

9.3.4.2.1 The cleaning of rock surfaces with petroglyphs has a long tradition. Rock surfaces have been washed and scrubbed with water and a variety of chemicals, and often have been cleaned of plant growth and debris. Cleaning serves two purposes. First, it makes the motifs more visible. Secondly the removal of plants, such as lichen or moss, is frequently considered as beneficial for the condition of the rock surface. However, cleaning removes potential dating evidence, since plant growth, such as lichen, could give an indication of the age of the site. The cleaning process can also remove particles from the rock surface and so accelerate erosion (see Chapter 6). Additionally, it is feared that exposed rock surfaces are more vulnerable to weathering. At Naquane, Valcamonica, Italy, the rock surfaces are frequently cleaned using water and brushes. The use of plastic brushes and of metal brushes (!) is reported. The cleaning of rock surfaces only poses a problem in the presentation of sites, but also for the recording process. Currently different approaches are taken. On the one hand the cleaning of rock surfaces is no longer advocated, as in Britain, on the other hand rock surfaces are generally cleaned for recording purposes in other regions, for example in Sweden and in Italy.

9.3.4.3 The painting of petroglyphs

9.3.4.3.1 The painting of petroglyphs, i.e. the infilling of the grooves with permanent paint, is a further practice for enhancing the visibility of petroglyphs. This method has been heavily criticised on various grounds. However, the painting of petroglyphs also serves a specific purpose in the presentation and protection of rock art sites. The practice of painting petroglyphs is, for example, used in the presentation of sites in Scandinavia in order to make the designs more visible. It is accepted by Scandinavian rock art researchers and expected by the public. The painting and re-painting of rock art sites in Scandinavia for better visibility has a long tradition, starting in the 1920s. "Since the sites have been painted for a number of years, the public has become used to having the opportunity to comprehend the figures and compositions clearly, to take nice pictures, etc. We realise that this is a fair demand that we have to meet" (Hygen 1996, 52). The good visibility of the petroglyphs guarantees satisfied visitors, which are aware of and interested in their heritage. Furthermore, in defence of the painting practice the argument is put forward, that the visitors themselves would try to enhance the visibility of the petroglyphs. Controlled painting, therefore, protects the petroglyphs from vandalism. Unpainted sites are "under-communicated" in contrast to the painted sites (Hygen 1996, 52). In this way visitors are kept away from the majority of unpainted sites and channelled to the painted sites. Only a small percentage of petroglyphs in Scandinavia are painted, between 1.4% to 4 % of all figures. The majority of petroglyphs has never been painted (Stanley-Price 1999).

9.3.4.3.2 The main arguments raised against the painting of petroglyphs are the potential deterioration of the petroglyphs by the effects of the painting, as well as the impossibility of applying current and future direct dating methods and the subjectivity applied in the painting process. Also, the painting of petroglyphs by some is regarded as intrusive, as compromising the site's integrity (Bahn *et al* 1995). At Aspeberget in southwest Sweden (see next chapter), petroglyphs were initially painted with dense epoxy paint for presentation purposes. Since the paint did not allow any moisture transport a gap developed between the petroglyphs and the paint, where moisture allowed "biological activity" (Bahn and Hygen 1996, 137). Eventually, the stability of the rock surface deteriorated and parts of the rock flaked off altogether with the paint. This effect is documented in Norway as well. According to current information the practice of painting petroglyphs has now been stopped in Norway (Stanley-Price 1999).

9.3.4.3.3 While the cleaning of petroglyphs removes potentially datable plants, particles or layers from the rock surface, the painting of petroglyphs, in contrast, potentially adds chemicals to the rock surface and in this way prevents direct dating efforts. Absolute dating methods are also inapplicable, since the effects of the painting of petroglyphs eventually destroy the rock surface (Bahn *et al* 1995).

9.3.4.3.4 The third main argument against the painting of petroglyphs, among others put forward by Bahn et al. (1995), sees painting as too subjective. Bednarik (1987) terms the painting of petroglyphs as "subjective enhancement method". What is painted and presented to the public is what the painter interprets to be there, not necessarily what is really there. Mistakes in the painting of petroglyphs may be permanent. Although Scandinavian researchers are aware of the shortcomings of the painting of petroglyphs in being too interpretive, this method also features in the rock art recording process, for example in Tanum, Sweden (Milstreu and Proehl 1996, 12). During the documentation of rock art at Tanum, wax rubbings, which are also banned in most other countries, formed the basis for the painting of the petroglyphs. Only then were the painted petroglyphs photographed.

9.3.4.4 The highlighting of petroglyphs

9.3.4.4.1 Highlighting petroglyphs is another method used for making petroglyphs more visible. Petroglyphs in the Sydney area, Australia, for example, are difficult to recognise for the untrained eye since much of the colour contrast between the rock surface and the petroglyphs has disappeared. Consequently, vandalism in the form of outlining or scratching–in petroglyphs has occurred frequently, such as at Bulgandry, Gosford. This action resulted in the loss of the original groove profile. Also, motifs were altered. The National Parks and Wildlife Service then decided to highlight the original petroglyphs in order to prevent further vandalism. In 1989 this was the only Australian site where highlighting was considered necessary. The method used in highlighting the petroglyphs involved the cleaning of the groove profile from organic material by soaking the grooves and brushing them with nylon brushes. This process had to be repeated at regular intervals. Alternatively, the area of rock outside the grooves could be cleaned, trying to give the rock surface beside the grooves a lighter appearance in contrast to the darker grooves. It is, however, recognised that the highlighting of petroglyph grooves could eventually, like the painting of grooves, reflect an interpretation of what is there rather than what is really there. After highlighting it is virtually impossible to see non-highlighted marks (Lambert 1989, 56).

9.3.4.4.2 At the site of Peterborough, Canada, the use of air-abrasive methods was suggested for highlighting the petroglyphs. At this site the petroglyphs are filled with dark wax crayon, which was applied in the 1950s and reapplied in the 1970s. Highlighting was suggested in order to remove the dark crayon and to bring the petroglyphs into their original state of being white shapes on the darker marble rock surface (Wainwright 1997). Air-abrasion was tried on one motif, which in result stood out clearly as light shape. The method was heavily criticised by Bahn, Bednarik and Steinbring (1995) as "professional vandalism", because it was considered to be too subjective and to potentially destroy the surface of the grooves. Apart from one trial motif, no further petroglyphs have been highlighted (see also section 9.3.6.4).

9.3.4.5 Non-contact methods

9.3.4.5.1 A non-contact method for making petroglyphs more visible is the use of side-light or raking light. Side-light creates shadows in the grooves and in this way makes petroglyphs more visible. Visitors can be informed in leaflets or at visitor centres at which time of the day the petroglyphs are most visible. Usually most detail can be seen in the morning and the evening with the sun standing at a low angle. Additionally, at other times of the day mirrors can be used to redirect sunlight onto the petroglyphs in a low angle. Very good visibility of the petroglyphs can be achieved at night with powerful side-light (see for example case study on Peterborough). Raking light is sometimes used in night photography in the documentation and recording of petroglyphs, e.g. in the Valcamonica, Italy (Kleinitz, *pers.ob*s.).

9.3.5 Visitor education

9.3.5.1 Site development measures all over the world put great emphasis on visitor education. Visitor education involves, on one hand, information about the rock art itself, on the other hand information conservation issues and on visitor conduct at the sites. Information on rock art provided at the sites can focus on the specific site alone, supply more general data on rock art regions or present rock art as part of archaeological landscapes. This information can be made available by various means, such as through signs or information panels, through leaflets, guided tours, or in site-related museums. However, visitor education is not limited to the sites themselves. Information material on rock art should be placed at Tourist Information Centres, regional museums and other communal places (the visitor information point in Millfield Café north of Wooler, Northumberland is a good existing example). Education on rock art should not only target tourists, but also aim at informing the local communities. Additionally, an awareness of rock art as an important and fragile part of the cultural heritage should be raised in schools, in public talks, organised excursions to rock art sites and by other means, such as popular books, TV and the World Wide Web. In the following chapter a range of visitor education measures at rock art sites are presented. Also, some indication is given as to what kind of information should be provided by the various means.

9.3.5.2 Signs which inform and direct visitors

9.3.5.2.1 Various categories of signs are used at rock art sites. First, directional signs placed by roads or along footpaths direct the visitors to the sites. At the sites themselves either administrative signs or information signs are placed. All signs should be placed in a visible location close to the rock art, but sufficiently distant to allow unhindered photography of the images.

- **Administrative signs:** This category consists of signs set up by various authorities. Administrative signs give an indication of official care for the site. They identify the site, the authority under whose care the site is placed and state regulations of visitor behaviour (Stanley-Price, pers. comm.). In Australia such signs are used specifically at isolated sites. The sign reveals that the site is known to the authorities and that it is frequently visited. Administrative signs help to prevent visitors feeling a sense of ownership towards seemingly newly discovered sites. It is hoped that graffiti to record this 'first' visit or removal of material are avoided in this way. A further function of these signs is the redirection of vandalism from the site to the sign. Vandals often seem to be satisfied with striking at "officialdom" (Lambert 1989, 37).

- **Information signs:** Information signs at the sites vary significantly in their content and their design. These signs, for example, inform about the site itself, about the surrounding landscape, about research at the site and about opportunities for recreation (Stanley-Price, pers. comm.). The information on such signs should be site specific. General information on the signs can often be misleading. A study at the site of Bulgandry, New South Wales, has shown that the generalised nature of the interpretive signs tended to confuse visitors, who were given little information on what they were actually looking at. The provision of site specific information enhances the visitor's experience and provides protection to the site. The information provided should be up to date. Regarding the information content and the layout of the sign, it has been shown that signs containing photos or other images in combination with a limited amount of text are most likely to be read (Lambert 1989). Modern information signs usually include a tracing or photo of the images on the rock surface, short information about the rock art, its age and its wider context. A short reminder of appropriate visitor behaviour should be added. If the site is a scheduled monument, this should be clear from the sign as well. The signs are most likely to be read when they are positioned at a convenient spot. They should not obstruct the view on the rock art. More than one copy of the sign should be at hand, so that they are easily replaced in the case of vandalism directed against the information sign.

9.3.5.3 Information material placed on sites

9.3.5.3.1 **Leaflets:** Beside information signs or panels that are permanently placed at the sites, information leaflets are a commonly used way of on-site visitor education and guidance. The content and design of information leaflets is addressing various needs. Visitors are supplied with site-specific and general information on a rock art region, while site managers can provide guidelines on visitor conduct at the sites. Leaflets are made available to the visitors directly at the sites, at the entrance of archaeological parks, in visitor centres, in museums or in Tourist Information Centres. At larger sites or at visitor centres a variety of leaflets and other information material, such as brochures and books, should be made available in order to provide a choice according to the level of interest and the age of the visitors. Specific leaflets for children are used at a number of rock art sites. A range of information is generally included on leaflets, such as:

- general background information (what is rock art, what is its importance);
- site-specific information, e.g. what is depicted on the rock surface, how old is it, who made it and how (descriptions and images are given);
- information on other archaeological attractions or places of natural beauty in the vicinity;
- location and access maps, opening times (if applicable);
- conservation concerns, protection measures taken, visitor behaviour guidelines;

- contact address for more information;
- Additional information can be provided on best visibility times of the images, for example in the mornings or evenings, when the sun is at a low angle. Some leaflets are organised according to the most frequently asked questions in a question-answer format and;
- Regular maintenance has to remove discarded leaflets from the sites and its surroundings.

9.3.5.3.2 **Behaviour guidelines**: A clearly visible section on visitor behaviour guidelines should always be included, which stresses the fragility of rock art and its importance as part of the cultural heritage. It should clearly state what is forbidden and why it is forbidden: do not cause damage in any way, do not cross barriers or fences, do not walk on or touch the rock art, do not scratch or draw in the grooves, etc., since you will damage the rock art. Some quotes from leaflets from Australian rock art sites show how a clear reason is always given for specific visitor guidelines:

- "Rock art is irreplaceable. We must all co-operate to ensure it will be preserved for the future. Please do not touch the art." (Mulka's Cave, Hyden, Western Australia).
- -"Do not walk on the engravings. If you walk over the sandstone surface containing the engravings the abrasion caused by your feet will damage the Aboriginal Art" (The Basin Track, Ku-Ring-Gai Chase National Park, Australia)
- "Make sure that you do not touch the art or the rock surface: the oils from your skin will damage the paintings, loose particles of paint will dislodge, small flakes of rock will dislodge" (Yankee Hat, Nama National Park, Australia)

Site managers may take the opportunity to explain to the public why certain protective measures had to be taken. The existence of fences and walkways, for example, could be explained as beneficial for the visitor, since they help preserve the art.

9.3.5.4 Guided Tours

9.3.5.4.1 Guided tours to rock art sites by trained tour guides or local enthusiasts with a wide knowledge on rock art are a valuable tool in the education of visitors, such as at the Coa valley sites. Guided tours also allow for the supervision of visitors at the sites. However, insufficiently trained guides can provide incorrect information. Also, badly supervised and informed tour groups can lead to damage on the sites. Regulations are therefore necessary as to who is qualified to lead guided tours (Lambert 1989, 40).

9.3.5.5 Interpretive trails

9.3.5.5.1 Interpretive trails are a successful means of guiding visitors through sites and at the same time of providing a large amount of information on rock art. Interpretive trails, also referred to as self-guiding trails, are often set up at larger rock art sites, such as at Deer Valley, Phoenix, Arizona or at Alta, Norway. They consist of a system of stops at the most spectacular points of the sites, where visitors are provided with more detailed information on specific rock art panels. This information is supplied on information signs at the stops and/or on leaflets. The signs are either positioned beside the panels or fastened to the handrails of walkways. Interpretive trails have the advantage that visitor movement can be well controlled, since they usually move through the site in one direction.

9.3.5.5.2 Clearly laid out paths, possibly with guidance barriers, have to be in place in order to guide the visitors from one stop to the other. Often interpretive trails are equipped with walkways, such as at Alta, Norway. At the park of Naquane, Valcamonica, Italy, a combination of paths and walkways guides the visitors through the extensive site. The visitor can choose between 5 different routes of varying length. According to their level of interest and their time, the visitors can take short or more extensive circuits across the site. At each of the stops an interpretive panel is provided, which states the number of the stop and provides information on the designs on the rock surfaces (text and images). Leaflets with brief information on each stop and more detailed guide-booklets are available at the park entrance.

9.3.5.6 Site-related Museums

9.3.5.6.1 A method for visitor education commonly used at very important rock art sites, groups of sites or rock art regions, is the erection of visitor centres and/or site-related museums. While visitor centres mainly cater for visitor needs, such as facilities (toilets, restaurants, etc.) and gift shops, they also aim at visitor education. Their display usually includes some general, and some site-specific information on rock art.

9.3.5.6.2 Site-related museums usually provide a more in-depth coverage of rock art related information and of specific site information. Beside the permanent exhibition, smaller temporary exhibitions may concentrate on special topics, such as on new discoveries or on a more detailed coverage of a specific area. Temporary exhibitions could also focus on rock art in other parts of the country or the world. Site-related museums may supply leaflets, maps, books and other media about the sites in the region and about rock art in general. Often these museums consist of two departments. One part consists of an indoor section that provides in-depth information on the sites and/or on general rock art studies in temporary and permanent exhibitions. The second part features the sites themselves in the open.

9.3.6 Rigid protective measures on rock art sites and their effect on the presentation of rock art

9.3.6.1 Some rock art sites show accelerated deterioration because of environmental factors, such as weathering, and of human intervention, such as erosion through visitors' feet or the touching of panels. To counter this development, rigid measures are developed for the protection of rock art sites. The first of these measures presented here is the use of replicas as replacement of the original sites, which can no longer be visited. An example for the complete closure of a site for the public is Lascaux, France, which was replaced with a replica, Lascaux II, close to the original site. A panel at Gardom's Edge, Peak District represents the rare replacement of a single rock art panel in the open with a replica, where the original panel was buried for conservation purposes. The second method presented is the complete or partial enclosure of sites with protective structures. Two case studies are presented. The first discusses a partial enclosure, a shelter at Aspeberget, Sweden. After the partial enclosure failed to improve the condition of the rock surface, the shelter was dismantled and the petroglyph panel was buried. The second case study presents the much-discussed complete structure at Peterborough, Canada. In this second case the rock art is presented to the public in a new context, separated from its natural environment.

9.3.6.2 The use of replicas in the presentation of rock art

9.3.6.2.1 Latex casts were used to provide museums with material, when the rock art panels were not removed from their original setting. Some rock art sites, such as small shelters, are copied as museum exhibits such as at the Southwest Museum, Los Angeles. Here a facsimile of a Chumash painted rock shelter is exhibited, which was modelled after a rather inaccessible site in the Santa Susanna Mountains, California. The exhibit was intended as an educational tool, to give visitors the possibility to familiarise themselves with an important part of the Native American Heritage. However, the replica was strongly criticised, since it was presented out of context and only reflected a small part of Chumash culture. Additionally, visitors were allowed to crawl into the shelter and touch the paintings, which was criticised as encouraging such behaviour at actual rock art sites (Faulstich 1991). This and other replicas are displayed in a museum context, far removed from their original setting. Rarely are replicas used in the presentation of rock art *in-situ*, at the actual sites, such as at Lascaux, France and at Gardom's Edge, England.

- **Lascaux II:** The replica of parts of the cave of Lascaux with its Palaeolithic paintings is possibly the most famous replica of rock art. Lascaux II, located close to the original site, is visited by about 2,300 visitors per day. It is a very successful attempt to replace an original attraction, Lascaux, with a copy. Lascaux II also diverts visitors from the actual rock art sites in the region to the replica, and so eases some of the visitor pressure on these sites. At Lascaux II a clear explanation is provided why a substitute site was developed. The visitor is introduced to the subject of conservation by learning about the causes of the deterioration of the original site and about how the paintings are now protected. The construction of Lascaux II consequently led to the conservation of an endangered site, but still allowed informed access to the heritage for visitors (Clottes and Chippindale 1999; Delluc and Delluc 1984; Perier-D'Ieteren 1998, 6).

- **Gardom's Edge, Peak District:** The burial of petroglyph panels under layers of turf, soil or sand is sometimes chosen to protect the sites from erosion and vandalism (Morris 1981, 125; Blanks and Brown 1991). This practice makes any further study or public presentation of these sites impossible. The placement of a replica of the rock art panel close to the location of the original could offer a solution. This approach was chosen in a Rock Art Project run by the Sheffield Arts and Museums Department and the Peak National Park Authority in 1995 and 1996, when a replica was mounted close to the buried petroglyph panel at Gardom's Edge (Walster 1996a and 1996b). Discovered and excavated in 1965, the rock surface of the Gardom's Edge stone, with several cups and cup-and-ring marks, started showing signs of increased erosion, leading to a loss of detail. Incidents of vandalism, for example, the use of bleach by some visitor to remove moss and lichen from the rock surface, were also noted. Since rock art in this area is a rare phenomenon and since the Gardom's Edge stone is one of the finest examples in the region, it was decided to bury the rock in order to preserve the petroglyphs. A durable outdoor replica made from rubber latex was to give an impression to visitors what had to be buried for protection. Before the latex mould was taken, several experiments as to most suitable materials and methods for taking the mould were undertaken, since damage to the rock surface was to be avoided. After the mould was taken, a cast of the rock was immediately made for the exhibition "Back to the Bronze Age" at Sheffield Museum. The cast was made in plaster of Paris, which was then painted with emulsion paint and acrylics. The area around the replica was "landscaped" with compost, leaf litter, heather and bracken. The cast is now on display in the Archaeology gallery at Sheffield Museum. The second phase of the project involved the burial of the rock art panel and the placement of the replica at the site. The outdoor cast of the rock art panel was made from fibreglass reinforced polyester strengthened with coremat. The final stone-like colour was achieved by both pigmenting the cast itself and by painting the cast with acrylic paints. The replica was placed close to the buried rock art panel, but does not interfere with it. It is mounted at a similar height and in a similar orientation as the original. Boulders were placed around the replica in order to recreate the original surrounding landscape. The original was then buried. In order to prevent people from re-excavating the original stone, its exact position was disguised. The process of taking the mould and of air-lifting the replica to the sites created a fair amount of media attention. However, no information is available on the current public acceptance of the project. The condition of the original panel under its cover will be monitored at regular intervals, only then will it be possible to evaluate the usefulness of its burial and replacement with a replica (Walster 1996a and 1996b).

9.3.6.3 Protective Structures (Aspeberget, Tanum, Sweden)

9.3.6.3.1 At the large and well known petroglyph site of Aspeberget, Bohuslan, the condition of the petroglyphs is rapidly deteriorating because of the effects of accelerated weathering through acid rain, water-flow, pollution, and visitor impact. In 1989 it was decided to cover the panel with a protective structure consisting of a wooden frame, which supported plastic walls, ending shortly above the ground. The aims of this structure were to stem the flow of water across the petroglyphs, to reduce the impact of weathering caused by chemical deterioration, acid rain and the impact of direct sunlight, as well as to keep visitors off the panel. In 1996 the structure was declared a failure, since only mechanical wear caused by visitors was stopped. Otherwise, the situation of the petroglyphs could not be improved and new problems appeared, such as the growth of new species of lichen and algae or the accumulation of soil under the structure.

Consequently, the structure was removed and the petroglyphs covered with a thick layer of soil and sand. Currently possibilities are being sought, which protect the petroglyphs, but still allow visitors to see them. In December 1998 the RockCare project of the Tanum laboratory of cultural heritage was launched. The project, which is co-financed by Sweden and the European Commission Raphael Project, examines methods of protection from erosion and pollution. Before any other structures are constructed on top of petroglyph panels, their impact will first be tested on outcrop rock without petroglyphs (Bahn and Hygen 1996; Stanley-Price 1999).

9.3.6.4 Protective Structures (Peterborough, Ontario, Canada)

9.3.6.4.1 The large petroglyph site in the Petroglyphs Provincial Park near Peterborough, Ontario, was enclosed by a fence in 1967. Later a wooden viewing platform was built on one side of the site to allow visitors a better view across the large petroglyph panel. Until 1977 wax crayon or charcoal were used to fill in the petroglyphs, since they otherwise could not be seen from beyond the fence (Wainwright et al 1997). After the major threats to the site, such as algae growth and frost weathering, were identified in the 1980s, it was decided to fully enclose the site with a permanent structure. A comprehensive management plan for Petroglyph Provincial Park was created, which focused at the conservation of the site, while at the same time taking into account visitor needs. In 1990 a permanent structure was built which fully encloses the petroglyph site. Such a structure makes the viewing of the rock art in its natural setting impossible, since it greatly alters the character of the site and its context. The design of the Peterborough structure therefore aimed at being as little intrusive as possible, preserving the petroglyphs as part of the landscape. A light and airy, tent-like structure was built, which was approved by the elders of the local Native American community. The alignment of the structure follows several factors, such as the shape of the rock outcrop, the general sloping of the site, the geological history (direction of fissures on the rock) and the suggested astronomical significance of a "large sun figure". The approach to the petroglyph site also was carefully planned. A car park, a gate-house and two picnic areas were developed along a meandering trail. A visitor centre was to provide information on the petroglyph site and on rock art in general. In addition to the interpretive displays the centre would house a 40 seat theatre, a library, and archives. Soon after the visitor centre the protective structure is reached. Inside the visitors are guided along an elevated concrete walkway with handrails, which slopes according to the terrain. The walkway, which is between 4 and 6 m wide, controls visitor access, facilitates optimum viewing angles and provides gathering areas for information, as well as comfortable access for disabled people. Special evening programmes allow visitors to experience viewing the petroglyphs under raking light. Visitors are informed via leaflets and information panels about conservation measures and research undertaken at the site (Wainwright 1997). The construction of the structure has generated a heated discussion about the appropriateness of such "massive intervention in rock art". Its opponents stress that before any substantial intervention at a rock art site is initiated, all other possibilities for a less interventionist protection and presentation of a site need to be considered (Bahn, Bednarik and Steinbring 1995, 1996, 1997; Bullen 1996; Franklin 1996; Wainwright 1996; Ford 1997).

9.4 Approaches to the presentation of greater numbers of sites or rock art regions

9.4.1 Up to now this chapter has primarily focused on the selection and development for public access of single sites. This chapter aims at presenting a collection of case studies on the *in situ* presentation of groups of sites or rock art regions. The management of larger or very important sites, groups of sites or rock art regions often is connected with presentation efforts on a larger scale, such as the construction of visitor centres, site-related museums and research facilities. Since the local conditions vary from case to case, a range of different presentation measures is chosen in each example. Here two case studies on the presentation of petroglyph sites and rock art regions in Europe are presented. Both case studies are concerned with World Heritage sites/regions and will show the specific challenges which were encountered in the presentation of rock art. Again, petroglyph sites have been chosen, since the experiences made in their management and public presentation are most relevant for the British context.

9.4.2 The presentation of rock art at Alta, Norway

9.4.2.1 From 1973 onwards 49 rock art sites in were discovered at Alta, arctic Norway (Helskog 1988b). Since industrial development, erosion caused by high numbers of visitors endangered the petroglyphs, steps for the preservation and public presentation of the rock art sites urgently needed to be taken (Helskog 1988a, 1992). Proposed protection and presentation methods involved the concentration of the visitor flow to the site at Hjemmeluft, which was located close to a major road. While Hjemmeluft would feel the main visitor impact, visits to other sites were actively discouraged, the most drastic action being the burial of the rock art panels under layers of turf. The presentation of the Alta petroglyphs made the Hjemmeluft area one of the major tourist attractions of northern Norway. Further interest in the site was generated by the inclusion of the Alta petroglyphs in the UNESCO World Heritage List in 1985 (Helskog 1988a, 1992).

9.4.2.2 At Hjemmeluft the local community was incorporated in the rock art project from the planning stage onwards. The involvement of the local community was crucial, since the management of the site would eventually be the responsibility of the local museum. Local commitment to the protection and subsequent development of the rock art site grew after the economic advantages of the development of the petroglyph site had become transparent. Rock art tourism became a major source of income in the area. Subsequently the local government took the chance of promoting Alta not just as a heritage site, but was also advertising business and housing of the basis of the newly found popularity of the area.

9.4.2.3 In order to be able to present and preserve the petroglyphs within a wider landscape setting, all private land in the area of the Hjemmeluft petroglyphs was bought by the state and the petroglyphs declared a protected monument according to the Cultural heritage Act. Long-term local interest and support for the Hjemmeluft site was secured by making some concessions to the local community. Those local landowners that had sold their land to the museum, were nevertheless allowed to continue certain activities close to the petroglyph areas, such as boating, fishing, stock-fish-drying, cattle-grazing and picking berries. These traditional activities were regarded as compatible with the preservation and presentation of the petroglyph site (Helskog 1988b). At the same time as these locals were using the land in the protected zone, they felt responsible for the site and were acting as its guardians (Helskog 1988b). Helskog stresses, that the area is "living and pulsating as before…It is not a dead fenced in museum area at any time of the year" (Helskog 1992, 103). However, although the involvement of the local community in the presentation and preservation of the Alta petroglyphs is stressed in the site development reports, no involvement of any kind is mentioned of the Sami population, which regards the petroglyphs as an old manifestation of their culture history (Helskog 1988a, 1992).

9.4.2.4 The Hjemmeluft petroglyph site is a large site with about 1500-2000 motifs scattered over c. 30.000 m^2. The first steps in the development of this site involved the construction of a car park, a ticket office, and a 3.5 km long interpretive trail across the site, based on a walkway system. The panels forming the trail were selected in order to show a variety of motifs, of different associations of petroglyphs with other archaeological sites as well as different environmental settings of the rock art panels. All in all 17 stops or posts with numbered information panels were established. A small guide-book can be bought which briefly describes the petroglyphs at each post. In addition to the guide-booklets, guided tours are offered on a regular basis (Helskog 1992). Two types of walkways were constructed, one in gravel and one in wood, the latter being slightly elevated because of the wet ground. Steps were avoided, to make access easy for disabled people. At the most popular points the walkway was widened to allow groups of people to gather. From a little platform at a lookout point photos can be taken of the area. Resting places with benches and tables were established along the walkway. Signs were set up, which remind visitors not to leave the walkways and not to damage the carvings. Initially the petroglyphs close to the walkway were painted with red/brown paint order to make them more visible for the visitors. This was considered necessary, since it was feared that dissatisfied visitors would step off the walkway to view the petroglyphs or even add colour to the images themselves (Helskog 1988a, 1988b). An evaluation of the walkway system in 1992 showed that nearly all visitors (99%) kept to the paths, while before the construction of the walkways they moved across the whole site. Damage to the environment and to the petroglyphs could be considerably reduced, while at the same time the visitors enjoyed a well developed site with visitor facilities and information on the petroglyphs (Helskog 1988a, 1992).

9.4.2.5 An important role in the presentation and protection of the petroglyphs is played by the Alta museum, which was erected close to the principal petroglyph site at Hjemmeluft. Although its exhibits and activities are mainly concerned with rock art, the exhibition does not repeat what can be seen outside. It rather focuses on the national and international context of the Alta petroglyphs, on general information about rock art and on recent rock art research. Since tourists only arrive during the short summer period, the museum aims primarily at the local community of about 10.000 individuals during the rest of the year. Therefore a range of temporary exhibits concentrates on local history and other themes of interest for the local population (Helskog 1988a, 1992).

9.4.3 The presentation of the petroglyphs of the Coa Valley, Portugal

9.4.3.1 The petroglyphs of the Coa valley in northeastern Portugal have been at the centre of a fierce debate since their discovery in 1992 (e.g. Bednarik 1995, 1996; Watchman 1995; Zilhao 1995, 1997). About 200 rock art panels with c. 1200 motifs were recorded over a distance of 17 km along the Coa river, in an area which was to be flooded due to the construction of a dam. The depictions of animals, such as aurochs, ibex and horse, were stylistically dated by some archaeologists to the Palaeolithic, making the Coa valley the most significant open-air Palaeolithic rock art region currently known (Bahn 1995a, 1995b, Zilhao 1995, 1998, Zilhao et al 1997). In 1995 the dam project was halted and subsequently an archaeological park of 200 km^2 was established. In 1997 the area became a National Monument (Coa River Valley Archaeological Sites National Monument), thus benefiting from the highest legal protection possible under Portuguese law. In 1998 it was elevated to World Heritage status.

9.4.3.2 In 1997 the Parque Arqueologico do Vale do Coa was created with the help of a generous government grant, which financed its research and visitor facilities, but also provided support for economic development in the region through the promotion of traditional land management practices. Related projects, such as the development of the infrastructure, of communication systems and of cultural tourism in the region peripheral to the park have been funded as well.

9.4.3.3 Created alongside the Coa Valley Archaeological Park is a research centre, the CNART (Centro Nacional de Arte Rupestre), which is dedicated to the study of all Portugese rock art. Its main task is to promote and co-ordinate the recording and study of the petroglyphs in the Coa Valley. Various new recording methods are tested, such as laser scanning and stereo photogrammetry. The aim is to achieve highly accurate recordings of the rock art panels, which allow an exact 3D reproduction of the petroglyphs without the use of direct contact recording methods, such as latex moulds. Systematic archaeological surveys of the areas surrounding the petroglyph sites aim at establishing the historic context of the rock art. Several Palaeolithic camp-sites have been located so far (Zilhao 1998).

9.4.3.4 A range of presentation measures has been adopted at the Coa Valley Archaeological Park. In the park itself three petroglyph sites have been heavily advertised and made accessible to the general public, Canada do Inferno, Ribeira de Piscos and Penascosa. These sites were selected since the petroglyphs, made by pecking the rock surface, are better visible than the incised petroglyphs at other sites (Zilhao 1999, *pers. comm.*). The remoteness of the rock art sites necessitates specific presentation measures. Visitor access is strongly controlled and restricted to organised tours either by the park authorities or by tour companies. Independent visitor access is not possible. Private cars, other than those of local landowners, are forbidden to enter the area. In restricting visitor access to organised tours, visitor behaviour can be closely monitored and vandalism prevented. Organised four-wheel drive tours, accompanied by guides, who are appropriately trained in archaeology and rock art studies, take small groups of visitors to the sites. The number of visitors in the groups is limited to eight persons, making crowding at the sites impossible. The tour schedules take account of the best visibility times during the day, since the colour contrast between the stone and the petroglyph has disappeared over time and the petroglyphs are only faintly visible. Additional to the information provided by the guides, information material is provided for each site. Large explanatory panels located next to the rock art were considered as too obtrusive. Instead, each visitor is supplied with an A4 sized folder with cards featuring photographs, tracings, reading schemes and written material on all panels visited. These folders can either be purchased or returned at the end of the tour. Since only a limited number of tours are available each day, it is possible for visitors to make advance bookings through the park office. About 2000 visitors per month visited the three sites (Zilhao 1998; Zilhao 1999, *pers. comm.*).

9.4.3.5 In addition to on-site information, visitor centres were set up in the villages and towns closest to the sites. The guided tours depart from the visitors' centres. These centres provide information on the rock art sites, such as panel tracings and presentations on computer screens. Visitor facilities, such as restaurants, toilets and shelter are also provided (Zilhao 1998). At Canada do Inferno a museum complex is planned, which will incorporate the new park offices, the research centre, as well as the Museum of Rock Art and Archaeology. After the completion of this complex, the sites of Canada do Inferno and Rego da Vide will be able to be visited as an outdoor extension of the museum. Access to these sites will be unrestricted, although guards will be placed by the panels. Other sites in the Coa valley, which are currently not visited by the guided tours, may in future be included in the tour schedule. Visits to these sites will be organised as "safaris", as is the current practice. In future, visitors will be able to chose between visiting sites according to the 'museum scheme' and/or to the 'safari scheme'. Beside the rock art a variety of other attractions are being made available to the public, aimed at raising the attractiveness as a tourist destination of the area as a whole. A privately run museum at Quinta da Ervamoira, which presents Roman remains uncovered at the property, as well as displays on local ethnography and local agricultural produce, has already been integrated into the archaeological park (Zilhao 1998).

9.5 Museum display and ex-situ rock art

9.5.1 Rock art today mostly is presented *in-situ,* in its original setting. However, portable samples of rock art, be they originally mobiliary, or forcibly removed from larger panels, can be found among the displays of museums with archaeological material all over the world. The display of rock art *ex-situ* in museums poses specific challenges, since the finds are separated from their original place in the landscape and, consequently, become museum objects often valued for their artistic qualities like western art. Therefore the removal of rock art from its natural environment is only justifiable if a site is in danger, since the museum environment can save rock art from destruction through flooding, mining or quarrying. However, the tendency now is to take the museums to the rock art sites and not the rock art to the museums.

9.5.2 Museums form a substantial factor in the education of the public and rock art can be presented in museums as an important part of the cultural heritage. The methods used in the presentation of rock art *ex-situ* are, however, only rarely a topic in publications (Anati 1990; Dowson and Lewis-Williams 1994). One of the aims of this Pilot Project was to evaluate how well rock art is represented and presented in museums in the British Isles and, consequently, to what extent the public is made aware of this part of Britain's heritage in a museum context. Many museums and private collections in Britain have examples of rock art, mostly formed by mobiliary samples from burial contexts, such as cist slabs (Beckensall 1983, 1986; Beckensall and Laurie 1998; Morris 1977, 1979, 1981). Also, some mobiliary examples, which had been incorporated into boundary walls or houses, have recently been offered to museums (S. Beckensall, *pers. comm.*).

Since no published information was available on the presentation of rock art in British museums a questionnaire was prepared and sent out to a range of museums with rock art samples in their collections. The questionnaire aimed at establishing the size and character of rock art collections held in British museums, and at gaining information on how these are conserved and displayed. The data collected via the questionnaire forms an important source which allows suggestions as to how rock art can be better presented in British museums and how public awareness on rock art can be raised in a museum context, for example, through temporary and/or travelling exhibitions. The questionnaire had the following sections:

Overview: Number of items accessioned; Motif types accessioned; Number of mobiliary and earthfast boulders both in storage and on display; Number of items forming part of temporary and permanent displays; Geographical areas are represented by the collection; the extent of replicas used and the level and types of conservation treatments (if any) undertaken.

Education: Whether visitors are allowed to touch the collection ad make rubbings / tracings and if this material is used in educational programmes.

Interpretation: Extent of information displayed with exhibits (basic archaeological information, dates, interpretations of the meaning of motifs or the use of rock art, information on techniques of manufacture, information on decay and conservation and references to other rock art sites / further reading)

Further details: Media types used; date of displays; public encouragement of site visits; provision of guide books and publications; web access facilities; whether the institution is interested in taking or mounting a temporary display on rock art; additional comments and; museum contact details.

9.5.3 Thirty three museums were targeted: eighteen in England, thirteen in Scotland, one in Wales and one in the Isle of Man, of which 21 replied (APPENDIX H lists those museums). Although only 64% of the museums responded (54% in England), it is hoped that the results reflect the general character of *ex-situ* rock art presentation in Britain. The results of the questionnaire are collated into Tables 9.1 and 9.2. An estimated 168 separate objects (91 in England) are held in British museums, however the majority of these (127) were in storage at the time of writing. Where items are on display they generally form part of a permanent display, most of which were set up since 1990 (the remainder were prepared as far back as 1931, and from the 1960s onwards). Excepting the national museums, most exhibits are apparently presented in county and local museums closest to the original location of the objects. The rock art examples in English museums, for example, originate in the following areas: Northumberland, West Yorkshire, North Yorkshire, Cumbria, Peak District (Derbyshire), Cotswold District (Gloucestershire) and Mendip (Somerset). One museum, the Museum of Antiquities, University of Newcastle upon Tyne, Tyne and Wear, in particular stands out from the replies as having the largest collection of rock art within British museums. The New Museum of Scotland did not reply to the questionnaire and so was not considered here. It holds over 50 rock art items alone with a range of different motifs present, such as cup marks, cup-and-ring marks, grooves, spirals and zoomorphs. Since different terminologies are used in the description of the motifs it is hard to evaluate which motifs are really present on the rock art examples in museum collections. The most frequently named motifs were cup marks and cup-and-ring marks. Other motifs named were spirals, ladders, ovals, lozenges and zoomorphs, while single examples of the following motifs were identified: human feet, cruciforms, grooves, rayed wheels and right angles.

9.5.4 When comparing the current display of objects in the museum to those in storage it appears that broadly, the larger panels tend to be displayed whilst proportionally more of the smaller mobiliary items are currently in storage. The display of original panels is normally favoured over the use replicas with only three institutions making use of the latter (Manor House Museum, Ilkley, Sheffield City Museum and the National Museum of Wales, Cardiff). Conservation measures are not normally undertaken on panels once in the museum, except in three museums

(Fulling Mill, Durham; Museum of Antiquities, Newcastle; Kilmarnock House). Seven institutions actively encourage physical interaction with rock art objects and of these, one (Sheffield City Museum) allows rubbings and tracings to be made. The use of these exhibits in formal and informal education programmes was cited in eight cases and one institution (National Museum of Wales) noted the use of rock art as part of the national curriculum.

