ROUTLEDGE STUDIES IN ARCHAEOLOGY

Open-Air Rock-Art Conservation and Management

State of the Art and Future Perspectives

Edited by
Timothy Darvill and
António Pedro Batarda Fernandes

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While much has been achieved in understanding and managing weather effects and erosion phenomena affecting ancient imagery within the relatively protected environments of caves and rock-shelters, the same cannot be said of rock-art panels situated in the open-air. Despite the fact that the number of known sites has risen dramatically in recent decades, there are few examples in which the weathering and erosion dynamics are under investigation with a view to developing proposals to mitigate the impact of natural and cultural processes. Most of the work being done in different parts of the world appears to be ad hoc, with minimal communication on such matters among teams and with the wider archaeological community.

This richly illustrated book evaluates rock-art conservation in an holistic way, bringing together researchers from across the world to share experiences of work in progress or recently completed. The chapters focus on a series of key themes: documentation projects and resource assessments; the identification and impact assessment of weathering/erosion processes at work in open-air rock-art sites; the practicalities of potential or implemented conservation interventions; experimentation and monitoring programmes; and general management issues connected with public presentation and the demands of ongoing research investigations. Consideration is given to the conservation of open-air rock-art imagery from many periods and cultural traditions across the Old and New Worlds. This timely volume will be of interest to conservators, managers, and researchers dealing with aesthetic and ethical issues as well as technical and practical matters regarding the conservation of open-air rock-art sites.

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12 **Open-Air Rock-Art Conservation and Management**
State of the Art and Future Perspectives
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Contents

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Figures

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Tables

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Abbreviations and Acronyms

AEMET	Agencia Estatal de Meteorología
AHRC	Arts and Humanities Research Council
AI	Action Index
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
AOTF	Acoustic-optical tunable filter
AURA	Australian Rock Art Association
BAP	Beckensall Archive Project
BAR	British Archaeological Reports
BP	Before Present (conventionally taken as 1950)
cal BC	calibrated radiocarbon determination in years Before Christ
CAR	ICOMOS International Committee on Rock Art
CARE	Condition assessment and Rick evaluation
CCD	Charge-coupled device
CD	Compact disk
CDEP	Community Development and Employment Program
CEI	Cultural Efficiency Index
CFC	Caring for Country
CHA	Cultural Heritage Assessment
CIMS	Cultural Information Management Systems
CMP	Conservation management plans
Co.	County
CSIRM	Carved Stone Investigations: Rombalds Moor
DEM	Digital Elevation Model
DNMI	Det Norske Meteorologiske Institutt
DTV	Diurnal temperature variation
DVD	Digital video disk
ECG	Electrocardiography
EKZNW	Ezemvelo KwaZulu-Natal Wildlife
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária
EPSRC	Engineering and Physical Sciences Research Council
EQ	Ever-Quest (square scanable graphic linked to an established website)

ERA	England's Rock Art
EU	European Union
FUMDHAM	Museum Foundation of the American Man
FWHM	Full width half maximum (waveband)
GIPRI	Grupo de Investigación de Arte Rupestre
GIS	Geographical information system
GNSS	Global navigation satellite system
GPS	Global positioning system
HER	Historic environment record
ICOMOS	International Council on Monuments and Sites
IFRAO	International Federation of Rock Art Organizations
IMP	Instituto de Meteorologia de Portugal
IMP	Integrated management plan
INORA	*International Newsletter on Rock Art*
IR	Infrared
ISCR	Istituto Superiore per la Conservazione ed il Restauro
KNP	Kakadu National Park
LiDAR	Light detection and ranging (laser-light surveying system)
	micro-CT micro computed tomography
MIP	Mercury intrusion porosimetry
MRI	Magnetic resonance imaging
NADRAP	Northumberland and Durham Rock Art Pilot Project
NHL	National Heritage List
NIEA	Northern Ireland Environmental Agency
NIR	Near infrared
NMC	National Monuments Council
NMI	National Museum of Ireland
NMS	National Monuments Service (in Ireland)
NMR	National Monuments Record (in UK)
NMR	Nuclear magnetic resonance
NRAP	Norwegian Rock-Art Project
NTNU	Norges teknisk-naturvitenskapelige universitet
OCT	Optical coherence tomography
OD	Ordnance datum
OUV	Outstanding universal value
PERAHU	Place, Evolution and Rock Art Heritage Unit
PDA	Personal digital assistant
PDF	Portable document format
PO	Post office
PRISMS	Portable remote imaging system for multispectral scanning
RANE	Rock-art in Northern Europe
RAMP	Rock Art Mobile Project (England, UK)
RAP	Rock Art Project (Norway)
RAPP	Rock Art Pilot Project (England, UK)

