



**CLIMATE CHANGE AND CULTURAL HERITAGE CONSERVATION
A LITERATURE REVIEW**

Prepared By

**Ann D. Horowitz, Maria F. Lopez,
Susan M. Ross and Jennifer A. Sparenberg**

for the

**APT Technical Committee on Sustainable Preservation's
Education and Research focus group**

June 30, 2016

This literature review provides an overview of recent English-language research and policy that addresses climate change and the conservation of cultural heritage. The initial purpose of this review is to help inform organizations like the Association for Preservation Technology (APT), the National Centre for Preservation & Training (NCPTT), and others involved in preservation/conservation research, in formulating priorities or strategies for research and education.

The APT Technical Committee on Sustainable Preservation's (TC-SP) focus group on Education and Research, chaired by Hugh Miller and Susan Ross, provides an ongoing forum for discussing APT's sustainable preservation research agenda. The 2016 *APT Bulletin* Special Issue on Climate Change and Preservation Technology is a related effort; articles in the Special Issue are included in this review.

The list of over sixty references that follow was compiled and reviewed between November 2015 and June 2016 by APT TC-SP members Ann D. Horowitz, María F. López, Susan M. Ross, and Jennifer A. Sparenberg. They started from materials compiled in their research, practice and teaching, including the annotated bibliographies of two theses completed at Goucher College (López, 2015, and Horowitz, 2013). Texts that only address climate change or conservation of cultural heritage were not included. The documents only include academic and gray literature in print format. No blogs, videos or webinars were included. As an introduction to each text, the review includes abstracts or summaries shown in “_” when the text appeared in the original source. Comments are signed (AH, ML, SR, and JS) but the literature review was a collective effort overall.

Many documents included in the review are web-based; direct web-links are provided where available. A limited number of documents are from scholarly journals that are only accessible by online subscription, usually available at local university libraries. Created as a working document, the list is not exhaustive in scope or regional representation, but should help to inform next stages of research and teaching by others. For further information on this initiative, please contact susan.ross@carleton.ca.

(Cover photo: Galveston Seawall, ca.1910-1920, Library of Congress Prints and Photographs)

A

Adger, W. Neil, Nigel W. Arnell and Emma L. Tompkins. "Successful adaptation to climate change across scales in "Global Environmental Change," **Adaptation to Climate Change: Perspectives across Scales** 15.2, Accepted 2 December 2004, Available online 9 April 2005 DOI: 10.1016/j.gloenvcha.2004.12.005 <http://www.sciencedirect.com/science/article/pii/S0959378004000901>

Keywords: Adaptation; vulnerability; scenarios; sustainability; decision making; policy

Abstract: "Climate change impacts and responses are presently observed in physical and ecological systems. Adaptation to these impacts is increasingly being observed in both physical and ecological systems as well as in human adjustments to resource availability and risk at different spatial and societal scales. We review the nature of adaptation and the implications of different spatial scales for these processes. We outline a set of normative evaluative criteria for judging the success of adaptations at different scales. We argue that elements of effectiveness, efficiency, equity and legitimacy are important in judging success in terms of the sustainability of development pathways into an uncertain future. We further argue that each of these elements of decision-making is implicit within presently formulated scenarios of socio-economic futures of both emission trajectories and adaptation, though with different weighting. The process by which adaptations are to be judged at different scales will involve new and challenging institutional processes."

Comment: This article is about the impacts of adaptation across scales. It informs about how to implement successful adaptation through policy, decision-making, and how time plays a role in the effectiveness of adaptation implementation. (ML)

Andrews, Thomas D. and Glen Mackay. "The Archaeology and Paleoecology of Alpine Ice Patches: A Global Perspective." **Arctic** 65.1 (2012): iii-vi. <http://pubs.aina.ucalgary.ca/arctic/Arctic65-S-1.pdf>

Keywords: Ice patch archaeology; caribou and reindeer hunting; terrestrial cryosphere; impact of ice melt on sites; diversity of ice patch sites; climate change; Arctic

Summary: "At a recent conference called Frozen Pasts, held in Trondheim, Norway, in October 2010, presentations by researchers from five continents addressed a broad sweep of human history and culture, including the archaeological remains of caribou or reindeer hunting preserved in ice patches

in North America and Norway; stratified Paleo-Eskimo middens in Greenland permafrost; First World War archaeological remains melting from snow patches in the Italian Alps; the conservation of Scott's hut in Antarctica; permafrost burials of Iron Age Scythians in the Altai Mountains; and the discovery of Inca mummies in the Andes of Argentina. Linked only by their setting in the cryosphere, that part of the Earth's surface where water is frozen for at least part of the year in the form of snow, ice, or permafrost (Slaymaker and Kelly, 2007), the papers also served to catalogue the impact that global warming is having on archaeological remains. Permafrost, alpine snow patches, glaciers, and other components of the cryosphere are melting at alarming rates. The impact of these changes - altered regional climate patterns, rising sea levels, and catastrophic slope collapses from thawing permafrost, among others - are putting heritage resources at risk, requiring urgent action from archaeologists and other heritage specialists. By sharing their experiences at conferences like Frozen Pasts, archaeologists and other researchers are cataloguing these impacts while working to define a new sub-discipline: archaeology of the terrestrial cryosphere. It is in this spirit that we present this special supplement of the journal *Arctic*, which brings together 12 articles in the emerging field of alpine ice patch archaeology from North America and Europe."

Comment: This paper explains subjects discussed in a conference called Frozen Pasts where ice melt is revealing hidden archaeological sites and new information. Melting of the ice at alarming rates creates risks for heritage resources. (ML)

Andrews, Thomas D., et al. "Permafrost Thaw and Aboriginal Cultural Landscapes in the Gwich'in Region, Canada." **APT Bulletin: Special Issue on Climate Change and Preservation Technology** 47.1 (2016): 15-22. <http://www.gwichin.ca/publications/permafrost-thaw-and-aboriginal-cultural-landscapes-gwich%E2%80%99-region-canada>

Keywords: Rising sea levels; ethno-archaeology; risk management; coastal erosion; melting permafrost; Gwich'in cultural landscape; NWT (Canada)

Abstract: "Throughout the Western Arctic, the thawing of ice-rich permafrost is leading to significant thermokarst landscape disturbance, which is in turn impacting cultural resources. Assessment and monitoring of the extent of impacts to cultural resources from climate change-induced landscape erosion is hampered by the vast and remote geography of the Northwest Territories, yet heritage managers are in need of a way to identify areas where the risks from these processes are greatest. In this paper we describe the integration of traditional land use data and information on retrogressive thaw

slump density to create a GIS-based heritage risk assessment for the Gwich'in cultural landscape in northwest Canada. Our results indicate that the greatest risk to Gwich'in cultural resources from thaw slumping occurs along the Peel Plateau, while areas adjacent to the Mackenzie River and Delta appear to be at lower risk of impact from this process. It is hoped that the risk map can be used to assist in prioritizing management actions for climate change impacts to cultural resources in this area."

Comment: Rich archaeological and cultural landscapes are at risk from permafrost melting in the summer months in Northwest Territories of Canada because significant sediment is released into water bodies. Traditional subsistence activities overlap cultural and archaeological records and to monitor risk a study using two databases using the Dene Mapping Project, ArcGIS, and polygon grids was used to analyze potential threat. This study serves as an example of a cost effective way to assess risk by layering information on maps to prioritize risk. (ML)

B

Barr, Susan. "The Effects of Climate Change on Cultural Heritage in the Polar Regions," in *Heritage at Risk 2006-2007*, edited by Michael Petzet and John Ziesemer, Paris: ICOMOS, 2008. 203-205.
http://www.icomos.org/risk/world_report/2006-2007/pdf/H@R_2006-2007_53_Special_Focus_Effects_GCC_Polar.pdf

Keywords: Climate change; cultural heritage; livelihood changes; native populations; Arctic region

Summary: "It is a now-documented fact that the changes to the climate in the Arctic are more rapid and deeper than in most other regions of the world. Several large international research programmes address the complexity and have already presented results that show serious implications. For example, the project "International Study of Arctic Change" (ISAC) takes as its starting point changes that already affect the lives of native populations and others who live in the circumArctic, including changes in fishery patterns, in vegetation growth and in shipping and transport (<http://www.aosb.org/isac.html>)."

Comment: Changes in temperature in the Arctic region are affecting how resources are preserved in the permafrost layer. The article expresses the risks to archeological resources that can be lost because the natural preservation method may disappear leaving them exposed to deterioration. With warmer temperatures tourism makes its way furthering the risk to exposed sites. (ML)

Beagan, Chris, and Susan Dolan. "Integrating Components of Resilient Systems into Cultural

Landscape Management Practices." *Change Over Time* 5.2 (2015): 180-99.

Keywords: Cultural landscapes; preservation management; resilient systems; National Parks; USA

Abstract: Cultural landscape managers are seeking to enhance the ability of landscapes to endure stressors, disturbances, and environmental change. The components of resilient systems—diversity, redundancy, network connectivity, modularity, and adaptability—are valuable tools to examine current landscape vulnerability and to attempt to minimize climate change impacts. These components are derived from the Federal Emergency Management Agency's "National Incident Management System" and were recently included in the United States Department of Housing and Urban Development's Rebuild by Design competition brief. This article discusses the resiliency components and provides examples from cultural landscapes in national parks across the country. It is intended to stimulate thought about sustainable practices and the ways in which cultural landscapes can be managed through preservation maintenance or rehabilitation treatment for greater resilience to the effects of changing climates.

Comment: This article has information on ways to mitigate risk to cultural landscapes through changes in maintenance techniques, and creating resilient systems. The resilient systems the authors explain are: diversity, redundancy, network connectivity, modularity, and adaptability. The authors explain their belief in the importance of the connection between cultural and ecological systems and the need to consider both when managing a cultural landscape. They recommend a revision of National Park Service (NPS) guidelines and treatments to consider resilience in planning and management since they did not consider climate change when they were written. (ML)

Berenfeld, Michelle L. "Climate change and cultural heritage: local evidence, global responses." *The George Wright Forum* 25.2 (2008): 66-82.
<http://www.georgewright.org/252berenfeld.pdf>

Keywords: Sustainability; preservation; nature conservation; adaptation; mitigation; triage

Abstract: "Recognizing the urgent threats to both natural and cultural resources posed by global climate change, the World Monuments Fund (WMF) organized a panel discussion at the 2007 George Wright Society Conference that gathered professionals in the fields of historic preservation, nature conservation, and green building and asked them to examine how these disciplines could collaborate to develop strategies both for adapting to those impacts and mitigating those threats by sustaining built and natural environments."

Comment: Evidence of the effects of climate change already affecting cultural heritage are found on the World Heritage Watch list. The essay reviews different conditions from melting ice, desert sand storms, flash flooding, and soil erosion due to extreme wet and dry periods that cause damage to heritage sites. The authors suggest preparing early triage consensus among preservationists for which sites to save and which sites to let go. (ML)

Berenfeld, Michelle L. "Planning for Permanent Emergency: "Triage" as a strategy for Managing Cultural Resources threatened by Climate Change." *George Wright Forum* 32.1 (2015): 5-12.
ISSN: 07324715 <http://www.georgewright.org/321berenfeld.pdf>

Keywords: Emergency planning; sea level rise; climate change; park management; triage; cultural resource management; planning; national parks; USA

Summary: "One hundred years from now, the world will look very different. The changes humans have made to the planet in the nearly 100 years since the establishment of the NPS will seem minor in comparison to the changes to come. By the time the next NPS Centennial Essay series appears, the Earth will be 2-4 degrees Celsius (4-11 degrees Fahrenheit) warmer, with some 0.25m higher sea levels, fewer plant and animal species, and perhaps two billion more human beings. The centennial of America's "best idea" is as good a time as any to think seriously about what the parks will look like at their next centennial and what we can do now to assure they have one."

