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## *Burning Libraries: A Community Response*

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**Abstract:** The first decade of the 21<sup>st</sup> century has seen a growing recognition that widespread impacts of climate change (erosion, sea level rise, wildfires, warming soil temperatures) are rapidly destroying archaeological sites and permanently wiping out millennia of cultural heritage and important scientific data on a global scale. This paper provides a brief overview of the efforts of the international archaeological community and its allies to organize a broad and coordinated response to this widespread and urgent threat to our basic record by mobilizing at the local, national, and international level. The work of the archaeological professional societies has supplemented a growing host of initiatives on multiple scales by national and local governmental agencies, regional research teams, local and indigenous heritage groups, and the international global change scientific community. This paper provides some reflections on the *Society for American Archaeology's Climate Change Strategies and the Archaeological Record* team effort 2015-2018, some links to more contacts and resources and some suggestions for future directions.

### **The Threat: Our Libraries are Burning**

In the late 20<sup>th</sup> and early 21<sup>st</sup> centuries, archaeologists have increasingly sought to use their data and long-term perspectives on human ecodynamics on the century to millennial scale to contribute to modern efforts to achieve societal resilience and sustainable resource use in a world affected by accelerating climate change (Dugmore et al. 2013, Jackson et al 2017, Fitzhugh et al. 2018, Hicks et al. 2017, Isendahl & Stump 2017, Sandweiss & Kelley 2012). Planners, scenario builders, and resource managers have increasingly recognized the value of the *longue durée* in managing the present for the future (Braje 2010, Englehard et al. 2015, Geudes et al. 2016, Hudson et al. 2012). The conceptual tool kit of Historical Ecology has now spread across multiple disciplines and represents a major force in applied archaeology and trans-disciplinary resilience approaches (Armstrong et al. 2017, Moss et al 2006, Nelson et al.2016, Haldon et al 2018, Riede 2017, Schwindt et al. 2016, West 2009). New analytic tools (including ancient DNA, stable isotopes, trace element analysis) combined with “big data” sets accumulated through decades of fieldwork allowing for large scale integrative modeling and synthesis all have combined in the first decades of this century to provide archaeology with unprecedented capacity to engage with grand challenges with direct relevance to the future of our species and planet (Altschul et al 2017, Kintigh et al. 2014a, 2014b). As several have noted, we have multiple “libraries of Alexandria” opening across the globe in what has been described as a “global observing network of the past” (Hambrecht et al. 2018).

In bitter irony, archaeology is also today facing unprecedented threat to its basic record, not only from the impacts of human landscape use and industrial development but from unstoppable global scale environmental impacts that in many areas will destroy the majority of the surviving archaeological record in a few decades (Anderson et al. 2017, Ashmore 1994, Bevan et al. 2017, Blankholm 2009, Daire et al. 2012, Dawson 2013, 2016, Dawson et al. 2017, Eberling et al 2011, English Heritage 1997, Erlandson 2008, Ezcurra et al. 2018, Fitzpatrick et al. 2006, Gibson 2008, 2014, Harvey & Perry 2015, Hollesen et al. 2012, 2015, 2018, Ives et al. 2017; Jensen 2017, Jordan 1988, Lopez-Romero et al. 2013, Manley et al 2007,

Matthiesen et al. 2014, Martens 2017, Murray et al. 2011, Reekin 2013, Reeder et al. 2012, Reeder-Myers 2015, Rick & Fitzpatrick 2012, Rivera-Collazo et al 2017,2018, Rivera-Collazo 2018, Rockman 2011, 2015, Sweet et al. 2017). This generation of archaeologists faces “burning libraries” across the globe, and all subsequent generations will judge us on our response to this threat. The need for collective action, pooling of resources, ideas, and funding support has never been more urgent.

## **Organizational Responses**

Responding to widespread concerns and growing local-level response efforts, in 2015 the *Society for American Archaeology* (SAA) expanded a task force investigating potential responses led by Dan Sandweiss (U Maine Orono) into the *Climate Change Strategies and the Archaeological Record Committee* (chaired by Dan Sandweiss and Tom McGovern, now chaired by Anne Jensen UIC). The CCSAR Committee has sponsored three successive “Burning Libraries” sessions (and multiple paper presentations in other sessions and three special SAA Presidential Forum panels) at the 2016 Orlando meeting, the 2017 Vancouver meeting (where many of the papers in this volume were presented) and the 2018 Washington DC meeting just completed. The SAA CCSAR committee continues to expand and prosper, and benefits from a very engaged, high-energy membership and team of international allies and collaborators (McGovern 2016, 2017, 2018). This set of papers is one product of this committee, and forms part of a growing set of peer-reviewed publications centered on climate change impacts and community response (Anderson et al. 2017, Dawson et al 2017, Hambrecht & Rockman 2017, Hollesen et al 2018).