RAS	Russian Academy of Sciences
RCB	Rock Carvings in the Borderlands
RGB	Red-green-blue
RI	Refractive index
RMP	Record of Monuments and Places
SEWPAC	Department of Sustainability, Environment, Water, Population and Communities (Australia)
SMR	Sites and Monuments Record
UAV	Unmanned aerial vehicle
uDP	uKhahlamba Drakensberg Park (South Africa)
UFPI	Universidade Federal do Piauí (Brazil)
UISPP	Union Internationale des Sciences Préhistoriques et Protohistoriques
UK	United Kingdom
UNESCO	United Nations Education, Scientific and Cultural Organisation
USA	United States of America
UV	Ultraviolet
WHS	World Heritage Site
WMO	World Meteorological Organization
WOC	Working on country
2-D	Two-dimensional
3-D	Three-dimensional

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Preface and Acknowledgements

While much has been achieved in understanding, conserving, and managing ancient imagery within the relatively protected environments of caves and rock-shelters, the same cannot be said of rock-art panels situated in the open-air. Despite the fact that the number of known open-air sites has risen dramatically in recent decades, there are few examples in which the weathering and erosion dynamics have been investigated with a view to developing proposals to mitigate the impact of natural and cultural processes. Much of the work being done in different parts of the world appears to be ad hoc, with minimal communication on such matters among teams and with the wider archaeological community.

The aim of this book, based on papers presented at a session organized by the editors at the 16th Annual Meeting of the European Association of Archaeologists held in The Hague, Netherlands, in September 2010 is to discuss rock-art conservation in an holistic way in an attempt to bring researchers together and to share experiences of work in progress or recently completed. The papers focus on documentation projects and resource assessments; on the identification and impact of weathering/erosion processes at work in open-air rock-art sites; on the practicalities of potential or implemented conservation interventions; on experimentation and monitoring work; and on management issues connected with public presentation and ongoing research. Consideration is given to the conservation of open-air rock-art imagery from many periods and cultural traditions across the Old and New Worlds.

Rock-art is notoriously difficult to date, but the ages cited in this volume are given in calibrated years before Christ as 'cal BC' based on relevant local calibration curves as cited by authors in their respective chapters.

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1 Open-Air Rock-Art Preservation and Conservation

A Current State of Affairs

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INTRODUCTION

One of the great achievements of archaeological investigation across the world over the past half century has been the recognition and recording of rock-art covering the whole span of human existence from the Pleistocene through to modern times (Bahn 1998; Clottes 2002). But this success also presents a challenge for the future, as protecting, conserving, and managing these remains is neither simple nor straightforward. It is extraordinary that so much open-air rock-art has survived at all given the abrasive environmental conditions that many sites face (Bahn 2010a, 170–97; Carrera Ramírez 2002; Dorn *et al.* 2008; Hall *et al.* 2007; Herráez 1996; Hygen 2006; Lucas Pellicer 1977; Manning 2003; Soleilhavoup 1993; Swantesson 2005; Tratebas *et al.* 2004; Walderhaug and Walderhaug 1998), the impact of human actions ranging in severity from destructive property development to vandalism and theft (Anon. 2011; Bahn 2010a, 170–97; Bauman 2005; Harry *et al.* 2001; Keenan 2000; Searight-Martinet 2006; Sims 2006; Soler i Subils and Brooks 2007; Taruvinga and Ndoro 2003), and the abrasive effects of environmental change affecting many of the landscapes where rock-art sites commonly occur (Aberg *et al.* 1999; Christensen 2005; Fitzner *et al.* 2004). Conserving and managing these open-air sites is a field of study that has received relatively little attention, a situation that contrasts with the conservation of motifs found in caves which has benefited from extensive research (see, for instance, Brunet *et al.* 1987; Brunet *et al.* 1995). Similarly, although methods to monitor environmental conditions and weathering dynamics within caves are well developed (Brunet and Vidal 1993; Malaurent *et al.* 2007; Vouvé *et al.* 1983), few comparative data are available from open-air rock-art sites, and what there are tend to warn of the dangers of ill-considered and hastily prepared conservation works (see, for instance, Bakkevig 2004; Devlet and Devlet 2002).

