

HOW-TO SERIES

Exploring Climate Change Adaptations for Cultural Heritage: The ADAPT Framework

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Abstract

There is an urgent need for climate change–informed decision-making and adaptation actions for cultural heritage. Challenges arise in incorporating and balancing multiple considerations, including robust understandings of climate change vulnerability, the objectives of current management paradigms, the need for meaningful engagement, the risk of maladaptation, and constrained resources to implement. We offer a conceptual framework and guide to integrate climate science and cultural heritage management to produce a range of adaptation actions for cultural heritage, categorized as *Acclimate*, *Dislocate*, *Abandon*, *Protect*, and *Tell the Story* (ADAPT) approaches. The ADAPT framework is intended to aid archaeologists and other cultural heritage managers in developing and evaluating possible adaptation actions that directly respond to findings from climate change vulnerability assessments, critically integrating management postures and constraints, and coproducing climate change adaptations with Indigenous rightsholders and community stakeholders.

Resumen

Existe una necesidad urgente de tomar decisiones informadas sobre el cambio climático y adaptaciones accionadas para el patrimonio cultural. Existen desafíos para incorporar y equilibrar múltiples consideraciones, incluida una comprensión fuerte de la vulnerabilidad al cambio climático, los objetivos de los paradigmas de gestión corriente, la necesidad para involucrar a las personas de manera significativa, el riesgo de mala adaptación, y los recursos limitados para implementar. Nosotros ofrecemos un plan conceptual y una guía para integrar la ciencia climática y la gestión del patrimonio cultural para producir una variedad de acciones de adaptación para el patrimonio cultural, categorizadas como los enfoques ADAPT: *Aclimatar*, *Desplazar*, *Abandonar*, *Proteger*, y *Contar la Historia*. La herramienta ADAPT tiene como objetivo ayudar a los arqueólogos y otros administrados del patrimonio cultural en el desarrollo y evaluación de posibles acciones de adaptación, en respuesta de los hallazgos de las evaluaciones de vulnerabilidad al cambio climático, abordando críticamente las posiciones y limitaciones de la gestión y coproducir adaptaciones al cambio climático con titulares de derechos indígenas y partes interesadas comunitarias.

Keywords: climate change; cultural heritage adaptation; engagement

Palabras clave: cambio climático; adaptación del patrimonio cultural; involucrando a las personas

Climate change poses direct and urgent threats to cultural heritage. As the planet warms, sea levels rise, wildfires rage, and the ocean acidifies, both cultural heritage sites and their environmental contexts face unprecedented changes that can result in degradation, destruction, and loss, as well as stretching the limits of management resources. To address these threats, we need *adaptations*: strategies and actions to adjust to the conditions of a changing climate. Cultural heritage adaptations include actions to protect archaeological sites and landscapes against current or future climate stressors, actions that revisit and change our management goals, and, above all, actions that are climate informed and acknowledge the very different world emerging from the climate crisis.

Intentional, proactive, and thoughtful adaptations are an improvement over responses that are poorly informed, reactive, or maladaptive (adaptation actions that unintentionally result in worsened vulnerability). They should be informed by diverse literature from both climate adaptation science and cultural heritage management disciplines, coproduced with Indigenous rightsholders and community stakeholders, and aligned with management missions. But the stakes are high: most cultural heritage management sectors are chronically underfunded and understaffed, forcing trade-offs and priorities for climate change adaptation decision-making and implementation: Which site is protected versus abandoned? What adaptation actions can be funded and maintain basic management solvency? The purpose of this article is to offer a conceptual framework for cultural heritage managers to develop and evaluate adaptation actions informed by climate change vulnerability assessments and critical cultural heritage considerations.

Climate Change Vulnerability Assessments and Cultural Heritage Management

A common entry point for climate change responses is to consider potential impacts from different *climate stressors*, such as observed or projected changes in sea-level rise, temperature, or precipitation. Most cultural heritage managers are deeply familiar with the sites and historic properties under their jurisdiction, so examining the impacts of different stressors is a readily available space to begin thinking about climate change. Vulnerability assessments provide a framework for observing, considering, and presenting this type of information. They may include different and expanded inputs and components from different practitioners to serve specific management aims (Berto et al. 2022; Daly 2014; Glick et al. 2011; Intergovernmental Panel on Climate Change [IPCC] 2022; Michalak et al. 2022; Peek et al. 2022:3; Soares et al. 2012).