Also in 2015 the *Integrated History and Future of People on Earth* (IHOPE) group began its *Global Environmental Threats to Heritage and the Long Term Observing Networks of the Past* hub (<http://ihopenet.org/global-environmental-change-threats-to-heritage-and-long-term-observing-networks-of-the-pas/>) . This international forum has provided excellent opportunities for sharing expertise and building best-practice connections internationally, in connecting government agency initiatives to local communities and self-organizing local response groups, and aiding graduate student participation in meetings and workshops facilitated by an NSF research coordination network grant 2012-16 from the NSF Arctic Social Sciences Program.

The *European Archaeology Association* (EAA) has also been increasingly active in climate change response, with a key session at the 2015 Glasgow meeting providing links between European and North American teams and producing an important edited volume (Dawson et al. 2017). The EAA 2016 Vilnius meeting launched a climate working group that has since expanded to community status in EAA. In 2017 the EAA Maastricht meeting featured three climate themed sessions (all well attended) and a very productive high- level roundtable organized by Peter Biehl, Vibeke Martens, and Felix Riede. Keynote speakers included Felipe Criado-Boado (EAA), Susan Chandler (SAA), Koji Mizoguchi (WAC), Ben Thomas (AIA), Thomas McGovern (SAA-CCSAR), Tom Dawson (Scotland’s Coastal Heritage at Risk), Marcy Rockman (USNPS), Michel Vorenhout (archaeomonitoring.nl).

The *Society for Historical Archaeology* established a Heritage at Risk Committee (HARC) at the 2017 mid-year meeting led by Sarah Miller of the *Florida Public Archaeology Network*. The Committee’s tasks are to coordinate with other groups monitoring the effects of sea level rise and other climate change actions on heritage resources; to share information about affected historical archaeological sites with these groups; and to communicate climate change studies, heritage documentation, and protection efforts to SHA members.

Archaeological professional organizations have now stepped up their formal participation in climate change impacts work and are forging strong international networks to connect communities and disciplines, spread best practice approaches, and work to increase funding support for urgent rescue and curation efforts. Many national and regional cultural resource and heritage management groups have developed excellent programs for climate impact response, and a sampling of these are provided below (*national and regional programs*). The international archaeological community is engaging with stakeholders and the global public about the threats to heritage and science and has become increasingly effective in getting the message out through a wide range of media (see the *media resources* listing below). There is much to be done, but some important progress has been made in the past few years.

### Some Milestones

In the past five years a remarkable outpouring of energy and enthusiasm has begun to engage with the threats posed by our burning libraries, and the papers in this collection provide some excellent illustrations of these initiatives. Some additional cooperative milestones can also be flagged up as well:

- **Arctic Horizons Visioning Process:** In 2016-17 the US National Science Foundation funded a major re-visioning process for the *Arctic Social Sciences Program* (Anna Kerttula program officer) that involved multiple meetings with a wide range of stakeholders and resulted in a major community-based report that is now available on line (<http://www.arctichorizons.org/>). Several CCSAR members participated in the process, and there was strong synergy across disciplines and (especially) between Indigenous scholars, academics, and practitioners. One major theme that emerged was the “burning libraries” issue, and threats to heritage and science were major concerns at all the workshops and breakout sessions. This report will help guide NSF Arctic Social Sciences program, which will have a major future role in climate impact response.
- **USGCRP (US Global Change Research Program)** held a 3-day workshop “Social Science Perspectives on Climate Change,” hosted by NASA HQ in Washington DC. This workshop was a collaboration between US Global Change Research Program, US federal scientists/planners from 13 agencies, and academic social scientists and professional associations of four disciplines (anthropology, archaeology, geography and sociology). The main objective was to shed more light on the four disciplines that have been under-represented in the federal research programs and past climate assessments. The SAA CCSAR team was represented by Marcy Rockman, George Hambrecht, Torben Rick, Tim Kohler, Isabel Rivera- Collazo, Peter Biehl, and Tom McGovern (with major help from Carrie Hritz). McGovern presented the SAA archaeology overview (with fine help from the rest of the team) and all have participated in creating a joint three-themed white paper now available on line <https://www.globalchange.gov/content/social-science-perspectives-climate-change-workshop>; Biehl et al 2018, Fisk et al 2018, Hardy et al. 2018). Tim Kohler (Washington State U) and Jia Li (EPA) are leading the effort to bring these out as a special issue of *WIREs Climate Change* in 2018.
- **USNPS Cultural Resources Climate Change Strategy:** The US National Park Service plan *NPS Cultural Resources Climate Change Strategy* (lead authored by Marcy Rockman) was released January 6, 2017 as an online download ([https://www.nps.gov/subjects/climatechange/upload/NPS-2016\\_Cultural-Resoures-Climate-Change-Strategy.pdf](https://www.nps.gov/subjects/climatechange/upload/NPS-2016_Cultural-Resoures-Climate-Change-Strategy.pdf)). Between January 25-27, 2017 the NPS *Strategy* went viral becoming the most downloaded federal document for three days. Multiple courses in environment and archaeology now use this document as a supplementary text book and it has become a

