# PUBLIC ARCHAEOLOGY & CLIMATE CHANGE

EDITED BY

*Tom Dawson, Courtney Nimura, Elías López-Romero & Marie-Yvane Daire*

*Public Archaeology and Climate Change* promotes new approaches to studying and managing sites threatened by climate change, specifically actions that engage communities or employ 'citizen science' initiatives.

Researchers and heritage managers around the world are witnessing severe challenges and developing innovative mechanisms for dealing with them. Increasingly archaeologists are embracing practices learned from the natural heritage sector, which has long worked with the public in practical recording projects. By involving the public in projects and making data accessible, archaeologists are engaging society in the debate on threatened heritage and in wider discussions on climate change. Community involvement also underpins wider climate change adaptation strategies, and citizen science projects can help to influence and inform policy makers. Developing threats to heritage are being experienced around the world, and as this collection of papers will show, new partnerships and collaborations are crossing national boundaries.

With examples from across the globe, this book brings together a selection of papers that detail the scale of the problem through a variety of case studies. Together they will demonstrate how heritage professionals, working in diverse environments and with distinctive archaeology, are engaging with the public to raise awareness of this threatened resource. The contributions in this volume will examine differing responses and proactive methodologies for the protection, preservation and recording of sites at risk from natural forces. It will demonstrate how new approaches can better engage people with the growing number of sites that are under increasing threat of destruction, thus contributing to the resilience of our shared heritage. The new insights using real-life examples presented in this volume will make it a key reference in the field of climate change and heritage studies.

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# Chapter 1

# Public archaeology and climate change: reflections and considerations

*Courtney Nimura, Tom Dawson, Elías López-Romero and Marie-Yvane Daire*

## Introduction

Heritage sites have the potential to inform us about past climates and to demonstrate how humans have adapted in times of change. Ironically, many of the sites that hold this information are themselves now vulnerable to changing climates. There is a long-established tradition of rescue archaeology at sites threatened by development, and the principle of the 'polluter pays' is referenced in the planning guidance of many countries. But what happens when there is no developer? Who should take action when natural processes put sites at risk? The threats are many, including flooding, erosion, desertification, sea level rise, thawing of permafrost, and the drying of waterlogged deposits. Worryingly, climate change predictions (*e.g.* Stocker *et al.* 2013) suggest that the problem is likely to increase in the future. Though discussions on action in the face of climate change have been taking place amongst governmental policy makers for many years, it is only very recently that threatened heritage has been included. In fact, the words 'cultural heritage' appear only twice in the 1550-page Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment report (Stocker *et al.* 2013). However, archaeologists and heritage managers on the ground are acutely aware of this issue and are employing new approaches at sites threatened by climate change, especially initiatives that engage communities or employ 'citizen science' techniques.

This was the motivation for organising the session 'Engaging the public with archaeology threatened by climate change' at the European Association of Archaeologists' (EAA) 2015 Annual Meeting in Glasgow. This conference session specifically focussed on the threats that climate change poses to heritage, a concern that has gained increased publicity in recent years (several sessions at the COP21: United Nations Conference on Climate Change meeting in 2014 also focussed on the problem: http://www.cop21paris.org/about/cop21). The Glasgow session included 15 presentations that highlighted examples of climate change threatened archaeology from across Europe, the United States, and Australia.

This volume, however, is not a conference proceeding, but rather a curated collection of papers intended to bring together the topics highlighted in our conference session, namely the intersections of climate change studies, public archaeology projects and cultural heritage management strategies. While several reports (*e.g.* English Heritage 2008), sessions and meetings on the threats to cultural and archaeological heritage had been organised by us and other colleagues in previous years (*e.g. Management and investigation of marine, coastal and intertidal prehistoric archaeology: Developing a research agenda* at the EAA 2007 Annual Meeting in Zadar, Croatia; *New challenges for sustainable coastal archaeology in the 21st century* at the *HOMER* 2011 conference in Vannes, France; *Over the edge: Heritage management and coastal erosion* at the EAA 2012 Annual Meeting in Helsinki, Finland; *Current trends in coastal heritage vulnerability and resilience* 2014 meeting in Durham, United Kingdom), the public dimension of the problem had not been the object of a specific, in-depth monograph. This was the main impetus for creating this volume.

In this chapter, we not only introduce the contents of this book (Fig. 1.1), but also discuss a number of concepts