9.5.5 Where exhibits are on display, basic information on the panels, such as their original location and a description of the motifs is provided by most of the institutions via some form of label or panel, rarely also via leaflets (Bristol City Museum and Art Gallery). More detailed information, such as estimated dates or techniques of manufacture are generally only provided on request, so is information on the decay and conservation of rock art. Whilst many museums now have websites, none of those polled have sections dealing with rock art. Only few museums encourage visits to rock art sites (Manor House Museum Ilkley; Museum of Antiquities, Newcastle; Bute Museum, Rothesay and Dundee Art Galleries and Museums). Two of these museums offer guided walks (Manor House Museum, Ilkley and Bute Museum, Rothesay), while the Museum of Antiquities provides leaflets. Only Dundee provides guidelines on visitor behaviour.

9.5.6 In summary, rock art forms part of the displays of at least 17 museums in Britain. Between 1 and 5 rock art examples are exhibited at any of these museums. In most of these cases basic information on the exhibits is provided, but no information on rock art in general. In about one third of the museums rock art was used for educational purposes. Visits to rock art sites are rarely encouraged, and if they are, visitors are usually not supplied with behavioural guidelines in order not to damage the rock surfaces. Issues concerning the decay and conservation of rock art are not normally addressed in a museum context, possibly because these issues have not been widely discussed in this country. A temporary travelling exhibition could raise awareness on this part of Britain's heritage. Thirteen institutions indicated that they would consider taking a travelling exhibition or mounting a temporary display on the subject.

9.5.7 An interesting aside to the discussion about the display of rock art is raised by the ongoing debate on where and at what level objects should be displayed. The Kilmartin House Trust, Kilmartin, Argyll has developed an attractive interpretation centre focusing on the surviving prehistoric monuments of Kilmartin Glen, an extensive monument complex in Argyllshire. The glen encompasses an important and dense concentration of carved panels and cist slabs (see RCAHMS 1999, 42-71), including the largest inscribed panel in Britain and display material on this is included in the exhibition. Currently the trust is disputing the decision made by Trustees of the New Museum of Scotland, Edinburgh to remove and display associated artefacts (in this case the 'Glebe cairn pot') from a local to a national context. Although not specifically related to carved rocks, the example highlights two issues.

- Locating *ex-situ* artefacts such as rock art panels some distance away from their 'find spot' removes them from their context and associative meaning i.e. their association with a place, area and other monuments / artefacts and;

- Along with those mobiliary items seen in gardens, walls, hedges and in general, removed from an archaeological context, artefacts can often be difficult to track.

9.5.8 Interestingly, Manx National Heritage has launched a programme of sensitive 'tagging' on all inscribed crosses on the Isle of Man (in museums, displays and in-situ) in order to keep a clear record of where items are and as a simple but effective method of identification. With the application of technology and an appropriate scheme, such a system might suit inscribed panels and museum display items on mainland Britain.

9.6 The future: Possibilities for the management and presentation of rock art in England

9.6.1 This section aims at summarising the earlier sections of this report with a view at the situation in England. Some suggestions will be given on how public awareness about rock art can be raised and how public access to rock art sites can be increased.

9.6.2 How can public awareness on rock art in England be raised?

9.6.2.1 In Britain little public awareness exists on the countries' rich rock art heritage. Rock art enthusiasts such as Ronald Morris in Scotland and Stan Beckensall in England have tried to bring this part of Britain's cultural heritage to public attention. Their extensive fieldwork has been published from the mid-1970s onwards in a range of books that are aimed at the general public. Some other attempts have been made to make rock art more known, such as the mounting of temporary exhibitions at the Manor House Museum, Ilkley, or at the Durham Light Infantry Museum, Durham City. The exhibition in Ilkley (c. 1980) focused on "The Bronze Age moor" and had a number of rock art panels on display. Children were encouraged to make their own cup-and-ring marks, using antler, on sandstone slabs provided. Although the attribution of most of British rock art to the Bronze Age is questionable and although curators should be cautious in encouraging visitors to make their own petroglyphs, such temporary exhibitions with a focus on rock art can be a good starting point for raising public awareness on this topic.

9.6.2.2 Beside temporary exhibitions mounted by the museums, a travelling exhibition on rock art could be taken by number of regional museums. Additional to providing information on rock art on a national and international level, this travelling exhibition could be given a regional focus according to where it is shown. Information on rock art in the region, its distinctiveness and its place in a wider context, could encourage local interest as well as more general visitor interest. Talks and organised excursions to rock art sites could provide a link between the exhibition and the actual rock art sites in the region. Museums also could place more emphasis on rock art in their permanent exhibitions. Information on rock art sites and access details could be provided in the museums, for example in leaflets.

9.6.2.3 County Councils could promote the visitation of rock art sites more strongly as part of the counties' prehistoric heritage. Northumberland County Council, for example, maintains a WWW-site on the prehistory of the area, which includes information on the Lordenshaws rock art site. Also, the rock art at Lordenshaws is briefly mentioned in a brochure on Northumberland's prehistoric past. The Northumberland National Park issued a leaflet on the Lordenshaws "historic landscape", which includes some information on the rock art site, on Bronze Age cists and the Iron Age hillfort at Lordenshaws. The inclusion of more rock art sites into visitors' maps, brochures, leaflets and internet sites could further interest in visiting rock art sites. Tourist Information Centres could be supplied with this material and their staff made aware of this part of Britain's heritage.

9.6.2.4 However, any attempt to raise the public awareness on rock art has to be integrated with a general management plan for rock art sites in England, since raising awareness of rock art will eventually lead to more visits to rock art sites. These could then suffer from the negative side-effects of visitor impact. Only if conservation and presentation measures at the sites are in place should public awareness of rock art be substantially increased. Furthermore, any activities of raising public awareness about rock art must not aim just at visitors/tourists, but also at the local communities and at the landowners on whose ground many rock art sites are located. Also, a considerable part of information on rock art has to centre on conservation and protection issues. The public needs to be made aware not only of the importance of rock art as part of their cultural heritage, but also of its fragility. Each rock art panel is unique and irreplacable!

9.6.3 How can public access to rock art sites in England be increased?

9.6.3.1 Before public access to rock art sites in England can be increased, the petroglyph sites must be recorded and their condition assessed. Only then can decisions be taken which sites are to be developed for public access. It seems advisable to direct the visitors to a small number of well-presented rock art sites and to discourage visits to other sites in order to protect the mass of sites from visitor impact. Such a selective presentation of rock art sites would promote a few rock art sites to the general public, sites which would be equipped with a range of visitor facilities, guidance systems and visitor education material of various kind. Other sites could be developed on a smaller scale for smaller visitor numbers, for example with low barriers and visitor information signs. Visitor access to all other, undeveloped sites could then be discouraged. Visitor access must be controlled if the sites are to be preserved in the long run.

9.6.3.2 The decisions as to which sites are to be developed for public access have to be based on a number of factors: the condition and the vulnerability of a site, its importance in a regional or national heritage context, the current level of visitation, ease of access, etc. The choice of which rock art sites to develop for increased visitor access and how to develop them will have to take local needs and wishes into account. After these decisions are taken, development plans have to be formed for suitable sites. The aim of site development is the protection of the rock art on the one hand, and the accessibility of the site for visitors on the other. Site development should change the character of a site as little as possible in order to preserve the integrity of the site. Therefore, all measures taken should be as little intrusive as possible. Low guidance barriers or low enclosures can keep visitors off the rock art panels in providing a psychological barrier. They also mark an appropriate viewing distance. Higher fences or railings prevent animals from walking over the panels on pastures, while walkways keep visitors to the paths and off the panels. Groups of sites may be presented together in an interpretive trail, which leads the visitors to various stops at the most important rock art panels. Generally, rock art should not be presented in isolation. In areas with a high concentration of rock art sites and other ancient monuments, these sites could be presented together.

9.6.3.3 The public presentation of petroglyph sites presupposes a certain visibility of the petroglyphs. At those sites that are made accessible for the public, moss and lichen might be removed for presentation purposes. Otherwise visitors will have great difficulties in making out the petroglyphs and damage based on attempts to enhance the visibility of the rock art will occur. Interpretive signs with images of the motifs can help visitors locate the designs on the rock surfaces. However, these signs should also state clearly that any enhancement of the petroglyphs is forbidden.

9.6.3.4 An important part in the presentation of the sites has to be educational. Visitor education generally is one of the cornerstones in the presentation and protection of rock art. Besides being informed about the age and interpretation of rock art, visitors and equally important, the local population/landowners, have to be made aware of the importance of rock art as source of knowledge about past populations and as part of their heritage. Equally, the fragility of rock art needs to be stressed. Clear visitor guidelines have to be given. Interpretive signs, leaflets and guided tours can provide this information. A hypothetical leaflet on a rock art site in Britain could incorporate the following information:

- general information (what is rock art, British rock art: common motifs, age, etc.);
- site-specific information: site description (also photo or drawing), motif types, interpretations, technique of manufacture, what is special about site/rock art of region, relation of the site to local archaeology and topography, site scheduled as National Monument;
- protective and conservation measures taken, why taken (e.g. why is lichen left on rock surface), proper visitor conduct at sites;
- further information, general reading.

9.6.3.5 Depending on the size and importance of the sites, a visitor centre or a site-related museum may be appropriate. These could provide more detailed information on rock art generally and on the specific sites, as well as allowing for facilities such as toilets or restaurants. Site-related museums or visitor centres could organise guided tours for school classes and other visitors, or lectures. Additionally they could provide a greater range of information material on rock art, such as brochures, books, video or WWW access. In Britain, where we have no access to the meaning of the images, it may be interesting for the public to learn about a range of speculations on the meanings of the petroglyphs and on ways in which rock art is studied today. Variations in the motif compositions could be stressed and the local distinctiveness underlined. Stressing the mystery that surrounds the meaning and the significance of the petroglyphs could ensure sustained visitor interest. No matter which approach is taken in order to increase and control visitor access, long-term management plans must be established which incorporate the regular monitoring of visitor impact and presentation measures to the sites.

9.7 Local interest groups and the management of rock art in England

9.7.1 The importance of the involvement of the local communities and interest groups into the management of rock art sites has been shown earlier. Experiences in other countries, for example at Alta, Norway, have shown the benefits of the incorporation of the local community into site management from the planning stage onwards. The local people may, for example, be asked to take on the responsibility for monitoring the rock art sites. Also, since the local community will be confronted with the consequences of site development, such as higher visitor numbers or restricted access to some sites, it therefore has to be consulted already during the planning stages of any site development. If rock art sites are located on private land, access agreements have to be signed with the landowners. These landowners then should be included in the management of the sites. For example, the World Heritage site at Tanum, Sweden, is jointly administered by the National Heritage Board and the local county. Local landowners are also included.

9.7.2 Consultation with local interest groups, such as rock art enthusiasts, in the development and management of rock art sites, is absolutely vital. Amateur archaeologists with a special interest in rock art, such as Ronald Morris in Scotland, Stan Beckensall in Northumberland, have done invaluable work in locating and recording rock art sites. Such rock art enthusiasts attempt to raise public awareness about rock art. They give talks on the subject, organise guided tours, and make local landowners aware of the sites on their land. The vast knowledge of these people concerning rock art locally and their contacts with local landowners, are crucial if a full record of rock art in Britain is to be made and if the public presentation of rock art sites is to be improved.

Appendices

LIST OF APPENDICES

APPENDIX A
PROJECT PUBLICITY, SEMINARS AND PAPERS

- British Archaeology. (December 1998, 8-9, by S. Beckensall)
  An ideology that faded in a New Age

- Bournemouth University Press Office. News release. (15 February 1999)
  Art rocks on.

- The Independent. News item. (01 March 1999)
  Ancient Britons left trail of secret Picassos.

- Project newsletter. (on general circulation) (01 March 1999)

- English Heritage Press Office. News release. (June 1999)
  Rock star, Bill Wyman, launhes first ever national survey of prehistoric rock art

- The Journal. (Northumberland local newspaper). (05 June 1999)
  Rock star meets a rock legend

- The Times. (05 June 1999)
  Craggy Wyman plugs old rock art

- Q Magazine. (August 1999, Issue 155, 25)

- The Archaeologist. (IFA membership magazine). (Winter 1999, Issue 36, 17)

- Archaeology in Northumberland 1998-1999 (Northumberland archaeology and building conservation service)
  Pioneering rock art study begins in Northumberland

- European Association of Archaeologists meeting, Bournemouth 14th-19th September 1999
  Rock Art Pilot Project. A conservation and management study of rock motifs in England

APPENDIX B
INTERNET SITES CONTAINING A MATERIAL ON, OR RELATED TO THE STUDY OF ROCK ART

The lists of websites containing material on rock art below are not exhaustive but reflect the diverse range of material available. Internet sites cited in the body text of the report are also listed here. When accessing any of these sites, the following address protocol should be prefixed to the address shown - *[followed by the Universal Resource Locator (URL)]*. URLs are not case sensitive, unless stated otherwise. Search words, such as “rock art”, “petroglyphs” or “cup-and-ring marks” were used to locate internet sites with reference to rock art. Such internet sites are maintained by universities or by academics working on rock art, by National Park authorities, tourist offices, local councils or interested individuals. The information provided, therefore, varies strongly in focus and quality.

The Rock Art Net, maintained by the Cooperativa Le’Orme dell’Uomo, Capo di Ponte, Italy, provides more than a thousand links to Web sites dealing with different aspects of world wide rock art studies (www.rupestre.net). Major rock art organisations, such as ARARA (American Rock Art Research Association) and AURA (Australian Rock Art Research Association), provide links to other internet sites on rock art. Articles from the rock art journal *Tracce*, published on the internet by the Cooperativa Le’Orme dell’Uomo. Are also listed. Access to internet sites listed below can be variable because of demand and occasionally, as pages are moved or assigned different URLs (information is therefore current to November 1999).

B.1 PAGES ON BRITISH ROCK ART

B.1.1 NORTHUMBERLAND

Maintained by Northumberland County Council:.

www.northumberland.gov.uk/VG/prehisto.html	Lordenshaws, Weetwood Moor and Fowberry Moor.
www.homeusers.prestel.co.uk/rothbury/around/lordenshawes.htm	Lordenshaws
www.stonepages.com/stones/tour/Lordenshaw.html	Lordenshaws
www.stonepages.com/stones/tour/RoughtingLinn.html	Roughting Linn

Maintained by the Museum of Antiquities, University of Newcastle Upon Tyne:

www.ncl.ac.uk/~nantiq/old_fotmm97/	Doddington and Woodside, Ryton

B.1.2 PEAK DISTRICT

Maintained by Department of Archaeology and Prehistory, Sheffield University:

www.shef.ac.uk/uni/projects/geap/rart.htm	Gardom’s Edge

B.1.3 SCOTLAND

Maintained by Martin McCarthy:

www.ehabitat.demon.co.uk/scotland/ballochmyle.html	Ballochmyle
www.ehabitat.demon.co.uk/scotland/picframe/monzie4_picfrm.html	Monzie Cairn Circle

www.kht.org.uk	Kilmartin
www.stonepages.com/stones/tour/Ballochmyle.html	Ballochmyle
www.stonepages.com/stones/tour/Images.html	Scottish rock art, general

www.stonepages.com/stones/tour/Achnabreck.html	Achnabreck
www.stonepages.com/stones/tour/Baluachraig.html	Baluachraig
www.stonepages.com/stones/tour/Cairnbaan.html	Cairnbaan
www.stonepages.com/stones/tour/KilmichaelGlassary.html	Kilmichael Glassary
www.stonepages.com/stones/tour/Newbigging.html	Newbigging
www.stonepages.com/stones/tour/Ormaig.html	Ormaig

Maintained by Tom Bullock Maintained by Tom Bullock:
odyssey.thomson.com/brookscole/astronomy/fieldtrip/balkemback.html Balkemback.

Maintained by Andy Burnham:
easyweb.easynet.co.uk/~aburnham/database/index.htm British petroglyph sites.

B.1.4 YORKSHIRE

Site produced and maintained by Graeme Chappell:

www.users.zetnet.co.uk/ptrglyph/index.htm	Main index to sites in Yorkshire
www.users.zetnet.co.uk/ptrglyph/nym8.htm	Introduction to rock art / archaeology in the North York Moors
www.users.zetnet.co.uk/ptrglyph/aislaby.htm	Aislaby Moor sites
www.users.zetnet.co.uk/ptrglyph/fylingda.htm	Brow Moor , Howdale Moor and Stony marl Moor
www.users.zetnet.co.uk/ptrglyph/goatland.htm	Goatland (Allan Tofts)
www.users.zetnet.co.uk/ptrglyph/upleathm.htm	Upleatham (Errington Wood)
www.users.zetnet.co.uk/ptrglyph/kildale.htm	Kildale (Warren Moor)
www.users.zetnet.co.uk/ptrglyph/thimbley.htm	Thimbleby (Over Silton Moor)
www.users.zetnet.co.uk/ptrglyph/whorlton.htm	Whorlton (Whorlton/Near Moor)
www.users.zetnet.co.uk/ptrglyph/wyorks.htm	Rock art in West Yorkshire
www.users.zetnet.co.uk/ptrglyph/rombald.htm	Ilkley (Rombalds Moor)
www.users.zetnet.co.uk/ptrglyph/snowden.htm	Snowden Carr (Tree of Life Stone)
www.users.zetnet.co.uk/ptrglyph/askwith.htm	Askwith and Denton Moor
www.users.zetnet.co.uk/ptrglyph/elerwood.htm	Ellers Wood
www.users.zetnet.co.uk/ptrglyph/pateley.htm	Pateley Bridge
www.users.zetnet.co.uk/ptrglyph/otley.htm	Otley (Otley Chevin)
www.users.zetnet.co.uk/ptrglyph/harewood.htm	The Greystone, Harewood and Spofforth
www.users.zetnet.co.uk/ptrglyph/whatrcr.htm	Definition of *cup and ring carvings*
www.users.zetnet.co.uk/ptrglyph/lore1.htm	Customs, folklore and associated beliefs
www.users.zetnet.co.uk/ptrglyph/lore2.htm	Customs, folklore and associated beliefs
www.users.zetnet.co.uk/ptrglyph/lore3.htm	Customs, folklore and associated beliefs
www.users.zetnet.co.uk/ptrglyph/lore4.htm	Customs, folklore and associated beliefs
www.users.zetnet.co.uk/ptrglyph/lore5.htm	Customs, folklore and associated beliefs
www.users.zetnet.co.uk/ptrglyph/biblio.htm	Bibliography and references on Yorkshire rock art
www.users.zetnet.co.uk/ptrglyph/kendall.htm	Pickering, Yorkshire
www.users.zetnet.co.uk/ptrglyph/hebden.htm	Calderdale, Pennine border region
www.users.zetnet.co.uk/ptrglyph/swaldale.htm	Gayles Moor and Barningham Moors, Teesdale.
www.users.zetnet.co.uk/ptrglyph/links.htm	Petroglyph WWW Links

B.2 PAGES ON ROCK ART IN OTHER COUNTRIES AND CONTINENTS

B.2.1 AFRICA

www.geocities.com/Athens/Forum/5067/wes.html Introduction to Saharan rock

Maintained by the Bradshaw Foundation
www.bradshaw-foundation.com/bushman/ South African rock art

Maintained by Grant McCall www.geocities.com/Athens/Delphi/9080/index.html	Namibian rock art (Brandberg, Twyfelfontein and Piet Alberts Kopjes. Also, Western Cape rock art
www.cesmap.it/mostrae2.html	Namibian rock (exhibition on "African Pictograms – Namibia Archaeology and Rock Art"
Maintained by the National Museum of Namibia www.natmus.cul.na/exhib/rockart/index.html	Namibia

B.2.2 THE ALPS

Maintained by Andrea Arca: yi.com/home/Arca'Andrea/carsch/carsch.html	Carschenna (Switzerland)
yi.com/home/Arca'Andrea/carsch/concentr.html	Carschenna (Switzerland)
yi.com/home/Arca'Andrea/carsch/horses.html	Carschenna

B.2.3 ASIA

www.arminco.com/havknet/naskal/svunik/ukhasar.htm	Armenia, specifically on the site of Syunik
Maintained by the University of Geneva anthropologie.unige.ch/~gregoire/fuj/index.gb.html	Fujairah, United Arab Emirates
www.archaeology.org/9701/newsbriefs/pakistan.html	Pakistan
www.stph.net/people-ap/history/prehist.htm	Hyderabad, India
www.worldmonuments.org/angonopprogf2.html	Rizal, Philippines
Maintained by Byon Kwang-Hyon myhome.shinbiro.com/~kbyon/rindex.htm	Korea (Bankudae, Chonzonri, Yogju, Koryong, Namhaedo, Haman and Namwon

B.2.4 CANADA

Maintained by the Provincial Museum of Alberta www.pma.edmonton.ab.ca/pma.htm	Rock art in Alberta and, Writing-On-Stone petroglyph site
www.lights.com/waterways/arch/rockart.htm	Saskatchewan
www.destinyweb.com/pinevista/petro.html	Petroglyphs Provincial Park, Ontario
www.island.net/~gm_chin/	Gabriola Museum, Gabriola Island, BC

B.2.5 FINLAND

blues.helsinki.fi/~lauhakan/whale/comics/vienaboy.html	Depiction as a human life-cycle.

B.2.6 FRANCE

Maintained by the Cooperativa Le' Orme dell'Uomo vi.com/home/Arca'Andrea/bego.html	Mont Bego petroglyphs
home.worldnet.fr/clist/Pacabrze/Fr/Rupestre/bego.htm	Mont Bego petroglyphs
www.civilization.ca/cmc/cmceng/pr06beng.html	Jean Clottes: Biography.
www.rock-art.com/books/clotte2.htm	The Shamans of Prehistory – Trance and Magic in the Painted Caves, 1998.

www2.ac-toulouse.fr/eco-belbeze-union/niaux.htm Visit to the cave of Niaux

Maintained by the Tourist Information Office at Montignac
www-eleves.iie.cnam.fr/faure_1/Aquitain/montigna/mon_ang.htm Montignac and the cave of Lascaux,.

www.culture.fr/culture/arcnat/lascaux/en/index3.html Lascaux
www.culture.fr/culture/arcnat/chauvet/en/grsites.htm Cave of Chauvet
www.culture.fr/culture/archeosm/en/img0013.htm Cave of Cosquer

B.2.7 ITALY

Maintained by the Gruppo Archeologico Pisano:
marolaws.iet.unipi.it:31442/rawt/rawt.htm North-western Tuscany,

Maintained by the Centro Camuno di Studi Preistorici, Capo di Ponte:
www.globalnet.it/graffiti/en_home.htm Valcamonica

Maintained by the Cooperativa Le Orme dell'Uomo:
www.geocities.com/Tokyo/2384/prehi.html Valcamonica
www.geopages.com/Tokyo/2384/west/html Western Alps
www.geocities.com/Athens/3857/valt.html Valtellina

www.geocities.com/Athens/3857/valt.html Valcamonica and Valtellina

www.comune.torino.it/servizi-educativi/rupestre/rupestre.html Education programme using rock art

globalnet.it/ccsp/newpubb/bcsp.htm *Bolletino del Centro Camuno di Studi Preistorici*

B.2.8 NORWAY

www.hiof.no/ludvigsen/webdoc/petroglyphs.html West of the Glomma river, SE Norway

B.2.9 THE PACIFIC

www.netaxs.com/~trance/petro.html Easter Island (birdman cult)
www.volcano-hawaii.com/bar/petroglyph.html Hawaiian petroglyphs

B.2.10 PORTUGAL

www.utad.geira.pt/irac/ingles/arte_rupestre/contents/arterupestre/texto.html Rock art in Portugal
www.worldmonuments.org/coavallprogf2.html Coa Valley Archaeological Park
www.ci.uc.pt/fozcoa/fr.index.html Coa Valley (in French and Spanish)

B.2.11 SOUTH AMERICA

www.unitru.edu.pe/arq/petrog.html Rock art in Peru

B.2.12 SPAIN

www.uned.es/departamentos/0702/frame2.htm Laboratorio de Estudios Paleoliticos (L.E.P.) at the Universidad Nacional de Educacion a Distancia (UNED).
rupestre.net/tracce/gali.html River Lerez, Pontevedra (Tracce 3)

Maintained by the University of Cantabria

www.unican.es/arte/Ingles/prehist/paleo/Default.htm	Palaeolithic art in the north of Spain
www.fundego.es/artcult/pintura/altamira.htm	Cave of Altamira (in Spanish).

B.2.13 SWEDEN

Maintained by the Scandinavian Society for Prehistoric Art:

www.ssfpa.se/eng/rockart/intro.html	Tanum World Heritage Site
home4.swipnet.se/~w-46425/ix_eng.htm	Excursions and walks in Tanum area
home7.swipnet.se/~w-75762/aktuellt.html	Rock Art Museum (Hallristningsmuseet) at Himmelstalund, Norrkoping (in Swedish)
www.nsb.norrkoping.se/bronze/enhallmus.htm	Rock-Carving Museum Himmelstalund
www.stromstad.se/gallery/ristning/frmain.htm	Photo gallery of rock art at Stroemstad

Maintained by Department of Archaeology, Umea University:

www.umu.se/arke/petroglyphs.html	General site (in Swedish)

B.2.14 UNITED STATES

Maintained by the City of Wrangell

www.wrangell.com/cultural/petroglyph.htm	Southeast Alaska
www.ruf.rice.edu/~raar/mabrams/index.html	North-west north American seaboard

Maintained by D. H. Martin

www.wvlc.wvnet.edu/wvarl/petro.html	West Virginia, Wyoming county, Wild Cat Branch, Salt Rock and Devil's Tea Table

Maintained by the Office of the State Archaeologist, University of South Carolina

www.pclink.com/deborah/	South Carolina Petroglyph survey
www.wrangell.com/cultural/petroglyph.htm)	Alaska
aztec.asu.edu/aznha/vbarv/panorama.html	Arizona
members.aol.com/sjflint/intro.htm	Saline River, Kansas (Paradise Site, Circle Rock Site, Hell Creek-Wilson Dam Site

Maintained by The Ohio Historical Society

www.ohiohistory.org/places/leopetro/	Leo petroglyph site, Jackson, Ohio
www.ohiohistory.org/places/inscript/	Inscription rock petroglyph site, Lake Erie, Ohio
www.pclink.com/cbailey/MRA.html	Minnesota
www.tcinternet.net/users/cbailey/pipestone.html Minnesota	Pipestone petroglyphs, Pipestone,
www.tradecorridor.com/grenora/gren-a.htm	Writing Rock, Grenora, North Dakota
www.tcd.net/~parowan/pgap.html	Parowan Gap petroglyph site, Utah
www.so-utah.com/feature/rockart/homepage.html	Southern Utah (Sego Canyon, Freemont Indian State Park, Sand Island, Capitol Reef, Newspaper Rock State Park, Potash Scenic Byway, Parowan Gap, Buckhorn Draw, Nine Mile Canyon, Horseshoe Canyon

www.nauticom.net/users/ata/greatgallery.html	Utah
www.trg-tech.com/rockart/	Rock art sites in the southwestern USA
net.indra.com/~dheyser/rockart.html	Rock art sites in Utah
www.azstarnet.com/solmar/	Astronomical significance of petroglyphs
members.aol.com/rockart01/Photopage.html	Rock art in the south-western USA
aztec.asu.edu/aznha/palatki/palatki.html	Palatki rock art, Segona, Arizona
www.niler.com/bighornarrows.html	Rock art in New Mexico
www.jointchiefs.com/gmalone/galrock.html	Rock art in the Galisteo Basin, New Mexico
www.zianet.com/snm/petrogly.htm	Three Rivers Petroglyphs site, New Mexico
www.jimpowers.com/index.shtml	Rock art in the Great Basin
www.cs.unm.edu/~brayer/rock/petro_rep.html	Petroglyph National Monument, Albuquerque
www,cs.unm.edu/~brayer/rock/sandia.html	Petroglyph National Monument, Albuquerque
swanet.org/yavp1.html	Prescott area, Arizona
www.anthroarcheart.org/newsrock.htm	Rock art in Arizona
www.dinoland.com/DryFork.html	Dry Fork Petroglyphs site, Arizona

Maintained by the Bureau of Land Management in California

www.ca.blm.gov/caso/rockart.html	Rock art in California
www.questorsys.com/rockart/	Rock art in California
members.aol.com/dierdorff2/darwin/nearby-8.html	Little Petroglyph Canyon, California
www.mammothweb.com/SierraWeb/sightseeing/petro	Bishop, California

B.3 INTERNET JOURNALS

B.3.1 Rock Art E-Zine 42Gr532(Rock Art Journal)

geocities.com/SoHo/Workshop/7724	Contents of WWW journal on rock art, mainly concerned with new discoveries in the southwestern USA, maintained by J Blazik
www.geocities.com/SoHo/Workshop/7724/bcs1.html	*The Barrier Canyon Style.* Paper by J Blazik
www.geocities.com/SoHo/Workshop/7724/ochre1.html	*The Ochre Alcove Panel.* Paper by J Blazik
www.geocities.com/SoHo/Workshop/7724/intestine1.html	*The Intestine Man Site.* Paper by J Blazik
www.geocities.com/SoHo/Workshop/7724/calf1.html	*The Calf Canyon Panel.* Paper by J Blazik
www.geocities.com/SoHo/Workshop/7724/moab1.html	*The Moab Panel.* Paper by J Blazik
www.geocities.com/SoHo/Workshop/7724/dito1.html	*Horseshoe Canyon's Great Gallery: A Possible Relationship to Archaic Performance Art.* Paper by R Morales, Jr
www.geocities.com/SoHo/Workshop/7724/bcrem1.html	*Barrier Canyon Remembered.* Paper by R M Jones (reproduced)
www.geocities.com/SoHo/Workshop/7724/nordeste1.html	*Current Research on the Nordeste Tradition of Rock Painting in the Sao Raimundo Nonato Archaeological Area of Piaui, Brazil.* Paper by J Blazik
www.geocities.com/SoHo/Workshop/7724/secret1.html	*The Secret Site.* Paper by J Blazik
www.geocities.com/SoHo/Workshop/7724/courthouse1.html	*Courthouse Rock: Time, Place and Style.* Paper by J Blazik
www.geocities.com/SoHo/Workshop/7724/tomorph1.html	*To Morph or Not To morph: Language, Form and Interpretation of Barrier Canyon Style Panels.* Paper by J Blazik

www.geocities.com/SoHo/Workshop/7724/highpanel1.html	*The High Panel.* Paper by J Blazik
www.geocities.com/SoHo/Workshop/7724/coalition1.html	*The Nine Mile Canyon Coalition.* Paper by L Miller.
www.geocities.com/SoHo/Workshop/7724/repetition1.html	*On the Repetition and Evolution of Form in the Barrier Canyon Style.* Paper by J Blazik
www.geocities.com/SoHo/Workshop/7724/ninemile1.html	*Nine Mile Canyon: Past and Present.* Paper by L Miller
www.geocities.com/SoHo/Workshop/7724/gr1.html	*A Site Near Green River.* Paper by J Blazik
www.geocities.com/SoHo/Workshop/7724/newsite1.html	*A Recent Find.* Paper by J Blazik
www.geocities.com/Athens/Olympus/6381/index.html	Editorial to Issue August/September 1999, Vol. 2, Issue 4.
www.geocities.com/Athens/Olympus/6381/dog1.html Blazik.	*The Curve-Tailed Canine.* Paper by J
www.geocities.com/Athens.Olympus/6381/broken1.html	*The Broken Panel* Paper by J Blazik.
www.geocities.com/Athens/Olympus/6381/gallery.html	*Rock Art Images From Southern Utah.* Paper by J Blazik.

B.3.2 TRACCE INTERNET ROCK ART JOURNAL

www.rupestre.net/tracce/tracce11.html — Tracce 11 (February 1999):

IRAC'98:
Computers and Rock Art session proceedings
- A Arca and J Bulas Cruz, "Rationale".
- J M Brayer, H Walt, B David, Quantitative Assessment of Rock Art Recording.
- P Clogg and M Diaz-Andreu, Digital Image Processing and the Recording of Rock Art.
- A Arca, Digital auto-tracing in Rock Art Recording.

Computers and Rock Art
- E Donnan, Recording British Rock Art.
- R P Firnhaber, Printing Digital Images.

Research: survey, recording, dating, interpreting
- A Fossati, Figures of boat in the rock art of Valcamonica.
- F Mandl, Depictions of Nine Men's Morris.
- B Brentjes, Rock Art in Russia's Far East and in Siberia.

South America
- M Braga, Conservation Project of rock art at the outbacks of the state of Bahia, Brazil.
- R Aguiar, The conclusion of the rock art survey in Santa Catarina Island – Brazil.
- G Munoz, Rupestre – Rock Art in Colombia.

www.rupestre.net/tracce/tracce10.html — Tracce 10 (May 1998):

Research: survey, recording, dating, interpreting
- S Marchi, Sub-Saharan Rock Art.
- J R Hanson, The Trowel and the Drum.
- B Brentjes, Orientalizing motifs in Alpine rock art.
- R G Bednarik, Petroglyphs dated in Central Bolivia.
- R Aguiar, The conclusion of the rock art survey.
- Y Mathpal, Rock Art in the Himalayas.

Preservation: save rock art sites
- M Leigh Marymor, Looking Back at Four Years of Advocacy.

G Omallini, The man of Bicorp.
Swastika and Camunian Rose
Gyrus, The Swastika Stone.
P Farina, The motif of the "Camunian Rose".

Rock Art Congresses
IRAC'98 (Vila Real, Portugal).
The Sword on the Rock (Novalesa, Italy).
International Prehistoric Art Conference (Kemerovo, Siberia, Russia).
Education: school and fieldworks

www.rupestre.net/tracce/tracce9.html Tracce 9 (October 1997)
Special Issue for 2nd International Congress of Rupestrian Archaeology.

www.rupestre.net/tracce/tracce8.html Tracce 8

www.rupestre.net/tracce/tracce7.html Tracce 7

www.rupestre.net/tracce/tracce6.html Tracce 6

www.rupestre.net/tracce/tracce5.html Tracce 5

www.rupestre.net/tracce/tracce4.html Tracce 4

www.rupestre.net/tracce/tracce3.html Tracce 3

www.rupestre.net/tracce/tracce2.html Tracce 2

www.rupestre.net/tracce/tracce1.html Tracce 1

B.4 DIGITAL VERSIONS OF PAPERS ON ROCK ART

Arca, A, 1997, ***Slide scanning for a digital archive***. Internet: www.rupestre.net/tracce/tracce8.html

Arca, A, 1999, ***Digital auto-tracing in rock art recording***. Internet: www.rupestre.net/tracce/tracce11.html

Arca, A, and Fossati, A, 1996, ***A question of skin – AMS vs. rupestrian archaeology***? Internet: www.rupestre.net/tracce4.html

Arca, A, and Fossati, A, 1996, ***A question of style – direct dating vs. rupestrian archaeology***? Internet: www.rupestre.net/tracce3.html

Bednarik, R G, nd, ***IFRAO standard scale***. Internet: www.cesmap.it/ifrao/scale.html

Blazik, J, nd, ***Current Research on the Nordeste Tradition of Rock Painting in the Sao Raimundo Nonato Archaeological Area of Piaui, Brazil***. Interet: www.geocities.com/SoHo/Workshop/7724/nordeste1.html

Brayer, J, Walt, H, and David, B, 1999, ***Quantitative assessment of rock art recording***. Internet: www.rupestre.net/tracce/newport.html

Cacho Toca, R, nd, ***Palaeolithic Rock Art - Applications of Digital Photography in the Analysis and Tracing of Rock Paintings.*** Internet: ccaix3.unican.es/~cachor/INGLES.HTM

Callahan, K L, nd, ***On the occurrence of a thunderbird motif in the rock art of the Upper Midwest***. Internet: www.geocities.com/Athens/Oracle/2596/thunderbird.html

Callahan, K L, nd, ***Petroglyph Boulders of the Upper Midwest.*** Internet: www.geocities.com/Athens/Acropolis/5579/midwestboulders.html

Callahan, K L, 1997, ***Shamanism, Dream Symbolism, and Altered States in Minnesota Rock Art.*** Internet: www.geocities.com/Athens/Oracle/2596/mnra1.html

Callahan, K L, 1997, ***Minnesota's Sacred Red Rock Boulder, Newport, Minnesota***. Internet: www.geocities.com/Athens/Forum/1059/redrock.html

Callahan, K L, 1997, ***What's happening in international rock art studies***. Internet: www.geocities.com/Athens/Acropolis/5579/whatshot.html

Clogg, P, and Diaz-Andreu, M., 1999, Digital image processing and the recording of rock art. Internet: www.rupestre.net/tracce/dip.html

Clouse, R A, nd, ***Jeffers Petroglyphs, Cottonwood County, Minnesota.*** Internet: www1.umn.edu/marp/rockart/rockart.html

Coles, G M, Gittings, B M, Milburn, P, and Newton, A J, 1998, ***Scottish Palaeoecological Archive Database.*** Internet: www.geo.ed.ac.uk/spad/

Donnan, E, 1999, ***Recording British rock art***. Internet: www.rupestre.net/tracce/donnan.html

Fernie, K, 1998, ***ExeGesIS software development project***. Internet: www.rchme.gov.uk/smr/news5/exegesis1.html

Footsteps of Man, nd, ***Rock Art Database***. Internet. www.rupestre.net/orme/database

Fossati, A, and Arca, A, 1997, ***Tracing the past***. Internet: www.rupestre.net/tracce/tracce7.html

Kolber, J, 1997, ***Scale drawings of the Vale de Vermelhos engravings***. Internet: www.rupestre.net/tracce/coatrac.html

Morwood, M J, and Smith, C E, 1996, ***Contemporary Approaches to World Rock Art Contemporary Approaches to World Rock Art*** Internet: www.une.edu.au/Arch/ROCKART/MMRockArt.html

Pettifor, E, 1996, ***Altered States: The Origin of Art in Entoptic Phenomena.*** Internet: www.wynja.com/arch/entoptic.html

Royal Commission on the Historical Monuments of England, 1998, ***Sites and Monuments Records database – progress report***. Internet. www.rchme.gov.uk/smr/news6/exegesis.html

Sounders, P, nd, ***Houses of Power - Rock Art, Shamanism, and Subsistence in the Coso Mountains of California***. Internet: home.earthlink.net/~psouders/research/rockart/rockart.html

Turpin, S, nd, ***Style and Substance: What is the Pecos River Style***. Internet: members.aol.com/rockart01/Turpin.html

Vicent Garcia, J M, Montero Ruiz, I, and Rodriques Alcalde, A, 1997, ***Digital image processing and prehistoric art***. Internet: www.rupestre.net/tracce/tracce8.html

Walt, H, and Brayer, J, 1994, ***A petroglyph recording demonstration project for Petroglyph National Monument, Albuquerque, New Mexico***. Internet: www.cs.unm.edu/~brayer/rock/petro_rep.html

Walt, H, David, B, and Musello, C, 1994, ***The international rock art database project: introduction***. Internet. www.cs.unm.edu/~brayer/rock/waltet.html

Zilhao, J, nd, ***The stylistically Palaeolithic petroglyphs of the Coa valley (Portugal) are of Palaeolithic age – A refutation of their "direct dating" to recent times***. Internet: www.ci.uc.pt/fozcoa/tuwams.html

Collection of papers on rock art in the Upper Midwest of the USA. All have the same URL: www.tcinternet.net/users/cbailey/index2.html

1996:
Callahan, K L, Nett Lake Petroglyphs.
Calahan, K L, Forth Ransom Writing Rock.
Callahan, K L, Atlatls in prehistoric Minnesota.
Higginbottom, D K, Projectile Points of Minnesota.
Morse-Kahn, D, The Fisk Site.
Morse-Kahn, D, Bluff's Rock Shelters.
Morse-Kahn, D, Reno Cave.
Morse-Kahn, D, Minnesota Rock Art.
Steinbring, J, Fisk Site Report.