In its most basic form, a cultural heritage vulnerability assessment is a structured approach to integrating *climate exposures* (the measure and extent of a climate stressor at a geographical place) with *resource sensitivities* (the susceptibility of the resource to the climate stressor) to produce a measure of *vulnerability*: what cultural heritage is at risk for adverse effects and why (Peek et al. 2022:3; Rockman et al. 2016; Yu et al. 2022). A site-specific example would be assessing the vulnerability of a metal-hulled underwater shipwreck site to ocean acidification (the stressor): a practitioner could assess projections of localized carbonate ion content in the water (the exposure) with site metal corrosion measures (the sensitivity) to produce a measure of vulnerability.

As relatively straightforward as the approach is, the utility of a vulnerability assessment depends on the management goal. The assessments can become as complex as your management question, the availability of data, and the management of inherent uncertainty within climate modeling will allow. One way to improve and complement vulnerability assessment data inputs and use is to integrate climate science and cultural heritage sensitivity data with observed local knowledge, Indigenous knowledge, and traditional ecological knowledge. There is a great potential to make climate change vulnerability assessments both much more robust and informed, as well as offering an entry point for stakeholder engagement at the earliest opportunity in climate change response.

Here, our intent is to use vulnerability assessments to directly inform the development of adaptations. Doing so requires robust data gathering on local climate stressors (current and projected) and exposures, targeted to whatever scale is appropriate for the adaptation question at hand, and considering compound, cascading, and transboundary hazards (IPCC 2022:67). Ideally, to work within understandings of uncertainty of both future emissions and climate models, these data should acknowledge multiple plausible climate futures. However, it is important to consider what minimum necessary information is required to develop and consider potential adaptations. We encourage seeking the balance between acquiring robust and necessary data so you do not enter into “analysis paralysis,” allowing pretexts of uncertainty to stall or undermine decision-making.

This work also includes assessing resource sensitivities focused on the collection/site/property/landscape to be assessed and informed both by multidisciplinary literature reviews and collaborations with stakeholders to incorporate observed, Indigenous, and traditional ecological knowledges. Such partnerships offer critical information on exposures and sensitivity, site governance, and representation in climate change response and decision-making. This information is also important when adaptation

discussions are targeted to spatial boundaries; climate change risks are not limited to management jurisdictions, and adaptation actions might result in major impacts to neighbors.

Cultural heritage management goals are often focused on the preservation of historic places to their condition at a specific point in time of their history, goals that may or may not be aligned with community or rightsholders' preferences. Preservation to a selected moment in the past is increasingly challenging in environmental settings that appear nothing like the past. In many cases, climate change adaptation and historical preservation appear diametrically opposed. The US Secretary of the Interior's Standards for the Treatment of Historic Properties (US Department of the Interior 1995) and other foundational historic preservation guidelines are being actively challenged by the rapid rate and severity of climate impacts. Core disciplinary concepts may no longer be automatically prioritized in the quickly evolving and challenging context of climate change, given the chronic paucity of cultural management resources. Treatments that were once thought too invasive or disruptive may rise to the top of the decision space.

Cultural heritage managers must therefore critically assess not only climate change vulnerabilities but also what they are trying to achieve through adaptation. This requires periodically revisiting their goals (National Park Service [NPS] 2021). Vague goals of "resilience" or the continuation of previous preservation and management norms for all cultural resources threatened by climate change are neither practical nor particularly helpful. Much better is a frank assessment of the management tools and capacities at hand and projected for the future, as well as a thoughtful and collaborative assessment of stakeholder community priorities and the sociocultural environment. These components—considering goals and data when doing a vulnerability assessment and developing localized adaptation actions—should ideally be coproduced with those stakeholders.

Introducing the ADAPT Framework

The knowledge gained through stakeholder collaboration, vulnerability assessments, and reviews of management goals are essential for directly influencing cultural heritage climate change adaptations. Here we propose a conceptual framework to assist cultural heritage managers with brainstorming, developing, and assessing a range of adaptation actions—ADAPT: *Acclimate, Dislocate, Abandon, Protect, and Tell the Story*. This framework acknowledges the difficult decisions facing cultural heritage managers who are tackling climate change responses and offers a practical pathway to integrate climate adaptation science with cultural heritage management while prioritizing collaborative coproduction with community partners and stakeholders.