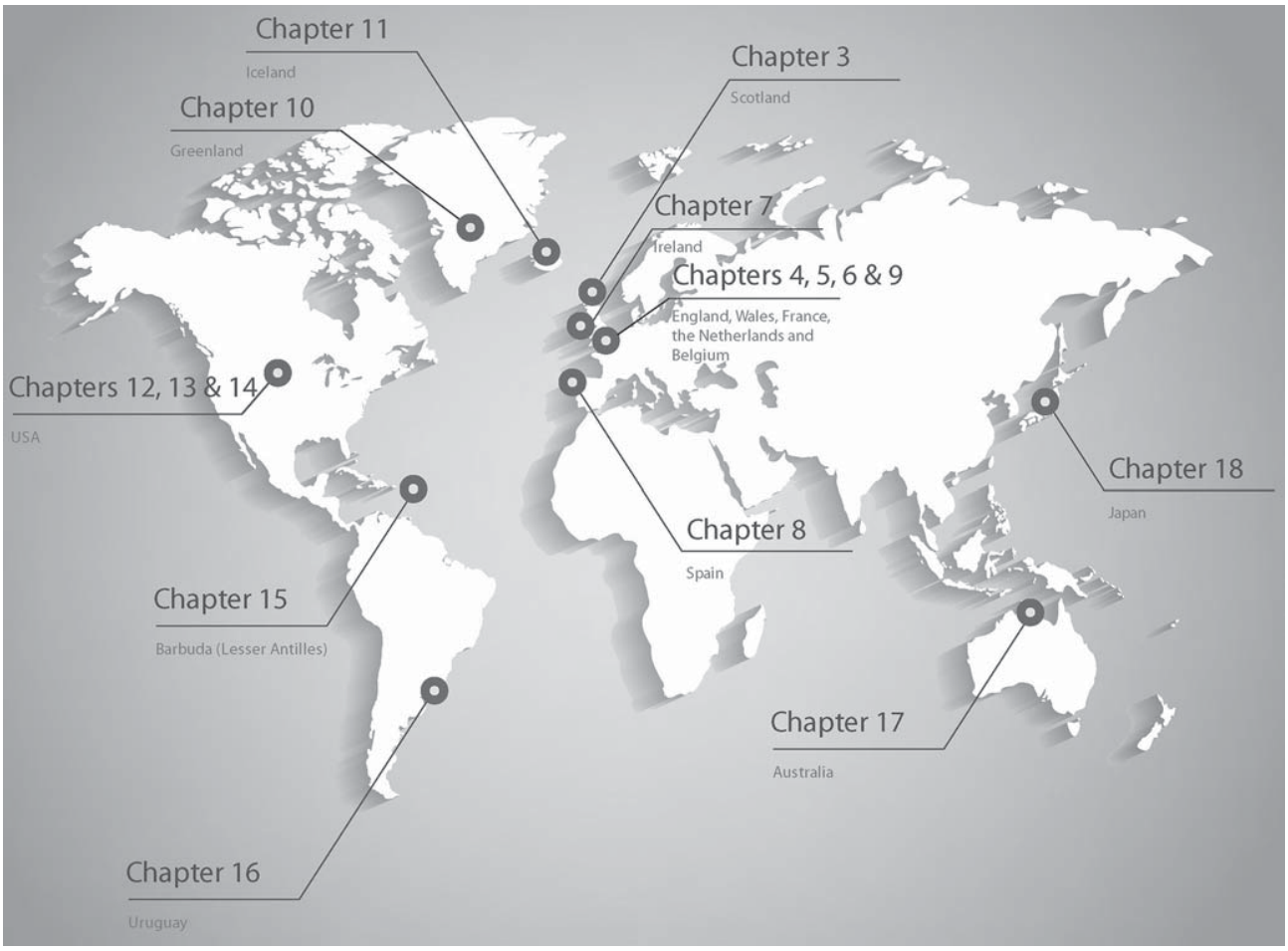


*Figure 1.1. Map showing the locations of the case studies featured in the chapters (modified by the authors using the original basemap design by Freepik: http://www.freepik.com).*

relating to the aforementioned topics, some of which are only reflected on here, and others which are expounded upon in later chapters.

## Defining heritage in a time of climate change

Climate change is a reality – from a long-term geological, archaeological and historical perspective we know that climatic processes and their effects are an inherent part of the shaping and evolution of our planet. From a heritage perspective, however, we cannot idly witness the loss of scientific and cultural information that these changes are causing – we must get involved in their study and preservation. Thousands of archaeological and, more widely, heritage sites are being affected and destroyed by the present global climatic shift, which is both creating new and exacerbating pre-existing threats. In addition to the destruction of more visible sites, deposits containing precious environmental information about the evolution of landscapes are also suffering from these changing conditions.

As the effects of these changes became more evident in the last few decades, concern increased in parallel with the development of an extended, more complex definition of *heritage*. Several attempts have been made to reduce the gap between definitions of 'cultural' and 'natural' heritage, considering that both of them have an equivalent, complementary and inclusive value for human societies. And new terms are being created to better define the ways in which people and communities define heritage for themselves. The process by which specific groups give a social value to objects, places or practices that represent their history, tradition or way of life has become known as *heritagisation* (for other definitions and a debate on this concept see *e.g.* Sánchez-Carretero 2013).

Heritage is approached subjectively, whether by visitors, local residents with a shared heritage, specialists, managers or even by landowners on which sites are located. Therefore,

the ways in which different individuals and communities understand heritage at risk is thus equally varied, context- and situation-specific, and subject to the perspectives of the stakeholders involved. The economic activities that take place at or around a site may be seen as a continuation of a traditional way of life that contributes to the preservation of the landscape by some, but as a hindrance to other types of activities by others. In many cases, preservation *in situ* is preferable. When that is not possible, the transfer of a site or some of its elements to a museum outside the local area may take place. This may elicit opposition by the community, which could perceive it as a sort of amputation of something that *belongs* to that place. Many of these scenarios highlight the different levels of heritage policies involved and the complications that might arise between them.