To an extent, this state of affairs is understandable given that painted caves were the first evidence of prehistoric art to be discovered and recognized, a triumph coinciding with the moment when archaeology came of age in Europe in the mid 1800s (Bahn 1998, 1–69). And it was the antiquarian

focus on the study of these painted caves and the quality of the early records that has led to modern realization of just how fragile the decorated panels are and how much conservation work is needed. Lascaux in France and Altamira in Spain especially must be seen as paradigmatic in terms of the step-changes prompted by the careful conservation and management of the Ice Age cave-based rock-art they contain. Both sites, and others besides, display the complexity and difficulties in designing and implementing preservation and conservation measures (Bahn 2010b).

ROCK-ART IN CONTEXT

According to the International Federation of Rock Art Organizations, rock-art is everything inscribed or painted on rock surfaces possessing no utilitarian use (IFRAO 2008, 130). This wide definition embraces motifs and symbols made by pecking, engraving, or painting, whether of prehistoric or historic date, located in caves, natural shelters, or the open-air, and from cup-marks and 'plain' drawings and paintings to the exquisite works present in the well-known caves of western France and northern Spain already referred to. Although there may be scope for further discussion about the precise wording of the IFRAO definition and the increasing range of evidence observed in the field that can be considered as rock-art, this fairly inclusive definition is widely accepted by rock-art researchers (but see also Bahn 1998; Clottes 2002).

OPEN-AIR ROCK-ART

Open-air rock-art is found throughout the world in a wide range of environments, and its investigation, conservation, and management are international problems. Its date, site characteristics, geological underpinning, and original cultural context are very diverse. Some of it is still in use and fully part of living traditions by indigenous communities. In Europe, rock-art imagery has survived in a few places at least since the Upper Palaeolithic (the Côa Valley of Portugal, for example, and see Bahn 1992, 1995), the Neolithic (in many parts of Atlantic northwest Europe and the British Isles, for example: Sharpe *et al.* 2008), and the Bronze Age (for instance in Scandinavia: Tansem and Johansen 2008) as well as from more recent historic times. Elsewhere, there is much discussion as to whether open-air rock-art panels, which are inherently difficult to precisely date, are prehistoric or not. Much of the best-known imagery was made by indigenous, aboriginal, or First Nation communities in Australia (for instance, in Kakadu National Park: Sullivan 1991), North America (the Coso Range, California: Whitley and Dorn 1987), South America (Serra da Capivara National Park, Brazil: Nash 2009), Asia (Altai, Russia: Kubarev *et al.* 2004), and Africa (Tassili n'Ajjer,

Algeria: Coulson and Campbell 2010). But more recent images by settlers, migrants, invaders, and colonists with all sorts of cultural backgrounds are also present in many of these areas. Because individuals painted or engraved rock-faces within their landscape, open-air rock-art can be found on almost every kind of rock type known (schists, granites, sandstones, etc.). Preferences for particular kinds of rock can certainly be detected in many areas, although some care is needed to ensure that patterns are not the result of differential preservation rather than cultural selectivity.

By definition, open-air sites comprise all rock-art that exists outside of caves or the enclosed spaces within constructed monuments, which possess very specific conservation and management issues related mainly to the disruption of the delicate environmental equilibrium associated with opening sites to the public. In general, open-air rock-art sites comprise panels that exist on exposed rock surfaces that are open to the sky, including natural cliff faces, exposed rock outcrops, earthfast boulders, and glacial erratics. A case can also be made for including decorated rocks incorporated into built structures where these were originally or have become exposed to the sky such as with the rock-art panels found on some of Europe's well-known megalithic tombs or the carved faces of stelae and standing stones. Not included in this book or elsewhere in the literature on open-air rock-art is a discussion of the wealth of inscriptions, dedications, and ornamentation cut into the walls of monumental structures associated with classical civilizations the world over, although it is recognized that these do share some conservation and management issues with what is traditionally defined as rock-art.