recognized international standard. On October 18, 2017 the World Heritage program expert meeting on Climate Change and Heritage embraced the NPS *Strategy* document.

### **Changing Business as Usual?**

During meeting and workshop discussions it has become clear that some things we need to do as a community of archaeologists are things we already are attempting:

- Expand digital documentation in the field, using technology to dig faster and smarter, create lasting 3 D imagery of standing structures and ruins that cannot be saved, creating community-based frameworks for prioritizing site rescue (organic preservation, uniqueness, heritage values, etc.)
- Expand engagement with digital media and place-based education initiatives to make the threat to heritage and science a “teachable moment” that will raise the profile of archaeology in primary and secondary schools and build public support for response actions.
- Improve digital archiving resources and contribute to initiatives like DINAA (Digital Index of North American Archaeology) which will become critical planning and prioritization tools.

We also are realizing that the archaeological community needs to re-think some of its long -held assumptions about good practice and responsible professional activities, as our current “business as usual” approaches are increasingly inappropriate:

- *In situ* preservation of archaeological sites is increasingly impractical. Rapid soil warming in South Greenland has already caused the near complete loss of organic preservation of over 90% of the once incredibly rich Norse midden deposits (Hollesen et al 2015, 2018). Bones excavated in the 1930’s now on museum shelves in Copenhagen remain in excellent condition, but bones left in the ground on the same sites are now unrecoverable mush. As a discipline we must realize that a minimal disturbance, *in situ* preservation strategy is no longer viable in many areas.
- *Ex situ* conservation of collections and data by large scale excavation will generate analytic backlogs. These are not sinful, permit endangering, “bad archaeologist” backlogs, but must be understood as positive and desired outcomes of large scale rescue work. Good archaeologists now deliberately must create backlogs, or the future will have nothing to study.
- *Doctoral theses for the future:* we must recognize that we will be creating analytical resources that will generate PhD and MA theses for students not yet born. This will require not only new attitudes towards backlogs, but also careful strategies for long term curation and effective digital stewardship of the site records that will make sense of collections for future analysts. The Digital Antiquity teams and related digital data management initiatives already becoming active will play a vital role in making this work and need commensurate funding support.
- *Large scale, sustained funding* for a coordinated international effort will be needed for at least a decade of intense rescue work, and for multiple decades of curation and post-excavation analyses. We need to approach private and institutional donors as well as the usual research-based funding agencies and build public and donor support for our mission. This will require commitment on the scale generated by the international geophysical community in the successful effort to emergency core multiple mid-latitude ice sheets (some now melted) and to

retain the ice cores for long term future study. We have allies in the natural science community, and we should make use of our increasing visibility as contributors to global change science to gain widespread support for a serious, sustained effort.

#### **National and International Response programs (partial listing):**

1) **CHERISH** (Climate Heritage & Environments of Reefs, Islands and Headlands) (Ireland and Wales)

<http://www.irelandwales.eu/projects/cherish> and <https://www.facebook.com/CherishProject/>

2) **Prince Edward Island Canada, Building Small Island Resilience to Global Climate Change: An International Symposium** <http://projects.upei.ca/unescochair/files/2016/10/Helen-Kristmanson.pdf>

3) **CoastAdapt Northern Peripheries Program EU**

<http://www.northernperiphery.eu/en/projects/show/&tid=61>

Set of Five Videos, Norway, Orkney, Outer Hebrides, Iceland, Eire

<https://www.youtube.com/playlist?list=PL43D9A077C476BC84>

4) **Historic England** <https://historicengland.org.uk/research/current/threats/heritage-climate-change-environment/what-effects/>