Comment: This essay adds perspective to existing management practices by the National Park Service and comments on the need to review those practices in view of climate change. The next one hundred years present challenges to the parks and a triage strategy is suggested for cultural heritage because funds should be allocated efficiently in view of the difficult decisions that need to be made when not all resources can be saved. (ML)

Brimblecombe, Peter. "Refining climate change threats to heritage." *Journal of the Institute of Conservation*, 37.2 (2014): 85-93.
DOI:10.1080/19455224.2014.916226
<http://www.tandfonline.com/doi/pdf/10.1080/19455224.2014.916226>

Keywords: Future English climate; salt weathering; mould growth; rainfall; humidity; insect damage; UK

Abstract: "A changing climate places shifting risks on heritage. Future English climate can be difficult to interpret and the outcomes may be probabilistic and subtle. In spite of this it can be tempting to reduce our future to one that is warmer or wetter or windier.

There is some truth to such a future, but particularly in the case of water-related variables the changes are likely to be complex. In terms of total rainfall and average relative humidity the English climate is likely to become drier. We have to think more in terms of the heritage climate; the particular variables likely to threaten heritage. Meteorological parameters affect heritage in different ways. Heavier rainfall is likely to affect drainage, while an increasing humidity range may be important for salt damage. Yet in the case of fungal attack on outdoor wood it might well be that temperature could be a more important variable than precipitation. This article calls for a careful consideration of the observed change in heritage damage and the climate factors to which this is attributed."

Comment: This article uses meteorological data and climate projections to understand the increase in dampness in England that will affect historic resources by their damaging effects. Specific analysis was studied to understand trends since oversimplification of the problem in the author's view can lead to misinformation and misdiagnosis. In order to manage material conservation properly, in their opinion, scientific data needs to be accurate for these purposes. (ML)

Brimblecombe, Peter and Caroline Brimblecombe.
"Climate change and Non-mechanically Ventilated Interiors." *APT Bulletin: Special Issue on Climate Change and Preservation Technology* 47.1 (2016): 31-39.

Keywords: Climate change; historic building interiors; museums; materials; England; Europe

Summary: This article is featured in the *APT Bulletin* Special Issue on Climate Change and Preservation Technology and addresses the potential impacts of climate change on the interiors and collections in European historic building museums, where non-ventilated interiors are common. The authors describe the anticipated affects of higher temperatures, increased rain events, and changes in humidity specifically on historic building fabric, displays, and visitor behavior. Relevant research at the Knole Cartoon Gallery in Kent (England) is cited. The authors suggest that long-term resiliency and management plans, incorporating cost-benefit analyses and stakeholder engagement, are essential to cultural heritage protection from climate change impacts.

Comment: The article provides unique insight into the affects of temperature, rainfall, and humidity changes on the interiors of historic properties in a temperate region. Although the impacts are not as severe on interiors, historic property managers would find the description of potential deterioration of building materials and open-air displays valuable as plans to minimize future damage are considered. The

type of scientific data available that relates to local conditions is introduced to guide historic property managers in developing resiliency plans. (AH)

C

Caffrey, Maria and Rebecca Beavers. "Protecting Cultural Resources in Coastal U.S. National Parks," *The George Wright Forum*, 25.2 (2008): 86-97.
<http://www.georgewright.org/252caffrey.pdf>

Keywords: National Parks; cultural resources; climate change; management; USA

Summary: "The U.S. National Park Service manages over 84 million acres of land on which are located around 26,000 historic structures. One hundred fifty areas under Park Service management are designated as "cultural landscapes." The impact of climate change on cultural resources will challenge many resource managers, in particular those responsible for protecting America's heritage in national parks. Rising sea level and projected increases in average annual temperatures will undoubtedly impact many parks' natural resources, which have led some to ask, "What is being done to protect cultural resources from climate change?" This paper will discuss what steps have already been taken to uphold the Park Service's mission to "preserve unimpaired the natural and cultural resources and values of the national park system." In particular, we discuss how cultural resources are being impacted by observed changes in climate and discuss how we expect cultural resources to be affected over the next century, based on projections by the Intergovernmental Panel on Climate Change (IPCC)."

Comment: The article begins with a literature review of National Park Service, UNESCO and other authors on the subject of climate change and cultural resources. Then it compares National Park Service resources and World Heritage sites that have already been affected by climate change and warns about future losses that can occur if not managed timely. The authors warn that national parks need to be managed properly taking into account the threats of climate change before catastrophic events happen. (ML)

Caffrey, Maria and Rebecca Beavers. "Planning for the Impact of sea-level rise on U.S. national parks" *Park Science* 30.1 (Summer 2013): 6- 13.
[http://www.nature.nps.gov/parkscience/Archive/PDF/Article_PDFs/ParkScience30\(1\)Summer2013_6-13_CaffreyBeavers_3647.pdf](http://www.nature.nps.gov/parkscience/Archive/PDF/Article_PDFs/ParkScience30(1)Summer2013_6-13_CaffreyBeavers_3647.pdf)

Keywords: Sea level rise; eustasy; glacial melting; isostasy; storm surge; thermal expansion; disaster planning; USA

Abstract: "Rising sea levels present a challenge for National Park System managers over the next century as they incorporate the latest sea-level rise information, including regional parameters when available, into individual park management plans. Rates of sea-level change vary throughout the National Park System, so the National Park Service (NPS) cannot define a single rate applicable to all parks. This complicates park planning and requires interpretation of research and modeling results. In this article we discuss many of the latest developments in sea-level rise research, including the drivers of sea-level change, global sea-level projections for this century, and what these mean for park managers. We also explain why tide gauge data in some regions have recorded decreasing mean sea levels and why potential storm surge should be included in planning."

Comment: This article analyses available sea rise data and how it pertains to the US national parks specifically. Since the vast majority of the coastal parks have experienced sea level rise the NPS is closely monitoring the National Oceanic and Atmospheric Administration's tide gauges to make the best planning assessments for storm surge. Recent natural disasters prompted the creation of a rapid review team to establish priorities for natural and cultural resources recovery and reconstruction efforts. (ML)

Cassar, May. *Climate Change and the Historic Environment*. London, UK: University College London, Centre for Sustainable Heritage, 2005. 98 p. <http://eprints.ucl.ac.uk/2082/1/2082.pdf>

Keywords: Climate change; coastal resources historic environment; adaptation strategies; England

Abstract: "In 2002, the Centre for Sustainable Heritage was commissioned by English Heritage to carry out a scoping study on climate change and the historic environment, including buried archaeology, historic buildings, parks and gardens (Archaeology Commissions PNUM 3167). The start of the study coincided with the publication of the current UKCIP02 climate change scenarios. The final report has been prepared by Professor May Cassar, while the original research was carried out by Dr. Robyn Pender. (...) It is intended that this report will make a contribution to the debate on the impact of climate change on the historic environment. Its recommendations and the gaps in information and research that it has identified should be the focus of discussion and timely resolution."

Comment: This study was commissioned by English Heritage to study the climate change impacts specific to the English coast and the effects on historic resources. (AH) The report describes the climate change research used in the study, determination of heritage susceptibility to climate change and policy implications. Other chapters

illustrate maps of vulnerability to climate change, and the gaps of information and research needed for future planning. Key recommendations for preservation planning and policy include: leadership, management, adaptation strategies, agency participation, integrated information system, and emergency preparedness. (ML)

Cassar, May. "Impact of Climate Change on Cultural Heritage: From International Policy to Action," *Conservation Perspectives, the GCI Newsletter, Heritage & Sustainability Issue*, 26.1 (2011): 10-11.
http://www.getty.edu/conservation/publications_resources/newsletters/26_1/impact.html

Keywords: Climate change; cultural heritage; adaptation

Summary: "Recent international policy initiatives by the UNESCO World Heritage Centre and the Council of Europe on the impact of climate change on cultural heritage have shown that while it is possible to identify individual climate parameters and the associated risks, the issues cannot be considered in isolation. Cultural heritage exists among people and communities—and because it is linked to social interactions and to ideas of cultural identity and cohesion, it is not possible, in response to climate change, to separate the physical, cultural, and social dimensions of cultural heritage. A multidimensional understanding of the impact of climate change on cultural heritage is required, and decisions on the actions necessary to mitigate the effects—and to adapt to climate change—depend on the input of disciplines that include the arts and humanities and the social sciences, as well as science, technology, and engineering."

Comment: This short article by May Cassar from the UCL Institute for Sustainable Heritage is a call for more research in order to understand the risks of climate change to cultural heritage to generate solutions that will work for each. The author reviews past initiatives and calls for more research, professional training, creation of policy, public involvement and collaboration. The article mentions and links organization's websites that have initiatives in relation to these topics. (ML)

Colette, Augustin. *Case Studies on Climate Change and World Heritage*. UNESCO, 2007, 82p.
<http://whc.unesco.org/en/activities/473>

Keywords: Climate change; World Heritage sites; cultural heritage; archaeological sites; historic sites; biodiversity

Summary: "Originally published in 2007 in English, this publication has now been reprinted for the third time in English and translated into French, Spanish and Arabic. It presents twenty-six case studies from

selected natural and cultural World Heritage sites in order to illustrate the impacts of climate change that have already been observed, and those that can be expected in the future. This is a foundation publication for the study of the effects of climate change that can be useful to experts as well as the general public."

Comment: This is a collection of case studies in twenty-six locations that present evidence of how climate change is affecting resources in World Heritage sites and how it can affect others in the future. The case studies are classified into five types of natural and cultural heritage themes: glaciers, marine and terrestrial biodiversity, archaeological sites, historic cities and settlements. Some of the sample sites provide adaptation measures that are reviewed in the text. (ML)

Crew, Rebecca. "Tree Preservation and the Cultural Effects of Climate Change." In Longstreth, Richard, ed. *Sustainability & Historic Preservation, Towards a Holistic View*. Lanham, Maryland: University of Delaware Press, 2011, 43-56.

Keywords: Sustainability; climate change; architecture landscape; historic preservation; USA

Summary: *Note that this is the summary of the entire book, however the review is of one chapter. (SR)* "Sustainability and Historic Preservation: Towards a Holistic View broadens the horizons of the mushrooming drive to correlate the objectives of these two spheres. To date, discussions of the relationship between historic preservation and sustainability have generally focused on the energy consumption of buildings. The nine chapters in this book show how that agenda can and should be expanded by examining many other facets of the environment, including agricultural lands, urban waterworks, irrigation systems, natural settings, an arboretum, and post-World War II suburbs. Written by specialists from a variety of disciplines—anthropology, architecture, landscape architecture, and urban history among them—the contents explore new realms in which historic preservation and sustainability can have common purpose. This book addresses subjects of concern to many persons engaged in both fields and argues the case for creating a greater spectrum of common ground between them."

Comment: The author in the book chapter makes a case for how US landscapes will change with global warming because as the different regions warm the current vegetation will no longer be there. She recommends preservationists to record the existing heritage landscape because it may disappear within our lifetime. She reviews survey forms pertaining to the National Register of Historic Places documentation for landscapes, which are

fundamental for defining the character of the resources setting. (ML)

Curran, Benjamin, Michael Routhier and Gopal Mulukutla. "Seal-Level Rise Vulnerability Assessment of Coastal Resources in New Hampshire." *APT Bulletin: Special Issue on Climate Change and Preservation Technology* 47.1 (2016): 23-30.
<http://www.apti.org/clientuploads/publications/2016/47.1Curran%20Sample%20Article%20APT%20Website.pdf>

Keywords: Rising sea levels; risk management; mapping; environmental monitoring; built heritage; New Hampshire (USA)

Summary: "As the impacts of sea-level rise increase for coastal communities, so too will the toll on the built heritage that has come to distinguish them. Fluctuations and drastic shifts in temperature, rainfall, mean global sea-level, and the frequency and severity of storms will have adverse impacts on the natural and built landscapes that define coastal cultures. Collectively, these factors will have catastrophic effects on the connectivity of many populations to their natural and cultural environments. Additionally, these factors will adversely affect the stability of the historic structures that define the flow, pace, and timbre of coastal communities. A grant from the Waitt Foundation and the National Geographic Society in 2010 enabled the beginning of a process to connect place-specific field research on climate change to culturally sensitive areas and the historic structures that will be directly impacted by climate change and sea-level rise."