1997:
Ribbon, G, Minnesota's Hidden Past.
Callahan, K L, Projectile Points & Minnesota Rock Art.

B.5 THEMATIC PAGES

B.5.1 PALAEOENVIRONMENTAL INFORMATION

www.intarch.ac.uk	Archaeobotanical Computer Database
www.eng-h.gov.uk	English Heritage Environmental Archaeology Bibliography
www.ngdc.noaa.gov/paleo/epd.html	European Pollen Database
www.soton.ac.uk	Global Atlas of Palaeovegetation
www.geo.ed.ac.uk/spad	Scottish Palaeoecological Archive Database
www.ngdc.noaa.gov	World Data Centre for Palaeoclimatology

B.5.2 RECORDING, CONSERVATION AND MONITORING

www.oi.uchicago.edu/OI/PROJ/EPI/Epigraphy.html	Epigraphic survey
sul-server-2.stanford.edu/waac/wn/wn08/wn08-1/wn-08103.htm	Conservation and preservation
www.leica.com	Global positioning systems
www.trimble.com	Global positioning systems
www.magellangps.com	Global positioning systems
www.polhemus.com/fastscan.htm	Laser scanning
www.3dscanners.com/	Laser scanning
www.cesmap.it/ifrao/scale.htm	Photographic scale

B.5.3 DATABASES AND GIS

www.palimpsest.stanford.edu	Bibliographic rock art studies database
www.rupestre.net/orme/database	Footsteps of Man rock art database
ads.ahds.ac.uk/project/goodguides/gis	Good practice in GIS

B.5.4 DATA

www.mimas.ac.uk/maps/barts/bart1.html	Bartholomews Digital Map Data
www.esri.com	Environmental Systems Research
Institute	
www.ngdc.noaa.gov	Globe (The Global Land One-km Base Elevation) Project
www.164.214.2.59/geospatial/	National Imagery and Mapping Agency
www.esdim.noaa.gov/NOAA-catalog/	NOAA Environmental Services Data Directory
www.ordsvy.gov.uk	Ordnance Survey
www.edina.ed.ac.uk/ukborders	United Kingdom digital boundary data

B.5.5 ASSOCIATIONS AND ORGANISATIONS

zzyx.ucsc.edu/Comp/Bill/ARARA/ARARA.html	American Rock Art Research
Organisation	
sunspot.sli.unimelb.edu.au/aura/Welcome.html	Australian Rock Art Research
Association	
www.cs.unm.edu	Australian Rock Art Research
Association	
www.geocities.com/Athens/Parthenon/6994/indexi.htm	Centro Investigacion de Arte Rupestre del Uruguay
www.cesmap.it/ifrao/ifrao.html	IFRAO homepage
zeus.questorys.com/rockart/orgs.htm	Rock Art Organisations
www.cesmap.it/index_e.html	Study Centre and Prehistoric Art Museum Pinerolo, Italy
rockart.org/homepage.htm	The Rock Art Foundation (Southwest
Texas)	
www.tara.org.uk/Homepage.htm	Trust for African Rock Art
www.tcinternet.net/users/cbailey/index.htm	Upper Midwest Rock Art Research Association
www.wolsi.com/~urara/right.htm	Utah Rock Art Research Association

B.5.6 DATING

www.une.edu.au/Arch/ROCKART/dating.htm

B.5.7 DIGITAL IMAGING

www.kodak.co.uk
www.digitalimaging.org

APPENDIX C
RAPP DATABASE TABLES, FIELD ROSTER AND CONTROLLED VOCABULARY

C.1 RAPP DATABASE TABLE LIST

Table	Description
SNMR	Holds basic data from SMR and NMR
OTHERREFS	Correlation to site numbers used by other archive sources
DESIGNATION	Legal status of panels as listed in SMR / NMR
LOCATE	Locational information from SMR / NMR and RAPP
PANEL	Physical attributes of the panel (size, geology etc.)
MOTIF	Motif level attribute recording
VIEW	View attributes, after Bradley *et al* 1993
LANDUSE	Land-use attributes
VEGETATION	Surrounding vegetation attributes
CONDITION	Detailed weathering and conservation record
CONSERV	Risk, impact, visibility, prevailing state attributes
CAUSEDAM	Observed cause of damage
PALAEO	Related palaeoenvironmental data
MEASURE	From SMR, NMR and project technical survey
VISIT	Project fieldwork conditions (date, time, weather etc.)
GRAPHIC	Digital images / or filename reference
INTERP	Interpretation and information and visitor facilities
BIBLIO	Additional bibliographic references

C.2 RAPP DATA BASE FIELD ROSTERS

An * in the field name tables listed below denotes that data is taken from the SMR / NMR. The letters 'LU' in the notes sub-sections identify fields using controlled vocabulary (see section C.3.1). The field 'type' codes are: S – Short integer; A – Alphanumeric; M – Memo; L – Logical; N – Numeric; G - Graphic; T – Time stamp; D – Date stamp.

C.2.1 SNMR.db

Field	Type	Length	Notes
RAPP NUMBER	S	Key Field	Unique number assigned by the Project
*** SMR Number**	A	10 Key Field	
*** NMR UID**	A	12 Key Field	
*** SMR Period**	A	4	LU
RAPP Period	A	4	LU
*** SAM**	A	8	LU
*** SMR Description**	M	240	Includes list of motif classes as sued by SMR
*** NMR Description**	M	240	Includes list of motif classes as sued by NMR
Located	A	10	LU

C.2.2 OTHERREFS.db

Field	Type	Length	Notes
RAPP NUMBER	S	Key Field	Unique number assigned by the Project
Other Reference type	A	7	LU
Other Reference number	A	20	

C.2.3 DESIGNATION.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
Designation	A	10 - Key Field	LU

C.2.4 LOCATE.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
*** Unitary Authority**	A	50	LU
*** County**	A	2	LU
*** District**	A	100	LU
*** Parish**	A	40	
Field name	A	50	Where available
Stone name	A	50	Where available
*** OS Grid Letter**	A	2	2 letter OS locator
*** OS Easting**	A	6	
*** OS Northing**	A	6	
NGR Accuracy	A	2	LU
Latitude	A	10	Recorded by RAPP using GPS
Longitude	A	10	Recorded by RAPP using GPS
Position Type	A	16	LU. Location of GPS point in reference to panel: 'centre' preferred
Rapp validated northing	A	12	Where GPS data produces a correction on OS data the corrected references are input here
Rapp validated easting	A	12	Where GPS data produces a correction on OS data the corrected references are input here
Height OD	N	-	Taken from OS map or SMR
Height source	A	15	LU Source for height data
Landmark proximity	L	-	Yes / No. Proximity to a prominent landmark for the purposes of locating the panel in future
Landmark distance	A	4	Distance to this landmark (in metres)
Landmark bearing	A	4	Compass bearing to this landmark (in Degrees)
Ease of locating	A	8	Free text on being able to locate the specific panel
Other non-SMR co-ordinates	M	200	Other co-ordinates are simply entered here with a note of their source.

C.2.5 PANEL.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
Panel Type	A	40	LU
Panel verification	A	15	LU
Panel geology	A	30	LU
Surrounding geology	A	30	LU
Proximity to water	A	40	LU
Panel Context	A	8	LU (Single or multiple)
Panel proximity	L	-	Yes / No. This identifies the proximity within 5 metres of other carved panels.
General Comments	A	200	For Additional Geological information
Longest length	N	-	Panel length (metres)
Widest breadth	N	-	Panel Breadth (metres)
Area	N	-	Average panel area (metres squared calculated from above)
Greatest height	N	-	From ground (metres)
Primary Slope Direction	A	25	LU
Max Slope Angle	A	3	Max panel angle from horizontal (1 to 90; 1 to –90 degrees)
Min Slope angle	A	3	Min panel angle from horizontal (1 to 90; 1 to –90 degrees)
Surface Preparation	A	12	LU
Archaeological proximity	L	Y/N	Proximity to known non-rock art archaeological site
Entity type	A	50	Proximal monument class (Using RCHME Thesaurus)
Entity distance	N	-	Proximal distance (metres)
Entity direction	A	3	Compass bearing from panel to archaeological site specified above
Total number of motifs	N	-	

C.2.6 MOTIF.db

Field	Type	Length	Notes
RAPP Number	S	-Key Field	Unique number assigned by the Project
Motif number	A	10-Key Field	Unique within each panel number only
Superimposition	L	Y/N	
Longest length	N		
Widest breadth	N		
Visibility	A	10	LU
Human impact	L	Y/N	
Natural impact	L	Y/N	
Motifclass	A	90	Keyword list used as a guide only. No lookup table used
Depth min	N	-	(mm). may not apply to all motif classes
Depth max	N	-	(mm)
Technique	A	9	LU

C.2.7 VIEW.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
Distant View Bearing(s)	A	100	After Bradley
Intermed View Bearing(s)	A	100	
Immed View Bearing(s)	A	100	
Obscured View Bearing(s)	A	100	Applies to vegetation and modern obstructions only.

C.2.8 LANDUSE.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
Land ownership	M	200	Contact details
Access	A	20	LU
AMIC land type	A	50	LU
LUSAG narrow class	A	50	LU
MARS land-use	A	50	LU
Management Agreement	A	10	
General information	M	200	Free text to describe the condition of the panel

C.2.9 VEGETATION.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
Surrounding vegetation	A	30 - Key Field	LU

C.2.10 CONSERVATION.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
Risk	A	10	LU
Visibility	A	12	LU
Amelioration	A	40	LU
Impact	A	50	LU
General state	A	9	LU

C.2.11 CONDITION.db

Field	Type	Length	Notes
RAPP number	S		
Rounding / notching	A	20	LU
Disintegration / crumbling	A	20	
Flaking /splintering	A	20	
Scaling / delamination	A	20	
Pitting	A	20	
Breakage / removal	A	20	
Non-prehistoric carvings	A	20	
Atmospheric soiling	A	20	
Water staining	A	20	
Internal staining	A	20	

C.2.12 CAUSEDAM.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
Cause of damage	A	50 – Key Field	LU

C.2.13 PALAEO.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
Reference source	A		
Palaeoenvironmental evidence type	A	Key field	
General notes	A	200	

C.2.14 MEASURE.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
SMR Measurements	M	200	Translation of measurements as recorded in the SMR
NMR Measurements	M	200	Translation of measurements as recorded in the NMR
GPS file names	M	200	Cross referenced details of appropriate GPS data files
TS file names	M	200	Cross referenced details of appropriate TS data files

C.2.15 VISIT(M).db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
Recorder	A	10 - Key Field	Surveyors initials: multiple visits possible
Date	D	- Key Field	Date of field visit: multiple visits possible
Time	T	- Key Field	Time of field visit: multiple visits possible
Conditions	M	200	General conditions experienced by the field recorders (weather....)

C.2.16 GRAPHIC.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
Graphic type	A	32 – Key field	LU
Graphic	G	200	
View direction	A	3	
Time of day	T	-	
Date	D	-	
Number	A	100	Cross referenced archive number for drawings

C.2.17 INTERP.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
Interpretive facility	A	20- key field	Names of museums, centres and other organisations.

C.2.18 BIBLIO.db

Field	Type	Length	Notes
RAPP Number	S	- Key Field	Unique number assigned by the Project
Lead authors surname	A	10	
Lead authors initials	A	3	
Additional authors surnames and initials	A	100	
Bibliography type	A	40	LU
Date	N	-	
Title	A	100	
Editors name	A	20	
Book/ Journal Title	A	100	
Publisher	A	10	
Place of Publication	A	10	
Abstract	M	240	
Topic	A	100	
On file	L		
Page numbers	A	10	
Volume	A	5	
Volume number	N	-	

C.3 RAPP DATA BASE FIELD ROSTERS

The following is a list of those database fields specified above that use controlled vocabulary. The values for each follow on from this.

DATABASE FIELDS USING CONTROLLED VOCABULARY / LOGICAL OPERATORS	DATABASE FIELDS USING CONTROLLED VOCABULARY / LOGICAL OPERATORS
Access	General condition
Archaeological period	Amelioration
Bibliographic type	Context (single or multiple panel)
Bibliographic topic	Land-use (3 classifications)
County	Presence of management agreement
District	Impact
Damage effect	*In-situ* / *ex-situ* panel location
Graphics type	Interpretation facilities
Height source	Surface preparation
Locational accuracy	Cause of damage
NGR accuracy	Visibility
Other legal status	Vegetation type
Panel and surrounding geology	Surface topography type
Position type	Slope direction
Position type	Risk
Reference types (for other sources)	Motif class
Schedule Monument status	Panel type
Unitary Authority	Tooling / technique
Proximity to water	Verification of prehistoric motifs

C.3.1 CONTROLLED VOCABULARY TERMS AND VALUES

C.3.1.1 SNMR.DB

RAPP Period:
Bronze Age; Early Medieval; Iron Age, Medieval; Mesolithic; Modern; Multi-period; Neolithic; Palaeolithic; post-Medieval; Prehistoric; Roman; Unknown.

SAM:
Yes; No; Unknown

Located:
in situ; museum; private; relocated; destroyed

C.3.1.2 DESIGNATION.db

Designation:

AGLV	Area of Great Landscape Value
AONB	Area of Outstanding Natural Beauty
ASA	Archaeologically Sensitive Area
CA	Conservation Area
CHS	Countryside Heritage Site
CS	Countryside Stewardship
Const Map	Constraints Map
Crown Land	Crown Land
DW	Designated Woodland
ESA	Environmentally Sensitive Area
FC	Forestry Commission Land

Green Belt	Green Belt
Haz Area	Hazard Area
LB	Listed Building
LB 1	Listed Building Grade 1
LB 2	Listed Building Grade 2
LB 2*	Listed Building Grade 2 star
LB 3	Listed Building Grade 3
LOCAL	Local county designation
MOD	Ministry of Defence
NNR	National Nature Reserve
NP	National Park
NT	National Trust
RPG	Register of Parks and Gardens
SAM	Scheduled Ancient Monument
SMR	Sites and Monuments Record
SSSI	Site of Special Scientific Interest
WHS	World Heritage Site

C.3.1.3 LOCATE.DB

Unitary Authority:
Barnsley; Bath and North East Somerset; Bedfordshire; Birmingham; Blackburn; Blackpool; Bolton; Bournemouth; Bracknell Forest; Bradford; Brighton and Hove; Buckinghamshire; Bury; Calderdale; Cambridgeshire; Cheshire; City of Bristol; City of Derby; City of Kingston upon Hull; City of Leicester; City of Nottingham; City of Peterborough; City of Plymouth; City of Portsmouth; City of Southampton; City of Stoke-on-Trent; Cornwall; Coventry; Cumbria; Darlington; Derbyshire; Devon; Doncaster; Dorset; Dudley; Durham; East Riding of Yorkshire; East Sussex; Essex; Gateshead; Gloucestershire; Greater London; Halton; Hampshire; Hartlepool; Herefordshire; Hertfordshire; Isle of Wight; Kent; Kirklees; Knowsley; Lancashire; Leeds; Leicestershire; Lincolnshire; Liverpool; Luton; Manchester; Medway Towns; Middlesborough; Milton Keynes; Newcastle Upon Tyne; Norfolk; North East Lincolnshire; North Lincolnshire; North Somerset; North Tyneside; North Yorkshire; Northamptonshire; Northumberland; Nottinghamshire; Oldham; Oxfordshire; Poole; Reading; Redcar and Cleveland; Rochdale; Rotherham; Rutland; Salford; Sandwell; Sefton; Sheffield; Shropshire; Slough; Solihull; Somerset; South Gloucestershire; South Tyneside; Southend-on-Sea; St. Helens; Staffordshire; Stockport; Stockton-on-Tees; Suffolk; Sunderland; Surrey; Swindon; Thameside; The Wrekin; Thurrock; Torbay; Trafford; Wakefield; Walsall; Warrington; Warwickshire; West Berkshire; West Sussex; Wigan; Wiltshire; Windsor and Maidenhead; Wirral; Wokingham; Wolverhampton; Worcestershire; York.

County:
Avon; Bedfordshire; Berkshire; Buckinghamshire; Cambridgeshire; Cheshire; Cleveland; Cornwall; Cumbria; Derbyshire; Devon; Dorset; Durham; East Sussex; Essex; Gloucestershire; Greater London; Greater Manchester; Hampshire; Hereford & Worcester; Hertfordshire; Humberside; Isle of Wight; Kent; Lancashire; Leicestershire; Lincolnshire; Merseyside; Norfolk; Northamptonshire; Northumberland; North Yorkshire; Nottinghamshire; Oxfordshire; Shropshire; Somerset; South Yorkshire; Staffordshire; Suffolk; Surrey; Tyne and Wear; Warwickshire; West Midlands; West Sussex; West Yorkshire; Wiltshire.

District:
Adur; Allerdale; Alnwick; Amber Valley; Arun; Ashfield; Ashford; Aylesbury Vale; Babergh; Barking and Dagenham; Barnet; Barrow-in-Furness; Basildon; Basingstoke and Deane; Bassetlaw; Bedford; Berwick-upon-Tweed; Bexley; Blaby; Blyth Valley; Bolsover; Boston; Braintree; Breckland; Brent; Brentwood; Bridgnorth; Broadland; Bromley; Bromsgrove; Broxbourne; Broxtowe; Burnley; Cambridge; Camden; Cannock Chase; Canterbury; Caradon; Carlisle; Carrick; Castle Morpeth; Castle Point; Charnwood; Chelmsford; Cheltenham; Cherwell; Chester; Chester-le-Street; Chesterfield; Chichester; Chiltern; Chorley; Christchurch; City of Westminster; Colchester; Congleton; Copeland; Corby; Cotswold; Craven; Crawley; Crewe and Nantwich; Croydon; Dacorum; Dartford; Daventry; Derbyshire Dales; Derwentside; Dover; Durham; Ealing; Easington; East Cambridgeshire; East Devon; East Dorset; East Hampshire; East Hertfordshire; East Lindsey; East Staffordshire; Eastbourne; Eastleigh; Eden; Ellesmere Port and

Neston; Elmbridge; Enfield; Epping Forest; Epsom and Ewell; Erewash; Exeter; Fareham; Fenland; Forest Heath; Forest of Dean; Fylde; Gedling; Gloucester; Gosport; Gravesham; Great Yarmouth; Greenwich; Guildford; Hackney; Hambleton; Hammersmith and Fulham; Harborough; Haringey; Harlow; Harrogate; Harrow; Hart; Hastings; Havant; Havering; Hertsmere; High Peak; Hillingdon; Hinckley and Bosworth; Horsham; Hounslow; Huntingdonshire; Hyndburn; Ipswich; Islington; Kennet; Kensington and Chelsea; Kerrier; Kettering; King's Lynn and West Norfolk; Kingston upon Thames; Lambeth; Lancaster; Lewes; Lewisham; Lichfield; Lincoln; Macclesfield; Maidstone; Maldon; Malvern Hills; Mansfield; Melton; Mendip; Merton; Mid Bedfordshire; Mid Devon; Mid Suffolk; Mid Sussex; Mole Valley; New Forest; Newark and Sherwood; Newcastle-under-Lyme; Newham; North Cornwall; North Devon; North Dorset; North East Derbyshire; North Hertfordshire; North Kesteven; North Norfolk; North Shropshire; North Warwickshire; North West Leicestershire; North Wiltshire; Northampton; Norwich; Nuneaton and Bedworth; Oadby and Wigston; Oswestry; Oxford; Pendle; Penwith; Preston; Purbeck; Redditch; Reigate and Banstead; Restmorel; Ribble Valley; Richmond upon Thames; Richmondshire; Rochford; Rossendale; Rother; Rugby; Runnymede; Rushclifffe; Rushmoor; Ryedale; Salisbury; Scarborough; Sedgefield; Sedgemoor; Selby; Sevenoaks; Shepway; Shrewsbury and Atcham; South Bedfordshire; South Bucks; South Cambridgeshire; South Derbyshire; South Hams; South Holland; South Kesteven; South Lakeland; South Norfolk; South Northamptonshire; South Oxfordshire; South Somerset; South Staffordshire; Southwark; Spelthorne; St Albans; St Edmundsbury; Stafford; Staffordshire Moorlands; Stevenage; Stratford-on-Avon; Stroud; Suffolk; Coastal; Surrey Heath; Sutton; Swale; Tamworth; Tandridge; Taunton Deane; Teesdale; Teignbridge; Tendring; Test Valley; Tewkesbury; Thanet; Three Rivers; Tonbridge and Malling; Torridge; Tower Hamlets; Tunbridge Wells; Tynedale; Uttlesford; Vale Royal; Vale of White Horse; Waltham Forest; Wandsworth; Wansbeck; Warwick; Watford; Waveney; Waverley; Wealden; Wear Valley; Welwyn Hatfield; West Devon; West Dorset; West Lancashire; West Oxfordshire; West Somerset; West Wiltshire; Weymouth and Portland; Winchester; Worcester; Worthing; Wychavon; Wyre Forest.

NGR Accuracy:
1. - 4 figure grid reference (accurate to 1km); 2. - 8 figure grid reference (accurate to 100m); 3. - 10 figure grid reference (accurate to 10m); 4. - 12 figure grid reference (accurate to 1m); 5. - NA No grid reference given; 6. - UI – RAPP user input (only where no NGR already exists).

Position Type:
Centre; East; East North East; East South East; North; North North East; North East; North; North West; North West; South; South East; South South East; South South West; South; West; West; West North West; West South West; Offset

Locational accuracy:
<50, 50-100, 100-150, 150-200, 200-250, 250-300,300-350, 350-400, 400-450, 450-500, 50+

C.3.1.4 PANEL.DB

Panel type:
Boulder; Outcrop; Mobiliary; Destroyed; Functional use; Boulder Relocated to archaeological context; Boulder Relocated to non-archaeological context; Mobiliary Relocated to archaeological context; Mobiliary Relocated to non-archaeological context; Functional use Relocated to archaeological context; Functional use Relocated to non-archaeological context.

Panel verification:
Prehistoric; Non-prehistoric; Natural; Modern

Panel geology:
Alluvium; Calcareous Rock; Clay; Gravel/Sand; Igneous/Metamorphic Rock; Organic Material; Sandstone/Sedimentary Rock.

Dominant Surrounding geology:
Alluvium; Calcareous Rock; Clay; Gravel/Sand; Igneous/Metamorphic Rock; Organic Material; Sandstone/Sedimentary Rock.

Height source
Ordnance Survey; Sites and Monuments Record; Global Positioning System; Total Station; National Monuments Record; Publication; Other

Proximity to water:
Standing pool Immediate; Running Immediate; Standing other Immediate; Standing pool Intermediate; Running Intermediate; Standing other Intermediate; Standing pool Distant; Running Distant; Standing other Distant; Multiple water features Immediate; Multiple water features Intermediate; Multiple water features Distant.

Pcontext:
Single; Multiple

Primary slopedirection
Horizontal; Vertical; Sloping; East; East North East; East South East; North; North North East; North East; North North West; North West; South; South East; South South East; South South West; South West; West; West North West; West South West.

Surface preparation
Smoothing; rough hewing; quarrying, absent

C.3.1.5 MOTIF.db

Mcontext:
Single, Multiple

Mclass:
cup; cups (can be conjoined); cup with attached groove; grooves (straight, serpentine or forming a closed irregular shape); radial groove; ring (single, concentric or multiple); ring with extension ring with single internal cup; ring with single internal cup and groove (sometimes extended and including radial, diametric and serpentine forms); ring with more than one internal cup; ring with more than one internal cup and attached groove; penannular; penannular with keyhole extension; penannular with single internal cup and keyhole extension; penannular with single internal cup and attached groove; penannular with single internal cup and attached groove and keyhole extension; penannular with more than one internal cup; penannular with more than one internal cup and keyhole extension; penannular with more than one internal cup and attached groove; penannular with more than one internal cup and attached groove and keyhole extension; cup-and-ring / cup-and-penannular forms (including variants) with attached ladder; cup-and-ring / cup-and-penannular with attached ladder; occulus forms; linear forms (including crosses and hatching); rectilinear forms; lozenge, chevron, and triangular forms; zoomorphic forms; anthropomorphic forms (hands, feet etc..); inanimate objects (axes, daggers etc..); single spiral (clockwise or anti-clockwise); horned spiral; 's' shaped spiral (either 's' or reverse 's'); triple spiral; interlocking spiral; hybrid spiral (combining a spiral with a cup and ring mark)

Technique:
Painted; ground; scratched; pecked; mixed; unknown

C.3.1.6 LANDUSE.DB

Access:
Free access; No access; Other; Payment for access; Visible from path.

AMIC land type around:
Arable; Built-up; Coastlands & estuaries; Established Grassland; Industrial land; Lowland Heath; Parkland and Ornamental gardens; Rivers, lakes and alluviual spreads; Unclassified; Upland moor; Wetland; Woodland.

LUSAG Narrow class:
Agricultural buildings; Airports; Allotments; Bog; Bracken; Broadleaved woodland; Coastal rocks and cliffs; Conifer woodland; Cropland with woody perennial crops; Derelict land; Docks; Dunes; Educational buildings; Fallow land; felled woodland; Field crop; Freshwater marsh; Heathland; Horticulture; Improved pasture; Industry; Inland rock; Institutional and communal; Institutional and communal accommodation; Institutional buildings; Intertidal sand and mud; Land cultivated for aforestation; Landfill waste disposal; Leisure and recreational buildings; Mineral workings and quarries; Mixed woodland; Offices; Outdoor recreation; Public car parks; Railways; Religious buildings; Residential; Residential houses and gardens; Retailing; Roads; Rough grassland; Rough pasture; Running water; Salt marsh; Scrub; Sea/estuary; Shrub; Standing water; Storage and warehousing; Unclassified; Undifferentiated young woodland; Upland grass moor; Upland mosaic; Urban land not previously developed; Utilities; Vacant land previously developed

MARS Land-use around:
Arable land; Coastal land; Developed & urban land; Forestry; Pasture land; Rivers & Lakes Semi-natural land; Unclassified; Wetland.

Management agreement:
Yes; no; not available

C.3.1.7 VEGETATION.DB

Surrounding vegetation:
Bare rock; water; improved pasture; pasture; rough grass; bracken; arable crop; scrub; shrubs; woodland.

C.3.1.8 CONS.db

Risk:
Low; medium; high; destroyed.

Visibility:
Not visible; just visible; obscured; visible.

Amelioration:
Fencing vertical barrier; Horizontal barrier; Removed; Earthen cover; Surface barrier; Replacement; Protective coating; None observed.

Impact:
Localised impact; Neighbourhood impact; No impact; Obscured; Peripheral impact; Segmenting impact; Unknown impact; Widespread impact

General Condition:
1:Very good, 2:Good, 3:Medium, 4:Poor, 5:Very Poor, 6:Destroyed

C.3.1.9 CAUSEDAM(M).db

Agriculture; Building alteration; Demolition; Development; Excavation; Forestry; Industry; Military damage; Mineral extraction; Natural process; Root action; No damage; Road building; Unknown; Urbanisation; Vandalism; Visitor erosion; Wild animal.

C.3.1.10 GRAPHIC.db

Graphic type:
Digitised drawing; Digitised map; Digital map; Digital photograph; Scanned photograph; Other; digitised tracing; scanned drawing; scanned tracing, digphoto derived image

C.3.1.11 BIBLIO.db

Bibliography Type:
Article in published serial / journal; Article in published monograph; Published monograph; Unpublished document / manuscript; Published report

Topic:
Relative dating; Absolute dating; General dating; Conservation; Presentation; Interpretation; Survey; Recording; Photography; Digital imaging

C.3.1.12 INTERP.DB

Interpretative facility:
interpretation boards, leaflets, guided tours, interpretation centre, museum, ranger facility

APPENDIX D
COPY OF SMR DATA REQUEST AND QUESTIONNAIRE LETTER

16th March 1999

Dear Colleague

***ROCK ART PILOT PROJECT** A Conservation and Management study*
A collaborative Project between the Institute of Archaeology, University College London and the School of Conservation Sciences, Bournemouth University for English Heritage

You may have read in the December 1998 issue of British Archaeology (pp 8&9) that English Heritage have commissioned a pilot study into the status of Rock Art studies in the United Kingdom (with special reference to England) and specifically, in order to define and suggest ways in which to manage threats to open-air rock art.

A partnership between Bournemouth University and UCL was successful in winning the contract to carry out the research for English Heritage and now that the two research teams have been deployed, work is underway following five research themes: Importance; Survey and record; Condition; Preservation and; Presentation. The Project's focus is not just to assess the rock art as it is currently known; rather at this stage it is aimed at defining and assessing appropriate methodologies in dealing with rock art. Consolidating knowledge gathered by local groups, amateurs, curators and other archaeological professionals is just as important to the study as is the testing and experimentation with equipment and recording / monitoring schemes.

One of the many research areas of interest to us is finding out the scale and extent of rock art sites in England. It is this that I am writing to you specifically about now. In defining distribution patterns I would be most grateful if you could assist in the following:

- *Completing the enclosed form, exploring information about rock art as held by your SMR; and*
- *The supply, where appropriate, of digital data for rock art records held by your SMR*

The term rock art in this context refers to the following monument classes as listed in the RCHME thesaurus: Carved stone; carving; cup and ring marked stone; cup marked stone; incised stone; rock carving and possibly passage grave (where motifs are present and recorded). This is not an exhaustive list and colleagues may know of other rock art sites classified differently to the above.

It is entirely possible that there are no such records in the area you are responsible for. This may not of course indicate an absence of rock art itself, but a negative response at this stage will help us to understand the current geographic limits of the 'known resource'. There may also be classes of rock art which are recorded either as fakes or bogus and we are interested in these too. Where information does exist, I would be grateful if you could send a digital version of all appropriate records (for all appropriate data fields). In terms of resourcing for this, we can set aside time to visit and help you with data transfer, if this is of use.

During the next week I will contact you, to discuss the enclosed form so if you are able to spend time between now and then, completing as much of it as possible, then this will speed things up. Perhaps we could also discuss the practicality of transferring data. Lastly, it is hoped that as many colleagues as possible will be able to attend a seminar on the pilot's findings towards the end of the Summer (details in a forthcoming issue of the Project's newsletter).

Yours sincerely

APPENDIX E
FIELD RECORDING PROMPTS

The following is a list of fields against which information was recorded for motifs and panels during Pilot Project fieldwork. They represent most but not all data fields as recorded in the RAPP database and thus overlap with those listed in Appendix C.

1. PANEL LEVEL RECORDING (Panel attributes)

General attributes

Unique reference number
Area
Breadth
Height
Length
Maximum slope angle

Minimum slope angle
Surface preparation
Surrounding geology
Panel Context

Panel type
Panel verification
Primary slope direction
Proximity to water
Archaeological proximity (to other monument classes)
Entity direction
Entity distance
Entity type
Total number of motifs

Total number superimpositions
RAPP Petroglyph Class
Interpretive facilities

Reference material

Other reference type
Other reference number

Location details

Field name
Stone name
Latitude
Longitude
Position Type
Validated easting

Validated northing
Description
Panel proximity
Height OD

Landmark proximity
Landmark distance
Landmark bearing
Ease of locating

Panel view information

Distant View Bearing(s)
Intermediate View Bearing(s)
Immediate View Bearing(s)

Obscured View Bearing(s)
View image

Existing measurements

SMR Measurements
NMR Measurements
GPS file names
TS file names

Land-use information

Access
Land ownership
AMIC land type around
LUSAG narrow class
MARS land-use
Management Agreement
Surrounding vegetation
General information

Condition, damage and weathering attributes

Amelioration
Impact
Risk
Visibility
General information

General condition
Observed decay Type
Cause of damage
Environmental parameters
Biological Factor

Field visit attributes

Date
Recorder
Time
Conditions

2. MOTIF LEVEL RECORDING (Individual motif attributes)

Motif context	Depth Maximum
Motif number	Depth Minimum
Motif class	Technique
Superimposition	Visibility
Height	Human intervention
Length	Biological intervention
Width	

3. GENERAL COMMENTS

Includes information on the following where this cannot be suitably stored in the above fields: *location, panel, engraved surface, associated artefacts, land-use, conservation attributes as well as general description of the situation of the panel and motifs*

APPENDIX F
UNIQUE ROCK ART PANEL NUMBERING SYSTEM

This scheme sets out the proposed allocation of a unique database numbering sequence for each county in England, for example Northumberland has been allocated database numbers 1 to 1999 (the first 100 of which relate to the area covered by the pilot study 3x2km transect). Counties are normally only allocated 999 numbers but in areas of known petroglyph densities, 1000 numbers are allocated. The sequence can be continued for Scotland, Ireland and Wales. For ease of reference, the old county names are used to allocate number groups, however, a correspondence is given to reconcile new Unitary Authorities covering the post 1974 county boundaries.

County	Unitary Authorities	Unique number allocation
Avon	Bristol, North Somerset, Bath & North East Somerset, South Gloucestershire	44000-44999
Bedfordshire	Luton, Bedfordshire,	31000-31999
Berkshire	Bracknell Forest, West Berkshire, Reading, Slough, Windsor & Maidenhead, Wokingham	35000-35999
Buckinghamshire	Milton Keynes, Buckinghamshire,	30000-30999
Cambridgeshire	Cambridgeshire, Peterborough	22000-22999
Cheshire	Halton, Warrington, Cheshire	14000-14999
Cleveland	Hartlepool, Middlesborough, Redcar & Cleveland, Stockton-on-Tees	5000-5999
Cornwall	Cornwall	47000-47999
Cumbria	Cumbria	3000-3999
Derbyshire	Derby City, Derbyshire	16000-16999
Devon	Plymouth,Torbay, Devon	46000-46999
Dorset	Bournemouth, Poole, Dorset	43000-43999
Durham	Darlington, Durham	4000-4999
East Sussex	Brighton & Hove, East Sussex	37000-37999
Essex	Southend, Thurrock, Essex	33000-33999
Gloucestershire	Gloucestershire	28000-28999
Greater London	Greater London	34000-34999
Greater Manchester	Greater Manchester	13000-13999
Hampshire	Portsmouth, Southampton, Hampshire	40000-40999
Hereford and Worcester	Herefordshire, Worcestershire	27000-27999
Hertfordshire	Hertfordshire	32000-32999
Humberside	East Riding of Yorkshire, City of Kingston upon Hull, North Kincolnnshire, North East Lincolnshire	10000-10999
Isle of Wight	Isle of Wight	41000-41999
Kent	The Medway Towns, kent	36000-36999
Lancashire	Blackburn with Darwen, Blackpool, Lancashire	7000-7999
Leicestershire	Leicester city, Rutland, Leicestershire	21000-21999
Lincolnshire	Lincolnshire	11000-11999
Merseyside	Merseyside	15000-15999
Norfolk	Norfolk	23000-23999
North Yorkshire	York, North Yorkshire	6000-6999
Northamptonshire	Northamptonshire	25000-25999
Northumberland	Northumberland	1-1999
Nottinghamshire	Nottingham city, Nottinghamshire	17000-17999
Oxfordshire	Oxfordshire	29000-29999
Shropshire	Telford & Wrekin, Shropshire	19000-19999
Somerset	Somerset	45000-45999
South Yorkshire	South Yorkshire	12000-12999
Staffordshire	Stoke-on-Trent, Staffordshire	18000-18999
Suffolk	Suffolk	24000-24999
Surrey	Surrey	38000-38999
Tyne and Wear	Tyne and Wear	2000-2999
Warwickshire	Warwickshire	26000-26999
West Midlands	West Midlands	20000-20999
West Sussex	West Sussex	39000-39999
West Yorkshire	West Yorkshire	8000-9999
Wiltshire	Thamesdown, Wiltshire	42000-42999

APPENDIX G
TECHNICAL SURVEY FEATURE CODE LIST

A basic library of feature codes was created for use with GPS and Total Station equipment when survey was undertaken at, on and around carved panels. The list is not exhaustive. The codes reflect what was thought important in order to distinguish the topography and edges of panels, the motifs contained therein, survey controls, proximal landmarks and intrusive features such as vegetation. The codes and their meanings are as follows.

TOTAL STATION CODES	FEATURE REPRESENTED
CB	Cup base
CE	Cup edge
CONTROL	Control
CRAG	Crag
GV	Groove edge
KERB	Cairn kerb
MDN	Motif Datum North
MDS	Motif Datum South
MDE	Motif Datum East
MDW	Motif Datum West
PE	Panel edge
PPOS	Panel position
QE	Quarry edge
RE	Rock edge
RG	Ring edge
TRIG	Trig point
VE	Vegetation edge
WALL	Wall

APPENDIX H
MUSEUM QUESTIONNAIRE

The following museums and interpretation centres were asked to complete a questionnaire on the presence of rock art on displays / storage and the level of interpretation undertaken. Entries with a '+' after the title denote that a reply was received.