5) **CARRA** (Newfoundland) <https://carra-nl.com/>

6) **CitiZan** (UK) <https://www.citizan.org.uk/>

7) **COASTAL** (Canada) <http://www.historymuseum.ca/blog/public-help-survey-endangered-archaeological-sites/>

8) **SCAPE & SCHARP** (Scotland) <http://www.scapetrust.org/>

[http://scharp.co.uk/media/medialibrary/2017/12/Review\\_of\\_Coastal\\_Heritage\\_at\\_Risk.pdf](http://scharp.co.uk/media/medialibrary/2017/12/Review_of_Coastal_Heritage_at_Risk.pdf)

9) **Historic Environment Scotland** <https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=55d8dde6-3b68-444e-b6f2-a866011d129a>

<http://www.dynamiccoast.com/>

#### **Media Resources**

**Union of Concerned Scientists** list-server on climate and heritage has become a critical communications link to a broad community (thanks to Alan Markham) that includes the CCSAR team and its allies:

[climate-heritage@cic.ucsusa.org](mailto:climate-heritage@cic.ucsusa.org)

**Bifrost Online** ([www.bifrostonline.org](http://www.bifrostonline.org)<<http://www.bifrostonline.org/>>) The Bifrost project is based in Sweden and led by Steven Hartman, and works at the cutting edge of digital media for environment. They have featured multiple segments on climate impact on heritage. BifrostOnline is an international, open-access channel promoting education for sustainability and climate change awareness. The website regularly presents and continuously updates a wide range of stories, reports, data, artistic engagements and insights from knowledgeable actors (individuals and groups) operating on the front lines of global

environmental change. One goal is to increase public understanding and awareness of the social and environmental challenges related to climate change. Another is to demonstrate the capacity for decisive individual, organizational and community engagement in climate-change mitigation and adaptation efforts as we work to realize the world's commitments to the landmark Paris agreement on climate change.

**Yale E360** (produced by Yale School of Forestry and Environmental Studies (<http://e360.yale.edu>) features well written and heavily illustrated articles (and videos) directly relevant to climate change impacts, and have recently featured stories on sea level impacts: <http://e360.yale.edu/features/on-the-chesapeake-a-precarious-future-of-rising-seas-and-high-tides>

**Hakai Magazine** regularly runs stories about coastal and marine heritage and has several now featuring climate change threats <http://www.hakaimagazine.com/article-long/history-melting>  
<http://www.hakaimagazine.com/article-long/what-history-gives-sea-steals>

**Smithsonian Magazine** has become a major platform for disseminating stories about climate impact on heritage and science:

Arctic Erosion <http://www.smithsonianmag.com/science-nature/arctic-erodes-archaeologists-are-racing-protect-ancient-treasures-180957933/>

Ice patch archaeology <https://www.smithsonianmag.com/smart-news/2000-artifacts-pulled-edge-norways-melting-glaciers-180967949/>

## References

Altschul, Jeffrey H. Keith W. Kintigh, Terry H. Klein, William H. Doelle, Kelley A. Hays-Gilpin, Sarah A. Herr, Timothy A. Kohler, Barbara J. Mills, Lindsay M. Montgomery, Margaret C. Nelson, Scott G. Ortman, John N. Parker, Matthew A. Peeples, and Jeremy A. Sabloff , 2017 Fostering Synthetic Research in Archaeology to Advance Science and Benefit Society. *Proceedings of the National Academy of Sciences* PNAS | October 17, 2017 | vol. 114 | no. 42 | 10999–11002.

Armstrong, Chelsey Geralda, Anna C. Shoemaker , Iain McKechnie, Anneli Ekblom, Péter Szabó, Paul J. Lane, Alex C. McAlvay, Oliver J. Boles, Sarah Walshaw, Nik Petek, Kevin S. Gibbons, Erendira Quintana Morales, Eugene N. Anderson, Aleksandra Ibragimow, Grzegorz Podruczny, Jana C. Vamosi, Tony Marks-Block, Joyce K. LeCompte, Sākihito win Awâsis, Carly Nabess, Paul Sinclair, Carole L. Crumley 2017 Anthropological contributions to historical ecology: 50 questions, infinite prospects. *PLoS ONE* 12(2): e0171883. DOI:10.1371/journal.pone.0171883.