Within the ADAPT framework, each category captures a distinct set of adaptation actions that respond to vulnerability assessment and cultural heritage management (Figure 1). The goal is to first enable the development of an array of climate change-informed actions, thinking across a spectrum of categories and responding to different data points. Actions across all categories can be considered at different physical scales (e.g., material type, specific artifact or assemblage, entire site) and at different temporal scales (temporary to semipermanent to permanent), using both climate projection data and common management data (e.g., site maps or reports, material analysis, GIS maps, environmental reports). Actions can be developed both in response to ongoing and observed impacts or in preparation for future impacts. They can be done individually or together (and, again, at different scales), and thresholds can be set for how long to pursue a certain set of actions. Finally, all assume a level of monitoring both for changes and climate impacts, as well as assessment of the effectiveness of the adaptation action deployed. Each action category is described next, with corresponding (nonexhaustive) examples.

Acclimate adaptation actions reduce the sensitivity of cultural resources to identified climate stressors. These are actions that change something intrinsic about the resource to reduce its susceptibility to identified climate stressors. They could range from temporary or reversible to permanent actions and could be deployed at material, artifact, or site scales. Many such actions likely include some loss of cultural integrity, which should be assessed and acknowledged before implementation and compared to the outcomes of taking no action. Examples include wet floodproofing a historic structure, using fire-retardant material treatments, applying permanent protective coatings,



Figure 1. The ADAPT framework and considerations for evaluation (image by author).

removing invasive vegetation species, and installing geotextiles. Consider that, for each action, the exposure will still be present: the sea will rise, the fire will burn, but the resource will be less sensitive to that climate stressor.

Dislocate adaptation actions remove cultural heritage sites from their environmental context. They are typically irreversible actions that include significant loss of cultural integrity. These major interventions likely require intensive management resources, with long-lasting considerations and deeply considered advance planning and engagement with all rightsholders and stakeholders. A critical requirement of *Dislocate* actions is robust documentation before implementation to enhance the potential for digital and virtual assessments of the resource in its original environment. Examples include emergency or “rescue” site excavation, select artifact excavation, and historic structure/collection relocation.

Abandon adaptation actions relinquish management of a cultural heritage site and accept its likely degradation or loss. This is distinguished from a passive unintentional acceptance of degradation (the do-nothing approach) because it emphasizes a deliberate choice to funnel resources and effort elsewhere. This is an immensely challenging decision, which requires both formal consultation and compliance pathways, as well as informal collaboration and decision-making with associated communities. Such a decision must explicitly modify preservation management goals. This decision may be

reversible, but many kinds of cultural heritage are nonrenewable: once historical data are lost, they are gone forever.

As with *Dislocate*, a critical consideration for *Abandon* actions is robust documentation to enable a form of virtual life once the resource is gone: a “preservation by record” (Andrews et al. 2000; Huggett 2015). Emerging technologies can support this goal, such as high-resolution laser scanning, 3D photogrammetry, lidar, and 3D printing. Such approaches can not only preserve data potential but also expand engagement with cultural heritage for both public and practitioners who may not otherwise get to experience or access a site personally (Wright 2018). *Abandon* actions also can include proactive preparation for abandonment, such as dismantling a hazardous structure, or gradual abandonment, such as removing selected highly sensitive components to extend the life of the resource and enable a paced deceleration in management. Examples could include deciding not to rebuild a historic structure after a major storm event; data mitigation, with no further actions planned; removing a site from a monitoring schedule; deciding not to attempt restoration of a cultural landscape after a wildfire; or landscape-scale coastal retreat.

Protect adaptation actions reduce the exposure of cultural heritage sites to climate stressors. They can range from temporary or reversible to permanent actions and could be conducted at artifact, site, or larger scales. We expect that these actions, when properly designed, would reduce the loss of cultural integrity. Their sustainability may depend on the severity of the climate stressor’s trajectory; it may become increasingly ineffective to reduce exposure to increasingly intensified or accelerated climate stressors. Such actions may also require critical judgments about which cultural heritage sites are deserving of the most robust protection actions, given available capacity, timeframes, policies, and rightsholder and stakeholder viewpoints. There may be limited consensus on these immensely challenging decisions. Examples could include constructing a seawall or protective structures, capping over fragile sites, building temporary or semipermanent fortifications, and establishing fuel-free zones around sites.

Tell the Story refers to the critically important need to share both the story of a resource and the effects of the adaptation action(s) implemented, particularly in cases where that action results in a loss of cultural integrity or even the total loss of the resource (Rockman and Maase 2017). Cultural resources can communicate truths about human stories, our past, and our heritage. These stories might be beautiful or foul, but they are central to humanity’s understanding of ourselves. When cultural heritage sites are prioritized for different climate adaptation approaches, this also tells a story about what we value and the choices we have made. This adaptation area both stands apart and underpins all the others, because we are obligated to expand the story of the cultural resource to include its impacts from anthropogenic climate change, as well as the effects and outcomes from climate adaptation actions implemented for both practitioners and the public to learn from. Finally, it also gives space and consideration for acknowledging grief and loss as cultural heritage sites are irretrievably lost to climate change and advocates for remembrance.