Comment: This paper focuses on the Strawberry Banke Museum, located in a historic district in Portsmouth, New Hampshire, that sits in a low coastal area vulnerable to sea level rise. Soil tests, ground survey and LIDAR data elevations helped to create a sea level rise inundation map to estimate the extent of the sites' vulnerability to more humid conditions than normal. The exhaustive analysis helps to understand the range of issues historic buildings and other resources can experience in the future to better plan for their preservation. (ML)

Curtis, Roger. "Water Management for Traditional Buildings: Adaptation for a Changing Climate." *APT Bulletin: Special Issue on Climate Change and Preservation Technology* 47.1 (2016): 8-14.

Keywords: Climate change; adapting historic buildings; effects of increased precipitation and wind-driven rain; adapting traditional buildings; materials durability; Scotland

Summary: One of six articles in the *APT Bulletin* Special Issue on Climate Change and Preservation Technology, this paper considers "the changing

climate and its effects on traditional fabric and will examine some examples of details used in traditional buildings and how they have enhanced durability. It will also consider what will need to be done to manage increased levels of precipitation, and examples of detailing and interventions will be described. While these examples are all based in Scotland, the principles will apply to a range of historic, traditional, and vernacular structures in many areas with the maritime climate of the North Atlantic periphery."

Comment: Informative article on how to cope with the effects of increased precipitation on traditional masonry and timber buildings. The article addresses the need for traditional materials to breathe and how the removal of modern materials and restoration of the traditional building fabric and construction detailing can protect buildings and allow saturated buildings to dry. Methods for managing change through adaptation to traditional buildings are also discussed as the use of appropriate materials may not provide sufficient protection against climatic changes. The techniques in the article are transferable to a variety of similar building types in similar climates. (JS)

D

Daly, Caithleen. "World Heritage in a Changing Climate; the Potential for a Global Laboratory." *Proceedings of the Japanese-German Colloquium World Heritage for Tomorrow: What, How and For Whom?* BTU Cottbus, Germany, 17-20 February 2010. N.p.
<http://arrow.dit.ie/cgi/viewcontent.cgi?article=1033&context=beschrecon>

Keywords: Climate change; World Heritage; monitoring; vulnerability; conservation; public awareness; Ireland

Abstract: "This paper presents ongoing research, partly undertaken on behalf of ICOMOS Ireland's Sub-Committee on Climate Change and the Department of Environment Heritage and Local Government, into the effects of climate change on World Heritage (and proposed World Heritage) in Ireland. World Heritage sites in Ireland have been key to the formation of a cutting edge climate change-monitoring project. The outlined monitoring scheme should form a legacy for the future, producing quantifiable data over the coming century, vital in the assessment of climate change impacts on cultural heritage. In turn this will enable the development of appropriate and sustainable management practices in terms of climate change impact mitigation and adaptation at sites."

Comment: Example of possible methods for monitoring the long term impact of climate change of on World Heritage or other heritage sites; monitoring

systems adapted to different factors of vulnerability are considered useful for conservation in general; demonstrates an expanded role for World Heritage in developing understanding of climate change across the globe; suggests integrating climate change monitoring in site information available to the public. This is a brief conference paper, but the author is also writing a PhD on the subject and has contributed to government reports. (SR)

E

Englander, John, et al. "High Water and High Stakes: Cultural Resources and Climate Change." *National Trust Forum Journal*, 29.4 (2015): 3-66.

Keywords: Climate change; sea level rise; cultural resources; national trust for historic; preservation; costs of mitigation; practical solutions; webinars

Summary: "The Summer issue of *Forum Journal* puts climate change and cultural resources in context, and are intended to spur additional discussion and action. Contributors examine the current and future costs of mitigation while illustrating real and practical solutions on the ground in the historic communities across the country. Enhanced content in this issue include a webinar and three interactive maps that allow you to see how heritage resources will be affected by coastal flooding."

Comment: The special issue includes seven popular or introductory articles by various authors and several video links. Selected articles are included as separate items in the literature review. The lead article by Englander presents the basic concepts and definitions of climate change and sea level rise. It explains geologic and climate history to help the reader understand current changes in the climate. And finally the author suggests what these changes will mean for the protection of cultural resources going forward. (SR)

English Heritage (Historic England). *Climate Change and the Historic Environment*. London: English Heritage, 2011, 15p. Accessed April 9, 2016. <https://content.historicengland.org.uk/images-books/publications/climate-change-and-the-historic-environment/climate-change.pdf/>

Keywords: Climate change; historic environment; United Kingdom; policy; guidance; research; UK

Summary: "Climate change is one of the most important and urgent problems facing us today. Without action to reduce greenhouse gas emissions, the direct impacts of a changing climate will have major adverse effects on society, the economy and the environment, including our cultural heritage. The wide-ranging actions required to limit further damaging emissions, combined with the need to adapt historic assets to make them more resilient to a changing climate, will also have significant

implications for the historic environment. English Heritage is the Government's adviser on the historic environment. Our responsibilities include the understanding and conservation of archaeology on land and under water; historic buildings, sites and areas; designed landscapes and the historic aspects of the wider landscape. We also manage an estate of more than 400 historic properties. This statement, which updates and replaces our 2006 position paper, sets out our current thinking on the implications of climate change for the historic environment. It is intended both for the heritage sector and also for those involved in the wider scientific and technical aspects of climate change; in the development of strategies and plans relating to climate change impacts; or in projects relating to risk assessment, adaptation and mitigation."

Comment: This is a useful and succinct overview of the UK government's understanding of the impact of climate change on its historic environment. It identifies related areas of policy, types of technical advice and research that are required, and provides a related reference list. A note at the front of this document updates the policy context and change of name from English Heritage to Historic England. (SR)

English Heritage (Historic England), 2010 (2015). *Flooding and Historic Buildings – Advice Note*. 2nd Edition. Accessed April 9, 2016. <https://content.historicengland.org.uk/images-books/publications/flooding-and-historic-buildings-2ednrev/heag017-flooding-and-historic-buildings.pdf/>

Keywords: Flooding; historic buildings; mitigation; clean up; UK

Summary: "We know that the risk of flooding is likely to increase due to a changing climate and the effects of increased urban development. Estimates suggest the number of people at high risk from flooding could rise from 1.5m to 3.5m by 2080. Currently around 400,000 homes and 75,000 businesses in England are located in areas where there is a significant annual chance of river or coastal flooding. Further properties are at risk from surface water or sewer flooding. Many of these buildings will be of historic importance. This guidance is designed to assist those who live in, own or manage historic buildings that together with their historic fixtures and fittings are threatened by periodic flooding. Advice is provided on preventative measures to minimise flood damage as well as on the inspection, conservation and repair of historic buildings after flooding."

Comment: Second edition of 2015 updates a 2010 document. This is a very practical, introductory level and yet detailed explanation of the types of floods, temporary and permanent means of protection against flood damage and cleaning up after flooding for small historic buildings and property owners. It includes a useful glossary and explanations of

responsibilities. Although it is for England/UK it is a model of an approach to providing accessible technical advice. (SR)

English Heritage. ***Coastal Defence and the Historic Environment, Technical Advice Note***. 2003.

NB. The PDF is no longer officially available on Historic England (English Heritage). See note in comments below. As of April 9, 2016, this website has a copy:
http://www.aldeandore.org/myfiles/19_Coastal_Defence.pdf

Keywords: Sea level rise; shoreline protection/management; archaeology; case studies; UK

Summary: “In recent years Government has increasingly adopted a more strategic, long-term and sustainable approach to flood and coastal defence, which seeks to embrace all aspects of the environment, including historic remains. This document: provides advice on the implications of coastal and flood defence for the historic environment to those involved in coastal planning and coastal defence and to local authority historic environment officers; sets out how the protection of historic remains can be fully integrated within the shoreline management planning process; and considers in detail the implications for the historic environment of the increasing number of managed realignment schemes likely to arise from a more sustainable coastal defence policy and provides guidance on appropriate responses.”

Comment: One of a series of English Heritage publications that provide background on climate change and its impacts. This one provides advice on the implications of coastal and flood defence for the historic environment to those involved in coastal planning and coastal defence. Detailed information on the effects of flooding on historic buildings and adaptation strategies is discussed. (AH) NB. From the Historic England (formerly English Heritage) website: “This guidance is no longer available/is being revised in response to the Government’s 2005 publication Taking forward a new Government strategy for flood and coastal erosion risk management.” (SR).

Eyring, Shaun and Goeken, Brian, guest editors.

“Cultural Resource Management and Planning for the Impacts of Climate Change.” ***The George Wright Forum*** 32.1 (2015): 35-88.
<http://www.georgewright.org/node/11164>

Keywords: Climate change; cultural resource management; national parks; cultural landscapes; interpretation; triage; decision frameworks; USA

Summary: “Across the National Park System, from War in the Pacific National Historical Park in Guam and American Memorial Park in Saipan to the

National Mall in Washington, DC, from Sitka National Historical Park in Alaska to Death Valley National Park in California and Nevada, from Saint-Gaudens National Historic Site in New Hampshire to Everglades and Dry Tortugas national parks in Florida, we are seeing the effects of climate change on the natural and cultural resources we are charged with protecting. The threats—melting permafrost, retreating glaciers, increasing intensity of storm surges, rising sea levels, changes in precipitation patterns, migrating pests—are as diverse as the resources we manage. These impacts are also being felt in communities across the nation, posing threats to the natural and cultural resources that represent the fabric of these special places and our shared heritage. Whether inside our parks, or beyond them in the cities, towns, and rural areas that the National Park Service also serves through a variety of programs, we face common challenges of planning for the preservation of the country’s heritage resources.” NB. Taken from the foreword by Stephanie Toothman. (SR)

Comment: Special issue on climate change of the *The George Wright Forum*. Although listed under Eyring and Goeken, there is no lead article by the editors, - the foreword is by Stephanie Toothman. See the articles by Michelle L. Berenfeld, Bob Page, and Robert Melnick et al, included in this list. (SR)

F

Federal Emergency Management Agency (FEMA).

“Integrating Historic Property and Cultural Resource Considerations into Hazard Mitigation Planning.” ***State and Local Mitigation Planning How-to Guide, FEMA 386-6***, May 2005. 202p.
https://www.fema.gov/pdf/fima/386-6_Book.pdf

Keywords: FEMA; hazard mitigation/disaster planning; historic properties; cultural resources; communities; USA

Summary: The importance of integrating historic property and cultural resource considerations into mitigation planning has been made all too apparent in disasters that have occurred in recent disasters, such as the Northridge Earthquake, the Midwest floods, and Hurricane Katrina. Whether a disaster impacts a major community museum, a historic “main street,” or collections of family photographs, the sudden loss of historic properties and cultural resources can negatively impact a community’s character and economy, and can affect the overall ability of the community to recover from a disaster. “How-To” Guide #6 (FEMA 386-6) shows communities, step by step with the needed tools and resources, how to develop and then implement a pre-disaster planning strategy for historic properties and cultural resources. While the emphasis is on the built environment, this Guide includes cultural institutions to address the

mitigation of cultural heritage, including museum collections, works of art, and books and documents.

Comment: Addressed to communities and professionals, this is a step-by-step approach to four phases of hazard mitigation planning (organizing resources, assessing risk, developing the plan, and implementing and monitoring the plan), in very clear language, with illustrated examples, worksheets, checklist and a glossary of keywords throughout.

Ferguson-Bohnee, Patty. "The Impacts of Coastal Erosion on Tribal Cultural Heritage Preservation." *National Trust Forum Journal* 29.4 (2015): 58-66.

Keywords: Sea level rise; Pointe-au-Chien Indians; climate change; cultural heritage; National Historic Preservation Act; National Register of Historic Places; State of Louisiana; Gulf Coast (USA)

Abstract: "This article discusses how rising sea levels are affecting the Pointe-au-Chien Indian Community in Louisiana. The author explains how their traditional tribal lands are now underwater and what this means for the tribe's way of life and its cultural heritage. The author is a Pointe-au-Chien Indian Tribal Member. She is faculty director of Indian Legal Program and director of the Indian Legal Clinic at the Sandra Day O'Connor College of Law."

Comment: A case study in understanding the impact of the changing environment over time to the cultural heritage of the Pointe-au-Chien community. This includes both recent sea level rise related disasters and longer-term floodplain management strategies that favoured protection of urban communities over the indigenous inhabitants of the wetlands. In the context of a tribe that is not recognized at the federal level, the article is as much about making a case for the recognition of their heritage and this is related to the UN Declaration on the Rights of Indigenous Peoples. (SR)

G

Glassberg, David. "Place, Memory, and Climate Change". *The Public Historian* 36.3 (2014): 17-30. DOI: 10.1525/tpb.2014.36.3.17.