Anderson DG, Bissett TG, Yerka SJ, Wells JJ, Kansa EC, Kansa SW, et al. (2017) Sea-level rise and archaeological site destruction: An example from the southeastern United States using DINAA (Digital Index of North American Archaeology). *PLoS ONE* 12(11): e0188142.  
<https://doi.org/10.1371/journal.pone.0188142>

Ashmore, P. 1994. *Archaeology and the coastal zone: toward a Historic Scotland policy*. Edinburgh: Historic Scotland.

Bevan, A. & Downes, J. Jun 2017 *Wilder Being: Destruction and creation in the littoral zone Relate North: Culture, Community and Communication*. Jokela, T. & Coutts, G. (eds.). Rovaniemi: Lapland University Press, p. 154-166 12 p.<https://urn.fi/URN:ISBN:978-952-310-957-5>

Biehl P. F., S. Crate, M. Gardezi, L. Hamilton, S.L. Harlan, C. Hritz, B. Hubbell, T. A. Kohler, N. Peterson, J. Silva, 2018. *Innovative tools, methods, and analysis: Social science perspectives on climate change, part 3*. Washington, DC: USGCRP Social Science Coordinating Committee. <https://www.globalchange.gov/content/social-science-perspectives-climate-change-workshop>

Blankholm, H.P. 2009. Long-Term Research and Cultural Resource Management Strategies in Light of Climate Change and Human Impact. *Arctic Anthropology* 46(1/2):17-24.

Braje TJ (2010) *Modern oceans, ancient sites: archaeology and marine conservation on San Miguel Island, California*. University of Utah Press, Salt Lake City

Daire, m.-y., e. López-romero, j.n. proust, h. Regnauld, s. Pian & b. Shi. 2012. Coastal changes and cultural heritage (1): assessment of the vulnerability of the coastal heritage in western France. *Journal of Island and Coastal Archaeology* 7: 168–82. <http://dx.doi.org/10.1080/15564894.2011.652340>

Dawson, T. 2013. Locating and prioritizing action at eroding coastal sites, in M.-Y. Daire, C. Dupont, A. Baudry, C. Billard, J.M. Large, L. Lespez, E. Normand & C. Scarre (ed.) *Ancient maritime communities and the relationship between people and environment along the European Atlantic coasts / Anciens peuplements littoraux et relations Homme/Milieu sur les côtes de l'Europe atlantique. Proceedings of the Homer 2011 Conference, Vannes (France), 27/09–1/10 2011* (British Archaeological Reports international series 2570): 77–84. Oxford: Archaeopress.

Dawson, Tom 2016 Community Rescue: Saving Sites from the Sea. *Arqueologia Publica: Online Journal in Public Archaeology* Special Vol. 2:5–42.

Dawson, T., C. Nimura, E. Lopez-Romero and M-Y. Daire (eds.). 2017 *Public Archaeology and Climate Change*. Oxbow Books.

Dugmore, Andrew J. ,Thomas H. McGovern, Richard Streeeter, Christian Koch Madsen, Konrad Smiarowski and Christian Keller, 2013 'Clumsy solutions' and 'Elegant failures': Lessons on climate change adaptation from the settlement of the North Atlantic islands , chapter 38 in: *A Changing Environment for Human Security: Transformative Approaches to Research, Policy and Action*, Edited by Linda Sygna, Karen O'Brien and Johanna Wolf. Routledge UK London.

Elberling, B., Matthiesen, H., Jorgensen, C.J., Hansen, B.U., Gronnow, B., Meldgaard, M., Andreasen, C., Khan, S.A. (2011) Paleo-Eskimo kitchen midden preservation in permafrost under future climate conditions at Qajaa, West Greenland, *Journal of Archaeological Science* 38, 1331-1339.

English Heritage. 1997. *England's coastal heritage: a statement on the management of coastal archaeology*. London: English Heritage.

Engelhard, G. H., Thurstan, R. H., MacKenzie, B. R., Alleway, H. K., Bannister, R. C. A., Cardinale, M., Clarke, M. W., Currie, J. C., Fortibuoni, T., Holm, P., Holt, S. J., Mazzoldi, C., Pinnegar, J. K., Raicevich, S., Volckaert, F. A. M., Klein, E. S., and Lescauward. A-K. (2015) ICES meets marine historical ecology:



placing the history of fish and fisheries in current policy context. *ICES Journal of Marine Science*, doi: 10.1093 /icesjms/fsv219.