Because of their recognized outstanding universal value, a number of rock-art sites have been inscribed on the World Heritage List (WHL) established by UNESCO (see Chapter 20). In 2013 the WHL included 33 rock-art sites (a small minority consisting of caves), and a further 43 were listed on the so-called Tentative List (Sanz 2008).[1] But it is a small and highly selective sample. A preliminary review suggests that worldwide there are more than 70,000 rock-art sites comprising some 45 million images (Anati 2004), although some commentators believe this estimate to be far too conservative (Malotki 2007, 6). Certainly there are many parts of the world where the search for open-air rock art has hardly begun, if at all, and, as several chapters in this book illustrate, even well-researched landscapes can still reveal big surprises because of the number and quality of sites and panels awaiting discovery.

On a world-wide scale, open-air sites are extremely significant. They vastly outnumber rock-art panels located in caves, not least because of the simplicity and widespread availability of natural rock surfaces as the main prerequisite for the creation of an open-air rock-art panel. Progress with the investigation of open-air rock-art and the recognition of its proper place within studies of material culture more generally was perhaps held back slightly through the later twentieth century by Euro-centric approaches. For a several decades, the study of open-air rock-art was perceived as being 'less spectacular' than other kinds of field archaeology, a view no doubt supported by the difficulties of

finding sites, the heavily weathered nature of the motifs and symbols, and the self-inflicted difficulties of interpretation brought about by trying to apply prevailing positivist models. This has now changed, and the interest in recognizing and understanding the symbolic meanings embedded within material culture that is central to post-processual archaeology has given rock-art studies a new lease of life, and new research agendas are starting to emerge (Bradley 1997, 2009; Fredell *et al*. 2010; Jones *et al*. 2011; Nash and Chippindale 2002). Behind these changes lies a fairly straightforward, recurrent, almost universal pattern of developing appreciation and investigation: discovery; mapping; description and documentation; interpretation; protection from human impacts; protection from natural decay; integrated conservation and management; and monitoring and critical reflection. All these stages require the investment of time and resources, and as several chapters in this book emphasize, obtaining and targeting such resources for best effect is often far from easy. Increasingly important, therefore, is making rock-art contribute to present-day society in a way that allows it to be valued and understood for what it is and for what it stands for. As several authors here show, there is much to be done in this field, but already a number of major themes are emerging, including questions of identity and tourism.

Across the world, rock-art (and the remains of the past more generally) has found an important role in providing social cohesion and new senses of identity for communities, particular ethnic groups, regions, and whole countries and nation states. Rock-art has found a place within the rising tide of interest in signalling the importance of non–Western pasts and political desires to provide time-depth to life in the modern age. Chapters 10, 12, 14, 15, 16, and 17 touch on aspects of these issues with respect to rock-art in Iberia, the southwestern US, Columbia, Brazil, Australia, and South Africa, respectively.

The tourism industry is a major consumer of knowledge about rock-art and exploits sites and landscapes where rock-art can be seen for visits, tours, and expeditions. Together with the interesting revenues that tourism generates in sometimes rather underdeveloped areas where rock-art sites can be seen, it also forces attention on issues of conservation and management (Anati 1983; Anati et al. 1984; Deacon 2006; McManamon and Hatton 2000; Soleilhavoup 1991–1992, 1998). People will not spend time and money looking at sites that are heavily damaged or in an advanced state of decay. Moreover, since tourists are often the people that quickly and independently make critical comparisons between what they see and experience in different places, they can be very demanding with high expectations. Tourism is considered in many of the chapters in this book, and in closing the volume, Chapter 20 offers an account of recent actions regarding management and conservation of rock-art undertaken by UNESCO and ICOMOS in the international arena.