Keywords: Public history; anthropogenic climate change; understanding change; social resilience

Abstract: "Scientists warn about the difficulty of predicting ecological relationships as climate conditions for many places begin to move well outside their historical range of variability. In recent years, ecologists have identified "no-analog" communities, associations of species in the past that arose because of novel climate conditions not found at present. They have suggested that the planet is heading toward a similar period of disappearing

climates and "ecological surprises." What role, if any, can history play as Americans enter that new world?"

Comment: Part of a special theme issue on the environment and sustainability of *The Public Historian* journal. This is the one article in the issue that is focused more on climate change (the others are more about sustainability or the environment more generally). It is concerned with positioning the possible roles of history and historians in providing critical perspectives on human adaptation to changes to environments and climate over time, such as the concept of "climate injustice." Instructive historic narratives may include ones about the collapse of societies, the tragedy of the commons, or stories of resilience. The article is also an update on thinking in environmental history (a separate area from public history) where climate history has developed into a whole sub-category. (SR)

H

Hall, Michael, and Yael Ram. "Heritage in the Intergovernmental Panel on Climate Change Assessment Reports: A Lexical Assessment (Research Notes)." *Journal of Heritage Tourism* 11.1 (2016): 96-104. DOI: 10.1080/1743873X.2015.1082572

Keywords: IPCC; content; heritage; tourism; indigenous heritage

Abstract: "A lexical analysis is conducted of the five Intergovernmental Panel on Climate Change (IPCC) assessments reports undertaken between 1990 and 2014. The analysis indicates that the term heritage is little used in the reports, although it has become more widely used over time in different chapters. In contrast, reference to indigenous culture and heritage has greatly increased. The implications are discussed especially for the way in which the IPCC frames culture and heritage. Implications for research communication are briefly discussed."

Comment: This study provides a useful overview of the purpose of the many IPCC reports and their focus. However the discussion of heritage, heritage tourism and indigenous heritage is limited to tracking the use of these terms. There is not per say much discussion of the role of climate change in heritage or vice versa. (SR)

Hall, Michael. "Heritage, Heritage Tourism and Climate Change." *Journal of Heritage Tourism* 11.1 (2016): 1-9. DOI: 10.1080/1743873X.2015.1082576.

Keywords: Heritage tourism; climate change; cultural heritage; natural heritage; emissions; IPCC

Abstract: "Climate change is increasingly recognised as a major threat to the sustainability of tourism,

including heritage tourism. Yet, despite growth in literature on climate change and heritage, there is little specific literature on the relationship between climate change and heritage tourism. The paper introduces a special issue on heritage tourism and climate change. It briefly outlines the future challenges of climate change before commenting on tourism's role in climate change and the challenge of reducing greenhouse gas emissions. Using UNWTO tourism estimates, a tentative figure of half of all emissions of tourism could be ascribed to heritage-related tourism.”

Comments: Introductory article to a special climate change theme issue of the *Journal of Heritage Tourism*. See also article by Hall et al in same issue. The focus of this particular article is more on climate change and tourism more broadly, however the journal's focus is on heritage tourism, and the relationship between heritage and climate change is also addressed. (SR)

Harvey, David and Jim Perry. ***The Future of Heritage as Climates Change: Loss, Adaptation and Creativity***. London: Routledge, 2015.
<https://www.routledge.com/products/9781138781832>, 306 pages. (Print)

Keywords: Climate change; natural and cultural heritage; historic environments; case studies; adaptation; resilience; creativity; materials

Abstract: “Climate change is a critical issue for heritage studies. Sites, objects and ways of life all are coming under threat, requiring alternative management, or requiring specific climate change adaptation. Heritage is key to interpreting the societal significance of climate change; notions (and images) of the past are crucial to our understanding of the present, and are used to prompt actions that help society define and achieve a specific and desired future. Relatively little attention has been paid to the critical intersections between heritage and climate change. *The Future of Heritage as Climates Change* frames the intellectual context within which heritage and climate change can be examined, presenting cases and sub-fields in which the heritage-climate change nexus is being examined and provides synthetic analyses through five overarching themes: The heritage of change among coastal communities: Liminality and the politics of engagement; Dwelling materials: processes and possibilities; Environmental heritage: meanings of the past – prospects for the future; Blurring the boundaries of nature and culture: the politics of anticipation; Climate change and heritage practice: adaptation and resilience. *The Future of Heritage as Climates Change* provides scholars, managers, policy makers and students with a much-needed examination of heritage and climate change to help make critical decisions in the next several decades.”

Comment: As a volume in the Routledge Key Issues in Cultural Heritage series, this edited collection fits more within critical heritage studies than heritage conservation, asking fundamental questions about what heritage is, why it matters, and who decides. The contents represent sixteen widely divergent views on the relationship of heritage to climate change, in multiple disciplinary contexts and across all continents, with reference to the full spectrum of natural and cultural heritage. Organized in two parts, a first part looks more at how climate change and heritage interact conceptually to contribute to ongoing ontological questions, while the second part provides more concrete examples of the processes and policies that are possible responses to change. A key idea in this book is that climate change is not necessarily a problem for heritage, as much as how we think about it. Without denying possible negative impacts, it also calls on those active in heritage to consider how to see adaptation and loss more creatively. Fortunately the theoretical framework of the book editors is not dogmatically represented within the examples, which provide a range of approaches, methodologies and orientations towards managing as well as understanding change. It would make a great book for a seminar. (SR)

Heritage Council and Fáilte Ireland, ***Climate Change, Heritage and Tourism, Implications for Ireland's Coast and Inland Waterways***, 2009. 126p.
http://www.heritagecouncil.ie/fileadmin/user_upload/Publications/Marine/CliamteReportWeb_version_june_09FINAL.pdf

Keywords: Climate change; natural and built heritage; tourism; recommendations; Ireland

Summary: “In the context of ever-growing concern in relation to climate change, the Heritage Council and Fáilte Ireland commissioned a review on the research carried out elsewhere to date in relation to the potential impacts of climate change on Ireland's maritime and inland waterways heritage, with a particular focus on those resources upon which tourism is dependent. The focus on these two elements of heritage is because of their particular vulnerability to climate change. The purpose of this report is to inform Heritage Council and Fáilte Ireland recommendations to Government for priorities for action or further research in this area, and also to inform Heritage Council and Fáilte Ireland plans and strategies in the future. Climate change presents a significant and imminent threat to the heritage of our coasts and inland waterways, to the ways of life which co-exist with these environments, and to our well being.”

Comment: This report, with its literature review started in 2007, was a first look at climate change and both natural and cultural heritage for Ireland, with a particular focus on coasts and waterways, and

related tourism. It provided a summary of known expected climate impacts specific to Ireland, and then for the heritage questions mainly reported to broader European Initiatives (Noah's Ark, ICOMOS) to make recommendations for the Irish context. Good example of an initial national level response. (SR)

Heyd, Thomas and Nick Brooks. "Exploring cultural dimensions of adaptation to climate change." In W. Neil Adger, et al, editors. **Adapting to Climate Change: Thresholds, Values, Governance**, Cambridge, UK: Cambridge University Press, 2009, 269-282. http://www.garama.co.uk/wp-content/uploads/2013/06/Heyd-Brooks_cultural.pdf

Keywords: Climate change; adaptation; governance; natural/cultural agency; sentient landscapes

Abstract: "Adapting to climate change is one of the most challenging problems facing humanity. The time for adaptation action to ongoing and future climate change is now upon us. Living with climate change involves reconsidering our lifestyles and goals for the future, which are linked to our actions as individuals, societies and governments worldwide. This book presents the latest science and social science research on how and whether the world can adapt to climate change. Written by some of the world's leading experts, both academics and practitioners, on governance, ecosystem services and human interactions, the book examines the nature of the risks to ecosystems and the thresholds of change. It demonstrates how values, culture and the constraining forces of governance can act as significant barriers and limits to action. Adaptation will not be costless, indeed it will be painful for many. As both an extensive state-of-the-art review of science and as a holistic assessment of adaptation options, this book is essential reading for all those concerned with responses to climate change, specially researchers, policy-makers, practitioners and graduate students." NB. The abstract above is for the entire book, but only one chapter is included in the bibliography (SR).

Comment: A more anthropological consideration of the possibilities of human adaptation to changing climate in the context of Western and non-Western or indigenous attitudes to the connections between humans and nature. Discussions of patterns of maladaptation, and critique of adaptation strategies that disregard cultural relationships to landscape. Need for new governance models at local levels. (SR)

Historic Scotland. **Flood Damage to Traditional Buildings: Information for Historic Building Owners**. 2014, 8p. <http://conservation.historic-scotland.gov.uk/inform-flood-damage-to-traditional-buildings.pdf>.

Keywords: Flooding; historic buildings; materials; damage; repairs; techniques; guidelines; Scotland

Summary: "Some areas of Scotland have always suffered from periodic flooding as part of natural weather events and as a consequence of land use, but in recent years the frequency and scale of flood events has increased. Predictions for climate change indicate that the frequency and severity of flood events throughout Scotland are likely to get worse over the coming years. This INFORM (guide) offers guidance on how to protect traditional buildings from flood damage, and how to mitigate the effects if flooding does occur. Flood damage can be prevented or mitigated by taking precautions to protect a building prior to a flood, although in many situations some water ingress cannot be avoided. Traditional buildings can be resilient to flood damage, and can often recover with appropriate treatment. However the longer a building remains damp, the more likely the risk of further deterioration and loss of fabric. The repair of flood-damaged buildings is a specialist sector, with advice and new technologies continually evolving. A balanced approach should be taken in drying, accepting that some damage to materials may result from rapid drying techniques."

Comment: A very practical and brief guideline with a balanced view, produced for a specific climatic context (northern UK) and traditional building fabric (smaller older houses in masonry and timber with plaster interiors). (SR)

Hoffman, Rebecca. "Culturecide in changing Micronesian climates? About the Unintentionality of climate change." **The International Journal of Human Rights** 18.3 (2014): 336- 349, DOI:10.1080/13642987.2014.914707.

Keywords: Climate change; sea level rise; cultural heritage; culturecide (cultural genocide); indigenous rights; migration; Micronesia; Pacific Islands

Abstract: "This article establishes and explains the (cultural) genocidal dimension of climate change, engaging aspects of identity, intellectual property and cultural heritage from an emic view of the people concerned, namely the inhabitants of Chuuk, Federated States of Micronesia. The Pacific Islands are widely recognised as being specifically vulnerable to the impact of a warming climate. The threat it poses to the scarcely, but partly densely populated land resources might climax in the need to evacuate the islands altogether in the not so distant future. As identity in these communities is intrinsically linked to locality, the erosion of land also threatens to destroy people's cultural roots. Although a society's cultural self-conception is covered in a whole collection of declarations and conventions, the connection between climate change and its impacts, including migration dynamics and (cultural) genocide, has so far largely been ignored. Here, cultural change and migration are a dynamic part of Micronesian people's

daily life. However, the consequences of current environmental changes, alongside the prospect of permanently losing the as yet well-guarded links to their homes, are likely to set in motion a re-evaluation of cultural self – a process that deserves global attention and legal consideration.”