Erlandson, J.M. 2008. Racing a rising tide: global warming, rising seas and the erosion of human history. *Journal of Island and Coastal Archaeology* 3: 167–69. <http://dx.doi.org/10.1080/15564890802436766>

Ezcurra ,Paula and Isabel Rivera-Collazo (in press 2018) "An assessment of the impacts of climate change on Puerto Rico's Cultural Heritage with a case study on sea-level rise" , *Journal of Cultural Heritage*.

Fiske S., K. Hubacek, A. Jorgenson, J. Li, T. McGovern, T. Rick, J. Schor, W. Solecki, R. York, A. Zycherman. (2018). *Drivers and responses: Social science perspectives on climate change, part 2*. Washington, DC: USGCRP Social Science Coordinating Committee. <https://www.globalchange.gov/content/social-science-perspectives-climate-change-workshop>

Fitzhugh, Ben, Virginia Butler, Kristine Bovy, Michael Etnier, 2018 Human Ecodynamics: A Perspective for the Study of Long-term Change in Socioecological Systems, *Journal of Archaeological Science: Reports* (2018), <https://doi.org/10.1016/j.jasrep.2018.03.016>

Fitzpatrick SM, Kappers K, Kaye Q (2006) Coastal erosion and site destruction on Carriacou, West Indies. *Journal of Field Archaeology* 31:251–262

Gibson, J. (2008) *Rising Tides: the loss of coastal heritage in Orkney*. Orkney College.

Gibson, J. (2014) Shaped by the Sea: The Endangered Archaeology of Orkney's Maritime Communities, pp. 21-34 in Harrison, R. and Maher, R. (ed)., *Human Ecodynamics in the North Atlantic*". Lexington Books.

Guedes, Jade A. d'Alpoim, Stefani A. Crabtree, R. Kyle Bocinsky, and Timothy A. Kohler 2016 Twenty-First Century Approaches to Ancient Problems: Climate and Society. *Proceedings of the National Academy of Sciences* 113(51): 14483-14491. DOI:10.1073/pnas.1616188113.

Hambrecht, G. and M. Rockman. 2017. International Approaches to Climate Change Threats and Cultural Heritage. *American Antiquity*. 82 (4) 627-641. <https://www.cambridge.org/core/journals/american-antiquity/article/international-approaches-to-climate-change-and-cultural-heritage/0F0B8408889E4A12817FB922397C6ED8>

John Haldon, Lee Mordechai, Timothy P. Newfield, Arlen F. Chase, Adam Izdebski, Piotr Guzowski, Inga Labuhn, and Neil Roberts 2018 History meets palaeoscience: Consilience and collaboration in studying past societal responses to environmental change PNAS March 12, 2018. 201716912; published ahead of print March 12, 2018. <https://doi.org/10.1073/pnas.1716912115>

Hambrecht, George, Anderung, C., Brewington, S., Dugmor.e, A., Edvardsson, R., Feeley, F., Gibbons, K., Harrison, R., Hicks, M., Olafsdottir, G., Rockman, M., Smiarowski, K., Streeter, R., Szabo, V., McGovern, T.H. In press 2018. Distributed Observation Networks of the Past. *Quaternary International*.

Hardy D., H. Lazrus, M. Mendez, B. Orlove, I. Rivera-Collazo, J. T. Roberts, M. Rockman, K. Thomas, B. P. Warner, R. Winthrop. (2018). Social vulnerability: Social science perspectives on climate change, part 1.

Washington, DC: USGCRP Social Science Coordinating Committee. <https://www.globalchange.gov/content/social-science-perspectives-climate-change-workshop>

Harvey D. & Jim Perry (eds.) (2015). *The Future of Heritage as Climates Change: Loss, Adaptation and Creativity* (Key Issues in Cultural Heritage) Routledge UK.

Hicks Megan, Árni Einarsson, Kesara Anamthawat-Jónsson, Ágústa Edwald, Adolf Friðriksson, Ægir Þór Þórsson, Thomas H. McGovern (2017) Community and Conservation: Documenting Millennial Scale Sustainable Resource Use at Lake Mývatn Iceland. in C. Isendahl & D. Stump (eds.) *Handbook of Historical Ecology and Applied Archaeology* Oxford University Press

Hollesen, J., Jensen, J.B., Matthiesen, H., Elberling, B., Lange, H., Meldgaard, M. (2012) The Future Preservation of a Permanently Frozen Kitchen Midden in Western Greenland, *Conservation and mgmt of arch. sites* 14, 159-168.

Hollesen, J., Matthiesen, H., Moller, A.B., Elberling, B. (2015) Permafrost thawing in organic Arctic soils accelerated by ground heat production, *Nature Clim. Change* advance online publication.