Local and regional policies tend to match the heritage use and preservation expectations of local communities more closely, but national, transnational (*e.g.* cross border) and international (*e.g.* UNESCO) regulations must consider a majority of the populations demands. And these regulations do not always agree. Determinations about accessibility, building of infrastructures, land-use, provision of funds or musealisation (a concept that critically questions the preservation of heritage or cultural material by, for example, placing it in a museum, consolidating structures, creating pathways for visitors or installing information panels *in situ*), may become points of conflict. The fact that, in some instances, several different policy levels converge on one site adds to the complexity of the problem. And different agents will have different priorities, creating gaps between how policy makers, specialists and the community perceive what heritage is, why some types of heritage are protected, and what measures are taken to protect – or not protect – different sites.

This is often the case when discussing the relationship between heritage, economy, development and tourism. On one hand, the effects of climate change on archaeological and heritage sites may negatively impact the economic income of certain areas, *i.e.* a decrease in the number of visits, if preservation issues arise. On the other, they may impact it positively, *i.e.* cruise ships travelling through the Bering Strait due to melting sea ice. As Chapter 8 shows, an uncontrolled increase in the number of tourists to a heritage site may contribute to the acceleration of natural and cultural site destruction in fragile ecosystems. In such cases, even though the economic impact of such tourist activity is positive, local communities may demand restricted access if they perceive tourism as the main threat to preservation. So while the tourist sector may be the main 'consumer' of heritage, several studies have warned of the risks of not adopting sustainable ways of developing the economic value of heritage (*e.g.* Pedersen 2002).

While this book mainly concerns the materiality (archaeology) of specific types of heritage (cultural landscapes, sites, buildings), it also recognises the intrinsic, immaterial values of heritage for the public and specific communities (Smith 2006). While considering the materiality of archaeological remains such as shell middens and rock art in Northern Australia, Chapter 18 shows how the very idea of material heritage loss impacts the meaningful, immaterial heritage represented by the different codes of interpretation passed from generation to generation of communities in the area. It is not just material heritage that is threatened by observed climate changes, but also the ideas, narratives and discourses that different communities have built around that heritage; the relevance of the local environment for defining 'public/community archaeology' is capital (Chapter 3 and see also Moshenska *et al.* 2007).

Heritage is a multi-vocal concept that can have multiple meanings and be thought of and approached from very different perspectives by very different social layers and individuals. Bridging these diverse perspectives is not an easy task. In fact, one could argue that the use of the term heritage itself is more a resource employed by specialists and managers than a widespread, understandable concept for members of the local community. An individual's expectations and ideas about climate change policies related to heritage sites do not always match those of the community, not to mention those of the different institutions responsible – at different stages and degrees – for their management and conservation. These 'fractures' (Sánchez-Carretero 2013) and the different sensibilities attached to archaeological sites threatened by climate change are the object of discussion in the different chapters of this book. To different degrees, each paper analyses the dialogue and conflicts existing between specialists, communities, visitors, managers and policy makers; and proposes ways of reducing the gap between their different points of view.

## Public archaeology and climate change: challenges

What is clear from the papers compiled in this book is that the process of building solutions to present climate change threats to cultural – and more precisely archaeological – heritage is well underway in some regions, and we should strive to better integrate public-driven approaches. This integration, as these distinctive case studies show, can take particular forms and can be adapted to very different geographical, societal, collective and individual contexts. But as complicated as the definition and interpretation of the term 'heritage' is, so is the definition of 'public archaeology'. As Gabriel Moshenska (2009, 46) pointed out in his paper 'What is Public Archaeology?': 'there is still a degree of uncertainty about the precise definition and delineation of public archaeology'. Much has changed even since 2009, but it remains clear that we are, perhaps, still working out as an international discipline what is the meaning of public

archaeology. The term is often used synonymously with other terms such as community archaeology, active/action archaeology (Sabloff 2008), applied archaeology, and other times terms like community archaeology are presented as a subset of public archaeology (see Sabloff 2012). And it is not always clear what we mean when we refer to the 'public'. Although we could list hundreds of different definitions, each influenced by varied national traditions, this is not the topic of discussion at hand (but see Matsuda 2016; Richardson and Almansa-Sánchez 2015 for recent reviews).

For our purposes here, we should clarify that the authors have interpreted the term 'public archaeology' in a variety of different ways. Generally, they have used the term 'public' to describe people who are not employed as archaeologists or within the heritage sector (other terms such as non-professionals are also used to describe people not employed as archaeologists in various chapters in this book). They use public archaeology as a descriptor for active and direct engagement with members of the public that are interested in their local archaeology (from outreach to education initiatives), indirect engagement with members of the public (publicising the resources and engaging via social media), or to describe archaeological work driven by, undertaken by, or involving community members (from citizen science projects to community excavations). Although grappling with the more political or theoretical aspects of public archaeology was beyond the remit of this book, we have hopefully touched on at least some aspects of these discourses in this chapter (and in this volume). Rather, the chapters herein present project case studies and examples of practical engagement that mainly follow two key aspects of public archaeology: the management of public archaeological resources and conducting archaeology with the public. These case studies show a capacity for acting critically and self reflexively, which has led to new standards for public archaeology practices, and highlight diversity in their approaches, as they attend to their varied heritage and wide array of stakeholders. They also highlight many shared challenges. In some countries national regulations hinder the involvement of the public in archaeological work, from excavation to monitoring to simply knowing the location of archaeological sites; in other places an historical lack of public involvement has delayed the growth or success of this type of work.