Using the ADAPT Framework

This framework was developed for broad use by cultural heritage managers, to be conducted in collaboration with stakeholders and partners. It focuses on applicability to local resource managers and decision-makers—those who have the most familiarity with local site features, climate concerns, stakeholders, and management goals. However, the concepts are also intended to support the development of larger-scale considerations and adaptation planning at regional and national practitioner levels, such as the development of adaptation menus that offer broad guidance and best practices for strategies, approaches, and tactics for climate change response.

Much of this approach may be already accomplished within other management tasks, such as the expanding inclusiveness and engagement with local communities and stakeholders, accumulation of relevant sociocultural data, stakeholder consultation, or assessment of climate change-informed management goals. ADAPT is intended to fit within and complement this work, as well as integrate with existing adaptive management planning (e.g., *Planning for a Changing Climate* [NPS 2021]). This work could be conducted in concert with multidisciplinary

practitioners engaged in climate change response, such as natural resource managers, social scientists, and other managers considering resource use, economics, or public safety. As much as possible, we urge a coproductive approach throughout this process with local, Indigenous, and associated community members and stakeholder partners to populate both baseline and vulnerability assessment information robustly (Hambrecht and Rockman 2017; Howarth et al. 2022; Klenk et al. 2017; Miller and Wright 2023).

With a localized vulnerability assessment in hand, cultural heritage managers can use the ADAPT framework to brainstorm different adaptation actions, preferably in a workshop setting. The goal is to whiteboard or map out adaptations across each category and at a variety of scales. We have found that looking at landscape, site, artifact, and material-type scales works well but may be subject to the focus resource and management goals at hand. For example, if the highest vulnerabilities for an archaeological site include increased temperature and high-intensity precipitation events, then the practitioner could produce the following potential starting place for each ADAPT category (limited examples at selected scales are provided in Table 1).

Each ADAPT category offers a different way of thinking about climate change response, and the exposure and sensitivity data produced should generate a wide array of possible adaptations. Innovations are highly encouraged at this phase. The goal is to consider a wide range of different approaches and avoid dismissal or critiques of ideas, even if they seem outlandish or likely infeasible. In forcing consideration of reducing sensitivity (*Acclimate*), removing the site from its context (*Dislocate*), *Abandoning* the site, *Protecting* against exposures, and specifying how you would *Tell the Story*, a manager can think through alternatives, get creative, and engage stakeholders to share proactive ideas that might not otherwise emerge.

With a broad list of possible ideas developed across adaptation categories, a good recommendation is to pause and reorganize the ideas to think about what might be missing and to generate various groupings. These may follow the ADAPT categories or may be grouped differently; for example, adaptations that emphasize technologies, adaptations that center on traditional ecological knowledges, adaptations that are low-hanging fruit. This process also forces discussion and

Table 1. Examples of ADAPT Category Responses at Various Scales in Response to Vulnerability Assessment.

Acclimate: Reduce sensitivity	
Sitewide	Native vegetation planted around the site; reburial
Material	Monitor materials for microcracking and deterioration; trial water-resistant treatments on sensitive material surfaces
Dislocate: Remove from environmental context	
Sitewide	Major site excavation
Artifact	Selected artifact recovery and conservation
Abandon: Reduce or relinquish management and accept likely degradation or loss	
Sitewide	Reduce or cease site monitoring and active management; reduce or limit visitation
Material	Cease monitoring and documentation of material changes
Protect: Reduce exposure	
Sitewide	Construct shade and precipitation protective structures over the site; install water diversion systems
Artifact	Install protective stabilizers (e.g., sandbags or geotextiles) around moveable artifacts before intense precipitation events
Tell the Story: Mitigate data loss, connect past to present, and commemorate heritage values	
Sitewide	Develop interpretive materials for climate change at site locale; prepare adaptation communication plan
Material	Disseminate findings from monitoring and changes to scientific literature to better understand material interactions with identified climate stressors

recognition of overarching management goals that might support or hinder different ADAPT approaches.