H.1 ENGLAND (12 REPLIES)

Bristol City Museum and Art Gallery, **Bristol +**
Royal Cornwall Museum, Truro, **Cornwall**
Bowes Museum, **County Durham**
Fulling Mill Museum, Durham, **County Durham +**
Museum of Archaeology, **County Durham + (* data arrived late – to be added)**
Penrith Museum, Penrith, **Cumbria +**
Tullie House Museum and Art Gallery, Carlisle, **Cumbria +**
Dorset County Museum, Dorchester, **Dorset + (* data arrived late – to be added)**
Corinium Museum, Cirencester, **Gloucestershire +**
British Museum, **London +**
Rotunda Museum of Archaeology and Local History, Scarborough, **North Yorkshire**
Whitby Museum, Whitby, **North Yorkshire +**
Berwick-upon-Tweed Borough Museum and Art Gallery, **Northumberland**
Earle Hill Household and Farming Museum, Wooler, **Northumberland**
Sheffield City Museum and Mappin Art Gallery, **Sheffield +**
Honey Hill Museum, Bury St Edmunds, **Suffolk**
Museum of Antiquities, Newcastle, **Tyne and Wear +**
Manor House Museum, Ilkley, **West Yorkshire +**

H.2 SCOTLAND (9 REPLIES)

Kilmartin House, **Arygll**
Dick Institute, Kilmarnock, **Ayrshire +**
Tweedale Museum, Peebles, **Borders +**
Falkland Palace and Garden, Falkland, **Fife**
Hunterian Museum, **Glasgow +**
Kelvingrove Art Gallery and Museum, **Glasgow +**
Bute Museum, Rothesay, **Isle of Bute +**
Stewartry Museum, Kirkcudbright, **Kirkcudbrightshire**
Low Parks Museums, Hamilton, **Lanarkshire +**
New Museum of Scotland, Edinburgh, **Mid-Lothian**
Tankerness House Museum, Kirkwall, **Orkney +**
Dundee Art Galleries and Museums, Dundee, **Perthshire and Kinross +**
Tain and District Museum, **Rosshire +**

H.3 Wales (1 REPLY)

National Museum & Gallery Cardiff, **Cardiff +**

H.4 Isle of Man (1 REPLY)

Manx Museum, Douglas, **Isle of Man +**

APPENDIX I
THEMATIC BIBLIOGRAPHY ON ROCK ART INTERPRETATION, CHRONOLOGY AND DATING

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APPENDIX J
THEMATIC BIBLIOGRAPHY ON CONSERVATION AND DECAY STUDIES, RESOURCE MANAGEMENT, PRESENTATION AND SURVEY AND RECORDING METHODS

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APPENDIX L
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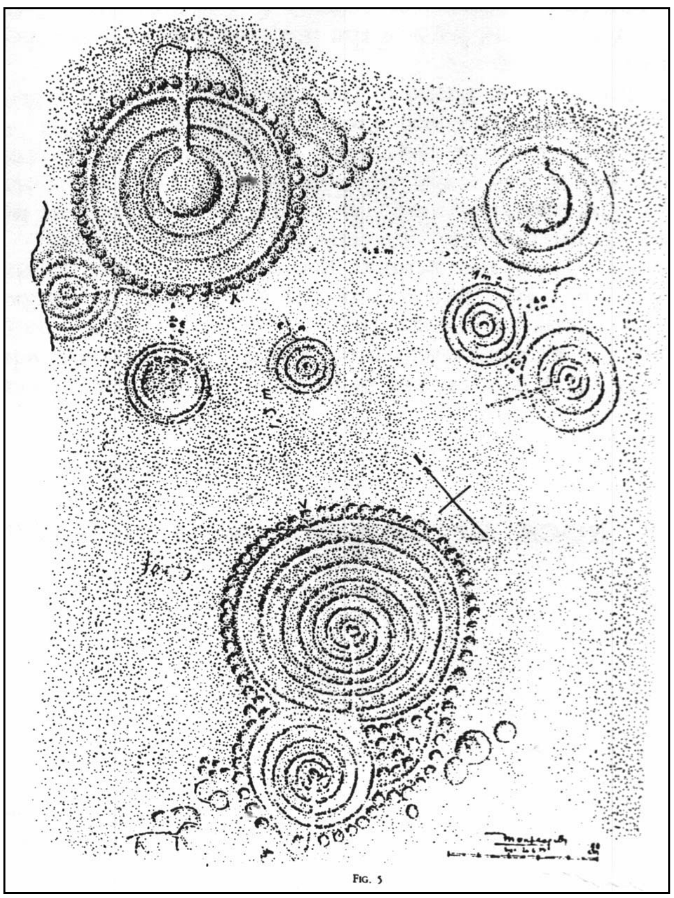

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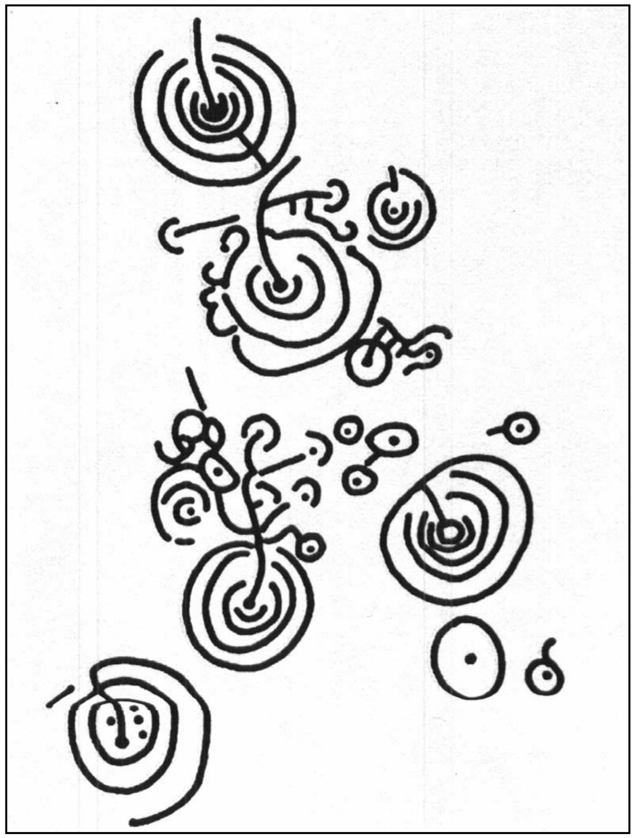

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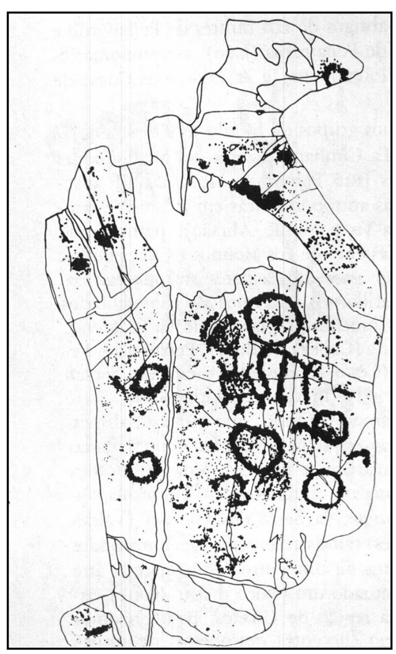

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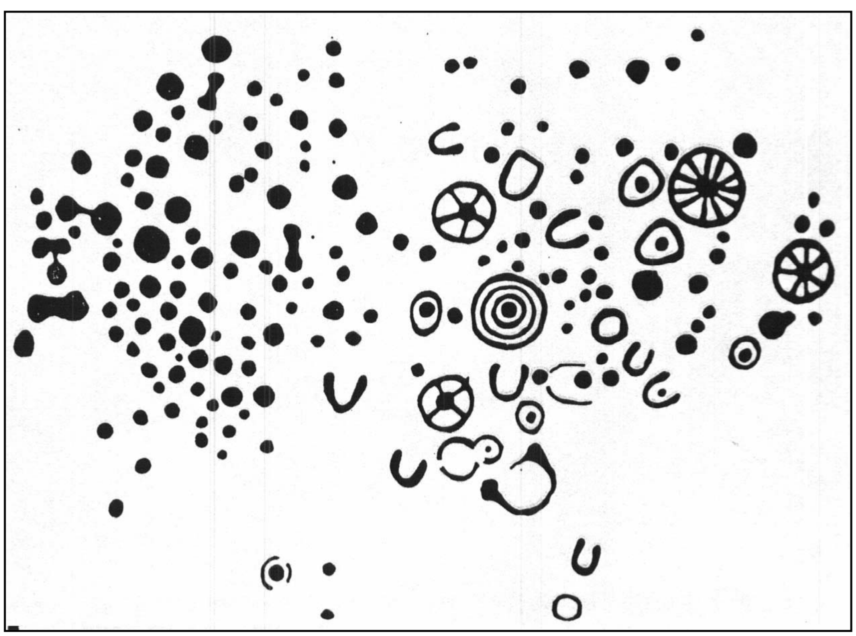

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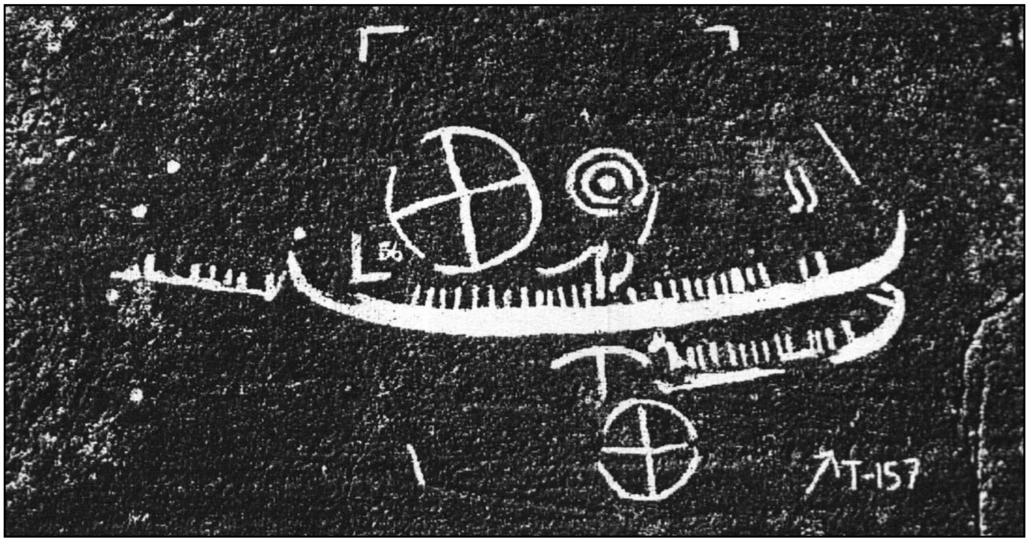


Figure 3.9 Scandinavia. Tanum, Sweden (after internet image: www.ssfpa.se/hallrist/bilder/T-157.jpg)

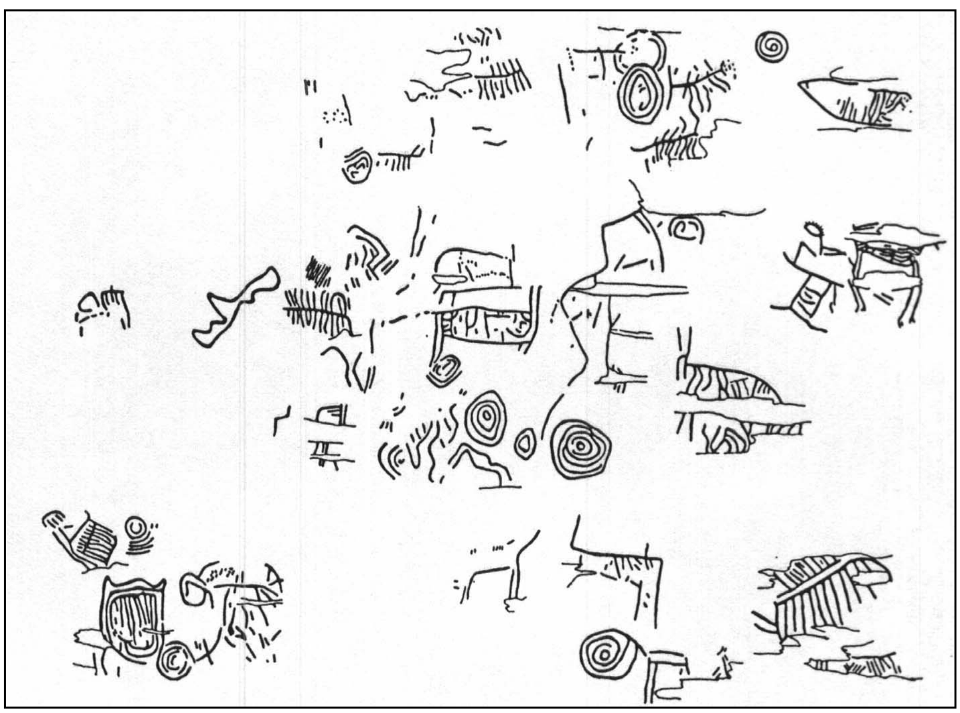


Figure 3.10 Scandinavia. Ausevik, Sogn og Fjordane, Norway. Rough concentric rings, frames or lattices, and animals (after Fett and Fett 1979, Fig. 12)

Figure 3.11 The Alps – Switzerland and Italy. Sonico, Valcamonica, Italy (after Priuli 1996, 35, Fig. 66)

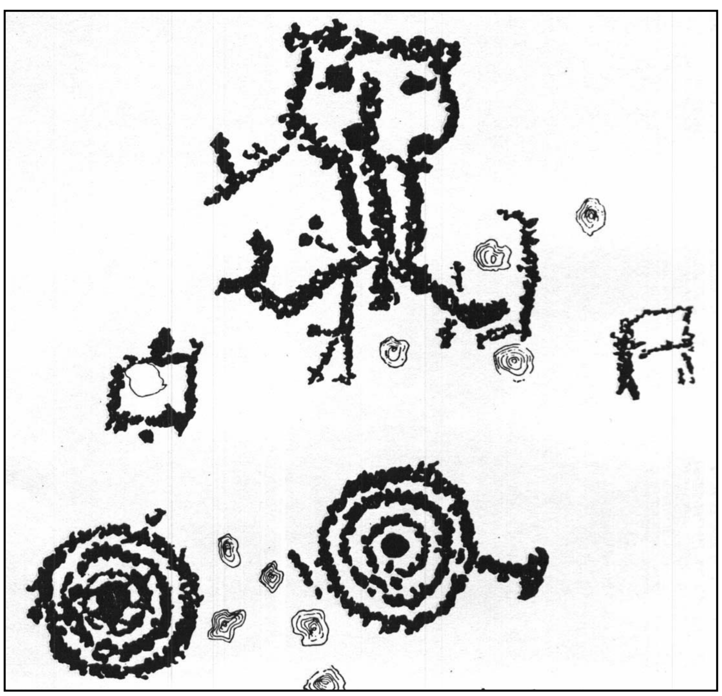


Figure 3.12 The Alps – Switzerland and Italy. Luine, rock 49-B, Valcamonica, Italy. Idoliform figure accompanying two series of concentric discs with central cup (after Anati 1976, Fig. 58)

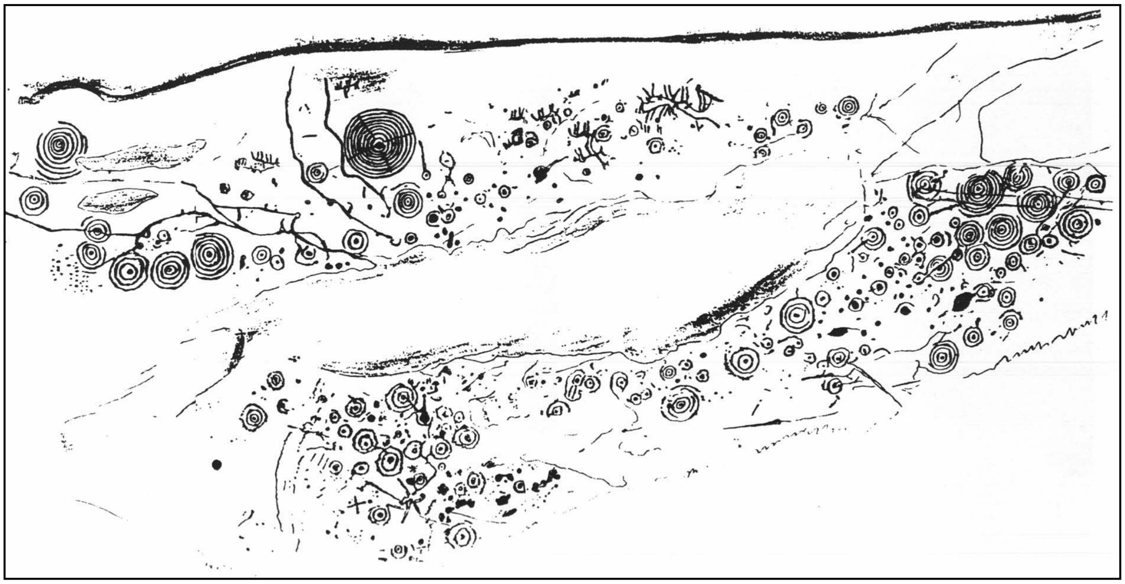


Figure 3.13 The Alps – Switzerland and Italy. Carschenna, rock II, Switzerland (after Priuli 1996, 92, Fig. 162, tracing)

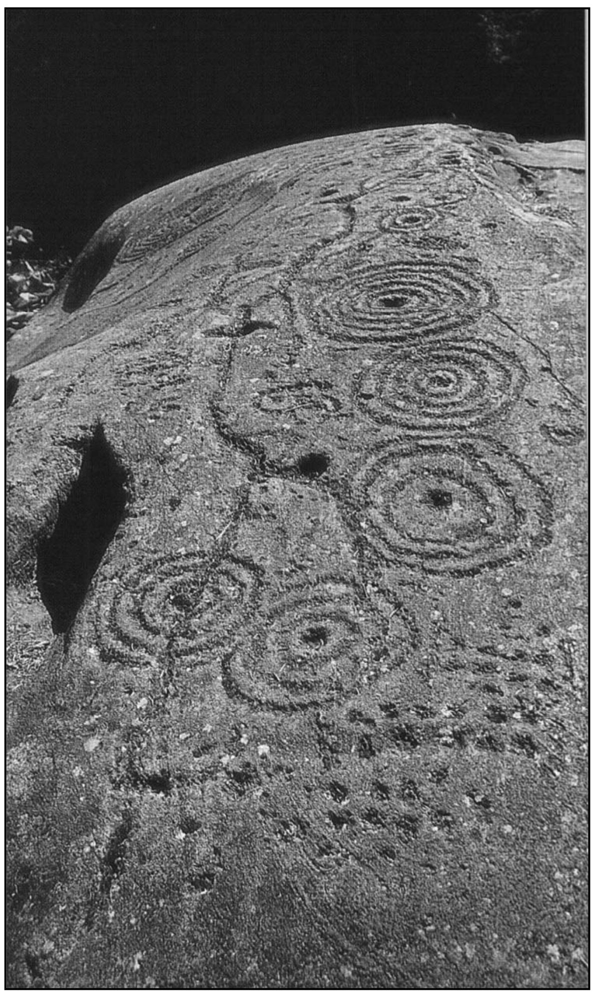


Figure 3.14 The Alps – Switzerland and Italy. Carschenna, rock II, Switzerland (after Arca and Fossati 1995, 103, detail of Fig. 11)

Figure 3.15 The Alps – Switzerland and Italy. Carschenna, rock II, Switzerland. Neolithic cup-and-nine-rings and possible Iron Age zoomorphic figure (after Van Hoek 1997, Fig. 2, detail of Fig. 11)

Figure 3.16 The Canary Islands. Fuente de la Zarza, La Palma (after McMann 1980, Fig. 121)

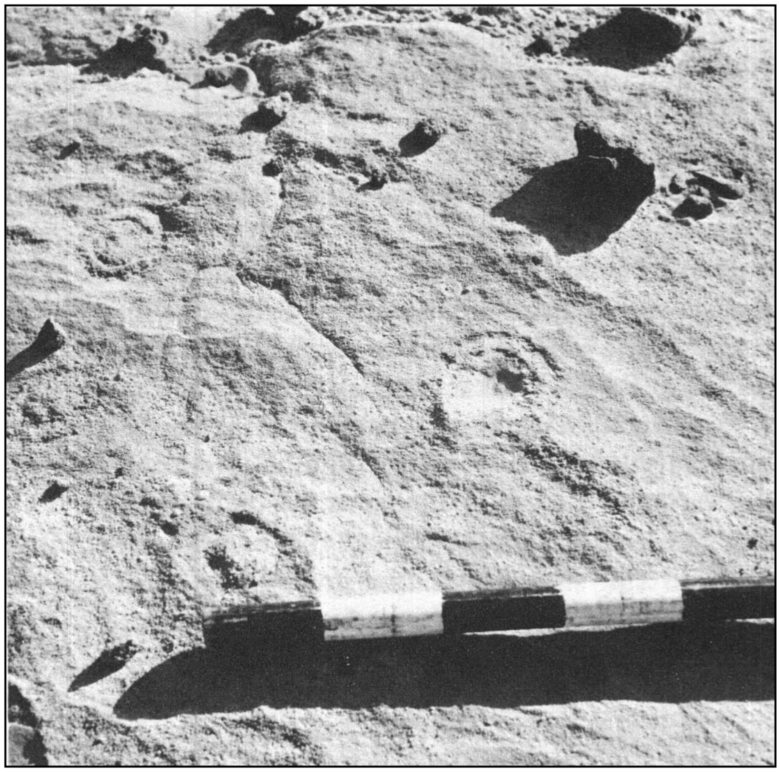


Figure 3.17 Africa. Between Izezou and Ourarene wells, Western Air, Nigeria. Possibly cup-and-ring marks (after Morris and Milburn 1976, 144, Fig. 1)

Figure
3.18 Africa. Elarmekora, Ogooue Valley, Gabon. Composition de trois cercles concentriques (after Oslisly 1993, Photo 10)

Figure 3.19 Africa. Elarmekora, Ogouue Valley, Gabon. Cercle aux neuf sillons (after Oslisly 1993, Photo 14)

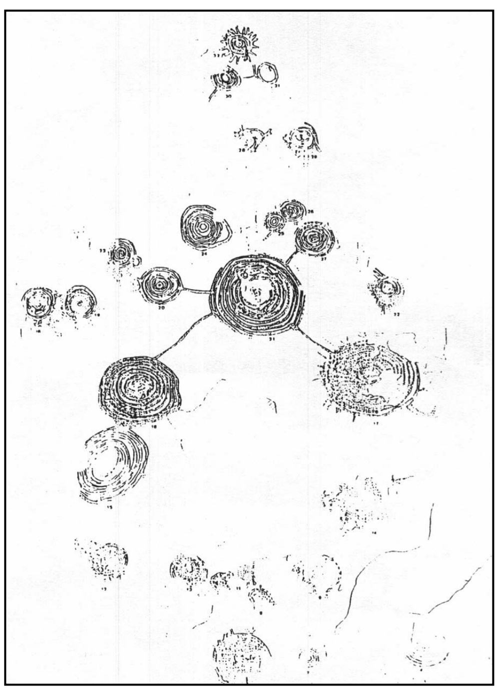


Figure 3.20 Africa. Tchitundo-hulo, Angola (after Gutierrez 1996, Fig. 5)

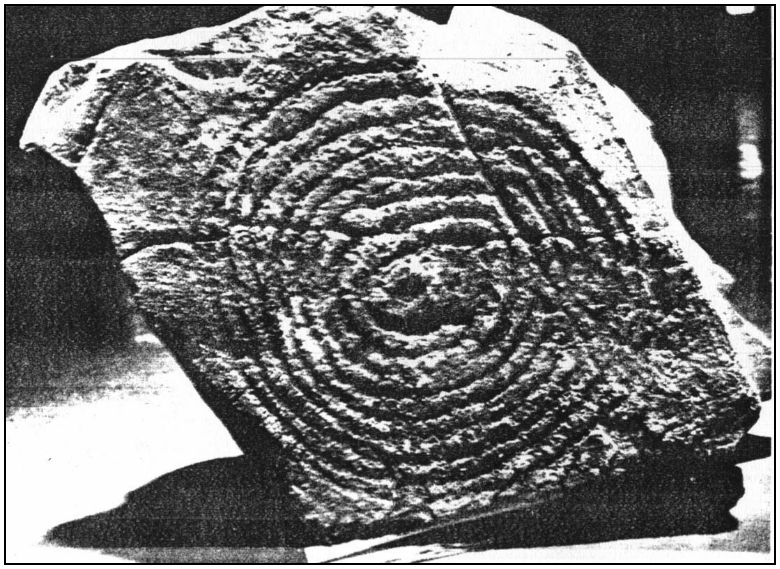


Figure 3.21 Africa. Loteteleit, Uganda. Spiral groove (after Morton 1967, 208)

Figure 3.22 Africa. Kangetet, Kenya. Circles (after Soper 1968, Plate 16)

Figure 3.23. Africa. Lydenburg District, South Africa. Boulder with cup and ring markings (after Pyper 1918, Pl. 11)

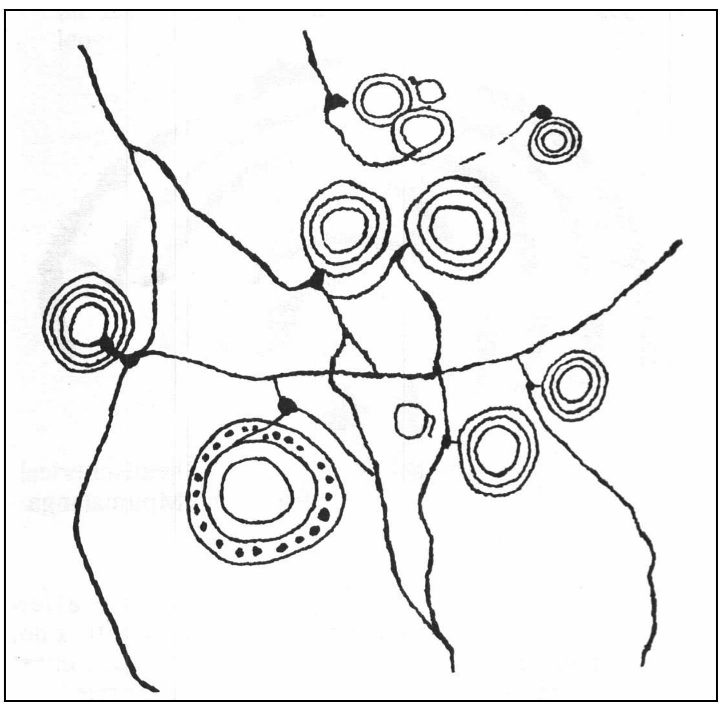


Figure 3.24 Africa. Mpumalanga, Lydenburg area. Engraving of circular homesteads linked by roads (after Maggs 1995, Fig. 14)

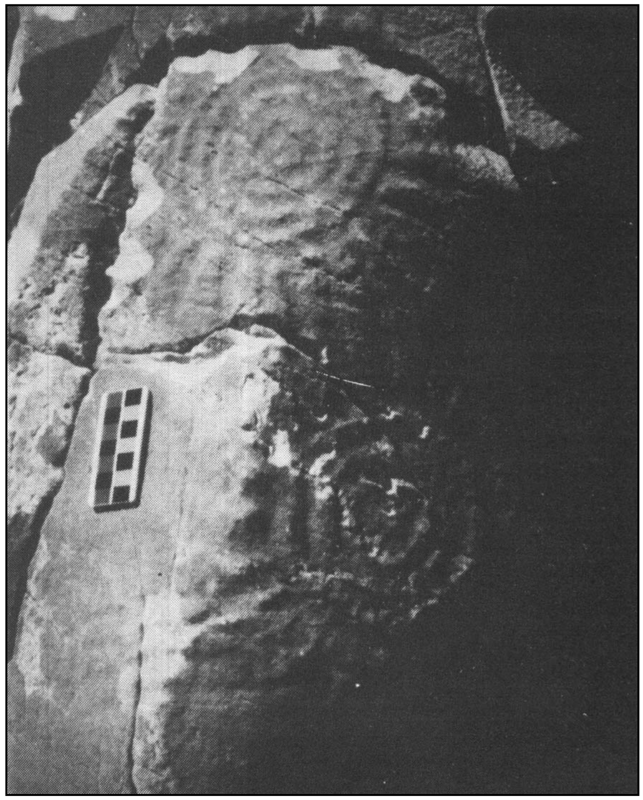


Figure 3.25 The Americas. Inyo county, site CA-Iny-272, California, USA. Light-coloured dolomitic marble. Cup-and-ring petroglyphs (after Mark and Newman 1995, Fig. 10)

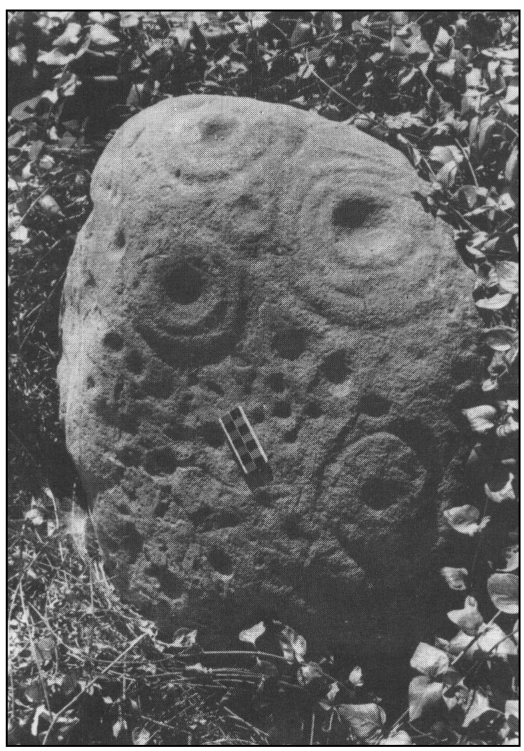


Figure 3.26 The Americas. Santa Barbara County, California, USA. Sandstone boulder. Cups-and-rings (after Mark and Newman 1995, Fig. 9)

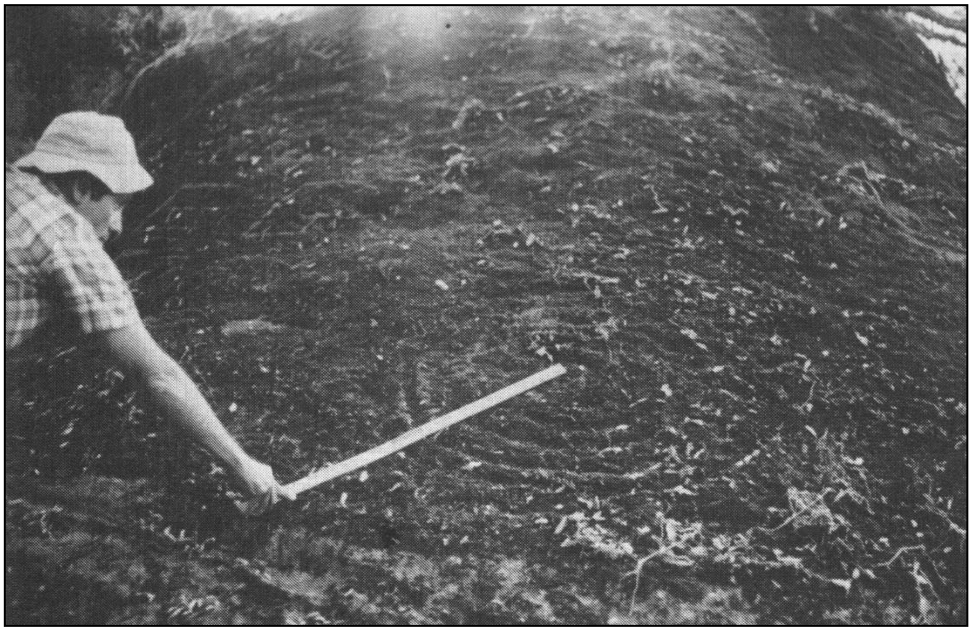


Figure 3.27 The Americas. Santa Clara County, site CA-SC1-111, California, USA. On river bank (Uvas Creek) in valley. Tertiary marine sandstone. Cup-and-ring petroglyph, 1m in diameter (after Mark and Newman 1995, Fig. 8C)

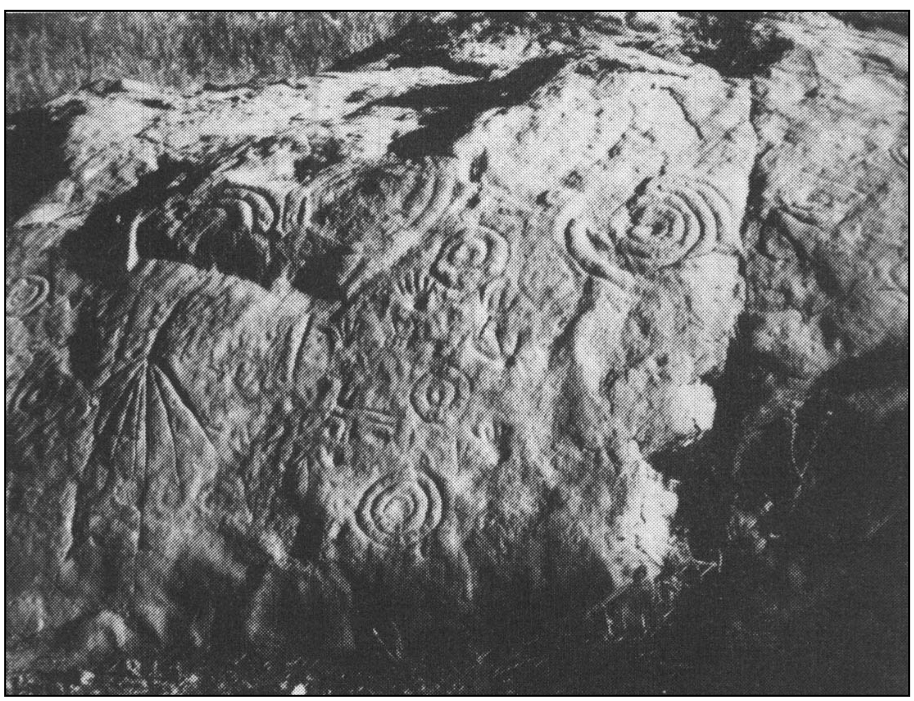


Figure 3.28 The Americas. Mendocino County, CA-Men-1912, California, USA. Metamorphic boulder Description: Petroglyphs including the cup-and-ring motif (after Mark and Newman 1995, Fig. 7A)

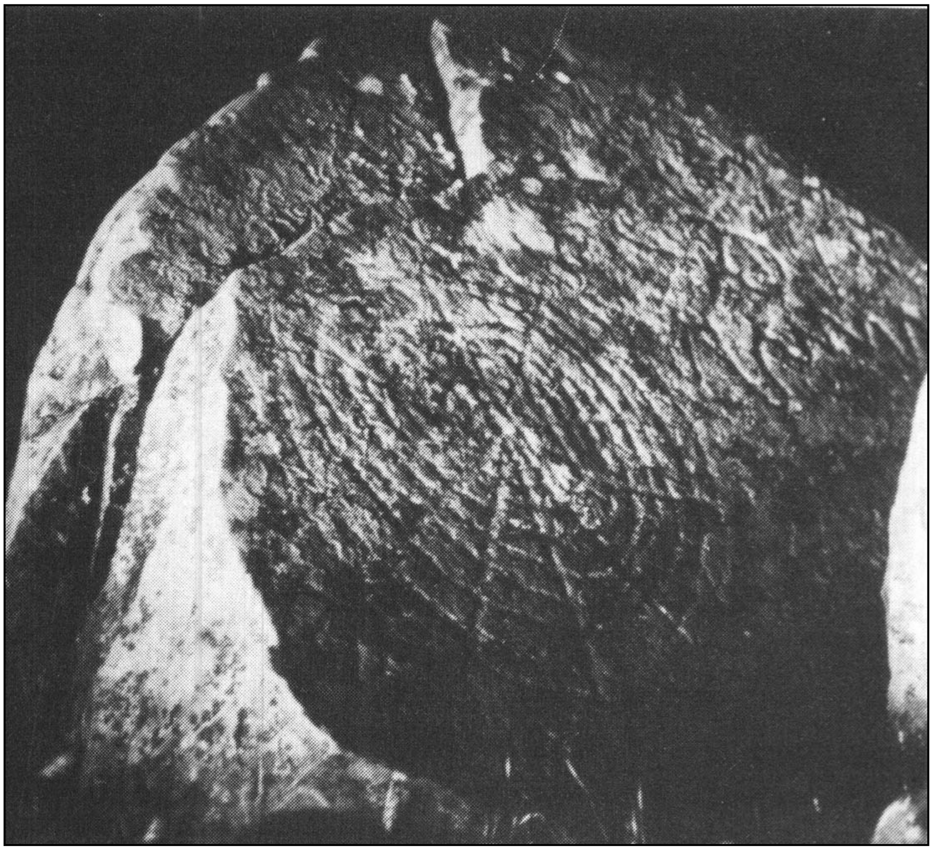


Figure 3.29 The Americas. Sacramento County, CA-Sac-228, California, USA. Cup-and-rings, radial spokes within the circles and curvilinear tail leading off to the right (after Mark and Newman 1995, Fig. 6A)

Figure 3.30 The Americas. Sacramento County, CA-Sac-228, California, USA. Cup-and-rings, radial groove extending beyond the rings (rare in USA) (after Mark and Newman 1995, Fig. 6B)

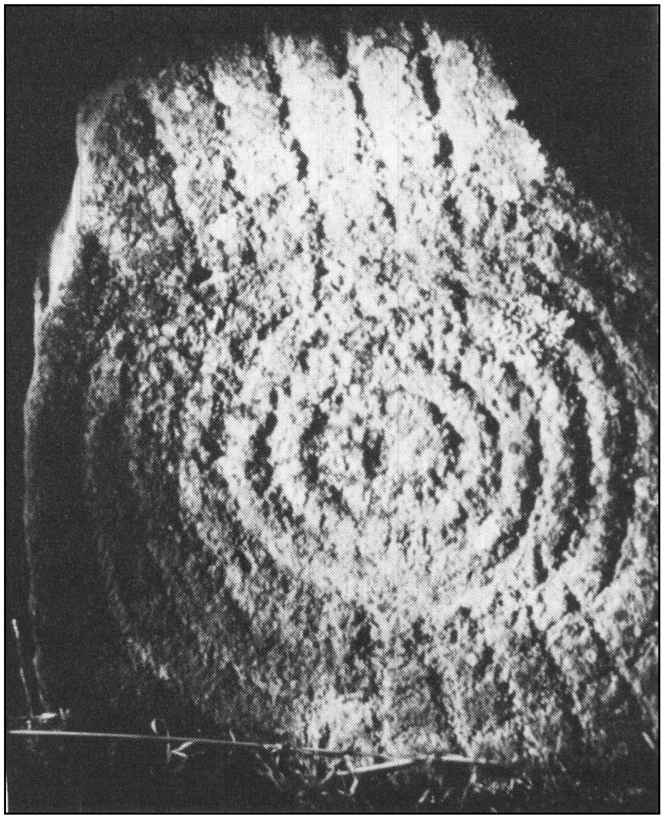


Figure 3.31 The Americas. Sacramento County, CA-Sac-228, California, USA. Cup-and-rings, nearly parallel rays extending from circles (after Mark and Newman 1995, Fig. 6C)

Figure 3.32 The Americas. V-Bar-V Ranch. Verde Valley, Arizona, USA (after internet site: aztec.asu.edu/aznha/vbarv/panorama.html)