One of the main challenges associated with a public-driven approach concerns the very different scales at which the integration of this approach – and the decision-making process attached to this integration – will have to take place, as it would ideally combine local and regional actions with wider national and international activities. This means that there is an urgent need for a more fluent exchange of information and the development of both new and flexible approaches between the managerial/political spheres and the people whom they serve. For instance, while there are regularly scheduled professional meetings on cultural heritage and climate change, very few – if any – of them are aimed at integrating the general public. At the interface of these two poles, the role of heritage professionals, including archaeologists, is pivotal. Considering this overall context, the main challenges archaeology has to face concerning climate change in the years to come can be classified as administrative, societal and technological challenges.

A number of administrative challenges are discussed throughout this book, mainly revolving around the implementation of high-level policies on the ground and negotiating the demands of a wide range of stakeholders. There are also interdisciplinary challenges, as climate change is under the purview of a diverse set of disciplines, which each have particular views when approaching concepts such as risk, vulnerability and resilience. Geographers, biologists, economists and more recently historians and archaeologists have developed their own ideas and nuances around these concepts (*e.g.* Pigeon 2005; Erlandson 2008; Briguglio *et al*. 2009; Thornton *et al*. 2014), which are frequently focal points of climate change discussions. Therefore, there is a need to promote the wider integration of cultural and archaeological heritage into the debate on the effects of climate change at the local, regional, national and international forums. There remains insufficient representation of cultural heritage on some of the leading panels currently discussing climate change across the globe, resulting in the need for a more effective interdisciplinary debate on climate change policies, its perspectives and consequences.

The same can be said for incorporating other parts of society into these discussions. As already stated, we should aim to better integrate the public and communities into the many stages of cultural heritage projects, from planning and research to management and dissemination. One of the most valuable characteristics of local communities is their capacity to observe changes in their local area – a characteristic that is applauded in many of the case studies in this book.

Digital technologies are aiding some of these integration processes, in some cases greatly increasing the numbers of people that are able to take part in surveying, registering, monitoring, preserving, analysing and displaying archaeological sites threatened by climate change. Smartphone apps, interactive websites and virtual displays are already being used to bridge the gap between the research and management of archaeological sites and the communities that live with them. However, as observed in some studies, these innovations also provide their own set of challenges, as some of these tools can be discriminating against those who may not feel comfortable using them. Developing user-friendlier applications, making available training workshops for non-specialists, and offering low-tech or no-tech alternatives, such as paper pro formas,

will help to maintain and improve the dialogue between specialists and the public.

## Public archaeology and climate change: the contents of this book

Unlike many natural ecosystems, which are subject to cycles and have some potential for regeneration, the inherent resilient capacity of most archaeological sites is extremely low. Once the conditions that have allowed their preservation change, they depend on external human action in order to maintain their balance and a certain degree of resistance against the agents threatening their integrity. This incapacity for regeneration constitutes one of the main aspects that defines the situation of most archaeological sites suffering the effects of climate change, and one that will need to be at the forefront of interdisciplinary discussion on this matter in the short to medium terms. What is highlighted in the case studies throughout this book is that there is no single answer to the issue of climate change threatened archaeology – the effects of climate change are as diverse as the environments on this planet, and as diverse as the archaeological material that it affects. And though the diversity of both the threats and the heritage it threatens presents significant challenges, it is also perhaps a source of potential to test innovative methods across a range of research areas. This is where we begin.

In Chapter 2, Adam Markham provides an overview of the scale of the problem facing heritage sites in a time of changing climate. Noting that climate change is probably the fastest growing threat to cultural heritage worldwide, he describes change at some of the most iconic heritage sites on the planet – those inscribed on the UNESCO World Heritage List. Markham argues that World Heritage sites are important not only for their cultural value, but that they also have economic benefits, are tools for educating the public about the impacts of climate change, and are resources for public engagement. He provides examples from around the world, highlighting different types of threatened world heritage from iconic monuments, sacred sites and objects to traditional lifestyles and intangible cultural heritage. Markham not only summarises the problems facing World Heritage Sites but also outlines the recommendations aimed at addressing climate-related threats to our shared, global cultural heritage.