Comment: This article considers the likely fate of Chuuk, a low lying Micronesian island, which is expecting to have to evacuate its inhabitants as sea levels rise. It suggests that the loss of the traditional relationship to land for the Chuuk inhabitants will represent a kind of cultural death. Even if they survive physically by migrating or adapting to new climate contexts, they will lose their cultural heritage. It explores the significance of climate-related loss of culture, whether or not there is intentional change, and relates this to the need for all heritages to survive through adaptation. It is speaking as much to intangible forms of heritage, such as food traditions and sacred signs, as to the related built forms such as landscapes. (SR)

Holtz, Debra, Adam Markham, Kate Cell, and Brenda Ekwurzel. *National Landmarks at Risk: How Seas, Floods and Wildfires Are Threatening the United States' Most Cherished Historic Sites*. Union of Concerned Scientists. May 2014. 72p. Accessed April 10, 2016.
http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/National-Landmarks-at-Risk-Full-Report.pdf

Keywords: National Landmarks; historic sites; climate change; risks; sea level rise; fires; flooding; resilience; USA

Summary: “The growing consequences of climate change are putting many of the country’s most iconic and historic sites at risk. From Ellis Island to the Everglades, Cape Canaveral to California’s César Chávez National Monument, these sites symbolize values that unite all Americans – patriotism, freedom, democracy, and more – and together help weave the very fabric of our shared history. Today these sites face a perilous and uncertain future in a world of rising sea levels, more frequent wildfires, increased flooding, and other damaging effects of climate change. We must prepare our cherished landmarks for these worsening climate impacts and take steps to make climate resilience a national priority. At the same time, we must work to minimize these risks in the future by reducing the carbon emissions that are causing climate change and its accompanying impacts.”

Comment: An overview of the impact that climate change is already having on seventeen quite different and representative historic sites across mainland USA and Hawaii. By presenting such a wide range of uniquely significant contexts and their specific risks, a very strong case is made for the urgency of the problem(s) and need for a range of strategies. The

report was produced for the Union of Concerned Scientists, and includes an overview of the science of climate change as well as a very useful reference list. (SR)

Horowitz, Ann D. “The Effects of Sea Level Rise on Historic Districts and the Need for Adaptation” MAHP diss. Goucher College, 2013.
http://blog.preservationleadershipforum.org/wp-content/uploads/2014/09/Horowitz_thesis_copyri ght_NTHP.pdf

Keywords: Sea level rise; historic districts; case studies; thesis; North Atlantic coast; USA

Abstract: “Shoreline communities are unprepared for the increasing effects of sea level rise hazards on the built environment. As a result, Atlantic Coast historic properties reflecting cultural heritage face degradation or destruction. Numerous scientific studies project that sea level rise will likely inundate shorelines, increase the frequency of flood events, and augment wave damage from severe storms. These natural occurrences worsened by sea level rise could diminish a community’s identity and quality of life, often represented by National Register historic districts. To minimize the threat, strategies to adapt to sea level rise can offer protection for communities and their irreplaceable historic resources. To determine a course of action, my thesis question is: How can hard, soft, and non-structural adaptation methods be applied to protect the cultural heritage of National Register historic districts from the impacts of sea level rise? English Heritage, the Mississippi Development Authority, and the 1000 Friends of Florida provide helpful insights into methods used to protect historic resources from flooding, storm surge, and erosion—the effects of sea level rise. Additionally, the case study cities of St. Augustine, Florida; Elizabeth City, North Carolina; and Alexandria, Virginia, furnish examples of National Register historic district vulnerability to sea level rise and of adaptation methods addressing current natural hazards. My research findings indicate that adaptation methods can protect historic properties, but may also impact their historic integrity. I discover that the historic preservation community is largely uninvolved in the adaptation planning process. Without an advocate, historic properties on low-lying shorelines face an uncertain future by the year 2100 and beyond. My findings and recommendations include the importance of adaptation planning at the local level and the urgent need for preemptive adaptation implementation. To ease the political, social and economic obstacles associated with adaptation planning, local decision-makers and stakeholders must be educated on sea level rise science. State legislative endorsements are also necessary for municipalities to successfully implement a broad range of adaptation strategies. It is essential that state and the federal governments offer technical and financial support to localities as

sea level rise intensifies. Most critically, the historic preservation community must campaign for historic property protection that will also preserve historic integrity. The country's coastal heritage and identity are at stake."

Comment: Possibly one of the first graduate level research theses on the subject of climate change and cultural heritage in the USA, with a focus on the impact on smaller coastal towns in the southeast Atlantic and the possibilities for adaptation within the National Register historic district planning framework. The author has also participated in other related publications, reports and presentations which may be in a more accessible format for public education purposes. (SR)

Horowitz, Ann D. "Planning before Disaster Strikes: An Introduction to Adaptation Strategies." *APT Bulletin: Special Issue on Climate Change and Preservation Technology* 47.1 (2016): 40-49.

Keywords: Disaster planning; adaptation, sea level rise; historic districts; building materials; North Atlantic coast

Summary: One of six articles in the *APT Bulletin* Special Issue on Climate Change and Preservation Technology, this piece presents the adaptation strategies available to address sea level rise and coastal storms as a means of protecting historic resources in communities that were established along low lying tidal shorelines of the US mid-Atlantic coast. The benefits of pre-emptive adaptation planning are described and the possible impacts of sea rise and flooding on historic resources summarized. Adaptation planning at a larger scale allows for additional strategies beyond building elevation and relocation. Five summary tables summarize benefits, disadvantages and impacts on integrity of hard (engineered) versus soft (landscaped) adaptations, building retrofits for dry and wet flood proofing, and broader consideration for infrastructure, zoning and building codes.

Comment: This article written by an urban planner with the City of Alexandria, Virginia reports on graduate research that focused on the communities of St. Augustine, Florida, Elizabeth City, North Carolina as well as Alexandria. With reference to recent policy developments in the US, UK and the Netherlands, the author presents a succinct step-by-step approach for use by historic preservation planners and professionals, including assessing vulnerability and analysis of adaptation options. Observations from the application to the three communities, all historic districts but with different development histories, building types and materials, and previous adaptation patterns, highlight the importance of local perspectives and opportunities. The subject of building elevation is addressed in the context of a district and the need for coherence in planning to retain the overall relationship between

buildings and sites. The article compliments the article in the same issue by Curran, Routhier and Benjamin that considers the detailed application of mitigation planning and recording for a single site on the New Hampshire coast. (SR)

Howard, Andy J. "Managing global heritage in the face of future climate change: the importance of understanding geological and geomorphological processes and hazards" *International Journal of Heritage Studies* 19.7 (2013): 632-658. DOI: 10.1080/13527258.2012.681680.

Keywords: Climate change; cultural heritage; archaeology; geology; geomorphology; natural hazard assessment; UK

Abstract: "It is now widely acknowledged that human adaptation of the planet is causing significant changes to the global climate, which are being felt currently and are likely to increase in the future. This is beginning to place exceptional strains on the historic environment, here defined as both above and below ground archaeological remains. Using examples from the cultural list of World Heritage Sites in mainland Britain, this paper explores how knowledge of past and contemporary geological and geomorphological processes can provide an understanding of natural hazards and risk assessment. This, in turn, can inform management strategies to allow the protection and stabilisation of sites, limit further degradation and ensure long-term sustainability. From the analysis of published documentation available from UNESCO, it appears that natural processes have not always received the attention they deserve, and in some cases appear to have been ignored. Given the complexity of future climate change and the role that natural processes will play in determining the vulnerability of individual heritage assets, it is essential that geoscientists, archaeologists and cultural heritage managers work together to develop appropriate strategies to mitigate the effects of change in the future, especially since many of the themes developed in this paper have generic applicability across a range of landscape environments."

Comment: This is a very useful example of how existing physical data about World Heritage sites in the UK could be better used to inform possible decisions about how to manage risks due to climate change. Site characterization using known geological and geomorphological context information helps to identify sites at higher risk, and possibly sites that cannot be saved. The use of such data is irregular across the UK in existing management plans, and overall is surprisingly not integrated in the current planning for mitigating the impact of climate change. Such data is familiar to archaeologists, but less to experts in built heritage, and points to the need for interdisciplinary strategies. (SR)

Hurd, John. "Preparing for climate change: The importance of 'maintenance' in defending the resilience of cultural heritage." *Historic Environment* 21.1 (2008): 45-47.

Keywords: Climate change; impacts of Extreme Climatic Incidents (ECIs); cultural heritage; maintenance; monitoring; resilience

Abstract: "This paper is an adaptation of two presentations delivered in Cairns in July 2007 in association with the ICOMOS Extreme Heritage conference. One of these was the ICOMOS Australia Symposium on Culture Heritage and Climate Change at which interested cultural heritage professionals came together to discuss this issue and the other was a Public Forum held at the Tanks Art Centre on the same topic which provided an opportunity for members of the public to engage with the issue. Presentations by other speakers at these events attest to the concerns of the Government, institutions, researchers and people of Australia in relation to the current and projected impact of global climate change on both the natural and cultural environments in the country, the region and internationally. This paper does not address the causes of climate change, although it is now clear that the activities of humankind have had an impact on exacerbating and accelerating climate change (IPCC 2007). Rather, it arises from the author's role as a scientist and a participant in the preservation of cultural heritage, both tangible and intangible. The international community must consider what can be done to adapt to the coming changes and what can be done to mitigate the disastrous effects that climate change can have on the cultures and lives of global society."

Comment: Excellent article highlighting the importance of maintenance for cultural heritage sites and buildings. Maintenance is the first line of defense against the impacts of climate change, such as flooding and changing environmental conditions. Buildings and sites in good condition are more able to absorb the impact of Extreme Climatic Incidents. Maintaining cultural heritage sites and buildings and monitoring their environment provide the basic tools needed to blunt the effects of climate change. (JS)

I

ICOMOS/World Heritage Centre, et al. *Heritage and Resilience: Issues and Opportunities for Reducing Disaster Risks*. 2013.
<http://icorp.icomos.org/images/documents/Heritage%20and%20Resilience%20Book%20for%20G2013%20Disaster%20Management.pdf>

Keywords: Cultural heritage; resilience; risk reduction; risk communication; post-disaster recovery; World Heritage sites

Abstract: "This paper presents the current thinking in the field as well as various examples – from different regions of the world – of how heritage can be better protected from disasters while contributing to the resilience of societies. It aims to bring these important issues to the attention of the larger disaster risk reduction community and to stimulate wider discussion in the context of ongoing consultations around a post-2015 framework for disaster risk reduction and a post 2015 development agenda. In advocating for integration of these issues within both disaster risk and heritage conservation policies and practices, this paper promotes strategic partnerships that bring the knowledge and capacities of actors in the fields of cultural heritage and disaster risk together and encourages support to the initiatives of local governments and, most importantly, communities that safeguard our shared cultural heritage for resilience." (...)

Comment: Provides an overview of risk management activities with examples of successful actions that protect World Heritage sites. Appendix I, describing objectives and actions to reduce and manage risks to World Heritage sites, could be adapted for local heritage sites and local hazard mitigation planning efforts. (JS)

Initiative for Heritage Conservancy. *Climate Change and Monuments: Colloquium on Climate Change and Its Impacts on Preservation Management of Archaeological Sites*, Athens, 2012. (Abstracts on conference website).
<https://sites.google.com/site/climatechangeandmonumentsihc/home/abstracts>

Keywords: Climate change; archaeological resources; cultural heritage; predictive models; impacts of climate change; Heritage Climate Index (HCI); risk assessment; managing change

Summary: The new think tank managed by the Initiative for Heritage Conservancy (IHC) and in partnership with ICCROM (the International Centre for the Study of the Preservation and Restoration of Cultural Property), the University of KENT, the Canadian conservation Institute (CCI) and University College London - Qatar (UCL-Qatar) organised the first International colloquium on Climate Change and its Impact on Preservation Management of Archaeological Sites. It took place in the Acropolis Museum from the 2nd to the 4th of April 2012.