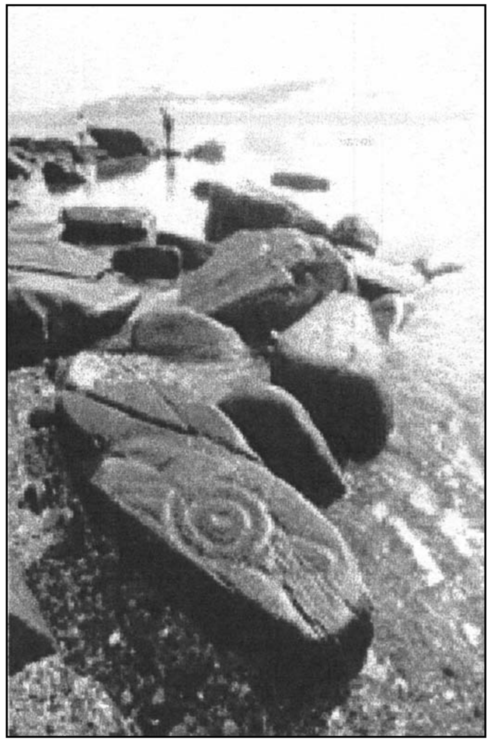


Figure 3.33 The Americas. Petroglyph Beach, Wrangell, Alaska, USA (after internet reference: wrangell.com/cultural/petroglyph.htm)

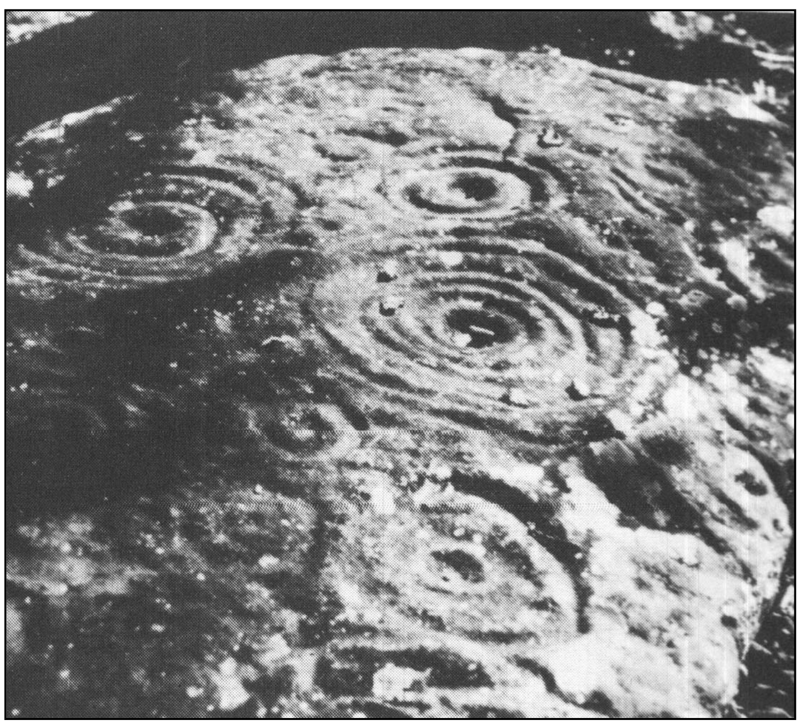


Figure 3.34 The Americas. Waleska, Georgia, USA. Granite boulder. Cup-and-ring petroglyphs (after Mark and Newman 1995, Fig. 11B)

Figure 3.35 The Americas. From Forsyth County, now at campus of the University of Georgia, Athens, Georgia, USA. Concentric circles. Owl effigy when standing upright (T.Lewis) (after Perryman 1964, 56)

Figure 3.36 The Americas. Columbia River area, Skamania County, Washington, USA. Basalt boulder. Cup-and-ring petroglyphs (after Mark and Newman 1995, Fig. 11A)

Figure 3.37 The Americas. Piedra Marcada, Prov. Nuflo de Chave, Brazil. Representations of faces (after Riester 1981, 155, Fig. 59)

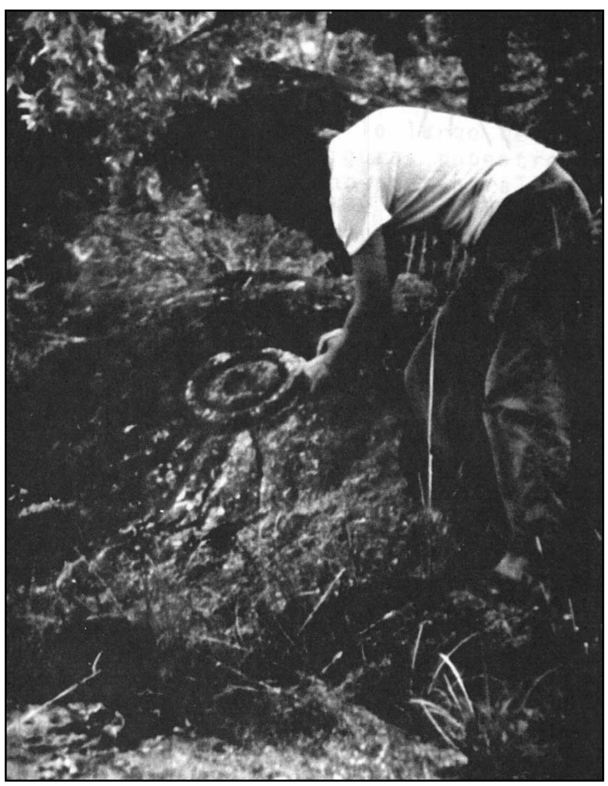


Figure 3.38 The Americas. Serrania de San Simon, Prov. Itenez, Brazil (after Riester 1981, 138, Fig. 49)

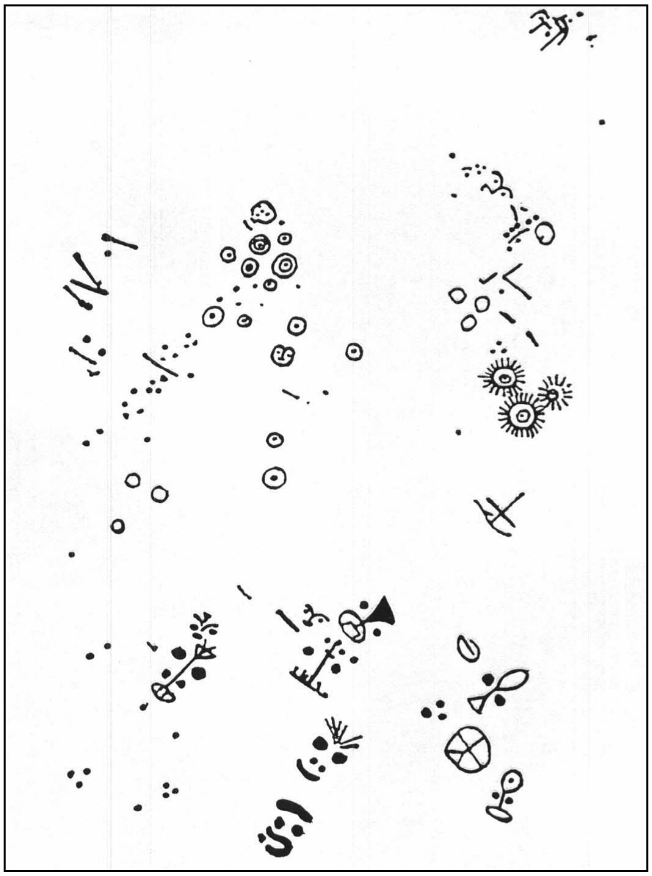


Figure 3.39 Asia. Lianyungang, Jinagsu, China. Serie di punti, linee, circoli, circoli raggiati, circoli concentrici e ideogrammi (after Chen 1987, Fig. 41)

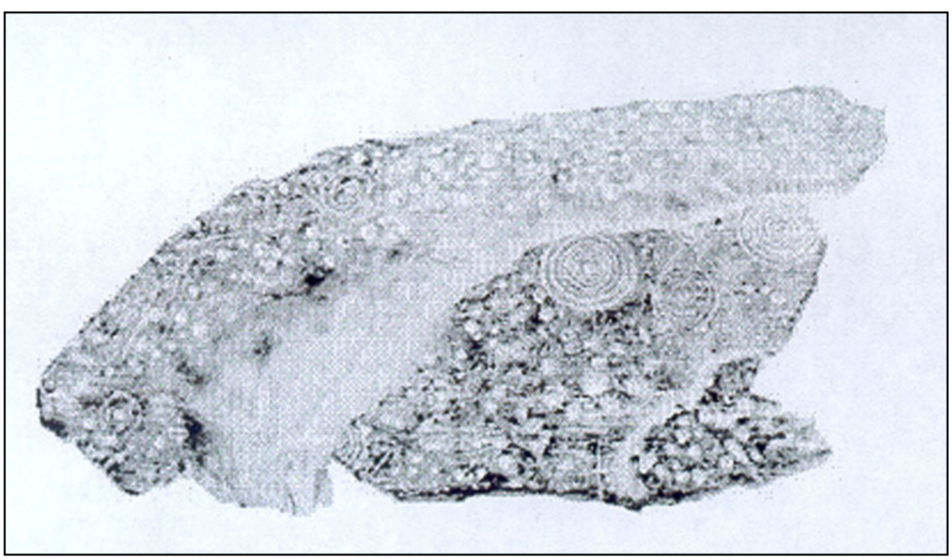


Figure 3.40 Asia. Dohangri, Haman (Kaya), Pusan, South Korea. Cupmarks and concentric circles (after internet reference: myhome.shinbiro.com/~kbyon/petro/dohang.htm/)

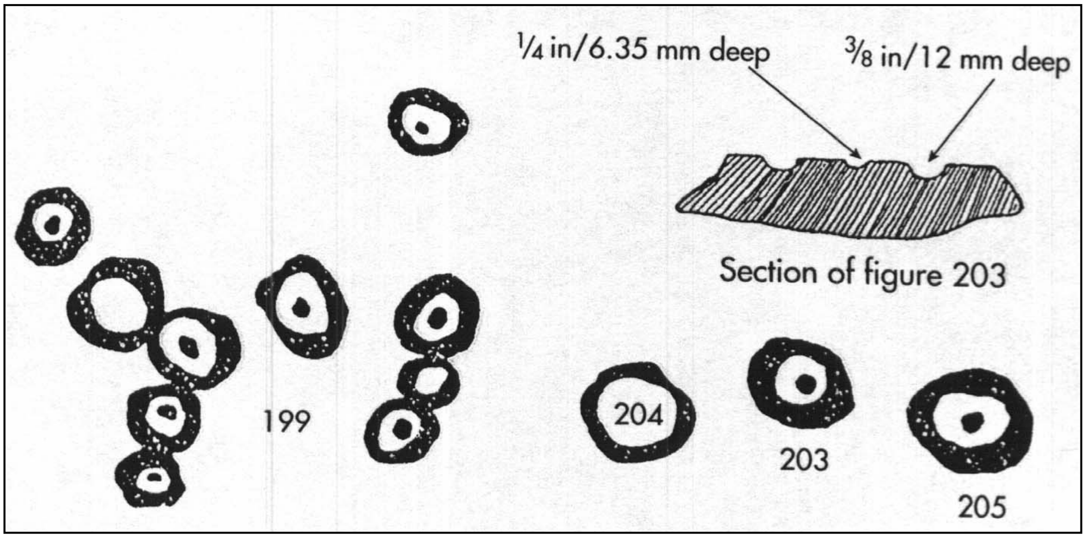


Figure 3.41 Australia. Huddlestone, South Australia. Cup and ring motifs (after Flood 1997, 149)

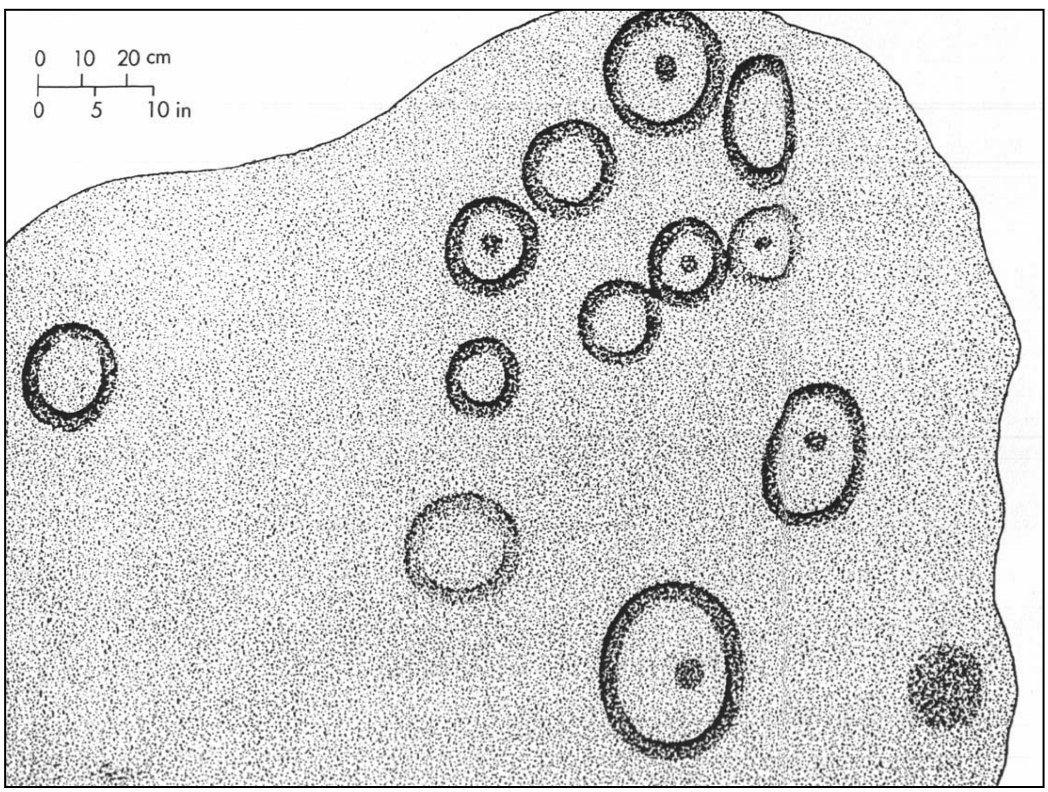


Figure 3.42 Australia. Trial Harbour, Tasmania. Circles with a central pit (after Flood 1997, 238)

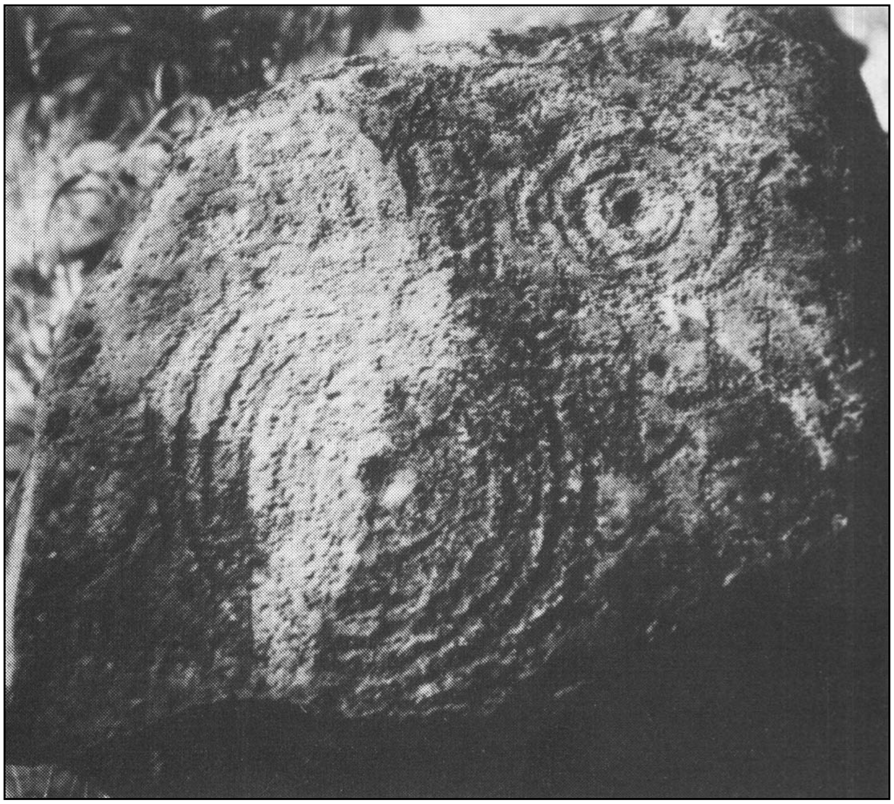


Figure 3.43 Australia. N'Dhala Gorge, Northern Territory. Quarzite boulder. Cup-and-ring petroglyphs (after Mark and Newman 1995, Fig. 12)

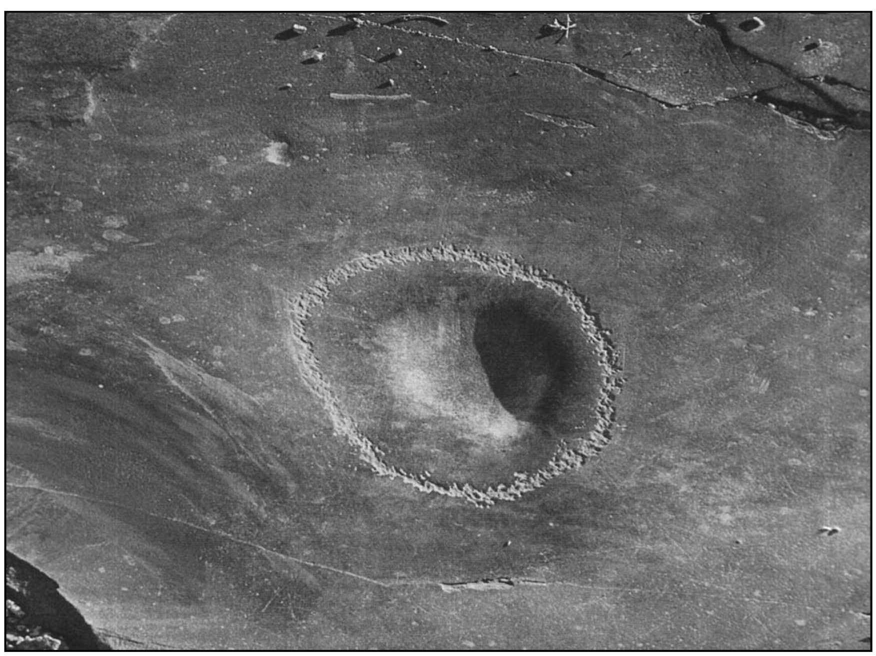


Figure 3.44 Australia. Sturt's Meadows, New South Wales. Circle of natural peck marks around the periphery of a natural hollow (after Flood 1997, 150)

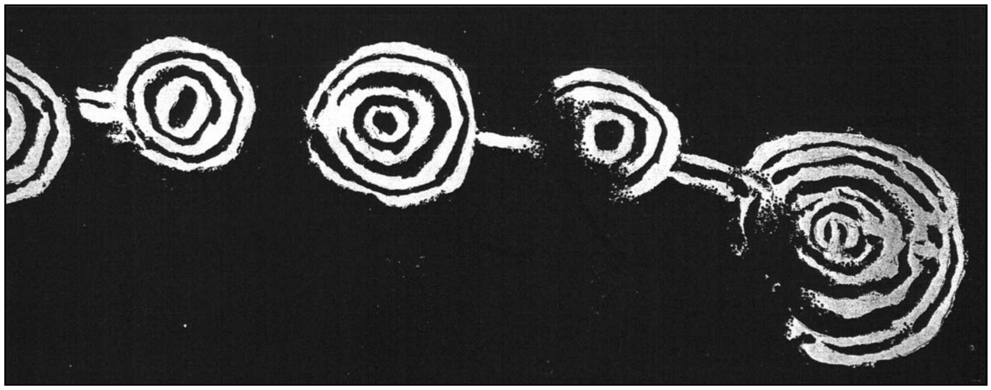


Figure 3.45 Australia. Mutitjulu, Uluru, rock painting. Depiction of the journey of the Kuniya pythons to Uluru (after Layton 1992, 53)

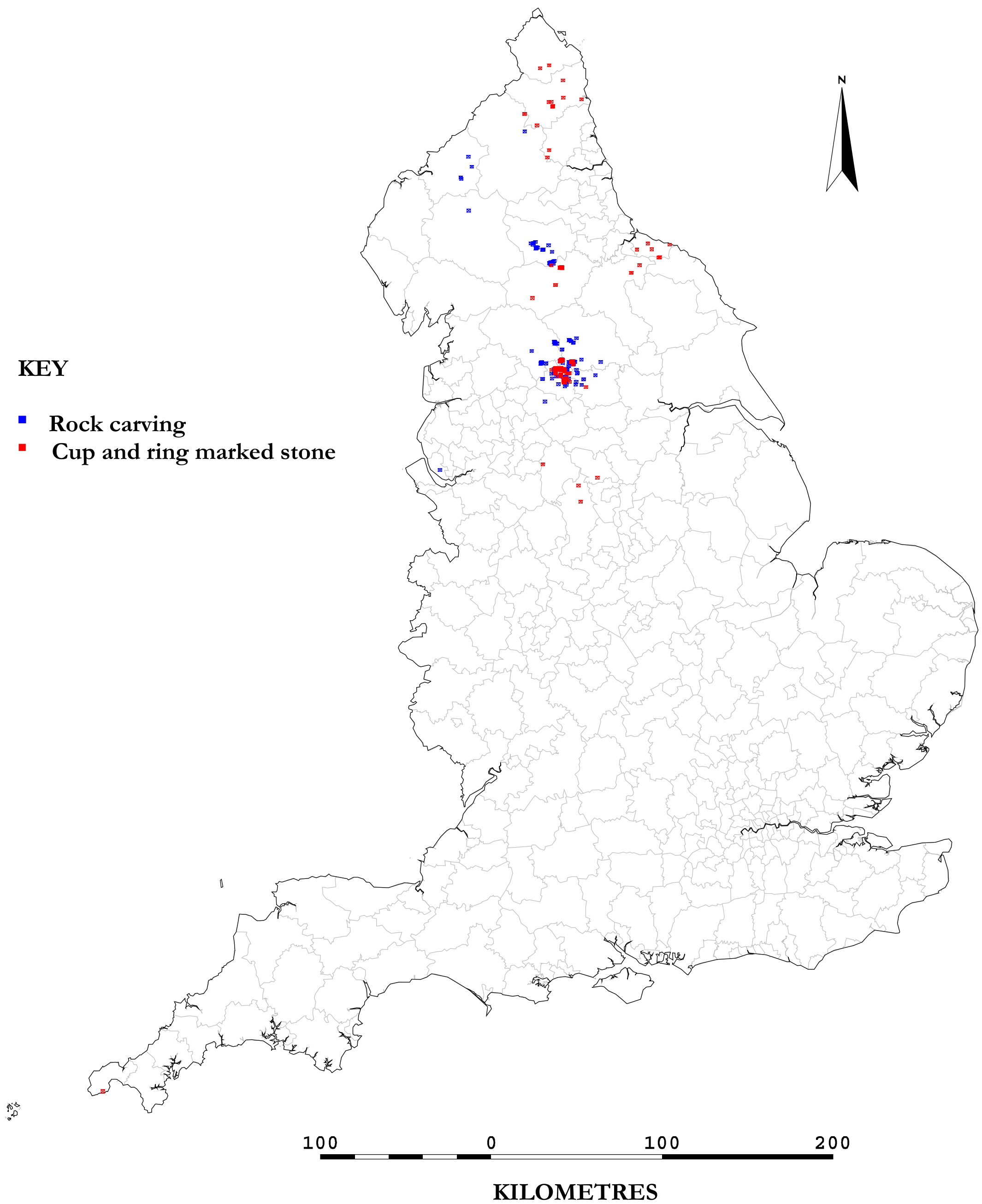


Figure 4.1 Map showing the distribution of rock art in England classified as rock carvings and cup and ring marked stones in the English Heritage Monuments Protection Programme (data supplied by English Heritage Records Office)

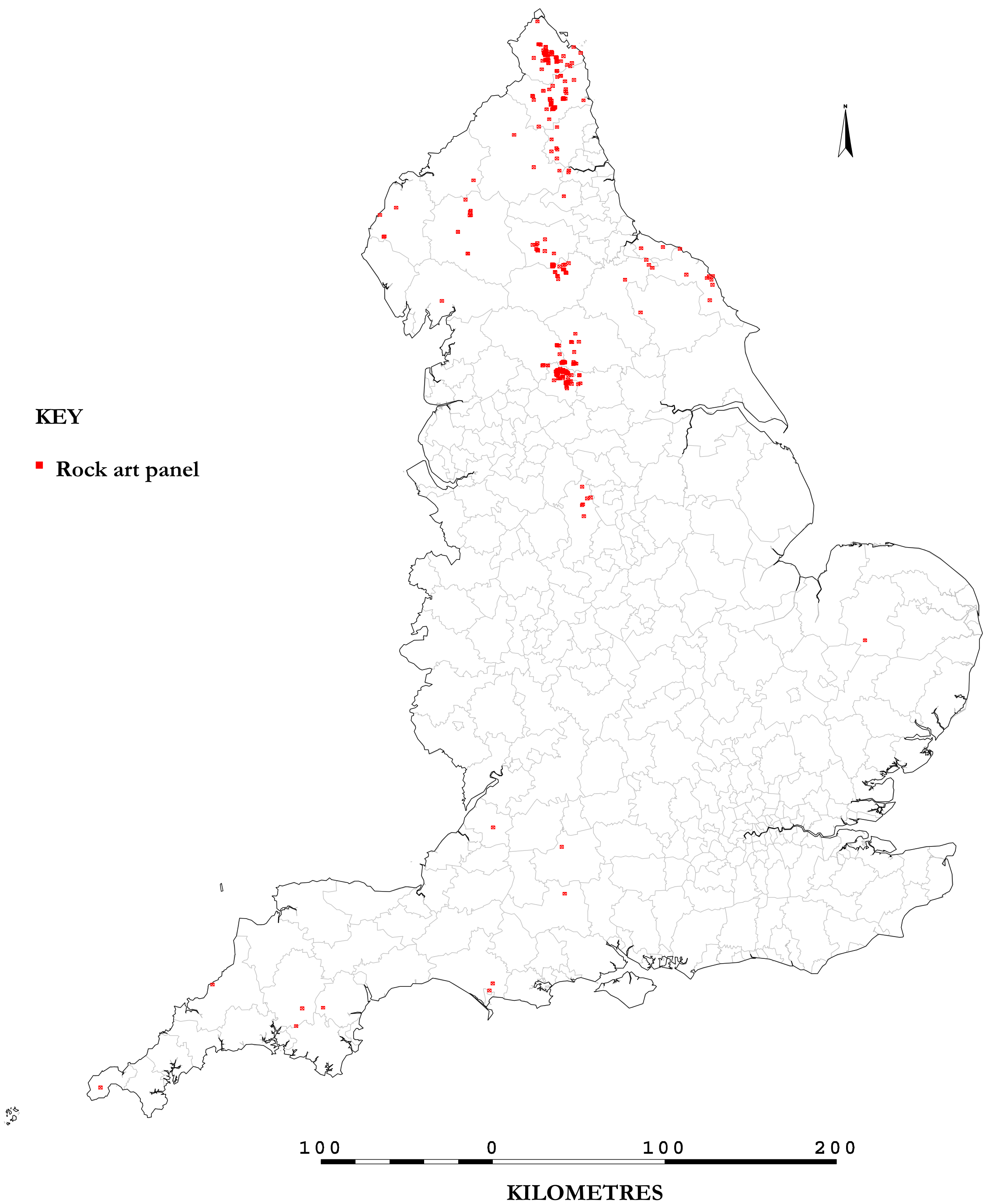
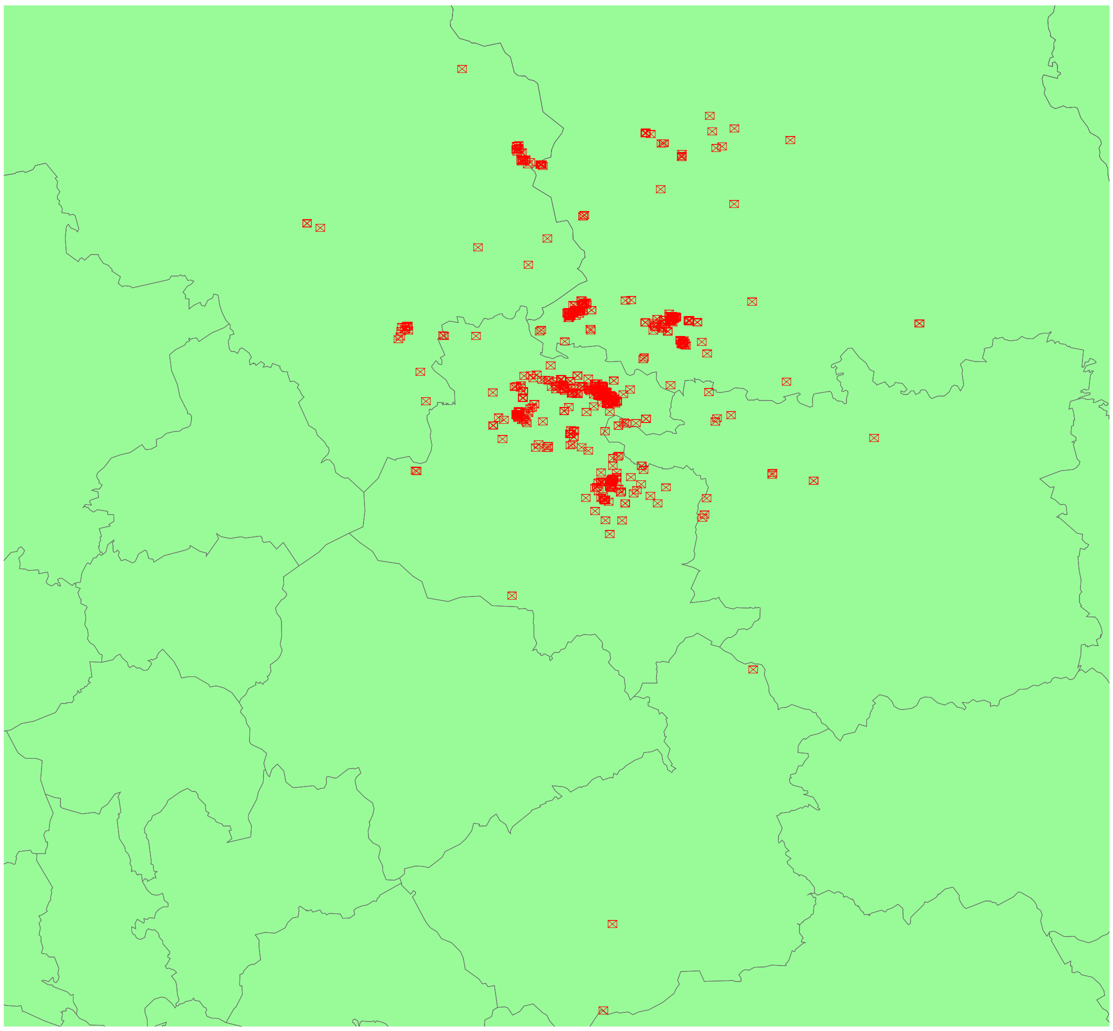


Figure 5.1 Map showing the distribution of rock art panels in England recorded by R.W. Morris (1989)

Figure 5.2 Map showing the distribution of rock art panels in England recorded in the HELICS database (data supplied by I.Hewitt)



KEY

Rock art panel
Unitary Authorities boundary

Figure 5.3 Map showing the distribution of rock art panels in West Yorkshire recorded by the Ilkley Archaeology Group (data supplied by the Ilkley Archaeology Group)

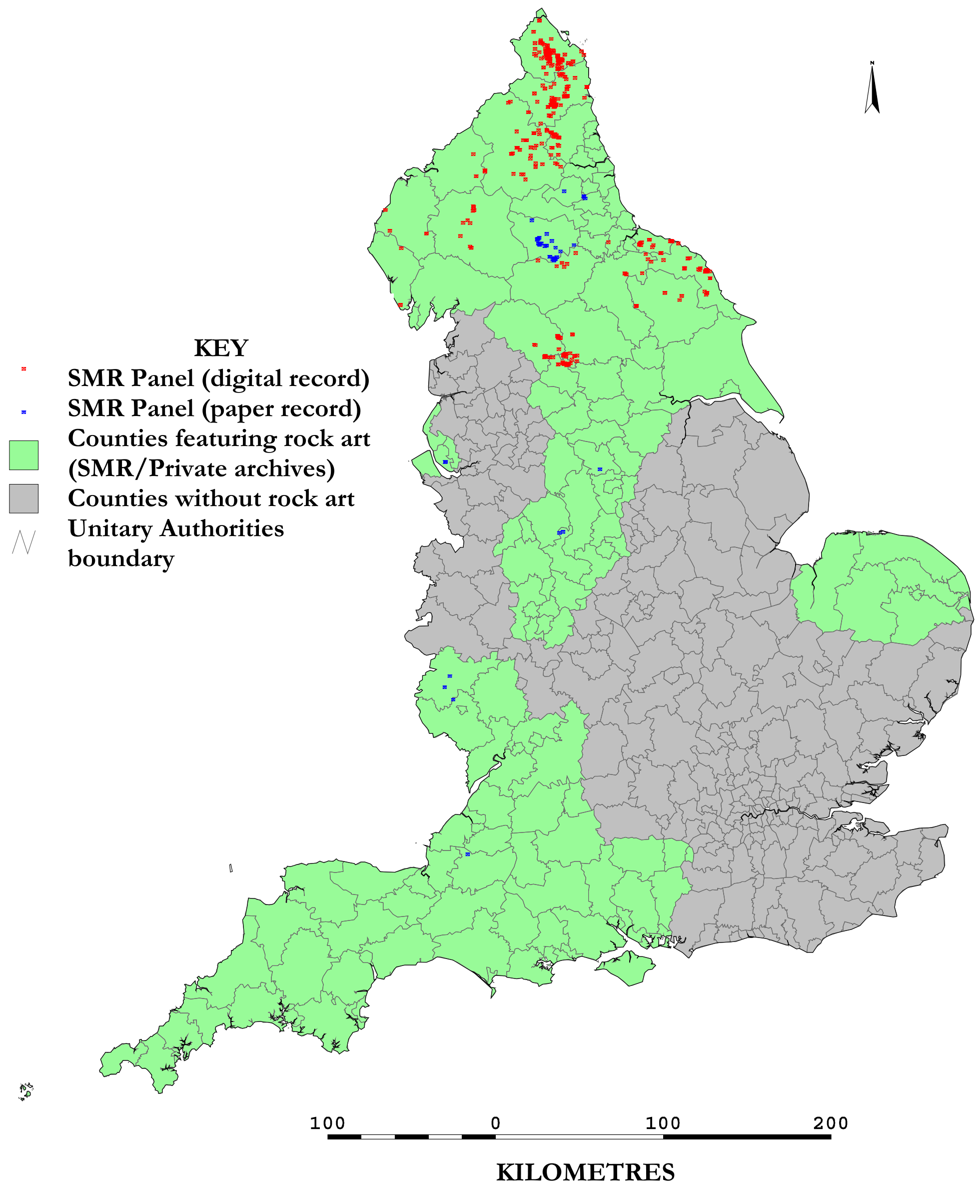
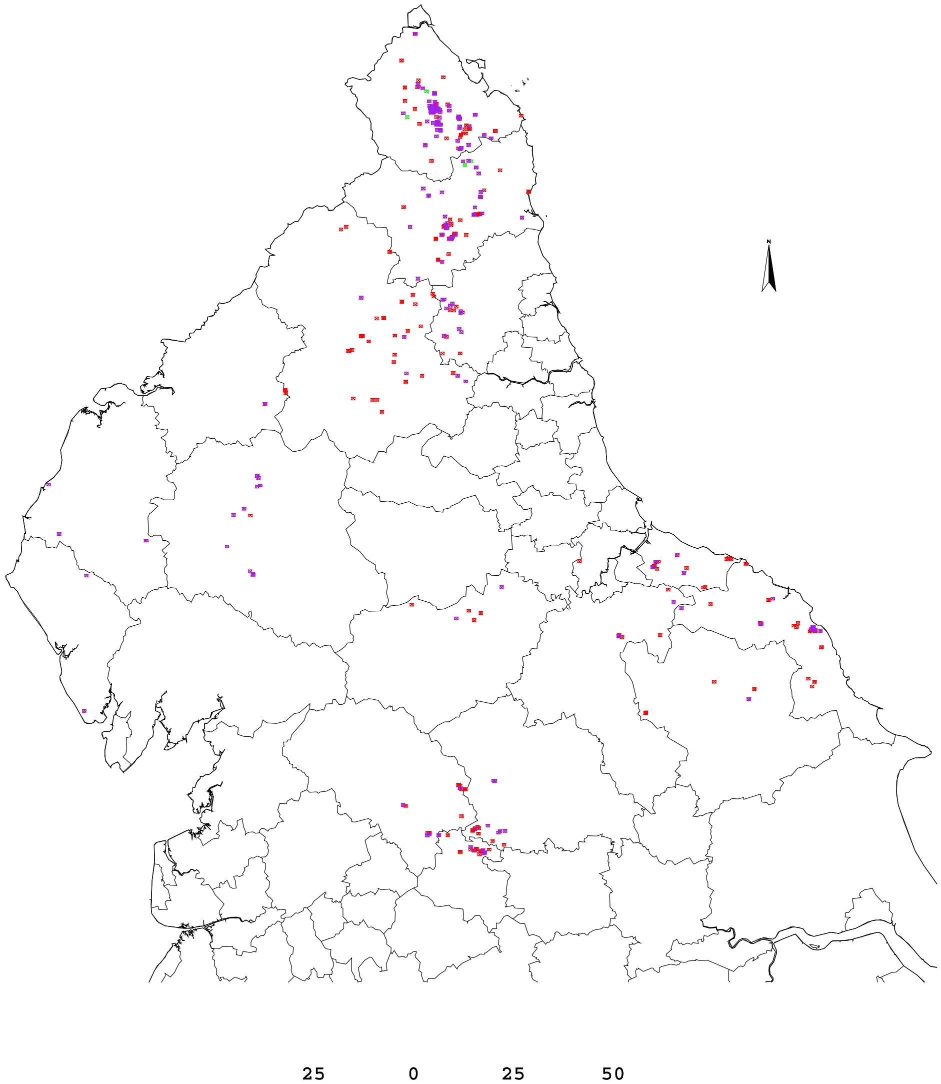


Figure 5.4 Map showing the distribution of rock art in England by county according to SMR and Private Archives with the locations of SMR panels supplied in digital and paper formats (note that the new Unitary Authority boundaries are shown)