Although the remaining chapters are based on case studies from specific countries, each contains elements and methodologies that can be applied globally – many of these recurring practices have been pointed out throughout this introductory chapter. In Chapter 3, for example, Tom Dawson and colleagues focus on the surprisingly varied coastline of Scotland (one of the longest in Europe), but the summary of threats posed to heritage sites is applicable to coastal areas around the world. These are areas which, in many countries, are likely to feel the effects of climate change soonest. In Scotland, there has been a tradition of working at sites threatened by coastal processes that extends back to the 19th century. Local and national agencies have developed a range of initiatives to record and monitor vulnerable sites, and there is also a strong Scottish tradition of involving the public in heritage projects, and community action at eroding coastal sites has evolved since community initiatives in the 1990s. The authors discuss *SCHARP*, a recent, two-staged community project. The first stage employs a citizen science approach and mobile technology to updating existing heritage records and redefining priorities. This has been followed by community action at locally-valuable sites, and a range of project types have been undertaken in order to test different approaches. Local groups have collaborated with heritage professionals in projects such as detailed 3D digital recording and the excavation and relocation of a threatened site. The chapter concludes by discussing the role of the non-professional in archaeology, giving examples of the strengths and weaknesses of such projects – a feature of almost every chapter in this book.

Chapter 4 also focuses on the coast, and discusses how heritage data can be useful in helping to understand longer-term environmental change, a topic also raised in Chapter 14. Garry Momber and colleagues present the *Arch-Manche* collaborative project, which showed how coastlines have evolved over time and assessed techniques that can be used by coastal managers and others to give an indication of the scale and rate of past change. The study focussed on the coastlines on either side of the sea that separates England from continental Europe. The team examined old maps, works of art and photographs, comparing them with modern depictions in order to determine change. They also reviewed and recorded ancient monuments, archaeological deposits, and palaeoenvironmental data, each of which was ranked with a score indicating the value of the resource and how useful it is for indicating past coastal change. The results of this review informed the development of a number of more detailed projects, such as fieldwork involving local volunteers. This included an investigation of the western Solent in southern England, where some historic sites were investigated, together with a project looking at submerged soils which were deposited before the area was flooded with sea water. The *Arch-Manche* project emphasises the importance of considering many forms of evidence and taking a long view of coastal processes.

Chapter 5 reviews two important initiatives taking place in England: the *Thames Discovery Programme* (*TDP*; which focuses on the foreshore of London's river) and *CITiZAN* (which records sites around the English coast). Eliott Wragg and his colleagues give a brief history of work at intertidal sites in England, noting the piecemeal nature of foreshore recording in London until a sustained programme of survey began in the 1990s. Over the years,

the survey developed into the *TDP*, which has trained a large number of volunteers (known as FROGs) to investigate this unique record. The project is closely connected to the work of *SCHARP* in Scotland (Chapter 3), and together inspired the development of the *CITiZAN* project. *CITiZAN* employs mobile technology to help the public record sites, focussing on four unique attributes of coastal archaeology (boats, coastal military remains, coastal industries and submerged landscape), together with projects that look at coastal change and sea level rise. In fact, the mobile technology was developed by the same company that created the data collection applications for SCHARP, with the goal to enabling better collaboration between volunteers of each programme. The paper concludes by pointing out that more sustainable models for the funding of community archaeology projects are needed, a point that is emphasised throughout this book.

Chapter 6 develops the topic of the sustainability of community projects further, demonstrating the value of a national community heritage project, but also providing an example of what can happen once project funding stops. Claudine Gerrard writes from the perspective of an archaeologist with the National Trust for Wales, a major conservation body that owns just over 25% of the Welsh coastline. Wales is managed by a number of organisations, each with specific responsibilities. In addition to landowners, there is a government body (Cadw), a non-governmental organisation (RCAHMW) and four Archaeological Trusts, each with responsibility for a different region of Wales. Together, these organisations have made all historic environment records publically accessible through the *Archwilio* online portal, and have also been involved in the successful *Arfordir* community project, which recorded threatened sites along the Welsh coastline. However, once funding for the 4-year *Arfordir* project came to an end, the National Trust for Wales, a major landowner and former project partner, was faced with a public that had become accustomed to help and guidance from heritage professionals. The paper gives examples of several coastal sites that have been damaged since *Arfordir* finished. These were places where, despite strong public interest, funding was not available to undertake community projects. Contrasting long and short-term community projects, the author highlights the benefits that the national programme delivered, but warns that the situation in Wales could be repeated in other places undertaking citizen science recording projects with short-term funding.

Continuing both the coastal and sustainability themes, Chapter 7 crosses the Irish Sea to the west coast of Ireland. James Bonsall and Sam Moore note that there is growing evidence for increasing storm damage along the coast of Ireland, leading to erosion and the destruction of heritage. The paper describes the heritage found along the County Sligo coast and under the sea; this rich resource contributes to the local economy and is embedded in the tourism and sustainability plans of Sligo County Council. However, the coastal heritage is threatened and severe storms over the winter of 2014–2015 led to the formation of the *Monitoring the Archaeology of Sligo's Coastline* (*MASC*) project. The project team had many problems to overcome, not least the robust heritage laws of Ireland that have limited the potential for public participation in projects, a problem similar to that experienced in the USA, as described in Chapter 13. There are also restrictions on walking across private land, and most monitoring had to be done from the beach. This chapter describes how the project team started working with the public and a range of societies, encouraging them to contribute information on the condition of threatened heritage sites. The authors describe how they developed their network, using easily accessible tools such as social media and open access software to ensure that volunteers remained informed and that information was shared. Although the benefit and value of this and other public archaeology projects can be demonstrated, as noted above, sustainability remains a major problem.