One outcome of these changing interests is the investigation of open-air rock-art sites that are subject to human impact issues. There are plenty of cases from all over the world in which such issues relate to heritage management in general (Hall and McArthur 1996 and 1998, for instance, provide

an overview of the most relevant current heritage management trends), but this is the first attempt to draw together experiences with specific reference to open-air rock-art sites. It is clear from the contributions here that current approaches to managing rock-art sites try to balance the need to preserve the art with the pressure arising from tourism and economic development. Chapter 17 presents an especially revealing case study of tourism management in a rock-art—rich region of South Africa. Among the most well-used strategies are management planning for impact reduction, access restrictions, seasonal closure, access only on guided tours, and the construction of pathways, fences, and interpretation facilities (Jacobs and Gale 1994; Lambert 1989; Ward and Ward 1995).

Of course, human factors are only part of the problem so far as management and conservation are concerned; natural processes represent an equally important field for consideration, not least as their impact is medium and long term. Natural processes play a critically important and rather understudied role in the long-term security of rock-art and yet are not well covered by archaeological research. Even among related disciplines such as geomorphology and geology, the study of weathering and the erosional dynamics of stone in its natural context are dominated by issue-based approaches such as physical, chemical, or biological decay under the very specific conditions of a particular site or landscape. These have undoubtedly made useful contributions to the wider understanding of such dynamics and informed conservation work beyond the individual case, but there is much more to do, and especially so in relation to the combined impacts of these interrelated processes such as we see discussed in Chapters 14 and 15. Trying holistically to understand and address degradation dynamics is not an issue unique to any one open-air rock-art site. Although each case has its own specific overall context, the case studies reported here have significant implications for other sites. The methodologies used, the research issues addressed, and the results obtained will be of use to rock-art managers and conservators worldwide. Importantly, the work presented in the studies included in this volume contributes to wider understandings of natural degradation processes and will help develop and implement sound and informed conservation actions at open-air rock-art sites.

OPEN-AIR ROCK-ART PRESERVATION AND CONSERVATION

A major focus of the present volume is the preservation and conservation of open-air rock-art. Critical here is a distinction between the terms 'preservation' and 'conservation', as they are used throughout this Introduction. Although the two terms are often seen as having an intertwined meaning (see, for instance, Bednarik 1996 or Herráez 1996), the authors consider there to be an important distinction between these two concepts (see Fernandes 2007, 72–3). The term 'preservation' is here applied to all actions that indirectly aim to address menaces to the perpetuation of a heritage asset (in this case,

rock-art). By 'indirect' we mean things such as protective legislation, land-use planning, and the creation of positive attitudes and education programmes that serve to provide the context for management activities and deflect or avert the impact of widespread menaces. Most of the menaces that can be dealt with in this way are anthropogenic, or at least greatly enhanced by human intervention in the landscape from the micro-scale (e.g. overvisiting at a heritage site that subsists in a delicate and interdependent natural equilibrium) to the mega-scale (e.g. climate change). Thus, heritage management strategies are created and implemented to try to inhibit human impacts from accelerating natural weathering or natural decay processes at work at a given site besides preventing the destruction of heritage assets due to vandalism or economic growth (farming, infrastructure building, or urban development).

On the other hand, the term 'conservation' is proposed to include all the 'hard' interventions brought to bear on heritage assets with the aim of prolonging their 'natural' physical lifetime. Therefore, actions such as stabilization, consolidation, and cleaning (either built, ruins, or rock-art) represent conservation actions. It is more than a matter of linguistics. Although different words might be used, it is suggested that such a distinction is made not only for clarification and systematization questions but also in relation to the theory, methodologies, and techniques behind each concept which are quite different and ultimately rest in different spheres of academic discourse and which anticipate a range of distinct approaches.

Transdisciplinary Approaches

From the many calls for conservation of rock-art coming from very different parts of the world (see, for instance, Anati 1983; Anati *et al.* 1984; Crotty 1989; Pearson 1978; Seglie 2006; Silver 1989; Vidal 2001), it becomes apparent that there are many threats to the perpetuation of this significant heritage. Nevertheless, while some authors reference physical weathering as the most pressing risk (see for instance Fitzner *et al.* 2004; Meiklejohn *et al.* 2009; Pope *et al.* 2002; Walderhaug and Walderhaug 1998), others invoke the negative effects of biodegradation, especially when lichen colonization is concerned (Dandridge 1999; Florian 1978; Knight *et al.* 2004; Tratebas 2004), or human factors (for instance, Cittadini 1993; Deacon 2006; Dragovich 1995; Fossati 2003; Haskovec 1991). In the present volume, Chapter 13 presents a relevant case study regarding vandalism at rock-art sites. It is suggested that the way emphasis is placed on the different forms of risk has much to do with the specific area of expertise of each researcher, and, more importantly, with the different environments where rock-art exists. Hence, different settings will determine which weathering patterns are more active and pose more urgent risks to be dealt with by rock-art managers and conservators.