Comments: The papers presented at the colloquium address the need for creating better local models for predicting climate change; using those models to understand the effects it will have on cultural heritage, both archaeological and built heritage, and using the models and impacts to plan to for better protection of and to ameliorate the impacts to cultural heritage. David Orrell's paper is particularly compelling in that it critically assesses the intellectual bias behind the science of predicting climate change

and how the current predictive climate change models have become cultural monuments in their own rights. Sujeong Lee's presentation asserts the importance of including climate change in the decision-making process for managing changes to cultural heritage. Much of climate change literature in regard cultural heritage is about the effects of climate change on the resource. Sujeong Lee's practical approach to managing those effects moves the climate change dialog from academia into action (preservation/conservation). Patrick McSharry's paper on the Heritage Climate Index provides a defensible, practical approach to conducting a vulnerability assessment for cultural heritage in a way that mirrors that of how risk assessment is conducted for nonhistoric resources by emergency managers. It provides a method for defining how hazards (e.g. climate change), exposure (e.g. physical location of resource in relation to a specific hazard) and vulnerability combine to estimate risk, and how risk is measured by the economic costs of the predicted damages and cost of recovery. This can be a powerful tool for managers of cultural resources to reinforce the message that cultural heritage is a valuable asset worth protecting from the effects of climate change and other hazards. (JS)

Isacoff, Rachel B. "Raised or Razed: The Challenge of Climate Adaptation and Social Equality in Historic Coastal Communities." MSHP diss. University of Pennsylvania, 2014.
http://repository.upenn.edu/hp_theses/562/

Keywords: Climate adaptation; FEMA; NFIP (National Flood Insurance Program); sea-level rise; TEK (traditional ecological knowledge); historic coastal communities

Abstract: "Climate change threatens historic coastal communities, and reducing vulnerability through adaptation will not be easy – but it is necessary. Differing values of government agencies and local communities – contingent on attitudes to risk and cultural restrictions on action – may limit the options for adaptation, This thesis analyses policy constraints for implementing the preventive strategies of constructing levees, elevating buildings and relocating towns in historic districts in the mid-Atlantic coastal region and makes recommendations for proactive, community-based decision making process."

Comments: Good primer for understanding the federal policies behind flood mitigation and how those policies are applied to historic properties in the United States. This treatise also evaluates the effect that flood mitigation actions may have on the National Register of Historic Places criteria for evaluation, and calls for a rethinking of the criteria to accommodate flood mitigation actions. (JS)

J

Jerome, Pamela. **Report from the ICOMOS Thematic Workshop on Cultural Heritage and Climate Change, 16th General Assembly and Scientific Symposium Quebec, Canada, October 2008.** 2009. 9p.
http://www.international.icomos.org/climatechange/pdf/ICOMOS_GCC_Cultural_Heritage_Workshop_Quebec_2008_Report_Final_EN.pdf

Keywords: Climate change; cultural heritage; maintenance; documentation; risk preparedness; disaster response

Summary: Report of a workshop held in Quebec (Canada), at the 16th General Assembly and Scientific Symposium, October 2008. Final Version issued 1 March 2009.

Comment: The discussion at the symposium centered on three inter-related ideas: maintenance, documentation and risk preparedness. John Hurd reinforced the importance of maintenance as a first line of defense in protecting cultural heritage from the effects of climate change and natural disasters and the need for a maintenance manual that could be understood by both cultural resources managers and those who were conducting the maintenance activities. Cliff Ogleby put forth the idea that documentation was needed to provide a baseline against which to measure and monitor changes because "monitoring allows intervention before failure." Robyn Riddett linked the practices of maintenance and documentation in her process for risk preparedness that also included a strategy for training non-cultural heritage disciplines in disaster response involving cultural resources to ensure resources are not further damaged by response activities. All participants in the symposium agreed upon the need for ICOMOS to distribute its publications more widely target them to those who will use, reinforcing the idea of protection as a "bottoms-up" approach that begins at the local level. (JS)

L

Lefevre, Roger-Alexandre and Cristina Sabbioni. **Climate Change and Cultural Heritage: Proceedings of the Ravello International Workshop, 14-16 May 2009 and Strasbourg European Master-doctorate Course, 7-11 September 2009.** Ravello: Centro Universitario europeo per I Bani Culturali/Bari: Edipuglia, 2010.

Keywords: Climate change; cultural heritage; vulnerability assessment; risk reduction; mitigation; adaptation; Europe

Summary: “This volume includes a collection of contributions of the workshop of the same name, held in Ravello in May 2009. The meeting provided a valuable opportunity for industry experts to debate on the disastrous effects of climate changes on the historical and cultural European heritage. In previous centuries, Europe was plagued with very different problems: wars, plagues, economic crises, religious persecution, racial, and political conflicts. Earlier generations experiencing our conflicts, over 60 years, have had to struggle against poverty and for the recognition of human rights, especially of women and children. Today’s challenge is that our generation and probably the next has to contend with is climate change; Congress of Europe has recognized the opportunity for a general mobilization of scientists and politicians so that carbon dioxide emissions and the continuous climatic oscillations cease to have disastrous repercussions on monumental wealth of our cities. Precautionary measures are needed and shared solutions, which will allow all European governments to preserve the integrity and the uniqueness of its artistic and architectural heritage. Historic buildings, archaeological sites, monuments, libraries, art collections are not only the precious legacy handed down to us by history, and of which boast the European nations, but also the primary and inexhaustible source of economic development that Europe owns.”

Comment: Several recommendations for EU Member States resulted from this conference: conduct risk assessment of cultural heritage in regard to climate change; protect high risk cultural assets; adopt emergency plans for the most vulnerable resources; assess potential impacts of protective measures; and other recommendations related to risk reduction policies and sharing knowledge between international organizations and heritage professionals. Abstracts contained in the volume cover a wide range of topics ranging from the effects of climate change on heritage resources to conducting risk assessments for vulnerable cultural heritage. Papers related to the education course associated with the conference were more technical in content when dealing with specific effects of climate change on buildings and building components, such as the impact of climate change on Mediaeval stained glass (Michael Melcher and Manfred Schreiner) or modeling the effects of wetting and drying on historic buildings (May Cassar). (JS)

López Martínez, María Fernanda. “The Coast in Peril: Preserving Puerto Rico’s Historic Resources from Sea Level Rise.” MAHP, diss. Goucher College, 2015.
<http://cdm16235.contentdm.oclc.org/cdm/ref/collection/p16235coll12/id/600>

Keywords: Climate change; sea level rise; flooding; coastal historic resources; historic resource adaptation; social and cultural disruption; triage; Puerto Rico

Abstract: “The deteriorating effects of sea level rise threaten coastal historic resources in Puerto Rico. An increase of one to two meters is expected for the Caribbean by the end of the century amplifying the risk of coastal flooding, erosion and storm surge. National Register of Historic Places listed resources will be affected and efforts to preserve them require planning for future adaptations. Historically, Puerto Rico’s coastal development has been intense with a great number of resources located in the now susceptible shoreline. A resource prioritization system is needed to evaluate how to mitigate damage prompting my research question: What classification methods are essential to create a prioritization system for resource adaptations to mitigate damage to the most important and resilient historic resources in the wake of sea level rise? The triage system theory is applied to classify threatened resources according to risk, cultural value and current conditions to determine urgency for mitigation and adaptation.”

Comment: Recognizing that there are too many constraints to preserving all cultural resources at risk to sea level rise, this treatise proposes a triage system as a basis for making decisions on which cultural heritage sites are the most likely to survive the effects of climate change in order to direct the resources needed to preserve and adapt those sites to ensure their continued survival. Preservationists will need to make hard choices about what to save and what to let go: this treatise provides a reasoned, defensible strategy for making those decisions. Although Puerto Rico is used as a case study, the triage system is applicable to other locations and could be adapted to fit other hazards. (JS)

M

Markham, Adam and Jeana Wiser. “A Heritage Coalition’s “Call to Action” on Climate Change and Cultural Heritage.” *National Trust Forum Journal* 29.4 (2015): 19-23.

Keywords: Climate change; cultural heritage; Union of Concerned Scientists; National Landmarks at Risk; Pocantico; call to action

Abstract: “This article explains the genesis of the study, “Landmarks at Risk” by the Union of Concerned Scientists and presents the findings and “Call to Action” resulting from the meeting of the Pocantico workshop--a 2015 convening to identify priorities for action to preserve and maintain cultural heritage in a changing climate.”

Comments: Brief article to raise awareness of the threat that climate change poses to cultural

resources. It also provides a summary and links to two major resources on the topic: the Union of Concerned Scientists' publication *National Landmarks at Risk*, and the Pocantico Proclamation on Sustainability and Historic Preservation. (JS)

Melnick, Robert. "Climate Change and Landscape Preservation: A Twentieth-First Century Conundrum." *APT Bulletin* 40.3-4 (2009): 35-42.

Keywords: Climate change; cultural landscapes; adaptation; management options; preservation policy

Summary: "The threat of climate change means that we must question the manner in which we see cultural landscapes, understand their significance, and plan for their future."

Comment: Thoughtful deliberation on how climate change will affect cultural landscapes and how the protection and preservation of those landscapes will challenge preservationists to develop policies and management options that may break away from established historic preservation practices. (JS)

Melnick, Robert, Burry-Trice, Olivia, and Malinay, Veronica. *Climate Change and Cultural Landscapes: Research, Planning and Stewardship*. NCPTT, 2015, 26 p. (Draft: June, 2015) <https://www.ncptt.nps.gov/blog/climate-change-and-cultural-landscapes-research-planning-and-stewardship-2015-02/>

Keywords: Climate change; cultural landscapes; planning; action plan; management strategies; USA

Summary: "This article discusses cultural landscapes and what they can teach us about climate change and its impact on our heritage resources. The author presents several examples of adaptation approaches to cultural landscape preservation in the face of climate change."

Comment: This is a draft of a planning guide for NPS personnel, however the decision-making process outlined in this publication can be utilized to develop an action plan for managing climate change impacts to any cultural landscape. The process is laid out in a straightforward manner that is easy to understand. The accessibility of this document for resource managers and the examples provided will make the final version of this guide a powerful tool for developing resource-specific methodologies to address the effects of climate change on cultural landscapes. (JS)

Melnick, Robert Z., Burry-Trice, Olivia, and Malinay, Veronica. "A Decision Framework for Managing Cultural Landscapes Impacted by Climate Change: A Preliminary Report." *The George Wright Forum* 32.1 (2015): 77-88.

Keywords: Climate change; cultural landscapes; planning; action plan; management strategies; USA

Summary: "This article presents a summary of preliminary findings from a project underway to provide resource managers at all levels with a suite of potential strategies through which to develop landscape-specific action plans for responding to, and when possible mitigating, the impacts of climate change on cultural landscapes. The project, sponsored through a grant from the NPS National Center for Preservation Technology and Training (NCPTT), uses six cultural landscapes in national parks in the eastern United States to assist the research team to explore climate change impacts on the ground. The team queried the case study resource managers¹ and many other NPS staff to better understand management challenges in each of the parks and related cultural landscapes. This project does not provide exact or definitive solutions to the multitude of questions that arise regularly in this realm. The intent, rather, is to outline a broad framework for discussion; a framework that explores ways of approaching these problems for any specific cultural landscape. As the impacts of climate change become more evident, the effects of these phenomena on NPS cultural resources require a concerted effort to understand the changes underway and develop appropriate management responses. We need to fulfill our societal value of historic preservation, legislative and regulatory requirements, and expectations as well. For cultural landscapes, this may be especially difficult to achieve. Cultural landscapes, through their inherent dynamic nature, present particular problems when faced with the impacts of climate change. Whether through a sudden event or a long-term trend, these impacts may range from subtle to obvious, and present the resource manager with myriad preservation challenges. In the era of climate change in which we now find ourselves, it is valuable to understand diverse challenges, yet recognize that climate change does not pre-empt established and tested policies, strategies, and techniques."

Comment: This article provides a preview of the authors' upcoming publication *Climate Change and Cultural Landscapes: Research, Planning and Stewardship* which is currently in draft form and not widely available. (JS)

Mississippi Development Authority, "Elevation Design Guidelines for Historic Homes in the Mississippi Gulf Region." N.d. http://www.nj.gov/dep/hpo/hrrcn_sandy_pdf%20files/mississippi.pdf

Keywords: Flood; coastal storm; building elevation; design guidelines; hazard mitigation; historic structures; Mississippi Gulf Coast (USA)

Summary: "Because of this unprecedented level of loss [due to Hurricane Katrina], the historic properties

that still exist in Coastal Mississippi are rare survivors. They have become even more important because of their limited numbers. These buildings represent special places that must—now more than ever— be protected as community resources. These structures also have unique architectural and design characteristics that communities strive to maintain and enhance. Within the framework of the Mississippi Development Authority (MDA) financial assistance programs available to property owners, this principle is of utmost importance. These Guidelines have been developed to ensure that both individual historic buildings, and historic buildings within historic districts, are preserved for future generations. The purpose of this design manual is to provide recommended elevation design guidance for the rehabilitation of historic buildings funded through MDA programs. The goal of this effort is to reduce risk from future flood events through elevation, and to preserve the physical integrity and character of historic buildings. Specifically, one of the most important outcomes of this effort is to limit the total height of elevation for historic buildings so they maintain their historic character in relation to other historic buildings within each local historic district, thus protecting the architectural qualities of each historic district as a whole.”