Chapter 8 focuses on a project to record archaeological remains on an island in Spain. Elías López-Romero and his colleagues demonstrate how heritage can capture local imagination and become a rallying point for community action. Guidoiro Areoso is a small, sandy, low-lying island in Galicia. It is vulnerable to storm damage and high waves, and over the years a number of large archaeological sites, including megalithic monuments, have been exposed (and in some cases destroyed). Recently, the island has seen an increase in tourist numbers as a result of improved access from nearby ports, but also partly due to the release of a video that imaginatively highlighted erosion on the island. The authors wanted to document the changing patterns of erosion, and adopted a crowd-sourcing approach that appealed to the public for historic images of the eroding monuments. People were asked to contribute copies of their holiday photographs, and the successful campaign resulted in an archive of images and video that allowed several of the monuments, including some that were subsequently destroyed, to be recreated as digital 3D models. These demonstrate change over time and have helped to recreate lost monuments, providing new detail that had not been previously recorded. The project has helped reveal erosion rates and has increased the awareness of the public and heritage managers of the scale of the threat. It has also demonstrated that there is a strong and committed public interest in documenting threatened heritage sites.

Chapter 9 moves us to neighbouring France, where the *ALeRT* project has developed a methodology for evaluating the vulnerability and resilience of heritage sites. Pau Olmos Benlloch and his colleagues describe how they have used a simple, standardised evaluation form to record heritage data in Brittany, with observations on threat and resilience

converted into numerical values. By applying a simple mathematical calculation, a score is derived which classifies sites as being at low, medium or high risk – creating standardised rubrics for risk management is also a technique employed in Chapter 17. The project team are working with members of the public, and are also collaborating with the *Conservatoire du Littoral*, a wildlife conservation organisation, with a hope of making the project more sustainable. *ALeRT* also created a mobile application for data collection and provided training for its users. Following severe storms over the winter of 2013–2014, the system was put to the test. The paper describes one case study, on the Island of Roc'h Santec, where volunteer surveys enabled the team to assess changes and map damage, partly by making 3D reconstructions (some of the project team also worked on the project described in Chapter 8). Although the project was developed in northern France, the methodology is now being applied to other areas, including parts of Spain. The authors hope that this methodology, together with others developed elsewhere (many of which are discussed in this book), will result in more collaborative partnerships.

Chapter 10 describes the extraordinarily well-preserved heritage of Greenland, where remains spanning over 4000 years of occupation have survived due to low temperatures and favourable soil conditions (see also Chapter 14). This has resulted in the preservation of organic artefacts and other material that does not usually survive. Climate change is often associated with global warming, and Jørgen Hollesen and colleagues describe how rising temperatures will have a devastating effect on the archaeological heritage in Greenland. In order to plan for the future, the authors have been conducting a number of investigations to measure the effects of rising temperatures on permafrost and organic remains. Their scientific observations, together with a comparison of current site conditions with past records, demonstrate that sites are being affected and that evidence is being lost. In order to help further understand and manage this change, the new *REMAINS* project is investigating individual sites. The team are using their results to help predict those areas and site types which will be most at risk, and thus prioritise action at the most threatened sites. Due to the enormity and remote nature of much of Greenland, a project such as this relies partly on the local population. Information about Greenlandic heritage has been provided by local Inuit people, such as the location of sites and their traditional use. The *REMAINS* project will build upon these previous collaborations, creating a methodology for preserving this extraordinary resource at a time of increasing threat.

A medieval fishing station on the west coast site of Iceland is the focus of Chapter 11. The inland area was already well-known for its large farm mound and remarkable collection of dry-stone storehouses or drying sheds. However, the detailed project described here began after a local resident informed the authors that erosion had exposed a number of fishermen's huts along the coast edge. Lilja Pálsdóttir and Frank Feeley describe the collaborative project, which aimed to save as much information as possible before the huts were destroyed. Several seasons of survey and excavation uncovered multiple structures and revealed some of the working practices at the site. The Snæfellsnes Peninsula already attracts large numbers of domestic and overseas tourists, both to the upstanding storehouses and to other local places (the site is on the route to Jules Verne's entrance to the Centre of the Earth). The project team, therefore, had a policy of open access for visitors, providing site tours to inform people about the value of the archaeological site and the threats it faces. They adopted lessons learned from another Icelandic community heritage project and applied them to their work with local schools, preparing educational material and giving talks to students and teachers. They also gave a number of talks in local villages, which resulted not only in increased awareness, but also in local fishermen expressing an interest in past fishing practices; they have since given insights into modern and traditional methods, thus providing a link between past and present.