Adaptation Assessment

With a broad range of adaptation strategies, approaches, and likely tactics identified across ADAPT categories, we encourage documentation of the full list for others to learn from and consider. Sharing such lists can support development of broad adaptation menus and ideation for other sites; proactively planning for documentation and sharing also aligns with *Tell the Story* goals. The next phase is to evaluate each for feasibility, implementation, effectiveness, prerequisites, and likely outcomes if implemented. This can be a qualitative evaluation, but we recommend at least four initial areas of assessment, listed in no particular order of importance or priority:

- (1) Consider how the adaptation action would affect the resource's cultural integrity. We frequently see that *Protect* actions often align with maintaining the highest levels of cultural integrity, with a gradual diminishment through the *Acclimate*, *Dislocate*, and *Abandon* categories.
- (2) Assess how climate adaptive the action is. Is the action sustainable in the face of increasing environmental changes, or is it reliant on maintaining current or near-future conditions? Is there a temporal component or critical threshold that would be necessary to identify? We have observed that *Acclimate* actions often reflect higher levels of climate adaptivity, with a gradual decrease until the *Protect* category.
- (3) Consider the reversibility or irreversibility of the action. Reversibility is a core tenet of historic preservation, but many climate adaptations will challenge that norm. *Dislocate* actions are likely the most irreversible, followed by *Abandon*, with *Protect* and *Acclimate* actions both likely to have high reversibility.
- (4) How easy is it to implement the action? Given consistent challenges with funding, human capital, and time, as well as the urgency and overwhelming management requirements associated with climate change, it is critical to consider what effort and resources the adaptation action will require and how much support is available now and projected for the future. Each adaptation category will require some management effort. In the long term, *Abandon* actions are the least management intensive and therefore may have high scores for ease of implementation; although they require robust documentation and consultation initially, their intention is to cease active management. *Protect* and *Acclimate* both require a management intensity relative to the magnitude of the actions, but both require consistent assessment of effectiveness. *Dislocate* actions likely require immense management effort up front, which may decrease once the action has been completed.

These assessments should allow an initial prioritization or dismissal of different actions and identification of scales for implementation. We also recommend additional assessment of high-priority actions that center on the sociocultural considerations identified, particularly rightsholders' and stakeholders' priorities through collaborative engagement. Without this coproduction, the risks of maladaptation, short-term gains for long-term problems, and the loss of resilience are dramatically increased, as are the risks of increased marginalization and inequity for Indigenous rightsholders and stakeholder communities (IPCC 2022:19).

We strongly encourage documentation and sharing of all stages of adaptation development, planning, implementation, and assessment, a core component of *Tell the Story*. This includes monitoring adaptations for their effectiveness and critically assessing development and engagement processes. We must embrace the potential for uncertainty and failure and commit to sharing the results not only of *what* occurred but also *how* the decision was made. A commitment to transparency and a willingness to learn from actions will both accelerate and improve others' ability to respond to the climate crisis.

This evaluation is intended to support decision-making and allow for critical and practical assessment of each potential adaptation action. Its intent is to explore similarities and divergences across the evaluation criteria, which includes looking at high scores across many or all categories or so-called no regrets options. More commonly and likely realistically, it involves considering trade-offs. This

reckoning with management goals is necessary when considering practical, effective, and coproduced adaptation actions.

Conclusion

In this article, we offer a basic conceptual framework for the development and evaluation of climate change adaptation actions for cultural heritage and a guide for its use. Critically important considerations underpinning this model include paths to understanding climate change vulnerability, engagement, collaboration, and coproduction with associated rightsholders, stakeholders, and communities, as well as robust understandings of relevant sociocultural environments and management paradigms. Moreover, we consider pathways needed to develop adaptation actions at various scales of management and options that can be assessed but also implemented with an eye toward the urgency of the climate crisis and real limitations on management resources.

Cultural heritage is intrinsically connected to people, identity, culture, and their natural environments, which requires engagement with stakeholders, multiple disciplines, and the public; this approach is also reflected in calls to advance broad engagement with conservation practitioners while using adaptive management frameworks (Schoorman et al. 2022:20, 23). Climate change responses must be intentionally inclusive and responsive to associated communities, including Indigenous rightsholders and sociocultural stakeholders, because climate risks not only affect “resources” but also cultural identities, memories, and the continuing sense of past and current place and a shared past (Miller and Wright 2023). These priorities, goals, and considerations are critical decision factors, every bit as much as climate vulnerability and cultural heritage management postures.

Four categories of adaptation actions in the ADAPT framework, all with various strengths and weaknesses, center on a fifth critical category: *Tell the Story*. The need to share impacts, actions considered, outcomes of implementation, and lessons learned is strategic and essential: too much needs to be accomplished, urgently, to not actively communicate. This need is not limited to explaining management actions but is also important to increase understanding of heritage values and their interactions with climate change. With this sort of diligent and courageous communication, others can act faster and more effectively as we all grapple with the challenges of climate change.

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