KEY **KILOMETRES**

Cup marked panels

Ring marked panels

Cup-and-ring marked panels

Coastline / English boundary

Unitary Authorities boundary

Figure 5.5 Map showing the distribution of rock art panels featuring cup marks only, ring marks only, and cup-and-ring marks based on SMR descriptions supplied in digital format

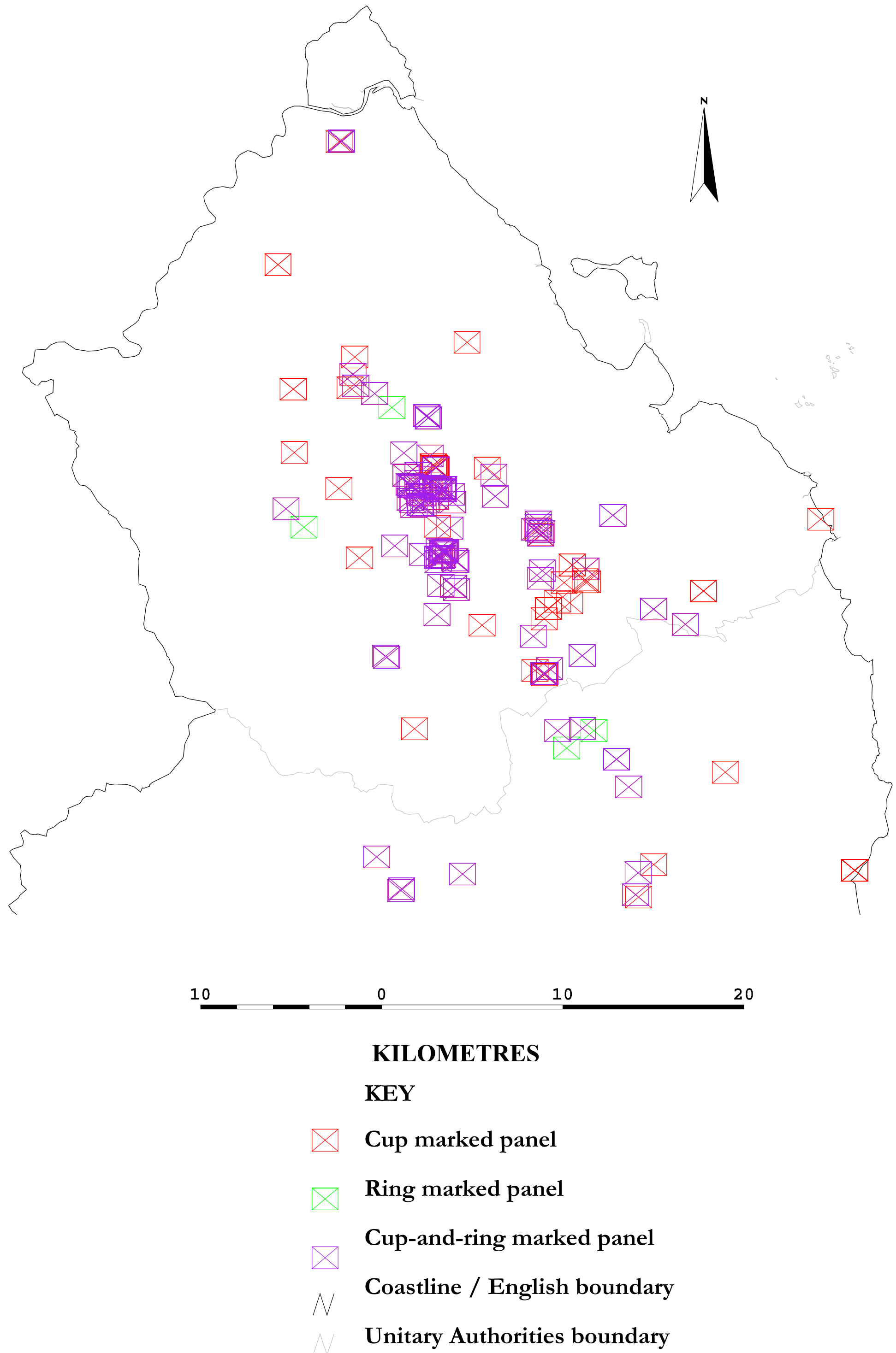


Figure 5.6 Map showing the distribution of rock art panels in Northumberland featuring cup marks only, ring marks only, and cup-and-ring marks based on SMR descriptions supplied in digital format

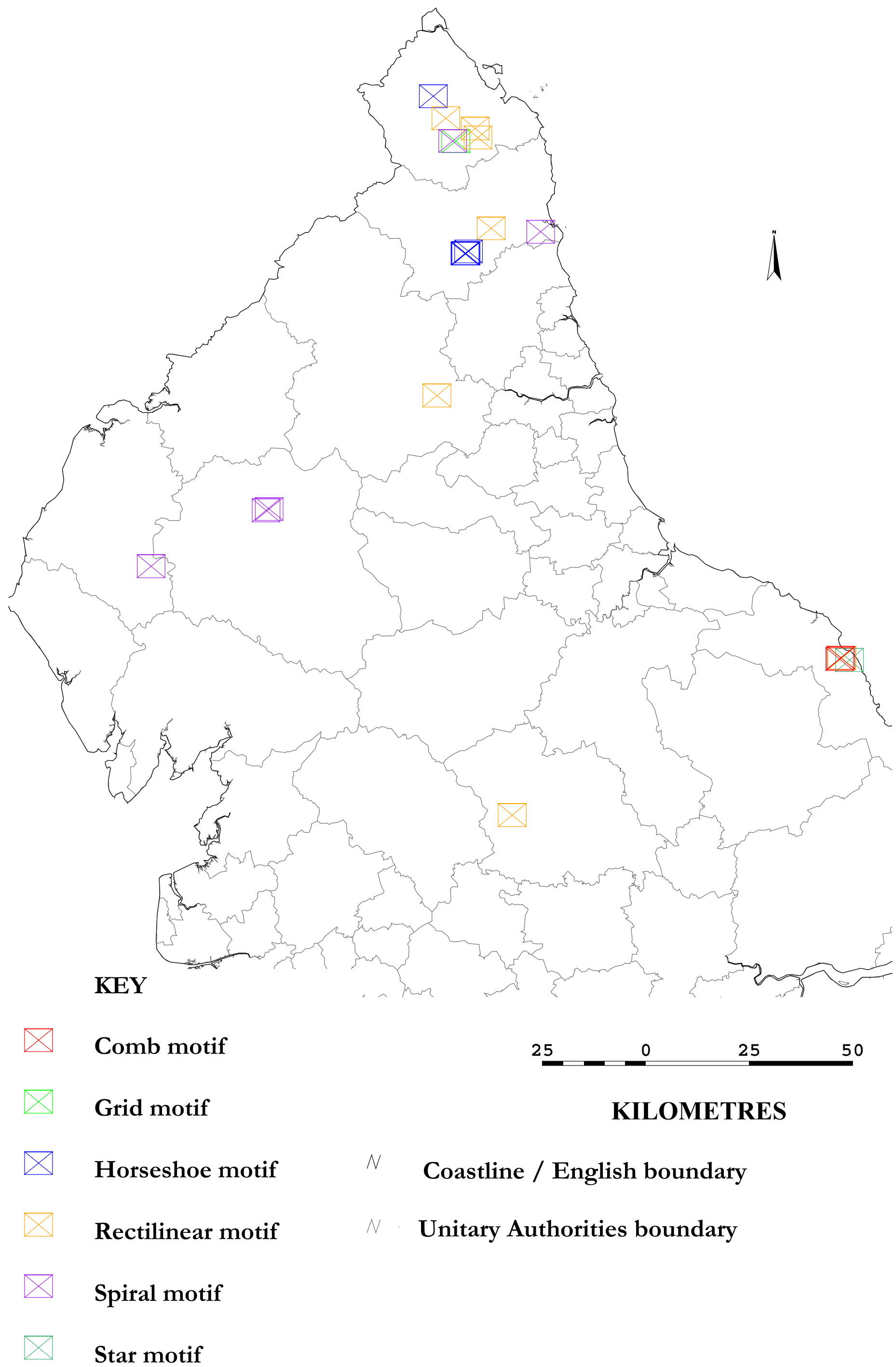


Figure 5.7 Map showing the distribution of panels featuring less common motif types based on SMR descriptions supplied in digital format

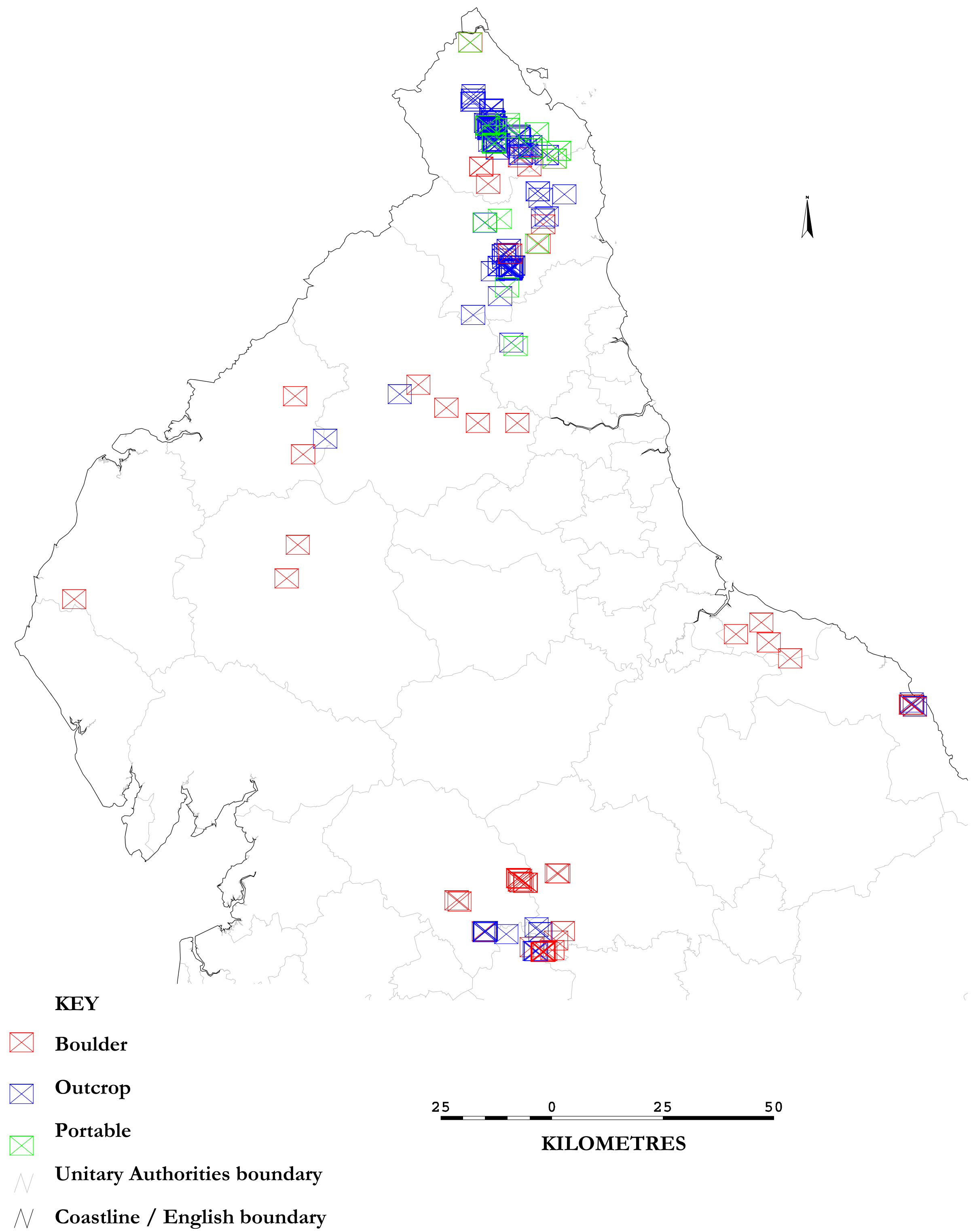


Figure 5.8 Map showing the distribution of rock art panels identified as outcrops, boulders and portables based on SMR descriptions supplied in digital format

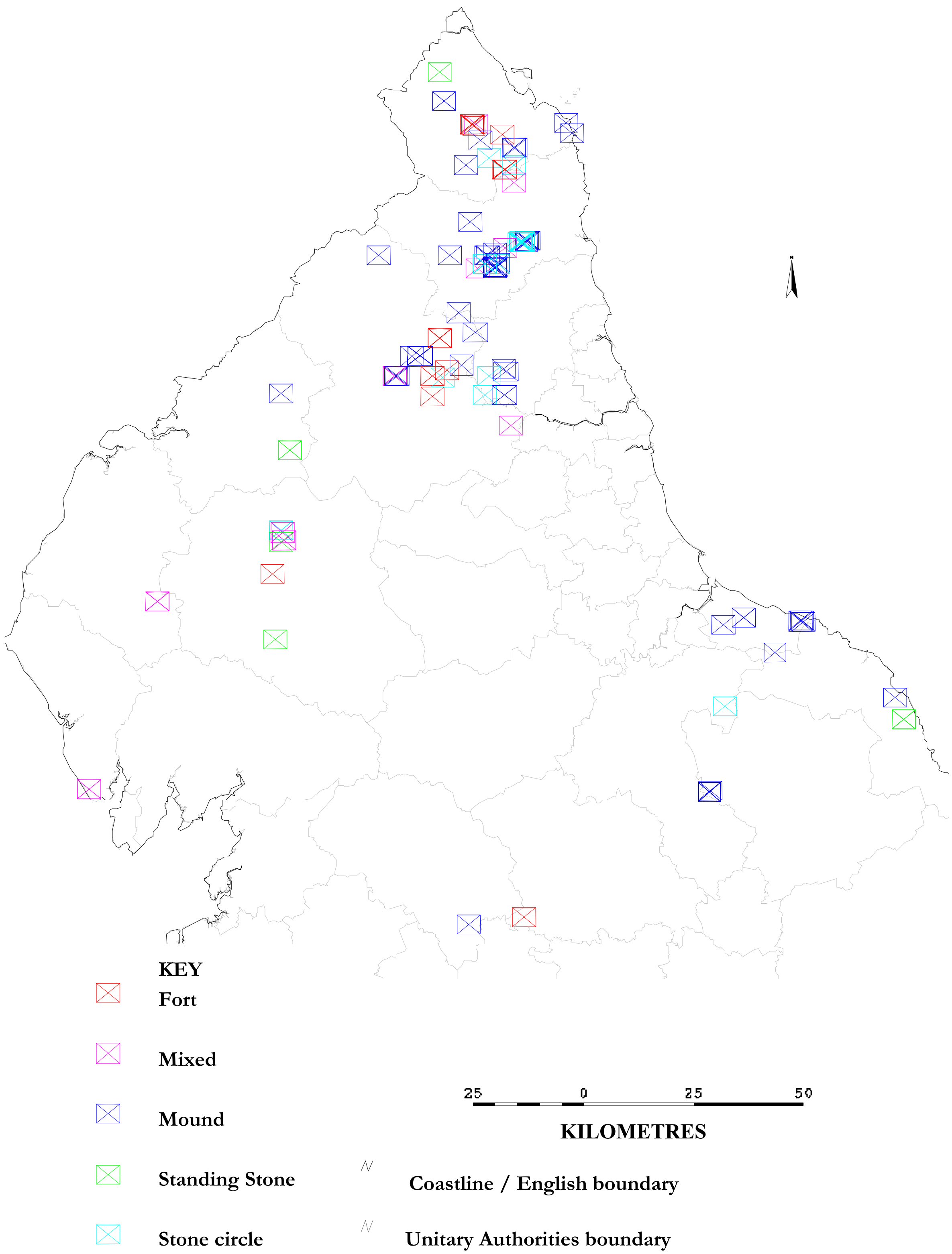


Figure 5.9 Map showing the distribution of rock art panels associated with other archaeological site types based on SMR descriptions supplied in digital format

Figure 6.1 The relocated situation of rock art; here part of a panel was broken and incorporated into the structure of a stone dyke near Chatton, Northumberland.

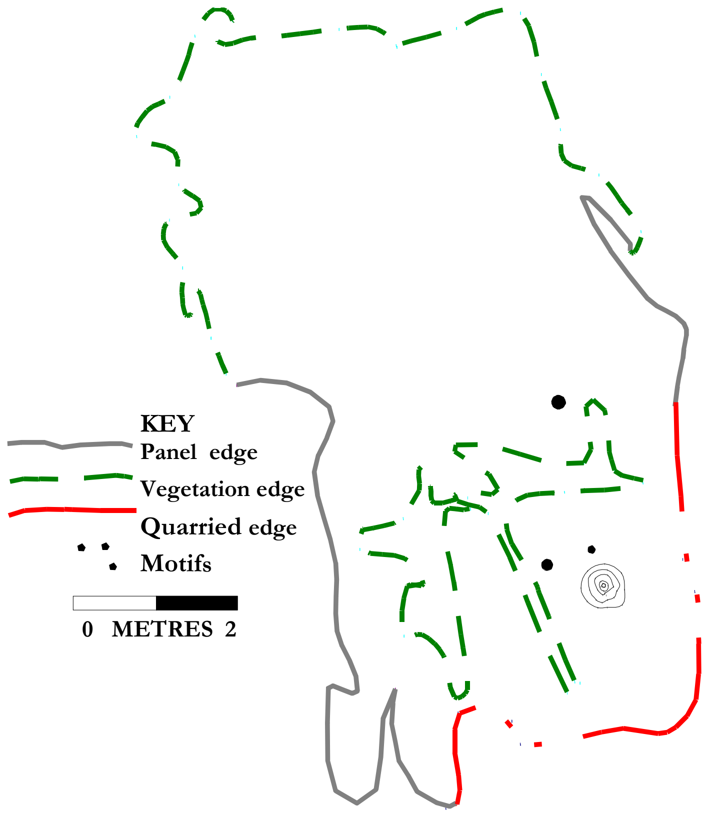


Figure 7.1 Figure showing the results of a Total Station survey of panel 1 on Weetwood Moor, Northumberland, with defined edge types

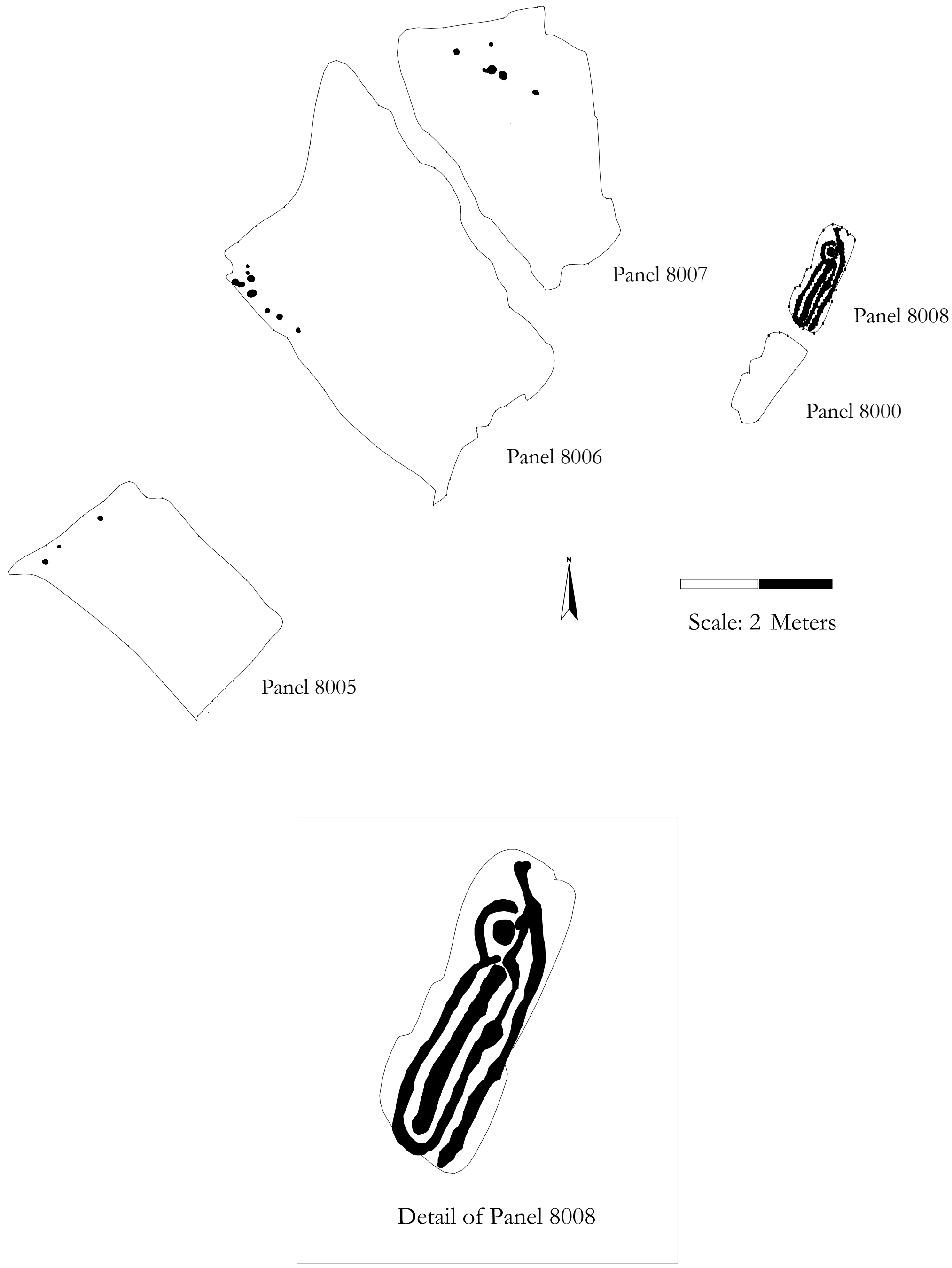


Figure 7.2 Figure showing the results of a Total Station survey using a mini-prism of rock art panels and motifs on Rivock Edge, West Yorkshire

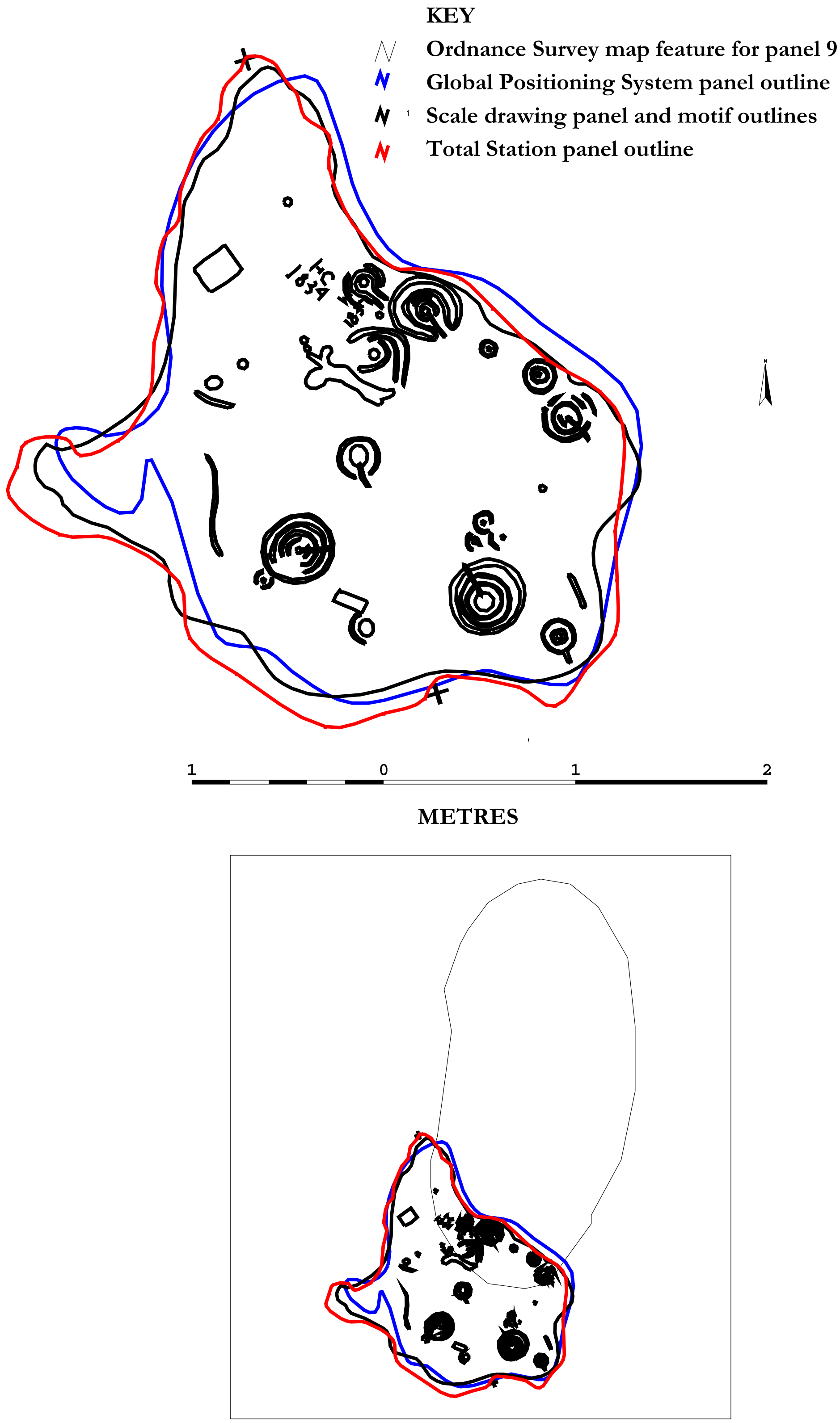


Figure 7.3 Comparison of total station, survey grade Global Positioning System, and scale drawing recording techniques for panel 9, Weetwood Moor, Northumberland. The lower figure also shows the relationship of this survey work to the Ordnance Survey map feature for the panel.

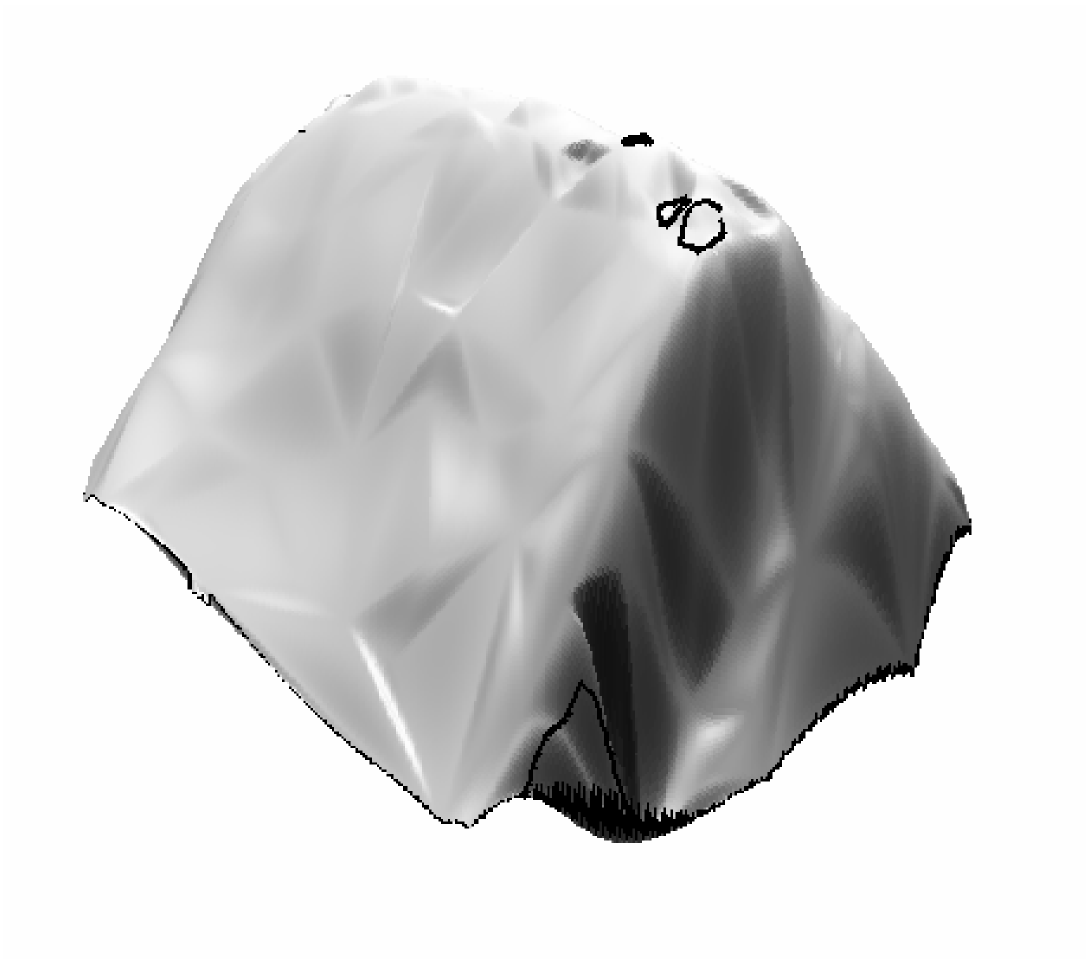


Figure 7.4 Figure showing the combination of a total station aided Digital Elevation Model (DEM) and motif plan for panel 8012 on Rivock Edge, Northumberland. The panel measures 2.65x2.25m, and motif edges are shown by black lines.

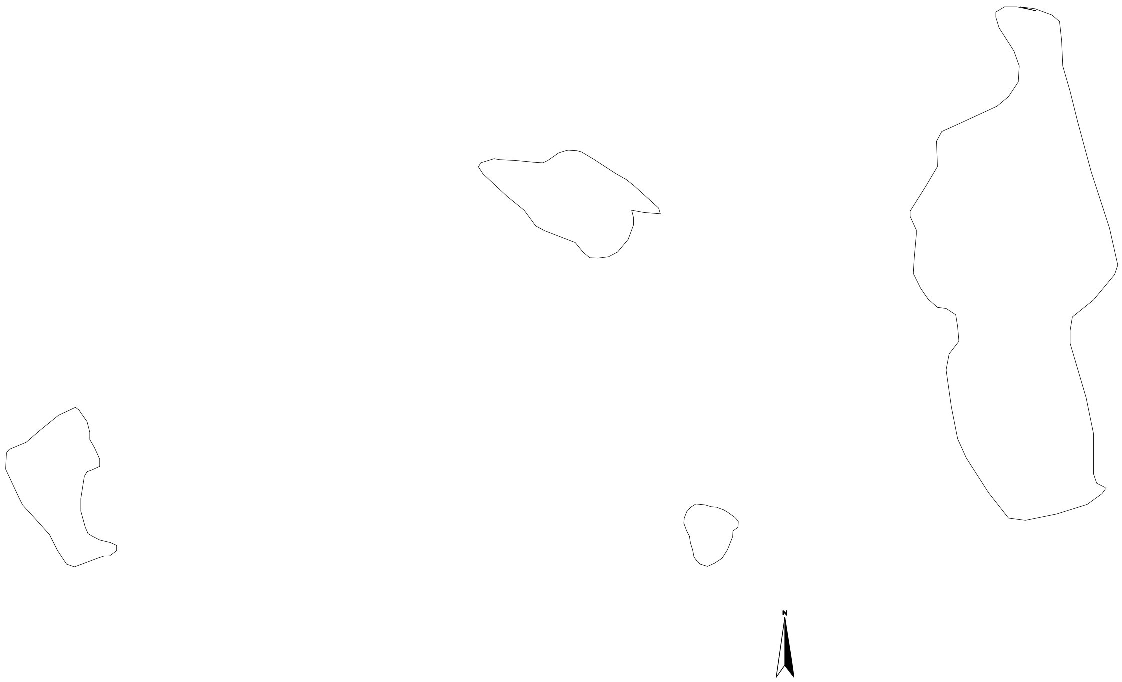


Figure 7.5 Outlines of panels 4-8 situated in a cairn on Weetwood Moor, Northumberland, recorded using a survey grade Global Positioning System

Figure 7.6. Example of SLR black and white photography taken at Panel 17, Weetwood, Northumberland

Figure 7.7. Example of SLR black and white photography taken at Panel 2, Weetwood, Northumberland

Figure 7.8 Example of digital photography taken at panel 16, Weetwood, Northumberland

Figure 7.9 Example of digital photography taken at panel 2, Weetwood, Northumberland

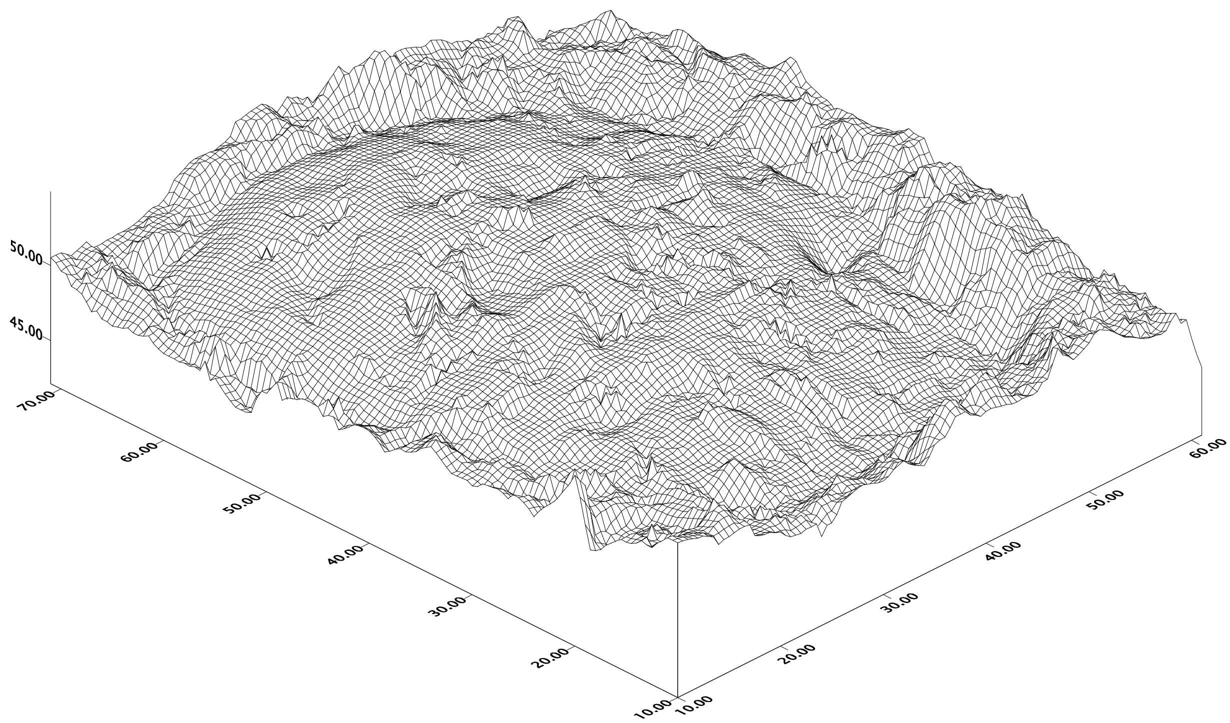


Figure 7.10 A digital elevation model of panel 8022 produced using data derived from close range photogrammetry.

Figure 7.11A Rendered digital elevation model of a small boulder (Panel 8022) showing a series of 14 cup marks produced by laser scanning

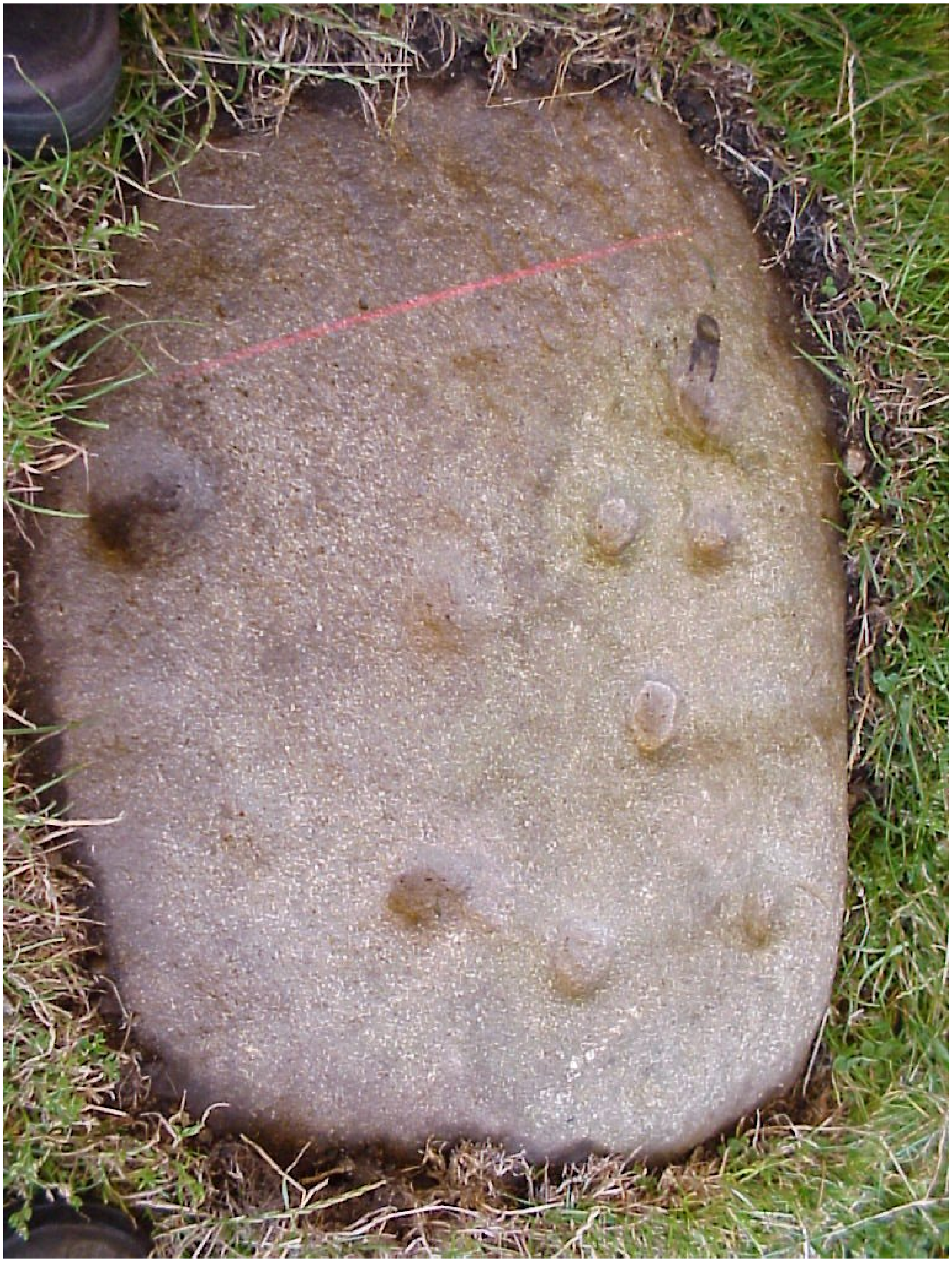


Figure 7.11B Photograph of the laser beam tracking across the surface of panel 8022.