Comments: The audience for this document is Historic Preservation Commissions, local building officials and property owners. The guidelines clearly articulate the impacts elevation can have on a property, adjacent properties, and on a district; addresses how to sensitively elevate historic properties; provides a concise and understandable summary of floodplain regulations, and outlines a project review process for local government to follow when implementing elevation projects. It is place-specific, but it could serve as a model document for creating similar design guidelines in other flood-prone historic areas. (JS)

Murphy, K. and M. Ings. *Climate Change and the Historic Environment of Wales: A Summary of Potential Impacts*. Wales: CCRI/Historic Environment Group, 2013, Accessed November 29, 2014, 8p.
http://cadw.wales.gov.uk/docs/cadw/publications/Climate_change_and_the_historic_environment_of_Wales_EN.pdf

Keywords: Climate change; sea level rise; cultural heritage; historic environment; Wales

Summary: “The CCRI, along with the Dyfed Archaeological Trust, and the Centre for Environmental Change and Quaternary Research at the University of Gloucestershire were asked to explore the direct impacts of climate change on the historic environment of Wales. In 2012, a report on a strategic approach for assessing and addressing the potential impact of climate change on the historic

environment of Wales was produced for the Historic Environment Group, which advises Welsh Ministers. The report has been approved by both the Minister for Culture and Sport and the Minister for the Natural Resources and Food. The report suggests it is likely that the historic asset most affected by climate change will be historic landscapes. Four climate change scenarios were examined: warmer mean temperatures, hotter drier summers, warmer wetter winters/wetter summers, and, more frequent extreme weather – all were identified as having an overall adverse impact. A series of potential impacts were identified and assessed as being of moderate significance: cumulatively these are of high significance. Historic assets (including historic buildings, historic settlements, archaeological sites and landscapes) lying below the one meter contour are assessed as being at significant risk from rising sea levels coupled with more frequent storm surges. Parts of many of Wales’ urban areas lie in this zone, and thus the potential damage and loss, not just to individual historic elements, but also to the overall historic character could be considerable.”

Comment: This short publication, which summarizes a longer report, lists different types of historic assets (i.e. cultural resources) including historic environments and briefly describes the effects of climate change on each asset. It presents the information in an uncomplicated, non-technical manner that would be best served as a means for communicating this information to the general public. (JS)

Murphy, Peter, David Thackray and Ed Wilson.
“Coastal heritage and Climate Change in England: Assessing Threats and Priorities.” *Conservation and Management of Archaeological Sites* 11.1 (2009): 9-15.

Keywords: Climate change; maritime archaeology; cultural heritage; England

Abstract: “There are now strong grounds for thinking that the rates of coastal processes will increase in the future, and that this speeding up is at least partly due to the impact of climate change on the coastline. The focus of this paper is on England only, primarily the impact of coastal change specifically upon archaeology rather than on the wider historic environment, but acknowledging, though not referencing here, the work of colleagues in Wales, Scotland and Northern Ireland on coastal and marine survey which contributes so much to our understanding of the processes and impacts of coastal change. The paper discusses the different climate change impacts on the coastal and maritime historic environment, including direct physical impacts, indirect impacts that are a consequence of decisions taken now by coastal managers anticipating future climate change, and indirect

impacts related to attempts at climate change mitigation.”

Comment: This paper provides a good introduction to the impacts of climate change and shoreline armoring on marine and coastal heritage. Although specific to England, it is germane to similar sites and processes occurring along other coastal areas rich in archaeological resources. (JS)

N

National Park Service. ***Cultural Resources and Climate Change, Cultural Resource Brief.*** 2003.
<http://www.nps.gov/subjects/climatechange/upload/CulturalResourceBriefMar2013.pdf>

Keywords: Climate change; cultural resources; response; Coastal Adaptation Handbook; National Park Service; USA

Summary: “Cultural resources, which include archeological sites, cultural landscapes, ethnographic resources, historic and prehistoric structures, and museum collections, have distinct considerations with respect to climate change. Most are fixed in place or derive much of their significance from the place within which they were created. Many are nonliving, and all are unique. As a result, the capacity of cultural resources to adapt to changing environments is limited.”

Comment: One-page summary of actions/projects the NPS is undertaking to address the effects of climate change in NPS units. Projects include: climate change policy and program development; scientific study of past and ongoing effects of climate change in NPS units; creation of a Coastal Adaptation Handbook and communicating stories related to climate change. Contact information is provided for NPS personnel leading the climate change actions. (JS)

National Park Service. ***Climate Change Response Strategy: Science, Adaptation, Mitigation, Communication.*** September 2010.
http://www.nps.gov/orgs/ccrp/upload/NPS_CCRS.pdf

Keywords: Climate change; Cultural resources; mitigation; adaptation; National Park Service; USA

Summary: “In 2016, the National Park Service (NPS) will begin its second century of preserving the nation’s natural and cultural heritage, a stewardship that now includes protection of more than 84 million acres within the National Park System. Global climate change threatens the integrity of our national parks. It challenges the NPS mission to leave park resources unimpaired for future generations unlike any threat in our history.”

Comments: The strategy sets forth a series of principles, goals, and objectives within four integrated “strategy components” (science, mitigation, adaptation, and communication) to guide the agency and its employees in how to address the impacts of climate change on NPS units. The strategy could be adapted for use by other organizations with a similar mission and function who are seeking to address climate change impacts to their cultural resources. (JS)

National Park Service. ***Using Scenarios to Explore Climate Change: A Handbook for Practitioners.*** July 2013
<http://www.nps.gov/subjects/climatechange/upload/CCScenariosHandbookJuly2013.pdf>

Keywords: Climate change; scenario planning; scenario thinking; park planning; resource management; resource stewardship; USA

Abstract: “Developed under the National Park Service Climate Change Response Strategy, this guide is part of an interdisciplinary, cross-cutting approach to addressing climate change. The overall program supports NPS efforts to understand climate science in national parks and surrounding areas and to adapt to a changing climate to promote the resiliency of our cultural and natural heritage. Actively engaging ourselves and our audiences in park stewardship is a key ingredient of the climate change communication strategy and an integral component in addressing the effects of climate change. This handbook describes the five-step process for developing multivariate climate change scenarios taught by the Global Business Network (GBN) during a series of training workshops hosted by the National Park Service in 2010 and 2011. The authors created this guide as a reference for workshop participants who possess some familiarity with scenario planning. The process featured in this manual is not a definitive method for building climate change scenarios, since many valid methods exist to develop climate change scenarios. The technique presented here is just one effective and proven approach.”

Comment: Scenario planning for climate change identifies future alternatives that guide resource managers toward planning to prepare for an uncertain future. Scenario workshops consist of a five-step process: Orientation, Exploration, Synthesis, Application, and Monitoring. Several NPS parks have conducted scenario-planning workshops based on these steps to plan for future climate change impacts. (AH)

National Trust for Historic Preservation. ***Climate Change and Historic Preservation.*** n.d. (online map data sets).
<http://nthp.maps.arcgis.com/apps/MapJournal/index.html?appid=a6e67c159c364434af3950b407e8d8f2>

Keywords: Sea level rise; flood-prone coastal areas; National Register of Historic Places datasets; sea level rise viewer; social vulnerability to environmental hazards; current FEMA-identified disasters; USA

Summary: “Climate change and rising sea level mandate a new kind of assessment of the vulnerability of historic resources, requiring stakeholders to look at adaptation and resiliency options and to decide what will be saved for future generations – both in terms of determining what is technically possible, and also in terms of allocating finite resources. This story map illustrates the effect of sea level rise on coastal communities, natural disaster occurrence, and the “social vulnerability” of local areas to environmental hazards.”

Comment: National Register of Historic Places datasets are merged with data for flood-prone coastal areas, sea level rise, and social vulnerability indices on ArcGIS maps. This provides the historic preservation professional with information to assess the vulnerability of specific historic resources to projected sea level rise impacts. In addition, a map of FEMA data on current natural disasters that may result from climate change is depicted. (AH)

National Center for Preservation Technology & Training. *Resilient Heritage: Protecting Your Historic Home from Natural Disasters*. 2015. <https://ncptt.nps.gov/blog/resilient-heritage-2015-03/>

Keywords: Disaster mitigation; building elevation; building retrofits; houses; USA

Summary: “With funding from the Governor’s Office of Homeland Security & Preparedness (GOHSEP), the Louisiana Division of Historic Preservation and the National Park Service’s National Center for Preservation Technology & Training (NCPTT) prepared this booklet to help residential property owners minimize risk, prepare for future disasters, and more.” (...)

Comment: This guide offers historic homeowners specific methods to minimize damage from natural disasters through building retrofits and landscape modifications. A table of options and a helpful glossary are included. (AH)

National Flood Insurance Program, *Floodplain Management Bulletin on Historic Structures*, FEMA, P-4-672, May 2008, 22p. http://www.fema.gov/media-library-data/20130726-1628-20490-7857/tb_p_467_2_historic_structures_05_08_web.pdf

Keywords: Flood; National Flood Insurance Program (NFIP); historic structures; flood mitigation; building elevation; flood proofing; relocation; USA

Summary: “The purpose of this floodplain management bulletin is to explain how the National Flood Insurance Program (NFIP) defines historic structure and how it gives relief to historic structures from NFIP floodplain management requirements (44 CFR §60.3). This bulletin also provides guidance on mitigation measures that can be taken to minimize the devastating effects of flooding to historic structures.”

Comment: National Flood Insurance Program regulations exempt property owners of historic structures from adhering to elevation and flood proofing requirements of the insurance program. Historic property owners have the opportunity to obtain flood insurance at the subsidized rates. Protecting historic structures from flood impacts is encouraged as long as the historic significance of the property is maintained. (AH)

O

Olynyk, Doug. “Summary of the Significance of and Threats to the Cultural Resources Located at the Historic Settlement Area on Herschel Island Territorial Park in Yukon.” In Michael Petzet and John Ziesemer, editors. *Heritage at Risk 2006-200.*, Paris: ICOMOS, 2008, 212-213.

Keywords: Sea level rise; erosion; flooding; archaeology; shoreline analysis; Arctic coast; Herschel Island, Yukon (Canada)

Abstract: “Arctic coastal infrastructure and cultural and archeological sites are increasingly vulnerable to erosion and flooding due to amplified warming of the Arctic, sea level rise, lengthening of open water periods, and a predicted increase in frequency of major storms. Mitigating these hazards necessitates decision-making tools at an appropriate scale. The objectives of this paper are to provide such a tool by assessing potential erosion and flood hazards at Herschel Island, a UNESCO World Heritage candidate site. This study focused on Simpson Point and the adjacent coastal sections because of their archaeological, historical, and cultural significance. Shoreline movement was analyzed using the Digital Shoreline Analysis System (DSAS) after digitizing shorelines from 1952, 1970, 2000, and 2011. For purposes of this analysis, the coast was divided in seven coastal reaches (CRs) reflecting different morphologies and/or exposures.”

Comment: This article raises awareness of the climate change impacts that affect the western Canadian Arctic due to decaying permafrost, the disappearance of sea ice, and sea level rise. These land and sea changes impact archaeological remains and historic structures in Yukon’s first Territorial Park and potential World Heritage site. (AH)

P

Page, Bob. "Cultural Landscape Preservation in Context: Responding to a Changing Environment." *The George Wright Forum* 32.1 (2015): 59-70.

Keywords: Climate change; cultural landscapes; NPS Olmsted Center for Landscape; USA

Summary: This essay focuses on altered cultural landscapes preservation practices due to climate changes by the U.S. National Park Service. It mentions that good cultural landscape management requires knowledge of existing conditions, knowledge of landscape's significance and historic character of landscape. Topics discussed include long-term sustainability of lands, cause of climatic changes such as reduction in number of plants leading to increment in diseases and pests.