The worldwide paucity of experienced rock-art professionals signals that open-air rock-art conservation has not received the attention (Silver 1989) that other archaeological remains have attracted (as, for instance, the

conservation of Roman sites). The panorama is slowly changing as touristic development is raising awareness, transforming selected sites into tourism attractions (for instance, Deacon 2006), and creating a demand for resource managers and conservators.

To understand and tackle, in the most complete way possible, the interconnections between all the various impacts on rock-art panels ideally requires an interdisciplinary approach whether through team building or the development of a wide experience base. But there are dangers, as the following words intended to portray the general situation amongst stone conservators imply:

> I am a bit worried to notice that you are carrying out your research without organized dialogue, each person working in his or her own corner, the exchange of information remaining very limited (. . .) I also have the feeling that the general tendency among researchers is to remain confined to one's own speciality (. . .) Don't fail to see the wood for the trees! Before going into detail, an assessment of the whole is necessary.
>
> (Chamay, quoted in Doehne and Price 2010, 69)

Much the same could be said about open-air rock-art conservation and management. To precisely see the wood as well as the trees requires an interdisciplinary approach that is fundamental and one that can be applied at different scales at once. Unfortunately, rock-art conservation experts often work in a 'closed circuit'. As Cerveny notes, "the application of stabilizing agents on rock art panels is not widely discussed in refereed publications, (although) proponents discuss active intervention on the stage of newsletters and similar forums" (2005, 8). She also "urge(s) treatment advocates to come out of the newsletters and short courses (and to) publish suggested treatments" (Cerveny 2005, 38). Even though her remarks refer only to proponents of the use of stabilizing agents on rock-art panels, it suggested that her criticism depicts quite accurately the global situation within (open-air) rock-art conservation research as a whole. Indeed, studies and contributions are rarely published in peer-reviewed journals but abound in the so-called 'grey literature'. Hence, the present volume also aims to foster a transdisciplinary approach to rock-art conservation and presentation in mainstream media of worldwide original contributions to this field of study. For instance, Chapters 5, 6, 9, 10, 13, 14, and 15 present diverse but transdisciplinary approaches to understanding and tackling the different threats faced by rock-art conservators in several parts of the world.

The Importance of Documenting Rock-Art

Since rock weathering processes are complex, dynamic, and not yet fully understood (Bland and Rolls 1998; Doehne and Price 2010), many authors suggest that compiling competent documentation is of paramount importance

to ongoing management of ancient rock-art imagery. The argument goes that since it is unrealistic to tackle weathering dynamics on the total corpus of the planet's rock-art resource (at least at the same time and in the foreseeable future), some panels and outcrops that now host ancient imagery will inevitably break up, and their motifs and symbols will be lost forever. Documenting panels now will assure that at least accurate copies of motifs will be available to future generations, a philosophy generally known as 'preservation by record' (see, for instance, Anati *et al.* 1984; Doehne and Price 2010; Letellier 2007, 15; Sharpe *et al.* 2008, 12; and see Chapter 8). Furthermore, documentation work (including motifs, symbols, and the rock massif where they are located) can be an essential tool to record, describe, and precisely locate weathering patterns active at a given rock-art panel or outcrop (Brink 2007; Fitzner 2004; Lewis 2007; Loubser *et al.* 2000; Vogt 2007). Multiple successive documentation events over decades and centuries will provide secure information on diachronic change and the dynamics of weathering.

In the last few years, quite a few methods have been developed for recording rock-art and associated natural weathering patterns. Most have taken advantage of the possibilities offered by combining new photographic and computer technologies (Clogg *et al.* 2000; and see Chapter 14). The rapid introduction and adoption of these new methods has almost entirely replaced the 'old-fashioned' intrusive and sometimes damaging methods of recording rock-art (Sundstrom and Hays-Gilpin 2011, 354).