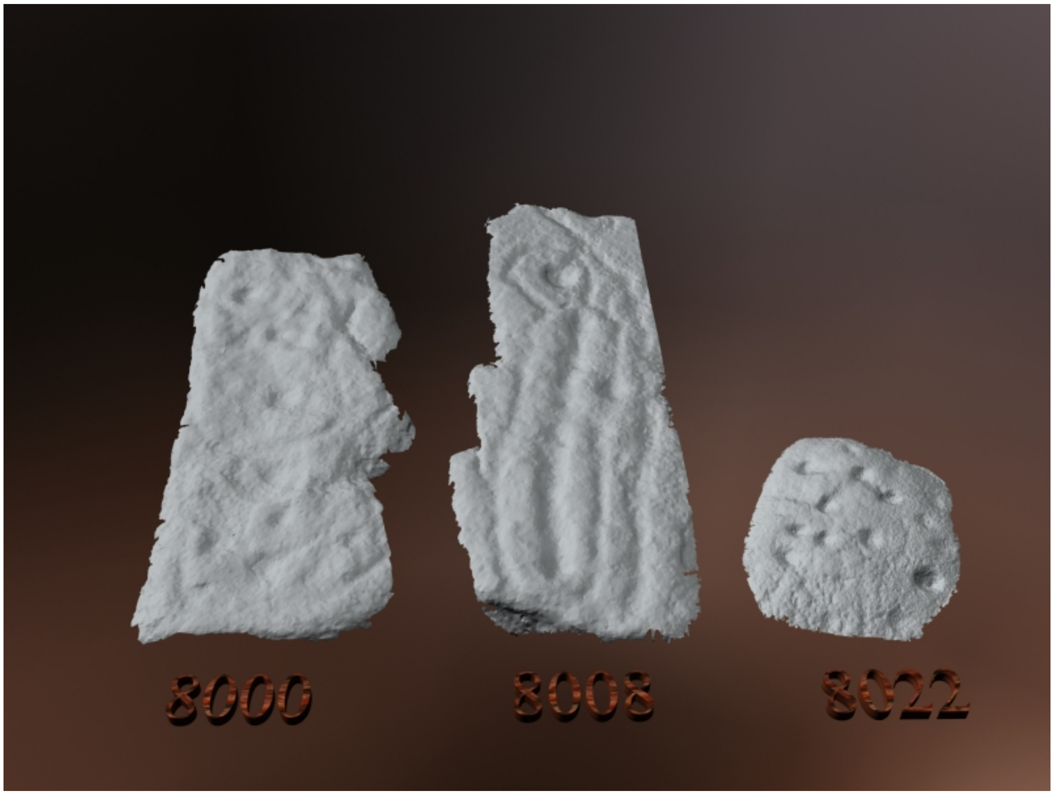


Figure 7.11C Rendered digital elevation models for Panels 8000, 8008 and 8022 produced by laser scanning

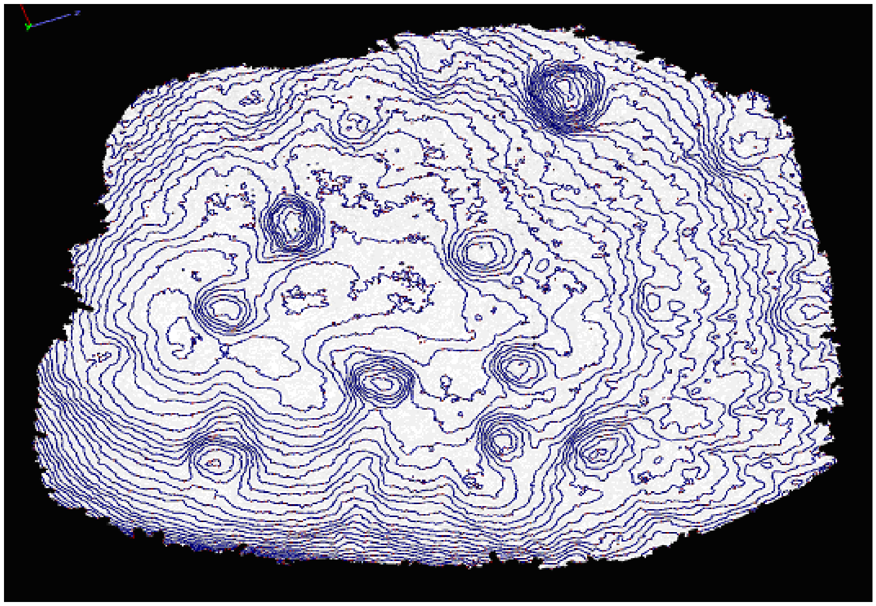


Figure 7.12 Figure showing the results of laser scanning data formatted as contour lines at 2mm intervals for panel 8022 (panel measures 480x570m)

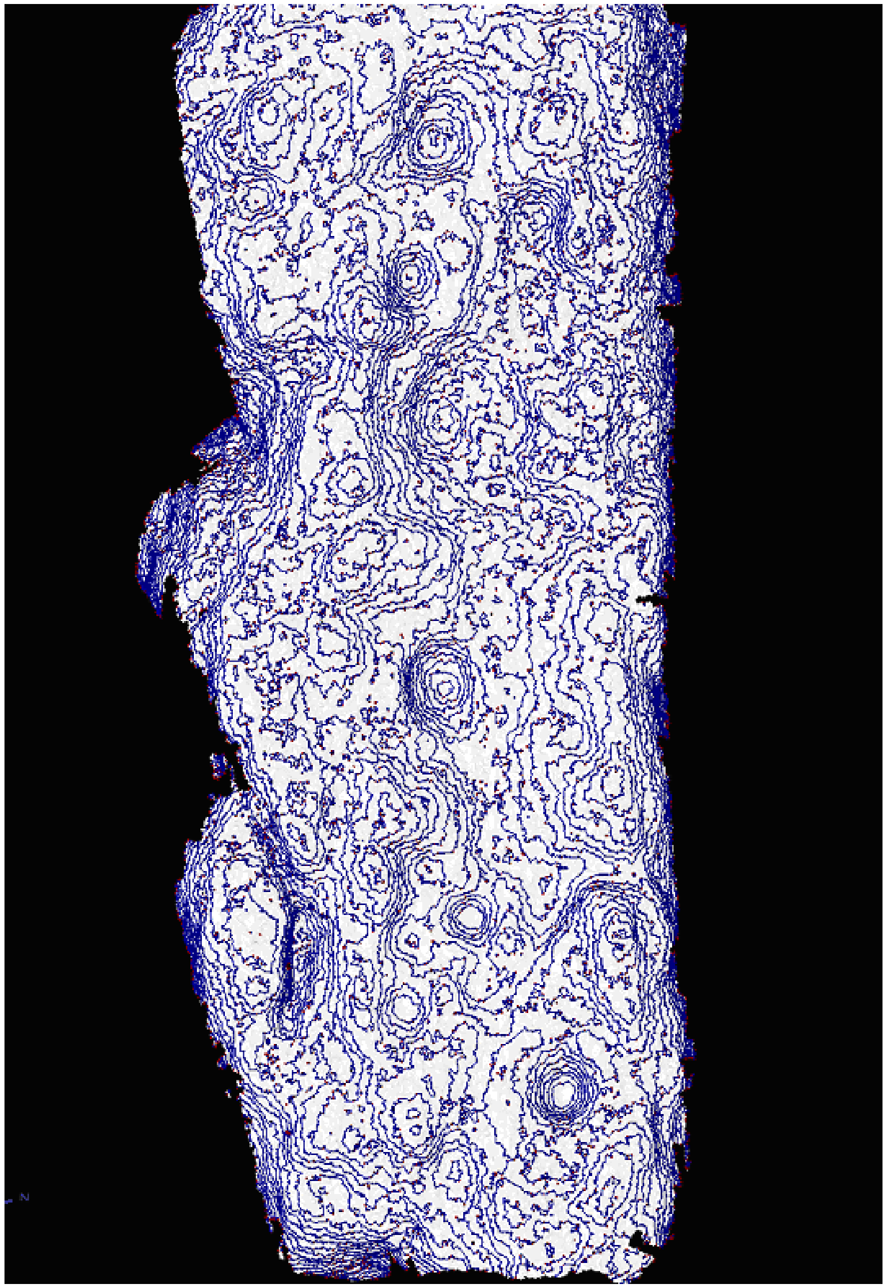


Figure 7.13 Figure showing the results of laser scanning data formatted as contour lines at 2mm intervals for panel 8000 (panel measures 1.3x0.58m)

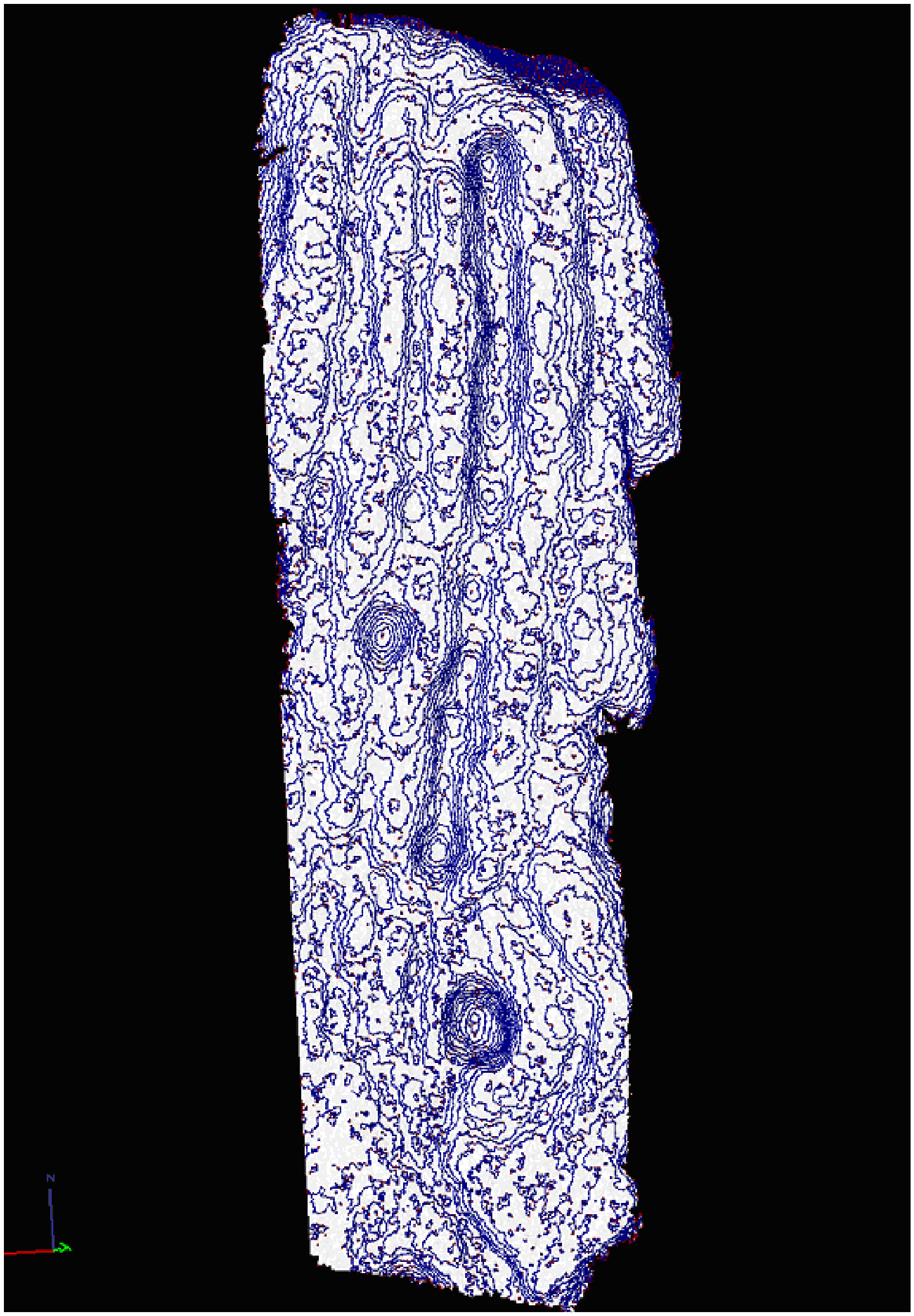


Figure 7.14 Figure showing the results of laser scanning data formatted as contour lines at 2mm intervals for panel 8008 (panel measures 1.5x0.55m)

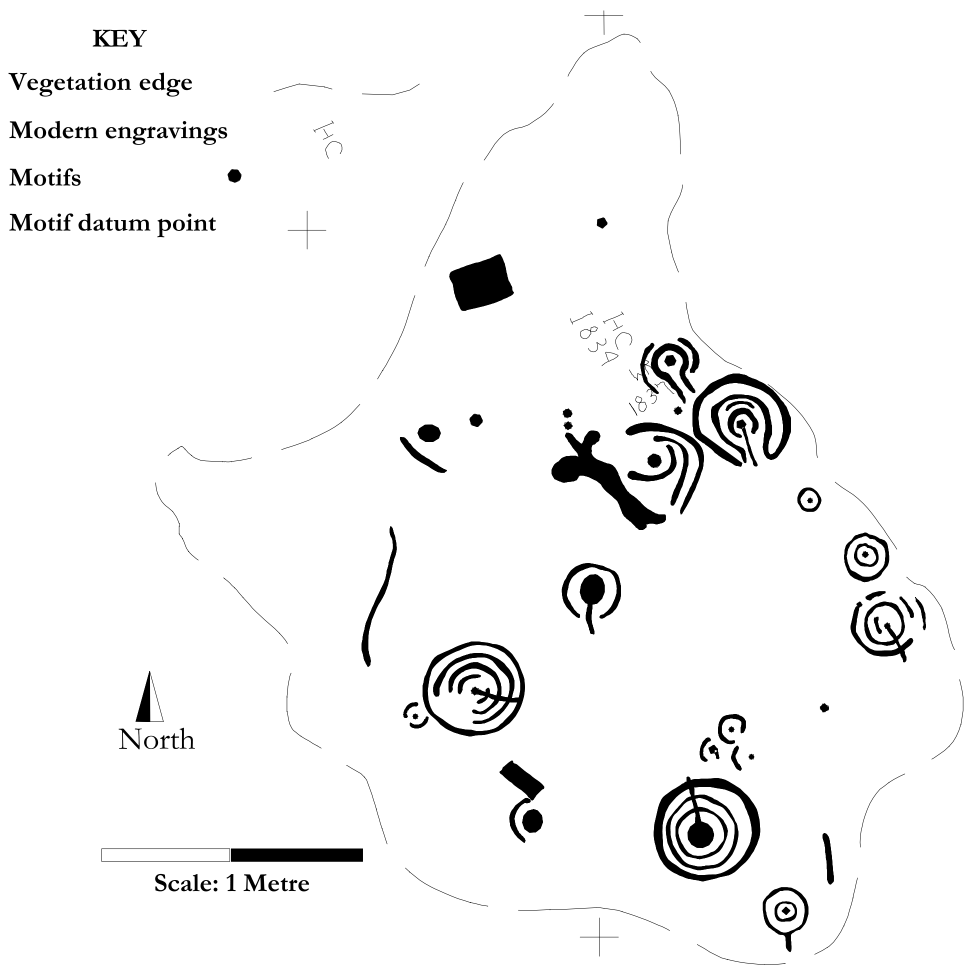


Figure 7.15 Figure showing the results of a digitised scale drawing of panel 9, Weetwood Moor, Northumberland

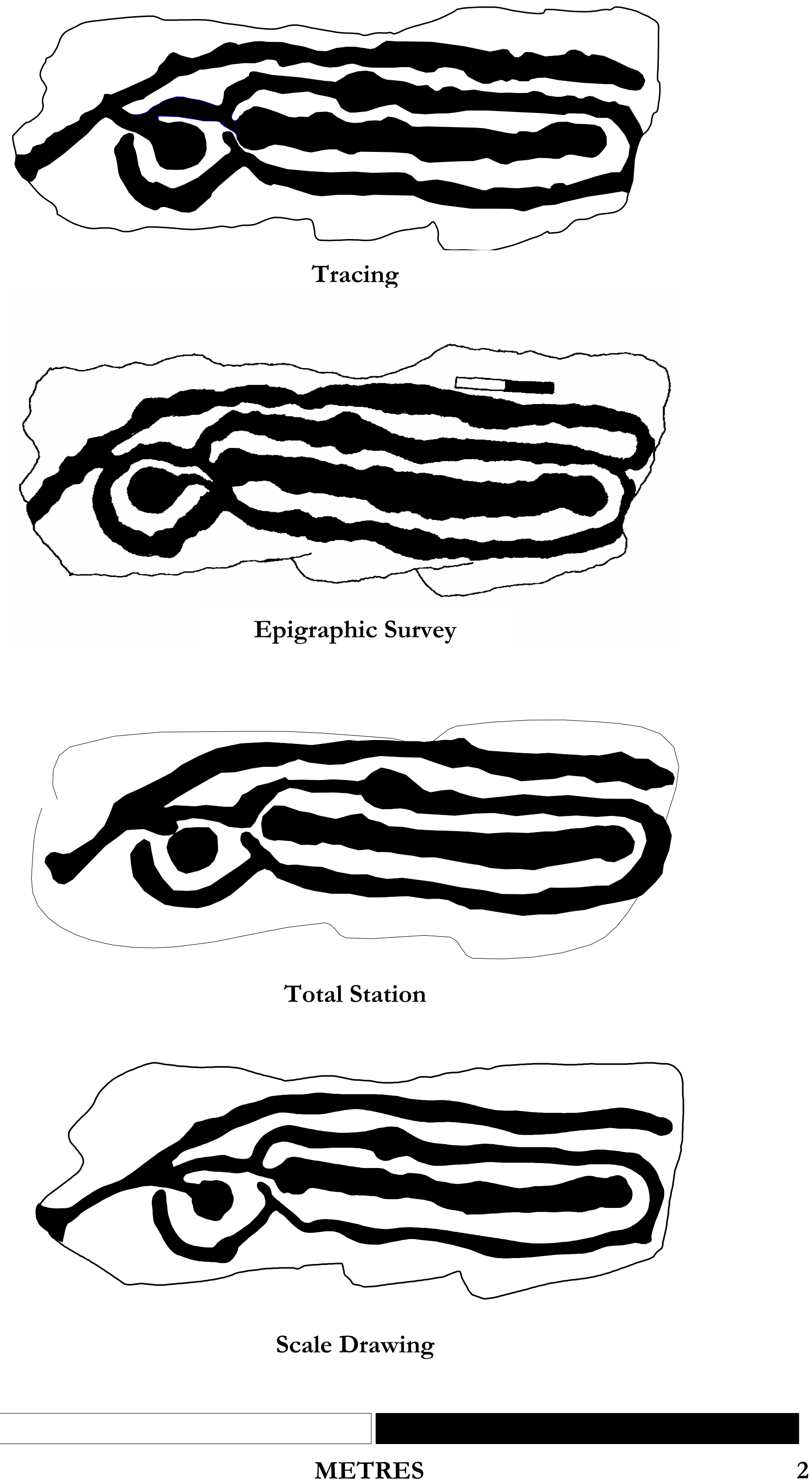


Figure 7.16 Comparison of motif plans using tracing, epigraphic survey, total station survey with mini-prism, and scale drawing recording techniques for panel 8008, Rivock Edge, West Yorkshire

Figure 7.17 Image showing the carbon rubbing technique in progress at Panel 8013

Figure 7.18 The result after placing damp cotton on a carved panel before photography (panel 8008), West Yorkshire

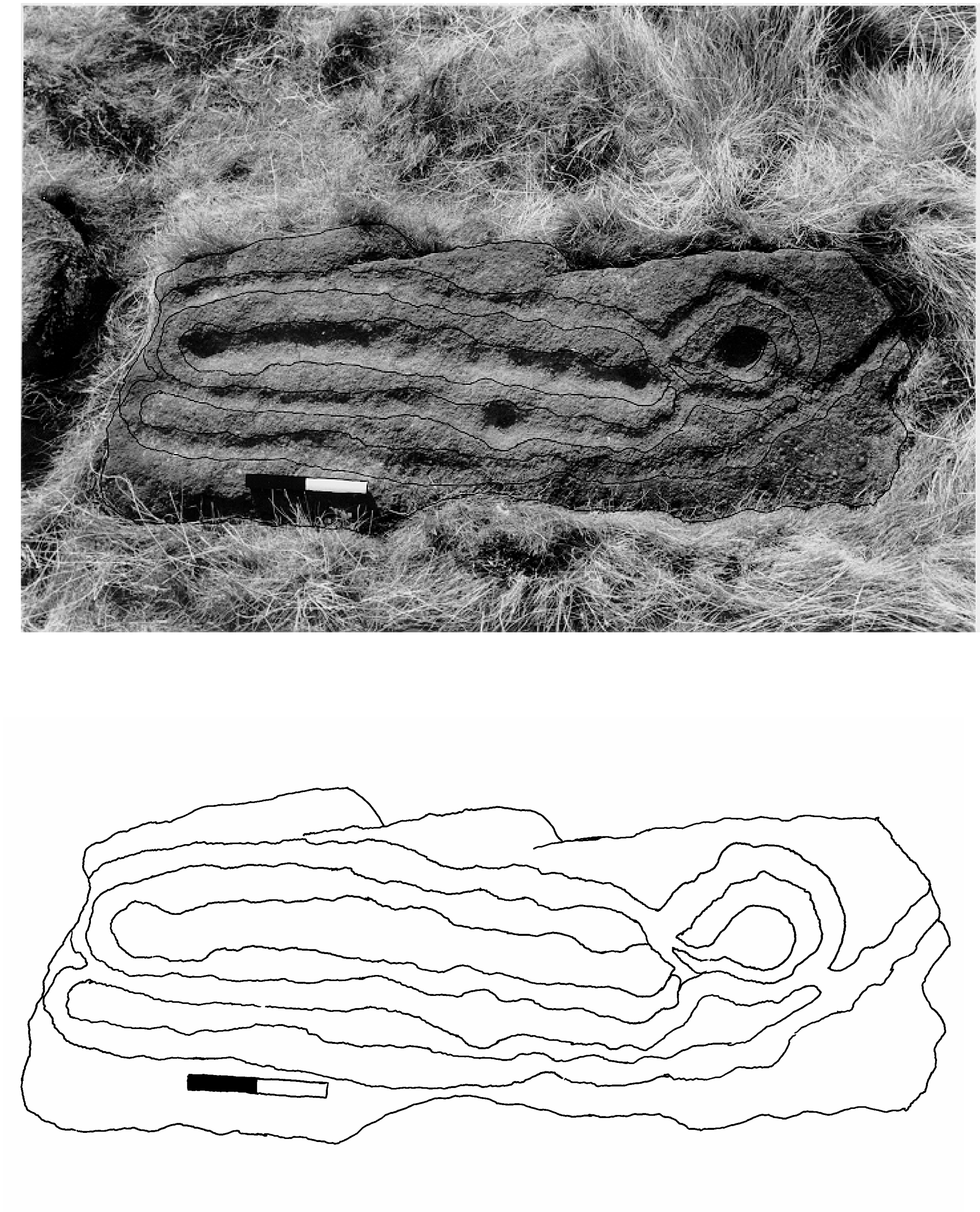


Figure 7.19 Epigraphic survey of panel 8008 on Rivock Edge, West Yorkshire, with the ink drawing on the photograph (top) and the bleached result (bottom)

Figure 720A Modern erosion graffiti on a vertical panel to the north of Ilkley moor, West Yorkshire.

Figure 7.20B A close up of the same modern, recent carving showing the appearance of millstone grit when freshly exposed to the atmosphere.

Figure 7.21 The use of natural surfaces for wildfowl management. Boulders and other natural, prominent surfaces are used to spread grit for consumption by wildfowl (Rombald's Moor, West Yorkshire)

Figure 7.22 The results of a digitised scale drawing showing vegetation and weathering forms on panel 8000, Rivock Edge, West Yorkshire

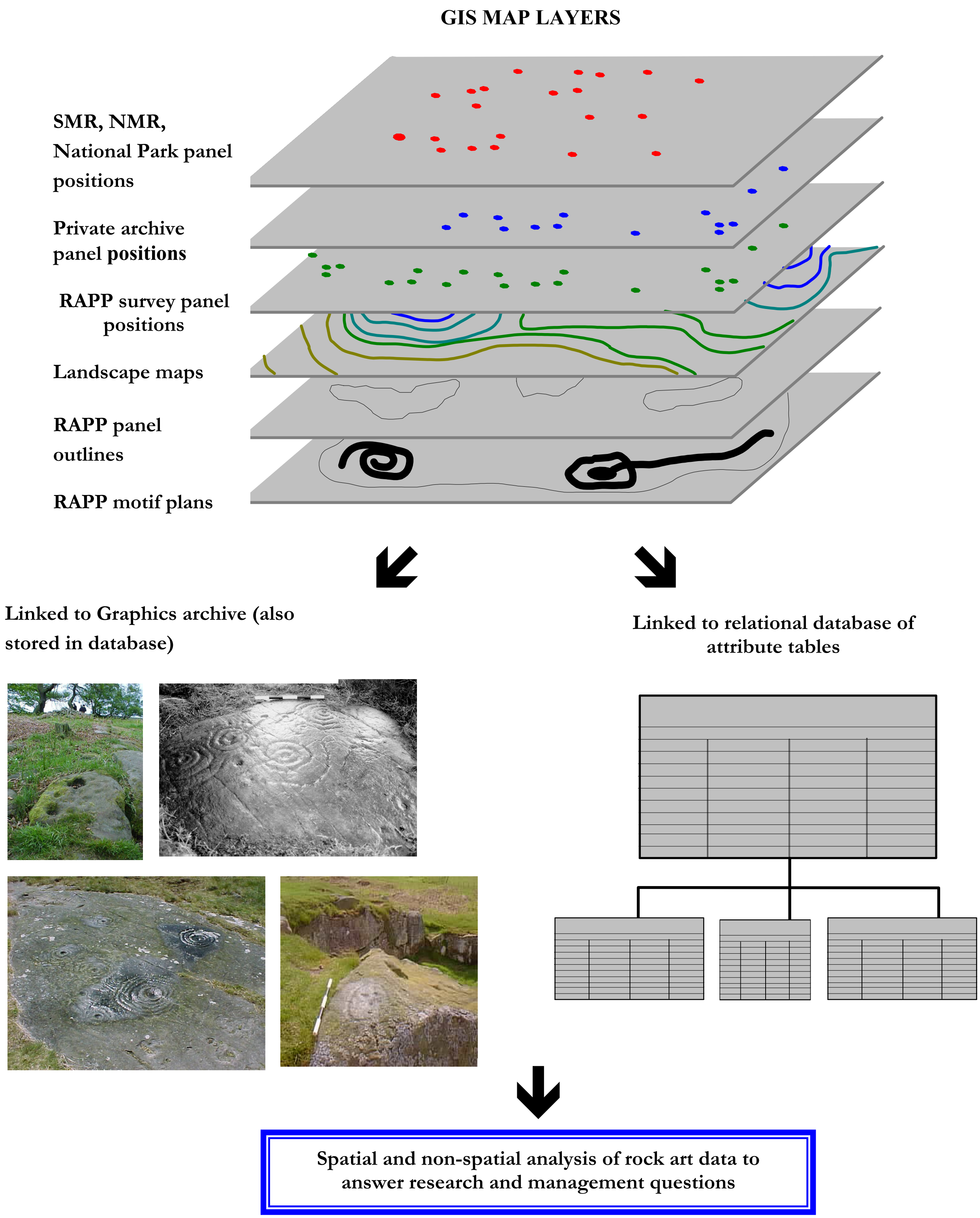


Figure 7.23 Diagram showing the components and structure of the RAPP recording system

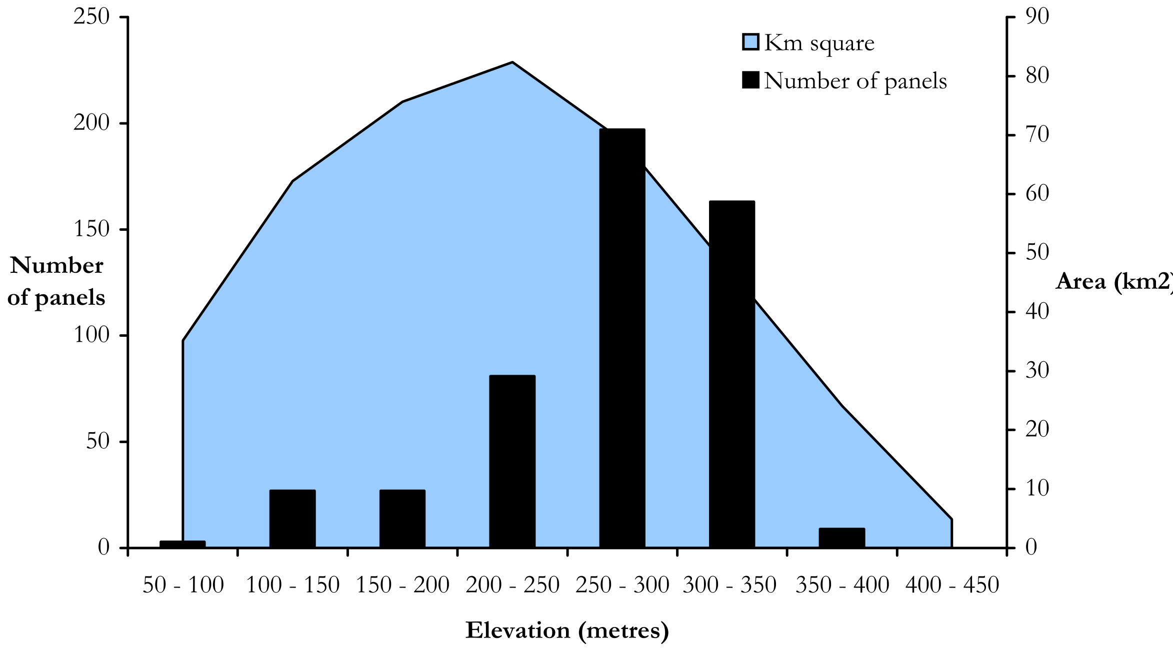


Figure 7.24 Graph showing the distribution of rock art panels across 50m contour bands and the corresponding areas of each contour band

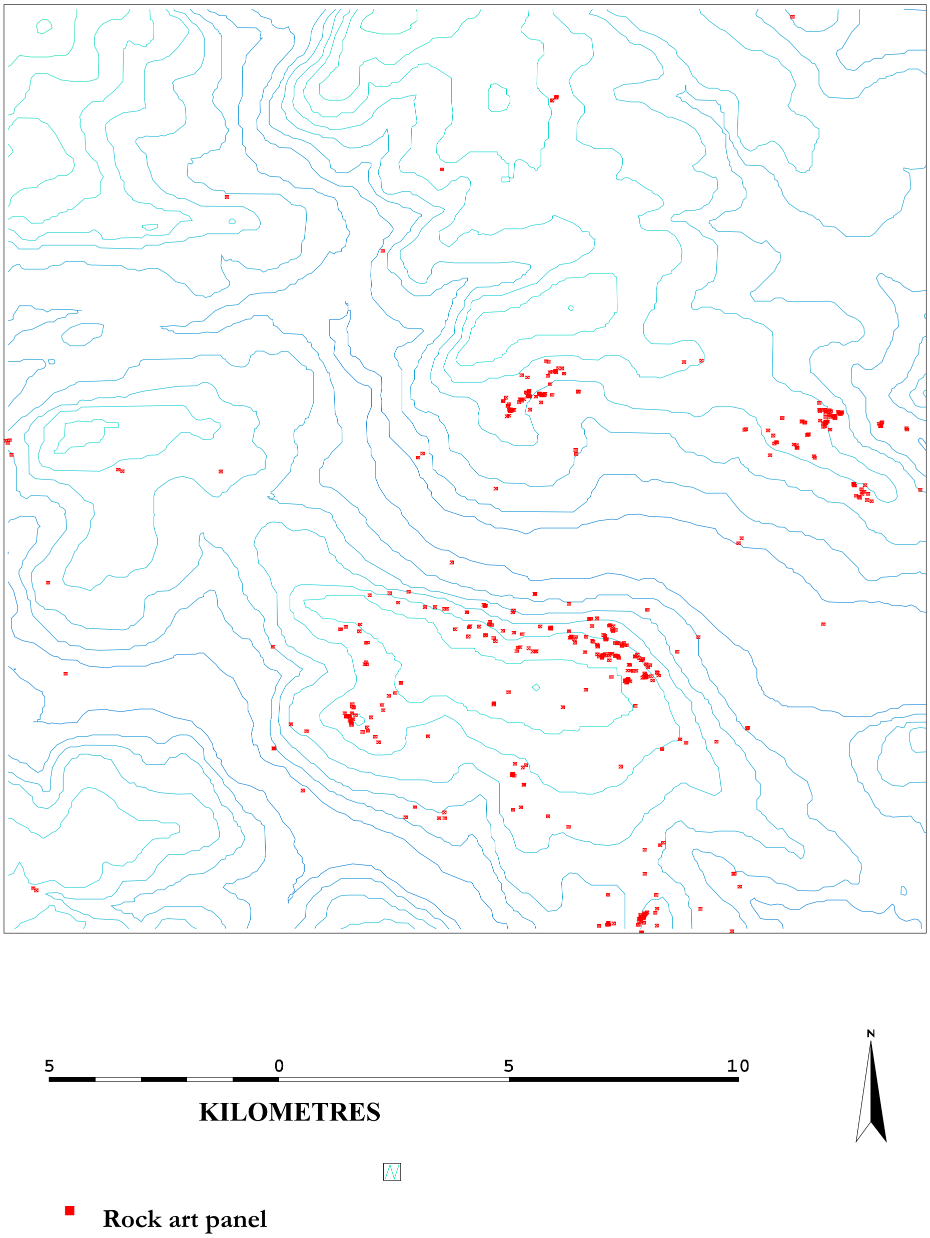


Figure 7.25 The distribution of panels recorded by the Ilkley Archaeology Group across 50m contour bands (data supplied by Ilkley Archaeology Group)

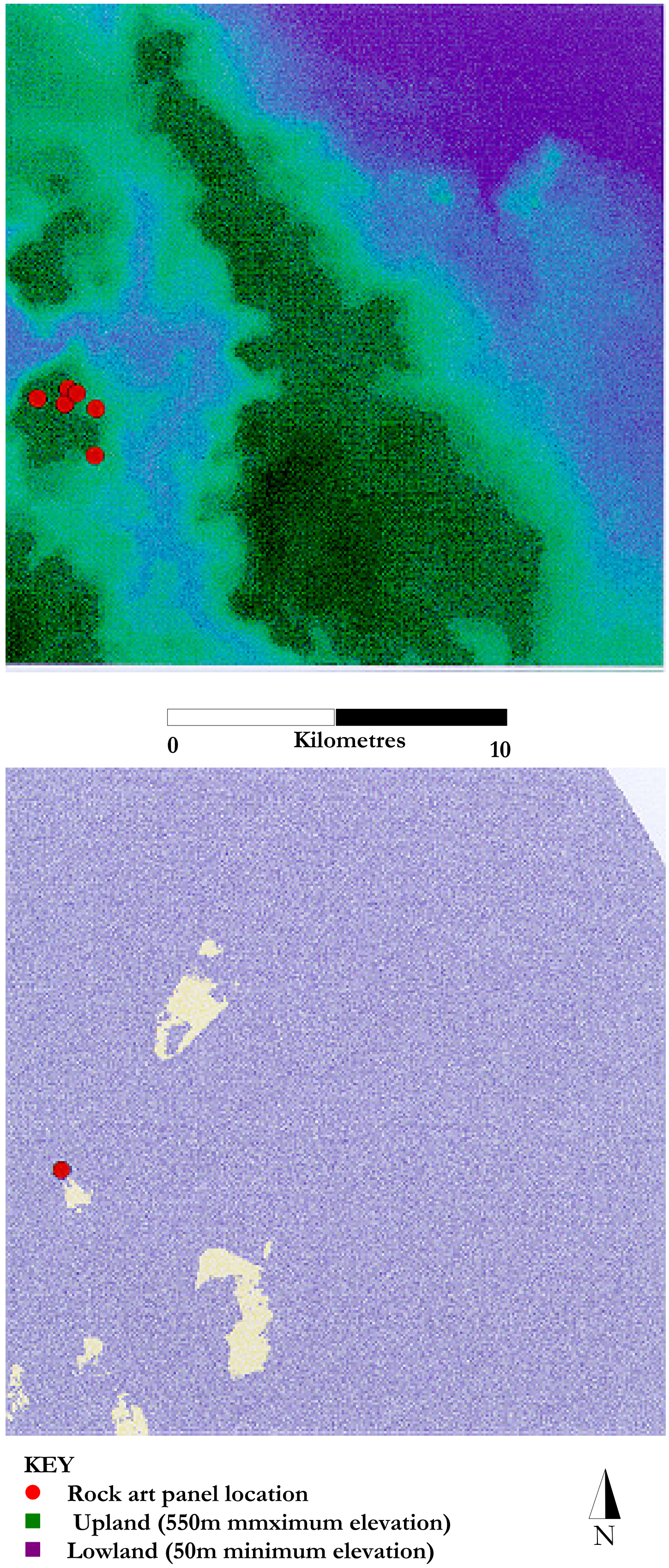


Figure 7.26 A – (Top) The elevation data and panel locations used in viewshed analysis for the Northumberland study transect
Figure 7.26 B – (Bottom) Viewshed analysis for panel 1 (with land visible from panel shown in yellow)