Comment: The author, from the National Park Service Olmsted Center for Landscape Preservation, provides a guide to managing change for cultural landscapes that can be applied to the impacts associated with climate change. Cultural landscape resource managers would likely find this itemization of practices beneficial to adapting resources to climate change impacts. (AH)

Phillips, Helen. "The Capacity to Adapt to Climate Change at Heritage Sites: The Development of a Conceptual Framework." *Environmental Science & Policy* 47 (2015): 118-125. Accessed May 5, 2015. DOI: 10.1016/j.envsci.2014.11.003

Keywords: Climate change; adaptive capacity; cultural heritage management; UK

Summary: "Despite the growing body of research on the concept of adaptive capacity, there is an absence of research which investigates adaptive capacity in the field of cultural heritage management. Climatic changes have potentially serious implications for the historic environment, which is itself a non-renewable resource. Cultural heritage sites can be particularly sensitive to severe weather events and to changes in climate, both due to direct impacts on built structures, archaeology and designed landscapes, but also due to changes in visitor behaviour and the potentially adverse implications of adaptive measures on heritage significance. This research investigated the adaptive capacity of the management of cultural heritage sites in the UK. The research methodology and a final conceptual framework of adaptive capacity relevant for heritage management are presented in this paper."

Comment: Adaptive capacity theory—the capacity of an institution to respond to change—is tested at three UK World Heritage sites. The research identified ways the site and the capabilities of its

leadership and employees could be enhanced to minimize vulnerability to climate change. Although the research indicated areas of weakness to adapt, the research methodology would be difficult for a small institution to undertake if it is sensitive to time and cost constraints. (AH)

R

Roncoli, Carla, Todd Crane, and Ben Orlove.

"Fielding climate change in cultural anthropology." In Susan A. Crate and Mark Nuttall, editors, *Anthropology and Climate Change: From Encounters to Actions*.

Routledge, 2009, 87-115.

http://cred.columbia.edu/files/2012/05/Roncoli-Crane-Orlove_2008_AnthroCC.pdf

Keywords: Climate change; cultural anthropology; perception; knowledge; valuation; response

Abstract: "This chapter examines a number of studies that exemplify the way anthropologists have engaged with various aspects of climate change. We do not intend to present a comprehensive review, but we seek to identify the epistemological and methodological approaches that have led to particularly valuable insights. We recognize that a great deal of research on climate change and its effects on cultural systems and social organization has been carried out in archaeology (Balter 2007; Kuper and Kropelin 2006; Migowski et al. 2006; Richerson 2001), historical ecology (Crumley 1994; McIntosh et al. 2000; Oldfield 1993), and cultural ecology (Bogin 1982; de Menocal 2001; Peterson and Haug 2005). In this chapter, however, we focus on the ways that cultural anthropologists address present-day issues related to global climate change, issues that are confronting both local communities and global scientific and policy communities with unparalleled urgency and severity (Batterbury 2008)."

Comment: The authors' state that an anthropological analysis of a culture can yield climate change data, derived from observations of area residents. This supports the importance of involving the community in the climate change analysis and adaptation process. (AH)

S

Sargent, Liz and Debora Slaton. "Heading into the Wind: Climate Change and the Implications for Managing Our Cultural Landscape Legacy" *Change Over Time* 5.2 (Fall 2015): 200-224. DOI: 10.1353/cot.2015.0017

Keywords: Sea level rise; cultural landscapes; adaptation; lifeways; North Carolina (USA)

Abstract: "The spectre of a rapidly changing environment, bringing with it more frequent extreme

weather events, changing temperatures, rising sea levels, and impacts we cannot entirely anticipate, suggests that current approaches to historic preservation will need to be adapted in order to continue to protect our cultural heritage with the same level of care that we expect today. In attempting to anticipate the needs of a constantly changing future, preservationists need to plan for a range of eventualities, consider new strategies, and determine how these strategies can be tested. Interestingly, appropriate adaptive strategies may exist in past cultural responses to harsh and shifting environments, like our coastal areas and barrier islands. One such historic coastal community, which represents the unique type of heritage and sense of place that preservationists work to protect and is currently at risk due to sea level rise, is Portsmouth Village on the Outer Banks of North Carolina. The particular responses and adaptations to a challenging and ever-changing environment, which were developed and adopted by residents of Portsmouth Village to address environmental forces, offer some clues for possible future responses to climate change. This paper examines historical approaches and potential future strategies for the preservation of cultural landscapes and other heritage resources threatened by climate change.”

Comment: The authors identify the adaptive “life ways” of the former residents of Portsmouth Village, an abandoned Village in the Outer Banks of North Carolina, and recommend these as solutions to climate change impacts on the cultural landscape. Community planners, historic preservation professionals, and resource managers would benefit from understanding this approach to adaptation. (AH)

Stiles, William A., Mason Andrews and Mujde Erten-Unal. *Tide Water Rising Resiliency Design Challenge*, Wetlands Watch/Sea Grant Virginia, January 2016, 30p.
<http://wetlandswatch.org/Portals/3/WW%20documents/Publications/report-chesterfield-heights.pdf>

Keywords: Sea level rise; flooding; historic district; adaptation; Chesterfield Heights; Virginia (USA)

Summary: “The overall goal of the work was to conduct a flooding/sea level rise adaptation design process in a shoreline community, at the street/parcel level, with full community involvement, focusing on adaptation before significant storm and flooding damage occurred, with a central goal to maintain or expand ecosystem services in any designs developed. We also wanted to work in a community that displayed the complex hydrologic conditions that reflect the challenge of adaptation in built-out communities in Southeast Virginia: development atop old creek beds and wetlands, groundwater close to the surface, restricted and constrained drainage due to sea level rise affecting infrastructure, etc. A secondary goal involved

developing interest for adaptation design and engineering within southeastern Virginia’s professional community so that a community of practice and expertise could be developed. We wanted to involve academic institutions with relevant departments of design, architecture, engineering, and policy in order to develop tomorrow’s expertise.”

Comment: A proposal to adapt the Chesterfield Heights historic district in Norfolk, VA to flooding impacts won a HUD Resiliency Grant to implement the adaptation plan. Resident preferences to avoid property elevation, led student designers to find alternatives that limit impacts on significance. The proposal provides planners and historic preservation professionals with a guide for community engagement related to adaptation and with information on environmentally-friendly adaptation responses. (AH)

T

Taylor Tim, Alistair Hunt, May Cassar, and Ian Wainwright. “Quantifying the cost of climate change impacts on the built heritage.” In May Cassar and Chris Hawkings. *Engineering Historic Futures: Stakeholders Dissemination and Scientific Research Report*. London: UCL Center for Sustainable Heritage, 2007, 124-129.
<http://eprints.ucl.ac.uk/2612/1/2612.pdf>

Keywords: Flooding; heritage preservation; adaptation; climate variable; buildings; materials; costs; UK

Summary: “Climate change is likely to have a significant impact on the cultural heritage sector. With increased flood risk, increased frequency of storms and risks of summer drought, the stock of buildings of historic and cultural significance is likely to be hit hard by climate related impacts. As part of the research project Engineering Historic Futures, funded by the Engineering and Physical Science Research Council and the United Kingdom Climate Impacts Programme, we attempted to quantify the direct and indirect costs of climate impacts on the built heritage. Quantitative information on the sectoral costs of climate change are likely to be useful in determining where adaptation initiatives should be focused since policy on climate change adaptation invariably involves trade-offs in the use of scarce resources.”

Comment: The essay is in a publication with compilation of six scientific research reports on the effects of moisture in historic materials. This is specific research on the cost of different rates of drying for a building to become habitable again after a flooding event. The cost method also provides estimates for future climate induced flooding to understand cost impacts of increased precipitation. (ML)

Terrill, Greg. "Climate Change: How Should the World Convention Respond?" *International Journal of Heritage Studies* 14.5 (2008): 328-404. DOI: 10.1080/13527250802284388

Keywords: Climate change; World Heritage; International Convention

Abstract: "The World Heritage Convention has been considering how best to respond to the impacts of climate change. This poses a number of challenges, aside from the complexities of climate change itself. The Convention is not accustomed to addressing broad, interdisciplinary matters beyond World Heritage; it has not historically had strong links with other conventions outside UNESCO; it has relatively few resources; and climate change will result in escalating change, whereas the World Heritage Convention is based upon a presumption of relative stability and manageable change. Responding to climate change in the longer term will require a clear definition of the role of the World Heritage Convention in this area, and new types of expertise within the Convention process. This article reviews these and other issues to chart a forward path."

Comment: The author presents a critical review of the ability of the World Heritage Convention to produce a comprehensive adaptation strategy to climate change. This work emphasizes that adaptation is a local solution, and cannot be implemented at a more global level. It illustrates the challenges that international and national governments and organizations must address when establishing climate change policy for local jurisdictions. (AH)

U

UNESCO, *Policy Document on the Impacts of Climate Change on World Heritage Properties*. 2008. <http://whc.unesco.org/en/CC-policy-document/>

Keywords: Climate change; World Heritage properties

Summary: "Policy document on the impacts of climate change on World Heritage properties, adopted by the 16th General Assembly of States Parties to the World Heritage Convention, has been published in English and French. The document was prepared with the participation of relevant climate change experts and practitioners of heritage conservation and management, appropriate international organizations and civil society, and was also endorsed by the World Heritage Committee at its 31st session in 2007. The document touches on synergies between conventions on the issue; identification of future research needs in this area, legal questions on the role of the World Heritage Convention with regard to suitable responses to

Climate Change, and linkages to other UN and international bodies dealing with the issues of climate change."

Comment: The World Heritage Centre has developed this policy statement to guide its response to climate change. It establishes research priorities, policy, and legal positions. This document primarily guides the organization to address climate change by working with partners, advocating for climate change research, and publicizing impacts on World Heritage properties. The publication offers an example of how a large, parent organizations can frame a position on climate change. (AH)

UNESCO/World Heritage Centre. *World Heritage Reports 22, Climate Change and World Heritage*. 2007, 55p.
<http://whc.unesco.org/en/activities/474>

Keywords: Climate change; World Heritage; World Heritage Convention; resilience

Summary: "World Heritage properties are affected by the impacts of climate change at present and in the future. Their continued preservation requires understanding these impacts to their Outstanding Universal Value and responding to them effectively. World Heritage properties also harbour options for society to mitigate and adapt to climate change through the ecosystem benefits, such as water and climate regulation, that they provide and the carbon that is stored in World Heritage forest sites. Cultural heritage, on the other hand, can convey traditional knowledge that builds resilience for change to come and leads us to a more sustainable future. World Heritage properties serve as climate change observatories to gather and share information."

Comment: An international and comprehensive perspective on protection of World Heritage properties from climate change impacts is included in this document. (AH)

V

Volk, Michael, Kathryn Frank and Belinda B. Nettles. "Managing Coastal Change in the Cultural Landscape: A Case Study in Yankeetown and Inglis, Florida." *Change Over Time* 5. 2 (Fall 2015): 226-246. DOI: 10.1353/cot.2015.0018

Keywords: Sea level rise; cultural landscapes; adaptation action areas; planning; community resilience; Gulf Coast; Florida (USA)

Abstract: "Climate change and sea level rise are phenomena with significant cultural dimensions at all spatial levels; however, these dimensions are often neglected in adaptation planning. The community and regional planning field is awakening to the importance of culture as a concern in planning,

including community well-being, distinctiveness, cohesion, and capacity. Since planning is often conducted with a spatial focus, the concept of cultural landscapes is a potentially useful tool, and in particular for climate change and sea level rise adaptation. This article describes an action research project for local sea level rise adaptation planning that attended to cultural landscapes. The planning process asked: (1) What core cultural landscapes are important to maintain? (2) What cultural landscapes may be lost due to external changes and adaptation choices? and (3) What cultural landscape adaptive capacities exist to achieve community resilience? The project communities are the towns of Yankeetown and Inglis, neighboring small towns situated in the rural Gulf coast of Florida. The project found that locally significant cultural landscapes emerge when residents participate in planning processes, and that these landscapes hold new keys to successful adaptation.”

Comment: The authors illustrate how to establish adaptation action areas to manage sea level rise impacts on cultural landscapes by applying the concept to two small shoreline communities in Florida. Planners and historic preservation professionals may be able to apply the concepts identified in this article. (AH)