Crossing the Atlantic, Chapter 12 shows how the US National Park Service (NPS) is highlighting climate change by using the numerous historical places in its care. With more than 280 million sites visitors per year, the NPS uses the cultural sites within its parks to provide information, making them the largest informal education institution in the United States. Marcy Rockman and Jakob Maase explain that the NPS has recognised the enormous impact that climate change will have on heritage sites, and has created response strategies for managing and addressing change within their parks. In addition, the NPS has looked at how the threatened resources can be used to teach the public about the past in order to help people become more aware of what may happen in the future. One recent strategy for educating visitors is the creation of climate stories – short but powerful tales that relate to cultural features within specific parks. The chapter details how this innovative way of interacting with the public evolved and explains how the stories were crafted. It also provides examples of some stories, showing how this technique can help inspire the public to think both about the past and the future.

Chapter 13 discusses the range of threats – the primary two being forest fires and damaging coastal processes – facing the Californian coast and highlights some of the complexities of working at vulnerable sites. Michael Newland and fellow archaeologists together with tribal representatives describe how natural processes will impact upon a range of heritage assets, with many of the vulnerable sites being of importance to Californian tribal groups. The tribal representatives detail how climate change is affecting both tangible and intangible heritage. They present the long view, explaining how tribal groups have cared for their

heritage in the past. Within the groups, there is debate on whether action should be taken to prevent sites from being destroyed, highlighting a tension between policymakers and traditional beliefs. In some cases, practical work has been undertaken on public land, and this chapter gives details of collaborative projects that have created records and assessed the state of heritage sites. As in Chapter 7, some of the problems of working with volunteers in parts of the United States are outlined. These include a system which requires archaeologists to hold permits before they can write reports and prohibitions on making site locations known to the public due to a fear of looting. The authors show how they have worked around these restrictions to undertake a project that is bringing real benefits to a range of stakeholders.

Chapter 14 discusses the threatened heritage in the vast, yet sparsely populated North Slope of Alaska. Anne Jensen begins by providing a chronology of the various different groups who have inhabited the area in the past. She discusses how the lifestyles of modern communities in the Arctic have resisted the radical transformations seen in other parts of the globe, with local communities curating a wealth of traditional knowledge. Jensen gives a brief summary of archaeological research, showing that, as in Greenland (Chapter 10), excavators recovered organic and other archaeological material displaying remarkable levels of preservation in the frozen ground. Jensen notes that the pristine condition of many sites means that archaeological and palaeoenvironmental data recovered through excavation should be shared with other scientific disciplines, thus adding an historic element to established observing networks (places where identical data are collected at multiple stations or nodes). However, this valuable resource is threatened, and warming permafrost and massive coastal change is putting sites at risk. Jensen discusses the work undertaken in partnership with local residents who are keen to see their heritage preserved, including training programmes and recording of heritage sites. This chapter also details the rescue excavation at Walakpa, an iconic and deeply stratified archaeological site that is being impacted by storm damage.

Chapter 15 presents a collaborative community project on the Caribbean island of Barbuda. Sophia Perdikaris and her colleagues argue that in many parts of the world, the effects of climate change are abstract, something that will happen elsewhere or in the future. In Barbuda, the effects are already being felt. As with many other island nations, the heritage of Barbuda faces a range of challenges in the face of changing climate. In order to better understand the impacts of predicted climate change, the team created locally-relevant computer models. These showed best and worst case scenarios for sea level rise, and also took various climatic factors into consideration, including hurricanes and other storm events. The models helped to highlight the most vulnerable sites, allowing action to be prioritised. The authors describe how they have employed a multidisciplinary approach to researching the interplay between culture and environment on the island. Collaborative community action was then undertaken at some sites, and the chapter gives four case studies which highlight different threats and shows how projects linked the arts and humanities with natural and social science research. Barbuda is a young nation, and the collaborative research involving the local community is helping to strengthen cultural identity and allowing the present population to see how people faced challenges in the past.

Camila Gianotti and her colleagues detail the different policies that have been developed to protect heritage in Uruguay in Chapter 16. Until recently, national laws legally protected archaeological sites, but this did not mean that they were effectively managed. The situation is now changing due to the creation of new categories of protection, which bring together the management of both cultural resources and natural heritage. The new system allows the effects of climate change to be included in assessments of cultural heritage, leading to new studies and better systems of protection. Three new types of protected area have been established within Uruguay and case studies from each are explored. These detail some of the ways that managers have worked with the public to raise awareness about heritage among the local population, including methods for stimulating heritage-related economic development. In the *Santa Teresa National Park*, archaeological trails and interpretation have been provided and activities created for local schools. At *Laguna de Rocha Protected Landscape*, participatory fieldwork, oral history recording, school projects and the design of exhibitions, including an international photography exhibition, have been undertaken.

Chapter 17 discusses the situation in northern Australia, where some have argued that ecological change is of less concern to indigenous communities because of the social and economic disadvantages that many groups face. Bethune Carmichael and his co-authors demonstrate that the communities do have grave concerns about climate change damage to heritage and spiritual sites, and give details of a collaborative project to help manage impacts. A bottom-up approach was taken during the project, which included interviewing senior Indigenous rangers, many of whom reported damage and loss of heritage sites which they agreed should be kept safe and strong. The project has developed a tool for use in field survey by Indigenous rangers, and a system for prioritising sites according to their significance and sensitivity to hazard was developed. The authors describe the variables recorded to determine risk and significance, and as the tool was intended for use by Traditional Owners, significance is determined according to their values. The paper also discusses the different adaptation options considered by the rangers for threatened sites. Some of the types of action discussed elsewhere in this volume

were not seen as appropriate, as many of the sites continue to be used in cultural practice and are important for 'learning on country'. Some options, such as relocation, were dismissed by rangers, while others, such as digital reconstruction, were considered to provide only a partial solution.