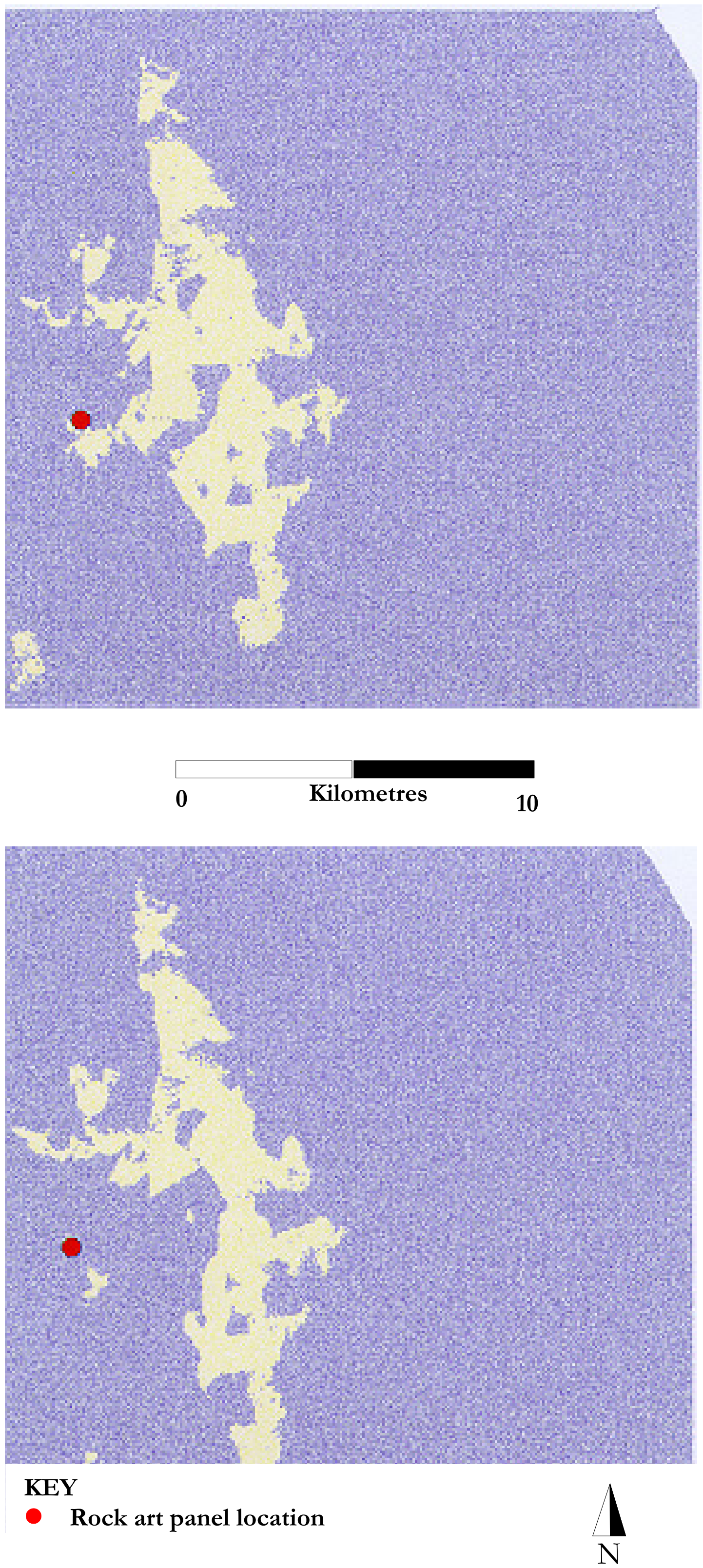


Figure 7.26 C – (Top) Viewshed analysis for panel 2 (with land visible from panel shown in yellow)
Figure 7.26 D – (Bottom) Viewshed analysis for panel 3 (with land visible from panel shown in yellow)

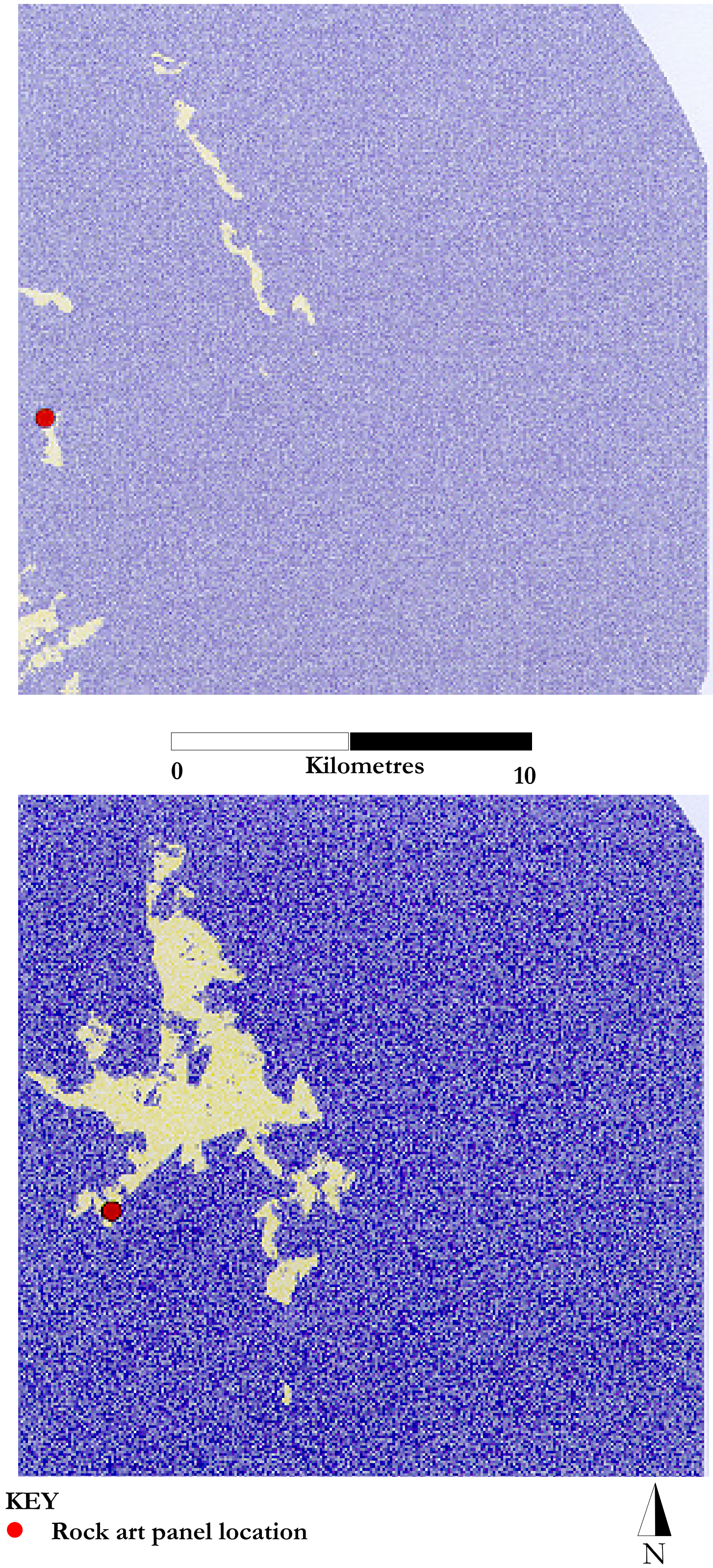


Figure 7.26 E – (Top) Viewshed analysis for panel 9 (with land visible from panel shown in yellow)
Figure 7.26 F – (Bottom) Viewshed analysis for panel 16 (with land visible from panel shown in yellow)

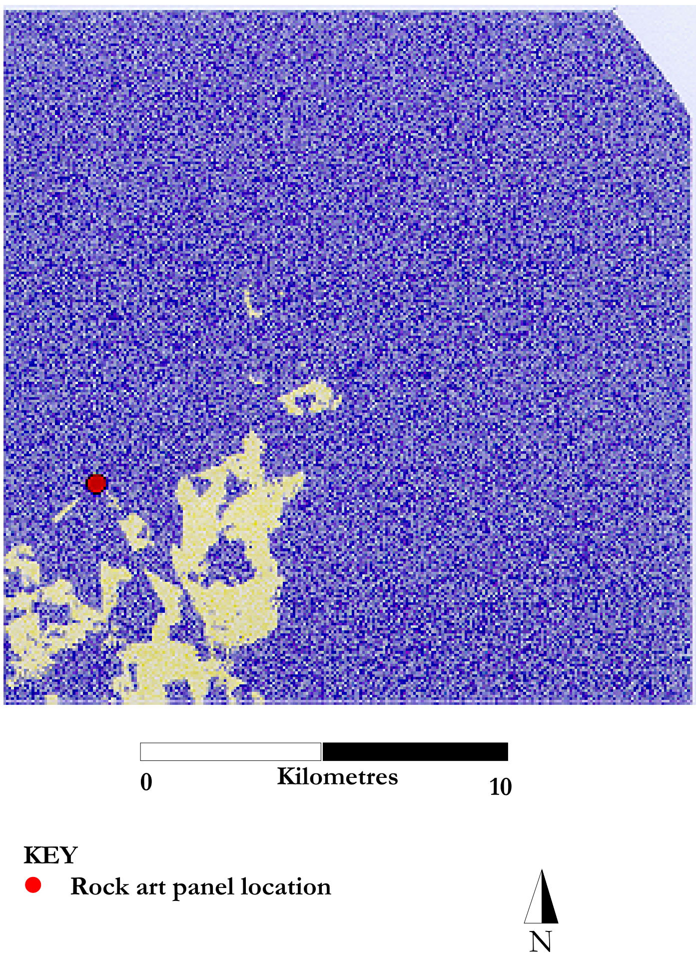


Figure 7.26 G – Viewshed analysis for panel 22 (with land visible from panel shown in yellow)

Table 4.1 Incidence of non-archaeological designations recorded in anaylsed SMRs for rock art panels.

DESIGNATION	NORTHUMBER-LAND	CUMBRIA	NORTH YORKSHIRE	WEST YORKSHIRE
Public Access	2	0	0	0
Listed Building (grade two)	2	0	0	0
Listed Building (grade one)	1	0	0	0
SSSI	3	0	0	0
Heritage Coast	32	0	0	0
Area of Outstanding Natural Beauty	36	0	0	0
World Heritage Site	1	0	0	0
Public Right Of Way	14	0	0	0
National Park	48	5	160	28
National Trust	0	4	0	0
Register of Parks and Gardens	2	0	0	0
Crown Land	2	0	0	0
Environmentally Sensitive Area	0	6	0	0
TOTAL	**143**	**15**	**160**	**28**

Table 5.1 Number of sites and panels per county. Figures taken from various sources / archives, as listed.

COUNTY	SMR RECORDRS	SMR PANELS	NATION-AL PARK SITES	NATION-AL PARK PANELS	HELICS SITES	HELICS PANELS	MORRIS SITES	MORRIS PANELS	IAG
Cleveland	25	26	N/A	N/A	1	12	19 (incl ENY)	183 (incl ENY)	N/A
Cornwall	50	50+	N/A	N/A	79	95	4	4	N/A
Cumbria	18	28	N/A	N/A	25	25+	17	22	N/A
Derbyshire	Not available	Not available	N/A	N/A	40	60	10	10	N/A
Devon	0	0	N/A	N/A	4	7	3	3	N/A
Dorset	1	1+	N/A	N/A	6	11	5	5	N/A
Durham	38	40 (250 backlog)	N/A	N/A	11	11+	26	30	N/A
Gloucestershire	0	0	N/A	N/A	4	4	1	1	N/A
Hampshire	0	0	N/A	N/A	1	1	0	0	N/A
Hereford / Worcester	3	3	N/A	N/A	4	4	0	0	N/A
Merseyside	1	6	N/A	N/A	0	0	1	1	N/A
Norfolk	0	0	N/A	N/A	N/A	N/A	1	1	N/A
North Yorkshire	Refer to NP	Refer to NP	91	160	0	0	58 (minus ENY)	94 (minus ENY)	N/A
Northum-berland	207	450	N/A	N/A	203	363	164 (incl T&W)	197 (incl T&W)	N/A
Somerset	1	1	N/A	N/A	5	6	1	1	N/A
South Yorkshire	1	1	N/A	N/A	N/A	N/A	0	0	N/A
Stafford-shire	2	2	N/A	N/A	0	0	0	0	N/A
Tyne-and-Wear	0	0	N/A	N/A	0	0	164 (incl Nthumb)	197 (incl Nthumb)	N/A
West Yorkshire	Est 300	Est 300+	12	28	N/A	N/A	116	129	640
Wiltshire	0	0	N/A	N/A	4	13	2	2	N/A
TOTAL									

ENY = Eastern North Yorkshire; Nthumb = Northumberland; T&W = Tyne-and-Wear; Est = Estimated only

Table 5.2 Level of response to SMR questionnaires

POSITIVE REPLIES	NEGATIVE REPLIES	NEGATIVE REPLIES	REFERRAL TO UA SMR	NO RESPONSE
Cleveland	Bath and NE Somerset	Lincolnshire	*Dartmoor National Park*	*Derbyshire*
Cornwall	Bedfordshire	Norfolk	*Exmoor NP*	
Cumbria	Berkshire	Northampton-shire	*Lake District NP*	
Dorset	Boston	North East Lincolnshire	*Northumberland NP*	
Durham	Buckinghamshire	North Kesteven	*Peak District NP*	
Herefordshire	Cambridgeshire	North Lincolnshire		
Merseyside	Cheshire	North Somerset		
Northumberland	Devon	North Yorskhire		
North York Moors National Park	East Sussex	Nottinghamshire		
Shropshire	Essex	Oxfordshire		
Somerset	Gloucestershire	South Kesteven		
South Yorkshire	Greater London	Suffolk		
Staffordshire	Greater Manchester	Surrey		
West Yorkshire	Hampshire	Warwickshire		
Yorkshire Dales NP	Hertfordshire	West Midlands		
	Isle of Wight	West Sussex		
	Kent	Worcestershire		
	Lancashire	Wiltshire		
	Leicestershre			

Table 5.3 Detailed responses to SMR questionnaires

SMR	NO. OF ROCK ART ONLY RECORDS	PERIODS REPRESENTED	NO. OF NON-ROCK ART RECORDS WITH A ROCK ART REFERENCE	MONUMENT CLASSES REPRESENTED
Cleveland	17	Bronze Age	<50	Burial mounds
Cornwall	50	Neolithic, Bronze Age and prehistoric undated	Unquantified	Barrows
Cumbria	5	Prehistoric, Bronze Age, Neolithic	14	Barrows; stone circles; cairns
Dorset	0	Neolithic	1	Causewayed enclosure
Durham	38	Late neolithic, Bronze Age	0	N/A
Herefordshire	3	Prehistoric and undated	0	N/A
Merseyside	2	Neolithic / Bronze Age	0	N/A
Northumberland	134 approximately	Bronze Age, Neolithic, Prehistoric	75 approx.	Cairn, Cairnfield, Camp, Hillfort, Stone circle, Standing stone.
North York Moors National Park	59	Early Bronze Age, Bronze Age, Prehistoric unknown, Unknown		
Shropshire	1 (possible only)	Unknown	0	N/A
Somerset	1	Bronze Age	0	Round Barrow
Staffordshire	0	Neolithic	2	Standing Stone
South Yorkshire	1	Undated	0	N/A
West Yorkshire	300	Bronze Age	12	Not given
York Dales National Park	47		0	N/A

Table 5.4 Rock art entities recorded in the NMR by county

	Carved stone	Carving	Cup and ring marked stone	Cup marked stone	Rock carving	Passage grave	TOTAL
Avon	7	0	0	0	0	0	**7**
Berkshire	3	0	0	0	0	1	**4**
Buckinghamshire	3	0	0	0	0	1	**4**
Cambridgeshire	5	1	0	0	0	0	**6**
Cleveland	5	0	1	11	0	0	**17**
Cornwall	13	0	1	38	0	0	**52**
Cumbria	12	0	15	4	0	0	**31**
Derbyshire	7	1	6	7	4	1	**26**
Devon	6	2	2	2	1	0	**13**
Dorset	16	0	0	1	0	0	**17**
Durham	8	0	46	67	7	0	**128**
East Sussex	9	1	0	0	0	0	**10**
Essex	3	0	0	0	0	0	**3**
Gloucestershire	14	0	1	2	0	0	**17**
Greater London	4	0	0	0	0	0	**4**
Greater Manchester	5	0	0	0	2	0	**7**
Hampshire	3	0	0	0	0	0	**3**
Hereford and Worcester	5	0	0	3	0	0	**8**
Hertfordshire	0	1	0	0	0	0	**1**
Humberside	4	1	1	0	0	0	**6**
Kent	2	0	0	1	0	0	**3**
Lancashire	6	3	0	1	1	0	**11**
Leicestershire	7	0	0	0	0	0	**7**
Lincolnshire	11	0	0	0	0	0	**11**
Merseyside	3	0	2	0	0	0	**5**
North Yorkshire	44	0	56	108	1	0	**209**
Northamptonshire	2	1	0	1	0	0	**4**
Northumberland	32	0	51	44	4	0	**131**
Nottinghamshire	3	0	0	0	0	0	**3**
Oxfordshire	5	0	0	0	0	0	**4**
Shropshire	2	0	0	0	0	0	**2**
Somerset	3	0	0	2	0	0	**5**
South Yorkshire	1	0	2	1	0	0	**4**
Staffordshire	3	0	0	2	0	0	**5**
Suffolk	2	0	0	0	0	0	**2**
Tyne and Wear	4	0	1	2	0	0	**7**
Warwickshire	1	1	0	0	0	0	**2**
West Sussex	1	2	0	0	0	0	**3**
West Yorkshire	32	0	97	65	0	0	**194**
Wiltshire	16	0	0	1	0	0	**17**
Isle of Man	4	0	0	11	0	4	**19**
Isles of Scilly	1	0	0	3	0	1	**5**
TOTALS	**316**	**14**	**262**	**377**	**20**	**8**	**1020**

Figures are broken into local authority groups, prior to local authority re-organisation.

Table 5.5 Table showing numbers of records and panels from various sources for the Project study transects

TRANSECT	SMR RECORDS	SMR PANELS	SMR RECORDS NOT GIVING PANEL NUMBERS	NMR RECORDS	NMR PANELS	PRIVATE ARCHIVE RECORDS	PRIVATE ARCHIVE PANELS	PANELS SURVEYED BY RAPP
Northumb-erland	14	21	3	7	15	47	65*	20 (plus 3 outside transect)
West Yorkshire	24	27	0	11	15	33	33	14
TOTALS	**38**	**48**	**3**	**18**	**30**	**80**	**98**	**34 (plus 3 outside transect)**

Note: All records were at the panel level except for 18 mobiliary stones. West Yorkshire SMR recording approach (largely panel level) results directly from Ilkley Archaeology Group's approach to recording]

Table 5.6 The range of motif classes found in SMR records

SMR / NP EXTRACTS AND FIELD NAME	MOTIF CLASSES USED	NUMBER OF RECORDS
NORTHUMBERLAND (208 RECORDS)		
'Type' field	Cup Marked Stone	90
	Cup & Ring Marked Stone	108
	Rock Carving	2
	Mixed Cup / Cup & Ring	8
CUMBRIA (18 RECORDS)		
'Site Type' field	Cup and Ring Marked Stone	17
	Carved Stone	1
CLEVELAND	Not recorded	N/A
NORTH YORK MOORS (56 RECORDS)		
'Décor Type' field	Cup & Ring	28
	Cup or Cup Marked	25
	Cup & Channel	1
	Cup & Ring: Cup: Channel	1
	Cup & Channel / Cup & Ring	1
YORKSHIRE DALES (47 RECORDS)		
'Type' field	Cup Mark	46 (1 blank)
'Name' field	Cup Marked	46
	Cup-and-ring Mark	1

Figures here relate to the original data as supplied by SMRs and so will not necessarily equate to 'panel' level recording. Entries for the term 'cup' and, 'ring' are mutually exclusive.

Table 5.7 Motif classes represented by SMR records (standardised and re-cast into 'panel' level recording using HELICS motif classes).

MOTIF CLASS	NORTH-UMBERLAND	CUMBRIA	CLEVELAND	NORTH YORKSHIRE	WEST YORKSHIRE	TOTAL
Anthropomorphic	1	0	0	0	0	1
Arc	2	0	0	0	0	2
Basin	22+	0	0	0	0	22+
Channel	18+	1+	1+	13+	0	33+
Chevron	0	1	0	0	0	1
Circle	23+	3	0	1	0	27+
Comb	0	0	0	2	0	2
Cup and ring (both present)	167+	19+	4+	36+	8	234+
Cup (exclusively)	196+	0	20+	101+	17	334+
Diamond	0	2	0	0	0	2
Dominoe	1	0	0	0	0	1
Duct	32+	0	0	0	0	32+
Foot / Feet	4	0	0	0	0	4
Grid	1	0	0	0	0	1
Groove	54+	3+	2+	11+	0	70+
Heart-shaped	1	0	0	0	0	1
Horseshoe	5	0	0	0	0	5
Line	0	0	1	1	0	2
Linear	2	1	0	0	0	3
Lozenge	0	2	0	0	0	2
Oculi /oculus	0	0	0	0	1+	1+
Oval /ovoid						
Oval cup	2	0	0	2	0	4
Oval basin	3	0	0	0	0	3
Oval ring	1	1	0	0	0	2
Oval groove	1	0	0	0	0	1
Oval / ovoid	4	2	0	2	0	8
Pennanular	2	0	0	0	0	2
Rectangle	5	0	0	1	0	6
Rectilinear	1	0	0	0	0	1
Ring (exclusively)	4	0	0	0	0	4
Spiral	2	5	0	0	0	7
Square	4	0	0	2	0	6
Star	0	0	0	1	0	1
Trapezoid	1+	0	0	0	0	1+

Table 5.8 Table showing the range of panel types recorded in SMRs (as taken from SMR description fields)

PANEL TYPE	NORTHUMBERLAND (SAMPLE - 458)	CUMBRIA (SAMPLE - 28)	CLEVELAND (SAMPLE - 26)	NORTH YORKSHIRE (SAMPLE - 160)	WEST YORKSHIRE (SAMPLE - 28)	TOTAL (SAMPLE - 700)
Boulder	15	5	4	27	11	62
Outcrop	177	0	0	9	2	188
Mixed (Boulder & outcrop)	39	0	0	0	0	39
Portable	22	0	0	0	0	22
Mixed (Portable & boulder)	3	0	0	0	0	3
Mixed (Portable & outcrop)	8 minimum*	0	0	0	0	8
Kerbstone	1	0	1	0	0	2
Shelter / cave	4	0	0	0	0	0
Conflicting type recorded (boulder and outcrop)	10	0	0	1	0	11
TOTAL	**279**	**5**	**5**	**37**	**13**	**335**

* Indicates that exact numbers were not determined.

Table 5.9 Table showing the presence of information about tooling and techniques as recorded in sampled SMRs

TECHNIQUE	Northumberland	Cumbria	Cleveland	North Yorkshire	West Yorkshire	Total
Engraved	1	0	0	0	0	1
Carved	22	11	0	8	1	42
Cut	61	3	0	0	0	64
Incised	55	0	0	3	0	58
Pecked	9	1	4	5	1	20

The table shows the number of panel descriptions mentioning technique. Scratched, ground and etched were not found in any of the descriptions.

Table 5.10 The dating of rock art as recorded in SMRs according to prehistoric sub-divisions and using validated 'panel' level records.

PERIOD	Northumberland	Cumbria	North Yorkshire	West Yorkshire	Total
Prehistoric	7	0	50	0	7
Neolithic	0	3	0	0	3
Bronze Age	362	20	109	28	519
Early Medieval	0	1	0	0	1
Multi-period	81	3	0	0	84
Unknown	8	1	1	0	9
Total	458	28	160	28	674

Table 5.11 The association of rock art sites with other monument classes as recorded in SMRs. (Information taken from SMR description fields).

SITE TYPE	Northumberland	Cumbria	Cleveland	North Yorkshire	West Yorkshire	Total
Barrow	67	11	10	8	0	96
Burial	100	7	10	1	0	118
Camp	87	0	0	0	0	87
Cairn	144	10	1	6	0	161
Cist	90	6	3	0	0	99
Cross	1	0	0	0	0	1
Ditch	21	10	0	1	0	32
Earthwork	19	2	0	0	1	22
Enclosure	51	5	1	11	1	69
Field system	5	0	0	0	1	6
Fort	27	1	0	1	0	29
Grave	14	11	3	2	0	30
Henge	1	0	0	0	0	1
Hut circle	11	0	0	0	0	11
Inhumation	24	1	0	0	0	25
Mound	80	11	10	16	0	117
Ridge and furrow	1	0	0	0	0	1
Rune stone	1	0	0	0	0	1
Settlement	31	0	0	1	1	33
Standing stone	72	9	0	1	0	82
Stone alignment	19	3	0	0	0	22
Stone avenue	0	2	0	0	0	2
Stone circle	5	12	0	4	0	21

Table 5.12 Table showing recorded geology and strata, taken from SMR geology and description fields.

SPECIFIC STONE TYPES QUERIED	GEOLOGICAL CATEGORIES QUERIED
Basalt	Calcareous
Chalk	Igneous
Chert	Metamorphic
Dolomite	Sedimentary
Flint	Volcanic
Granite	
Greenstone	
Greywacke	
Grit (millstone grit, gritstone, grit rock)	
Ironstone	
Limestone	
Marble	
Quartzite / Quartz	
Sandstone	
Schist	
Scoria	
Slate	
Whinstone	

Table 5.13 Results of the panel verification process for SMR and National Park digital data.

Data source	NUMBER OF ORIGINAL RECORDS	NUMBER OF PANELS	NUMBER OF MULTIPLE PANELS INCLUDED IN SINGLE RECORDS	NUMBER OF RECORDS WHERE PANEL NUMBER NOT ESTABLISHED	NUMBER OF PANELS ADDED BY RAPP FIELD TRIAL
Northumberland SMR	207records 287 NGRs	458	2-37	12	5
Cleveland SMR	25	26	2	0	N/A
Cumbria SMR	18	28	2-4	0	N/A
Yorkshire Dales National Park	47	94	2-15	0	N/A
North York Moors National Park	56	94	2-20	2	N/A

Table 5.14 Level of accuracy achieved in SMRs for National Grid coordinate information

ACCURACY LEVEL	NORTHUMB-ERLAND	CUMBRIA	CLEVELAND	NORTH YORKSHIRE	WEST YORKSHIRE	TOTAL
1m accuracy (12 or 10 digit & grid letter)	32	28	0	94	0	154
10m accuracy (8 digit & grid letter)	339	0	26	57	23	445
100m accuracy (6 digit & grid letter)	77	0	0	7	5	89
1000m accuracy (4 digit plus grid letter)	10	0	0	2	0	12
Total number of panels	**458**	**28**	**26**	**160**	**28**	**700**

Note: The table highlights the potential accuracy of grid referencing according to the number of digits in the co-ordinate string. It does not indicate whether the references themselves are correct.

Table 6.1 The spatial nature of impacts of rock art panels observed in the two study transects.

Impact categories	**Northumberland (Sample: 10 panel)**	**West Yorkshire (Sample: 13 panels)**
Peripheral impact	1	1
Widespread impact	7	10
Localized impact	2	1
Segmenting impact	0	1

The sample sizes are relatively small and so the results should be seen as being indicative of spatial impact.

Table 7.1 List of rock art recording techniques assessed by the Pilot Project during fieldwork in Northumberland and West Yorkshire

PANEL CONTEXT	**PANEL CONTENT 1.** *Non-Contact optical method s*	**PANEL CONTENT 2.** *Non-contact drawing methods*	**PANEL CONTENT 3.** *Contact methods*	**PANEL CONTENT 4.** *Combined methods*	**PANEL ATTRIBUTES**
Total Station Global Positioning System	SLR photography Digital photography Photogrammetry Laser scanning	Representative Scaled planning	Tracing Carbon and wax Rubbing Damp cotton Foil impression Moulding and casting	Epigraphic survey	Rebound Hammer Geological identification Soil sampling Lichen Identification Weathering attributes recording

Table 7.2 Table listing the results of soil samples taken around panels 8008, 8013 and 8020 within the West Yorkshire study transect

	PH	**NITRATE (MG/L) NO_2^- & NO_3^-**	**SULPHATE (MG/L) WITH ADJUSTED PH**	**CHLORIDE (MG/L)**
Near panel 8008	3.6	- & 0	400-800 (pH 5.5)	0
Near panel 8020	3.6	- & 0	400-800 (pH 5.0)	0
Near panel 8013	3.9	- & 0	400-800 (pH 5.0)	0

Table 7.3 The distribution of panels in West Yorkshire recorded by the Ilkley Archaeology Group across 50m elevation bands (the elevation data intersected with 507 of the 640 original panels)

ELEVATION (M)	**50-100**	**100-150**	**150-200**	**200-250**	**250-300**	**300-350**	**350-400**	**TOTAL**
Number of panels	3	27	27	81	197	163	9	507

Table 7.4 Summary matrix assessing field recording techniques and their applicability in rock art fieldwork

Technique	TRAINING	ACCESS	EXPENSE / EQUIPMENT	TIME	WEATHER / CONDITIONS	Location
Photography (SLR & digital)	4	4	4	4	Weather dependent	4
Epigraphic Survey	4	4	4	4	Weather dependent	4
Damp Cotton Photography	4	4	4	4	Weather dependent	4
Foil Impression	4	4	4	4	Weather dependent	4
Photo Grammetry	Training Required	Requires equipment transport	£	◷	Weather dependent	Limited by access to Panel
Total Station Panel Outlines	Training Required	Requires equipment transport	£	4	4	4
Total Station / GPS Surface Modelling	Training Required	Requires equipment transport	£	◷	4	4
Total Station Motif Recording	Training Required	Requires equipment transport	£	◷	4	4
GPS Panel Positions (Garmin handheld)	4	4	4	4	4	Limited by tree cover
GPS Panel Positions (Survey grade)	Training Required	Requires equipment transport	££	4	4	Limited by tree cover
GPS Panel Positions (Beacon)	Training Required	4	£	4	4	Limited by tree cover
GPS Panel Outlines (Beacon)	Training Required	4	£	4	4	Limited by tree cover
GPS Panel Outlines (Survey grade)	Training Required	Requires equipment transport	££	4	4	Limited by tree cover
Laser Scanning	Training Required	Requires equipment transport	££	◷	Weather dependent	Limited by access to Panel
Scale Drawing (Motifs / Panels) (Planning Frame, Baseline, Different Scales) Datums surveyed in GPS / TS	4	4	4	◷	4	4
Scale Drawing (Weathering / Damage Observations)	4	4	4	4	4	4
Tracing	4	4	4	4	4	4
Carbon / Wax Rubbing	4	4	4	4	Weather dependent	4

4 = indicates that technique is not problematic with regard to the particular evaluation criteria.

Table 9.1 Museum questionnaire replies. Overview and education details (table continues over).

Respondent	Number of items	Motif types (See footnote 1)	Mobiliaries (on display / in storage)	Earthfast slabs (on display / in storage)	Number of exhibits on permanent display / temporary display	Number of replicas used / and on display ?	Visitor contact allowed / rubbings allowed (see footnote 2)	Use of rock art for education	Conservation works undertaken?
Bradford (Manor House, Ilkley)	2	a, c	NA	1/1	1/0	3/2	Yes	Yes	No
Bristol city	1	a,f,g	0/0	1/0	1/0	No/No	Not encouraged	Yes	No
British Museum	7	a,d,h	0/7	0/0	NA	No/No	Don't know	Don't know	No
Carlisle (Tullie House)	4	c,d,e	1/0	3/1	3/0	No/No	No	No	Don't know
Corinium (Cirencester)	1	c	0/1	0/0	0/0	No/No	NA	No	Don't know
Durham (Fulling Mill)	3	a,c	0/0	3/0	3/0	No/No	Yes,I	Yes	Yes
Newcastle (Museum of Antiquities)	50+	a,c,d,e,i,j	2/50+	1/1	2/1	No/No	Yes,I	Yes	Yes
Penrith	4	a,c	2/2	0/0	1/0	No/No	Not encouraged	No	No
Sheffield City	19	a,c	1/10	5/3	6/0	4/2	Yes,i,ii	Yes	Don't know
Whitby	3	a,c	3/0	0/0	3/0	No/No	No	No	No
ISLE OF MAN									
Manx Museum (Douglas)	17	a,c	0/3	0/14	0/0	No/No	No	No	No

Footnotes:

1. Motif types: a - Cup; b - Ring; c - Cup and ring; d - Spiral, ladder designs, ovals; e - Others, such as axes and daggers, anthropomorphs, zoomorphs, lozenges, labyrinths, etc. f - Human feet; g - Square shaped symbols with two prongs; h - Cruciforms; i - Grooves and rebates; j - Dots; k - Circles, spheres and arcs; l - cups and non-radial rings; m - Rayed wheels; n - Right angles

2. Visitor contact to rock art displays
i - visitors allowed to touch panels; ii - visitors allowed to make rubbings / tracings of motifs

Table 9.1 (*continued*). Museum questionnaire replies. Overview and education details (table continued from over).

Respondent	Number of items	Motif types (See footnote 1)	Mobiliaries (on display / in storage)	Earthfast slabs (on display / in storage)	Number of exhibits on permanent display / temporary display	Number of replicas used / and on display ?	Visitor contact allowed / rubbings allowed (see footnote 2)	Use of rock art for education	Conservation works undertaken?
SCOTLAND									
Bute	2	a,c	1/0	1/0	2/0	No/No	Yes, I	Yes	No
Dundee	3	a,c,i	1/0	1/1	2/0	No/No	Yes,i	Yes	No
Glasgow (Kelvingrove)	6	c,e	1/0	2/3	3/0	No/No	Yes,I	No	Don't know
Glasgow (Hunterian)	3	a,b	0/2	1/0	1/0	No/No	No	No	No
Hamilton	1	d,i,k	0/0	1/0	1/0	No/No	No	No	Don't know
Kilmarnock	17	a,c,k	4/6	0/7	0/4	No/No	No	No	Yes
Orkney (Kirkwall)	7	d,l	2/5	0/0	2/0	No/No	No	No	No
Tain	1	a,m,n	0/0	1/0	1/0	No/No	No	No	No
Peebels (Tweedale)	0	--	--	--	--	--	--	--	--
WALES									
National Museum (Cardiff)	<10	a,e	1/<10	1/0	1/0	Yes/No	No	Yes	Yes

Footnotes:
1. Motif types:
a - Cup; b - Ring; c - Cup and ring; d - Spiral, ladder designs, ovals; e - Others, such as axes and daggers, anthropomorphs, zoomorphs, lozenges, labyrinths, etc.
f - Human feet; g - Square shaped symbols with two prongs; h - Cruciforms; i - Grooves and rebates; j - Dots; k - Circles, spheres and arcs; l - cups and non-radial rings; m - Rayed wheels; n - Right angles

2. Visitor contact to rock art displays
i - visitors allowed to touch panels; ii - visitors allowed to make rubbings / tracings of motifs

Table 9.2 Museum questionnaire replies. Interpretation and further details (table continued over).

Respondent	Levels of interpretation	Information provision	Display dates	Interest in mounting an appropriate display	Encouragement of site visits to rock art panels and therefore guidance in visitor behaviour? what about information on decay and conservation works?	is electronic media used by the museum to portray information ?
Bradford (Manor House, Ilkley)	Archaeological information given for some of the objects. No information given on conservation and decay.	Labels/panels	NA	Yes	Yes (Guided walks). No information given on behaviour and decay / conservation	Basic website for museums service
Bristol city	Archaeological information given for all objects. Information given on conservation and decay - not ticked	Labels/panels/ leaflets	mid 1960s	Yes	No/No	Museum has own website but no information on rock art
British Museum	Not given	Not given	Not given	Not given	No/No	Museum has own website but no information on rock art
Carlisle (Tullie House)	Basic information given for all objects. No interpretation or references offered?	Labels/panels	1990	No	No/No	No
Corinium (Cirencester)	Not given	Not given	N/A	No	No/No	Museum has own website but no information on rock art
Durham (Fulling Mill)	Basic archaeological information given for selection of objects. No conservation information given.	Labels/panels	1986	Yes	No guidance on behaviour. Information provided on decay/conservation, if requested	Museum has own website but no information on rock art
Newcastle (Museum of Antiquities)	Archaeological information given for most of the objects. Some information given on conservation and decay.	Verbal or written response to visits or queries	1998	Yes	Yes, encouraged with leaflets. No guidance on behaviour or decay and conservation, unless specifically asked	Museum has own website and information on rock art

Table 9.2 (*continued*) Museum questionnaire replies. Interpretation and further details (table continued from over).

Respondent	**Levels of interpretation**	**Information provision**	**Display dates**	**Interest in mounting an appropriate display**	**Encouragement of site visits to rock art panels and therefore guidance in visitor behaviour? what about information on decay and conservation works?**	**is electronic media used by the museum to portray information ?**
Penrith	Archaeological information given for all of the objects. (conservation & decay not ticked)	Labels/panels. Computerised catalogue	1990	Yes	No/No	No, but brief reference on the Local Authority's website
Sheffield City	Archaeological information given for some of the objects. Some information on conservation and decay	Labels/panels	1970s + 1990s	No	No/No	No
Whitby	Only basic information given	Labels /panels	after 1931	No	No/No	Museum has own website but no information on rock art
ISLE OF MAN						
Manx Museum (Douglas)	No Archaeological information given. No information given on conservation and decay.	--	--	Yes	No/No	No
SCOTLAND						
Bute	Only basic archaeological information given	Labels/panels	1990	No	Yes (Guided walks) No information on conservation and decay	No

Table 9.2 (*continued*) Museum questionnaire replies. Interpretation and further details (table continued from over).

Respondent	Levels of interpretation	Information provision	Display dates	Interest in mounting an appropriate display	Encouragement of site visits to rock art panels and therefore guidance in visitor behaviour? what about information on decay and conservation works?	is electronic media used by the museum to portray information ?
Dundee	Only basic information given for all objects. Conservation and decay information offered for select objects	Labels/panels	1987	Yes	Yes (Gazetteer information) Does provide guidance on behaviour and information on conservation and decay	Museum has own website but no information on rock art
Glasgow (Kelvingrove)	Archaeological information given for most of the objects. No information given on conservation and decay.	Labels/panels	1965	Yes	No/No	No
Glasgow (Hunterian)	Archaeological information given for all of the objects. No information given on conservation and decay.	Labels/panels	1990	Yes	No/No	Museum has own website but no information on rock art
Hamilton	Archaeological information given for all of the objects. No information given on conservation and decay.	Labels/panels	2000	Possibly.	No guidance on visitor behaviour. Does provide general information on decay and conservation issues for collections	No
Kilmarnock	Basic information given for some objects. No information given on conservation and decay.	Labels/panels	1996/97	Yes	No/No	No
Orkney (Kirkwall)	Only basic archaeological information given. No information given on conservation and decay.	--	1985	--	No/No	Museum has own website but no information on rock art

Table 9.2 (*continued*) Museum questionnaire replies. Interpretation and further details (table continued from over).

Respondent	Levels of interpretation	Information provision	Display dates	Interest in mounting an appropriate display	Encouragement of site visits to rock art panels and therefore guidance in visitor behaviour? what about information on decay and conservation works?	is electronic media used by the museum to portray information ?
Tain	Archaeological information given for all of the objects. (Information on conservation and decay - boxed not ticked)	Labels/panels	1996	Yes	Leaflets. No information given on behaviour and decay and conservation	Museum has own website but no information on rock art
Peebles (Tweedale)	--	--	--	Yes	--	No
WALES						
National Museum (Cardiff)	Only basic archaeological information given for all objects. No information given on conservation and decay.	Labels	late 70s	Yes	--	Visitors have www access & museum has own web site. No information on rock art