Hollesen, J., Callanan, M., Dawson, T., Fenger-Nielsen, R., Friesen, T., Jensen, A., Markham, Adam; Martens, Vibeke; Pitulko, Vladimir; Rockman, M. (2018). Climate change and the deteriorating archaeological and environmental archives of the Arctic. *Antiquity*, 92(363), 573-586. doi:10.15184/aqy.2018.8

Hudson, M.J., M. Aoyama, K.C. Hoover and J. Uchiyama. 2012. Prospects and challenges for an archaeology of global climate change. *Wiley Interdisciplinary Reviews: Climate Change* 3(4):313-328.

Isendahl C. & D. Stump (eds.) 2017 *Handbook of Historical Ecology and Applied Archaeology* Oxford University Press

Ives, Timothy H., Kevin A. McBride, and Joseph N. Waller 2017 Surveying Coastal Archaeological Sites Damaged by Hurricane Sandy in Rhode Island, USA. *The Journal of Island and Coastal Archaeology* 0(0):1–23. Published online February 21,2017.

Jackson, R., Dugmore, A. J., & Riede, F. (2017). Towards a new social contract for archaeology and climate change adaptation. *Archaeological Review from Cambridge*, 32(2), 197-221.

Jensen, Anne M. 2017 Threatened heritage and community archaeology on Alaska's North Slope. In *Public Archaeology and Climate Change*. T. Dawson, C. Nimura, E. Lopez-Romero and M-Y. Daire (eds.). Oxbow Books.

Jordan, J.W. 1988. *Erosion characteristics and retreat rates along the north coast of Seward Peninsula*. The Bering Land Bridge National Preserve: an archaeological survey, edited by J. Schaaf, Vol. I. Anchorage, Alaska: National Park Service. pp. 322-362.

Kintigh, Keith W., Jeffrey H. Altschul, Mary C. Beaudry, Robert D. Drennan, Ann P. Kinzig, Timothy A. Kohler, W. Fredrick Limp, Herbert D.G. Maschner, William K. Michener, Timothy R. Pauketat, Peter Peregrine, Jeremy A. Sabloff, Tony J. Wilkinson, Henry T. Wright, and Melinda A. Zeder

2014a Grand Challenges for Archaeology. *American Antiquity* 79(1): 5-24

2014b Grand Challenges for Archaeology. *Proceedings of the National Academy of Sciences*. 111(3): 879-880. DOI:10.1073/pnas.1324000111

Lopez-Romero, Elias, Marie-Yvane Daire, J.N. Proust, Hervé Regnaud, Soizig Pian, and Schaeffer Erik 2013 Le projet Alert: une analyse de la vulnérabilité du patrimoine culturel côtier dans l'Ouest de la France. In *Ancient Maritime Communities and the Relationship between People and Environments along the European Atlantic Coasts*, edited by MarieYvane Daire, Catherine Dupont, Anna Baudry, Cyrille Billard, Jean-Marc Large, Laurent Lespez, Eric Normand, and Chris Scarre, pp. 127–136. British Archaeological Reports Ltd., Oxford, England.

Manley, W.F., O.K. Mason, J.W. Jordan, D.M. Sanzone, E.G. Parrish and L.R. Lestak. 2007. *Coastal Change since 1950 in the Southeast Chukchi Sea, Alaska, Based on GIS and Field Measurements*. Paper presented at the Arctic Coastal Zones at Risk workshop in Tromso, Norway.

Matthiesen, H., Jensen, J.B., Gregory, D., Hollesen, J., Elberling, B. (2014) Degradation of Archaeological Wood Under Freezing and Thawing Conditions—Effects of Permafrost and Climate Change, *Archaeometry*, 56, 3, 479–495.

Martens, V. V. 2017. Mitigating Climate Change Effects on Cultural Heritage Sites? *Archaeological Review from Cambridge* Volume 32.2., November 2017, 123-140.