Chapter 18 focuses on Japan, a mountainous country where much of the upland area is tree-covered. The abundance of timber is one of the factors that has led to 90% of the important cultural properties and national treasures of Japan being built of wood. Wooden objects and structures present a differing set of vulnerabilities in the face of climate change to other sites discussed in this volume, and Peter Brimblecombe and Mikiko Hayashi note that challenges include temperature variations and rainfall shifts, and also threats associated with fire, insect infestations and mould growth. Additionally, many of the historic buildings are living monuments, associated with festivals that attract large numbers of visitors who view the historic and natural heritage in tandem. Climatic variations are leading to changes in the timing of the flowering of blossom and autumn leaf colour, affecting the experience of many festival visitors and the way in which they appreciate historic properties. Although public understanding of climate change is extremely widespread in Japan, there is, as yet, limited appreciation of the impact of climate change on heritage, with most public understanding centred on extreme events such as earthquakes and tsunamis. The chapter notes that efforts are now underway to improve understanding about climate threats to heritage. The school curriculum already includes lessons on climate change, and some educational groups are developing materials which will include information about heritage as well as climate change.

Researchers and heritage managers around the world are facing severe challenges and developing innovative mechanisms for dealing with them. Increasingly, archaeologists are engaging with practices learned from the natural heritage sector, which has long worked with the public in practical recording projects: citizen science projects involving communities are now being further developed and adopted around the globe. These initiatives develop partnerships that include using mobile technology to collect data; sharing new digital recording techniques; undertaking a range of practical projects; and using innovative outputs to make information more readily available. By involving the public in projects and making data accessible, archaeologists are engaging society in the debate on both threatened heritage and wider discussions on climate change. Community involvement is also key to climate change adaptation strategies, and citizen science projects can help to influence and inform policy makers. The papers included in this book encompass current debates on the topic and propose novel solutions and approaches to managing heritage sites affected by climate change across the globe, making it a key reference for those involved in climate change and heritage studies.

## References


Briguglio, L., Cordina, G., Farrugia, N. and Vella, S. 2009. Economic vulnerability and resilience: Concepts and measurements. *Oxford Development Studies* 37(3), 229–47.

English Heritage. 2008. *Heritage Counts 2008, England: Climate Change*. London, English Heritage.

Erlandson, J. M. 2008. Racing the rising tide: Global warming, rising seas and the erosion of human history. *Journal of Island and Coastal Archaeology* 3, 167–69.

Matsuda, A. 2016. A consideration of public archaeology theories. *Public Archaeology*, DOI: 10.1080/14655187.2016.1209377.

Moshenska, G. 2009. What is public archaeology? *Present Pasts* 1(2009), 46–48.

Moshenska, G., Dhanjal, S., Doeser, J., Phillips, S. and Allen, S. 2007. Community archaeology: Against the odds. *Current Archaeology* 213, 34.

Pedersen, A. 2002. *Managing Tourism at World Heritage Sites: A Practical Manual for World Heritage Site Managers*. World Heritage Manuals 1. Paris, UNESCO World Heritage Centre.

Pigeon, P. 2005. *Géographie Critique des Risques*. Paris, Economica-Anthropos.

Richardson, L.-J. and Almansa-Sánchez, J. 2015. Do you even know what public archaeology is? Trends, theory, practice, ethics. *World Archaeology* 47(2), 194–211.

Sabloff, J. A. 2008. *Archaeology Matters: Action Archaeology in the Modern World*. Walnut Creek, CA, Left Coast Press.

Sabloff, J. A. 2012. Public Archaeology. In *Oxford Bibliographies in Anthropology*. Available at: http://www.oxfordbibliographies.com/view/document/obo-9780199766567/obo-9780199766567-0021.xml [accessed 3 January 2017].

Sánchez-Carretero, C. 2013. Significance and social value of cultural heritage: Analyzing the fractures of heritage. In M. A. Rogerio-Candelera, M. Lazzari and E. Cano (eds), *Science and Technology for the Conservation of Cultural Heritage*, 387–92. London, Taylor and Francis.

Smith, L. 2006. *Uses of Heritage*. New York, Routledge.

Stocker, T. F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S. K., Boschung, J., Nauels, A., Xia, Y., Bex, V. and Midgley, P. M. (eds). 2013. *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, Cambridge University Press. Available at: http://www.ipcc.ch/report/ar5/wg1/ [accessed 3 January 2017].

Thornton, P. K., Ericksen, P. J., Herrero, M. and Challinor, A. J. 2014. Climate variability and vulnerability to climate change: A review. *Global Change Biology* 20, 3313–28.