Careful documentation is fundamental for the dissemination and depiction of rock-art. It also provides a valuable resource to draw upon when attempting to raise awareness of rock-art and its value amongst members of the public, local communities, and, especially, future generations. Promoting the message that rock-art deserves to be preserved within an ethical framework that also covers topics such as visiting rock-art sites and what can be done while viewing them is also important (Fossati 2003; Pilles 1989; Seglie 2006; Soleilhavoup 1991–1992). Several chapters in this volume deal with documentation and public education, especially Chapters 2, 7, 8, 11, and 12. It should be noted that Chapter 11 presents a methodology (and its results) to document rock-art in a non-invasive fashion using 3-D laser scanning.

Many techniques for the documentation of rock-art have been developed, sometimes with general application and sometimes with a specific type of rock-art in mind. Chapter 2 includes a review of a range of methods applied to the documentation of rock-art in England, and it is noted that, at a rather general level, the methods can be subdivided into contact and noncontact techniques. One of the contact methods is based on making 'rubbings' of the rock surface and has been widely used with some success in the past (see also Chapter 8). However, in recent years this has become a controversial method, as intrusive documentation methods are increasingly frowned upon by the wide rock-art community. Certainly at panels made in soft rock and carrying fine engravings, the scope for damage by rubbing is considerable, especially when the practice is repeated many times over and

by inexperienced operators (see Historic Scotland 2005, 27, for useful summary of the issues and a set of guidelines published by a national heritage agency). The editors wish to state that, in principle, they do not support the use of rubbing because of the impact that it can have upon rock-art surfaces and motifs. Nevertheless, it is accepted that it makes sense to report documentation work undertaken with rubbing as one of the recording methods used because in some parts of the world the technique is still valued; there is also a large corpus of documentation that includes rubbings that has built up from research dating back several decades. We believe that it is best not to sweep such situations under the carpet but rather to make them known and subject to open discussion by those interested in rock-art recording, management, and conservation and to enjoin researchers to consider rather carefully the most appropriate techniques to use within the framework of their research and the nature of the panels under scrutiny.

UNDERSTANDING NATURAL DEGRADATION OF OPEN-AIR ROCK-ART

Complementing the documentation work detailed previously, identifying and understanding the natural degradation patterns at open-air panels is another facet of the worldwide effort to save the planet's rock-art. In fact, it can be said that in every country with rock-art, some sort of study dedicated to the conservation and preservation of rock-art sites has been published. Unfortunately, standards vary greatly, and many studies are incomplete. Few try to offer a comprehensive characterization of each site's specific condition. Typically, one or two examples of weathering patterns at work are examined, while other erosive forces are either poorly addressed or not considered at all.

More ambitious works are available, some aiming at the full characterization of the conservation, management, and documentation issues related to a country's rock-art. Darvill and colleagues (2000) coordinated a detailed study (the Rock Art Pilot Project—RAPP) that describes the situation in England and offered proposals to address some of the problems faced by rock-art in that country (see Chapter 2). The results of RAPP enabled English Heritage to create a Rock Art Management, Access, Study and Education Strategy aimed at the amelioration of the situation regarding the management and divulgation of England's rock-art (Sharpe *et al.* 2008, and see Chapters 3 and 4). For a perspective regarding the situation in Ireland, see Chapter 5. Other countries have also developed their own systematic studies on these matters, such as the projects coordinated by Hygen (2006) and by Bjelland and Helberg (2007) devoted to Norwegian rock-art. For a wider discussion of Scandinavian rock-art management and conservation studies, the Leirfall case study presented in Chapter 6 provides a valuable example. Chapters 18 and 19 introduce novel methodologies to assess and monitor the condition of rock-art.

CONSERVATION INTERVENTIONS ON OPEN-AIR ROCK-ART

In the last few decades, crack filling, reattachment, massif consolidation, and the impregnation of rock surfaces have been approached with increasing caution, especially given the scale of unintentional damage that resulted from past interventions of this kind (Andersson 1986; Finn and Hall 1996; Walderhaug and Walderhaug 1998). Against a background where conservation actions are of a complex and delicate nature, there is often little information on the long-term implications of using new materials (Dean 1999), especially in largely uncontrollable environments.