McGovern, Thomas H. 2016 Report of 2015 SAA Climate Change Strategies and the Archaeological Record Committee ( available [www.nabohome.org](http://www.nabohome.org) )

McGovern, Thomas H. 2017 Report of 2016 SAA Climate Change Strategies and the Archaeological Record Committee (available [www.nabohome.org](http://www.nabohome.org))

McGovern, Thomas H. 2018 Report of 2017 SAA Climate Change Strategies and the Archaeological Record Committee (available [www.nabohome.org](http://www.nabohome.org))

Moss, Madonna L. , Dongya Y. Yang, Seth D. Newsome, Camilla F. Speller, Iain McKechnie, Alan D. McMillan, Robert J. Losey, and Paul L. Koch 2006. Historical Ecology and Biogeography of North Pacific Pinnipeds: Isotopes and Ancient DNA from Three Archaeological Assemblages, *Journal of Island & Coastal Archaeology*, 1:165–190, 2006 DOI:10.1080/15564890600934129

Murray, Maribeth, Anne M. Jensen, and Max Friesen (2011) Identifying Climate Change Threats to the Arctic Archaeological Record: Global Climate Change and the Polar Archaeological Record; Tromsø, Norway, 15-16 February 2011. *EOS* 91(21):180.

Nelson, Margaret C., Scott E. Ingram, Andrew J. Dugmore, Richard Streeter et al. (2016) Climate challenges, vulnerabilities, and food security. *PNAS* 113(2):298-303.

- Reckin, R. 2013. Ice Patch Archaeology in Global Perspective: Archaeological Discoveries from Alpine Ice Patches Worldwide and Their Relationship with Paleoclimates. *Journal of World Prehistory* 26(4):323-385.
- Reeder, L.A., T.C. Rick & J.M. Erlandson. 2012. Our disappearing past: a GIS analysis of the vulnerability of coastal archaeological resources in California's Santa Barbara Channel region. *Journal of Coastal Conservation* 16: 187–97. <http://dx.doi.org/10.1007/s11852-010-0131-2>
- Reeder-Myers Leslie A. (2015) Cultural Heritage at Risk in the Twenty-First Century: A Vulnerability Assessment of Coastal Archaeological Sites in the United States, *The Journal of Island and Coastal Archaeology*, 10:3, 436-445, DOI:10.1080/15564894.2015.1008074
- [Rick](#), Torben & [Scott Fitzpatrick](#) (ed.s) 2012. Special Issue: Archaeology and Coastal Conservation, *Journal of Coastal Conservation* Volume 16, Issue 2, June 2012
- Riede, F. (2017). Past-Forwarding Ancient Calamities. Pathways for Making Archaeology Relevant in Disaster Risk Reduction Research. *Humanities*, 6(4), 79, doi:10.3390/h6040079. > OBS. This is part of the SI in the journal on env hum, all OA.
- Rivera-Collazo, Isabel C., Cristina Rodríguez-Franco, and José Julián Garay-Vázquez 2018 A Deep-Time Socioecosystem Framework to Understand Social Vulnerability on a Tropical Island. *Environmental Archaeology* 23:97-108.
- Rivera-Collazo, Isabel C., and Paula Ezcurra 2017 Climate Change Impacts to Puerto Rico's Cultural Heritage. Contribution to the *PRCCC Working Group 3 2017 Report*. San Juan, Puerto Rico.
- Rivera-Collazo, Isabel C., 2018 "Grassroots activism and catastrophes: The case of Cultural Heritage and Hurricane Maria in Puerto Rico" in the *SAA Archaeological Record* January 2018 volume.
- Rockman, M. 2011. *The necessary roles of archaeology in climate change mitigation and adaptation*. In *Archaeology in Society: Its Relevance in the Modern World*, edited by M. Rockman and J. Flatman, New York: Springer. pp. 193-215.
- Rockman, Marcy 2015 An NPS Framework for Addressing Climate Change with Cultural Resources. *The George Wright Forum* 32(1):37–50.
- Sandweiss, D. and Kelley, A.R., (2012). The Archaeological Record as a Paleoclimatic and Paleoenvironmental Archive, *Annual Review of Anthropology*, v. 21, pp.371-409.
- Schwindt, D. M., R. K. Bocinsky, S. G. Ortman, D. M. Glowacki, M. D. Varien, and T. A. Kohler (2016) The Social Consequences of Climate Change in the Central Mesa Verde Region. *American Antiquity* 81(1):1-23.
- Sweet, W.V., R.E. Kopp, C.P. Weaver, J. Obeysekera, R.M. Horton, E.R. Thieler, and C. Zervas 2017 *Global and Regional Sea Level Rise Scenarios for the United States*. NOAA Technical Report NOS CO-OPS 083. NOAA/NOS Center for Operational Oceanographic Products and Services, Washington, DC.
- West, Catherine Foster (2009) Kodiak Island's Prehistoric Fisheries: Human Dietary Response to Climate Change and Resource Availability, *Journal of Island & Coastal Archaeology*, 4:223–239, 2009 DOI: 10.1080/15564890903178432