Avery (1978) offers an enlightening account of how laboratory testing might prove helpful in avoiding ill-prepared interventions at rock-art outcrops. He notes how in one case, "a preservative with penetration of over one centimetre was introduced into a rock sample" (Avery 1978, 68). Subsequent weathering tests suggested that the consolidation was satisfactory and that the rock surface had been suitably strengthened. However, after a short time, the 'protected' outer surfaces tidily broke off from the parent body precisely "at the point of deepest penetration" (Avery 1978, 68). Not the intended consequence at all! Avery also offers a word of warning about prior laboratory testing where the results are going to be used for the conservation of particular rock-art panels: "success in simulated laboratory experiments may not necessarily indicate results which might be obtained over long periods of time under natural conditions in the field" (1978, 68).

ETHICAL AND AESTHETICAL ISSUES REGARDING CONSERVATION WORK

Finally, attention may be directed towards ethical and aesthetical issues, particularly in the case of the Côa Valley, where one of the authors (APBF) has attempted to demonstrate that it is the whole outcrop that should be considered when planning and carrying out conservation works (Fernandes 2008). It would be pointless to try only to tackle the weathering patterns active on individual panels of rock-art without endeavouring to stabilize and consolidate the whole outcrop. On the other hand, the *entirety* of the outcrop should be regarded as the 'total' art object because it has been singled out for attention by those executing the rock-art in the first place. Hence, our conservation efforts should be aimed at promoting the long-term endurance of the total art object: outcrop + panel + existing ancient rock-art (and its milieu). The goal would thus be to intervene only when strictly necessary (and in the least intrusive fashion possible) to ensure the endurance of a rock-art site if and when it is agreed that the panels should not be allowed to completely decay because of weathering or other natural processes.

CONCLUSION

In setting the scene for the chapters which follow, two important general points can be identified. First, a transdisciplinary approach will significantly increase the likelihood of attaining the fullest possible comprehension of weathering dynamics and their impacts on the rock-art panels at any given site. Second, a case-by-case approach is fundamental to conceptualize, plan, and implement *in situ* interventions since each site is unique and presents different technical, ethical, and aesthetical challenges. What might be justifiable in one case might be entirely indefensible in another.

The 19 chapters that follow provide a unique global review of the state of open-air rock-art conservation and management and consider future perspectives. In Chapters 2 to 5, attention is directed to work in Britain and Ireland, where a wide range of projects is not only exploring the rock-art itself but taking the findings and the excitement of discovery out into the community. Chapters 6 to 8 turn the spotlight on research in Scandinavia, where figurative engraved rock-art provides particular challenges of documentation and conservation. Chapters 9 and 10 look at recent and current work in Iberia, where some of the oldest open-air rock-art in Europe was discovered as recently as the 1980s and now stands proudly alongside the painted rock-art found on the walls of chambered tombs. In both cases, the panels are extremely fragile and sensitive to contact-based recording; Chapter 11 illustrates what can be achieved by 3-D laser scanning to overcome these problems. North America is the focus of Chapters 12 and 13, where the important contribution from Indigenous peoples is discussed. Chapters 14 and 15 consider approaches used in South America, highlighting some of problems associated with tourism and the technical demands of documenting rock-art in these areas. Community involvement in rock-art conservation and management is a theme picked up in Chapters 16 and 17, looking at work in Australia and South Africa, respectively. Novel technical developments in noninvasive assessment and monitoring and in mathematical modelling of rock-decay processes are discussed in Chapters 18 and 19. Fittingly, the volume concludes with Chapter 20, which looks at the role of UNESCO and ICOMOS in creating international legislative frameworks for promoting the preservation, conservation, and management of the very best of the world's open-air rock-art sites.

NOTE

1. A detailed examination of the inventory provided by Sanz (2008, 59–62) reveals that in some of the listed sites, the principal criterion for inclusion in the WHL was not the existing rock-art but rather combined cultural and natural features. Nevertheless, even if rock-art was not the main reason for inscription, it is now a major contributor to the overall significance of these properties. In other cases (such as Rapa Nui Island, Chile, or Petra, Jordan), the property is not listed in the inventory as a rock-art site but contains elements that could easily be classified as rock-art as defined by the IFRAO.